ISSN 0142-7229

electronics today INTERNATIONAL

JULY 1979

50p

FULL SPEC TELETEXT DESIGN

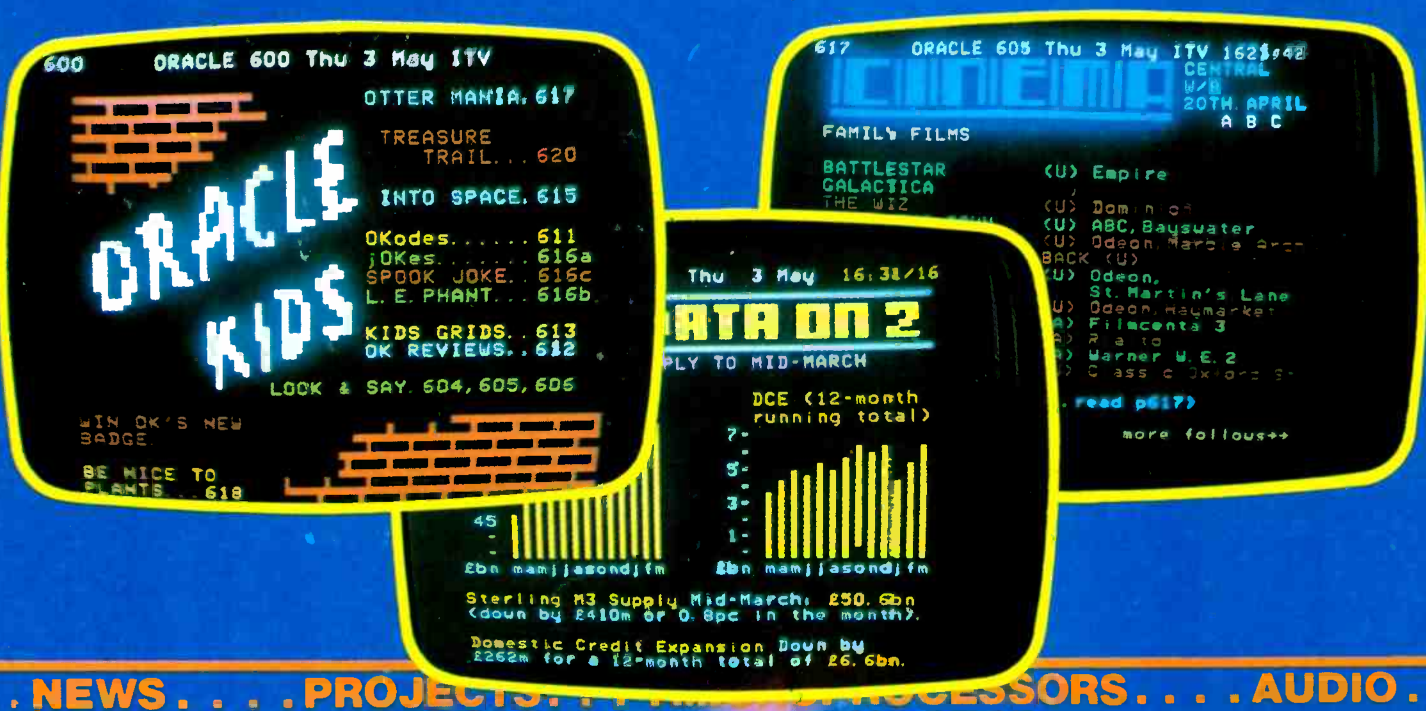
Plugs In To The Aerial Socket!

POLYPHONIC KEYBOARD

40 CMOS CLOCKS!

LIFE ON OTHER WORLDS

SOIL MOISTURE INDICATOR



...NEWS.... PROJECTS.... MICROPROCESSORS.... AUDIO...

ORDERING INFORMATION AND MORE KITS ON PAGE 8

electronics today

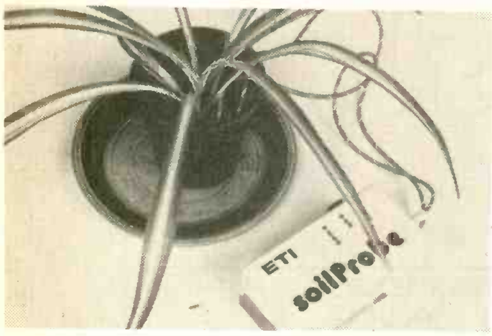
JULY 1979 VOL 8 NO 7 INTERNATIONAL

FEATURES

PROJECTS

Text for tellies p.20

INFORMATION



Plant pampers p.67

INTERNATIONAL EDITIONS

AUSTRALIA Collyn Rivers Publisher
Roger Harrison Acting Editor

HOLLAND Anton Kriegsman Editor-in-Chief

CANADA Graham Wideman Assistant Editor

GERMANY Udo Wittig Editor

ABC

EDITORIAL AND ADVERTISEMENT OFFICE
25-27 Oxford Street, London W1R 1RF. Telephone 01-434 1781/2. Telex 8811896

Ron Harris, B.Sc	Editor
Ian Graham B.Sc.	Editorial Assistant
Diego M. Rincon	Art Director
Gayle Armbrust, Pete Howells	Production
Paul Edwards, Tony Strakas	Technical Illustrators
Ray Marston	Project Editor
John Fitzgerald	Project Engineer
Steve Ramsahadeo	Project Development
Margaret Hewitt	Administration
Alan Carlton (Manager)	Reader Services
Christopher Surgenor (Manager)	Advertising
Halvor Moorshead	Editorial Director

PUBLISHED BY Modmags Ltd., 25-27 Oxford Street,
DISTRIBUTED BY Argus Distribution Ltd. (British Isles)
Gordon & Gotch Ltd. (Overseas)
PRINTED BY QB Limited, Colchester

Electronics Today International is normally published on the first Friday of the month prior to the cover date

Quality audio modules and accessories for

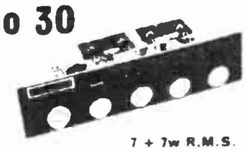
S450
STEREO FM TUNER
Fitted with phase lock-loop

£26.14 +40p p&p

FREQUENCY RANGE	88–108 Mhz
SENSITIVITY	3 0 μV
BANDWIDTH	250 kHz
SPURIOUS REJECTION	50 dB
SELECTIVITY ± 400 kHz	55 dB
AUDIO OUTPUT (22 5 kHz deviation)	100 mV
STEREO SEPARATION	30 dB
SUPPLY REQUIREMENTS	20 to 30V (90mA max)
AERIAL IMPEDANCE	75 ohms
DIMENSIONS	240mm · 110mm · 32mm

The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, simply by changing the settings of the pre-set controls. Features include FET input stage. Vari-Cap diode tuning. Switched AFC LED Stereo Indicator.

Stereo 30
COMPLETE AUDIO CHASSIS



7 + 7w R.M.S.

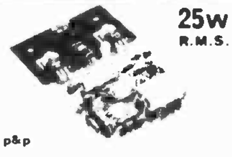
£21.57 +66p p&p

OUTPUT POWER	7 Watts RMS
LOAD IMPEDANCE	8 ohms
TOTAL HARMONIC DISTORTION	Less than 5% (Typically 3%)
FREQUENCY RESPONSE	50 Hz to 20 kHz ± 3dBs
TONE CONTROL RANGE	± 12 dBs at 100Hz and 10kHz
SENSITIVITY	190 mV for full output
INPUT IMPEDANCE	1 M ohms
TRANSFORMER REQUIREMENTS	22 V A C rated at 1A
DIMENSIONS (Less controls and panel)	200mm · 130mm · 33mm

The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i e high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, main switch, fuse and fuse holder and universal mounting brackets.

AL60
AUDIO AMPLIFIER MODULE
25 Watts RMS

25w R.M.S.



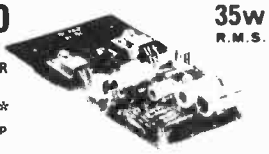
£5.27 +35p p&p

OUTPUT POWER	25 Watts RMS
SUPPLY	30-50 V
LOAD IMPEDANCE	8-16 ohms
TOTAL HARMONIC DISTORTION	Less than 1% (Typically 06%)
FREQUENCY RESPONSE	20 Hz to 30 kHz · 2 dBs
SENSITIVITY	280 mV for full output
MAX HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm · 64mm · 15mm

This high quality audio amplifier module is for use in audio equipment and stereo amplifiers and provides output powers up to 25 RMS with distortion levels below 0 1%

AL80
AUDIO AMPLIFIER MODULE

35w R.M.S.



£7.92* +35p p&p

OUTPUT POWER	35 Watts RMS
SUPPLY	40-60 V
LOAD IMPEDANCE	8-16 ohms
TOTAL HARMONIC DISTORTION	Less than 1% (Typically 06%)
FREQUENCY RESPONSE	20 Hz to 30 kHz · 2 dBs
SENSITIVITY	280 mV for full output
MAX HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm · 64mm · 15mm

The AL80 is similar in design to the AL60 above and is of the same high quality but provides output powers up to 35W with distortion levels below 0 1%

AL250
POWER AMPLIFIER

125w R.M.S.

£19.24* +66p p&p

OUTPUT POWER	125 Watts RMS continuous
OPERATING VOLTAGE	50-80 V
LOADS	4-16 ohms
FREQUENCY RESPONSE	25 Hz 20 kHz measured at 100 Watts
SENSITIVITY FOR 100 WATTS O/P AT 1 kHz	450 mV
INPUT IMPEDANCE	33 K ohms
TOTAL HARMONIC DISTORTION 50 WATTS into 4 ohms / 50 WATTS into 8 ohms	0 1% / 0 06%

This unit, designated AL250, is a power amplifier providing an output of up to 125W RMS, into a 4 ohm load.

AL30A
AUDIO AMPLIFIER MODULES

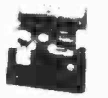
10w R.M.S

£4.26 +35p p&p

MAXIMUM SUPPLY VOLTAGE	30 V
POWER OUTPUT for 2% THD	10 Watts RMS
TOTAL HARMONIC DISTORTION	Less than 25%
LOAD IMPEDANCE	8-16 ohms
INPUT IMPEDANCE	100 K ohms
FREQUENCY RESPONSE	50 Hz-25 kHz ± 3 dBs
SENSITIVITY	75 mV for full output
DIMENSIONS	74mm · 63mm · 28mm

These low cost 10 watt modules offer the utmost in reliability and performance, whilst being compact in size.

SPM80
STABILISED POWER SUPPLY



£4.95 35p p&p

INPUT A.C. VOLTAGE	33-40V
OUTPUT D.C. VOLTAGE	33 V nominal
OUTPUT CURRENT	10 mA-1 5 amps
OVERLOAD CURRENT	1 7 amps approx.
DIMENSIONS	105mm · 63mm · 30mm

Designed to power two AL60s at 15 Watts per channel simultaneously. Circuit Techniques include full short circuit protection.

PA100
STEREO PRE-AMPLIFIER

£18.05 +40p p&p

FREQUENCY RESPONSE	20 Hz to 20 kHz · 1 dB	
TOTAL HARMONIC DISTORTION	Less than 1% (Typically 07%)	
SENSITIVITY INPUTS 1. TAPE	100 mV/100 K ohms	For an output 250 mV
2. RADIO TUNER	100 mV/100 K ohms	
3. MAGNETIC P U	3 5 mV/50 K ohms	
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz	
BASS CONTROL RANGE	± 15 dBs at 75 Hz	
TREBLE CONTROL RANGE	+ 10-20 dBs at 15 kHz	
SIGNAL/NOISE RATIO	Better than 65 dBs (All inputs)	
INPUT OVERLOAD	Better than 26 dBs (All inputs)	
SUPPLY	20 to 40 V	
DIMENSIONS	300 · 90 · 33mm (less controls)	

A top quality stereo pre-amplifier and tone control unit, the PA100 provides a comprehensive solution to the front end requirements of stereo amplifiers or audio units. The six push button selector switch gives a choice of inputs together with two filters for high and low frequencies.

MPA30
STEREO MAGNETIC CARTRIDGE PRE-AMPLIFIER

£3.35 +35p p&p

Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the MPA 30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only.

SENSITIVITY	3 5 mV for 100 mV output
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
INPUT IMPEDANCE	50 K ohms
SUPPLY	18 to 30 V—re earth
DIMENSIONS	110 · 50 · 25mm (inc DIN socket)

PA12
STEREO PRE-AMPLIFIER

£8.75 + 35p p&p

The PA12 Stereo Pre-Amplifier chassis is designed and recommended for use with the AL 20/30 Audio Amplifier Modules, the PS12 power supply and the T538 Transformer. Features include on/off volume. Balance, Bass and Treble controls. Complete with tape output.

FREQUENCY RESPONSE	20 Hz–20 kHz (—3dB)
BASS CONTROL	± 12 dB at 60 Hz
TREBLE CONTROL	± 14 dB at 10 kHz
INPUT IMPEDANCE	1 Meg. ohm
INPUT SENSITIVITY	300 mV
CROSSTALK	—60 dB
SIGNAL/NOISE RATIO	—65 dB
OVERLOAD FACTOR	± 20 dB
TAPE OUTPUT IMPEDANCE	25 K ohms
DIMENSIONS	152mm · 84mm · 25mm

PS12 POWER SUPPLY MODULE

Power supply for AL20A-30A, PA12, S450 etc.
Transformer T538.
Input A.C. Voltage 15 20V
Output D.C. Voltage 22 30V approx. (Dependent upon input.)
Output Current 800mA maximum.
Dimensions 60 · 43 · 26mm.

£2.13 + 35p p&p.

BP124 SIREN ALARM MODULE

5 WATTS —

American Police screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer break-down, and other security purposes.

ONLY £3.78
35p p&p.

MA60 HI-FI AMPLIFIER KIT

Build you own top quality amplifier, save yourself pounds. The MA60 kit comprises the following BI-kits modules, 2 · AL60 amps, 1 · PA100 pre-amp, 1 · SPM80 stab. power supply, 1 · BMT80 transf. giving 15 watts RMS per channel STEREO. All modules covered by the BI-PAK satisfaction or money back guarantee. Details of the above modules are in this ad.
Price £36.00 + 82p p&p.

TC60 KIT

A beautifully designed genuine TEAK WOOD veneered cabinet to put the professional touches to your home built amplifier. Full set of parts incl. Front & Back Panels, Knobs, Chassis, Fuses, Sockets, Noen, etc. Ideal for the MA60. Size: 425mm · 290mm · 95mm.
Price £22.44 + 86p p&p.

TRANSFORMERS

T538 For use with S.450 AL30A MPA30 Order No. **2036**	Price: **£3.60 + 55p p&p**
T2050 For use with Stereo 30 Order No. **2050**	Price: **£3.66 + 55p p&p**
BMT80 For use with AL60 SPM80 Order No. **2034**	Price: **£6.08 + 86p p&p**
BMT250 For use with AL250 Order No. **2035**	Price: **£7.14 + £1.10 p&p**
2040. For use with AL60 Order No. **2040**	Price: **£5.85 + 80p p&p**
2041. For use with AL80, AL120 and AL250 Order No. **2041**	Price: **£7.65 + 86p p&p**

CASES

TEAK 30, 32 × 23 × 8cm. designed mainly for use with our stereo 30 Audio System but has proved very helpful to home constructors. Fitted with solid uncut front and back o/n 139 **£6.69 + p&p 70p.**
TEAK 60, 42 × 29 × 9cm. for use with AL60/MK60 Audio Kit. Useful for the home constructor requiring an amplifier sleeve — has no front or back panel o/n 140 **£7.87 + p&p 85p.**

GMT ELECTRONICS

(A DIVISION OF GOTHIC ELECTRONIC COMPONENTS LTD)
PO Box 290
8 Hampton Street
Birmingham B19 3JR

TELEPHONE: 021·233·2400

MAIL ORDER ONLY

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

CAPACITORS

Electrolytic Axial Leads
10% to +50% Tol

Order Code: Cap 015 + μF + V d.c.

μF \ V d.c.	16	25	40	63
1.0				8
1.5				8
2.2				8
3.3				8
4.7				8
6.8			8	9
10		7		9
15	7		8	10
22		7		12
33	7		8	
47		7	10	12
68	8			
100		8	12	
150	8	9		29
220	12		24	34
330			28	37
470		21	30	44
680	19	28	36	50
1000	23	28	55	
1500	32	36		
2200	39			

Electrolytic Can Type
High Ripple, IEC Grade 1, Low E.S.R.
Supplied complete with Vertical Fixing Clip

Order Code: Cap HR + μF + Volts

		Ripple 1A @ 85°C	1.4A @ 50°C	
2200 μF	16V	Ripple 1A @ 85°C	1.4A @ 50°C	166
4700 μF	16V	2.6A	3.6A	184
10000 μF	16V	5.8A	8.1A	222
22000 μF	16V	9.8A	13.7A	346
2200 μF	25V	1.3A	1.8A	175
4700 μF	25V	4.6A	6.4A	201
10000 μF	25V	8.0A	11.2A	264
22000 μF	25V	12.8A	17.9A	438
1000 μF	40V	0.9A	1.2A	168
2200 μF	40V	2.4A	3.3A	188
4700 μF	40V	5.6A	7.8A	231
10000 μF	40V	9.2A	12.8A	367
1000 μF	70V	1.8A	2.5A	190
2200 μF	70V	4.0A	5.6A	235
4700 μF	70V	7.5A	10.5A	376
1000 μF	100V	4.0A	5.6A	222
2200 μF	100V	7.8A	10.9A	346

Miniature Low Value

	Order Code
Polystyrene, Axial, ±1% Tol., ≥ 63V D.C. Wkg	Cap 424
Ceramic Plate, Radial, Low K, 1.8pF–8.2pF ±.25pF Tol, 10-330pF ±2% Tol, 100V D.C. Wkg	Cap 632
Ceramic Plate, Radial, Med K, ±10% Tol, 100V D.C. Wkg	Cap 630
Ceramic Plate, Radial, High K, –20% to +80% Tol, 63V D.C. Wkg	Cap 629
	+ Value

pF	424	632	630	629
1				
1.2				
1.5				
1.8		5		
2.2		5		
2.7		5		
3.3		5		
3.9		5		
4.7		5		
5.6		5		
6.8		5		
8.2		5		
10		5		
12		5		
15		5		
18		5		
22		5		
27		5		
33		5		
39		5		
47		5		
56		6		
68		6		
82		6		

pF	424	632	630	629
100	16	6		
120	16	8		
150	16	8		
180	16	6		
220	16	6		
270	18	8		
330	18	8		
390	18		5	
470	18		5	
560	16		5	
680	16		5	
820	16		5	
1000	16		5	5
1200	16		5	
1500	18		6	
1800	18		6	
2200	18		6	6
2700	18		6	
3300	18		6	
3900	18		6	
4700	23		7	6
5600	23			
6800	23			
8200	23			

nF	424	632	630	629
10	25			6
12	26			
15	26			
18	27			
22	28			8
27	38			
33	41			
39	43			

Electrolytic Radial Leads
10% to +50% Tol.

Order Code: Cap 034 + μF + Volts

μF \ V d.c.	6.3	10	16	25	35	40	50	63
.47								6
.68								6
1.0								6
1.5								6
2.2								6
3.3								6
4.7						6		7
6.8				6			7	8
10			6			7		8
15			6	7			8	10
22		6	7			8	10	
33			7	8		10		
47		7	8		10			
68			8	10				
100		8	10					
150		10						
220	10							

Tantalum Bead
20% Tol

Order Code: Cap PR + μF + Volts

μF \ V d.c.	3.15	6.3	10	16	25	35
0.1						9
0.15						9
0.22						9
0.33						9
0.47						9
0.68						9
1						9
1.5						10
2.2				9		11
3.3				9	11	14
4.7				10	14	15
6.8		9		11	15	.6
10		10	11	14	16	20
15		11	14	15	20	
22	11	14		16		
33		15	16	20		
47		16	20			
68	16	20				
100	20					

Trimmers

250V D.C. Wkg. Film Dielectric, Miniature

		Order Code
1.4 – 4.1pF	19	Cap 808 A
2 – 8pF	19	Cap 808 B
2 – 20pF	21	Cap 808 C
5.5 – 59.5pF	29	Cap 808 D

500V D.C. Wkg. C004 EA Tubular Type

		Order Code
.8 – 3.8pF	46	Cap 802 3
.8 – 6.8pF	48	Cap 802 6
1 – 13pF	61	Cap 802 12
1.7 – 19.7	62	Cap 802 18

Polyester Radial Leads

	Order Code
Dipped Type, ±20% Tol, ≥ 250V D.C. Wkg. C280/352 Style	Cap 352
Moulded Type, ±10% Tol, ≥100V D.C. Wkg. 10.2mm Pitch Centres	Cap 360
Moulded Type, ±10% Tol, ≥100V D.C. Wkg. 7.6mm Pitch Centres	Cap PHE280
	+ Value

μF	352	360	PHE280
.001		5	6
.0015		5	6
.0022	5	6	7
.0033	5	6	7
.0047	5	6	7
.0068	5	6	7
.01	5	6	7
.015	5	7	8
.022	5	7	8
.033	5	7	8
.047	5	7	8
.068	6	8	9

μF	352	360	PHE280
.1	6	8	9
.15	7	9	
.22	8	10	
.33	10		
.47	12		
.68	15		
1.0	19		
1.5	27		
2.2	32		

CASES

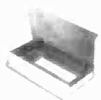
Small Desk Console — Boss Industrial Mouldings
Slope Front Console, Recessed Top
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

		Order Code
W161, D96, H39 (57)	186	Case BIM1005 OR
W215, D130, H47 (73)	268	Case BIM1006 OR

Plastic Boxes — Boss Industrial Mouldings
Moulded Box and Close Fitting Flanged Lid
ABS Box, C/W Brass Bushes, and Lid In Orange

		Order Code
L112 W62 D31	87	Case BIM2003 OR
L150 W80 D50	115	Case BIM2005 OR
L190 W110 D60	195	Case BIM2006 OR

Instrument Case — Boss Industrial Mouldings
Covers Manufactured from 14SWG Aluminium
Chassis Manufactured from 18SWG Mild Steel
Covers Finished Orange
Chassis Finished Matt Black



		Order Code
W250 D167.5 H 68.5 (Chassis 153mm Deep)	1480	Case BIM3000 OR

Plastic Boxes with Metal Lids — Boss Industrial Mouldings
Recessed Top Box
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

		Order Code
L85 W56 D29	97	Case BIM4003 OR
L111 W71 D42	130	Case BIM4004 OR
L161 W96 D53	182	Case BIM4005 OR

Diecast Boxes — Boss Industrial Mouldings
Diecast Box and Flanged Lid
Aluminium Box and Lid in Natural Finish

		Order Code
L113 W63 D31	104	Case BIM5003 NA
L152 W82 D50	181	Case BIM5005 NA
L192 W113 D61	280	Case BIM5006 NA

VERO ELECTRONICS PRODUCTS

2.5" x 5" .1" pitch Veroboard	59	VERO 21069J
3.75" x 5" .1" pitch Veroboard	66	VERO 21072D
2.5" x 1" .1" pitch Veroboard (5)	70/Pack	VERO 21076C
3.75" x 5" .1" pitch Plain Board	56	VERO 21078E
5.82" x 2.9" .1" pitch V-Q DIP Board	111	VERO 21084E
Spot Face Cutter	89	VERO 21013A
Pin Insertion Tool for .040 type pin	122	VERO 21015F
DS Pins .040 (100)	38/Pack	VERO 21087G
SS Pins .040 (100)	38/Pack	VERO 21017B
6mm Board Standoff (100)	181/Pack	VERO 21321K
15mm Board Standoff (100)	215/Pack	VERO 21322G
19mm Board Standoff (100)	226/Pack	VERO 21323D
Verowire Kit (1-pen, 2-wire, 25-comb)	375/Kit	VERO 21341D
Verowire Combs (100)	407/Pack	VERO 21339F
Verowire Wire (4)	228/Pack	VERO 21340G
Flip Top Box, Small, Black	192	VERO 21317D
Flip Top Box, Large, Black	250	VERO 21319J

Small Desk Consoles — Boss Industrial Mouldings
Slope Front Console, Recessed Top
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey
Ventilation Slots In Base

		Order Code
W105 D143 H32 (56)	206	Case BIM6005 OR
W170 D143 H32 (56)	271	Case BIM6006 OR
W170 D214 H32 (82)	375	Case BIM6007 OR

All Metal Desk Consoles — Boss Industrial Mouldings
Slope Front Console, Recessed Top
Two Piece All Aluminium Construction
Ventilation Slots In Rear and Base
Choice of 15° or 30° Sloping Front
Off White Top Panel, Blue Base

		Order Code
W102 D140 H28 (51) 15° slope	1018	Case BIM7151A
W165 D211 H33 (76) 15° slope	1350	Case BIM7154A
W254 D287 H33 (76) 15° slope	1572	Case BIM7156A
W356 D287 H33 (76) 15° slope	1823	Case BIM7158A
W102 D140 H28 (76) 30° slope	1018	Case BIM7301A
W165 D183 H28 (102) 30° slope	1202	Case BIM7303A
W254 D259 H28 (102) 30° slope	1572	Case BIM7306A
W356 D259 H28 (102) 30° slope	1823	Case BIM7308A

Eurocard Size Desk Console — Boss Industrial Mouldings
Slope Front Console
ABS Case, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel, Finished Grey

		Order Code
W169 D127 H45 (70)	375	Case BIM8006 OR

HARDWARE

D.I.L. Sockets

		Order Code
8 Pin Low Profile Socket Tin	11	DIL SKT 8
14 Pin Low Profile Socket Tin	13	DIL SKT 14
16 Pin Low Profile Socket Tin	14	DIL SKT 16
24 Pin Low Profile Socket Gold	66	DIL SKT 24
28 Pin Low Profile Socket Gold	78	DIL SKT 28
40 Pin Low Profile Socket Gold	127	DIL SKT 40

Heatsinks

Individual Type for 1 x T05 50°C/W	10	Sink 5F
Individual Type for 1 x T066 10.5°C/W	26	Sink TV2
Individual Type for 1 x T03 7.2°C/W	24	Sink TV3
Individual Type for 1 x T0126 17°C/W	23	Sink TV4
Individual Type for 1 x T0220 17°C/W	23	Sink TV5

P.C.B. Components

Dalo Pen, Blue Ink, Slow Drying	92	Pen 33PC

Fuseholders
Suit 20mm x 5mm Fuses.

P.C.B. Mounting, Open Type	8	Fuse/H20B
Chassis Mounting, Open Type	17	Fuse/H20C
Panel Mounting, Screwdriver Slot	77	Fuse/H20PT
Panel Mounting, Finger Release	56	Fuse/H20P

Fuses
20mm x 5mm Glass.

Quick Blow, Range 100mA–5A	8	Fuse 20
Slow Blow, Range 250mA–5A	22	A/S Fuse 20
		+ Rating

Lampholders, Panel Mounting
Similar In Style to Fuse/H 20P
Low Voltage Type Suits LES and M/F Bulbs

Low Voltage, Red, Amber or Green	75	Lamp LV
Internal Neon 200/240V Red or Amber	95	Lamp N
		+ Colour

Bulbs, Low Voltage, L.E.S.

6V, 0.36W, 6.5V, 1W, 14V, 0.75W	22	Bulb LES
		+ Voltage

RESISTORS

Carbon Film, Fixed

				Order Code
0.25W, E24 Values 1R0-10M, 5% Tol	1.5 ea	90p/100 (Mult 10/Value)	£7.90/1000 (Mult 100/Value)	Res RD¼
0.5W, E12 Values 1R0-4M7, 10% Tol	2 ea.	1.25p/100 (Mult 10/Value)	£10.10/1000 (Mult 100/Value)	Res RD½
				+ Value

Metal Film, Fixed

0.5W, E24 Values, 5R1-1M, 2% Tol	6 ea.	3.80/100 (Mult 10/Value)	£32.40/1000 (Mult 100/Value)	Res MR30
2.5W, E12 Values 10R-27K, 5% Tol.	13 ea	7.90/100 (Mult 10/Value)		Res PR52
				+ Value

Metal Glaze, Fixed

0.5W, E24 Values, 1M-33M, 5% Tol.	10 ea.	5.40/100 (Mult 10/Value)	Res VR37 + Value

Skeleton Presets, Miniature

		Order Code
0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting	7	Min Preset V
0.1W, E3 Values, 100R-1M, Lin. Horizontal Mounting	7	Min Preset H
		+ Value

Skeleton Presets, Standard

0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting	10	Std Preset V
0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mounting	10	Std Preset H
		+ Value

Potentiometer, Rotary

0.5W, E3 Values, 1K-2M2 Lin.	34	Pot Lin
0.25W, E3 Values, 4K7-2M2 Log.	34	Pot Log
		+ Value

news digest................

CARRY–PACKS FROM JVC

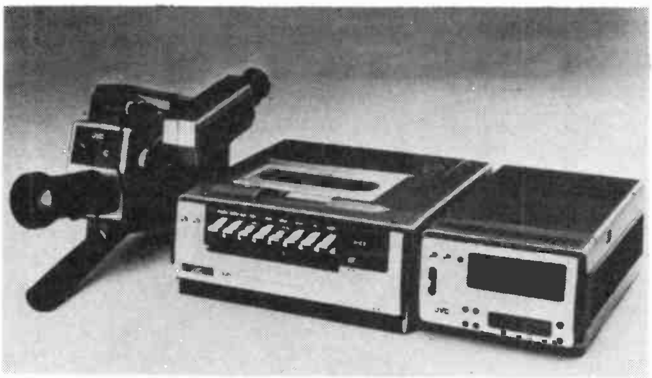
A new range of equipment from JVC brings their VHS domestic video system into the portable market.

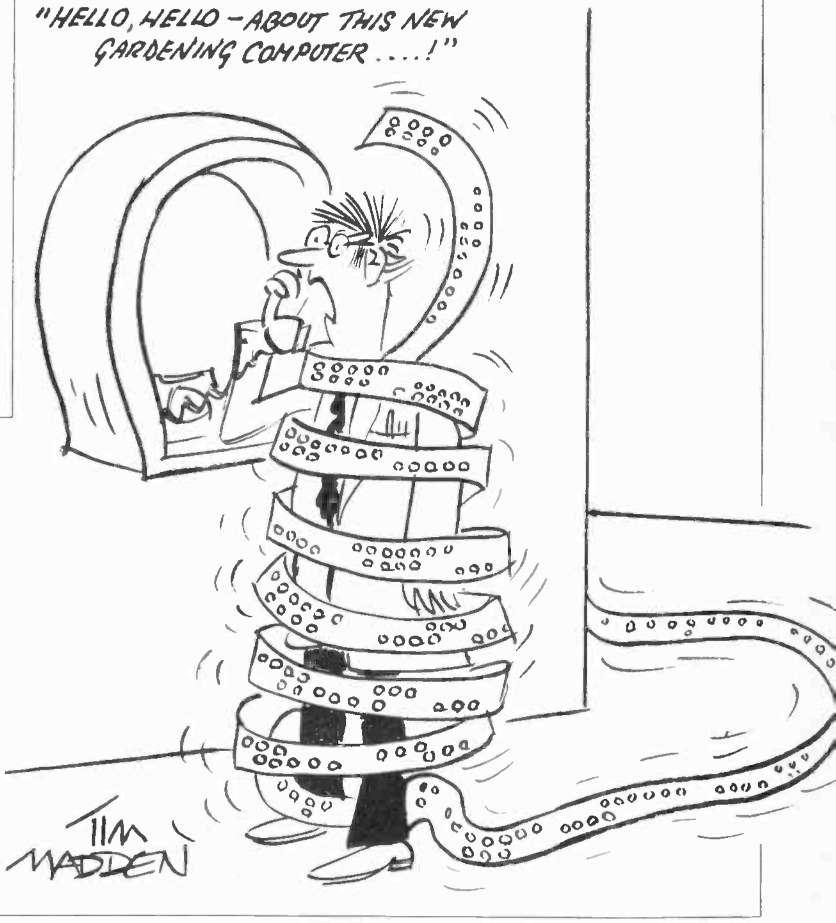
Leading the range is the HR4100 colour portable video vassette recorder, with a price tage of £799.92 including VAT' it is fully compatible with all VHS recorders and weighs only 9.3 kg, complete with cassette, battery pack and RF converter.

The new GC4100 colour video camera is a self-contained unit with the camera control unit built into the camera head. Two-tube design uses a new colour strife filter to improve colour reproduction, with an aperture correction circuit to give excellent resolution. Recording is possible with illumination as low as 100 lux. Retail price will be £934.20p.

JVC have also launched the TV41 tuner/timer, which, when connected to the HR4100, provides all the usual record/playback facilities of a deck-type recorder, the HR 3330, is a development of the previous successful model, but also includes extra refinements such as eight day timer, remote-control pause switch and audio dubbing facilities.

For further information on this new video range, contact JVC (UK) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2 7AF.
to give





OPTO FETS

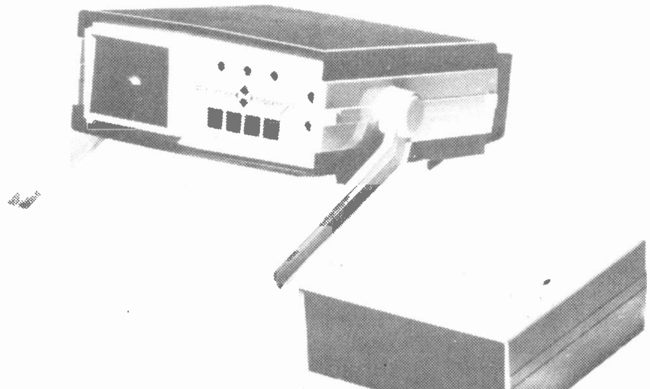
A new trio of opto-coupled FETs, available from Jermyn-Mogul Distribution, feature a minimum isolation resistance of 100 gigohms between input and output.

These new GE opto-couplers consist of a gallium arsenide infra-red emitting diode coupled to a symmetrical bilateral silicon photo detector. The detector is electrically isolated from the input and performs like an ideal isolated FET designed for distortion - free control of low level AC and DC analogue signals. They do this by varying in resistance from between 100 ohms to 300 megohms, the change in resistance being controlled by the amount of current flowing through the infra-red emitting diode.

Applications include isolated variable attenuators, 70 db automatic gain control, remote band switching, sample and hold circuits, optically isolated multiflexers and reed relay replacement. The H11F family come in the popular six pin DIL package.

For products and application sheets contact Jermyn-Mogul Distribution of Vestry Estate, Sevenoaks, Kent.

.... news digest ......



BARGAIN BOXES

A new service from OK Machine & Tool can save up to 65% on the cost of cases for some commercially produced items.

If you need more than 1000 units, OK can incorporate your special requirements into their latest range of Pac Tec moulded enclosures, available in over 25 sizes.

As an example of the success of their new cost-cutting service, OK have been able to produce 2,500 alarm unit housings for £3.92 each, compared to £5.52 for sheet metal units. Taking the total assembly time into account, the saving rose to 65%. Customised front and rear panels can be supplied.

For further information, contact OK Machine & Tool (UK) Ltd, 48a The Avenue, Southampton, Hants SO1 2SY.

ELECTRONIC TACHO

Orbit Controls are now producing a four decade electronic tachometer for measuring speed, rate, flowrate and frequency.

The 74A 430 has a four decade, solid state, digital readout and a pre-wired timebase, controlled by a high precision 1MHz crystal oscillator.

Flexibility of construction allows pre-wiring to any interval from 1mS to 10S. The unit features high noise immunity and freedom from false triggering counts.

The frequency range extends from 0.5Hz to 10kHz with an input sensitivity of 100mV (adjustable). Input, positive pulse or sinewave, is fully protected to 240V rms. Power may be from 100 – 110V or 210 – 260V 50/60Hz, or from 12V DC.

Further details from Orbit Controls Ltd, Lansdown Industrial Estate, Gloucester Road, Cheltenham, Gloucestershire GL51 8PL

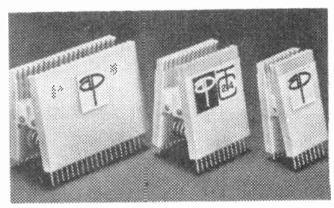
TEST CLIPPY

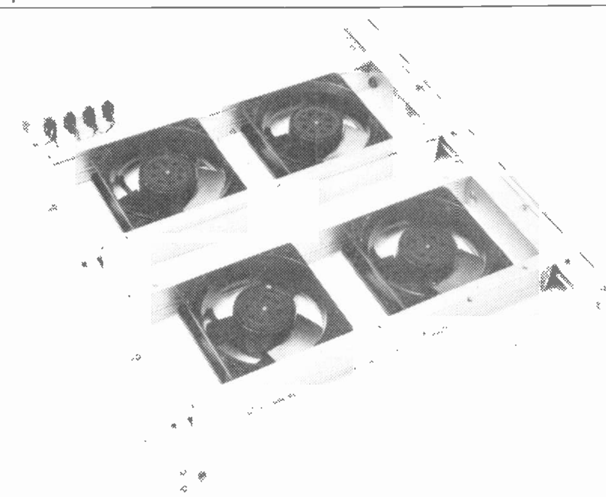
New IC test clips from Lektrokit offer a simple means of accessing any IC pin or lead.

The new aid clips over the IC bringing its individual pin connections out to a set of contacts at the opposite end of the clip. There are test clips available to match 8, 14 and 16 pin DIL packages.

The gold-plated, phosphor bronze spring contacts have been designed to achieve a wiping/cleaning action, making for high reliability.

The TC-14 which, as its name suggests, clips over a 14 pin DIP, costs £2.95. Further details from Lektrokit Ltd., Sutton Industrial Park, London Road, Earley, Reading, Berkshire RG6 1AZ,





COOLING OFF

Got any hot-spots in your cabinets? You can get the air circulating round your equipment with the Vero Electronics Fan Tray (AB 087).

Two versions (1U and 2U) are available for either 115V or 230V (50/60 Hz) input. Each is supplied with four 119mm square axial fans, but additional fans can be fitted as required.

The 2U version has a polyurethane foam filter covering the air intake. If your living room or office isn't a smokeless zone, never fear, the filter is cleanable. Both versions operate at low noise levels.

If you need cooling off, contact Vero Electronics Ltd, Industrial Estate, Chandler's Ford, Hampshire SO5 3ZR.

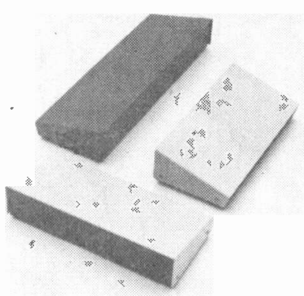
LOW KEY

A new range of enclosures designed for housing a variety of keyboards has recently been introduced by Boss Industrial Mouldings.

Bimconsoles are all-aluminium cases with a textured black base which contrasts with either the semi-gloss sand or charcoal grey top panels.

The top panels slope at about 20 to provide a relaxed keyboard operating position. Vibration is reduced to a minimum by the use of a gasket assembly between top and bottom panels.

Bimconsoles are available in three sizes and are suitable for both prototype and OEM type applications. Further details from Boss Industrial Mouldings Ltd, Higgs Industrial Estate, 2 Herne Hill Road, London SE24 0AU.



........news digest.......

LATEST CASIO MINIS

Casio have managed to reduce their successful LC-78G calculator in three ways.

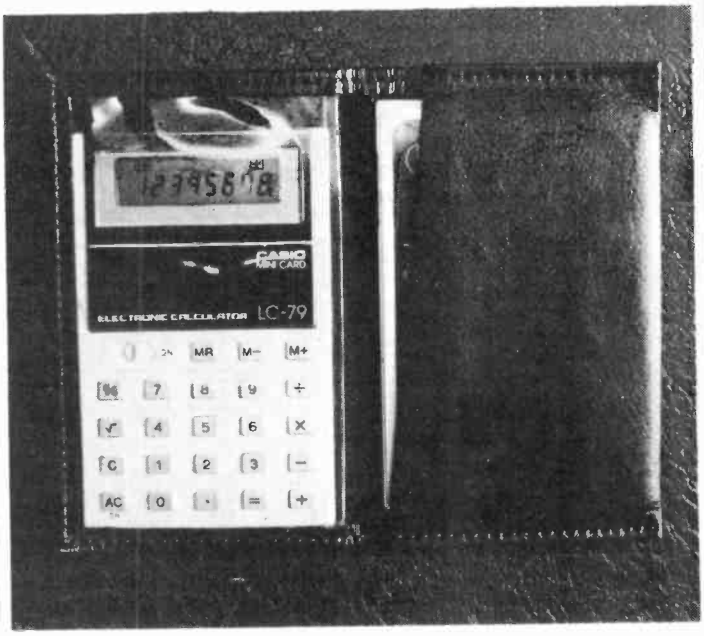
First of all - price. The RRP of the LC-78G is down by £3.00 to £16.95.

Second is the new Casio LC-7 which has the same display and functions except that the fully independent memory is replaced by a simple automatic accumulating memory and a square root function. The LC-78S has a RRP of only £13.95.

Thirdly, thickness has been cut down from four to two millimetres. Casio's new Mini Card LC-79 remains credit card size, but in upright format. It keeps eight digits capacity and LCD, four functions and independent memory plus perfect percent and function indicator. Also featured is a responsive, 'feather touch' keyboard, so light that it can be operated inside its protective wallet. A battery-conserving circuit automatically switches off nine minutes after the last key depression. The Casio LC-79 will retail at £19.95 (or less, if you're lucky).

If you prefer something a bit beefier, try the LC-841, another new one from Casio. With the same technical features as Mini Cards (including independent memory), the LC-841 is 62 x 110mm, but still only 3.9mm thick, with digits 6mm high, and will retail at about £15.95.

For enquiries, get in touch with Casio Electronics Co Ltd, 28 Scrutton Street, London EC2A 4TY.



MILITARY FLASHER

Need a tough twinkler? Oxley are now producing a solid state indicator lamp, type PS/LH/8, in a military style rugged mounting.

The mounting incorporates the latest high brightness, high reliability LEDs. The lamp is fitted with a sealed glass lens and black shroud to optimise the visual effect and afford emitter protection.

Standard colours are available, red, yellow and green, and light output is calibrated to photometric standards to ensure consistent performance. The aluminium alloy body is compatible with standard chassis and provides electromagnetic shielding for military applications. Further details from Oxley Developments Co Ltd, Ulverston, Cumbria LA12 9Qg.

TTLs by TEXAS

7400	13p
7401	14p
7402	14p
7403	14p
7404	14p
74S04	90p
7405	18p
7406	32p
7407	32p
7408	17p
7409	19p
7410	15p
7411	24p
7412	20p
7413	30p
7414	50p
7416	27p
7417	27p
7420	17p
7421	40p
7422	22p
7423	34p
7425	30p
7426	40p
7427	34p
7428	36p
7430	17p
7432	30p
7433	40p
7437	35p
7438	35p
7440	17p
7441	70p
7442A	65p
7443	112p
7444	112p
7445	100p
7446A	93p
7447A	60p
7448	80p
7450	17p
7451	17p
7453	17p
7454	17p
7460	17p
7470	36p
7472	30p
7473	34p
7474	30p
7475	38p
7476	35p
7480	50p
7481	100p
7482	84p
7483A	70p
7484	100p
7485	90p
7486	30p
7489	175p
7490A	30p
7491	80p
7492A	46p
7493A	30p
7494	84p
7495A	70p
7496	65p
7497	180p
74100	130p
74104	65p
74105	65p
74107	34p
74109	55p
74110	55p
74111	70p
74116	200p
74118	130p
74119	210p
74120	110p
74121	25p
74122	48p
74123	48p
74125	55p
74126	60p
74128	75p
74132	75p
74136	75p
74141	70p
74142	200p
74145	90p
74147	190p
74148	150p
74150	100p
74151A	70p
74153	70p
74154	100p
74155	90p
74156	90p
74157	70p
74159	190p
74160	90p
74161	90p
74162	90p
74163	90p
74164	100p
74165	130p
74166	140p
74167	200p
74170	240p
74172	720p
74173	120p
74174	85p
74175	85p
74176	75p
74177	75p
74178	160p
74180	93p
74181	150p
74182	90p
74184A	150p
74185	150p
74186	500p
74190	90p
74191	90p
74192	90p
74193	90p
74194	100p
74195	95p
74196	95p
74197	80p
74198	150p
74199	150p
74200	£10
74221	160p
74251	140p
74259	250p
74265	90p
74278	290p
74279	110p
74283	190p
74284	400p
74285	400p
74290	150p
74293	150p
74294	200p
74298	200p
74365	120p
74366	120p
74367	120p
74368	120p
74390	200p
74393	180p
74490	225p

74LS SERIES

74LS00	13p
74LS02	14p
74LS04	14p
74LS05	25p
74LS08	22p
74LS10	20p
74LS11	40p
74LS13	36p
74LS14	70p
74LS20	20p
74LS21	40p
74LS22	28p
74LS27	38p
74LS30	22p
74LS32	27p
74LS42	95p
74LS47	90p
74LS55	30p
74LS73	55p
74LS74	40p
74LS75	45p
74LS76	45p
74LS83	90p
74LS85	100p
74LS86	40p
74LS90	60p
74LS92	72p
74LS93	60p
74LS96	75p
74LS107	45p
74LS112	100p
75LS123	65p
74LS124	180p
74LS125	80p
74LS126	90p
74LS132	95p
74LS133	60p
74LS136	55p
74LS138	80p
74LS139	60p
74LS148	180p
74LS151	100p
74LS153	60p
74LS154	140p
74LS157	50p
74LS158	120p
74LS160	130p
74LS161	100p
74LS162	140p
74LS163	110p
74LS164	120p
74LS165	160p
74LS166	180p
74LS173	110p
74LS174	90p
74LS175	110p
74LS181	320p
74LS190	100p
74LS191	100p
74LS192	140p
74LS193	140p
74LS194	90p
74LS195	140p
74LS196	120p
74LS221	140p
74LS240	175p
74LS241	175p
74LS242	170p
74LS243	170p
74LS244	195p
74LS245	195p
74LS251	140p
74LS253	140p
74LS257	120p
74LS258	250p
74LS259	160p
74LS266	50p
74LS273	130p
74LS279	140p
74LS298	249p
74LS324	200p
74LS365	160p
74LS367	160p
74LS368	160p
74LS373	180p
74LS374	195p
74LS377	180p
74LS378	200p
74LS390	160p
74LS393	160p

FULL 74LS SERIES AVAILABLE

4000 SERIES

4000	15p
4001	17p
4002	17p
4006	95p
4007	18p
4008	80p
4009	40p
4010	50p
4011	17p
4012	18p
4013	50p
4014	84p
4015	84p
4016	45p
4017	80p
4018	80p
4019	45p
4020	100p
4021	110p
4022	100p
4023	22p
4024	50p
4025	20p
4026	130p
4027	50p
4028	84p
4029	100p
4030	55p
4031	200p
4033	180p
4034	200p
4035	110p
4040	100p
4041	80p
4042	80p
4043	90p
4044	90p
4046	110p
4047	100p
4048	55p
4049	40p
4050	49p
4051	80p
4052	80p
4053	80p
4054	150p
4055	125p
4056	135p
4059	600p
4060	115p
4063	120p
4066	55p
4067	450p
4068	22p
4069	20p
4070	30p
4071	22p
4072	22p
4073	22p
4075	22p
4076	107p
4081	22p
4082	22p
4093	80p
4094	175p
4098	120p
4411	£11
4502	120p
4503	70p
4507	55p
4510	99p
4511	150p
4514	250p
4516	110p
4518	100p
4520	90p
4528	100p
4532	140p
4538	140p
4543	180p
4553	450p
4556	90p
4560	250p
4569	180p
4583	90p
4584	90p
14411	£11
14412V	£11
14433	£11
14500	£7
14599	290p

INTERFACE ICs

MC1488	100p
MC1489	100p
75107	160p
75150	175p
75154	175p
75182	230p
75322	275p
75324	375p
75325	375p
75451	72p
75491/2	96p
8T26	250p
8T28	300p
8T95	160p
8T97	160p
81LS95	140p
81LS96	140p
81LS97	140p
81LS98	140p
9601	140p
9602	220p
9603	60p

93 SERIES

9301	160p
9302	175p
9308	316p
9310	275p
9311	275p
9312	160p
9314	165p
9316	225p
9321	225p
9322	150p
9334	225p
9368	200p
9370	200p
9374	200p

VEROBOARD

(copper clad)	0.1	0.15
2½ x 3¼"	41p	33p
2½ x 5"	49p	45p
3¾ x 3¾"	49p	45p
3¾ x 5"	56p	60p
2½ x 17"	180p	150p
3¾ x 17"	230p	190p
4¾ x 17"	280p	—
Pkt of 35 pins		30p
Spot face cutter		85p
Pin insertion tool		99p

VERO WIRING PEN

Plus Spool	325p
Spare spool (wire)	80p
Combs	7p each.

LINEAR ICs

*AY1-0212	600p
*AY1-1313	668p
*AY1-1320	320p
*AY1-5050	200p
*AY5-1315	600p
*AY5-1317A	636p
*CA3019	80p
*CA3046	70p
*CA3048	225p
CA3080E	72p
CA3086	48p
*CA3089E	225p
*CA3090AQ	375p
CA3130E	100p
CA3140E	70p
CA3160E	100p
CA3161E	150p
CA3162E	450p
FX209	750p
ICL7106	850p
ICL8038	340p
LF356P	95p
LF358P	75p
LM301A	30p
LM311	120p
LM318	200p
LM319	200p
LM324	70p
LM339	75p
LM348	95p
*LM377	175p
*LM380	75p
*LM381AN	160p
*LM389N	140p
LM709	36p
LM710	50p
LM725	350p
LM733	100p
LM741	20p
LM747	70p
LM748	35p
LM3302	80p
LM3900	70p
LM3911	130p
LM4136	120p
*MC1310P	150p
MC1458	55p
MC1495L	350p
*MC1496	100p
*MC3340P	120p
*MC3360P	120p
MK50398	750p
NE531	110p
*NE540L	200p
NE543K	225p
NE555	25p
NE556	70p
NE5618	425p
NE562B	425p
NE565	130p
NE566	155p
NE567	175p
*NE571	425p
*SAD1024A	£14
SFF96364	1150p
*SN76003N	175p
*SN76013N	140p
*SN76018	140p
*SN76013ND	120p
*SN76023N	140p
*SN76023ND	120p
*SN76131	110p
*SN76033N	175p
SN76477	250p
*SP8515	750p
*TAA621	275p
*TBA641B11	225p
*TBA651	200p
*TBA800	90p
*TBA810	100p
*TBA820	90p
*TCA940	175p
*TDA1004	300p
*TDA1008	320p
*TDA1022	600p
TDA1034B	250p
*TDA2020	320p
TL071	70p
TL072	95p
TL074	150p
TL084	130p
TL170	50p
ULN2003	100p
XR2206	350p
XR2207	400p
XR2211	600p
*XR2216	675p
XR2240	400p
*ZN414	90p
ZN424E	135p
ZN425E	400p
ZN1034E	200p
95H90	800p
IIC90	£14

VOLTAGE REGULATORS

Fixed Plastic TO-220

1A	+ve		−ve	
5V	7805	75p	7905	90p
12V	7812	75p	7912	90p
15V	7815	75p	7915	90p
18V	7818	90p	7918	100p
24V	7824	90p	7924	100p

100mA	TO-92			
5V	78L05	35p	79L05	80p
12V	78L12	35p	79L12	80p
15V	78L15	35p	79L15	80p

OTHER REGULATORS

LM309K	135p	LM320T-12	90p
LM317T	200p	LM340T-12	75p
LM323K	625p	78HO5KC	675p
LM723	37p	78MGT2C	135p

OPTO-ELECTRONICS

2N5777	45p	OCP71	130p
ORP12	90p	ORP60	90p
ORP61	90p	TIL78	70p

LEDS

0.125		0.2	
TIL32 I.R.	75p	TIL220 Red	16p
TIL209 Red	13p	TIL222 Gr	18p
TIL211 Gr	20p	TIL228 Red	22p
TIL212 Ye	25p	MV5491 TS	120p
TIL216 Red	18p	Clips	3p

DISPLAYS

3015F	200p	FND500	120p
DL704	140p	FND507	120p
DL707 Red	140p	MAN3640	175p
707 Gr	140p	TIL311	600p
DL747 Red	225p	TIL312/3	110p
747 Gr	225p	TIL321/2	130p
FND357	120p	TIL330	140p
		7750/60	200p

DRIVERS 9368/9370 200p

TRANSFORMERS (Prim 220-240V)

6-0-6	100mA	88p	9-0-9	1A	270p+
9-0-9	75mA	92p	12V	2A	350p+
12-0-12	100mA	95p	0-12-15-20-24-30	1A	340p+
0-12 0-12	500mA	280p+	15-0-15	1A	265p+

(Please add 50p p&p charge to all items marked + above our normal p&p charge)

TRANSISTORS

AC126	25p
AC127/8	20p
AC176	25p
AC287/8	25p
AF116/7	30p
AD149	70p
AD161/2	45p
BC107/8	11p
BC109	11p
BC109C	13p
*BC117	20p
*BC147/8	9p
*BC149	10p
*BC157/8	10p
*BC159	11p
*BC169C	12p
*BC172	12p
BC177/8	17p
BC179	18p
*BC182L	10p
*BC182/3	10p
*BC183L	10p
*BC184L	11p
BC187	30p
*BC212L	11p
*BC212/3	11p
*BC213L	11p
*BC214L	12p
BC461	36p
BC477/8	30p
*BC516/7	50p
*BC547B	16p
*BC548C	16p
*BC549C	18p
*BC557B	16p
*BC558B	16p
*BC559C	18p
BCY70	18p
BCY71/2	22p
BC131/2	50p
BD135/6	54p
BD139	56p
BD140	60p
BD242	70p
BDY56	200p
BF200	32p
*BF244B	35p
*BF256B	70p
BF257/B	32p
BF259	36p
*BFR39	30p
*BFR40	30p
*BFR41	30p
*BFR79	30p
*BFR80	30p
*BFR81	30p
BFX29	30p
BFX30	34p
BFX84/5	30p
BFX86/7	30p
BFX88	30p
BFW10	90p
BFY50	22p
BFY51/2	22p
BFY56	33p
BFY90	90p
BRY39	45p
BSX19/20	20p
BU104	225p
*BU105	190p
*BU108	250p
BU109	225p
*BU205	200p
*BU208	200p
*BU406	145p
MJ481	175p
MJ491	200p
MJ2501	225p
MJ2955	100p
MJ3001	225p
*MJE340	65p
MJE2955	100p
MJE3055	70p
*MPF102	45p
*MPF103/4	40p
*MPF105	40p
MPSA06	30p
*MPSA12	50p
*MPSA13	50p
*MPSA20	60p
*MPSA56	32p
*MPSU06	63p
*MPSU56	78p
OC28	130p
OC35	130p
*R2008B	200p
*R2010B	200p
*TIP29A	40p
*TIP29C	55p
*TIP30A	48p
*TIP30C	60p
*TIP31A	58p
TIP31C	62p
TIP32A	68p
TIP32C	82p
TIP33A	90p
TIP33C	114p
TIP34A	115p
TIP34C	160p
TIP35A	225p
TIP35C	290p
TIP36A	270p
TIP36C	340p
TIP41A	65p
TIP41C	78p
TIP42A	70p
TIP42C	82p
TP120	100p
TIP122	110p
TIP2955	78p
TIP3055	70p
*TIS43	34p
*TIS93	30p
*ZTX108	12p
*ZTX300	13p
*ZTX500	15p
*ZTX502	18p
*ZTX504	30p
2N457A	250p
2N696	35p
2N697	25p
2N698	45p
2N706A	20p
2N708A	20p
2N918	45p
2N930	18p
2N1131/2	20p
2N1613	25p
2N1711	25p
2N2102	60p
2N2160	300p
2N2219A	22p
2N2222A	20p
2N2369A	16p
2N2484	30p
2N2646	50p
2N2904/5	25p
2N2906A	24p
2N2907A	30p
*2N2926	9p
2N3053	22p
2N3054	65p
2N3055	48p
2N3442	140p
2N3553	240p
*2N3565	30p
*2N3643/4	48p
*2N3702/3	12p
*2N3704/5	12p
*2N3706/7	14p
*2N3708/9	12p
*2N3773	300p
*2N3819	25p
*2N3820	50p
2N3823	70p
2N3866	90p
*2N3903/4	18p
*2N3905/6	20p
*2N4036	65p
2N4058/9	12p
*2N4060	12p
*2N4061/2	18p
*2N4123/4	22p
*2N4125/6	22p
*2N4289	20p
*2N4401/3	27p
2N4427	90p
*2N4871	60p
*2N5087	27p
*2N5089	27p
*2N5172	27p
2N5179	90p
2N5191	83p
2N5194	90p
*2N5245	40p
*2N5296	55p
*2N5401	50p
*2N5457/8	40p
*2N5459	40p
*2N5460	40p
2N5485	44p
*2N6027	48p
2N6247	190p
2N6254	130p
2N6290	65p
2N6292	65p
3N128	120p
3N140	100p
3N141	110p
3N201	110p
40290	250p
40360	40p
40361/2	45p
40364	120p
40408	70p
40409	65p
40410	65p
40411	300p
40594	97p
40595	105p
40673	75p
40841	90p
40871/2	90p

DIODES

*BY127	12p
*OA47	9p
*OA81	15p
*OA85	15p
*OA90	9p
*OA91	9p
*OA95	9p
*OA200	9p
*OA202	10p
*1N914	4p
*1N916	7p
*1N4148	4p
1N4001/2	5p
1N4003/4	6p
1N4005	6p
1N4006/7	7p
1N5401/3	14p
1N5404/7	19p
*1S920	9p

*ZENERS

2.7V-33V	
400mW	9p
1W	15p

TRIACS PLASTIC

3A 400V	60p
3A 500V	65p
6A 400V	70p
6A 500V	88p
8A 400V	75p
8A 500V	95p
12A 400V	85p
12A 500V	105p
16A 400V	110p
16A 500V	130p
T2800D	130p

HEAT SINKS

For TO220 Voltage Regs. and Transistors	22p
For TO5	12p

THYRISTORS

1A 50V	40p
1A 400V	65p
1A 600V	70p
3A 400V	90p
8A 600V	140p
12A 400V	160p
16A 100V	160p
16A 400V	180p
16A 600V	220p
BT106	110p
C106D	45p
*MCR1D1	36p
2N3525	130p
2N4444	140p
*2N5060	34p
*2N5064	40p

BRIDGE RECTIFIERS

*1A	50V	21p
*1A	100V	22p
*1A	400V	30p
*1A	600V	35p
*2A	50V	30p
*2A	100V	35p
*2A	400V	45p
*3A	200V	60p
*3A	600V	72p
*4A	100V	95p
*4A	400V	100p
6A	50V	90p
6A	100V	100p
6A	400V	120p
10A	400V	200p
25A	400V	400p

*LOUDSPEAKERS

2½"	64R	70p
2½"	8R	70p
2"	8R	75p
1½"	8R	75p

MEMORIES

2102-2L	120p
2107B	500p
2111-2	225p
2112-2	300p
2114	700p
4027	370p
4044	900p
4116	1100p
5101	610p
6810	350p

ROM/PROMs

74S188	225p
74S287	350p
74S387	350p
74S571	650p
93427	400p
93436	650p
93446	650p
93448	£10

CPUs

1610	930p
6502	1200p
6800	900p
6802	£12
8080A	550p
Z80	1150p

EPROMs

1702A	600p
2708	900p
2716	£29
4702	900p

UART

AY-3-1015P	500p
AY-5-1013P	400p
IM6402	500p
TMS6011NC	400p

CHARACTER GENERATOR

3257ADC	995p
MCM6576	£10
RO-3-2513U.C.	650p
RO-3-2513L.C.	650p
SN74S262AN	1360p

OTHER

3245	400p
6820	600p
6850	700p
8205	320p
8212	225p
8216	225p
8224	400p
8228	525p
8251	700p
8253	£12
8255	550p
8257	£11
8259	£14
MC14411	£11
MC14412V	£11
Z80P10	875p
Z80CTC	875p

SUBMINIATURE SWITCHES

Toggle	
SPST	51p
SPDT	53p
DPDT	55p
DPDT (centre off)	75p
Push to make (Red, Green, Yel., Blue)	15p
Push to break (Black only)	25p

CRYSTALS

100KHz	300p
1MHz	370p
1.008MHz	370p
3.2768MHz	350p
10.7MHz	350p
18MHz	300p
27.135MHz	300p

EDGEBOARD CONNECTORS

0.156" Solder Tail

2 x 10 way	85p
2 x 15 way	100p
2 x 18 way	120p
2 x 22 way	135p
2 x 25 way	160p

KEYBOARD ENCODERS

AY-5-2376	£10

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	11p	18 pin	25p	24 pin	33p
14 pin	12p	20 pin	28p	28 pin	42p
16 pin	13p	22 pin	30p	40 pin	51p

WIRE WRAP SOCKETS

8 pin	30p	18 pin	65p	24 pin	90p
14 pin	40p	20 pin	70p	28 pin	110p
16 pin	55p	22 pin	80p	40 pin	140p

COUNTERS

74C925N	475p
ICM7217A	850p
ZN1040E	700p

4 DIGIT DISPLAY

NSB5881 C C	570p

All items are normally stocked in depth and stock items are despatched by return.

Data Books on TTLs, CMOS, LINEARS, MEMORIES, TRANSISTORS ETC. AVAILABLE.

LOW VOLTAGE CAPACITORS ELECTROLYTIC TANTALUM POLYESTER MICA AVAILABLE

VDU SYSTEM PARTS

Convert your TV into a VDU using Thompson-CSF TV CRT Controller IC. 16 line by 64 characters, cursor management, on screen, line erasing, compatible with any microprocessor system.

Thompson-CSF CRT Controller IC SFF96364 **1150p.** RO-3-2513 **650p.** AY-5-1013 **400p.** 71301 ROM **700p.**

PE Memory Mapped VDU System Kit **£49** inc. VAT (Reprint of PE articles **75p**)

Elekterminal VDU System Kit **£69** inc. VAT

PARTS AVAILABLE FOR MANY PROJECTS 4 DIGIT COUNTER, CLICK ELIMINATOR, TACHOMETER, 5A VARIABLE POWER SUPPLY. Send SAE for the list.

S100 Busboard **£12**

***RESISTORS** High Stab Carbon Film 5% Tol E12
*½W 10R-10M **5p**/pack of 3 (one value)
*¼W 10R-1M **7p**/pack of 5 (one value)

***MINIATURE PRESETS** Horz/Vert 100R-1M **10p**

***CARBON TRACK POTENTIOMETERS** 1/4 LOG or LIN

Single	5K-2M	26p
Single with DP Switch	5K-2M	55p
Dual	5K-2M	66p

ANTEX SOLDERING IRONS

Model C 15W	360p
CX 17W	380p
X25	380p
CCN	380p
Spare Bits C/CX/CCN	46p
X25	50p

VEROBOARDS

DIP Breadboard 4.5 x 6.15 (Suitable for 20 x 14 pin or 16 x 16 pin DIL ICs)	270p
Dip Board 4.5 x 6.15 (With tracks for 31 way connector)	340p
Connector Plug 31 way	100p
Connector Socket 31 way	110p
VQ Board for ICs — no track cutting	105p

We carry a large stock of standard TTLs, 74Ls TTLs, Memories, CMOS, Linears, Regulators, Opto-Devices etc., and can offer very competitive prices. We welcome inquiries for bulk quantities. Official orders from local and overseas govt. depts., universities, colleges, research organisations, Broadcasting Authorities etc., are accepted without prepayment.

VAT RATE: All items at 8% except where marked * where 12½% applies.

Please send SAE for list

Please add 25p p&p & VAT at appropriate rates.

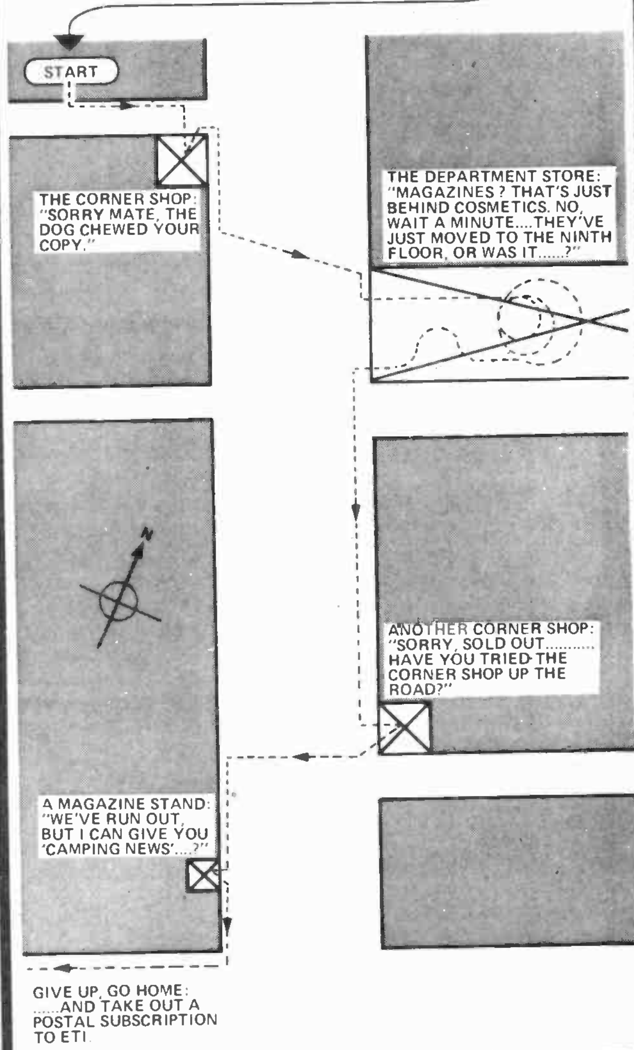
Government, Colleges, etc. Orders accepted.

CALLERS WELCOME — Mon.-Fri. 9.30-5.30, Saturday 10.30-4.30

TECHNOMATIC LTD.

17 Burnley Road, London NW10
(2 minutes Dollis Hill tube station) (ample street parking)
Tel: 01-452 1500 **Telex: 922800**

NON-SUBSCRIBERS START HERE



It can be a nuisance can't it, going from newsagent to newsagent? "Sorry squire, don't have it — next one should be out soon."

Although ETI is monthly, it's very rare to find it available after the first week. If it is available, the newsagent's going to be sure to cut his order for the next issue — but we're glad to say it doesn't happen very often.

Do yourself, your newsagent and us a favour. Place a regular order for ETI; your newsagent will almost certainly be delighted. If not, you can take out a postal subscription so there's nothing for you to remember — we'll do it for you.

For a subscription, send us £7.00 (£8.00 overseas) and tell us which issue you want to start with. Please make your payment (in sterling please for overseas readers) to ETI Subscriptions and keep it separate from any other services you want at the same time.

ETI Subscriptions
Map Publications
PO Box 35
Bridge Street
Hemel Hempstead
Herts

KEY:

1: The bit of chocolate you thought you'd leave for later.

2: Coffee stains (instant).

3: A useful-sized bit of stiff paper to stop the window from rattling.

4: Rough calculations for your new combined egg timer/laser cannon project.

5: ETI makes a fair soldering iron stand.

6: The dog insisted on carrying your copy to you along with your slippers.

WHAT A BIND!

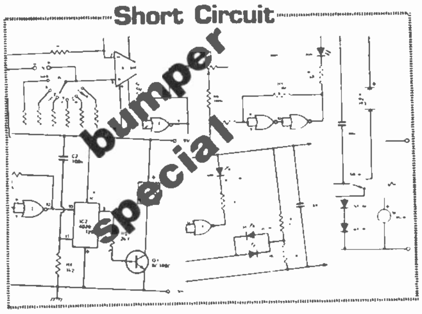
Half our orders for binders are repeats: we think that says a lot for their quality. At £3.00 all inc. you get a great deal of peace of mind too!

ETI Binders
25-27 Oxford Street,
London W1R 1RF.

Hobby Electronics

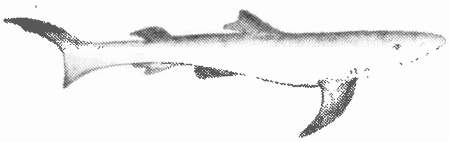
Next Month

BUMPER SHORT CIRCUIT ISSUE



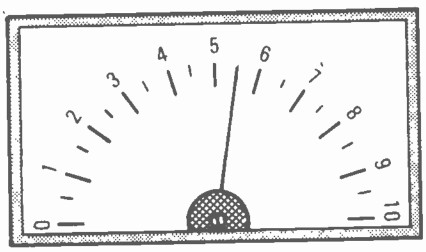
Look out this month for more than your usual share of our very popular, Short Circuit feature. Plenty of circuit designs for you to develop and experiment with.

SHARK



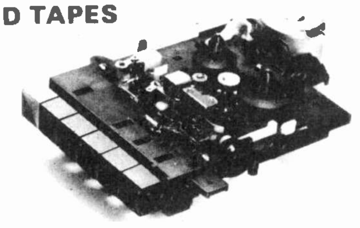
Not a game for the nervous. An LED-based game for two players which involved two swimmers in a race for survival in a shark-infested sea. Which of these two castaways will reach the safety of the island? The unfortunate one is swallowed by the hungry shark, accompanied by a shrill scream. All good family fun!

LINEAR SCALE OHMMETER



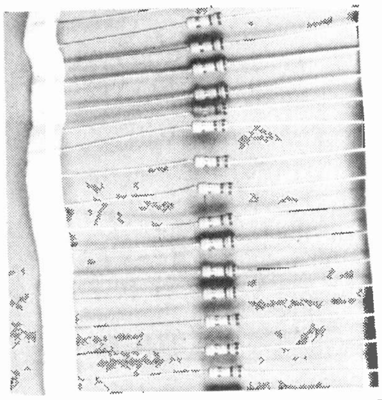
If you ever look at a multimeter on the ohms range you'll notice that most of the numbers are all squashed up one end; this makes accurate readings difficult. The HE Ohmmeter overcomes this difficulty with a linear scale. The range of resistance covered is from 1 k to 1 M ohms in four ranges, a useful addition to any workshop's range of test equipment.

CASSETTE DECKS AND TAPES



Next to the TV and Transistor radio, the Cassette tape recorder is probably the most common piece of domestic electronic equipment. Next month Gordon King takes a close look at what has made the Compact Cassette so popular and one or two of its advantages and drawbacks, warts and all.

RESISTORS

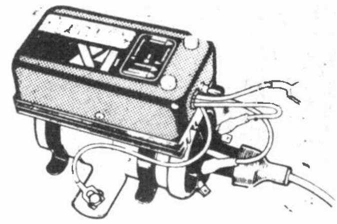


Following the success of our feature on Capacitors (according to our reader questionnaire) we're doing a follow up on the ins-and-outs of Resistors. Like Capacitors it's *not* going to be a formula-strewn study but a rather slanted look into their construction and use. So if you've never heard of Thick Film resistors and Metal Oxide, now's your chance.

HOBBY CHIT CHAT

Ray Marston our Project Editor/Designer starts a new monthly series looking at our fast-moving hobby from the technical point of view. These articles are designed to take a look into the worlds largest growth industry, what's new and how it will affect us in our daily lives as well as a more specific look at our own side of the fence in HE.

KIT REVIEW

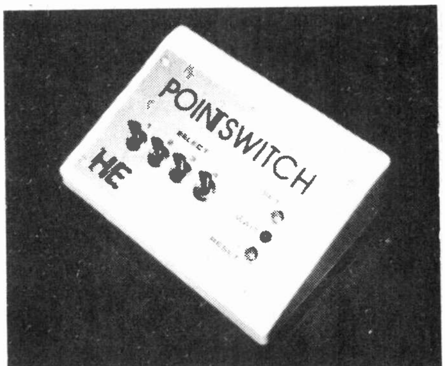


One for the motorist this month, we have built up an Electronic Ignition system from Sparkrite (X4); read all about it next month.

LINEAR ICs

If you've been wondering what's going to happen now Into Electronics has finished, don't worry. Ian Sinclair has begun his follow-up series Linear ICs. Month by month the articles will introduce most aspects of IC use, construction and theory. With the background knowledge gained from Into Electronics your understanding of new technology should increase dramatically.

POINTS CONTROLLER



Another project for model railway buffs. This unit gives full control over an unlimited number of electro-mechanical points using a push-button control. This makes an ideal companion to our HE Model Train Controller featured in the April issue.

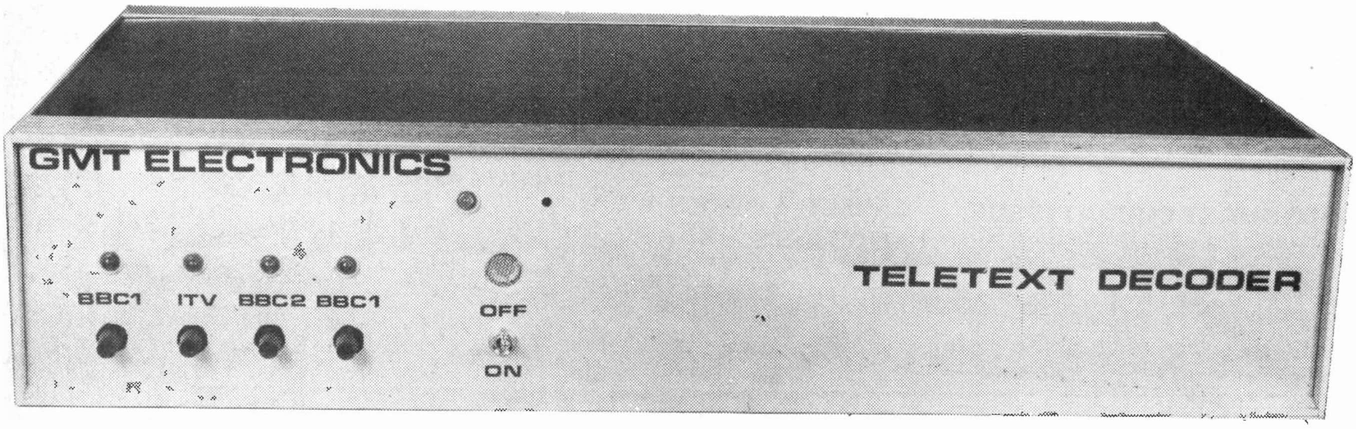
BABY ALARM

A really simple project to keep one ear on the kids whilst you're building your latest HE project.

The July issue will be on sale June 8th

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

TELETEXT SYSTEM



A complete ultrasonic controlled Teletext design employing the newly released Mullard chip set. Design by GMT Electronics for ETI. Facilities include double size characters and video superimpose.

THIS PROJECT is designed to allow the home constructor to produce himself a full spec Teletext unit at around half the cost of comparable commercial units. The design requires no hard wiring into the set, as it contains its own modulator and works into the aerial socket. Definition usually suffers utilising this method, but here great attention has been paid to overcoming this problem.

As with all decent designs remote control is ultrasonic, and gives both full and half page displays. The keyboard arrives already fitted to the PCB, and only needs the decoder chip and transducer soldering in to produce a complete unit.

A complete kit is available from GMT electronics, which includes plated–through hole PCBs, full metalwork and the hand controller. See Buylines for final details.

Construct-a-Text

Despite the complexity of this project construction is amazingly straightforward, all that is required is to assemble the four boards CAREFULLY following the overlays, and fit these into the chassis. Interwiring between the PCBs is dealt with by following the list given here, and referring to the wire nos. shown on the overlays. Don't be tempted to change this, best results — indeed any results — will only be obtained by strict adherence!

Once you're satisfied that all is as it should be, fit the ICs into their sockets and move on to the setting up.

FACILITIES

Keyboard Commands

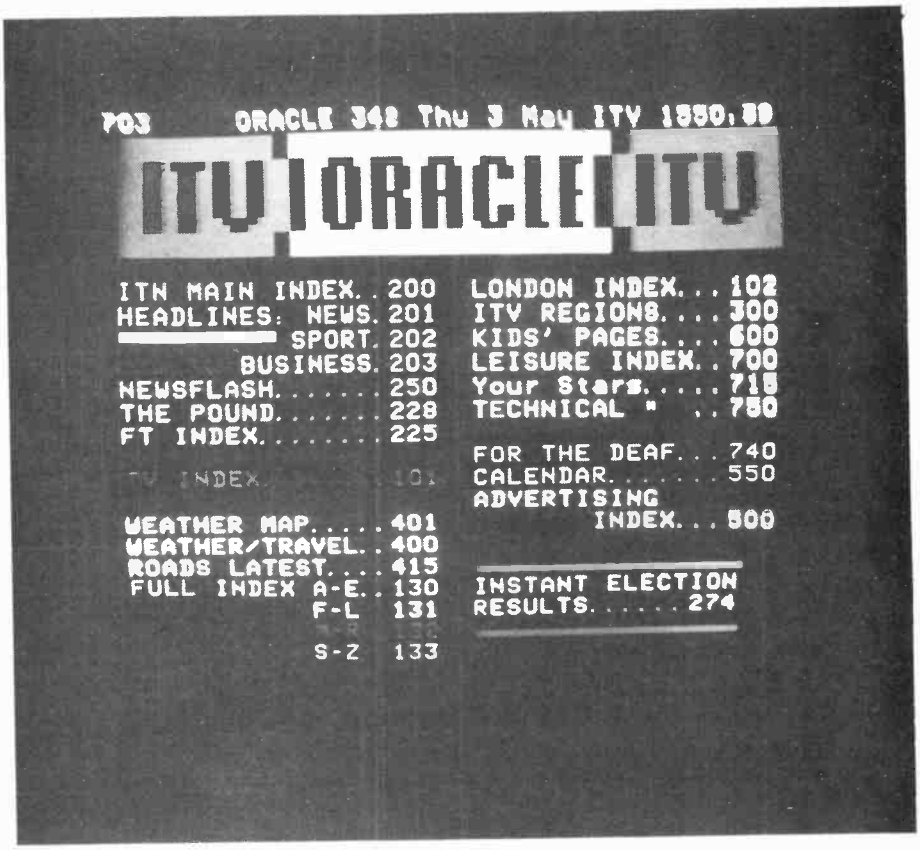
RESET	**The screen is cleared and the converter is ready for channel change (timed page is cancelled).**
STATUS	**Television station identification appears top left of screen.**
HOLD	**Displayed page is held.**
TOP	**Large (2x) top half of display.**
BOTTOM	**Large (2x) bottom half of display.**
MIX PAGE	**Cancels both above displays channel video and teletex together.**
TIMED PAGE	**On: — The selected time for the page selected can be inserted and is displayed in the top right of screen (4 Digits).** **Off: — Above cancelled.**
REVEAL	**Displays hidden characters.**
TEXT	**Calls up teletext. Page 100 selected automatically (currently for BBC 2 Ceefax key in 200).**
CANCEL	**Cancels text.**
DATA	**Used for external data (not used in current design).**
TV ON	**Not used in current design.** **Last two facilities available for further expansions.**

Set up!

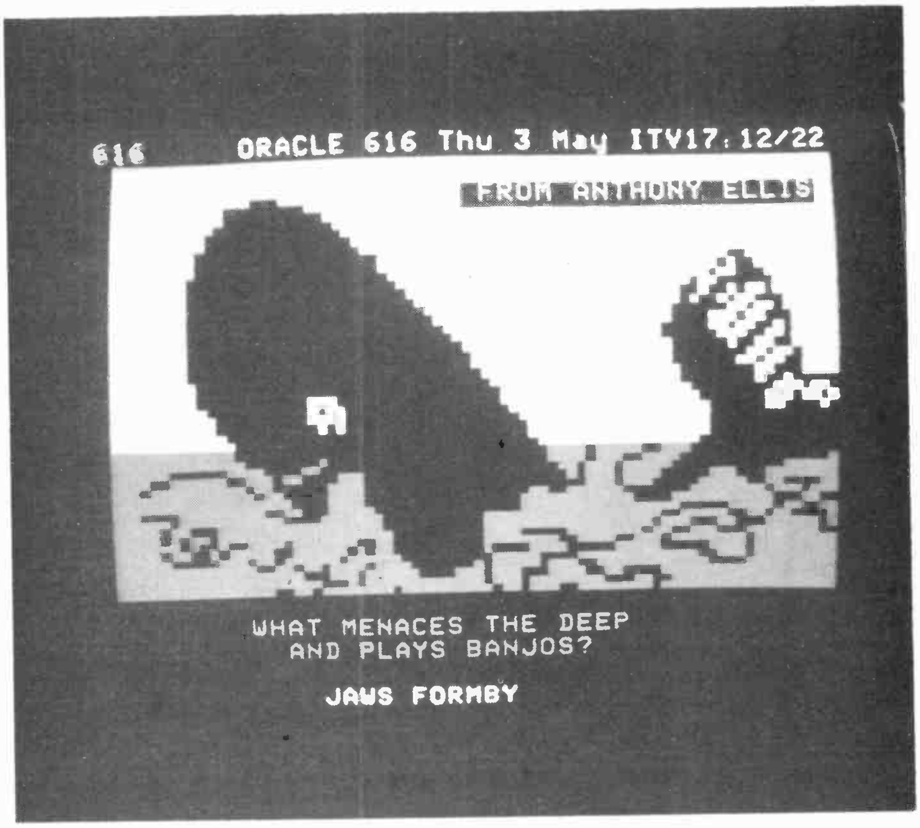
1) Disconnect encoder video O/P from the modulator board.
2) Disconnect blanking and picture on (PO) outputs from main board.
3) Connect UHF O/P to set, and UHF aerial to converter.
4) Select spare channel on T/V set.
5) Tune T/V for blank screen (ie. no noise).
6) Switch off.
7) Link P.O. input of UHF and mixer board to 12V.
8) Switch on.
9) Tune RV 201 (front panel to obtain best picture on BBC1.
10) Re-adjust set for best colour picture, modulator RV 401 may need adjustment.
11) Repeat 7 and 8 as required.

12) Switch off.
13) Reconnect steps 1 and 2 remove link step 6.
14) Switch on.
15) Set RV 100 to midpoint.
16) Connect pin 1 1C103(VIP) to 12V.
17) Connect pin 7 via 5M6 to 12V.
18) With transmitter switch to mix mode.
19) Adjust CV101 until characters lock with picture.
20) Switch off.
21) Remove steps 14 and 15.
22) Switch on.

23) Adjust L101 to obtain page header and time clock stepping (note this setting is sharply defined). L101 should not need adjustment (ignore any colour flicker).
24) Switch off.
25) Link pin 10 1C103 to 12V rail.
26) Switch on. Note CV102 and L101 interactive repeat 20 and 24 as necessary.
27) Adjust CV102 for best display (approx ¼ closed).
28) Switch off.
29) Remove step 22.
30) Switch on.
31) Switch to text mode.
32) Adjust CV301 for best colour.
33) Other channels can now be tuned (hit reset followed by channel No 1=BBC1; 2=ITV; 3=BBC2). ▶



Above and below, two typical screen displays from the ITV, Oracle service. Now do you see what you're missing out on?



HOW IT WORKS

Ultrasonic Receiver And Transmitter

In the transmitter the keyboard, commands are encoded by the SAA 5000 which switches the HEF 4069 transmitter IC in the correct code sequence.

This pulse coded 40Hz transmission is received by the TDB 1033 which provides 90dB of gain in AGC system and a carrier filter. The output is fed to the decoder section.

The Decoder

This design is based on the Mullard L.S.I. design and uses four main IC's and a memory section of seven 2102's.

The signal from the TDB 1033 is fed to the SAA 5010 receiver decoder and checked for error content and then produces various outputs.

1. Analogue Controls — Not used in this design.
2. Station Selector Drive Output — Used via an HEF 4011 inverter to step an HEF 4017 station selector.
3. Message Received Output — Used to drive an LED and audible indicator.
4. Control Signals for the SAA 5040 TAC.

SAA 5030 VIP Video Input Processor

The data retrieval section of IC, slices the incoming data signal by means of an automatic adaptive data slicer circuit. This circuit sets the threshold level for slicing at half the data amplitude, regardless of the amplitude of the incoming signal, and provides some compensation for distortion such as co-channel interference; the performance of the system under noisy conditions is thus improved. A clock signal is generate from the sliced data by using an external 6M9375Hz tuned circuit, and this signal is used to clock the data into the TAC integrated circuit.

A 6MHz display system clock is also included in the VIP, the output of which is divided in the TIC to produce a clock pulse every 64us. This signal is passed back to the VIP where it is compared with the incoming line sync signals. By this means, the timing system of the teletext display is phase-locked with the incoming television picture signal.

A 'signal quality' detector circuit is also included. When a signal with a high noise content is being received, or in the absence of an incoming signal, the signal quality detector cuts off the teletext data to the TAC and allows the display system to free-run. Thus the detector prevents the data stored in the memory from being corrupted by noise. This facility, combined with the local display clock, allows a stable display even in the absence of an incoming television signal. Both are essential for after-hours display.

The IC also contains an adaptive sync separator which extracts the sync signals from the incoming video signal and also provides a sync output signal for the timebases of the television receiver. When a full page of text is displayed, the sync output signal is derived from the SAA 5020 TIC.

SAA 5040 TAC Teletext Data Acquisition And Control

The principal function of the data acquisition section of the TAC integrated circuit is to process the teletext data so that it can be written into the memory. The control section processes the information from the remote control

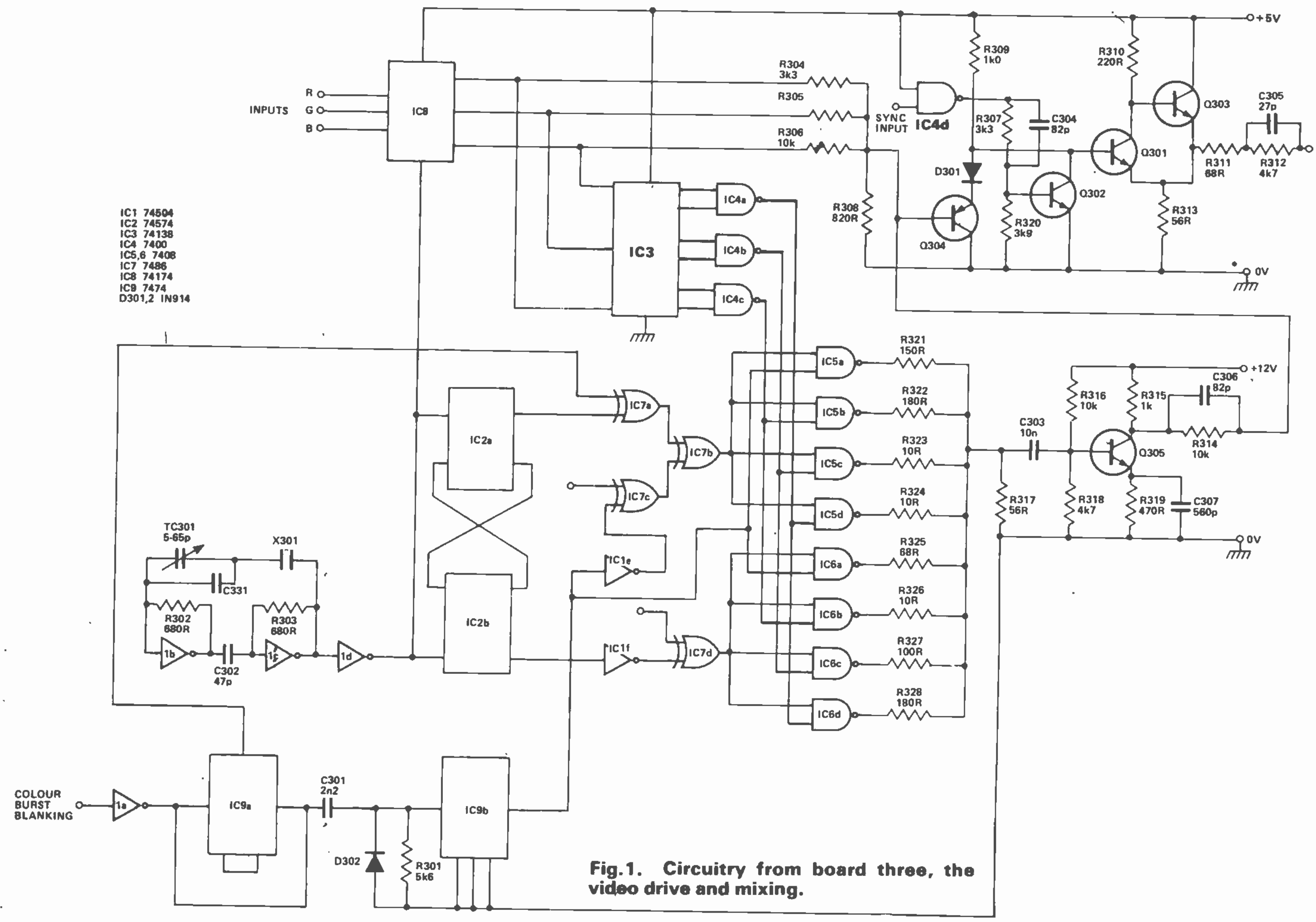


Fig.1. Circuitry from board three, the video drive and mixing.

system, and uses this information to operate the various display functions of the teletext decoder system such as selection of television, teletext, or viewdata modes; page hold, time display, or timed page select.

The data acquisition section, divides the data from the VIP into its component parts. The Hamming-coded address words are checked, and words having a single wrong bit are corrected. Address words having two wrongs bits are rejected. The row address of the incoming data line (one of twenty-four) is fed by this section to the 5-bit row address bus, and the character date is fed through the data to the memory as a sequence of forty 7-bit parallel words.

A signal denoted as WOK (Write O.K.) indicates to the memory when valid data is to be written in, and a WACK (Write Address Clock) signal causes the address counters 74LS161 to step on after each character.

The IC also contains circuits for the implementation of the control bits for the page header.

SAA 5020 TIC Timing Chain

The divider stages in the TIC integrated circuit sub-divide the 6MHz clock signal from the VIP down to 25Hz, the television frame rate, and generate all the timing signals for the teletext display. During the display period, a 1MHz clock signal RACK (Read Address Clock) takes over from WACK to step the character addresses. The address counters 74LS161 are cleared at the end of every line and reset to the first position. After every ten lines during the display, the TIC steps the row address on by one to access the next row of characters in the memory.

In addition to providing all the timing signals for the display, the IC also generates a complete composite sync signal. This signal can be used to drive the timebases of the television receiver without the need for the transmitted sync signal. (This form of operation is also termed 'after-hours' operation.)

Memory Blcok

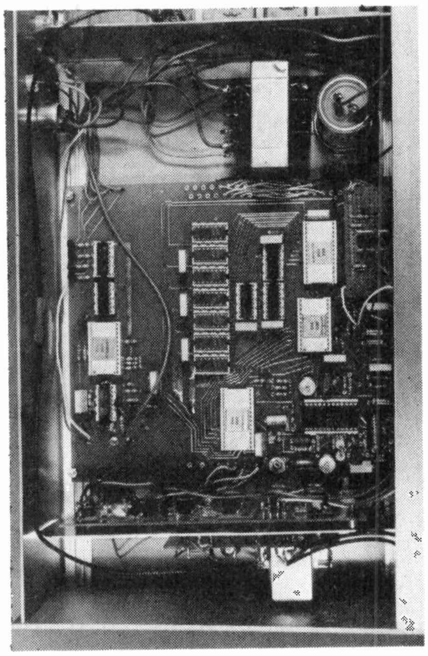
The memory block consists of seven 1k x 1 static RAMs.

SAA 5050 TROM Teletext Read-Only Memory

The read-only memory of the TROM converts the 7-bit character data from the memory into a dot matrix pattern. This matrix is in a 7-by-5 dot form for each character. It also contains a 'character rounding' facility which effectively increases this matrix to 14-by-10 dots, giving improved definition to the displayed characters.

Additional circuits enable various control functions to be performed. These functions are determined by control characters received from the memory. Examples of these control functions are the selection of graphics or alphanumerics, 'flashing' words, or newsflashes and subtitles displayed in boxes within television pictures.

A 'concealed display' function is also provided which can be operated by the user.



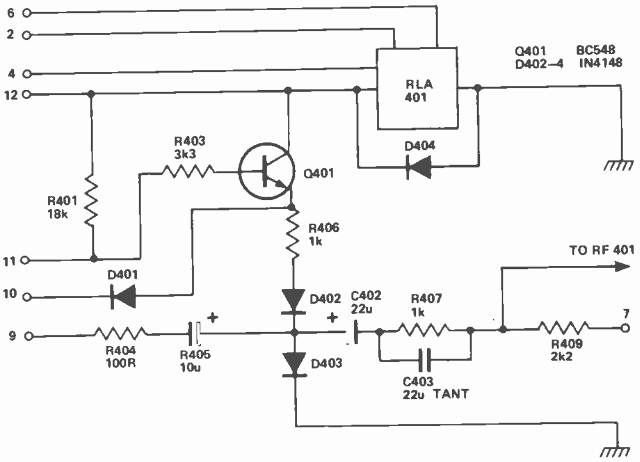


Fig. 2. Relay switching circuit (board four).

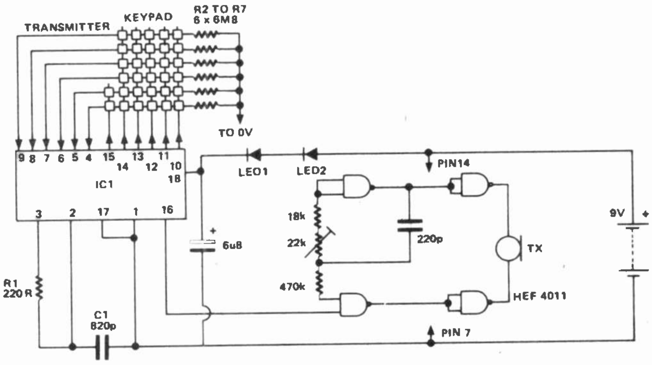
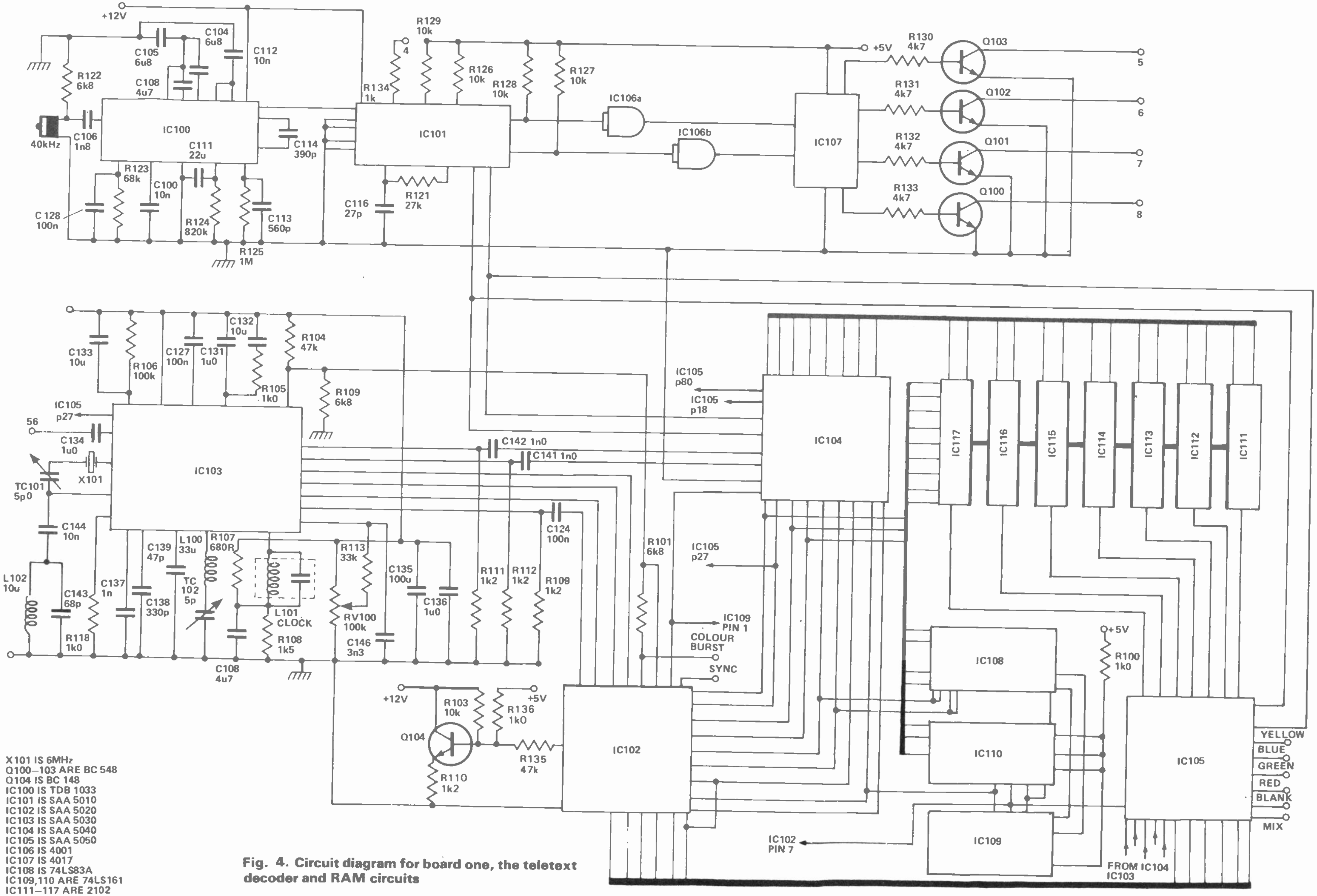
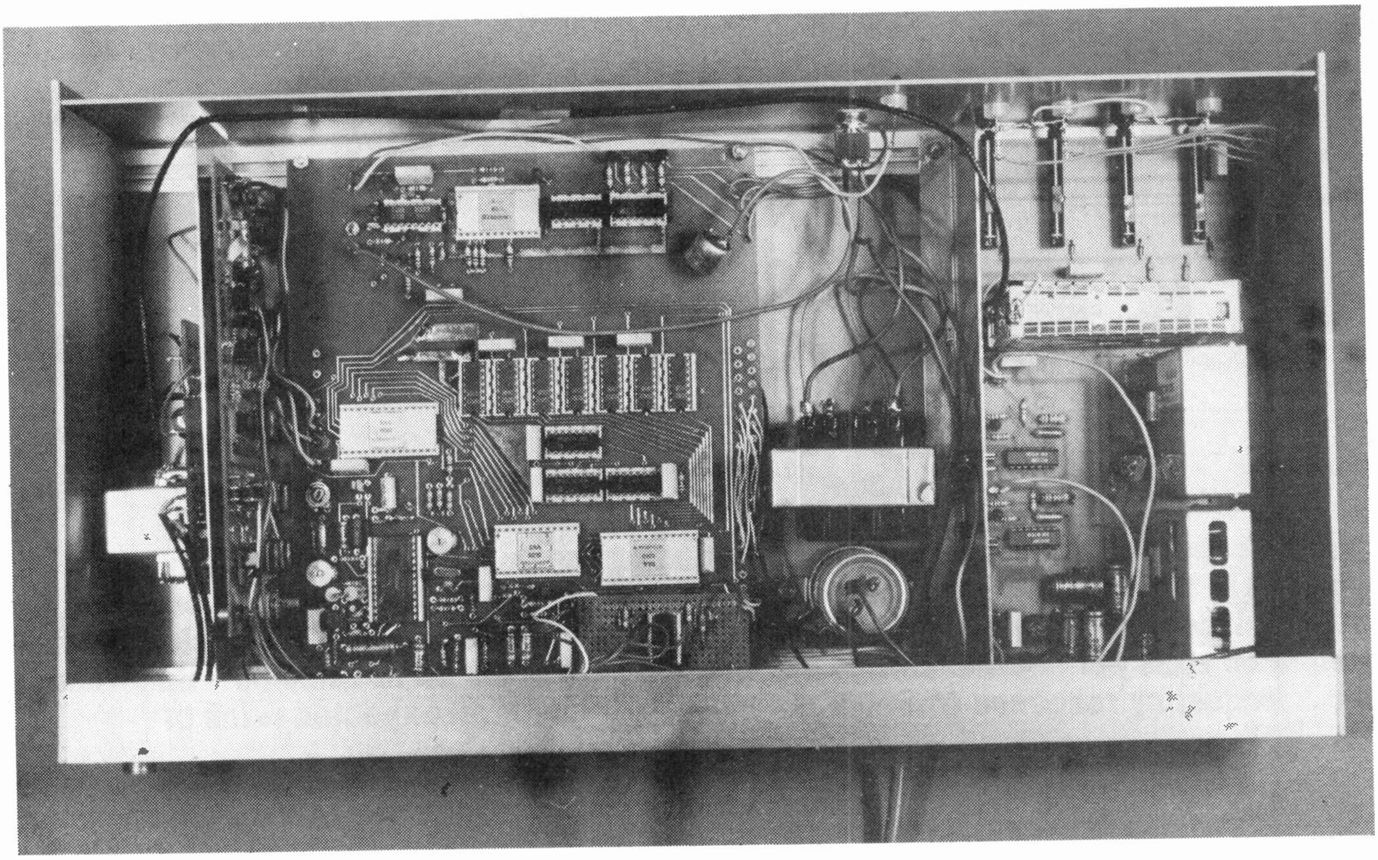


Fig. 3. Hand controller circuitry. Note that no overlay is shown for this, as no constructional work is needed using the kit. IC1 is a SAA5000 for those wishing to go it alone.

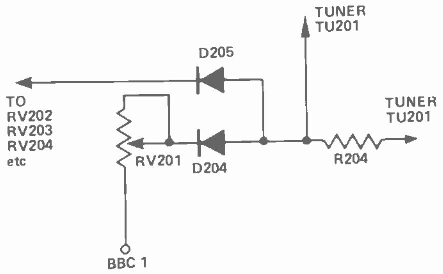


X101 IS 6MHz
Q100–103 ARE BC 548
Q104 IS BC 148
IC100 IS TDB 1033
IC101 IS SAA 5010
IC102 IS SAA 5020
IC103 IS SAA 5030
IC104 IS SAA 5040
IC105 IS SAA 5050
IC106 IS 4001
IC107 IS 4017
IC108 IS 74LS83A
IC109,110 ARE 74LS161
IC111–117 ARE 2102

Fig. 4. Circuit diagram for board one, the teletext decoder and RAM circuits



Above: a unit complete except for mounting of the ultrasonic receiver

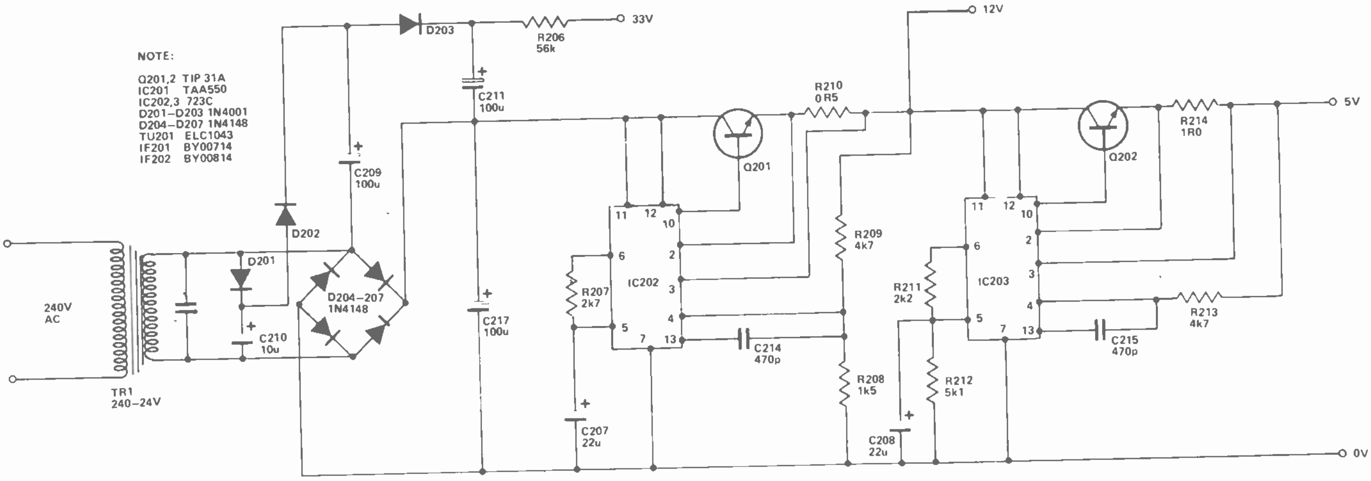


Next month we conclude the project with component overlays, parts lists and some erudite hints upon getting the best results from this superlative design.

ETI

Fig. 5. (Above, left): tuning circuit.

Fig. 6. (Below): Power supply circuitry to produce the three rails needed.



MAGNETIC FIELD AUDIO AMPLIFIERS

Carver Corporation's Model M400 amplifier using the unique 'magnetic cavity' was released in the US a few short months ago. Employing FETs throughout, except for bipolar silicon output transistors, Carver Corp. claims that the M400 has a slew rate around 80 volts per microsecond, hum and noise over 100 dB down, 0.05% distortion and a frequency response from 1 Hz to 250 kHz — all for an expected retail of US$300!

IT REALLY DOES EXIST. ETI first reported Bob Carver's Magnetic Field Audio amplifier in our Australian issue saying . . . *"we hear from normally authoritative sources that Bob Carver — founder of Phase Linear — has developed a totally new concept in audio amplifiers which . . . stores energy in a magnetic field rather than in power supply capacitors . . . his new device generates no heat, weighs a mere five kilos for vast numbers of watts and lasts for ever".*

It seemed a bit hard to take seriously — even though we were totally aware of Bob's previous efforts such as the range of Phase Linear super-amps and the Autocorrelator noise reducer.

But it seems as if this revolutionary concept in audio amplifiers is for real — patent protection has been arranged and preliminary details have been released.

Bob's basic concept is to store energy in a magnetic field rather than very large value electrolytic capacitors — eliminating at the same time the need for a bulky expensive power transformer.

Our circuit drawing shows the essential features. The heart of the circuit is the magnetic cavity (MC). This is basically similar to the AM detector transformer used in conventional AM radios but constructed on a grand scale. A further and significant difference is that the transformer is arranged such that an output occurs as the primary field collapses rather than builds up.

The secondary winding of the magnetic cavity is centre-tapped and the resultant full-wave output is rectified by a pair of high current diodes — the output waveform is thus a conjugate pair of time-varying audio voltages. Further circuitry, described later in this article, provides a feedback loop to remove commutation noise and reduce distortion.

The primary of the magnetic cavity is energised by an amplitude-modulated current (corresponding to the audio signal voltage). The current signal is produced from the audio input, via the optical isolator and modulation and control logic, to the scanning SCR, the ramp SCR, a pair of scanning and commutating diodes, and L1, L2 and C1.

This current signal energises the primary of the magnetic cavity. The time taken for this is called the 'ramp period'. The primary energy is then reflected in the secondary windings (and thence to the speaker) during the subsequent 'scan period'.

As our graph shows, the ramp and scan periods are made up of four separate timing intervals. During the period $t_o - t_2$ an incoming audio signal has caused a magnetic field to 'ramp' up in the primary of the magnetic cavity. At t_2 the field has reached its peak and is beginning to collapse. This collapsing field generates an associated decaying current i_1 and this decaying current falls to zero when the energy in the primary field falls also to zero (point t_3). During the time period $t_2 - t_3$, the control logic provides a positive signal on the gate of the scanning SCR, however this SCR will not again conduct until sufficient voltage is applied between its anode and cathode.

Throughout the scanning period, energy is of course being transferred from the primary of the magnetic cavity to the secondary — and thence to the speaker load.

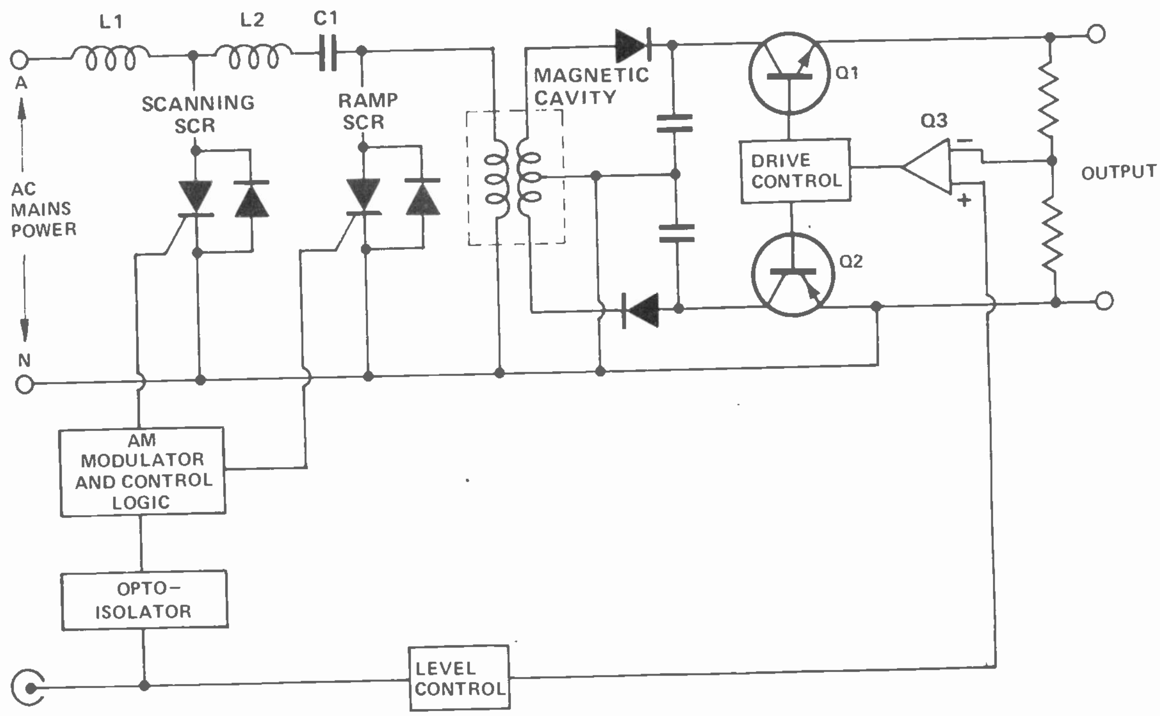


Fig. 1. This schematic shows the major operating components.

At time t_3 the direction of current is reversed — current being no longer maintainable by cavity inductance — and the scanning diode is reverse biased — this causes the scanning SCR to be forward biased and current flows as shown in our sketch.

Summarising then, energy stored in the magnetic cavity is caused to shuttle around the circuit of L1, L2, C1 and the speaker load depending on instructions from the control logic.

Noise and distortion

Components Q1 — Q3 form a feedback loop which reduces the inherently poor bandwidth, noise and distortion to very acceptable levels. Theoretically the circuit has some quite strong objections — at low frequencies Q1 and Q2 will act much as switches except that the feedback correction voltage developed by Q3 will adequately cancel aberrations — but at higher frequencies, i.e. 10 kHz — 20 kHz the modulator circuit is unable to follow accurately the audio input signal. Hence the filtered output from the magnetic cavity is a dc level with a superimposed ac signal and Q1 and Q2 thus operate much as any other conventional amplifier.

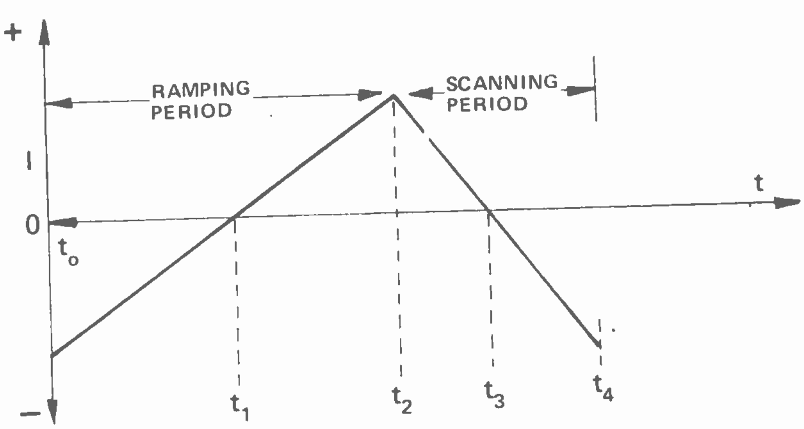


Fig. 2. During the ramping period energy builds up in the primary of the 'magnetic cavity'. Throughout the scanning period energy is transferred from the primary to the secondary of the magnetic cavity and thence to the speaker load via Q1 and Q2.

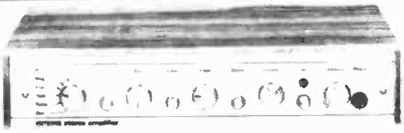
Nevertheless as less power is generally required at high audio frequencies than at mid frequency and low frequency, amplifier efficiency is very high if fed with music signals. This situation does not of course apply if the amplifier is fed with a high frequency steady tone.

Bob Carver's radical amplifier will be rated in accordance with FTC rules — the specification is expected to include power output: 200 watts-per-channel into eight ohms from 20 Hz to 20 kHz. Total harmonic distortion is expected to be less than 0.08% across this range.

Signal noise ratio is expected to be 100 dBA below rated maximum output. All-up weight is an incredible 5.5 kg.

As far as we are aware the magnetic field amplifier exists at present solely as a prototype unit but we understand that Bob Carver has very real plans for putting the unit in to production at a presently projected price of US $300 or so.

It's a fascinating concept, one that will cause amplifier designers and manufacturers world-wide to furiously rethink their design philosophies. It may even herald the coming of a new hi-fi technology. ETI



20 x 20 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet. Silver finish rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic, magnetic and crystal pickups, tape tuner and auxiliary. Rear panel features two mains outlets DIN speaker and input sockets plus fuse 20x20 watts RMS 40x40 watts peak. For use with 8 to 15 ohm speakers.

£29.90 £2.50 p&p

30x30 WATT AMPLIFIER IN KIT FORM

For the experienced constructor complete in every detail, same facilities as Viscount IV, but with 30x30 output 60x60 watts peak. For use with 4-15 ohms speakers.

£29.00 + p&p £2.50

SPECIAL OFFER

30 x 30 WATT AMPLIFIER KIT

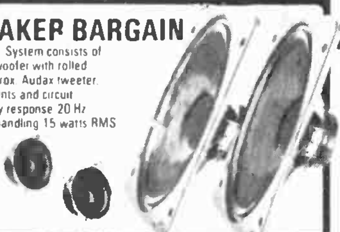
with BSR P200 belt drive deck and Shure M75 cartridge.

£55.00 + p&p £5.00

EMI SPEAKER BARGAIN

Stereo pair 350 kit. System consists of 13" x 8" approx woofer with rolled surround, 2½" approx. Audax tweeter, crossover components and circuit diagram. Frequency response 20 Hz to 20 KHz. Power handling 15 watts RMS 20 watts max. 8 ohm impedance.

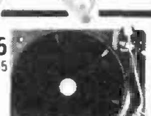
£14.95 Per stereo pair + £3.40 p&p



BSR P200

Belt drive chassis turntable unit semi automatic, cueing device **£24.95** p&p £2.55

A D C QLM 30 Mk III Magnetic Cartridge to suit **£7.75**



BSR

Manual single play record deck with auto return and cueing lever, fitted with stereo ceramic cartridge 2 speeds with 45 r.p.m. spindle adaptor ideally suited from home or disco use.

OUR PRICE **£10.95** p&p £2.55

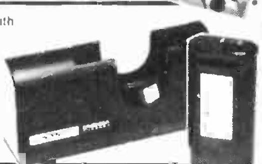
GARRARD DECK MODEL CC 10A

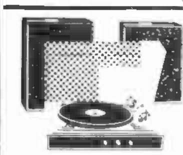
Record changer with cueing device fitted with stereo ceramic cartridge ready to fit into your own plinth

£7.95 p&p £2.00 Size 12" x 8½"

SANYO Nic/cad battery with mains charger equivalent in size and replaces 4 SP11 type batts. Size 3¾" x 1¼" x 2" approx

£7.50 p+p £1.50p





BARGAIN FOR PERSONAL SHOPPERS ONLY

Altone UA4 Stereo System

Features 8 watt total output. Full size BSR manual turntable with cueing and auto return. Socket for tape in and out and stereo headphones

complete with speakers **£34.95**

Micro Cassette Recorder

Pocket size—home or office use or when travelling **£13.95**

Battery operated fluorescent camping lamp.

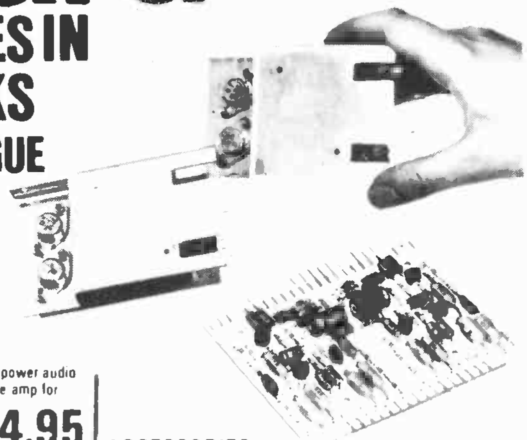
Runs off 8 U2 batteries **£4.50**

Mullard

AUDIO MODULES IN BARGAIN PACKS

CURRENT CATALOGUE PRICE £ AT OVER ~~25~~ PER PACK

ACCESSORIES ARE ONLY AVAILABLE TO THOSE CUSTOMERS WHEN BUYING OUR BARGAIN PACKS



SEE OUR PRICES

1 PACK 1 2 x LP1173 10w RMS output power audio amp modules, + 1 LP1182/2 Stereo pre amp for ceramic and auxiliary input

OUR PRICE p+p £1.00 **£4.95**

2 PACK 2 2 x LP1173 10w RMS output power audio amp modules + 1 LP1184/2 Stereo pre amp for magnetic, ceramic and auxiliary inputs

illus. OUR PRICE p+p £1.00 **£7.45**

AVAILABLE ALSO TO PURCHASERS OF THE 10 + 10 AMPLIFIER KIT

ACCESSORIES

Suitable mains power supply parts consisting of mains transformer, bridge rectifier, smoothing capacitor and set of rotary stereo controls for treble, bass, volume and balance **£2.90** plus £1.50 p&p

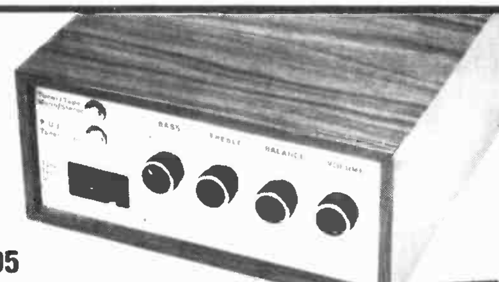
Two Way Speaker Kit

Comprising of two 8" x 5" approx 4 ohm bass and two 3½" 15 ohm mid-range tweeter with two cross-over capacitors **£3.95** per stereo pair plus £1.50 p&p

10 + 10 AMPLIFIER KIT

An opportunity to buy a 10 watts per channel stereo amplifier kit which is suitable for use with a ceramic cartridge. The amplifier utilises proven Mullard modules and is available at a very competitive price. The amplifier kit comes complete with instructions and includes a Mullard LP1183 stereo preamplifier module, two LP1173 power amplifiers with integral heatsinks, a power supply, Zobel networks, front and back mounting panels, a finished fascia panel, all control potentiometers (bass, treble, volume and balance), switches, input, output and headphone sockets, wire, and an easily assembled wrap around cabinet to house the finished unit.

Size approximately 9¼" x 8¾" x 4" p&p £2.05 **£11.95**



BARGAINS FOR PERSONAL SHOPPERS

LED 5 function men's digital watch stainless steel finish	£5.95
LCD 5 function men's digital watch stainless steel finish	£6.95
LCD 8 Function **CHRONOGRAPH** men's digital watch, stainless steel finish	£12.95
POCKET CALCULATOR With LED display memory and percentage key	£2.95
AM/FM DIGITAL CLOCK RADIO Accurate 4 Digit Electronic Clock with ½" LED display Buzzer and snooze timer	£11.95
125 Watt Power Amp Module	£13.95
Mains power supply for above unit	£3.50
MULLARD Built power supply	£1.50
DECCA 20w Stereo speaker kit comprising 2 8" approx bass units + 2 3½" approx tweeter inc crossovers	£20.00
VIDEOMASTER Super Score TV Game with pistol mains operation	£14.95
PORTABLE RADIO/CASSETTE RECORDER AM FM with clock LW MW SW VHF mains battery operation	£41.95

VIDEOMASTER COLOUR SHOT TV GAME

Choice of three games—Football, Tennis and Squash. Ready to play—one or two players. MAINS OPERATED

OPPORTUNITY AT **£9.95** ONLY

50 WATT MONO DISCO AMP

£29.95

Size approx 13⅛" x 5¼" x 6¾"

50 watts rms 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume

70 & 100 WATT MONO DISCO AMP

Size approx 14" x 4" x 10½". Brushed aluminium fascia and rotary controls. Five vertical slide controls, master volume, tape level, mic level, deck level, PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak

70 watt 140 watt peak **£57**

p&p £4.00

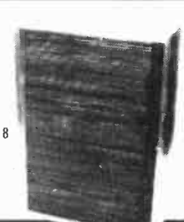
100 watt **£65**

For personal shoppers only

DUO II SPEAKERS

Attractive teak finish, modern design, incorporating 2 speaker units — 6" approx. woofer and 2½" approx. tweeter. 45 to 1800 Hz. Impedance 8 ohms. Power 15 watts RMS. 20 watts max. Per stereo pair

£17.00



R T V C

325 EDGWARE ROAD, LONDON W2

21E HIGH STREET, ACTON W3 6NG

ACTON: Mail Order only. No callers

ALL PRICES INCLUDE VAT AT 12½%

All items subject to availability. Price correct at 17/5/79 and subject to change without notice.

FOR PERSONAL SHOPPERS ONLY

STEREO RADIOGRAM CABINET

Finished in a natural teak veneer with opening top. Easily modified to accommodate stereo equipment of your choice. Price **£10.95**

Size approximately 47" x 15½" x 15"

Personal Shoppers EDGWARE ROAD LONDON W2 Tel: 01-723 8432. 9.30am-5.30pm. Closed all day Thursday. ACTON: Mail Order only. No callers. GOODS NOT DESPATCHED OUTSIDE UK

Extracts from our lists, which are now available, of Equipment, Components etc THAT MUST BE SOLD.

TEK scope 545A with H plug-in **£125 ea.**
TEK scope 545A with CA plug-in **£175 ea.**
H.P. scope 175A 50MHZ Dual trace **£175 ea.**
Single Trace **£125 ea.**
SOLARTRON CD1014 6 MHZ Twin Beam **£90 ea.**
SOLARTRON CD1400 15 MHZ Twin Beam **£120 ea.**
Telequipment D33R 6MHZ Twin Beam **£80 ea.**
SOLARTRON CT316 6MHZ Single Beam **£47.50 ea.**
Ex-Ministry CT52 Small. Single Beam **£37.50 ea.**
WAYNE KERR Universal Bridge CT375 **£75 ea.**
MARCONI Wave Analyser TF2330 **£500 ea.**
MARCONI Audio Oscillator TF1101 20HZ-200KHZ **£45 ea.**
ADVANCE Signal Generator J1A (CT433A) **£35 ea.**
MARCONI Valve Voltmeter TF1041C **£30 ea.**
NOISE GENERATOR CT410 — covers audio to VHF **£8 ea.**
DIGITAL EQUIP. CORP. Disk Drives (Fixed) **£160 ea.**
Carriage all units **£4 ea.** V.A.T. at 8%.

10Way Multi Colour Ribbon Cable. New 40p per metre P&P 50p
STEPPING MOTORS 6/12 position with aditional where the rote is coils. Devise can be used as a tacho. Diagram supplied. Will actually work on 5 volts. 12/24 recommended. £1.50 ea. P&P 75p. Reduction for quantity.
RAPID DISCHARGE capacitors 8mfd 4KV. £5 ea. P&P £1.50.
GEC UHF 4 button tuner £2.50 ea. P&P 85p.
BIG INCH Motor 110V AC 3rpm 50 cycle — very small. 50p ea. P&P 50p.
CENTAUR 115V FANS. Brand New 4.5 × 4.5 × 1.5in. £4.50 ea. P&P 75p.
EX Used Equipment — tested 60p ea. P&P 75p.
POTTER & BRUMFIELD TIMER RELAY 115V AC Heavy duty 2 pole c/o with 2 second delay. Change R & C for different timing 50p ea. P&P 25p.
CONTACTORS Heavy Duty 24V AC/DC 5 make. £1 ea. P&P 85p.
GEC UHF/VHF 6 button tuner £4.50 ea. P&P £1.
CAPACITORS 500pf 6 KV 20p ea. P&P 15p.
SMITHS encapsulated transistorised AUDIBLE WARNING DEVICES 4V-12V Can be driven from TTL 35p ea. P&P 25p.
DIGITAL 24 HOUR CLOCK with built-in alarm as used in BRAUN Digital clocks. Silent running. Large illuminated numerals. AC mains. Size 6¾ × 2¾ × 2¾. ONLY £3.75 ea. P&P 50p.
931A PHOTOMULTIPLIER in stainless steel container with window and built in resistor network £2 ea. P&P £1.
SLIDER CONTROL 500K Log Single track complete with knob. Length 3½in. 25p ea. P&P 25p.
RANCO 250V 16A THERMOSTATS with Control knobs calibrated 50-200 degree F. £2.50 ea. P&P £1.
SOLID STATE UHF TUNERS 38 mcs. £1 ea. P&P 75p.
GROUZET/MURTEN 4rpm syncronous motors 115V. With detachable gearbox 30p ea. P&P 75p.
BRAND REX Blue wire wrap 30 metres for £1. P&P 25p. 5in. SOLID RUBBER RINGS (1in. dia rubber) Keep the kids (or dog) happy. 4 for £1 ea. P&P £1.25.

TRANSFORMERS
AUTO 240V input 115V 1 Amp output £1.25 ea. P&P £1.25.
240V input Sec 6V 1.66A Size 2¾ × 2 × 2in. Good quality £1.50 ea P&P £1.
240V input Sec 12V 0.92A Size 2¾ × 2 × 2in. Good quality £1.50 ea. P&P £1.
240V input Sec 12V 100MA Size 60 × 40 × 42 mm. 50p ea. P&P 75p.
240V input Sec 12-0-12V 50 MA. Size 53 × 45 × 40mm £1 ea. P&P 75p.

SEMICONDUCTORS
At 2p ea.
1N3063; 1N4005; 1N1N4001; 1N4002; 1S44; 1N4007.
At 5p ea.
BC147; BC148B; BC157; BC158; BC184L; BC237; BF197; OA90; OA91; BA154; BA243; 1N4303; 11.3V Zener.
At 25p ea.
TIP31; TIP41A; TIP47; 2N5296; AF139; ZTX341.
BY127-10p; BF181-20p; BD239-40p; BD241-40p; MJE340AT-40p; BD222-50p;
BD233 & BD234 Comp pair 25W — 80p per pair or 50p each.
Regulator TBA625 8-20V in-5V out 100MA. TO5 Can. 50p ea.
BF256C-20p.
FND10 7 segment display 0.15in. 40p ea.

Integrated Circuits

7453	5p	74H51	7p
7451	5p	74S38	10p
7401	5p	74S02	12p
7402	12p	74S00	12p
7443	70p	74154	70p
7476	20p	75325	£1
7495	35p	SN15862	4p
709	15p	9-314	8p
74H74	12p	MC4028	60p
74S74	12p	7417	14p
74S10	5p	7441	40p
74S04	12p		

Motorola Dual in Line 6 pin Opto Coupler 50p ea.
AM9130 } AM9140 } 4K RAMS STATIC 5 Volt. Ceramic £4 ea.
Telephones. 706 style Black or Grey £5.50 ea. 746 style Black or Grey £7.50 ea.
Older style Black £2.50 ea. Postage £1 each.
Postage and VAT at 8% must be added to all orders.

CALLERS VERY WELCOME STRICTLY BETWEEN 9am-1pm and 2pm-5pm Monday to Saturday incl.
BARCLAYCARD (VISA) and ACCESS taken. Official orders welcome.

CHILTMEAD LTD

NORWOOD ROAD, READING **TEL NO. READING 669656**

(2nd left passed Reading Tech College in Kings Road then first right — look for 'Spoked Wheel' on right)

7400N AND 74LS00N SERIES TTL

	74N	74LSN
7400	.10	.19
7401	.12	.19
7402	.12	.19
7403	.12	.19
7404	.13	.19
7405	.13	.23
7406	.24	
7407	.24	
7408	.14	.20
74508	.40	
7409	.14	.22
7410	.12	.20
7411	.19	.22
7412	.15	.23
7413	.25	.35
7414	.50	.76
7415		.24
7416	.24	
7417	.24	
7420	.12	.20
7421	.22	.22
7422	.18	.23
7423	.22	
7425	.22	
7426	.24	.26
7427	.24	.28
7428	.28	.32
7430	.12	.20
74530	.30	
7432	.23	.24
7433	.32	
7437	.22	.25
7438	.22	.25
7440	.13	.25
7441	.52	
7442	.43	
7443	.75	
7444	.74	
7445	.55	
7446	.62	
7447	.50	.80
7448	.58	.95
7449		1.00
7450	.13	
7451	.13	.21
7453	.13	
7454	.13	.18
7455		.18
7460	.13	
7470	.28	
7472	.24	
7473	.25	.34
7474	.25	.35
74S74	.50	
7475	.32	.40
7476	.28	.34
7478		.34
7480	.45	
7481	.90	
7482	.75	
7483	.60	.75
7484	.90	
7485	.70	.80
7486	.24	.38
74S86	1.50	
7489	1.80	

	74N	74LSN
7490	.34	.60
7491	.65	
7492	.36	
7493	.32	.60
7494	.80	
7495	.52	.80
7496	.50	
7497	1.90	
74100	.90	
74104	.42	
74105	.40	
74107	.25	.38
74109	.30	.38
74110	.38	
74111	.60	
74112		.38
74113	.30	.38
74114		.38
74116	1.25	
74118	.82	
74119	1.30	
74120	.85	
74121	.25	
74122	.42	
74123	.40	.72
74124	1.75	
74125	.35	.46
74126	.35	.46
74128	.65	
74130	.50	
74132	.50	.78
74134	.36	
u4135	.68	
74136	.55	.38
74137	.80	
74138		.60
74139		.60
74141	.56	
74142	2.00	
74143	2.50	
74144	2.50	
74145	.58	
74147	1.10	
74148	.90	
74150	.70	
74151	.50	.65
74153	.50	.55
74154	.85	1.20
74155	.52	.96
74156	.52	.96
74157	.53	.55
74158	.58	.60
74159	2.00	
74160	.60	1.20
74161	.65	.75
74162	.65	1.20
74163	.65	.75
74164	.70	1.10
74165	.70	
74166	.80	
74167	2.50	
74170	1.35	2.00
74172	4.00	
74173	.95	1.00
74174	.68	.80
74175	.65	.75

	74N	74LSN
74176	.60	
74177	.60	
74178	1.00	
74179	1.20	
74180	.90	
74181	1.40	
74182	.60	
74S182	2.30	
74H183	.99	
74184	1.50	
74185A	1.10	
74186	7.50	
74188	2.70	
74189		3.60
74190	.72	.92
74191	.72	.92
74192	.70	.90
74193	.65	.90
74194	.62	
74195	.60	1.30
74196	.65	1.00
74197	.62	1.05
74198	1.10	
74199	1.10	
74221	1.50	1.00
74247		.95
74248		.97
74249		.97
74251		.80
74253	1.00	
74257	1.05	
74258	1.15	
74266	.42	
74273	2.15	2.40
74279	1.25	.55
74283	1.70	.80
74284	4.00	
74289		3.92
74290		.70
74293	1.35	1.00
74298	1.92	1.00
74352		1.00
74353		1.05
74365		.52
74366		.52
74367		.46
74368		.52
74386		.58
74390	1.92	
74393	2.12	
74670		1.75

Op Amps

CA3130-T099	.95
LM301A-8	.30
LM348 14	1.00
LM702-14	.50
LM709-8	.40
LM709-14	.42
LM709-T099	.46
LM741-8	.22
LM741-14	.20
LM741-T099	.42
LM747-14	.48
LM3900N-14	.50
MC1458P-8	.34

Memory

2102	1.20
TMS 4030 (2107A)	2.70

Linears

CA3045-14	.45
CA3046-14	.50
LM380N-14	.75
LM381N-14	1.05
LM710N-14	.32
LM711N-14	.32
MC1310P-14	1.50
NE555-8	.28
NE556-14	.65
NE25018-14	2.00
SN75110N	.50
SN76003N	1.95
SN76013N	1.35
SN76023N	1.35
SN76033N	1.95
TAA550B	.35
TAA661B	1.20
TBA120S	.64
TBA641A	1.88
TBA800	.75
TBA810S	.90
TBA820S	.86
TCA270SQ	2.00
TDA2020	3.20
ZN414	1.00

Voltage Regulators

LM300H-T099	1.00
LM309K-T03	1.25
uA723-14	.38
7805-T0220	.70
7812-T0220	.70
7815-T0220	.70
7824-T0220	.70
7905-T0220	.90
7912-T0220	.90
7915-T0220	.90

LOW PROFILE SOCKETS

8-pin DIL	.11
14-pin DIL	.12
16-pin DIL	.13
18-pin DIL	.20
20-pin DUL	.23
22-pin DIL	.24
24-pin DIL	.26
28-pin DIL	.30
40-pin DIL	.44

CMOS

4000	.14	4012	.14	4160	.95
4001	.14	4013	.34	4161	.95
4002	.14	4014	.80	4162	.95
4006	.90	4015	.66	4163	.95
4007	.13	4016	.36	4164	.95
4008	.64	4017	.66	4174	1.10
4009	.34	4018	.70	4175	1.10
4010	.40	4019	.42	4194	1.10
4011	.14	4020	.75	4404	.88
		4021	.75	4412	.25
		4022	.68	4428	.68
		4023	.15	4445	1.30
		4024	.50	4449	.28
		4025	.15	4501	.17
		4026	.99	4502	.80
		4027	.36	4503	.62
		4028	.58	4506	.48
		4029	.66	4507	.48
		4030	.36	4508	2.10
		4031	2.00	4510	.68
		4032	.95	4511	.80
		4033	1.20	4512	.70
		4034	1.80	4513	1.60
		4035	1.10	4514	2.50
		4036	2.60	4515	2.50
		4037	.90	4517	3.80
		4038	.90	4518	.70
		4039	2.50	4519	.42
		4040	.70	4520	.70
		4041	.75	4521	1.60
		4042	.58	4522	.85
		4043	.60	4526	.85
		4044	.70	4527	1.25
		4045	1.20	4528	.95
		4046	.99	4529	1.10
		4047	.90	4530	.90
		4048	.45	4531	.80
		4049	.36	4532	1.05
		4050	.35	4534	4.50
		4051	.58	4536	3.00
		4052	.58	4538	1.15
		4053	.65	4539	.78
		4054	1.00	4541	1.00
		4055	1.00	4543	1.28
		4060	.98	4549	3.25
		4066	.40	4553	3.60
		4067	2.80	4554	1.05
		4068	.20	4555	.82
		4069	.16	4556	.82
		4070	.16	4557	3.65
		4071	.16	4558	1.05
		4072	.16	4559	3.25
		4073	.16	4560	1.62
		4075	.16	4561	.70
		4076	.90	4562	4.45
		4077	.43	4566	1.15
		4078	.17	4568	1.98
		4081	.16	4569	1.55
		4082	.17	4580	5.00
		4085	.65	4581	2.25
		4086	.65	4582	.90
		4089	1.35	4583	.80
		4093	.48	4584	.38
		4094	1.50	4585	1.03
		4095	.90	AC128	.16
		4096	.90	AD161	pr .72
		4097	3.25	AD162	
		4098	1.00	BAX13	.04
		4099	1.30	BAX16	.05

BC107	.09	BSY25	.25	ZTX314	.22	2N3709	.08
BC107B	.10	BY127	.15	ZTX341	.20	2N3710	.07
BC108	.09	BY206	.32	ZTX450	.20	2N3771	2.20
BC108B	.10	BYX10	.18	ZTX502	.18	2N3773	2.70
BC109	.10	BYX36-150	.08	ZTX504	.25	2N3819	.20
BC109B	.11	BZX61c3v3—c100V	.16	ZTX541	.20	2N3903	.13
BC109C	.12	BZY88c2v7—c33V	.09	ZTX550	.20	2N3904	.12
BC142	.25	BZY91c15v	.50	1N821	.26	2N3905	.12
BC143	.25	C1060	.60	1N823	.30	2N3906	.12
BC147	.09	ME0413	.12	1N914	.06	2N4058	.12
BC148	.09	ME0492	.12	1N916	.07	2N4062	.12
BC149	.09	ME3001	.12	1N4001	.05	2N4123	.16
BC157	.10	ME4103	.09	1N4002	.055	2N4124	.16
BC158	.11	ME8002	.10	1N4003	.06	2N4126	.16
BC159	.11	MJE340	.48	1N4004	.065	2N4443	.72
BC171	.10	MJE371	.52	1N4005	.07	2N4444	.88
BC172B	.11	MJE521	.46	1N4006	.075	2N5060	.29
BC177	.15	MJE2955	.92	1N4007	.08	2N5061	.32
BC178	.15	MJE3055	.65	1N4184	.04	2N5062	.38
BC182/L	.11	MPF102	.32	1N5400	.13	2N5063	.41
BC183/L	.11	MPS5172	.14	1N5402	.16	2N5064	.45
BC184/L	.11	MPS6522	.20	1N5404	.17	2N5133	.12
BC208	.12	MPSA-06	.22	1S44	.05	2N5134	.12
BC212/L	.12	MPSA-13	.24	1S020	.11	2N5136	.12
BC213/L	.11	MPSA-56	.22	1S920	.06	2N5138	.12
BC214/L	.13	MPSA-93	.25	1S921	.07	2N5142	.18
BC237B	.16	MPSH-04	.15	1S922	.08	2N5416	1.05
BC261B	.15	MPSU-01	1.35	1S923	.09	2N5458	.30
BC327	.13	MPSU-51	.38	2N438	.50		
BC328	.12	MXT404	1.00	2N696	.15		
BC337	.13	OA47	.08	2N697	.15		
BC477	.16	OA79	.10	2N706	.20		
BC549	.12	OA81	.08	2N708	.18		
BCY42	.25	OA90	.07	2N929	.20		
BCY70	.17	OA91	.075	2N930	.18		
BCY71	.18	OA202	.085	2N1303	.28		
BCY72	.15	OC20	1.80	2N1305	.35		
BD115	.50	OC28	.85	2N1307	.35		
BD121	1.25	OC35	.95	2N1613	.21		
BD123	1.35	OC36	.95	2N1711	.24		
BD124	1.50	OC71	.25	2N1893	.26		
BD131	.40	OC84	.45	2N2219	.20		
BD132	.41	SC1420	.85	2N2219A	.24		
BD133	.50	TIL31	1.70	2N2221	.17		
BD135	.40	TIL111	1.00	2N2221A	.20		
BD139	.38	TIP29A	.40	2N2222	.18		
BD140	.40	TIP29B	.42	2N2222A	.20		
BD189	.60	TIP29C	.45	2N2368A	.20		
BF241	.20	TIP30A	.41	2N2368	.20		
BF258	.24	TIP30B	.43	2N2369	.22		
BFR39	.24	TIP30C	.50	2N2646	.42		
BFR40	.24	TIP31A	.42	2N2647	.50		
BFR41	.26	TIP31B	.44	2N2904	.20		
BFR79	.24	TIP31C	.50	2N2904A	.22		
BFR80	.26	TIP32A	.43	2N2905	.18		
BFR81	.24	TIP32B	.50	2N2906	.18		
BFX34	.75	TIP32C	.55	2N2906A	.19		
BFX85	.23	ZIP41A	.45	2N2907	.20		
BFX86	.24	TIP41B	.55	2N3053	.17		
BFX87	.22	TIP41C	.60	2N3054	.50		
BFX88	.22	TIP42A	.48	2N3055	.60		
BFY50	.20	TIP42B	.60	2N3440	.50		
BFY51	.20	TIP42C	.64	2N3644	.16		
BFY52	.18	TIP3055	.50	2N3702	.08		
BFY64	.20	TIS43	.22	2N3703	.07		
BR100	.22	ZTX107	.10	2N3704	.07		
BRY39	.28	ZTX304	.20	2N3705	.07		
BSX19	.18			2N3706	.08		
BSY21	.20			2N3707	.08		

TRIAC
10A 400V .85

DIAC
BR100 .22

S.C.R.'s

0.8A 30v	.29
0.8A 60v	.32
0.8A 100v	.38
0.8A 150v	.41
0.8A 200v	.45
1A 200v	.38
4A 200v	.50
4A 400v	.60
7A 100v	.50
7A 400v	.65
8A 400v	.72
8A 600v	.88
10A 100v	.75

LEDs

	.125in	.2in
Red	.09	.10
Green	.15	.15
Yellow	.15	.15
LED clip	.03	.04

BRIDGE RECTIFIERS

1A 100V	.25
1A 200V	.30
1A 600V	.35
6A 50V	.70
6A 100V	.72
6A 200V	.78
6A 400V	.80
6A 600V	.86
25A 50V	1.30
25A 100V	1.50
25A 200V	1.80

MICRO-PROCESSOR QUARTZ CRYSTALS

Freq. Mhz.	
0.100	4.30
0.262	4.30
0.300	4.30
1.000	4.30
1.008	4.30
1.8432	4.25
2.000	4.25
2.097	4.25
2.457	4.20
3.276	3.40
3.579	3.40
3.932	3.40
4.000	3.40
4.433	1.50
4.915	3.40
5.000	3.75
5.068	3.75
5.185	3.75
5.875	3.75
6.000	3.75
6.144	3.75
6.553	3.75
8.000	3.75
8.8867	3.79
10.000	3.75
12.000	3.75
13.516	3.75
18.000	4.15
18.432	4.15
19.660	4.30
20.000	4.30
32.000	4.05
48.000	4.05

400mW ZENER DIODES
2.7V-33V .09 each. .08 for 10; 3.50 for 50; 6.50 for 100 (Any mix).

1 WATT ZENER DIODES
3.3V-100V .16

ELECTROLYTICS

uF	16v	25v	40v	63.
1	.045	.05	.055	.06
2.2	.045	.05	.055	.06
3.3	.045	.05	.055	.06
4.7	.045	.05	.055	.06
6.8	.05	.055	.06	.07
10	.05	.06	.07	.09
22	.06	.07	.09	.13
33	.07	.085	.10	.15
47	.08	.10	.12	.19
68	.09	.12	.16	.23
100	.10	.13	.18	.26
150	.11	.15	.20	.28
220	.12	.16	.22	.32
330	.14	.18	.26	.36
470	.16	.20	.29	.40
680	.18	.24	.35	.48
1000	.20	.29	.41	.56
.29	.41	.56		
2200	.38	.48	.65	.95
4700	.47	.60	.90	
4700uF			6.3v	.20
6800uF			6.3v	.25

POLYESTER 100V Radial lead
.001, .0012, .0015, .0018, .0022, .0027, .0033, .0039, .0047, .0056, .0068, .0082, .01, .04; .012, .015, .018, .022, .045; .027, .033, .039, .047, .05; 0.56, .068, .06; .082, .1, .12; .15, .07; .18, .22, .27, .08; .33, .10; .39, .11; .47, .12; .68, .16.

BEAD TANTALUM
.1, .15, .22, .33, .47, .68, 1uF, 1.5uF, 2.2uF, 35V, .09; 3.3uF, 4.7uF, 6.8uF, 35V, .12; 10uF, 25V, .13; 68uF 3V, .14; 10uF, 35V, .15; 22uF 16V, 33uF 10V, 47uF, 68uF, 6.3V, 100uF, 3V, .16; 15uF 35V, 22uF 25V, 33uF 16V, 47uF 10V, 150uF 3V, .18; 47uF 16V, .20; 100UF 10V, .30.

CARBON FILM RESISTORS
¼ Watt 1Ω-10MΩ-E12 Series .013 each, .125 for 10 any one value, 1.00 for 100 any value.

TMS 4030 4096-BIT DYNAMIC RANDOM-ACCESS (2107A) MEMORY 22 PIN DIL 2.70
300ns max. access time, 470ns max. read or write cycle time. TTL compatibility on all inputs. No pull up resistors needed. Low power dissipation. 350mW operating 0.3mw standby. Single low capacitance clock.

ASTRA-PAK
92 GODSTONE ROAD
WHYTELEAFE
SURREY CR3 0EB

All prices INCLUDE VAT. Add 25p for P&P (Extra for overseas). DISCOUNTS: Over £10 less 5%. Over £20 less 10%. Over £50 less 15%. Over £100 less 20%. Send SAE for complete list of components.

ETIPRINTS

ETIPRINTS are a fast new aid for producing high quality printed circuit boards. Each ETIPRINTS sheet contains a set of etch resistant rub down transfers of the printed circuit board designs for several of our projects.

ETIPRINTS are made from our original artwork ensuring a neat and accurate board. We thought ETIPRINTS were such a good idea that we have patented the system (patent numbers 1445171 and 1445172).

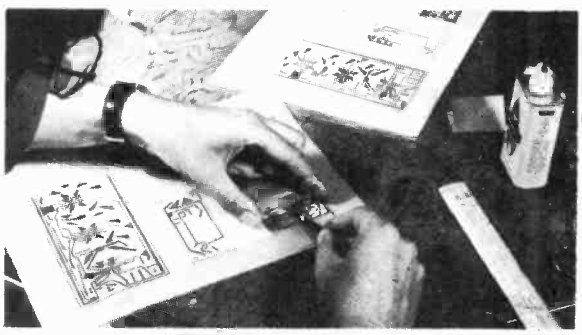
PARTS LIST

Shown below is the listing for the last year's ETIPRINTS.

Earlier sheets are available, ring Tim Salmon for details.

Sheet	Project	Issue
003	Race Track Game	Jan 78
	Hammer Throw	Jan 78
	Freezer Alarm	Dec 77
004	Metal Locator Mk II	Feb 78
	Ultrasonic Tx/Rx	Feb 78
	5 Watt Stereo Amp (modified)	Jan 77
	Metronome	Feb 78
	Shutter Time	Feb 78
005	Op-Amp Supply	
	Frequency Shifter	Mar 78
	LCD Panelmeter	
	Light Dimmer (3 times)	
006	CMOS Switched Preamp	
	From Experimenters	"Electronics
	P.S.U.	Tomorrow"
	555 Boards (twice	
007	Star Trek Radio	May 78
	CD Ignition	May 78
	CCD Phaser	May 78
	White Line Follower	April 78
008	Tank Battle	
	Helping Hand	May 78
009	AM/FM Radio	
	Bridge Oscillator	June 78
	CMOS Stars & Dots	
010	Bench Amplifier	
	Freezer Alarm	Project
	Marker Generator	Book
	LED Dice	Six
	Watchdog (2 PCBs)	
	Stars & Dots PSU	
011	Noise Generator	
	General Preamp	
	Flash Trigger	Project
	Compander	Book
	Active Crossover (2 PCBs)	Six
012	Disco Lightshow	Project
	Stereo Simulator	Book
	Digital Thermometer	Six
013	Amplifier Module	
	Amplifier PSU	Book
	Equaliser	Six
	Equaliser PSU	
014	Skeet Game	
	Sweep Oscillator	Project
	Burglar Alarm	Book
	GSR Monitor	Six
015	UFO Detector	July 78
	Torch Finder (twice)	July 78
	Etiwet (twice)	Aug 78
016	Stac Timer	
	Xhatch Gen	Sept 78
	Wheel of Fortune	
017	Complex Sound Gen	
	Tele Bell Extender	Oct 78
	Power Bulge	
018	RF Power Meter	Oct 78
	Proximity Switch	Oct 78
	Audio Oscillator (2)	Nov 78
019	Car Alarm (2)	Dec 78
	Wine Temp (2)	Dec 78
	Curve Tracer	Dec 78
020	Digital Tacho	Jan 79
	Module	Jan 79
	Digital Dial	Jan 79
021	Tape Slide Synch	
	Tape Noise Limiter	Feb 79
	Light Tacho	
022	Logic Trigger	
	Power Meter	Mar 79
	Headlight Delay (x2)	

HOW IT WORKS



Lay down the ETIPRINT and rub over with a soft pencil until the pattern is transferred to the board. Peel off the backing sheet carefully making sure that the resist has transferred. If you've been a bit careless there's even a 'repair kit' on the sheet to correct any breaks!

BUY LINES

ORDER TODAY

Send a cheque or P.O. (payable to ETI Magazine) to:

ETI PRINT, ETI MAGAZINE
25/27 OXFORD STREET, LONDON W1R 1RF

75p INC P & P

DIODES/ZENERS

QTY.				
	1N914	100v	10mA	.05
	1N4005	600v	1A	.08
	1N4007	1000v	1A	.15
	1N4148	75v	10mA	.05
	1N4733	5.1v	1 W Zenner	.25
	1N4749	24v	1W	.25
	1N753A	6.2v	500 mW Zener	.25
	1N758A	10v	"	.25
	1N759A	12v	"	.25
	1N5243	13v	"	.25
	1N5244B	14v	"	.25
	1N5245B	15v	"	.25
	1N5349	12v	3W	.25

SOCKETS/BRIDGES

QTY.					
	8-pin	pcb	.16	ww	.35
	14-pin	pcb	.20	ww	.40
	16-pin	pcb	.25	ww	.45
	18-pin	pcb	.30	ww	.95
	20-pin	pcb	.35	ww	1.05
	22-pin	pcb	.40	ww	1.15
	24-pin	pcb	.45	ww	1.25
	28-pin	pcb	.50	ww	1.35
	40-pin	pcb	.55	ww	1.45
	Molex pins		.01	To-3 Sockets	.35
	2 Amp Bridge			100-prv	.95
	25 Amp Bridge			200-prv	1.50

TRANSISTORS, LEDS, etc.

QTY.			
	2N2222M	(2N2222 Plastic .10)	.15
	2N2222A		.19
	2N2907A	PNP	.19
	2N3906	PNP (Plastic)	.19
	2N3904	NPN (Plastic)	.19
	2N3054	NPN	.55
	2N3055	NPN 15A 60v	.60
	T1P125	PNP Darlington	1.95
	LED Green,	Red, Clear, Yellow	.19
	D.L.747	7 seg 5/8" High com-anode	1.95
	MAN72	7 seg com-anode (Red)	1.25
	MAN3610	7 seg com-anode (Orange)	1.25
	MAN82A	7 seg com-anode (Yellow)	1.25
	MAN74	7 seg com-cathode (Red)	1.50
	FND359	7 seg com-cathode (Red)	1.25

9000 SERIES

QTY.			QTY.		
	9301	.85		9322	.65
	9309	.50		9601	.30
				9602	.45

MICRO's, RAMS, CPU's, E-PROMS

QTY.		
	8T13	2.50
	8T23	2.50
	8T24	3.00
	8T97	1.75
	74S188	3.00
	1488	1.25
	1489	1.25
	1702A	4.50
	AM 9050	4.00
	ICM 7207	6.95
	ICM 7208	13.95
	MPS 6520	10.00
	MM 5314	4.00
	MM 5316	4.50
	MM 5387	3.50
	MM 5369	2.95
	TR 1602B	3.95
	UPD 414	4.95
	Z 80 A	22.50
	Z 80	17.50
	Z 80 P10	10.50
	2102	1.45
	2102L	1.75
	2107B-4	4.95
	2114	9.50
	2513	6.25
	2708	11.50
	2716 D.S.	34.00
	2716 (5v)	69.00
	2758 (5v)	26.95
	3242	10.50
	4116	11.50
	6800	13.95
	6850	7.95
	8080	7.50
	8085	22.50
	8212	2.75
	8214	4.95
	8216	3.50
	8224	4.25
	8228	6.00
	8251	7.50
	8253	18.50
	8255	8.50
	TMS 4044	9.95

— T T L —

4-1-79

QTY.			QTY.			QTY.			QTY.		
	7400	.20		7492	.45		74H20	.25		74LS76	.70
	7401	.20		7493	.35		74H21	.25		74LS86	.95
	7402	.20		7494	.75		74H22	.40		74LS90	.85
	7403	.20		7495	.60		74H30	.30		74LS93	.85
	7404	.20		7496	.80		74H40	.35		74LS96	2.00
	7405	.35		74100	1.15		74H50	.30		74LS107	.90
	7406	.25		74107	.35		74H51	.30		74LS109	1.50
	7407	.55		74121	.35		74H52	.20		74LS123	1.95
	7408	.20		74122	.55		74H53	.25		74LS138	2.00
	7409	.25		74123	.55		74H55	.25		74LS151	.95
	7410	.20		74125	.45		74H72	.35		74LS153	1.15
	7411	.25		74126	.45		74H74	.35		74LS157	1.15
	7412	.25		74132	.75		74H101	.95		74LS160	1.15
	7413	.45		74141	.90		74H103	.55		74LS164	2.90
	7414	.75		74150	.85		74H106	1.15		74LS193	2.00
	7416	.25		74151	.95		74L00	.30		74LS195	1.15
	7417	.40		74153	.95		74L02	.30		74LS244	2.90
	7420	.25		74154	1.15		74L03	.35		74LS259	1.50
	7426	.25		74156	.70		74L04	.40		74LS298	1.50
	7427	.25		74157	.65		74L10	.30		74LS367	1.95
	7430	.20		74161/9316	.75		74L20	.45		74LS368	1.25
	7432	.30		74163	.85		74L30	.55		74LS373	2.50
	7437	.20		74164	.75		74L47	1.95		74S00	.45
	7438	.30		74165	1.10		74L51	.65		74S02	.45
	7440	.20		74166	1.75		74L55	.85		74S03	.35
	7441	1.15		74175	.90		74L72	.65		74S04	.35
	7442	.55		74176	.95		74L73	.70		74S05	.45
	7443	.45		74177	1.10		74L74	.75		74S08	.45
	7444	.45		74180	.95		74L75	1.05		74S10	.45
	7445	.75		74181	2.25		74L85	2.00		74S11	.45
	7446	.70		74182	.75		74L93	.75		74S20	.35
	7447	.70		74190	1.25		74L123	1.95		74S22	.55
	7448	.50		74191	1.25		74LS00	.40		74S40	.30
	7450	.25		74192	.75		74LS01	.40		74S50	.30
	7451	.25		74193	.85		74LS02	.45		74S51	.35
	7453	.20		74194	.95		74LS03	.45		74S64	.15
	7454	.25		74195	.95		74LS04	.45		74S74	.70
	7460	.40		74196	.95		74LS05	.45		74S112	.60
	7470	.45		74197	.95		74LS08	.45		74S114	.85
	7472	.40		74198	1.45		74LS09	.45		74S133	.85
	7473	.25		74221	1.50		74LS10	.45		74S140	.75
	7474	.30		74298	1.50		74LS11	.45		74S151	.95
	7475	.35		74367	1.35		74LS20	.45		74S153	.95
	7476	.40		75491	.65		74LS21	.45		74S157	.98
	7480	.75		75492	.65		74LS22	.45		74S158	.80
	7481	.85		74H00	.20		74LS32	.50		74S194	1.50
	7482	.95		74H01	.30		74LS37	.45		74S196	2.00
	7483	.95		74H04	.30		74LS38	.65		74S257 (8123)	2.50
	7485	.75		74H05	.25		74LS40	.70		8131	2.75
	7486	.55		74H08	.35		74LS42	.95			
	7489	1.05		74H10	.35		74LS51	.75			
	7490	.55		74H11	.25		74LS74	.95			
	7491	.70		74H15	.45		74LS75	1.20			

C MOS

QTY.			QTY.			QTY.			QTY.		
	4000	.15		4017	.75		4034	2.45		4069/74C04	.45
	4001	.20		4018	.75		4035	.75		4071	.25
	4002	.25		4019	.35		4037	1.80		4081	.30
	4004	3.95		4020	.85		4040	.75		4082	.30
	4006	.95		4021	.75		4041	.69		4507	.95
	4007	.25		4022	.75		4042	.65		4511	.95
	4008	.75		4023	.25		4043	.50		4512	1.50
	4009	.35		4024	.75		4044	.65		4515	2.95
	4010	.35		4025	.25		4046	1.25		4519	.85
	4011	.30		4026	1.95		4047	2.50		4522	1.10
	4012	.25		4027	.35		4048	1.25		4526	.95
	4013	.40		4028	.75		4049	.65		4528	1.10
	4014	.75		4029	1.15		4050	.45		4529	.95
	4015	.75		4030	.30		4052	.75		MC14409	14.50
	4016	.35		4033	1.50		4053	.95		MC14419	4.85
							4066	.75		74C151	2.50

I²L, LINEARS, REGULATORS, ETC.

QTY.			QTY.			QTY.		
	MCT2	.95		LM320K24	1.65		LM373	3.95
	8038	3.95		LM320T5	1.65		LM377	3.95
	LM201	.75		LM320T12	1.65		78L05	.75
	LM301	.45		LM320T15	1.65		78L12	.75
	LM308	.65		LM323K	5.95		78L15	.75
	LM309H	.85		LM324	1.25		78M05	.75
	LM309 (340K-5)	1.50		LM339	.75		LM380 (8-14 Pin)	1.19
	LM310	.85		7805 (340T5)	1.15		LM709 (8-14 Pin)	.45
	LM311 (8-14 Pin)	.75		LM340T12	.95		LM711	.45
	LM318	1.50		LM340T15	.95		LM723	.40
	LM320H6	.79		LM340T18	.95		LM725	2.50
	LM320H15	.79		LM340T24	.95		LM739	1.50
	LM320H24	.79		LM340K12	1.25		LM741 (8-14)	.45
	7905 (LM320K5)	1.65		LM340K15	1.25		LM747	1.10
	LM320K12	1.65		LM340K18	1.25		LM1307	1.75
	LM320K15	1.65		LM340K24	1.25		LM1458	.65
							LM3900	.95
							LM75451	.65
							NE555	.45
							NE556	.85
							NE565	1.15
							NE566	1.25
							NE567	.95
							TA7205	6.95
							76477	2.95
							95H90	9.95

CABLE ADDRESS: ICUSD

Telex #697-827 ICUSD SDG

HOURS: 9 A.M. - 6 P.M. MON. thru SUN.

INTEGRATED CIRCUITS UNLIMITED

7889 Clairemont Mesa Blvd. • San Diego, California 92111 U.S.A.

NO MINIMUM

COMMERCIAL AND MANUFACTURING ACCOUNTS INVITED

ALL PRICES IN U.S. DOLLARS. PLEASE ADD POSTAGE TO COVER METHOD OF SHIPPING.
ORDERS OVER $100 (U.S.) WILL BE SHIPPED AIR NO CHARGE.

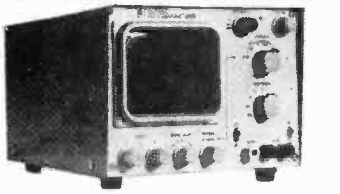
PAYMENT SUBMITTED WITH ORDER SHOULD BE IN U.S. DOLLARS.
ALL IC'S PRIME/GUARANTEED ALL ORDERS SHIPPED SAME DAY RECEIVED.
CREDIT CARDS ACCEPTED:

Phone (714) 278-4394 BarclayCard / Access / American Express / BankAmericard / Visa / MasterCharge

SPECIAL DISCOUNTS

Total Order	Deduct
$35-$99	10%
$100-$300	.15%
$301-$1000	20%

MORE SCOPE FOR YOUR MONEY

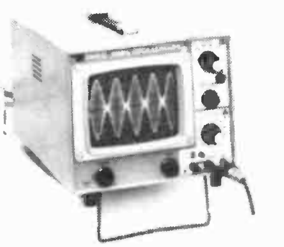


SPECIFICATIONS — **ELMAC 4" SCOPE**

ELECTRICAL DATA
VERTICAL AXIS (Y) Deflection Sensitivity — 100m V/division. Bandwidth (between 3 dB points) — DC — 5MHz. Input Attenuator — (calibrated) — 9 step 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50/div. Input impedance — 1 Meg/40 pf in shunt Input Voltage — Max — 600V P.P.
HORIZONTAL AXIS(X). Deflection Sensitivity — 0.400mV/division. Bandwidth (between 3 dB points — 1Hz-350KHz. Gain Control — Continuous when time bases in EXT position. Input Impedance — 1 Meg. Input Voltage — Max — 500V P.P.
TIME BASE. Sweep Range (calibrated) — 100msec/div to 1μ sec/div in 5 steps. FINE Control — Variable between steps — includes time-base calibration position. Blanking — Internal — on all ranges.
SYNCHRONISATION. Selection — Internal external. Synchronisation Level — Continues from positive to negative.
POWER SUPPLY. Input voltage — 115/200V AC± 10% at 50/60Hz Power Dissipation — 18W.
CRT DATA — 4in. — flat face, single beam. — Maximum high voltage — 1.5kV. — Fitted with 8x10 division blue filter graticule.
PHYSICAL DATA Dimensions — 15cm(h)x20.5cm(w)x28cm(d) Weight — 4.3Kg(approx.) Stand — 2 position flat and inclined Case — Steel, epoxy enamelled. Front panel — Aluminium enamelled epoxy printing. **(As recommended by ETI)**

Cash with order — **Test leads available £2.00**
£109 (+ £8.72 VAT + £2.08 Carriage — **Barclay and Access**

10MHz Scope with 5 x Magnifier for £147.95.
(+£11.84 VAT + £2 carriage)



3106C

5" CRT

SAE for further details

- 10mV to 50V/cm in 12 calibrated steps.
- 0.5 μS to 0.1 Sec/cm sweep range in 6 calibrated steps plus 12.1 Vernier.
- Magnifier x5.
- Fully automatic trigger.
- DC to 2 MHz horizontal bandwidth.
- Rise time on 35ns.
- Time base range from 0.5us to 10ms/cm in 6 steps.
- Flat 8x10cm display with graticule on blue filter. Smallest sub-division 2mm.
- Fastest sweep 100ns/cm with magnifier.

Sensitivity: <1 cm deflection 10 Hz to > 15MHz L.F. trigger extends below 5 Hz with 2 cm deflection. Trigger circuit locks to the mean value of the displayed waveform. It will lock to almost any waveshape including sine, square, triangle, pulse and TV video signals. When no signal is present to repetition rate is below 5Hz the trace free runs producing a bright base line. Company orders welcome by phone and Telex.

6MHz OSCILLOSCOPE 3106B

Similar in appearance to 10 MHz scope. SAE for details.

SINCLAIR PFM 200

FEATURES include Resolution to 0.1Hz and sensitivity to 10mV. 8-digit LED displaying frequency range of 20Hz to 200MHz. Xtal time base accurate to 0.3ppm/°C at 10ppm/year and all this in a package weighing just 6oz. and 6.2" x 1.25". Adaptor **£3.20.** Padded case **£3.20.**
PDM35 £29.20

UK microvision	**£90.24**
DM350	**£96.76**
DM450	**£68.08**

Boris Microprocessor chess game £178

KRAMER & CO.

9 October Place, Holders Hill Road
London NW4 1EJ. Telex: 888941
attn. Kramer k7. Tel: 01-203 2473
Mail order only. Callers by appointment

HOBBYISTS! ENGINEERS! TECHNICIANS! STUDENTS!

SPECIFICATION
- ★ RCA 1802 8 bit microprocessor with 256 byte RAM expandable to 64K bytes
- ★ RCA 1861 video IC to display program on TV screen via the RF Modulator

Single Board with professional hex keyboard fully decoded to eliminate the waste of memory for keyboard decoding circuits
Load, run and memory protect switches
16 registers
Interrupt, DMA and ALU
Stable crystal clock
Built-in power regulator
5 slot plug in expansion bus (less connectors)

Write and run machine language programs at home, display video graphics on your TV set and design microprocessor circuits — the very first night — even if you've never used a computer before!

ELF II featuring RCA COSMAC microprocessor/mini-COMPUTER

ONLY
£79.95
+ VAT

THE FASTEST WAY TO LEARN COMPUTER FUNDAMENTALS! Owning an ELF II is probably the fastest, easiest, most foolproof way to gain a working knowledge of computers the world has ever known. First of all, you get your hands on *your own* computer, so you can spend all the time you want with it and use it for anything that turns you on.

Secondly, our *Short Course in Microprocessor And Computer Programming* makes it impossible for you to fail. We take you inside the RCA 1802 and teach you every instruction it can be given. Everything is explained in plain English. When you're finished, you'll know everything there is to know about using an ELF II. You'll be able to make ELF II do whatever you want it to do. You won't be limited to predeveloped software.

Third, once you understand ELF II inside and out, you'll be ready to use its highly sophisticated add-ons intelligently. And, as you expand your ELF II, you'll begin to appreciate just how advanced its technology really is.

Now Available! Text Editor, Assembler, Disassembler and a new Video Display Board!

The TEXT EDITOR gives you word processing ability and the ability to edit assembly language programs while they are displayed on your video monitor. Lines and characters may be quickly inserted, deleted or changed. Add a printer and ELF II can type letters for you — error free — plus insert names and addresses from your mailing list!

ELF II's ASSEMBLER translates assembly language programs into hexidecimal machine code for ELF II use. The Assembler features mnemonic abbreviations rather than numerics so that the instructions on your programs are easier to read — this is a big help in catching errors.

ELF II's DISASSEMBLER takes machine code programs and produces assembly language source listings. This helps you understand the programs you are working with and improve them when required.

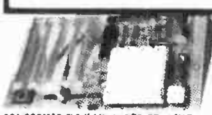
The new ELF II VIDEO DISPLAY BOARD lets you generate a sharp, professional 32 or 64 character by 16 line upper and lower case display on your TV screen or video monitor — dramatically improving your unexpanded £79.95 ELF II.

In addition to I/O, monitor, memory, ASCII keyboard and BASIC, ELF II offers you exotic add-on features such as the ELF II Light Pen and the ELF II Colour Graphics and Music System.

It's no wonder ELF IIs are being used by schools and universities, factory training programmes, trade schools and R&D Labs.

ELF II and all ELF II add-ons are also available wired and tested. And, as if all that weren't enough, the help that's always available from our Service Department further guarantees your success!

PHONE ORDERS ACCEPTED
Call 01-739 1582



To: NEWTRONICS, HL AUDIO LTD
138 Kingsland Road, London E2 8BY
Please send me the items below

☐ RCA COSMAC ELF II kit @ £79.95 +VAT and handling (requires 6.3 to 8 volts AC power supply)
☐ Power Supply (required) £5 +VAT
☐ RCA 1802 User's Manual £4
☐ Tom Pittman's Short Course on Microprocessor & Computer Programming teaches you just about everything there is to know about ELF II or any RCA 1802 computer. Written in non-technical language it's a learning breakthrough for engineers and laymen alike. £4
☐ Deluxe Metal Cabinet with plexiglas dust cover for ELF II £23.01 +VAT
☐ I am also enclosing payment (including postage and handling) for the items checked below.
☐ I want my ELF II wired and tested £99.95 +VAT
Add £2 p&p for orders over £15

Total enclosed £

Charge it to: ☐ Access ☐ Barclaycard

Account No. ....

ALSO AVAILABLE FOR ELF II

☐ GIANT BOARD TM kit with cassette I/O, RS 232-C/TTY I/O, 8 bit P I/O, decoders for 14 separate I/O instructions and a system monitor/editor £39.00 +VAT
☐ Kluge (Prototype) Board accepts up to 36 ICs £12.33+VAT
☐ 4K Static RAM kit. Addressable to any 4K page to 64K £69.44 +VAT
☐ Gold plated 86-pin connectors (one required for each plug in board) £4 +VAT each
☐ Expansion Power Supply (required when adding 4K RAM) £19 +VAT
☐ Professional ASCII Keyboard kit with 128 ASCII upper/lower case set, 96 printable characters, onboard regulator, parity, logic selection and choice of 4 handshaking signals to mate with almost any computer £50.58 +VAT
☐ Deluxe metal cabinet for ASCII Keyboard £15.02 +VAT
☐ Video Display Board kit lets you generate a sharp professional 32 or 64 character by 16 line upper and lower case display on your TV screen or video monitor — dramatically improving your unexpanded £79.95 ELF II. Fits inside ASCII Keyboard cabinet £69.95 +VAT
☐ ELF II Tiny BASIC on cassette tape. Commands include SAVE, LOAD, ± × + ( ) 26 variables A-Z, LET, IF/THEN, INPUT, PRINT, GO TO, GO SUB, RETURN, END, REM, CLEAR, LIST, RUN, PLOT, PEEK, POKE. Comes fully documented and includes alphanumeric generator required to display alphanumeric characters directly on your TV screen without additional hardware. Also plays tic-tac-toe plus a drawing game that uses ELF II's hex keyboard as a joystick. 4K memory required £13.50 +VAT
☐ Tom Pittman's Short Course on Tiny Basic for ELF II £4
☐ ELF-BUG TM Deluxe System Monitor on cassette tape. Allows displaying the contents of all registers on your TV at any point in your program. Also displays 24 bytes of memory with full addresses, blinking cursor and auto scrolling. A must for the serious programmer! £13.50 +VAT
☐ Text Editor on cassette tape gives you the ability to insert, delete or edit lines and words from your programs while they are displayed on your video monitor. (Add printer and you can use ELF II to type error-free letters plus insert names and addresses from your mailing list) £16.95 +VAT
☐ Assembler on cassette tape translates assembly language programs into hexidecimal machine code for ELF II use. Mnemonic abbreviations for instructions (rather than numerics) make programs easier to read and help prevent errors £16.95 +VAT
☐ Disassembler on cassette tape takes machine code programs and produces assembly language source listings to help you understand and improve your programs on cassette tape £16.95 +VAT
☐ SAVE 10% Text Editor, Assembler and Disassembler purchased together only £45.76 +VAT (requires Video Display Board plus 4K memory)
☐ ELF II Light Pen, assembled and tested £6.50 +VAT
☐ ELF II Colour Graphics & Music System Board kit £55.95 +VAT
☐ ELF II connects directly to the video input of your TV set without additional hardware. To connect ELF II to your antenna terminals instead, order RF Modulator £2.77 +VAT
Coming soon: A-D, D-A Converter, Controller Board and more!

Print
Name ....

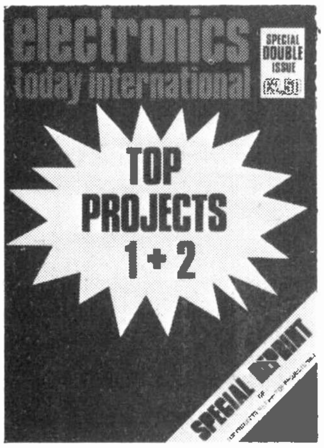
Address ....

....

....

DEALER ENQUIRIES INVITED

SPECIALS



TOP PROJECTS
Book 1 + 2: £2.50 + 25p P&P.
Master mixer, 100W guitar amp., low power laser, printmeter, transistor tester, mixer preamp., logic probe, Ni-Cad charger, loudhailer, 'scope calibrator, electronic ignition, car theft alarm, turn indicator canceller, brake light warning, LM3800 circuits, temperature alarm, aerial matcher, UHF-TV preamp., metal locator, four input mixer, IC power supply, rumble filter, IC tester, ignition timing light, 50W stereo amp. and many more.

Book 3: SOLD OUT!

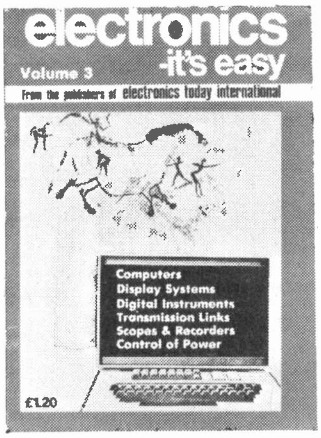
Book 4: £1.00 + 25p P&P.
Sweet sixteen stereo amp., waa-waa, audio level meter, expander/compressor, car theft alarm, headlamp reminder, dual-tracking power supply, audio millivoltmeter, temperature meter, intruder alarm, touch switch, push-button dimmer, exposure meter, photo timer, electronic dice, high-power beacon, electronic one-armed bandit . . .

Book 5: £1.00 + 25p P&P.
5W stereo amp., stage mixer, disco mixer, touch organ, audio limiter, infra-red intruder alarm, model train controller, reaction tester, headphone radio, STD timer, double dice, general purpose power supply, logic tester, power meter, digital voltmeter, universal timer, breakdown beacon, heart rate monitor, IB metal locator, temperature meter . . .

Book 6: £1.00 + 25p P&P.
Graphic equaliser, 50/100W amp. modules, active crossover, flash trigger, "Star and Dot" game, burglar alarm, pink noise generator, sweep oscillator, marker generator, audio-visual metronome, LED dice, skeet game, lie detector, disco light show . . .

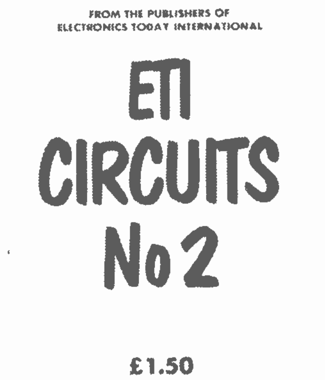
ELECTRONICS TOMORROW
Comprised entirely of new material, the edition covers such diverse topics as Star Wars and Hi-Fi! The magazine contains projects for everyone — none of which have appeared in ETI — and a look at the future of MPUs, audio, calculators and video. How can you not read it?

75p + 25p P&P.



ELECTRONICS — IT'S EASY
Books 1, 2 & 3.
Our successful beginners series came to an end some time ago now, and the whole series is available from us in reprint form. The three books between them contain all the information presented in the series (sometimes in more detail!) and together form an excellent starting point for any-one interested in learning the art of electronics.

£1.20 + 25p P&P each.



ETI CIRCUITS
Books 1 & 2.
Each volume contains over 150 circuits, mainly drawn from the best of our Tech-Tips. The circuits are indexed for rapid selection and an additional section is included which gives transistor specs, and plenty of other useful data. Sales of this publication have been phenomenal — hardly surprising when the circuits cost under 1p each!

£1.50 + 25p P&P each.

ORDER FROM

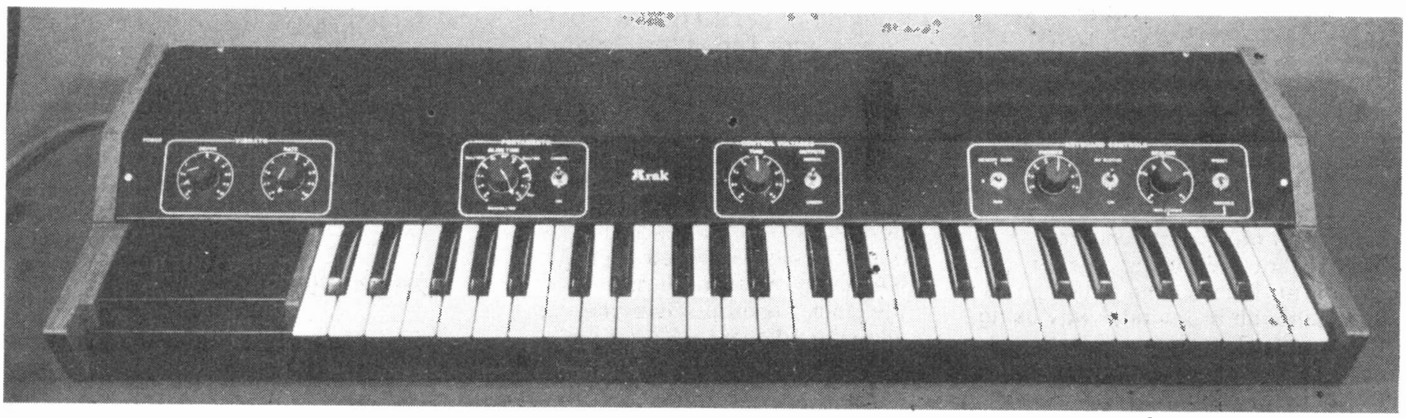
Specials Modmags Ltd 25-27 Oxford Street London W1R 1RF

Postage and packing also refers to overseas. Send remittance in Sterling only.
Please mark the back of your cheque or PO with your name and address.

from ETI

POLYPHONIC KEYBOARD CONTROLLER

Tired of playing one note at a time on a boring old monophonic synthesizer? In this design Tim Orr describes how you can build a four octave polyphonic keyboard controller incorporating first note priority.



THE MUSIC synthesizer is probably the most powerful musical instrument of today, and it will most probably form the basis of the next generation of keyboard instruments. However, the synthesizer suffers from one major drawback due to its unique structure. The disadvantage is that it is a monophonic instrument as opposed to traditional keyboard instruments, such as organs and piano's which are polyphonic, or multi-voiced. A brief resumé of synthesizer structure should clarify the reasons behind this.

To start with, the synthesizer is composed of a set of modules or independent circuit packages whose parameters in most cases are voltage controllable. For instance, a voltage controlled oscillator (VCO) has an output frequency (pitch) which is dependant on the magnitude of the input control voltage. These modules can be split up into three distinct groups. Firstly there are Sources, such as:

1. Noise
2. Voltage controlled oscillators

Secondly there are Modifiers which form by far the largest group:

1. Voltage controlled filters (VCF's)
2. Voltage controllled amplifiers (VCA's)
3. Ring modulators
4. Filter banks or graphic equalisers
5. Phase shifters
6. Reverbration

Thirdly there are control voltage sources:

1. Sample and holds
2. Sequencers
3. Transient generators
4. Trigger delays
5. Keyboard controllers

Getting Your Priorities Right

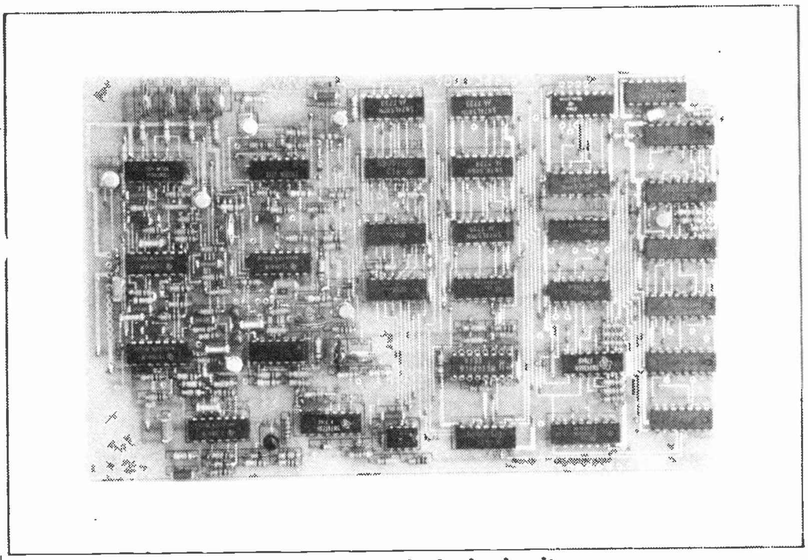
First note priority was adopted for this design, i.e. first note pressed to channel 1, second to channel 2, and so on. If more notes are pressed then the system can cope with, these are locked out. The reason for this, as opposed to last note priority, is that first note priority stops the note jumping that can occur when, momentarily, more notes are pressed than the system caters for.

Binary Notation

When the code (note code) driving the decoder energises a contact which is closed, the output of the OR gate goes high, showing a unique code on the input representing the particular note being pressed. This code, the note code, is arranged such that the lowest note is binary zero, the next note up binary one, the next

two and so on up to N.
The scanning can also be achieved using a multiplexer.

The size of keyboard decided on was a 4 octave one having 49 notes. Hence this makes the value of N 49 and therefore the size of the note code will be 6 bits (64 possibilities). In fact this is useful in that a 6 bit code will be just big enough to scan a 5 octave keyboard (61 notes) if required. In the case of this design it will simply be a mattter of adding 12 extra diodes since the decoder already had a total of 64 outputs. Incidentally, the scanner will have another output not yet mentioned. This is called 63rd note, (the 63rd output on the decoder) which simply provides a pulse to the decision logic to say that a scan has been completed. The multiplexer method would require decoding of the note code to do this.
The scanner simply gives each note a binary code, but how can this be extracted as a set of control voltages with associated gate signals?


The largest of the four PCB's, carrying the logic circuitry.

Pumping Caps

The note code is changed to an analogue voltage using a D-A converter, the output of which is switched onto the correct analogue channel and held using a set of sample and holds. The gate signals are dealt with in a similar way using CR circuits. The counter for the note code causes the scanner to increment from the lowest note upwards. If three notes are depressed the scanner reaches the lowest note first and causes the output of the D-A to be stored by channel 1 sample and hold, and channel 1 gate capacitor to be pumped up. On moving on the channel counter is incremented, prepairing the output channels for channel 2 data. When the scanner reaches the second note up the process occurs again only using channel 2 and again for channel 3, with the third note. When the scan has been completed the channel counter is reset and made ready for the next scan.

Dying Charge

If on the next scan the notes are still depressed, the gate capacitor will again be pumped up maintaining the gate output high. When a note is released the time constant is such that the gate capacitor's charge dies away in about one and a half scan times, thus removing the gate signal. By experiment it was found that the scan time needs to be about 4 mS. Even when a key is pressed and released very quickly, it will have been scanned about ten times or more. The NAND gate should be mentioned because it allows two adjacent notes to be played. This is because if two notes right next to each other are depressed, the output of the scanner remains high for the duration of both notes and so only one note would be detected. By NANDing the scanner output with the clock the output is broken up allowing adjacent notes to be detected.

Note Jumping

Although this circuit will work, it is far from satisfactory. When notes other than the top note are released, the channels on which the remaining notes appear, above the released note, all jump down one place. This makes the instrument very difficult to play as it must be remembered to release the keys from the upper one downwards, to get a chord that dies away nicely without the note jumping effect.

Special Decision

This means that the simple logic must be replaced by some special decision logic, incorporating a memory of notes already activated in previous scans.

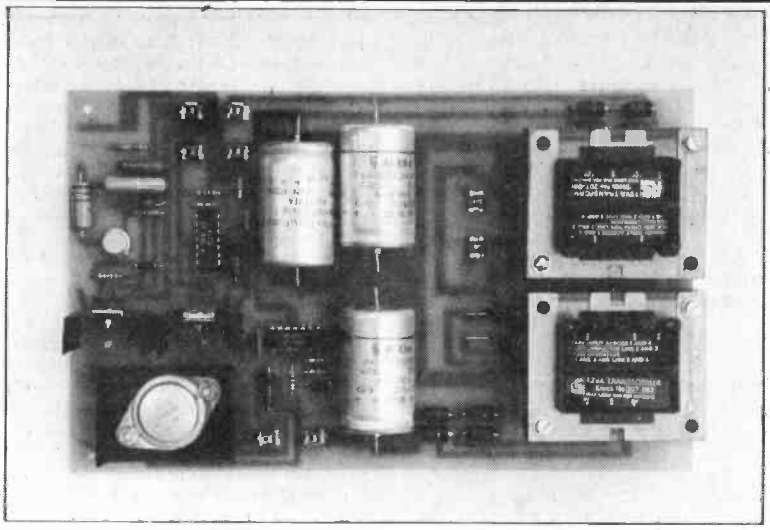
The scheme here is that note codes are gathered into the memory as the scanner sweeps up the keyboard. When the 63rd note is reached, the entire memory is dumped onto the output channels by sequencing the peripheral address lines. It is also necessary to reset all of the gate data bits in preparation for the next scan.This means that while a particular key remains pressed, the gate for that channel will be refreshed on every scan. When the key is released, the gate for that channel will go low when data is again output.

Logical Channels

The effect of the decision logic from the musicians point of view, is that upon playing a chord, say C, E and G the first one depressed normally comes out on channel 1, the second on channel 2 and the third on channel 3 (the difference in time between depresssions need only be milliseconds). There is, however, an exception to this when a note is depressed that is already stored in memory. For instance, if the three note chord described above were depressed such that C was first E second and G third, then it would be expected that C would come out on channel 1, E on channel 2 and G on channel 3. But if a previous chord had been played using the same C which had emerged on channel 2 then the decision logic would cause it to remain on channel 2 and so the E would be placed onto channel 1 and G onto channel 3.

Key Question

Construction of this project will depend almost entirely upon the keyboard it is built around. If you ▶



Power for the keyboard controller comes from this twin transformer board.

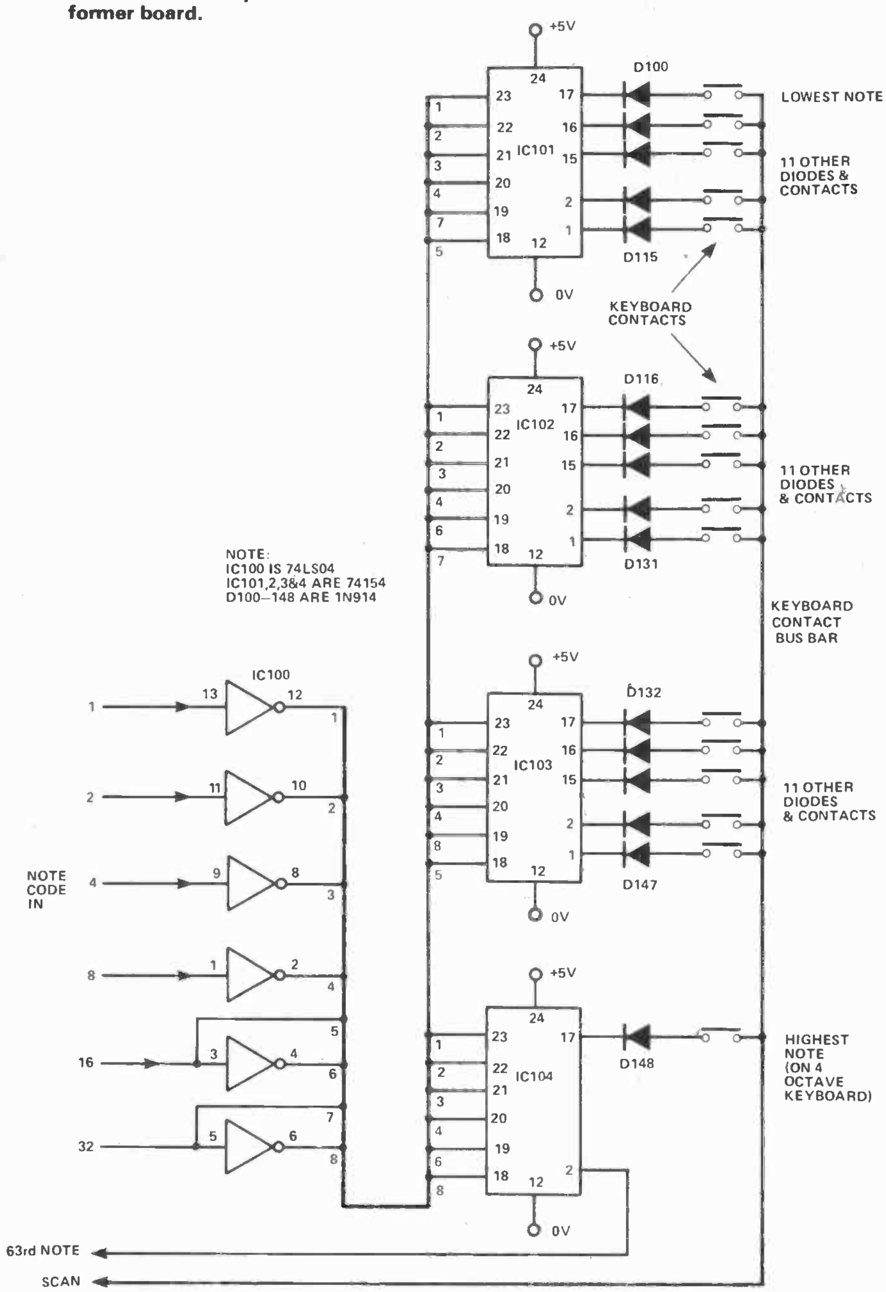


Fig. 1. Circuit diagram of the scanner. The four 74154's are used as a one out of 64 line decoder.

HOW IT WORKS

The Scanner: The IC's used for the scanner itself are 74154, which are one out of 16 line decoders. They are arranged such that one output goes low with the rest remaining high, dependent on the four bit code on the input. These IC's also have a pair of enable inputs both of which must be low. These allow four 74152's to be used as a one out of 64 line decoder, simply by the inclusion of the two inverters on inputs 16 and 32. The 63rd note output is obtained from the 63rd output of the decoder, and the scanner output is taken from the keyboard contact bus bar, having been ORed using the diodes.

Logic: The reaction of the circuit to a new note that has not been picked up by the scanner before is as follows: the note code counter increments the scanner by one note on alternate falling edges of the clock, until it reaches this particular note. The output of the scanner goes high registering that the contact is closed. This triggers the monostable IC12 pin 2 causing its $\bar{Q}$ output to go low long enough to set the decision cycle flip flop IC15 input pin 9 The output of this flip flop pin 11, then inhibits further pulses from clocking the note coder by taking pin 1 of IC15 low. At the same time it initiates the first decision cycle by allowing the counters IC9 (address counter) and IC13 (decision counter) to run by taking their $\overline{\text{clear}}$ inputs high. When the output of the decision counter is zero the memory address counter is clocked round, so that the logic can check if the note is already in the memory.

The memory address counter is incremented on the low going edge of the K pulse, which is simply the clock divided by two. Since the decision counter is only 2 bits it was convenient to derive K using the spare single stage counter in the 7493. Note that K is only active during the decision cycles and data block since the counter is cleared down when the scanner is scanning.

When the address counter reaches the number set on the Phonics switch, it is reset, and the decision counter incremented by one via the NAND gates IC18. This starts the second decision cycle where the logic is looking for a spare location to insert the new note. It has been assumed that channel 1 is in use and that the first available channel is channel 2. The circuit stops the data being entered in channel 1 by observing the state of the gate data output from the gate RAM pin 5. If this output is a logical 'O' the channel is in use and must not be corrupted, and so the address counter is incremented so that the next channel can be tested.

In the case of this example the decision logic succeeds in entering its data in channel 2, but if the decision counter is incremented a second time before an empty channel is found, simply because all channels are in use, the decision cycle is ended and the scan continued. This third condition of the decision counter is decoded by the NAND gate IC16 and the invertor IC19, and reset is achieved via the three input NAND gate IC22 and invertor IC20, which reset the decision cycle flip flop restarting the note code counter and clearing down the memory address and decision counters.

The second and subsequent times that the scanner is stopped by the note that was loaded in channel 2, the decision logic will only get as far as its first test 'Is the note already in the RAM', so when the memory address counter reaches 2 the comparator output goes high acknowledging that the note is already entered. This causes the gate bit to be refreshed (since it is reset during data block) along with the data being re-entered into the note memory, (re-entering the data in the note memory is not necessary but occurs due to circuit architecture) after which the decision flip flop IC15 is again reset and the scanner restarted.

All the time a note remains depressed the decision logic will refresh the gate bit associated with the channel in which the note has been placed. At the end of a scan the gate bits are reset immediately after they have been placed on the output channels meaning that if the note is not still depressed on the next scan the gate signal on the output channel will go low in the next data block period.

During a scan the data valid signal is high, it only toggles in data block. Simply enabling the gate RAM during the decision cycle loads it with a '1', since data valid is the input. Note that loading these Ram's with a '1' results in the output going to a 'O' as they invert. This is the reason for the invertors on the outputs of the note RAM's, which are also tri-state for the computer interface.

The clock for the system is an NE555 timer wired in the astable mode.

The Output Channels

There are two outputs per channel which are multiplexed out by the data block period. These are the gate outputs and the control voltage outputs. The gates are obtained from the CD4099 addressable latch (note that these outputs may need buffering depending on the impedance they are driving as the CD4099 is CMOS). The address lines of the latch are attached to the memory address counter and the input is connected to the gate data line (IC10 pin 2). The enable input of the latch is connected to the data strobe line so that as the data is output from the memory the correct gate state (1 or 0) is stored on the relevant channel.

The data sample pulses are for loading the sample and holds on the analogue channels. They are derived from the 1 of 8 decoder and the clock. To interface between the TTL logic and the analogue switches comparators are used so that the analogue signals can be between —3 volts and +12 volts. All the comparator outputs are disabled when the clock is high by using the two resistors R65 and R53 to feed the reference input to the comparators, the clock signal being attached to R65. The binary codes representing the notes are converted into analogue voltages using the D-A convertor IC14.

As the memory address counter is incremented in data block the data in the note memory is converted into an analogue voltage and passed onto the correct analogue channel by the comparator and analogue switch. The D-A convertor has a current output such that when the resistor R82 is added to convert it into a voltage, the output goes more negative with increasing binary codes. The op-amp IC29 (pins 12, 13 and 14) corrects this by inverting the output of the D-A. It also allows the scaling or volts per octave of the keyboard to be adjusted, by varying the resistor in the feedback loop. Another function that the op-amp allows is the summing of voltages that have to appear on all the output channels at once.

There are three sources of voltage that are summed at this point, the tune voltage, the vibrato voltage, and the pitch bender voltage. The tune voltage is derived from a potentiometer which draws its current from the voltage reference circuit. The vibrato voltage is generated by a standard triangle wave generator comprising a regenerative comparator IC29 pins 8, 9 and 10 and an integrator IC29 pins 5, 6 and 7. The output is coupled to the summing amplifier via a pair of back to back electrolytics to remove any DC offset and a pair of resistors that allow their centre point to be connected to earth via an external vibrato depth potentiometer.

Offsets around the circuit are trimmed out using the trimmer RV1 which obtains its reference from the diode D1. Since the offsets are predominantly in one direction due to Q2 the offset control only works in the negative voltage direction.

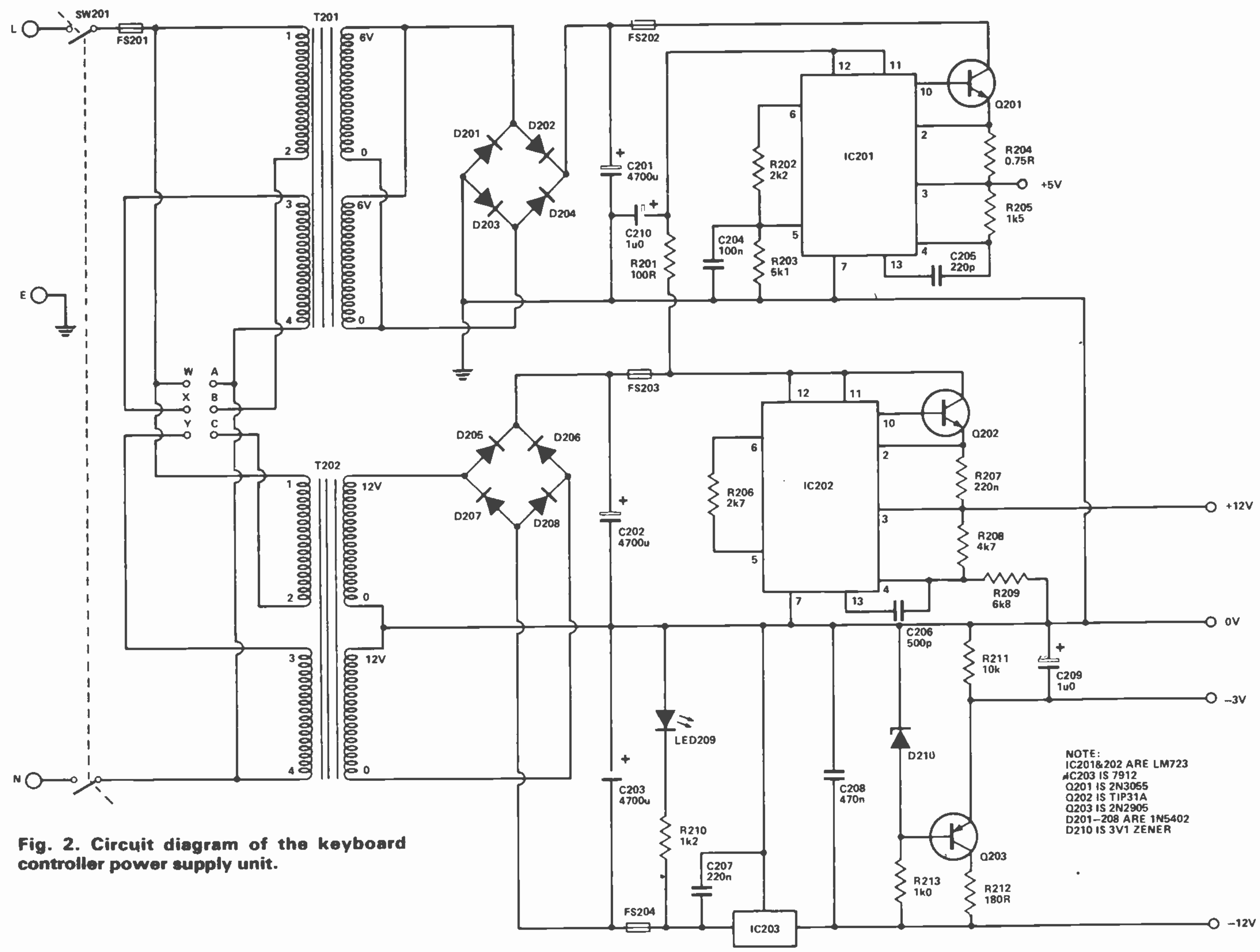


Fig. 2. Circuit diagram of the keyboard controller power supply unit.

employ the ARAK kit, no problems should arise at all. The PCBs are designed to fit their keys and comprehensive instructions are included with the kit.

We have not attempted to go into any detail with any other unit, simply because there is such a great diversity available on the market.

Setting Up

Once the components are all mounted on their boards, each section has to be set up. Let's start with the

PSU

Before the mains is connected to the PSU it should be thoroughly checked for shorts. The three low voltage fuses FS202, FS203 and FS204 should then be removed and the mains turned on. Now check the voltages across the smoothing capacitors C201, C202 and C203 which should be around +8V, +17V and —17V respectively. If this is the case the +12V regulator can be tested by replacing FS203. If this works the +5V regulator can be tested by replacing FS202. As the +5V regulator is supplied from the +12V supply via R201 they must be tested in this order. Finally the —12V and —3V supplies can be tested by inserting FS204. It should be noted that the fuse holders may need bending to give correct contact to the fuses as they are very simple pressed steel pieces for PC mounting.

The Logic Board

Check the logic board thoroughly for shorts on supplies. It is also wise to 'buzz out' every connection on the board to test for continuity which may well save a lot of fault finding time, but note that it will not guarantee correct operation as it does not test for shorts.

When these preliminary tests have been carried out and the power supply unit is functioning correctly power can be applied to the logic board. Firstly only apply the +5V supply until the TTL is known to be working correctly.

And a Log

Once the logic is working the analogue section can be tested. This time some setting up can also be done:

First check the positive reference is sitting at about 6V2 above earth. This level can be increased using the trimmer RV7 if a higher reference is required for any reason.

If the touch circuit is not to be used R63 should be removed as it will probably cause the output of IC29 pin 14 to saturate against one of the supplies as the output of the touch circuit is indeterminate.

R19 sets the maximum glide rate. The smaller it is the longer the maximum glide rate will be. However, it is unwise to make it any smaller as the maximum range is set by the V_{CE} on SAT of the switching transistor, this only creating an offset when it is turned on and not when it is turned off. It may be necessary to increase the value of R19 although problems will probably occur on one channel only and will most likely be remedied by replacing the switching transistor for one with a lower V_{CE} SAT.

ETI ▶

PARTS LIST

BOARD 2

R201	100R
R202	2k2
R203	5k1
R204, R207	0R75 1W
R208	4k7
R209	6k8
R210	1k2
R211	10k
R212	180R 1W
R213	1k
CAPACITORS	
C201-203	4700u 25V electrolytic
C204	100n polyester
C205	220p
C206	500p
C207	220n polyester
C208	470n polyester
C209, C210	1u0 35v electrolytic
SEMICONDUCTORS	
Q201	2N3055
Q202	TIP31A
Q203	2N2905
IC201, IC202	LM723
IC203	7912
D201-208	1N5402
D209	LED
D210	3V1 Zener
MISCELLANEOUS	
TX201	RS 207-683
TX202	RS 207-699

1A, 1A5, A (2 off) fuses and holders, DPST rocker switch.

BOARDS 3 AND 4

SEMICONDUCTORS

IC100	74LS04
IC101-104	74154
D100-148	1N914

2 off of these components are required, as board 4 is identical to board 3.

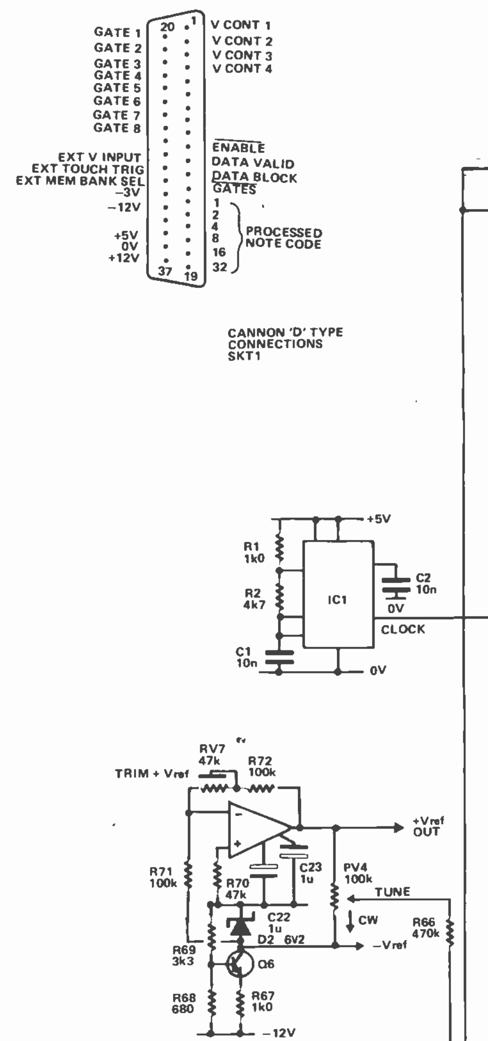
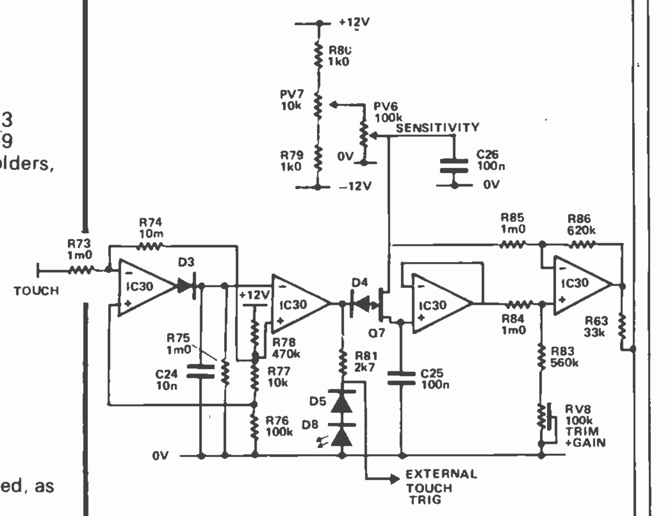
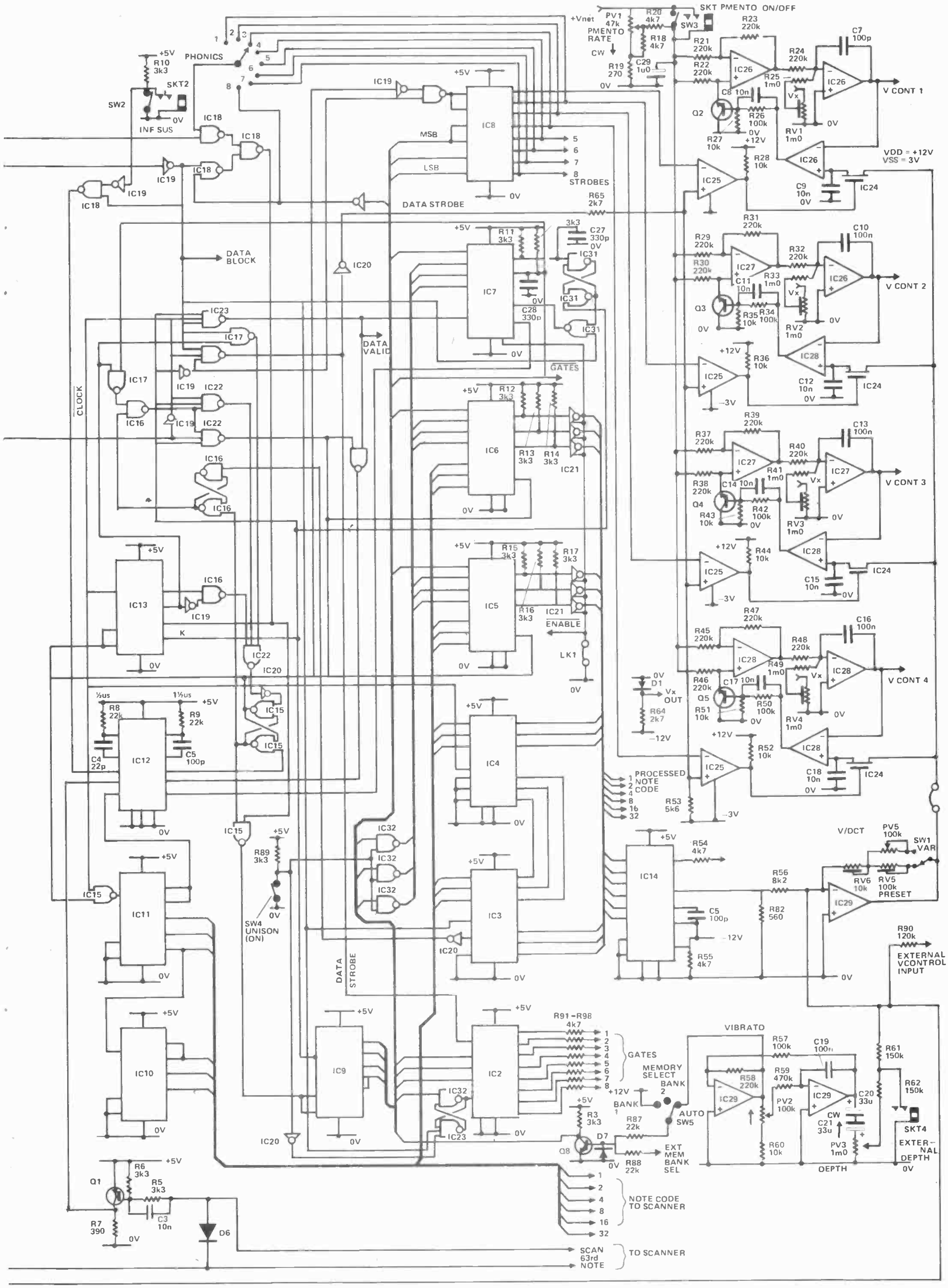


Fig. 3. Circuit diagram of the logic board.




PHONICS
INF SUS
SW2
SKT2
SKT PMENTO ON/OFF
PMENTO RATE
SW3
DATA BLOCK
DATA STROBE
DATA VALID
MSB
LSB
STROBES
GATES
CLOCK
ENABLE
LK1
V CONT 1
V CONT 2
V CONT 3
V CONT 4
VDD = +12V
VSS = 3V
Vx OUT
PROCESSED NOTE CODE
V/OCT
SW1 VAR
PRESET
EXTERNAL VCONTROL INPUT
SW4 UNISON (ON)
VIBRATO
GATES
MEMORY SELECT
BANK 1
BANK 2
AUTO SW5
EXT MEM BANK SEL
DEPTH
EXTERNAL DEPTH
SKT4
NOTE CODE TO SCANNER
SCAN 63rd NOTE
TO SCANNER

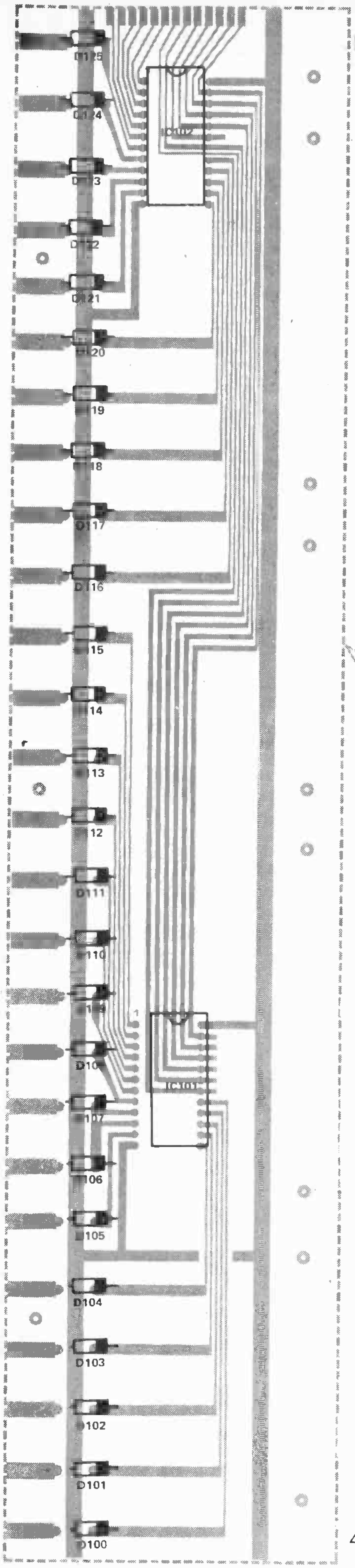
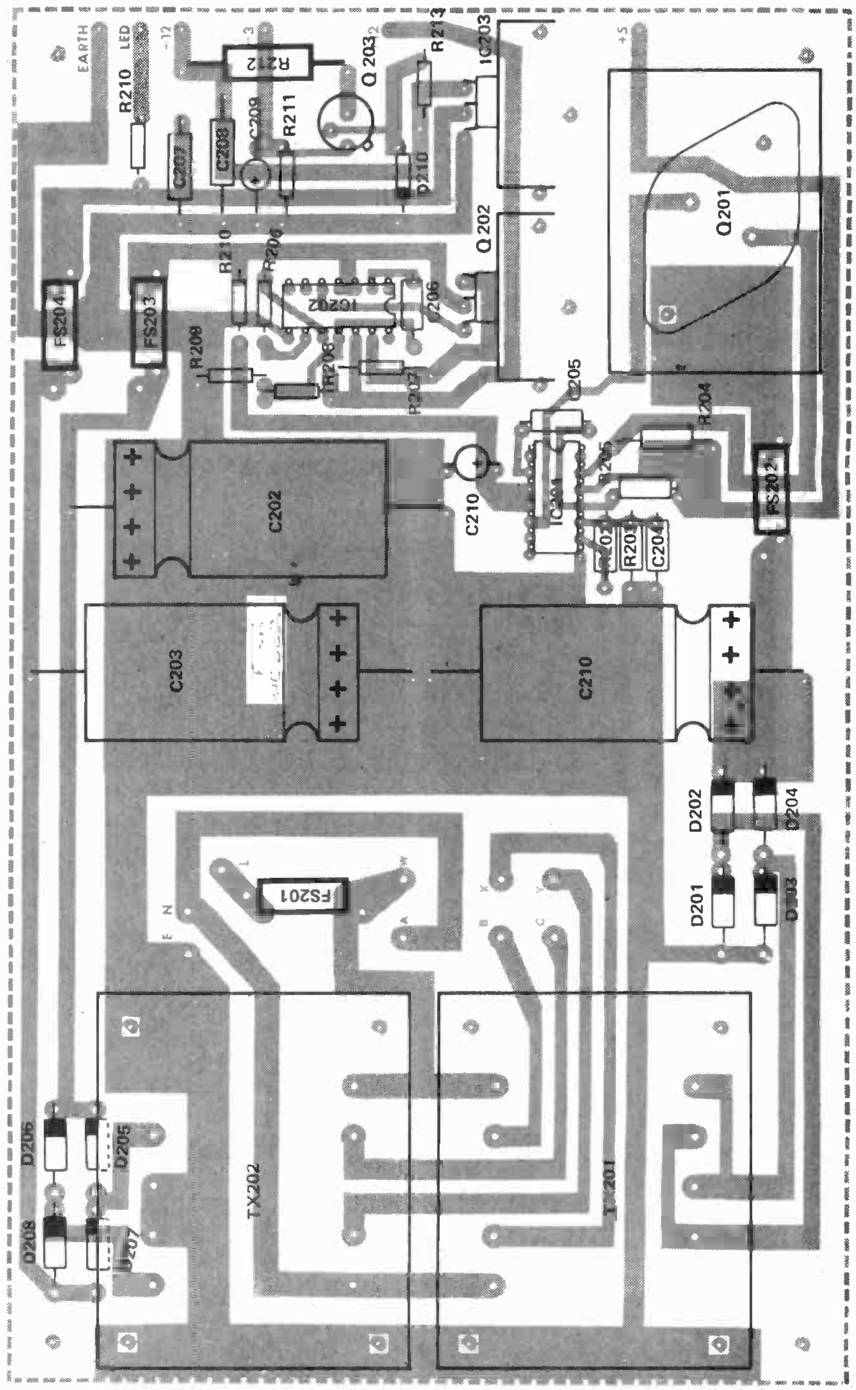


Fig. 4. (below) Component overlay of power supply board.
Fig. 5 (above) One of the two keyboard PCBs, designed to fit Araks keys.



PARTS LIST

RESISTORS		R61, R62	150k
R1, R67, R79, R80	1k0	R63	33k
R2, R18, R20, R54, R55, R91-R98	4k7	R65, R81	2k7
R3-R6, R10-R17, R69, R89	3k3	R68	680R
R7	390R	R70	47k
R8, R9, R87, R88	22k	R74	10M
R19	270k	R82	560R
R21-R24, R29-R32, R37-R40, R45-R48, R58	220k	R83	560k
R25, R33, R41, R49, R73, R75, R84, R85	1M0	R86	620k
R26, R34, R42, R50, R57, R71, R72, R75	100k	R90	120k
R27, R28, R35, R36, R43, R44, R51, R52, R60, R64, R77	10k	POTENTIOMETERS	
R53	5k6	PV1	47k
R56	8k2	PV2, PV4, PV5, PV6	100k
R59, R66, R78	470k	PV3	1M0 Log
		PV7	10k
		RV1-4	1M0
		RV5, RV8	100k
		RV6	10k
		RV7	47k

CAPACITORS	
C1-3, C8, C9, C11, C12, C14, C15, C17, C18, C24	10n polyester
C4	22p
C5, C6	100p
C7, C10, C13, C16, C19, C25, C26	100n polyester
C20, C21	33u
C22, C23, C29	1u0 35V electrolytic
C27, C28	330p
SEMICONDUCTORS	
Q1	BCY72
Q2-6, Q8	BC107
Q7	2N5163
IC1	NE555
IC2	CD4099
IC3, IC4	74LS85
IC5-7	7489
IC8	74LS155
IC9-11, IC13	74LS93
IC12	74LS123
IC14	MC1408L-8
IC15-18, IC31, IC32	74LS00
IC19, IC20	74LS04
IC21	74LS366 (or 74LS368)
IC22, IC23	74LS10
IC24	CD4066
IC25	LM339
IC26, IC27, IC28, IC30	TL084
IC29	LM4741
D1, D3-7	1N914
D2	6V2 Zener
D8	LED

MISCELLANEOUS

37 way 'D' skt, stereo jack (3 off), SPDT switch (4 off), SPDT centre off.

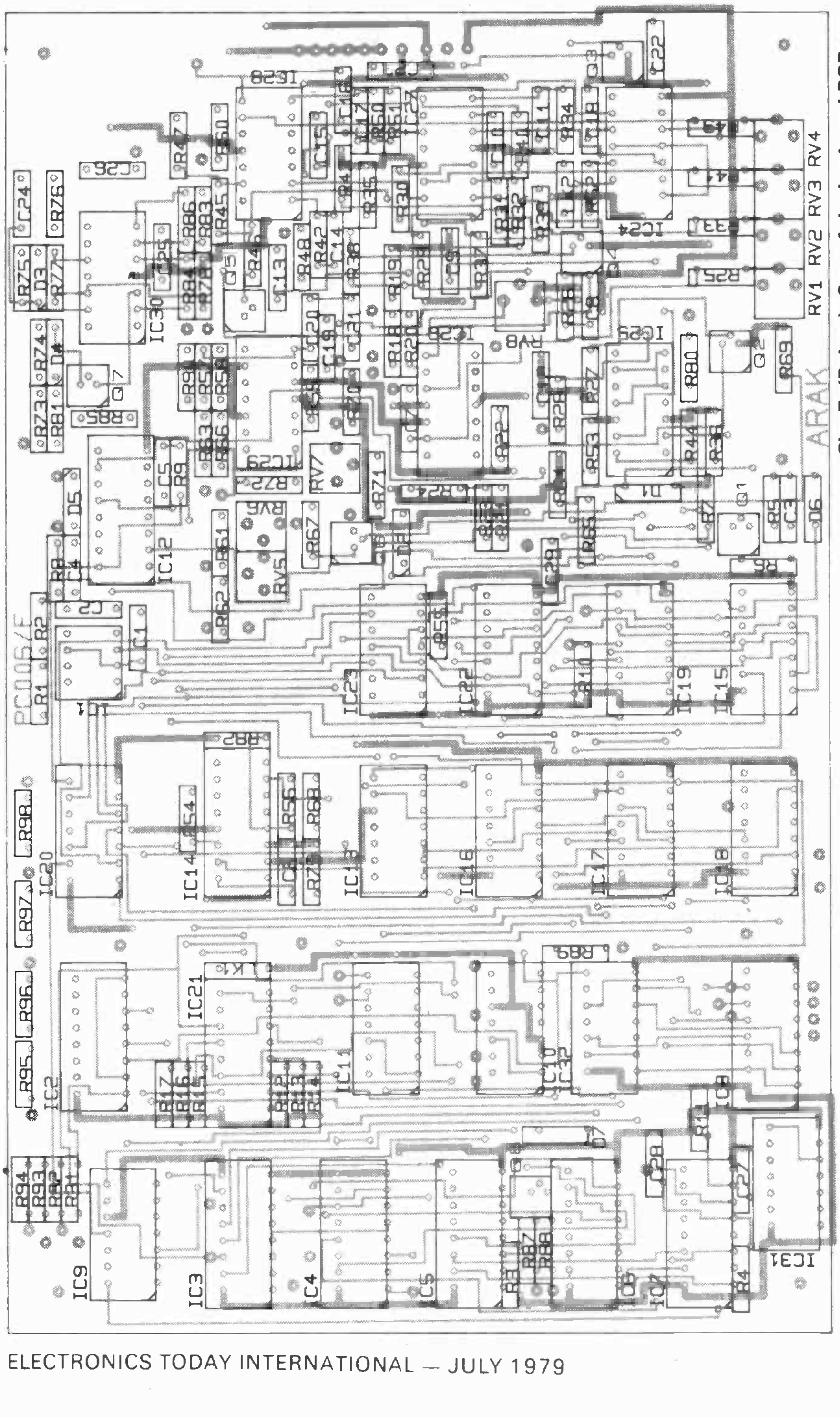


Fig. 6. (above) Component overlay for the logic board.

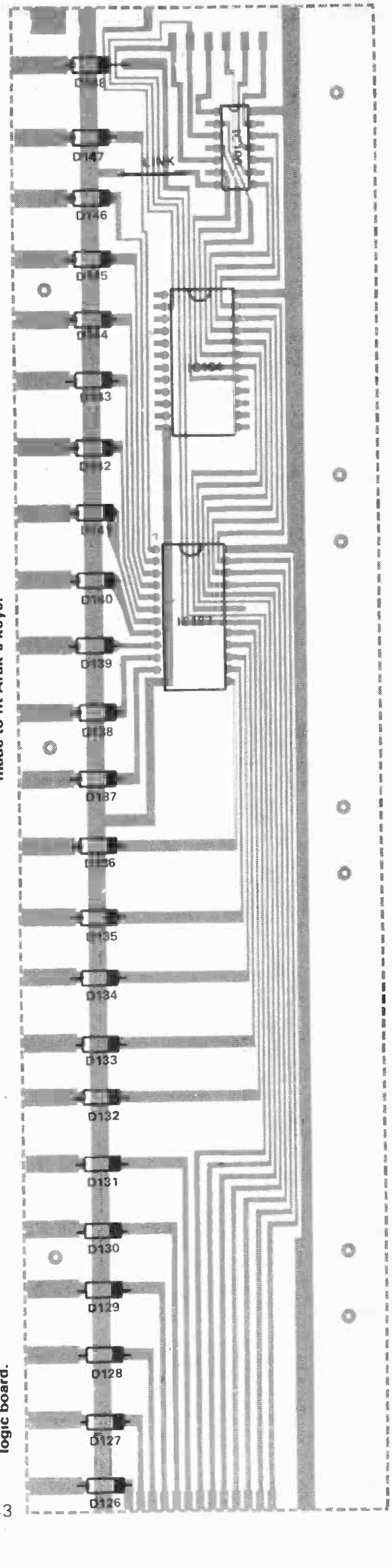


Fig. 7. (Below). One of the keyboard PCBs made to fit Arak's keys.

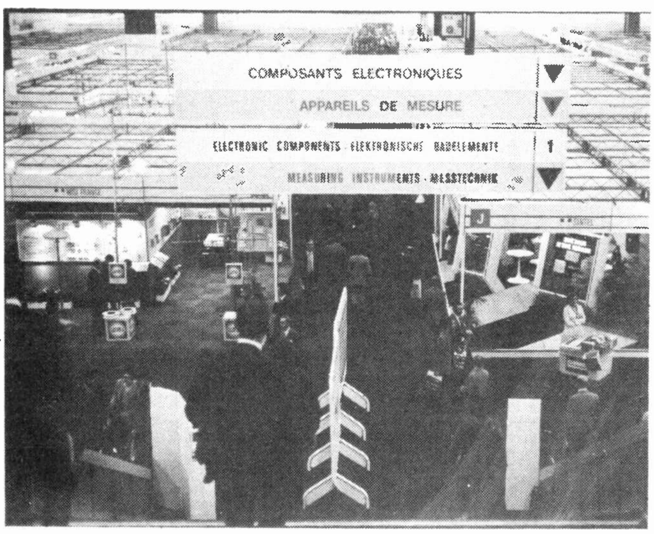
PARIS IN SPRINGTIME

As a London-based magazine, we tend to concentrate our interest on exhibitions and electronics shows in the London area. Lest we become too parochial in our outlook, we decided to see what our fellow Europeans have to offer. We sent our roving reporter, Ian Graham, to Paris to see how the other half live.

I PROBABLY RECEIVE a couple of hundred Press releases every day. Most, concerning orders for electronic equipment won by companies or appointments to the top management of larger corporations or annual accounts, end up in the waste paper bin. Our reports on the cream of the rest appear monthly in our news pages. Occasionally I am invited to attend Press receptions. Again, few are interesting enough to prise us out of our armchairs. However, I did sit up and take notice when I was invited to attend an electronic components exhibition 'sur le continent'. The occasion was the Salon International des Composants Electroniques 79, held in Paris from the 2nd to 7th of April. Well, I thought about it, for several seconds at least, and decided that I had indeed been neglecting our European brothers.

On a sunny April morning I made my way from Charles de

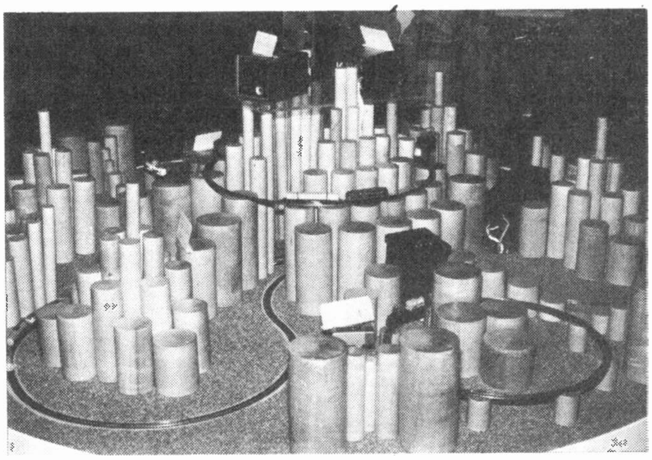
Row upon row of stands full of goodies — paradise for the exhibition addict.



The tops of stands stretch into the distance, in the biggest of the three exhibition halls.

Gaulle airport to the exhibition site at the Parc des Expositions in the Place de La Porte de Versailles. My first impression as I emerged from the Metro station was of the unexpected size of the exhibition, which stretched over a staggering 63,000 square metres, split up into four sections. It would have taken several days to see everything on display, certainly more than the single day I had allowed myself.

Although it was essentially a trade show, the atmosphere inside was more akin to that of our own Ideal Home Exhibition. However, great expectations of an entertaining exhibition were not borne out by my admittedly swift tour of the stands.



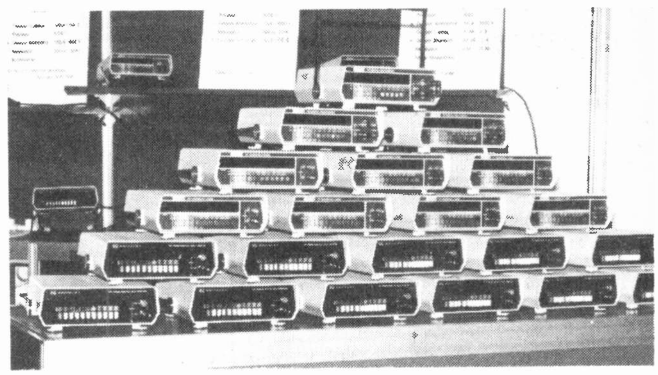
A fun way of counting trains with photocounters. This stand attracted a great deal of interest from people who had probably never seen a photocounter before. This simple display illustrated the principle of the unit admirably for the layman.

Dry Stuff?

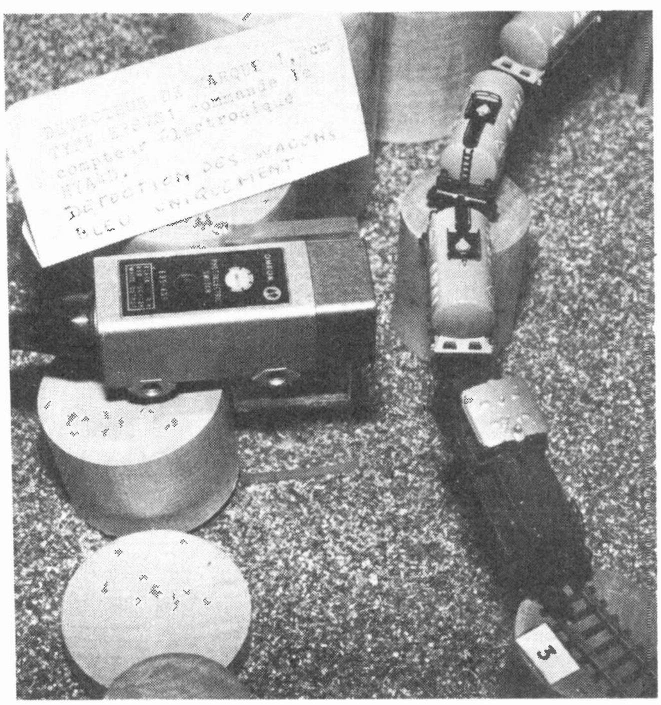
Unfortunately, few exhibitors showed any imagination in the presentation of their wares. Sound to light units and TV games naturally lend themselves to entertaining stands, but what about more mundane electronic components? General Instrument Microelectronics (a British firm, I'm happy to say) managed to make microprocessors a crowd puller (I wouldn't have thought it possible) by using one to control a noise generator. Pretty dry stuff, you might say. However, the generator was producing car engine, gear change, skid and crash noises for a model racetrack. Visitors could control the cars with conventional pistol grips. Well, perhaps a model race track has little to do with microprocessors and vice versa, but it did attract interested visitors. Isn't that what it's all about?

Eyecatching Pyramids

Another firm displayed photocounters by using them to count wagons on a pyramid of model railway layouts. Talking about pyramids, yet another firm (American) presented a striking display, a pyramid of multimeters. They might uncharitably be called gimmicks, but they *were* eye-catching. Too many exhibitors relied on a glass case full of components accompanied by row upon row of standard black and white exhibition photos, none of which deserved or got a second look. Still, there were plenty of product demonstrations to keep me busy, as I made my way through the maze of stands. There were also lectures. How do you fancy soaking up 'Monolithic Memories' at half nine in the morning? No, neither did I.



Keithley's pyramid of multimeters. We strongly suggest that you don't try this with your Avo. 8's, or if you do, don't blame us if there are disastrous consequences.



A closer look at the electronic 'train' spotter above. One colour of wagon, in this case blue, can be counted, ignoring the train and all the other wagons.

Light Entertainment to Heavy Machinery

Although I found plenty to criticise at the Paris show, it put some of our own electronics shows to shame. Whatever you are interested in, from hi-fi to heavy machinery, there's plenty of it at the Salon, with some 1300 firms exhibiting. Hi-fi enthusiasts could spend a day or two wandering round the stands devoted to the love of their life. That goes equally well for every field of interest represented and there wasn't much that was not represented.

See You Next Year

My brief visit to the show was very enjoyable. There was plenty of food and drink to be had from seemingly numerous bars. The French exhibition staff were so good to me that I'm thinking of doing it again next year. If you feel like joining me, the Salon International des Composants Electroniques 80 will be held from March 27 to the 2nd of April. If you feel like nipping across the pond to pay your visit on Sunday, March 30th, don't......they're closed. ETI

MOTOR SPEED CONTROLLER

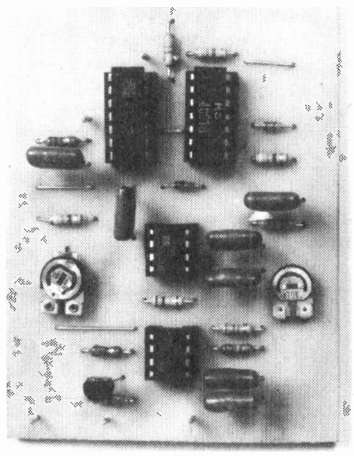
A sophisticated unit that allows control of model electric motor speed and direction via a single radio control channel. The unit can supply peak currents up to 10 amps.

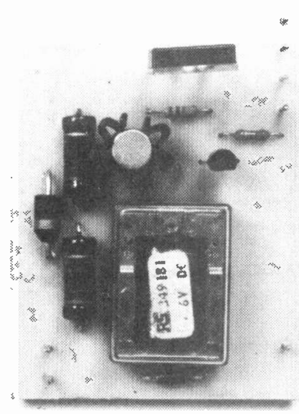
THIS DEVICE lets you use a single channel of your radio control system to control both the speed and direction of an electric model motor. The unit has been designed specifically to control the drive motor of our 1/16th scale Tamiya Leopard tank, but can in fact be used to control any 4V5 to 8V DC electric motor that draws peak current below 10 amps. The unit is ideal for use in model boats and large-scale land vehicles, and costs only a fraction of the price of equivalent commercial units.

The unit derives it's control signals from one of the output channels of a radio control decoder. It accepts standard positive or negative decoder pulses, which have widths variable over the 1 mS to 2 mS range, and is designed to work with systems having fixed frame (or frame repeat) periods of approximately 20 mS. The Strato 4+2 system, published in the May and June editions of ETI, can be used with the controller.

The controller circuit incorporates only two pre-set pots. One of these is a 'set null point' control, and can be used to set the motor speed to zero in any desired position of the transmitter joystick control. The other pre-set is used to set the maximum speed of the motor.

The two pre-sets can be used to give a variety of operating modes. If they are adjusted so that the null point occurs at the centre of the joy stick travel, the motor will have identical maximum speeds in forward and reverse. If the null is set to occur towards the 'low' end of the joy stick travel, the motor will have a high maximum forward speed and a low maximum reverse speed.





Construction And Use

The unit is assembled on two PCB's. Board 1 holds all the logic, timing components, and the two pre-set pots, and board 2 holds the power driver transistors and the relay. Construction of board 1 should present few problems: note, however, that no provision is made on the PCB for decoupling capacitor C8, since we hooked this component into the wiring harness on our prototype unit.

Note when constructing board 2 that power transistor Q4 can either be mounted directly on the board in low- to medium-power applications, or can be mounted externally on a suitable heat sink (such as a vehicle chassis, etc) in high power applications. The relay used on this board is a 6 volt two pole changeover type with a coil resistance of 70R (see Buylines).

When construction is complete, the two boards can be mounted in the model, preferably as far away from interference-generating motors and servos as possible. Board 1 is powered from the radio control decoder supply lines. The signals from the selected output channel of the decoder are fed to either the positive pulses or negative pulses input leads of board 1, depending on the pulse polarity of the particular decoder that is used.

Board 2 is powered from the motor supply leads. Note that the 0V line of the motor supply must be made common with the 0V line of the decoder. Also note that one lead must be connected between R6 on board 2 and pin 4 of IC1 on board 1, and another lead must be connected between R12 on board 2 and Q1 collector on board 1.

▶

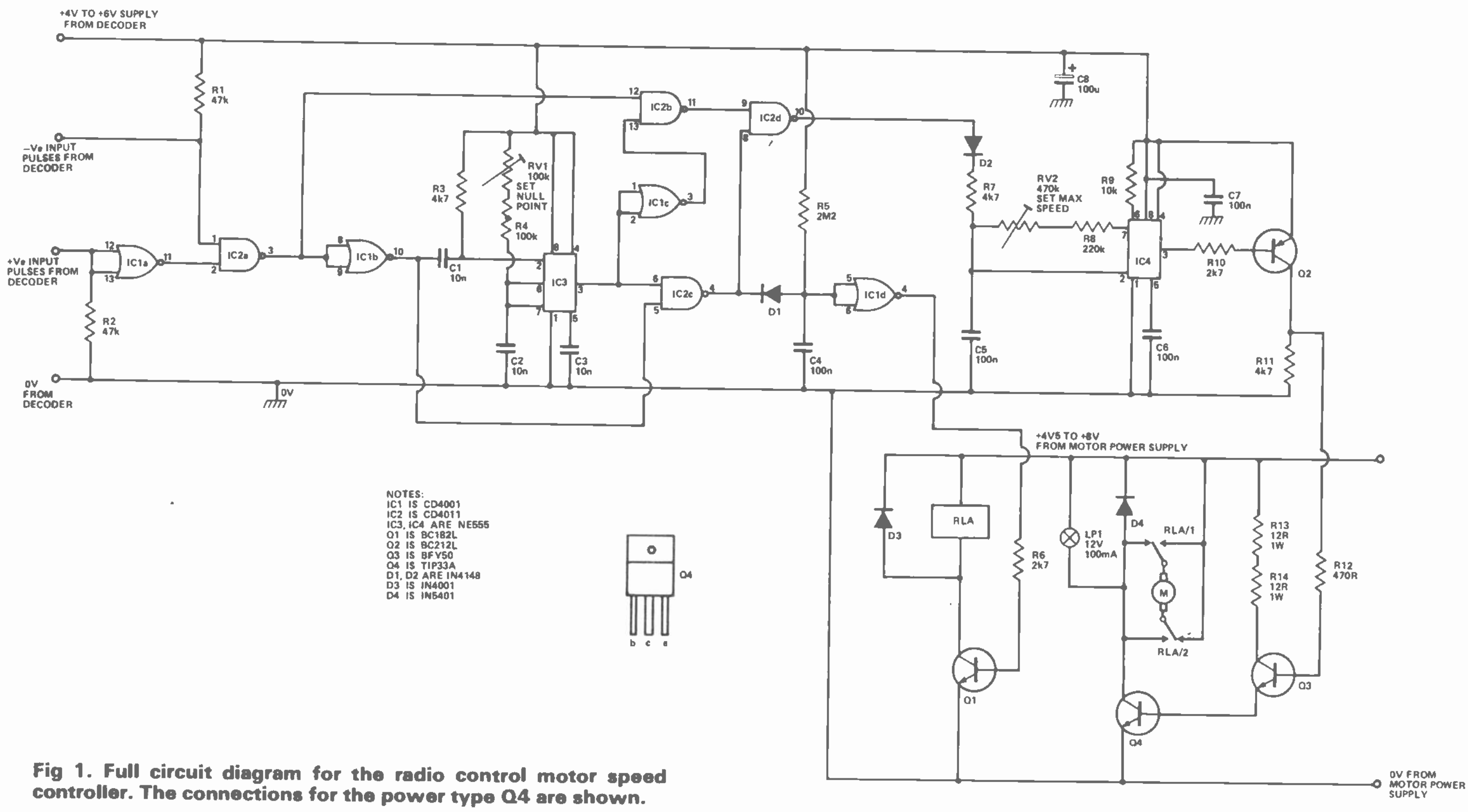


Fig 1. Full circuit diagram for the radio control motor speed controller. The connections for the power type Q4 are shown.

HOW IT WORKS

The input pulses from one channel of the decoder, which have widths that are variable between 1mS and 2mS, are fed to either pin 1 or IC2a (negative input pulses) or to pins 12 and 13 of IC1a (positive input pulses), and appear in positive-going form at the output of IC2a. This positive-going pulse is fed directly to pin 12 ot IC2b, and is fed in inverted form to pin 5 of IC2c: the inverted pulse is also used to trigger reference-pulse generator IC3 via C1. This reference pulse has a nominal width of 1.5mS, which equals the mid-band width of the input pulses from the decoder.

The positive-going reference pulse is fed directly to pin 6 of IC2c, where it is compared with the negative-going version of the input pulse on pin 5. The action of IC2c is such that its output is normally high, but switches low for a period equal to the difference between the reference and input pulse widths only when the input pulse duration is less than that of the 1.5mS reference pulse. This negative-going output pulse, which has a width that is variable between zero and a nominal 0.5mS, is used to rapidly discharge C4 via D1 and thus cause the output of IC1d to switch high and drive relay RLA on via Q1 and R6. This relay, which dictates the direction (forward or reverse) of the motor that is being controlled, is thus off when the input pulses are greater than 1.5mS (nominal), and on when the input pulses are less than 1.5mS.

The 1.5mS reference pulse of IC3 is inverted by IC1c and fed to pin 13 of IC2b, where it is compared with the positive-going version of the input pulse from the decoder. The action of IC2b is such that it's output is normally high, but switches low for a period equal to the difference between the reference and input pulse widths only when the input pulse duration is greater than that of the 1.5mS reference pulse. This negative-going pulse, which also has a width that is variable between zero and a nominal 0.5mS, is fed to pin 9 of IC2d.

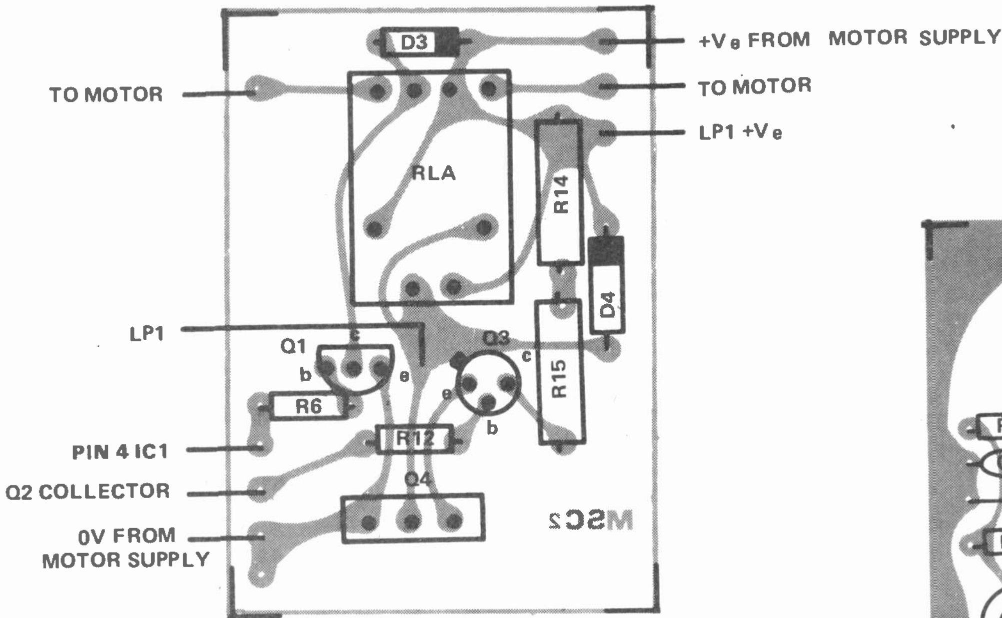
Thus, a negative-going pulse appears on pin 9 of IC2d if the decoder pulse is greater than 1.5mS, or on pin 8 of IC2d if the decoder pulse is less than 1.5mS. Consequently, IC2d generates a positive-going output pulse that has a width that varies from zero on a 1.5mS decoder input pulse to 0.5mS on a 1mS or 2mS input pulse.

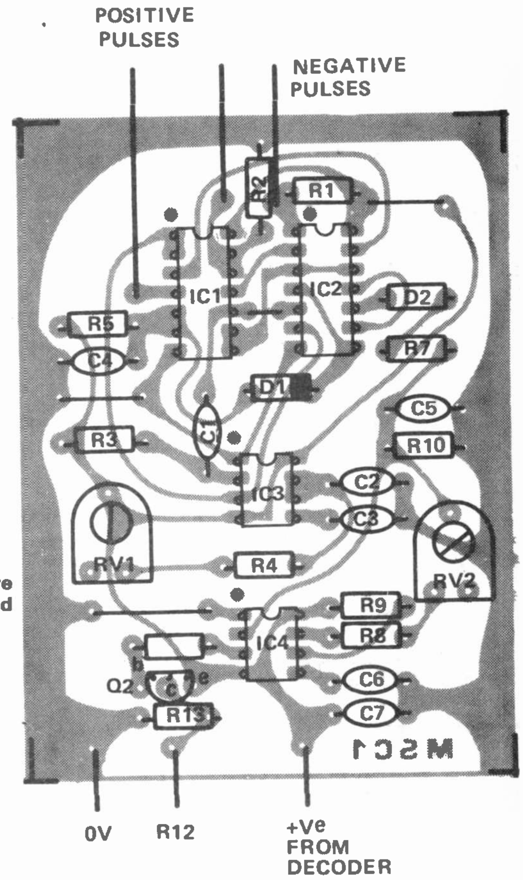
This pulse is fed, via D2, to a pulse-expander circuit designed around IC4, which expands the pulse width by a factor of about 40. The resulting expanded pulse is passed on to the external motor via transistors Q2 to Q4 and the contacts of the relay, and is used to give pulse-width or variable mark/space-ratio control of the motor speed. Diode D4 is used to damp motor back-EMF, and lamp LP1 is used to minimise the effects of interference-generating current surges.

In practice, RV1 is used to adjust the width of the reference pulse (nominally 1.5mS) so that the motor speed is zero when the transmitter joy-stick control is in its central or null position, and RV2 is used to adjust the expansion factor of the pulse expander circuit and thus pre-set the maximum speed of the motor when the transmitter control is in its 'maximum' position.

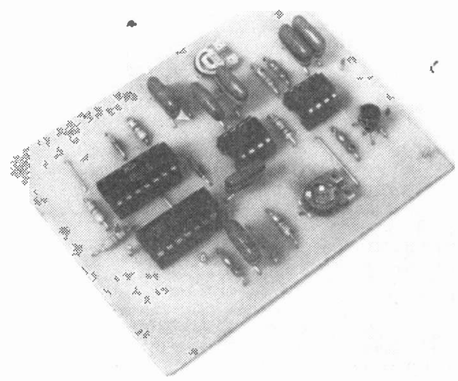
BUYLINES

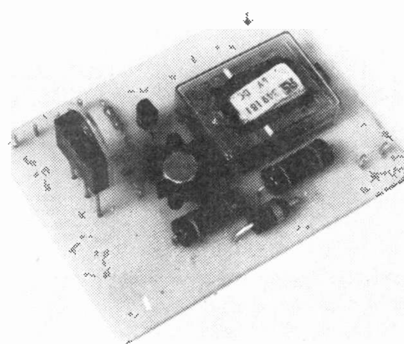
The relay is the only component that calls for comment here. It is a 6 Volt 2-pole changeover type with a coil resistance of 70R, and is available from Greenweld, 443 Millbrook Road, Southampton, SO1 0HX. The price is £3.30, including postage and the usual extras.





Above left and almost absolutely right are the component overlays for the speed controller.





And this is how the boards should look once you've built them up. Check very carefully before switching on.

PARTS LIST

RESISTORS (all ¼w 5%)

R1, 2	47k
R3, 7, 11	4k7
R4	100k
R5	2M2
R6, 10	2k7
R8	220k
R9	10k
R12	470R
R13, 14	12R 1W

CAPACITORS

C1, 2, 3	10n polyester
C4, 5, 6, 7	100n polyester
C8	100u 25V electrolytic

SEMICONDUCTORS

IC1	4001
IC2	4011
IC3, 4	555
Q1	BC182L
Q2	BC212L
Q3	BFY50
Q4	TIP33A
D1, 2	IN4148
D3	4001
D4	IN5401

Relay = 6V, 2-pole changeover type. Coil resistance 70R.

What A Turn On

When installation is complete, turn on all power switches, check that the unit functions correctly, and then adjust pre-set pots RV1 and RV2 for the required operation. To set RV1, move the transmitter joy stick to the required 'null' position, and then adjust RV1 for zero motor speed: under this condition the relay should be on the verge of switching between the on and off states. Next, move the transmitter joy stick fully forward, and adjust RV2 for the desired maximum motor speed. The setting up procedure is then complete.

Finally, note that the operation of the motor speed controller can be adversely affected by electrical interference from motors, etc. All motors in the model must therefore be adequately suppressed. A 100n disc ceramic connected directly across the motor terminals works pretty well in most cases. ETI

TAMTRONIK LTD. (DEPT. ETI)

217 TOLL END ROAD, TIPTON
WEST MIDLANDS DY4 OHW

TEL. 021-557 9144

PRINTED CIRCUIT BOARDS and KITS FOR ETI PROJECTS

Mag. Issue	Project	Kit. Ref.	P.C.B.	Kit.	Kit. contents (see key)
Sep. 77	*Graphic Equaliser	601	2.50	23.75	BFGH
Sep. 77	*Graphic Equaliser P.S.U.	602	.90	2.50	BFG
Oct. 77	*Watchdog	604	1.20	21.95	BEGHL
Oct. 77	*Watchdog P.S.U.	605	1.10	7.45	BEH
Aug. 77	*Sweep Oscillator	606	4.00	41.95	BFGHL
Sep. 77	*Stereo Simulator	607	1.05	6.95	BEGHL
Dec. 77	*Freezer Alarm	608	.85	8.45	BFHL
Nov. 76	*General Purpose Preamp	609	1.00	4.85	BEG
Jul. 77	*GSR Monitor	612	1.10	19.75	BEGHL
Apr. 77	*Burglar Alarm	613	1.10	10.85	BEGH
Feb. 77	*Bench Amplifier	615	1.15	13.20	BEGHL
Nov. 77	*Compander	617	2.55	27.35	BEGHL
Mar. 77	*50 watt High Power Amp	618	2.10	9.75	BE
Mar. 77	*100 watt High Power Amp	619	2.10	12.80	BE
Mar. 77	*High Power Amp P.S.U.	620	1.65	8.70	BEJ
Oct. 77	*Digital Thermometer	621	1.70	21.85	BFGHL
Feb. 77	*LED Dice	624	.90	7.10	BEGHL
	*Active Crossover (2 pcbs)	625	3.30	15.30	BFGHL
	*Marker Generator	626	1.20	8.40	BEGHL
Nov. 77	*Skeet	627	2.55	21.90	BEGHL
	*Flash Trigger	628	1.10	6.25	BEGJ
	*Disco Light Show	629	4.25	25.95	BFGJ
	*Pink Noise Generator	630	1.05	4.30	BEL
Nov. 76	541 Train Controller	T001	1.35	18.85	BEHL
Jan. 77	444 5 watt Stereo (2 pcbs)	T002	3.10	26.95	BEGK
Feb. 77	448 Disco Mixer	T003	2.35	19.40	BEJ
Dec. 77	Clock B.	T004	3.30	16.75	BE
Jan. 78	House Alarm A.	T005	3.20	30.50	BEHM
	House Alarm B.	T006	1.50	5.50	BE
Feb. 78	Metal Locator Mk. II	T007	1.60	22.60	BEHL
March 78	Frequency Shift P.S.U.	T008	1.10	5.95	BE
	Frequency Shifter	T009	2.50	24.95	BEL
	L.C.D. Meter	T010	1.60	27.95	BEG
	Light Dimmer	T011	.90	8.60	BEH
Apr. 78	Gas Monitor	T012	1.40	15.95	BEHL
May 78	Star Trek Radio	T013	1.55	9.80	BFH
	Stars & Dots	T014	3.00	T.B.A.	BEHL
June 78	Spectrum Analyser (2 pcbs)	T015	13.90	76.95	CEHM
	Wein Oscillator	T016	1.45	17.20	BEHL
	Torch Finder	T018	.75	2.40	BE
	Temperature Meter	T019	1.60	27.70	BEG
Aug. 78	Etiwet Plant Waterer	T020	1.30	6.10	BEH
Sept. 78	Cross Hatch Generator	T021	2.10	14.95	BEGHL
	Stac Timer	T022	3.00	27.45	BEJL
	Wheel of Fortune	T023	1.55	9.80	BEHL
Oct. 78	Complex Sound Generator	T024	3.95	25.75	BEH
	R.F. Power Meter	T025	1.60	15.30	BEHL
	Power Bulge	T026	.85	3.65	BEHL
	Telephone Bell Extender	T027	1.25	11.40	BEHL
Oct. 78	Proximity Switch	T028	2.30	15.35	BEGH
Feb. 78	Ultra Sonic Receiver	T029	1.00	10.75	BEH
Feb. 78	Ultra Sonic Transmitter	T030	.90	5.65	BEH
Nov. 78	Cuts Cassette Interface	T031	2.70	14.95	BEH
	Audio Oscillator (2 pcbs)	T032	4.60	39.95	BEHL
Dec. 78	Car Alarm (2 pcbs)	T033	2.50	6.95	BEJ
	Wine Temperature Meter	T034	1.30	—	—
	Curve Tracer	T035	1.20	10.95	BEHL
	Eprom Programmer	T036	2.65	23.35	BEH
	Eprom Programmer P.S.U.	T037	1.70	6.25	BE
Jan. 78	Car Tachometer	T038	2.50	12.20	BF
	Digital Module A & B (2 pcbs)	T039	2.55	21.55	BE
	Digital Dial (Excl. T039)	T040	1.40	8.90	BE
	Log Converter	T041	3.60	26.75	BE
Feb. 79	Tape Slide Synchroniser	T042	2.30	20.95	BEHL
	Tape Noise Limiter	T043	.80	3.70	BEHL
	Light Activated Tachometer	T044	2.65	35.85	BEH
Mar. 79	Headlight Delay	T045	.75	6.75	BEHL
	Logic Trigger	T046	2.70	18.95	BEH
—	Stage Dimmer Control Module	T047	2.95	47.95	TBA
	Stage Dimmer Module 10 amp	T048	6.30	28.30	BEH
	Stage Dimmer Module 20 amp	T049	6.30	27.05	BFJ
	Audio Power Meter	T050	3.45	72.45	BEH
Apl. 79	Click Eliminator	T051	4.55	49.95	BEHL
	Wind speed indicator	T052	3.40	27.40	BEH
	Guitar effect unit	T053	1.20	11.69	BEGHL
May 79	Double Die	T054	1.65	14.95	BEHM
	Headphone amp.	T055	2.75	23.30	BEHL
	Car immobiliser	T056	1.20	7.95	BEH
	Ambush (3 pcb's)	T057	8.65	TBA	—
June 79	Tuner Amp	T058	TBA	TBA	—
	Mains speaker	T059	.90	5.45	BEGHL
	Accentuated beat metronome	T061	2.10	15.95	BEGHL

ADDITIONAL PRINTED CIRCUIT BOARDS

Pcbs are available for all projects from September 1976 (except where copyright restrictions exist).

1976		
Mar	Audio Level Meter	1.60
May	Audio Exp/Compressor	4.70
Sep.	560 ABC VDU (Set 3)	7.55
	710 2m Power Amp	1.50
Oct.	241 Double Dice	2.10
	252 1-2 Hour Timer	1.10
	152AB TV Pattern Gen (Set 2)	3.80
Nov.	543AB STD Timer (Set 2)	3.10
Dec.	544 Heart Rate Monitor	1.65
	447 Audio Phaser	2.15
	446 Audio Limiter	1.85
1977		
Jan.	570 Reaction Tester	2.25
	549 Metal Locator 125	
	Patch Detector	1.55
	Heads or Tails	.80
Feb.	448A Headphone Amp	.85
	449 Balanced Pre-Amp	.95
	449A VU Meter	1.15
	Door Bell	1.50
Mar.	155 ABCD Digital Voltmeter (Set 4)	6.10
	Drill Controller	1.05
	Function Generator	1.25
	Temperature Alarm (Set 2)	1.75
Apr.	Fuzz	.85
	630 Hex Display	1.00
	P.S.U.	.85
	804 TV Game	2.30
May	Metronome (Simple)	0.80
	Inject Tracer	1.00
June	Digital Freq. Meter (Set 4)	5.35
	Bass Enhancer	3.15
Jul	081 Tachometer	.85
	Micro Amplifier	.85
	Alarm Alarm	.80
Aug.	Moisture Indicator	1.20
	Bongas	1.15
	Egg Timer	1.10
Sep.	Loud Hailer	1.10
	Continuity Tester	.90
Oct.	Spirit Level	1.45
	3 Channel Tone Control	1.00
Nov.	Clock A	1.80
	Rev. Monitor	1.65
Elect	CMOS Switched Pre Amp Set 2)	5.10
To-morrow	132 Experimenters P.5	1.30
	555 Timer pcb	0.90
1978		
Jan.	Hammer Throw (Set 3)	7.45
	Race Track	2.00
Feb.	Acc. Beat Metronome	1.05
	Porch Light	1.20
	586 Shutter Timer	2.00
Mar.	RMS Meter	1.60
	Line Follower	1.05
Apr.	Rain Alarm	1.60
May	Electronic Ignition	1.50
	Helping Hand (Set 2)	3.25
1979		
Jan.	Digital Module A	1.55
	Digital Module B	1.00
	Digital Module C	1.05
Feb.	VCT	1.70
	Twonky	2.55

SYSTEM 68

631	3.35
Mainframe PSU	1.45
VDU A	4.50
VDU B	4.30
CPU	3.80
TTY	3.70
Cuts & 4K Ram	3.80

KITS WITH A PROFESSIONAL FINISH

SPECTRUM ANALYSER

June '78 Ref. T015

Includes: 2 x Pcbs with component screened layout. Components, switches. Electret Microphone, etc. Screen printed End Plate, Screen printed Case.

Price includes VAT & P&P £76.95

HOUSE ALARM

Jan. '78 Ref. T005/6

Control Console for complete house protection.

Kit includes Vero '6' range brushed aluminium instrument case with black front panel screen printed.

Price includes VAT & P&P £36

KEY TO KIT CONTENTS

A. Vero-board(s).
B. Printed Circuit Board(s).
C. With Screen printed component layout.
D. Tag strip.
E. All Resistors, potentiometers, capacitors, semi-conductors.
F. As E but with exclusions. Please ask for details.
G. Dil and/or transistor sockets and/or soldercon pins.
H. Hardware includes switches, knobs, lamps and holders, fuses and holders, plugs and sockets, microphones, transformers, speakers, meters, relays, terminal blocks, battery connectors, etc. BUT excludes nuts, bolts, washers, connecting wire, batteries and special miscellaneous items.
J. As H but with exclusions. Please ask for details.
K. As H but including connecting wire.
L. Suitable case(s).
M. Suitable case with screen printed facia.
N. Full kit to magazine specified standards.
P. Kit with professional finish — incorporating all prime features including screen printed pcb and case where appropriate.

SPECIAL OFFERS

Plug-in mains PSU 3v/6v/9v/12v DC 300MA. Suitable for calculators, TV Games, etc. £2.99

100 × ½W 1k resistors 30p

4 × NE 555 £1.00

Pcbs and kits available from TAMTRONIK LTD. for projects from HOBBY ELECTRONICS AND EVERYDAY ELECTRONICS. Send sae for free catalogue. Please quote project and kit reference number when details of a specific kit are required. sae.

Tamtronik Ltd. reserves the right to change kit content without notice to incorporate current modifications or to make valid substitutions for temporarily unavailable components.

The majority of kits advertised can be supplied from stock, however please allow 21 days delivery since demand on any kit is unpredictable.

Kits can be supplied excluding pcb and/or case. Send sae for details naming kit and kit reference and free catalogue.

Trade and Educational enquiries welcome

Minimum order £3 please

Prices include VAT & P&P

Visit our shop at

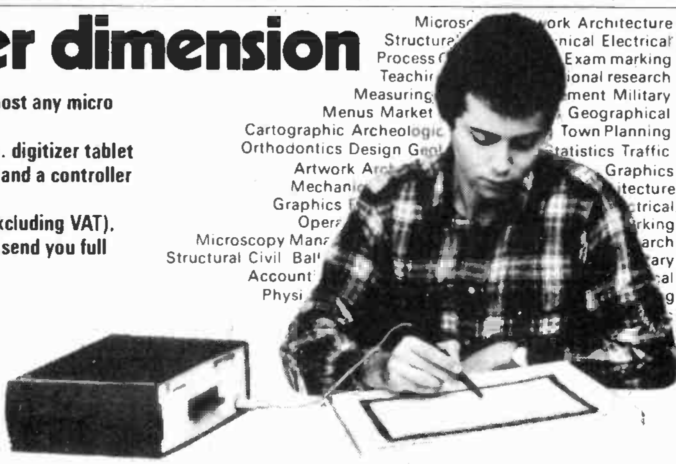
32 Market Place
Great Bridge, Tipton
West Midlands

Telephone or Letter

a digitizer adds another dimension

The Bit Pad computer digitizer converts graphic information into digital form for direct entry into a computer. By touching a pen like stylus or a cursor, to any position on a drawing, diagram, photograph, or other graphic presentation, the position co-ordinates are converted to digital equivalents.

- **Bit Pad interfaces with almost any micro computer.**
- **Bit Pad consists of a 15" sq. digitizer tablet (11" sq. active area), a stylus, and a controller cabinet.**
- **Bit Pad costs only £450 (excluding VAT). Fill in the coupon and we will send you full information and details.**



Terminal Display Systems Ltd., Hillside, Whitebirk Industrial Estate, Blackburn BB1 5SN, Lancs. England

Send to Department CP ET. Terminal Display Systems Ltd., Hillside, Whitebirk Industrial Estate Blackburn BB1 5SN, Lancs. England

Name ....

Address ....

Largest range of quality components in the U.K. — over 8,000 types stocked

Marshall's

Head Office and Mail Order to Dept. ETI
A. Marshall (London) Ltd.
Kingsgate House, Kingsgate Place
London NW6 4TK. Tel: 01-624 0805
Telex 21492

Retail Sales: London: 40 Cricklewood Broadway, NW2 3ET. Tel: 01-452 0161/2. Also 325 Edgware Road, W2. Tel: 01-723 4242. Glasgow: 85 West Regent Street, G2 2QD. Tel: 041-332 4133. And Bristol: 108A Stokes Croft, Bristol. Tel. 0272 426801/2

BRIDGE RECTIFIERS

Type	Rating		Price	Type	Rating		Price	Type	Rating		Price
W005/				S005	2A	50V	.39	PW01	6A	100V	.95
T1005	1A	50V	.28	S01	2A	100V	.44	PW02	6A	200V	.97
W01	1A	100V	.30	S02	2A	200V	.48	PW04	6A	400V	£1.08
W02	1A	200V	.32	S04	2A	400V	.60	PW06	6A	600V	£1.18
W04	1A	400V	.40	S06	2A	600V	.70	PW08	6A	800V	£1.28
W06	1A	600V	.50	S08	2A	800V	.84	PW10	6A	1000V	£1.60
W08	1A	800V	.60	S10	2A	1000V	£1.35	K005	25A	50V	£2.20
VM18	1A	100V	.44	840				K01	25A	100V	£2.37
				C1500	1.5A	100V	.53	K02	25A	200V	£2.75
				840				K04	25A	400V	£3.40
VM28	1A	200V	.48	C3200	3.2A	100V	£1.20	K06	25A	600V	£3.99
VM48	1A	400V	.50	B80							
BY164	1.4A	120V	.75	C1500	1.5A	200V	.82				
BY179	1A	800V	.70	B80							
				C3200	3.2A	200V	£1.25				
				PW005	6A	50V	.90				

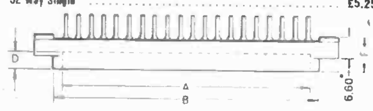
CMOS (for full range see catalogue)

74C00N	.24	74C83N	1.30	74C162N	1.11	74C901N	.54	74C918N	1.15
74C02N	.24	74C85N	1.30	74C163N	1.11	74C902N	.54	74C922N	3.90
74C04N	.24	74C86N	.64	74C164N	1.04	74C903N	.54	74C923N	3.74
74C08N	.24	74C89N	4.39	74C165N	1.04	74C904N	.54	74C925N	5.22
74C10N	.24	74C90N	.85	74C173N	.90	74C905N	7.28	74C926N	5.22
74C14N	.95	74C903N	.85	74C174N	.90	74C906N	.54	74C927N	5.22
74C20N	.24	74C95N	1.04	74C175N	.90	74C907N	.54	74C928N	5.22
74C30N	.24	74C107N	1.22	74C192N	1.11	74C908N	.96	74C932N	1.56
74C32N	.24	74C150N	4.14	74C193N	1.11	74C909N	1.63		
74C42N	.92	74C151N	2.47	74C195N	1.04	74C910N	6.79		
74C48N	1.38	74C154N	3.68	74C200N	6.70	74C911N	7.70		
74C73N	.54	74C157N	2.21	74C221N	1.36	74C112N	7.70		
74C74N	.56	74C160N	1.11	74C373N	1.87	74C914N	1.41		
74C76N	.54	74C161N	1.11	74C374N	1.87	74C915N	1.11		

MULTI-WAY CONNECTORS

2.54mm (.1 inch)

	Price
16 Way Double	£2.03
24 Way Single	£3.90
32 Way Single	£5.25



3.96mm

6 Way Double	£2.03
10 Way Double	£2.66
15 Way Double	£3.08
22 Way Double	£4.60

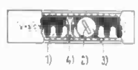
SINGLE IN LINE PLUGS AND SOCKETS

Providing a simple and economical alternative to edge connectors for bringing cable into a pcb.

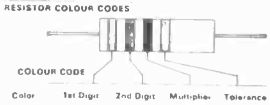
12 WAY 90p   24 WAY £1.20

NEW SIEMENS TURN-SLIDE SWITCHES

This new version of the rotary switch is especially suitable for setting programs. The rotary switch is of a 1 element no stops.
Voltage rating 60V≈
Current rating 0.5A≈
fixed contacts gold-plated
PRICE £2.65



RESISTORS



CARBON FIXED	PRICE
0.25 watt ± 5% Tol Available in E12 range 10Ω to 1 meg	2p each
0.5 watt ± 5% Tol Available in E12 range 10Ω to 10 meg	3p each
1.0 watt ± 10% Tol. Available in E12 range 10Ω to 10 meg	5p each
2.0 watt ± 10% Tol. Available in E12 range 10Ω to 10 meg	9p each
WIRE WOUND	
2.5 watt + 5% Tol. .22 to 330 ohms	10 each
5 watt + 5% Tol. .5 to 12K	12p each
10 watt + 5% Tol. 1 to 25K	14p each
METAL OXIDE	
0.5 watts ± 2% Tol. E24 range 10Ω to 1 meg	4p each

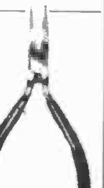
See catalogue for full list of available values.

BRINDLEY TOOLS AND CUTTERS

GENERAL PURPOSE 100mm (4½in)

Diagonal Cutters	£3.40
Round Nose Pliers	£3.25
Flat Nose Pliers	£3.20
Snipe Nose Pliers	£3.20
End/Top Cutters	£3.60

Also in stock — BAHCO quality tool range. See catalogue for full details.

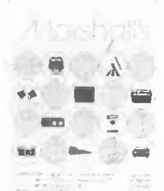


TTLs

SN74H05N	.60	74LS49N	1.09	74LS166N	1.65	74LS326N	2.70
SN74H10N	.55	74LS51N	.26	74LS168N	1.45	74LS327N	2.55
SN74H11N	.55	74LS54N	.26	74LS169N	1.45	74LS348N	1.10
SN74H20N	.55	74LS55N	.26	74LS170N	1.90	74LS352N	1.07
SN74H21N	.55	74LS63N	1.26	74LS173N	1.10	74LS353N	1.07
SN74H30N	.55	74LS73N	.42	74LS174N	.75	74LS365N	.55
SN75H40N	.55	74LS74N	.42	74LS175N	.75	74LS366N	.55
SN74H51N	.55	74LS75N	.58	74LS181N	2.75	74LS367N	.55
SN74H53N	.55	74LS76N	.42	74LS183N	2.70	74LS368N	.55
SN74H54N	.55	74LS78N	.42	74LS189N	3.74	74LS373N	.85
SN74H55N	.55	74LS83AN	.90	74LS190N	1.00	74LS374N	.85
SN74H60N	.55	74LS85N	.95	74LS191N	1.00	74LS375N	.66
SN74H62N	.55	74LS86N	.44	74LS192N	.95	74LS377N	1.30
SN74L00N	.55	74LS90N	.64	74LS193N	.95	74LS378N	1.00
SN74L02N	.55	74LS91N	1.20	74LS194N	.70	74LS379N	1.25
SN74L04N	.60	74LS92N	.70	74LS195N	.70	74LS386N	.44
SN74L47N	3.10	74LS93N	.64	74LS196N	.80	74LS390N	.90
SN74L74N	.90	74LS95AN	.90	74LS197N	.80	74LS393N	.90
SN74L85N	2.62	74LS96N	1.35	74LS221N	.80	74LS395N	1.50
SN74L93N	2.30	74LS107N	.42	74LS240N	1.50	74LS398N	1.90
74LS03N	.26	74LS109N	.42	74LS241N	1.50	74LS399N	1.45
74LS11N	.26	74LS112N	.42	74LS242N	1.25	74LS490N	.90
74LS02N	.26	74LS113N	.42	74LS243N	1.25	74LS670N	1.90
4LS03N	.26	74LS114N	.42	74LS244N	1.50	SN74S00N	.77
74LS04N	.29	74LS122N	.62	74LS245N	1.65	SN74S03N	.77
74LS05N	.29	74LS123N	.83	74LS247N	1.09	SN74S04N	.94
74LS08N	.26	74LS124N	1.70	74LS248N	1.09	SN74S10N	.77
74LS09N	.26	74LS125N	.50	74LS249N	1.09	SN74S20N	.77
74LS10N	.26	74LS126N	.50	74LS251N	1.00	SN74S40N	.77
74LS11N	.26	74LS132N	.85	74LS253N	1.00	SN74S64N	.77
74LS12N	.26	74LS136N	.42	74LS257N	1.00	SN74S65N	.77
74LS13N	.58	74LS138N	.65	74LS258N	1.00	SN74S112N	1.70
74LS14N	.75	74LS139N	.65	74LS259N	1.55	SN74S114N	1.70
74LS15N	.26	74LS145N	1.30	74LS261N	3.25	SN74S140N	.77
74LS20N	.26	74LS147N	1.65	74LS266N	.44	SN74S157N	2.95
74LS21N	.26	74LS148N	1.35	74LS273N	1.30	SN74S188N	2.70
74LS22N	.26	74LS151N	.58	74LS275N	3.20	SN74S189N	1.81
74LS26N	.32	74LS153N	.58	74LS279N	.58	SN74S200N	3.50
74LS27N	.26	74LS154N	1.45	74LS280N	1.65	SN74S201N	3.71
74LS28N	.29	74LS155N	.80	74LS283N	1.20	SN74S262N	12.50
74LS30N	.26	74LS156N	.80	74LS289N	3.74	SN74S287N	2.95
74LS32N	.27	74LS157N	.60	74LS290N	1.00	SN74S288N	2.70
74LS33N	.29	74LS158N	.65	74LS293N	1.00	SN74S289N	1.81
74LS37N	.32	74LS160N	.80	74LS295N	1.35	SN74S300N	5.06
74LS38N	.32	74LS161N	.85	74LS298N	1.35	SN74S301N	3.71
74LS40N	.26	74LS162N	.80	74LS299N	2.95	SN74S387N	3.05
74LS42N	.80	74LS163N	.85	74LS323N	3.50	SN74S470N	5.06
74LS47N	1.09	74LS164N	1.10	74LS324N	1.65	SN74S471N	5.06
74LS48N	1.00	74LS165N	1.15	74LS325N	2.40	SN74S472N	13.48

NEW 1979 CATALOGUE

48 page catalogue — new enlarged micro section — largest range of quality components from franchised suppliers available in UK. All VAT inclusive prices. Over 8,000 line items plus lots more. 50p post paid or 40p to callers at any of our four branches.



★ MAIL ORDER ★

Please add 40p for p/p to all orders. Telephone orders on credit cards £10.00 minimum.

LINEAR (for full range see catalogue)

LM339N	.60	LM1310N	2.10	MC861P	.85
LM340T-5	.88	LM1351N	1.30	MC1035P	1.90
LM340T-12	.88	LM1458N	.45	CA3000	3.30
LM340T-15	.88	LM1496N	.97	CA3001	4.25
LM340T-24	.88	LM1800N	1.94	CA3002	3.30
LM341P-5	.56	LM1801N	2.25	CA3006	4.60
LM341P-12	.56	LM1808N	2.10	CA3007	4.15
LM341P-15	.56	LM1812N	6.20	CA3008	2.55
LM341P-24	.56	LM1820N	1.16	CA3012	1.65
LM345K	6.97	LM1828N	1.90	CA3013	1.85
LM348N	.95	LM1830N	1.90	CA3014	2.20
LM350K	6.50	LM1845N	1.50	CA3018	.75
LM358N	.60	LM1848N	1.98	CA3018A	1.10
LM360N	3.00	LM1850N	1.90	CA3020	2.20
LM370N	3.30	LM1889N	2.50	CA3020A	2.50
LM371H	2.35	LM1890N	P.O.A.	CA3021	2.40
LM373N	3.35	LM2907N-8	1.80	CA3022	2.20
LM374N	3.35	LM2917N-8	1.80	CA3023	2.20
LM377N	1.80	LM3301N	.60	CA3026	.70
LM378N	2.40	LM3302N	.55	CA3028A	.90
LM379S	4.25	LM3401N	.55	CA3028B	1.25
LM380N-8	.96	LM3900N	.68	CA3029	.75
LM380N-14	1.08	LM3905N	1.15	CA3029A	.90
LM381AN	2.70	LM3909N	.78	CA3030	1.50
LM381N	1.69	LM3911N	1.10	CA3030A	2.20
LM382N	1.32	LM3913N	P.O.A.	CA3033	3.70
LM384N	1.55	LM3914N	2.79	CA3034	2.75
LM386N	.88	LM4250CN	1.30	CA3035	1.95
LM387N	1.10	LM78L05CH	.85	CA3036	1.21
LM388N	1.00	LM78L12CH	.85	CA3038	2.90
LM389N	1.00	LM78L15CH	.85	CA3038A	4.10
LM392N	.87	LM78L24CH	.85	CA3039	.77
LM701B	2.99	LM7805KC	1.56	CA3040	3.75
LM701C	2.99	LM7812KC	1.56	CA3041	1.65
LM702C	.81	LM7815KC	1.56	CA3042	1.65
LM703LN	1.15	LM7824KC	1.56	CA3043	2.20
LM709CH	.70	LM78L05CZ	.30	CA3045	1.55
LM709-8	.50	LM78L12CZ	.30	CA3046	.77
LM709-14	.49	LM78L15CZ	.30	CA3047	2.20
LM710CH	.67	LM78L24CZ	.30	CA3047A	3.70
LM710-14	.48	MC667P	2.75	CA3048	2.45
LM711CN	.48	MC671P	1.75	CA3049	1.98
LM716	1.00	MC672P	1.75	CA3050	2.66
LM723CN	.62	MC724P	2.10	CA3051	1.83
LM723C-14	.45	MC789P	1.80	CA3052	1.78
LM741CH	.50	MC790P	3.10	CA3053	.77
LM741C-8	.30	MC798P	2.20	CA3054	1.10
LM741C-14	.60	MC799P	2.20	CA3059	2.10
LM747CN	.78	MC832P	.70	CA3060	2.50
LM748-8	.50	MC833P	.70	CA3062	3.75
LM748-14	.50	MC836P	.82	CA3064	1.10
LM900	.50	MC837P	.82	CA3065	1.10
LM911	.50	MC838P	2.35	CA3068	3.80
LM921	.50	MC840P	1.65	CA3070	1.90
LM923	.50	MC844P	.70	CA3071	1.90
LM1303N	1.15	MC846P	.70	CA3072	1.90
LM1304N	1.52	MC848P	1.10	CA3075	1.70
LM1305N	1.52	MC849P	.70	CA3076	2.12
LM1307N	1.22	MC857P	.85	CA3080	.85

NEW TELETEXT CHIPS

from Mullard — available now from Marshall's. Sole UK distributor to the hobbyist market.

SAA Series, for the reception, display and control of television based text display systems. Suitable for 'CEE-FAX' and 'ORACLE' Remote Control.

SAA5000 Infrared/ultrasonic	£3.48
SAA5010 Station selector DICS	£8.13
SAA5012 Binary Input Tuners	p.o.a.

TELETEXT (Dedicated I.C.'s)

SAA5020 TIC (Timing Chain)	£8.71
SAA5030 VIP (Video-Input Processor)	£11.61
SAA5040 TAC (Teletext Data Acquisition and Control)	£31.82
SAA5050 TROM (Teletext Read-Only Memory)	£18.86

TIC, TAC & TROM and NMOS — VIP is linear bipolar.
We recommend using DIL SOCKETS with these chips.

TRANSISTORS (for full range see catalogue)

2N335	N70	3.00
2N388	N70	.80
2N388A	N70	.77
2N398	P70	.80
2N456	P66	2.20
2N489	U71	4.90
2N489A	U71	5.40
2N489B	U71	5.90
2N490	U71	4.99
2N490B	U71	6.50
3N490C	U71	6.90
2N490C	U71	6.90
2N491A	U71	5.75
2N491B	U71	6.25
2N491	U71	7.50
2N492	U71	6.25
2N492A	U71	6.75
2N492B	U71	7.75
2N492C	U71	10.00
2N493A	U71	7.99
2N493B	U71	8.75
2N494	U71	6.90
2N494A	U71	7.65
2N494B	U71	8.40
2N494C	U71	9.35
2N549	N70	3.25
2N696	N70	.39
2N697	N70	.31
2N698	N70	.49
2N699	N70	.58
2N706	N70	.30
2N706A	N70	.30

2N708	N70	.30
2N718	N70	.30
2N718A	N70	.54
2N720A	N70	.85
2N721	P70	1.05
2N722	P70	.45
2N727	P70	.50
2N744	N70	.35
2N753	N70	.35
2N760	N70	.35
2N869	P70	.35
2N914	N70	.38
2N916	N70	.33
2N917	N65	.38
2N918	N65	.45
2N929	N70	.37
2N929A	N70	.37
2N930	N70	.37
2N930A	N70	.95
2N1131	P70	.32
2N1132	P70	.35
2N1204	P70	1.65
2N1302	N70	.80
2N1303	P70	.80
2N1304	N70	.80
2N1305	P70	.80
2N1306	N70	1.00
2N1307	P70	1.00
2N1308	N70	1.10
2N1309	P70	1.10
2N1370	P70	.55
2N1420	N70	.55
2N1483	N70	

2N1485	N70	2.20
2N1507	N70	.35
2N1524	P54	.60
2N1553	P66	1.50
2N1613	N70	.30
2N1637	P70	.72
2N1638	P54	.70
2N1711	N70	.30
2N1889	N70	.30
2N1890	N70	.30
2N1893	N70	.30
2N1907	P66	5.95
2N1974	N70	.98
2N1990	N70	.45
2N1991	P70	1.10
2N2060	N73	7.00
2N2102	N70	.50
2N2147	P66	1.55
2N2160	O71	1.55
2N2192	N70	.58
2N2193	N70	.50
2N2193A	N70	.52
2N2194	N70	.42
2N2194A	N70	.45
2N2195	N70	.49
2N2195A	N70	.49
2N2217	N70	.55
2N2218	N70	.35
2N2218A	N70	.38
2N2219	N70	.38
2N2219A	N70	.39
2N2220	N70	.39
2N2221	N70	.25

2N2221A	N70	.25
2N2222	N70	.25
2N2222A	N70	.25
2N2223	N73	6.78
2N2223A	N73	6.99
2N2270	N70	.49
2N2303	P70	1.54
2N2368	N70	.27
2N2369	N70	.27
2N2369A	N70	.27
2N2405	N70	.66
3N81	SCS90	3.50
3N83	SCS90	2.25
3N128	NF82	1.35
3N139	NF82	1.60
3N140	NF92	1.10
3N141	NF92	.95
3N142	NF82	.70
3N143	NF82	.88
3N152	NF82	1.10
3N153	NF82	1.89
3N154	NF82	.99
3N159	NF92	1.35
3N187	NF92	1.80
3N200	NF92	2.85
3N201	NF92	1.35
40050	P66	1.70
40081	N70	1.20
40232	N70	.60
40233	N70	.70
40235	N65	.65
40237	N65	.45
40242	N65	.66

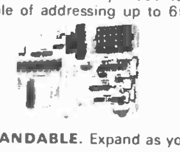
40251	N66	1.15
40254	P66	.66
40264	N70	.95
40280	N70	3.70
40309	N70	.60
40310	N66	.85
40311	N70	.55
40312	N66	.99
40313	N66	1.38
40315	N70	.60
40316	N66	.95
40317	N70	.60
40324	N66	.95
40325	N66	1.35
AC126	P54	.48
AC127	N54	.48
AC128	P54	.48
AC151	P54	.43
AC152	P54	.54
AC153	P54	.59
AC153K	P54	.59
AC176K	N54	.70
AC176	N54	.54
AC187	N54	.59
AC187K	P54	.65
AC188	P54	.54
AC188K	P54	.65
AD136	P59	2.75
AD142	P66	1.45
AD143	P66	1.45
AD149	P66	2.85
AD150	P66	3.10
AD161	N56	1.00

AD162	P66	1.00
AF106	P65	.60
AF109	P65	.82
AF114	P64	.70
AF115	P64	.70
AF116	P64	.70
AF117	P64	.70
AF118	P64	.70
AF124	P20	.70
AF125	P20	.70
AF126	P20	.70
AF139	P65	.75
AF172	P98	.70
AF178	P64	1.30
AF186	P65	.55
AF200	P65	1.30
AF201	P20	1.30
BC107/A/B	N70	.16
BC108/A/B/C	N70	.16
BC109/B/C	N70	.16
BC113	N54	.22
BC114	N54	.22
BC115	N66	.22
BC116	P59	.21
BC116A	P59	.22
BC117	N59	.22
BC118	N54	.22
BC119	N70	.33
BC122	N100	.61
BC123	N100	.65
BC125	N70	.22
BC132	N54	.33
BC134	N54	.22

BC135	N54	.22
BC136	N54	.21
BC137	P70	.22
BC138	N70	.44
BC140	N70	.30
BC141	N70	.32
BC142	N70	.32
BC143	P70	.32
BC147/A/B/C	N61	.13
BC148/A/B/C	N61	.13
BC149/B/C	N61	.15
BC152	N50	.38
BC153	N54	.30
BC154	N54	.30
BC157/A/B	P61	.15
BC158/A/B	P61	.15
BC159/A/B/C	P61	.17
BC160	P67	.38
BC161	P67	.38
BC167A/B	N50	.13
BC168/A/B/C	N50	.13
BC169/B/C	N50	.13
BC170/B/C	N51	.19
BC171/A/B	N51	.17
BC172/A/B/C	N51	.15
BC173/B/C	N51	.17
BC174/A/B	N51	.26
BC175	N50	.43
BC177/A/B	P70	.22
BC178/A/B	P70	.22
BC179/A/B	P70	.22
BC182/A/B	N51	.12
BCL182L/A/B	N50	.12

NEW LOW PRICE "KIM" — THE READY TO USE MICROPROCESSOR SYSTEM

Not a kit but supplied fully tested, wired and guaranteed. Expandable Memory that grows with your system not just an evaluation kit. Starting with **KIM 1 at £107.95** VAT inclusive you get immediate capability which can be expanded to a complete system capable of addressing up to 65K BYTES of Memory.



KIM IS EXPANDABLE. Expand as you learn up to 65K.

KIM 1 — Basic board with above features assembled **£107.95**

KIM 3 — 8K static RAM card plugs into motherboard **£140.35**

KIM 4 — Motherboard (takes 8 x KIM 3) plus power supply **£75.55**

40 CMOS CLOCKS

There are many ways of using the CD4001 and CD4011 CMOS ICs to make bistable, astable and monostable multivibrator circuits. Ray Marston presents the definitive work on the subject, with 40 practical circuits.

THE AMATEUR AND PROFESSIONAL circuit designer often finds himself in the situation where he needs to use a minimum-cost CD4001 or CD4011 CMOS pulse or clock generator circuit, or where he needs to use a few spare CMOS NAND or NOR gates from an existing circuit to make up a multivibrator that will meet his specific design needs. In either case, the designer will find a concise guide to practical NAND- and NOR-gate CMOS multivibrator circuits of inestimable value.

This article is just such a guide. It presents some forty different ways of using the low-cost CD4001 and CD4011 quad 2-input gate CMOS integrated circuits in bistable, astable and monostable multivibrator applications. All of the circuits shown can be operated over the full five volts to fifteen volts supply range when used with 'B' series CMOS.

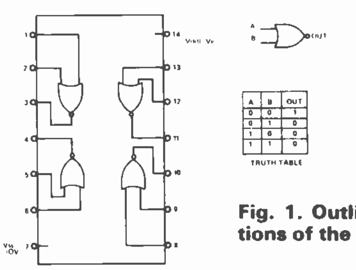


Fig. 1. Outline and pin connections of the CD4001.

THE CD4001 and CD4011 ICs

Figures 1 and 2 show the outlines and pin connections of the CD4001 and CD4011 integrated circuits. These two ICs are quad 2-input gates. The CD4001 provides NOR gate functions and the CD4011 provides NAND gate functions. Fig. 1 shows the truth table of each of the four NOR gates of the CD4001. Note that the output is high if both inputs are low, but goes low if either or both inputs go high. Fig. 2 shows the truth table of each of the four NAND gates of the CD4011. The output is normally high and goes low only if both inputs are high.

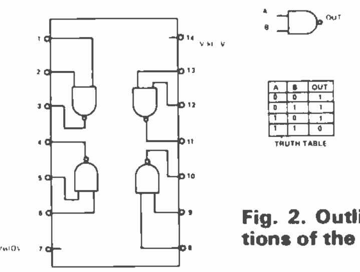


Fig. 2. Outline and pin connections of the CD4011.

The CD4001 and CD4011 are very inexpensive ICs. They typically retail at about 16 pence each in one-off quantities (allowing for some variation between suppliers), which works out at about 4 pence per gate. They can be used in a wide variety of very useful two-gate multivibrator applications and are thus highly cost-effective devices.

Bistable Multivibrator Circuits

The CD4001 and CD4011 can both be used in two-gate R-S (Reset-Set) bistable multivibrator circuits, but have quite different input triggering requirements. Fig. 3 shows the practical circuit and waveforms of a pulse-triggered NOR version of the bistable. The circuit has two outputs, a normal output from IC1a and an inverted output from IC1b. When a positive-going trigger pulse which switches between roughly zero and full supply is applied to the IC1b input, the normal output sets high and locks in this state irrespective of any further signals at the input of IC1b. The output can only be reset low again by applying a positive-going pulse to the input of IC1a, at which point the output goes low and is then immune to any subsequent trigger pulses at the input of IC1a.

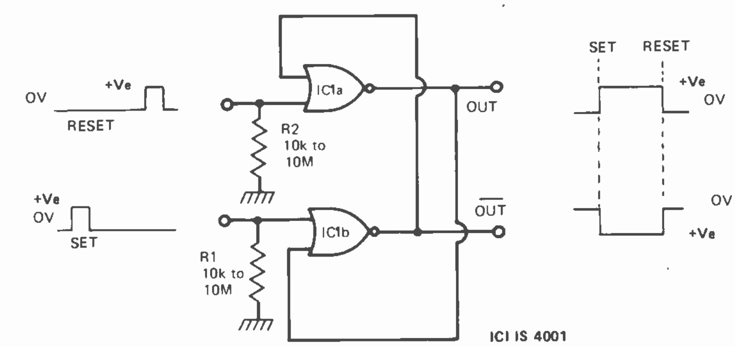


Fig. 3. Practical circuit of a pulse-triggered NOR bistable.

Note that the input terminals of IC1a and IC1b are tied to ground (the zero-volts line) via R1 and R2: these resistors can have any convenient values in the range 10k to 10M. If inputs to IC1a and IC1b are direct-coupled from preceding logic networks, however, R1 and R2 can be omitted from the circuit.

Manual NOR Gate

Fig. 4 shows a manually-triggered version of the Fig. 3 NOR gate circuit. This type of circuit is often referred to as a 'noiseless' switch, since its output is unaffected by the contact bounce, etc., of its two control switches. ▶

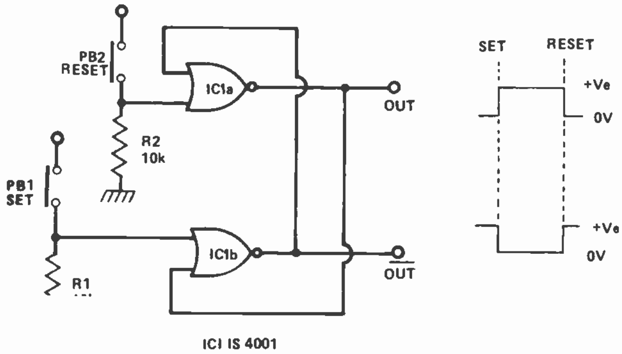


Fig. 4. Manually triggered NOR bistable.

NAND Bistable

Fig. 5 shows the CD411 NAND gate version of the bistable circuit. This circuit is almost identical with that of Fig. 3, except for the positioning of R1 and R2. Note, however, that the NOR gate circuit needs positive-going trigger pulses, while the NAND circuit needs negative-going pulses, and that the set pulse is applied to IC1b in the NOR circuit, but to IC1a in the NAND circuit.

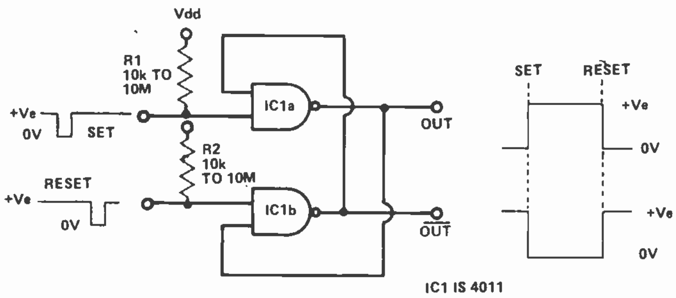


Fig. 5. A CD4011 NAND bistable, pulse triggered.

Manual NAND Bistable

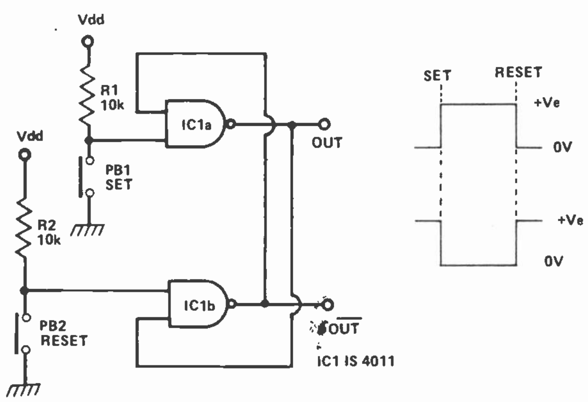


Fig. 6. Manually triggered NAND bistable.

Fig. 6 shows the manually-triggered version of the NAND-type bistable. Note here that although R1 and R2 are shown as having values of 10k, they can in fact have any resistance values from a few thousand ohms up to about 10M, depending on the precise details of the specific application. This versatility leads to the development of the touch-triggered NAND bistable circuit of Fig. 7, in which R1 and R2 have values of 10M, and the circuit can be triggered by placing any resistance that is significantly less than 10M (such as finger resistance) across the touch contacts. R3 and R4 are used in this circuit to protect the inputs of the two gates.

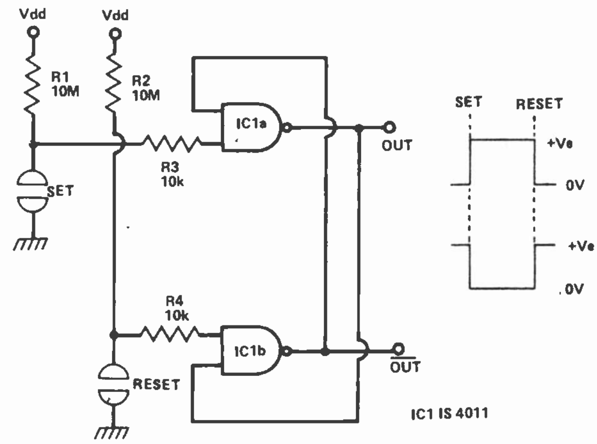
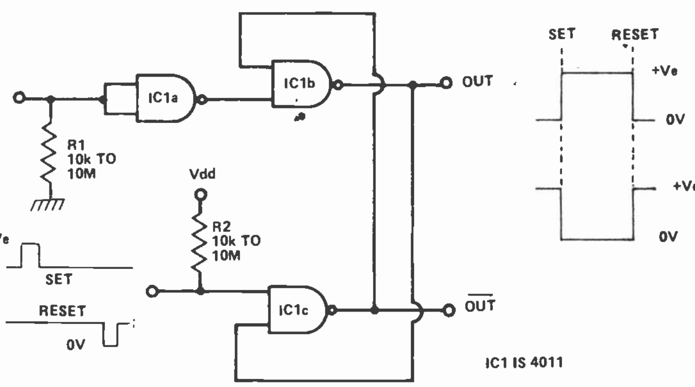


Fig. 7. Touch-triggered NAND bistable.

The bistable circuits that we have looked at so far all use same-polarity (either both positive or both negative) trigger signals. In some applications, however, it is necessary or convenient to use opposite-polarity signals to trigger the bistable, and this type of action can be obtained by placing an inverter stage in series with one or other of the normal bistable input terminals. Figs. 8 and 9 show two alternative circuits of this type.



Using opposite-polarity signals to trigger a 4011 bistable, Fig. 8 (above), and a 4001 bistable, Fig. 9 (below).

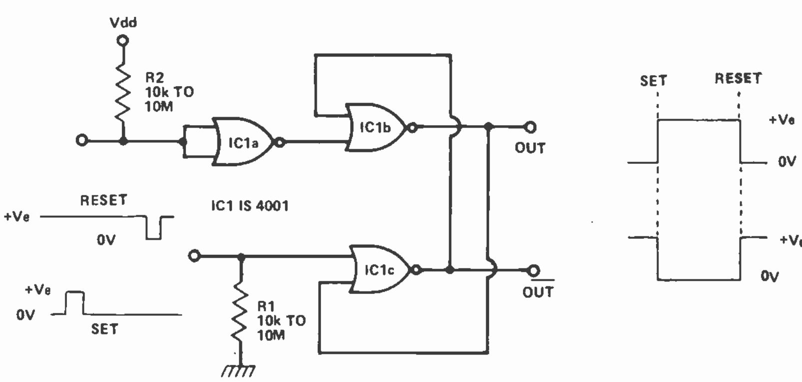


Fig. 10 shows alternative ways of connecting a 2-input NAND or NOR gate so that it acts as a simple pulse inverter stage. These circuits are useful in a multitude of applications.

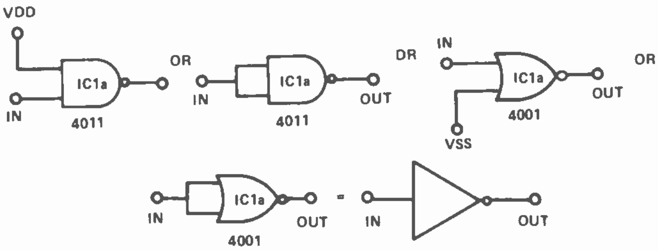


Fig. 10. Using a 2-input NAND or NOR gate as an inverter.

Basic 2-Gate Astable Circuits

The CD4001 and CD4011 can both be used in a variety of basic 2-gate astable multivibrator circuits. In these circuits the gates are connected as simple inverters, so the two types of IC give identical performances.

CMOS Astable

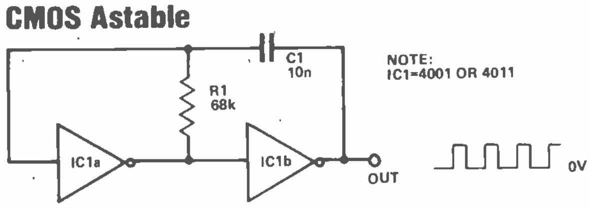


Fig. 11. Circuit of the basic 2-gate CMOS astable.

The most basic and useful 2-gate CMOS astable circuit is shown in Fig. 11. This circuit generates a decent square wave output, has excellent thermal stability and operates at about 1 kHz with the comfort values shown. The frequency is inversely proportional to the C-R time constant, so the frequency can be raised by lowering the values of either C1 or R1. In practice, C1 must be a non-polarized capacitor, and can have any value from a few tens of picofarads to a few microfarads. R1 can have any value from about 4k7 to 10M. For variable frequency operation, wire a fixed and a variable resistor in series in the R1 position.

The output of the Fig. 11 astable circuit switches (when lightly loaded) almost fully between the zero and positive supply voltage levels, but the junction of R1 and C1 is prevented from swinging below zero or above the positive rail levels by the built-in clamping diodes at the input of IC1a. This characteristic causes the operating frequency of the circuit to be somewhat dependent on supply rail voltages. As a rough rule of thumb, the frequency falls by about 0.08% for each 1% rise in supply voltage. Typically, if the frequency of this astable is normalised with a 10 volt supply, the frequency will fall by 4% at 15 volts, or rise by 8% at 5 volts.

Also, the operating frequency of the Fig. 11 circuit depends somewhat on the transfer voltage value of the individual gate that is used and can be expected to vary by as much as 10% between individual ICs. The output symmetry of the waveform is also dependent on the transfer voltage value of the IC and, in most cases, the circuit will give a non-symmetrical output. In the vast majority of 'hobby' and other non-precision applications, these deficiencies of the basic astable circuit are of little practical consequence.

Some can be minimised by using the 'compensated' astable circuit of Fig. 12, in which resistor R2 is wired in series with the input of IC1a. This resistor can have any value between two and ten times that of R1, and its main purpose is to allow the R1-C1 junction to swing freely below the zero and above the positive supply rail voltages during the switching action and thus reduce the dependance of the circuit operating frequency on the supply voltage. Typically, when R2 is given a value ten times greater than R1, the frequency varies by only about 0.5% when the supply voltage is varied between 5 and 15 volts.

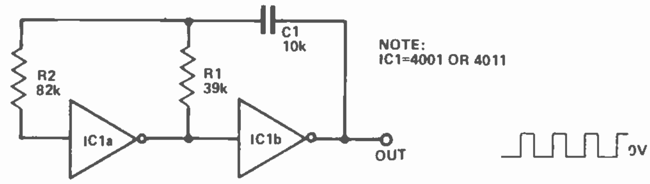


Fig. 12. A compensated astable circuit.

The basic and compensated astable circuits of figs. 11 and 12 can be built with a good number of detail variations. Some of these are shown in Figs. 13 to 18. In the basic astable circuit, for example, C1 alternately charges and discharges via R1. Figs. 13 to 15 show how the basic circuit can be modified to give alternate C1 charge and discharge paths.

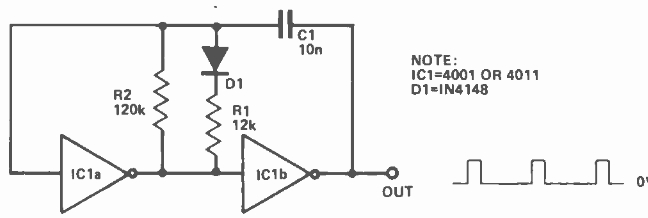


Fig. 13. Modifying the circuit to give C1 alternate charge and discharge paths and produce a non-symmetrical output waveform.

Fig. 13 shows one way of modifying the stable so that it gives a non-symmetrical output waveform. Here, C1 charges in one direction via R1 and R2 in parallel, to give a high output, but discharges in the reverse direction via R2 only, to give a low output.

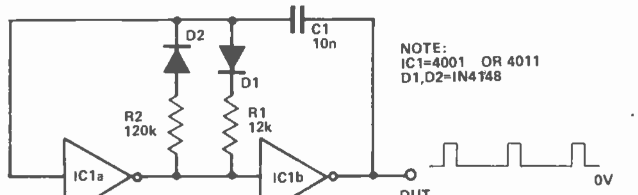


Fig. 14. Controlling the astable's on and off time.

On/Off Control

Fig. 14 shows how the circuit can be further modified by also wiring a diode in series with R2, so that the ON time of the output is controlled only by R1, and the OFF time is controlled only by R2. These two circuits can be made to give variable outputs by replacing either or both of their timing resistors with a fixed and a variable resistor in series. ▶

Variable Symmetry

Fig. 15 shows how the astable can be modified to give a variable symmetry or M/S-ratio output, while maintaining a near-constant frequency. C1 in this circuit charges on one direction via D1-R2 and one half of RV1, and in the other direction via D2-R1 and the other half of RV1. The M/S-ratio can be varied over the range 1:10 to 10:1 via RV1.

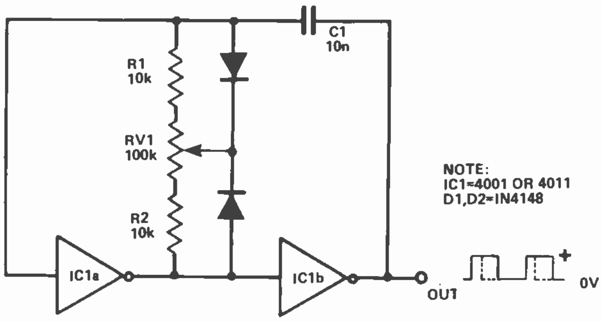


Fig. 15. Controlling the mark/space ratio.

Fig. 16 shows the circuit of a multi-tone push-button activated astable. Normally, when all push-button switches are open, R5 holds the input of IC1a (and thus the output of IC1b) low. Resistors R1 to R4 all have values that are low relative to R5, so the circuit acts as a normal astable when any one of the push-button switches is closed. This circuit can be used in multi-tone musical instruments and gadgets, etc. and has the major advantage that it draws negligible current when in the standby mode. There is no limit to the number of push-button switches that can be used with the circuit.

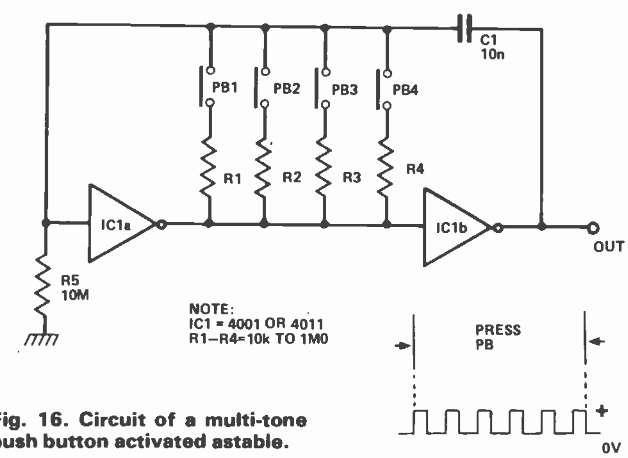


Fig. 16. Circuit of a multi-tone push button activated astable.

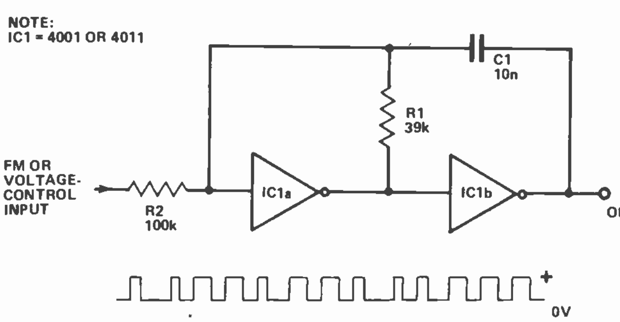


Fig. 17. Frequency modulation of an astable.

Frequency Modulation

Fig. 17 shows how the astable can be subjected to frequency modulation or voltage control of frequency by simply feeding the FM or voltage-control signal to the input of IC1a via a resistance that is much larger than R1 and Fig. 18 shows how the circuit can be further modified to act as a special-effect voltage-controlled oscillator that shuts off when the input voltage falls below a pre-set value.

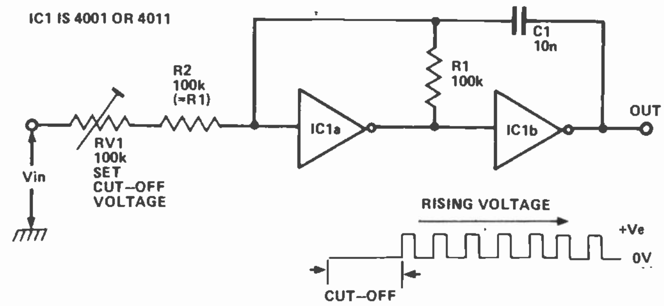


Fig. 18. Using an astable as a voltage-controlled oscillator with an output cut-off.

Gated 2-Gate Astable Circuits

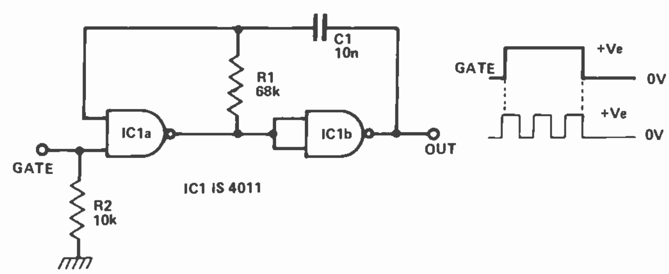


Fig. 19. A NAND astable with a normally-low output, gated by a high input signal.

All of the astable circuits of Figs. 11 to 15 can be modified for gated operation, so that they can be turned on and off via an external signal, by simply using a 2-input NAND or NOR gate in place of the inverter in the IC1a position and applying the input control signal to one of the gate input terminals. The CD4001 and CD4011 ICs can both be used in this type of application, but give quite different types of gate control and output operation. Figs. 19 and 20 show the two basic versions of the gated astable circuit.

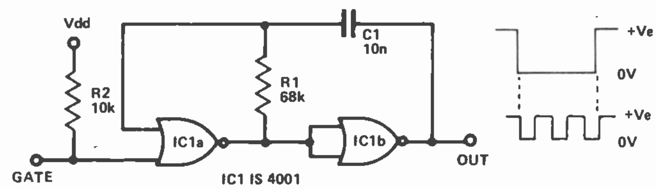


Fig. 20. A NOR astable with a normally-high output, gated by a low input signal.

Note that the Fig. 19 NAND astable circuit has a normally-low output and is gated by a high input signal, while the fig. 20 NOR astable has a normally-high output and is gated by a low input signal. Also note that, although R2 is shown in the diagram as having a value of 10k, R2 can in fact have any value in the range 10k to 10M and can be omitted altogether if the gate signal is applied from a preceeding logic state.

Note in the Fig. 19 and 20 circuits that the output signal terminates immediately the input gate signal is removed. Consequently, any noise present at the gate terminals of these circuits also appears at their outputs.

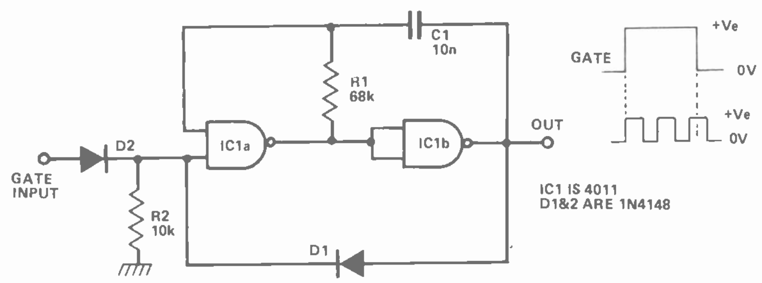
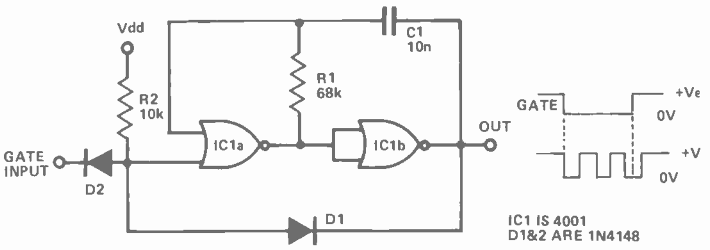
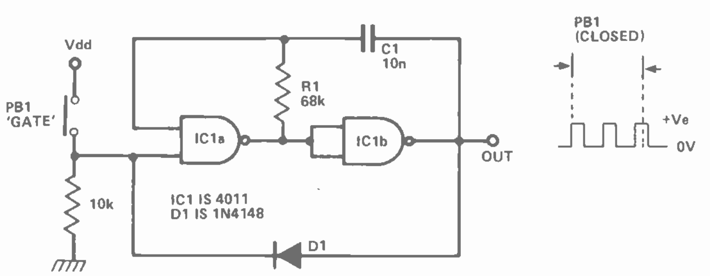


Fig. 21 (above) and Fig. 22 (below) overcome the problem of noise appearing at the gate terminals.



Figs. 21 and 22 show how the circuits can be modified to overcome this defect. Here, the gate signal of IC1a is derived from both the outside world and from the output of IC1b via diode OR gate D1-D2-R2. As soon as the circuit is gated from the outside world via D2 the output of IC1b reinforces the gating via D1 for the duration of one half astable cycle, thus eliminating any effects of a noisy outside world signal. The outputs of the circuits are complete numbers of half cycles. Note that R2 is an essential part of these circuits.



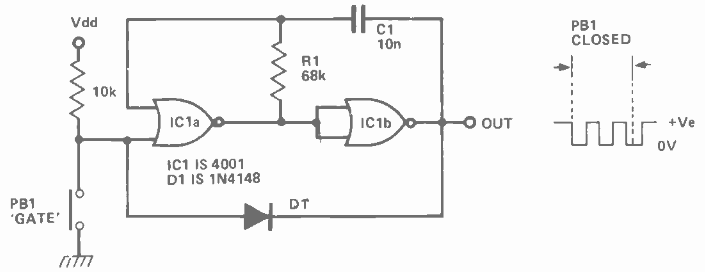


Fig. 23 (top) and Fig. 24 (above) show manually-triggered astables with noise-elimination networks.

Figs. 23 and 24 show manually-triggered versions of the Fig. 21 and 22 circuits. These circuits are of particular value when they are used as low speed clock generators, operating at about 5 Hz: when PB1 is briefly stabbed, the generate a single clean clock pulse: when PB1 is held down, they generate five clean clock pulses per second.

Clock Generator Circuits

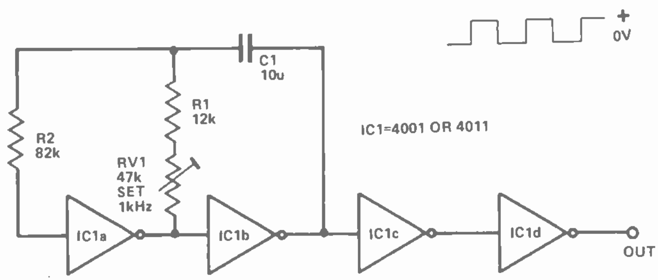


Fig. 25. Speeding up the rise and fall times of the astable output to produce clean clock signals.

The 2-gate astable circuit is generally not suitable for direct use as a clock generator with fast-acting counting and dividing circuits. Such circuits require the use of clean clock signals, with fast rise and/or fall times. The problem is that 2-gate astables designed around 'A' series or non-buffered CMOS produce clock outputs with rather slow rise and fall times, whereas 2-gate astables designed around buffered-output 'B' series CMOS produce outputs with good rise and fall times, but tend to produce 'dirty' clocking if there is the slightest trace of noice on their power supply lines.

Fortunately, these problems can easily be overcome by wiring a couple of inverter-connected gate stages in series with the output of the astable circuit, as shown in the example of Fig. 25. These inverter stages speed up the rise and fall times of the astable output waveform and also produce effective level shifting between the output of the astable and the clock input terminal of any external device, thereby reducing or eliminating the effects of noise on the clock circuit.

The Ring-of-Three Astable Circuit

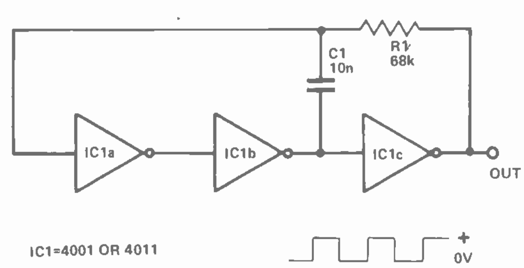


Fig. 26. The 'ring of three' astable circuit produced a very clean output waveform.

An alternative way of making a clock generator is to use the 'ring-of-three' astable circuit of Fig. 26. This circuit is similar to the basic circuit of Fig. 11, except that the positions of R1 and C1 are transposed, and the inverting input stage (IC1a) of the Fig. 11 circuit is effectively replaced by an ultra-high-gain non-inverting stage (comprising IC1a and IC1b in series) in the Fig. 26▶

circuit. Because of the very high gain of its composite input stage, the Fig. 26 'ring-of-three' circuit produces a very clean output waveform, with excellent rise and fall times, and is directly suitable for use as a clock generator.

The 'ring-of-three' astable circuit can be subjected to all of the basic design variations shown for the 2-gate astable. For example, C1 alternatively charges and discharges via R1 in the same way as in the Fig. 11 circuit, so the circuit can be subjected to all of the variations shown in Figs. 13 to 15. It can be designed in either basic or 'compensated' versions, etc.

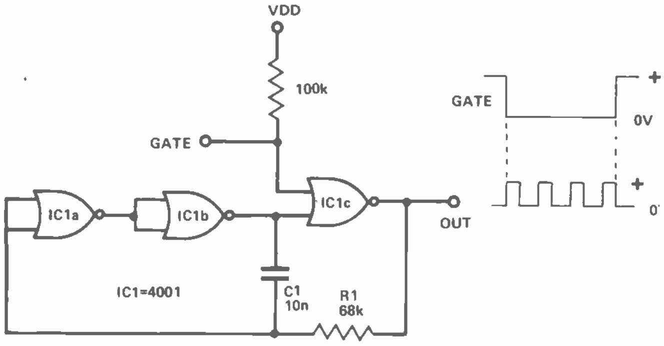


Fig. 27. A gated NOR 'ring of three' circuit with a normally low output, gated by a low input.

The 'ring-of-three' circuit offers interesting possibilities when it is used in the gated mode, because it can be gated on and off via either its IC1b or IC1c stages. Figures 27 to 30 show four variations on this theme.

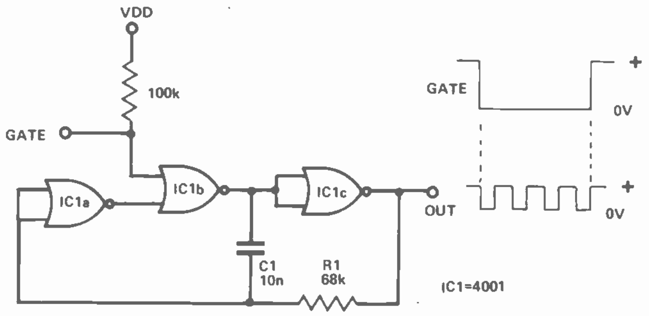


Fig. 28. A gated NOR 'ring of three' circuit with a normally high output, gated by a low input.

Figs. 27 and 28 show alternative versions of the gated NOR-type 'ring-of-three' circuit. Both circuits need a 'low' signal to gate the astable on. Note that the output of the circuit is normally-low if the gate signal is applied to IC1c, or is normally-high if the gate signal is applied to IC1b.

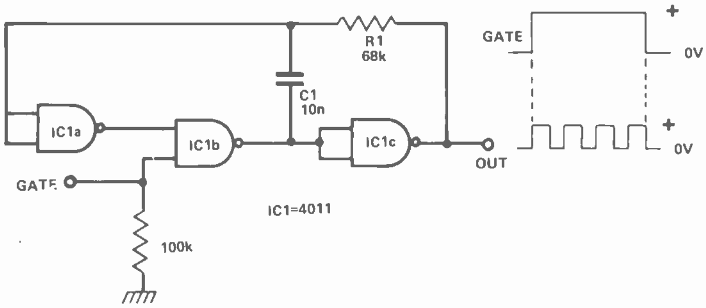


Fig. 29. A gated NAND 'ring of three' circuit with a normally low output, gated by a high input.

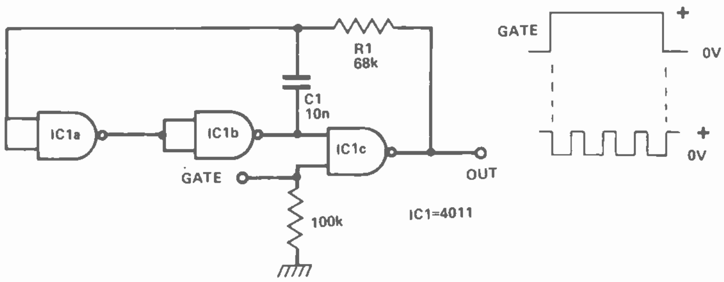
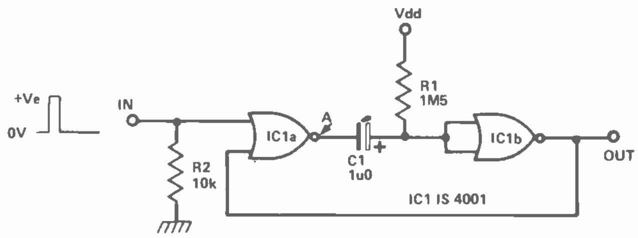


Fig. 30. A gated NAND 'ring of three' circuit with a normally high output, gated by a high input.

Similar variations are found in the NAND version of the gated 'ring-of-three' circuit, as shown in Figs. 29 and 30. These circuit need a 'high' signal to gate them on, and have a normally-low output if the gate signal is fed to IC1b, or a normally-high output if the gate signal is fed to IC1c.

Monostable Multivibrator Circuits



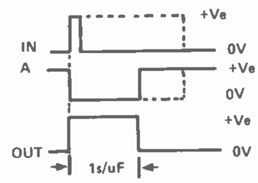


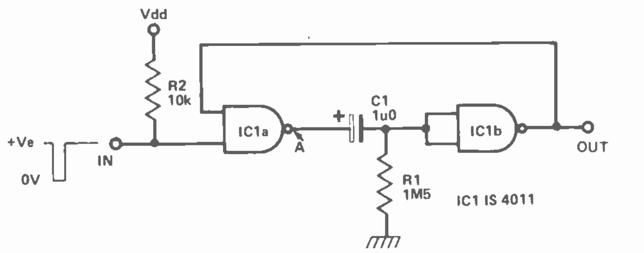
Fig. 31. A 2-gate NOR monostable multivibrator.

The CD4001 and CD4011 can both be used to make an exceptionally useful type of 2-gate monostable multivibrator or pulse generator circuit. The two basic versions of this circuit are shown in Figs. 31 and 32. In these circuits the duration of the output pulse is determined by the values of R1 and C1, and approximate one second per microfarad of C1 value when R1 has a value of 1M5. In practice, C1 can have any value from roughly 100 p to a few thousand u, and R1 can have any value from about 4k7 to 10M.

One outstanding feature of these circuits is that the input trigger pulse or signal can be direct coupled and has no appreciable effect on the length of the circuit's output pulse: the trigger pulse can be shorter or longer than the output pulse. The NOR version of the circuit has a normally-low output, and is triggered by a positive-going input pulse, while the NAND version of the circuit has a normally-high output and is triggered by a negative-going input pulse.

A signal feature of these circuits is that the pulse signal appearing at point "A" has a length that is equal to that of either the output pulse or the input trigger pulse, depending on which is the greater of the two. This feature is of value when making pulse-length comparators and over-speed alarms, etc.

The Fig. 31 and 32 circuits have only two significant defects. One of these is that the pulse length depends somewhat on the transfer voltage value of the individual IC that is used in the circuit. The other is that the pulse length also depends somewhat on the supply voltage value that is used with the circuit, just as the operating frequency of the basic 2-gate CMOS astable varies slightly with the supply voltage value. These defects are of little consequence in most practical applications, however.



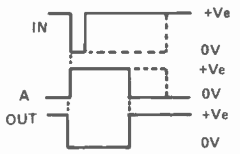
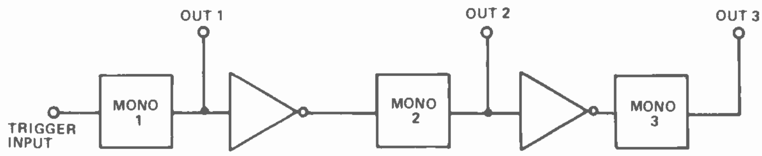


Fig. 32. A 2-gate NAND monostable multivibrator.

If a number of the Fig. 31 and 32 circuits are to be interconnected to give cascaded delays (as in a delayed-pulse generator, for example), an inverter stage must be interposed between the outputs and inputs of successive monostables, to give correct-polarity trigger signals. Figure 33 shows the basic system.



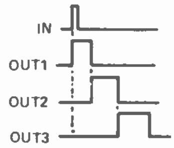


Fig. 33. Using monostables with inverters to produce cascaded delays.

Alarm Call Sound Generator Circuits

A single CD4001 or CD4011 IC and one or more transistors can readily be used to make a variety of types of very useful alarm call sound generator circuits. Figs. 34 to 41 show some practical circuits of this type. In all cases, the circuits can be powered from any supply in the range 5V to 15V and can be used with any speaker in the range 3R to 100R. Output powers range from tens to hundreds of milliwatts, depending on speaker impedances and supply rail voltages used, but can readily be boosted to tens of watts by using additional transistor power-boosting stages.

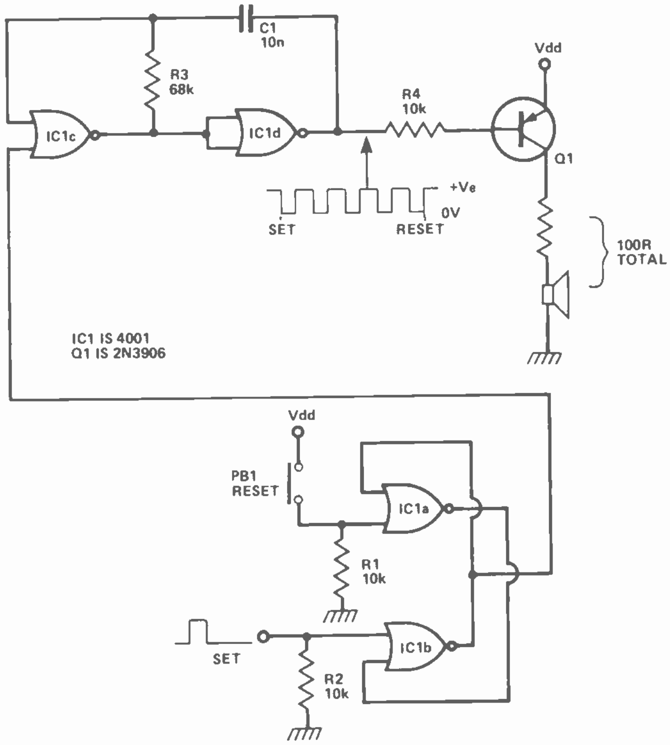


Fig. 34. Circuit of a NOR latching monotone alarm call generator.

Figs. 34 and 35 show two versions of a latching monotone alarm call generator. IC1a and IC1b are wired is applied to the circuit the IC1a-IC1b bistable self-latches and switches on the IC1c-IC1d-1kHz astable tone generator. The circuit can be reset to the OFF state by momentarily closing PB1.

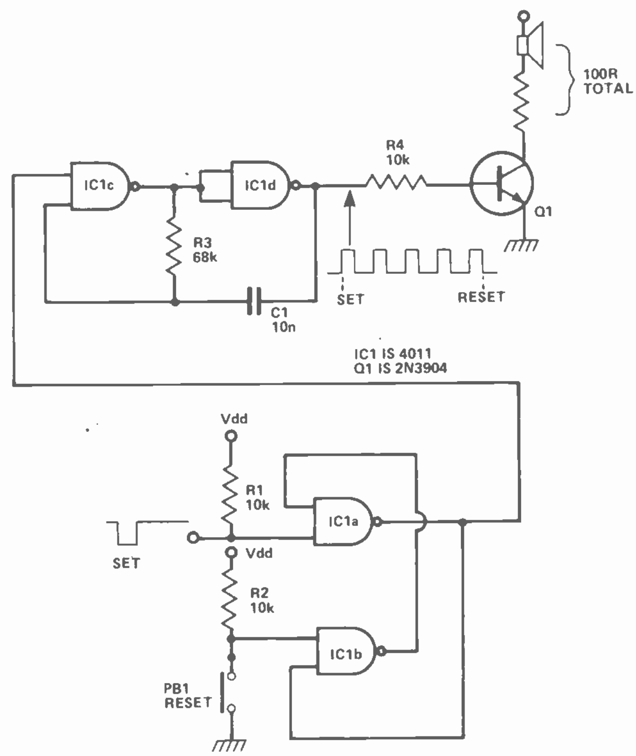


Fig. 35. Circuit of a NAND latching monotone alarm call generator.

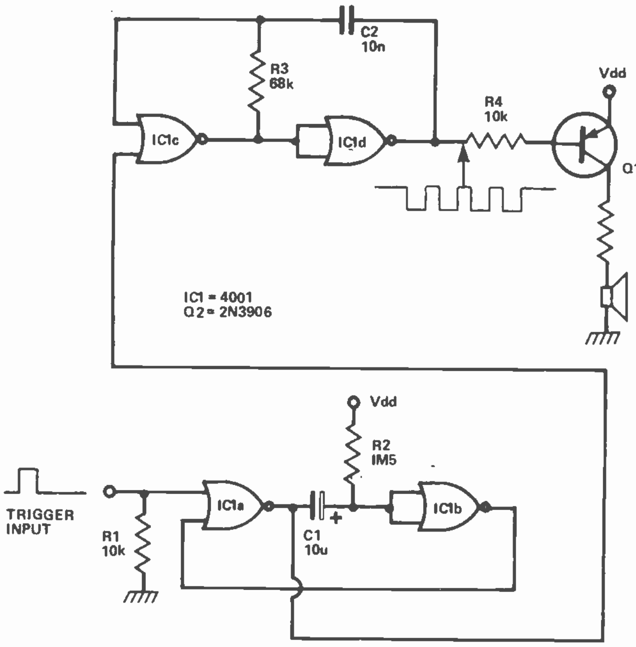


Fig. 36. A NOR alarm call generator with auto turn-off.

Figs. 36 and 37 show versions of an auto-turn-off monotone alarn call generator. IC1a and IC1b are wired as a monostable multivibrator, which turns on the IC1c-IC1d astable for about 10 seconds each time that it is triggered.

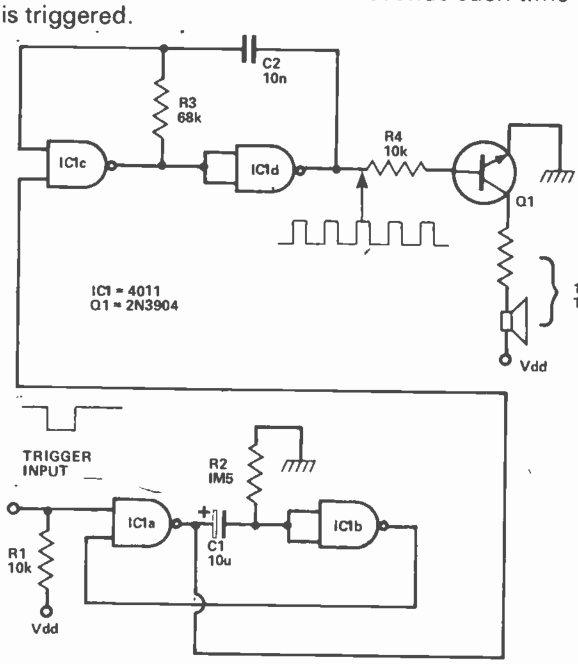


Fig. 37. A NAND alarm call generator with auto turn-off.

The Fig. 38 and 39 circuits generate a pulsed-tone signal, in which a 1 kHz astable (IC1c and IC1d) is gated on and off by a 6 Hz astable (IC1a and IC1b) when a suitable control signal is applied to the input terminal of IC1a.

Finally, Fig. 40 shows a warble-tone generator, which switches through a 2-tone cycle once per second when a suitable control signal is applied to the inputs of IC1a and IC1c, and which generates a sound similar to a British police car siren. The depth of frequency variation of the circuit is determined by R3, which can have any value in the approximate range 120k to 1M0. ETI

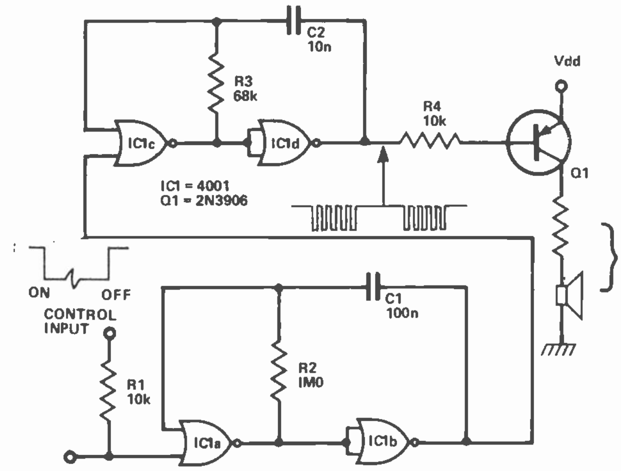


Fig. 38. Generating a pulsed-tone signal with 6Hz and 1kHz NOR astables.

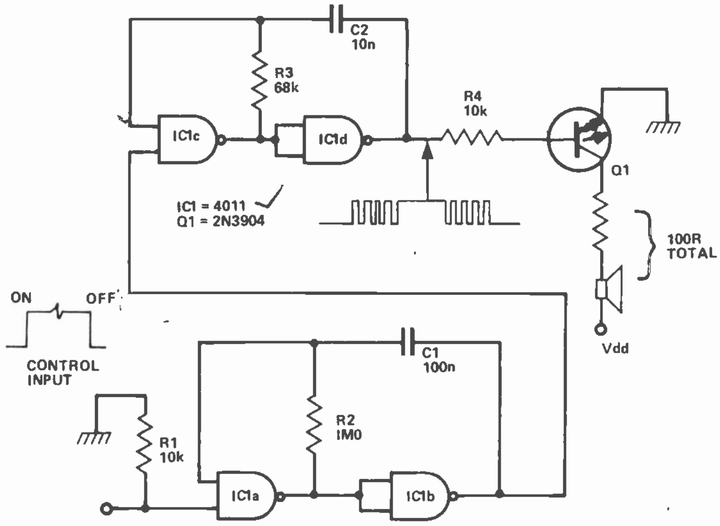


Fig. 39. Generating a pulsed-tone signal with 6Hz and 1kHz NAND astables.

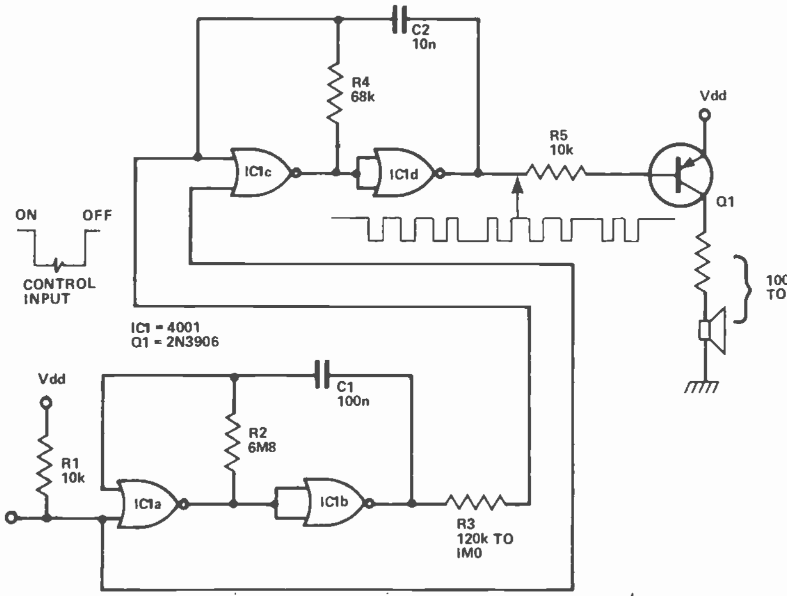


Fig. 40. A warble-tone generator — sounds like a police car siren.

audiophile...

Hi-fi 79 at the Cunard Hotel attracted Ron Harris this month, as did a new record cleaner. Also a good chance to show how witty you are and win a free subscription.

A TALE OF MANY speakers is what the 1979 Spring hi-fi show turned into. Wandering the halls of the Cunard in search of the sonic grail you get buffeted from side to side by the alternate blasts of sound emanating from the demo rooms. After about two hours of solid listening I start to get ear fatigue and thingd son't seem the same somehow.

In consequence things get done in bursts of two hours at a time punctuated with clincking of refreshments. On the first pass this year it became apparent that it was to be the Year of the Cone.

MA24U

Monitor Audio first. The MA2 is a 'domestic reference' design and stands some 850mm high. (About 33in in English height). It will handle around 100W of programme power, and produces a very nice sound indeed. At about £300 the pair they are going to give the competition a tough time.

Wharfedale have extended their 'E' series upwards into an E90 design which is twice the size of the E70 nearly and more than twice as imposing. We've got no photographs of the beast simply because Wharfedale hadn't got any and haven't kept their promise to send us any since! So there. Its still a nice speaker anyway.

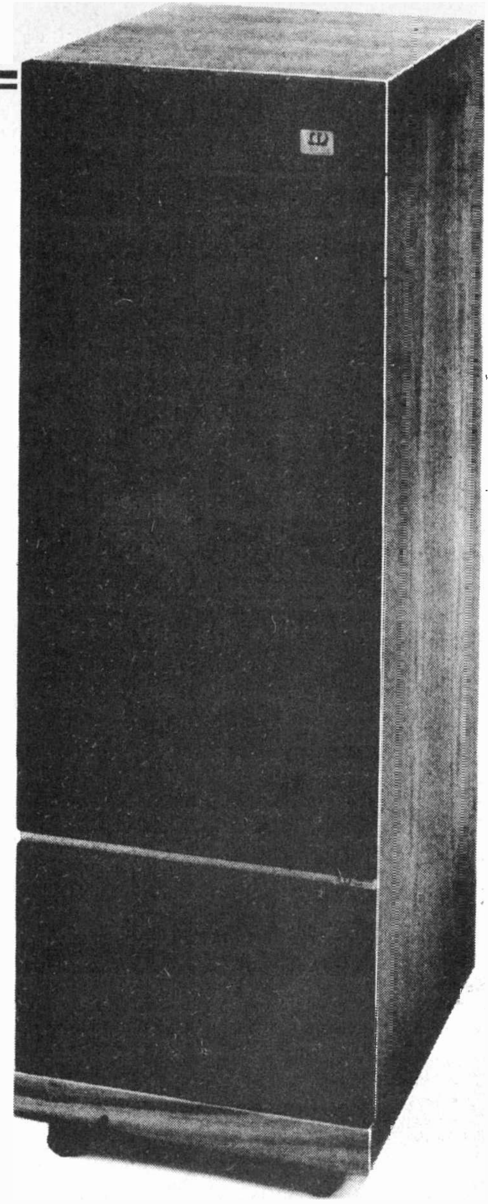
KEFs contribution to the herd was a small one. Tiny in fact. I'd go so far as to say it was so small I almost missed it. The Reference 101 is a bookshelf speaker that just might fit into a bookshelf. This was the real surprise of the show, however, as upon first encounter the almost universal reaction was to hunt the 105s that were not hiding behind the curtains.

The sound was open and spacious with good imaging and a convincing bass response. Very nice one Kef.

Celestions Follies

The Celestion stand was dominated by two huge double boxes which, when energised, did a quick 'room empty' job. The efficiency is somewhat high you see, and the amplifier somewhat powerful.

I think they're designed for PA and studio usage but they are finished in wood veneer and more than likely quite a few dozen will end up in living rooms. Big living rooms I hope. At their price and size they come up against things like the JBLs and for sound quality I personally prefer the P1s (that's what they're called by the way). Well worth the listen if you're in that market.



Above: the Monitor Audio MA2 loudspeaker. A highly recommended domestic design.

Below: the Celestion P1. It sounds as imposing as it looks.

Left: JVCs KDA8 computerised cassette deck. It fixes up its own own bias and equalisation levels, and can cope with metal tape.

Right: Goldring headphones! Superex classic CL1s, a good smooth sound at a decent price. No, I'm not gonna tell you how much, find out yourselves!

Head Man

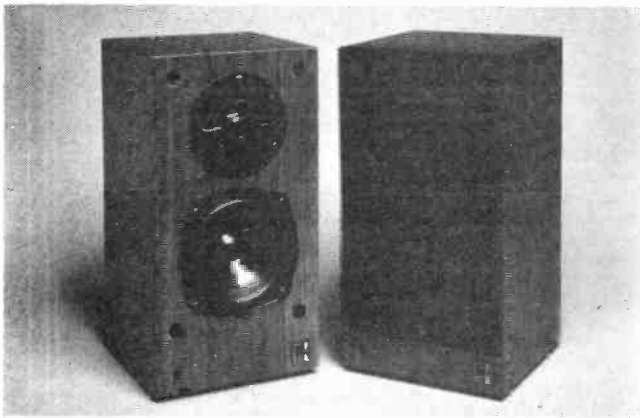
New for heads from Goldring is the Suprex headphone range. Amongst the four models they decided to import the Classic C1 — the middle of the group caught my attention most. They possess a nice smoothness to them that could be lived with. And they're comfortable. Koss take note please. Speaking as someone stuck with the habitual earache engendered by ESP10s the Suprex could be very attractive if for no other reason than that.

On Your Metal

Scotch and JVC between them made an exhibition of the new metal tape formulations and the JVC KDA8 machine to use them. The KDA8 is quite a story in itself really. It sets up for each type offered to it by recording a test tone and optimising bias, sensitivity and equalisation automatically — it even rewinds to the beginning again and all in 25secs. The demonstration was most impressive — as they usually are — and we hope to do more with the machine in the near future.

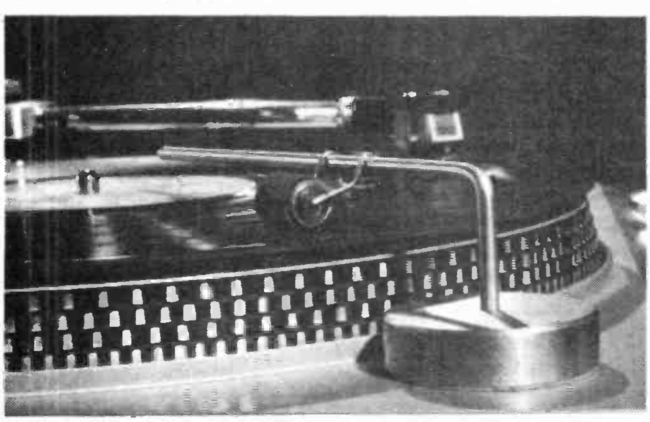
Before anyone asks I could find no possible reason to include the beautiful Felicity Kendal in this months Audiophile. She was not at the exhibition nor has she anything to do with any of the products featured here. That being the case I have no reason to mention the lovely lady and therefore I shall refrain. ETI

Below: KEF's 101 reference model. If your living room (or preference) favours small enclosures then don't miss 'em out.



Below: Celestions new Dittons. In the centre is the new 662, which is their new version of our reference the faithful ole 66. It remains to be compared whether it is *that* much better!

Below: No this wasn't at the show but it's worth the look anyway. A new record cleaner called a TANTRACK. Two arms are provided to cope with any turntable height, and the finish is a very posh steel and chrome. Available from Dorking Systems Ltd, 23 South Street, Dorking, Surrey. Price £6.25 plus VAT.



This here picture advertises Marantz. But we couldn't find the Marantz stand!! Now with a picture like this, there just HAS to be a brilliant, witty, superb caption. But *we* can't find THAT either, so its open to you lot. The best wins a years subscription. Closing date June 30th. Mark envelopes 'Audiophile Caption.'

More people in Britain buy

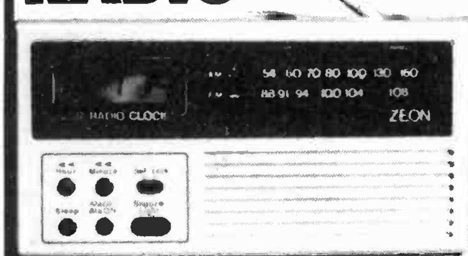
than any other electronics magazine. Why?

Most magazines have their circulations independently audited according to very strict rules and ETI has just taken over as the largest selling magazine in the field in Britain. Starting as a small "also-ran", ETI has now overtaken mags originally selling four times the number of copies.

Find out why ETI is No. 1 for yourself. Could it be something to do that it's better than the competition?

ETI MA

CLOCK RADIO



You probably won't believe us as we're selling the goods but we're going to tell you anyway! We have *rejected* eight clock radios for Marketplace, they were all cheap enough but the quality was so poor that we couldn't have lent our name to them. However, we are now able to offer a portable LCD Clock Radio to you which meets our standards.

The clock is a 12-hour one with AM/PM indicated and a back light. The radio is Medium Wave and FM with very nice quality for a small speaker — for FM there's a telescopic aerial. The alarm can be either a 'beep-beep' type or the radio, there's also a snooze facility.

The case is sensibly rugged and is printed on the back with a World Time Zones map, a bit of a cheek really, especially as the time is relative to Japan!

We won't even mention the RRP — but just check on comparable prices — you'll find ours a bargain.

An example of this Clock Radio can be seen and examined at our Oxford Street offices.

£20.50

(Inclusive of VAT and Postage),

To:
CLOCK RADIO Offer,
ETI Magazine,
25-27 Oxford Street, London W1R 1RF.

Please find enclosed my cheque/PO for £20.50 (payable to ETI Magazine) for my Clock Radio.

Name . . . .

Address . . . .

. . . .

. . . .

Please allow 28 days for delivery.

DIGITAL ALARM

THIS IS THE THIRD digital alarm clock that we are offering (we regret the earlier versions are no longer available). We have sold thousands and thousands of these and our buying power enables us to offer a first rate branded product at a really excellent price.

The Hanimex HC-1100 is designed for mains operation only (240V/50Hz) with a 12 hour display, AM/PM and Alarm Set indicators incorporated in the large display. A switch on the top controls a Dim/Bright display function.

Setting up both the time and alarm is simplicity itself as buttons are provided for both fast and slow setting and there's no problem about knocking these accidentally as a 'locking' switch is provided under the clock. A 9-minute 'snooze' switch is located at the top.

A example of this clock can be seen and examined at our Oxford Street offices.

£8.95

(Inclusive of VAT and Postage)

To:
Hanimex Alarm Offer
ETI Magazine
25-27 Oxford Street
London W1R 1RF

Please find enclosed my cheque PO for £8.95 (payable to ETI Magazine) for a Hanimex Digital Alarm Clock.

Name . . . .

Address . . . .

. . . .

. . . .

Please allow 28 days for delivery.

ARKET PLACE

LCD CHRONO

We feel we've got to tell you carefully about this offer which we're introducing for the first time. Why? Because our price is so enormously lower than anywhere else you may suspect the quality.

The exact same watch is currently being offered by another magazine as a special at £24.95 — some of the discounters are selling it at £29.95, the price to ETI readers for exactly the same watch is £12.95.

The display is LCD and shows the seconds as well as the hours — and minutes — press a button and you'll get the date and the day of the week.

Press another button for a coujple of seconds and you have a highly accurate stopwatch with hundredths of a second displayed and giving the time up to an hour. There is a lap time facility as well — and of course a back light.

Our Chrono comes complete with a high grade adjustable metal strap and is fully guaranteed.

A sample of this watch can be seen and examined at our Oxford Street offices.

£12.95

(Inclusive of VAT and Postage)

To:
LCD Watch Offer
ETI Magazine
25-27 Oxford Street
London W1R 1RF

Please find enclosed my cheque/PO for £12.95 (payable to ETI) for my LCD Chronograph.

Name ....

Address ....

....

....

Please allow 28 days for delivery.

DIGITAL ALARM MK2

Both ETI and Hobby Electronics have sold a lot of digital alarm clocks — over 10,000 in fact — maybe that's something to do with the fact that we sell at real bargain prices. Now we can offer you a truly modern, space age model.

It includes all the facilities expected in a good design — fast, slow setting, snooze facility, etc plus two unusual features — automatic brightness control and a weekend alarm cancel.

An example of this clock can be seen and examined at our Oxford Street offices.

£10.50

(Inclusive of VAT and Postage)

To:
DIGITAL ALARM CLOCK MK2 Offer,
ETI Magazine,
25-27 Oxford Street,
London W1R 1RF.

Please find enclosed my cheque/PO for £10.50 (payable to ETI Magazine) for my digital alarm clock.

Name ....

Address ....

ALARM-CHRONO LCD

This new addition to our unbeatable selection of bargains is no ordinary LCD watch. It's a slim, multi-function, dual time chronograph alarm watch, no less.

This model will show hours, minutes, seconds, date, day of the week, stop watch, split time, alarm and alternate dual time zone — not all at once, of course. There is also a night light.

Hours, minutes, seconds and day of the week are displayed continuously, while the date will appear at the touch of a button. The day of the week is indicated by a flag. When used as a stopwatch, the maximum count is 0.1secs. short of thirteen hours.

An example of this watch can be seen and examined at our Oxford Street offices.

£22.95

(Inclusive of VAT and Postage)

To:
ALARM/CHRONO LCD WATCH Offer,
ETI Magazine,
25-27 Oxford Street,
London W1R 1RF.

Please find enclosed my cheque/PO for £22.95 (payable to ETI Magazine) for my Alarm/Chrono LCD watch.

Name ....

Address ....

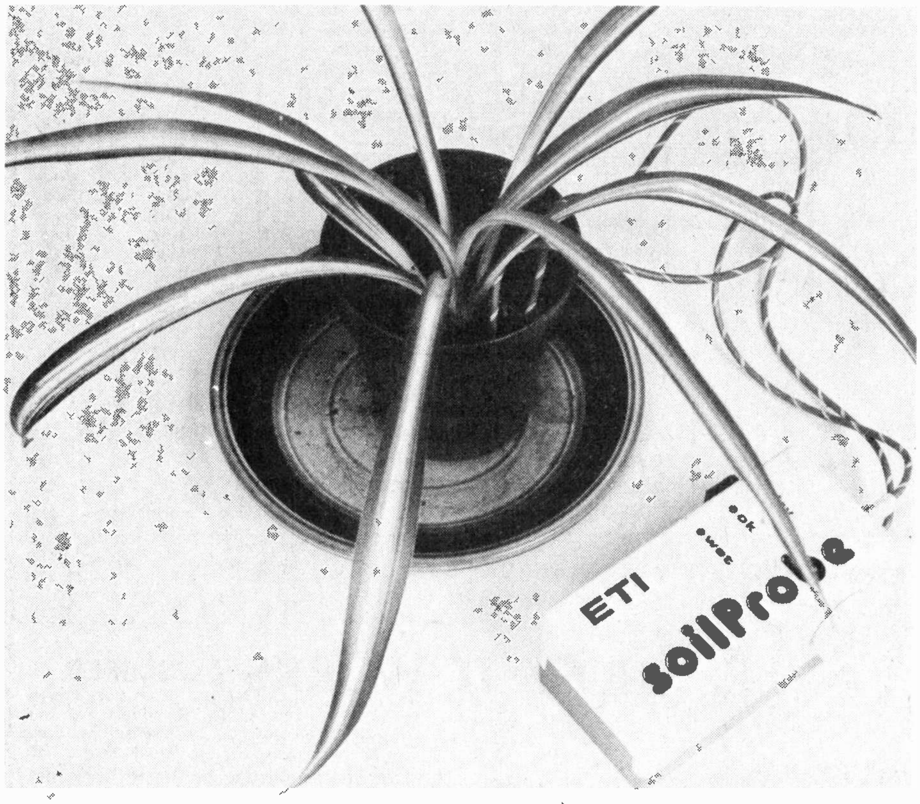
....

....

Please allow up to 28 days for delivery.

SOIL PROBE

Check out the roots scene with this ETI soil probe and have happier, healthier plants.



THIS COMPACT UNIT enables you to accurately check the moisture content of your plants' soil in one simple operation. Its range and sensitivity may be adjusted to complement the most fastidious horticulture and horticulturist. The unit works by measuring the resistance of the water in the soil between two probes and comparing it with a previously selected internal resistance adjustable between 1k and 250k.

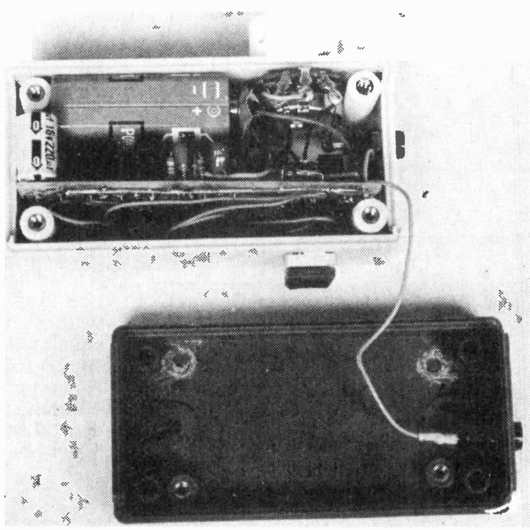
A Better Buzz

A small 9 volt battery powers the circuit which is built around a few cheap CMOS chips and a low power quad op-amp. To avoid undesirable electrolytic effects at the probes, the resistance bridge is AC energised. We don't known if the plants like this but we have had no complaints. The probes may be made of any conducting material or just tinned copper wires placed in the soil a few inches apart and a couple of inches deep. The circuit will tolerate wire leads up to a few feet in length and no special screening is required. A three level comparator whose pass range is internally preset indicates whether the soil is too wet, dry or OK and the required resistance is set by adjustment of a case-mounted potentiometer.

Construction and Use

If you want to use the case shown in the accompanying photographs, be prepared for some precision work as some of the internal pillars need to be removed and the components and PCB are a very snug fit.

Construction is straightforward provided care is taken and attention paid to the polarity and orientation of the diodes and capacitors. Wire links should be inserted first, note that some of these are mounted under the integrated circuit sockets, followed by the sockets themselves, resistors, capacitors, transistor and diodes. The ICs should be inserted last after the off-board components have been



What it is that is on the inside. ETIs Soilprobe exposed. Note that there is not much room in here — not even enough to swing dahlia. So be ye careful of placing and wiring up. A PP3 is the only power source that will fit the box specified so if you want more amps (not needed) be it in your own case.

connected. Also ensure that the flying leads have all been soldered into place and that the LEDs are connected correctly. A short lead, indent or flat on the plastic encapsulation usually indicates the cathode. We used miniature LEDs, two red and one green. However, any desired colour may be used. The prototype also featured a miniature 'keypad' type pushbutton for SW1 though this is only critical if the specified verobox is used. 2mm sockets were used to connect the probe leads and the power source was a PP3.

In use, the unit is turned on; the probes plugged in, and RV2 adjusted until the OK LED lights. This setting may be noted and recorded on a calibrated scale. As the probes are simple and cheap to make they may be left permanently buried in the soil and a set made for each plant, facilitating the repeatability of measurements.

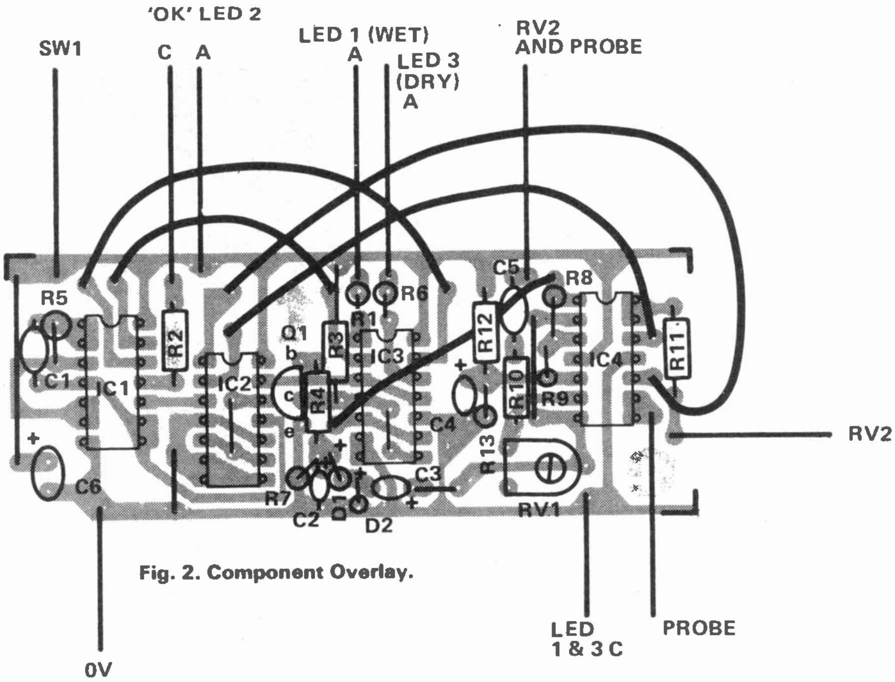


Fig. 2. Component Overlay.

BUYLINES

All components should be readily available. If you use the PCB they should be as small as possible.

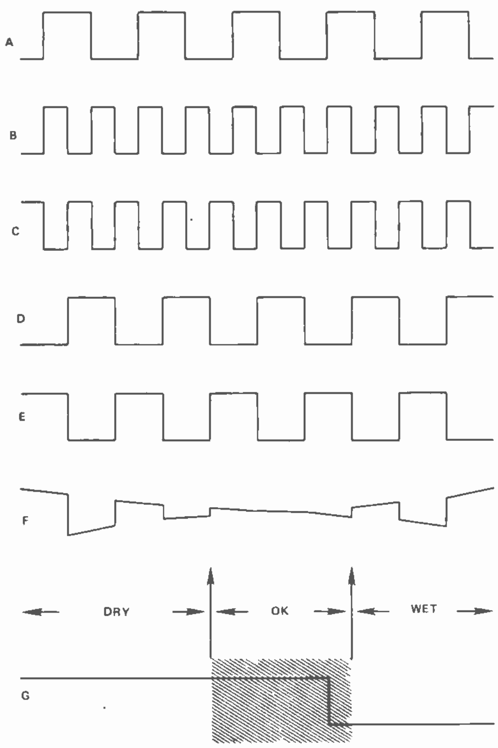


Fig. 1. Waveforms associated with the ETI Soil Moisture indicator, resulting in an LED display of whether the soil is wet, OK or dry.

HOW IT WORKS

The circuit consists of an AC energised bridge whose two active arms are formed by R11 plus RV2 and the soil resistance between the probes. Its operation may be best understood by reference to the circuit diagram and Fig.1. IC1a and IC1b are configured as an astable oscillator whose squarewave output (Fig. 1b) clocks IC2a. This signal, inverted by IC1c (Fig.1c), clocks IC2b.

The antiphase Q and $\bar{Q}$ outputs of IC2b are buffered by IC4a and IC4b whose outpits (Fig. 1d and 1e) drive the resistance bridge formed by R11 plus RV2 and the soil resistance between the probes. R11 protects the amplifier outputs against inadvertent short circuits.

The output of IC2a (Fig. 1a) is a squarewave of the same frequency, phase shifted by 90 degrees. This means that the edges of the waveform are coincident with the centre of the squarewave from IC2b (Fig 1d and 1e) and facilitates phase detection by IC3a and IC3b. When the soil resistance measured between the probes is equal to the resistance of R11 plus RV2, the signals from IC4a and IC4b will cancel out. However, when an imbalance occurs, there will be an error signal whose phase will depend on whether the soil has a greater or lesser resistance than the other arm of the bridge. The amplitude of the error signal will also diminish as the bridge approaches balance (Fig. 1f).

This signal is coupled via C5, R10 to amplifier IC4c and squared up to provide CMOS input levels by schmitt trigger IC4d, where it is input to IC3a and IC3b and clocked in by the signal from IC2a. The outputs of IC3a and IC3b will follow the phase of the input; reflecting the state of imbalance of the bridge, and either LED 1 or LED 3 will be lit (Fig. 1g).

The amplified signal from IC4c is also fed via C3, D1 and D2 to C2 which will acquire a charge proportional to the level of the input. This drives Q1 which controls the direct, clear, and set inputs of IC3a and IC3b respectively. When the input signal is insufficient to turn on Q1, these inputs are driven to their active high state by R3.

This causes both LED 1 and LED 3 to extinguish and the condition (shown shaded in Fig. 1g) is detected by nand gate IC1d whose output goes low causing LED 2 to light. The sensitivity of the circuit to this condition is preset by adjustment of RV1 which controls the gain of IC4c. The required soil resistance is set by RV2. The circuit is powered from a 9V battery decoupled by C6. A mid voltage point is provided by R12 and R13 decoupled by C4.

PARTS LIST

RESISTORS

R1, 2, 6	820R
R3, 4, 10	100k
R5	10M
R7, 12, 13	10k
R8	1M
R9	100R
R11	68R

POTENTIOMETERS

RV1	470k preset
RV2	250k lin

CAPACITORS

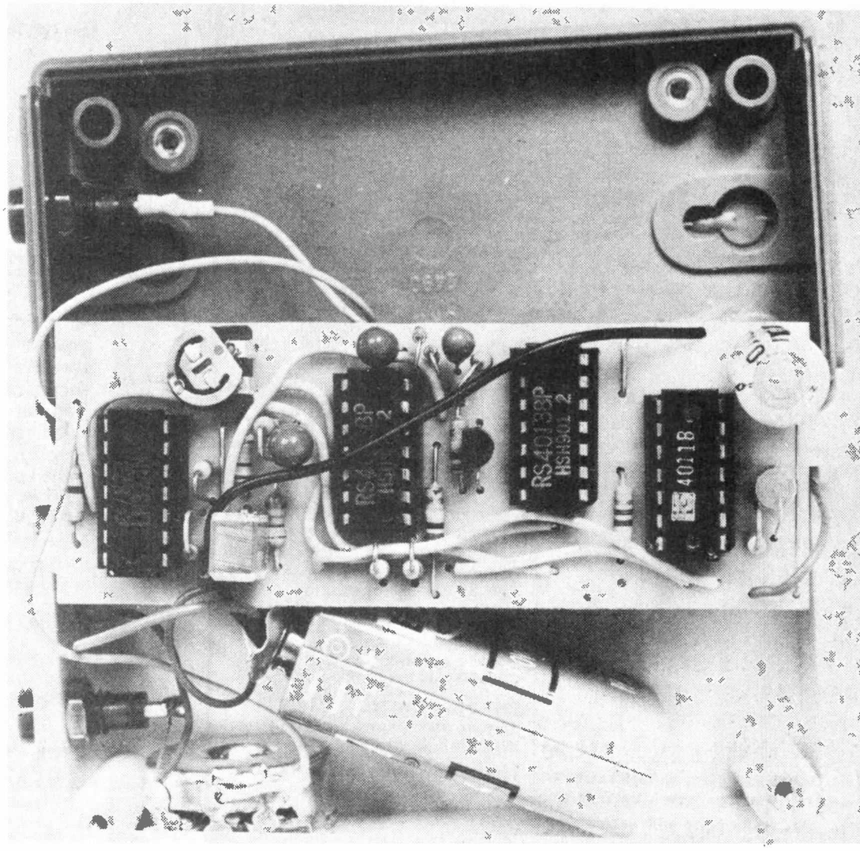
C1	1n
C2	4u7
C3	10u
C4	22u
C5	220u

SEMICONDUCTORS

IC1	4011B
IC2, 3	4013B
IC4	LM324
Q1	BC108
D1, 2	IN4148
LED 1, 2, 3	0.125"

MISCELLANEOUS

PCB	
SW1	SPST
VERO BOX 65-2516G	



An internal view of the Soil Moisture Indicator, showing the position of the four ICs.

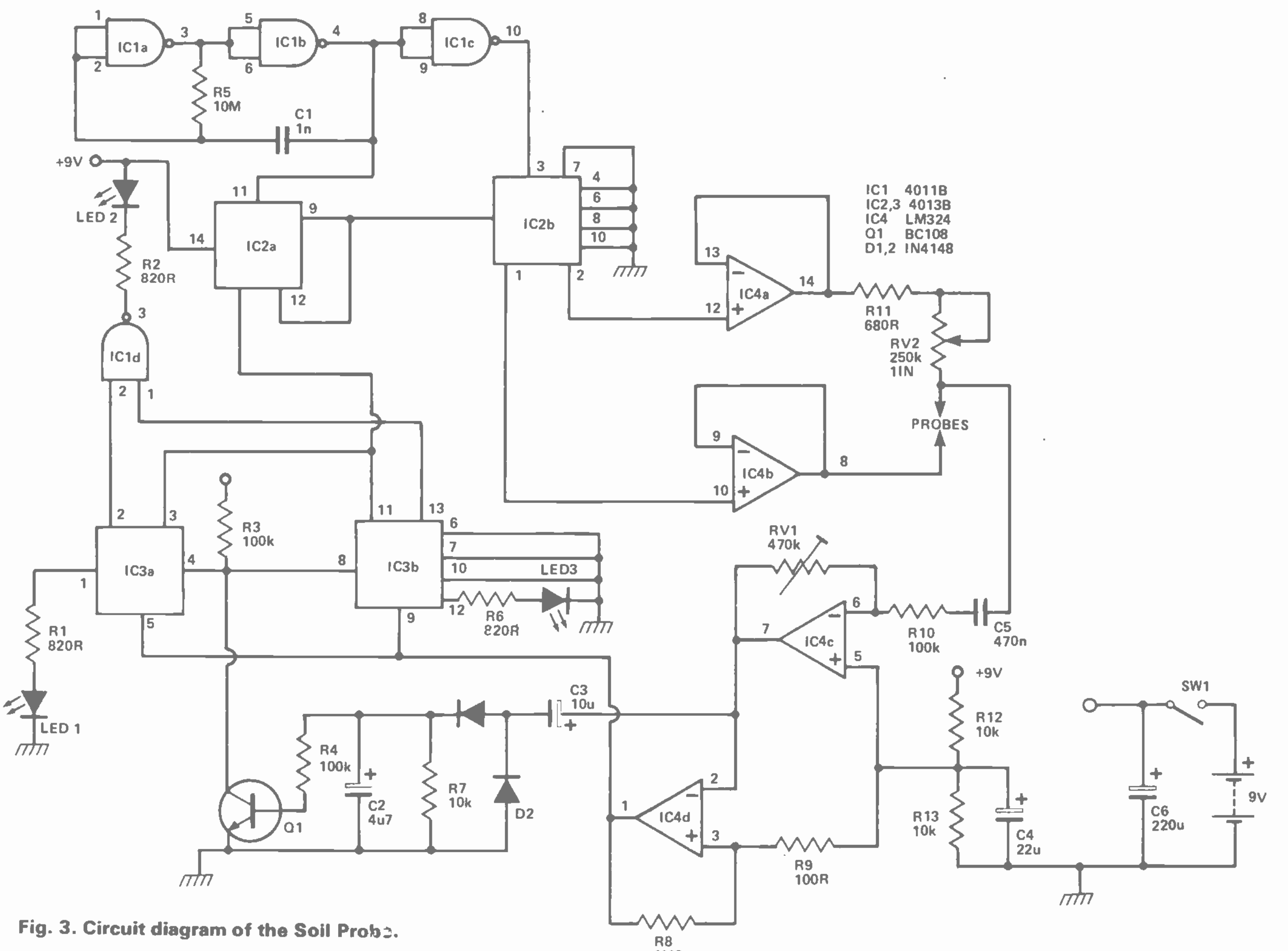


Fig. 3. Circuit diagram of the Soil Probe.

electronics today international

What to look for in the August Issue: On sale July 6th

STRING THING

To call this project an electronic piano would be an injustice. To call it a string ensemble likewise fails to explain all the mysteries and beauties awaiting the builder once this beast is activated. Yes it can be a piano. Yes it can play string sounds.

The designer (Tim Orr who also can be blamed or praised for the Transcendent 2000) wanted to call it a "Digital Multi-Voice String Synthesising Keyboard Instrument". But we wouldn't let him. We couldn't think of a better title ourselves, but we still wouldn't let him. It's the way we are.

Being fitted with a CCD choraliser allows our String Thing to sound like several of 'em at once. Why not tune in and be amazed next month?

BENCH AMPLIFIER

One for the workshop or table top. How many times have you been half-way through a project and needed to test something, somehow, somewhen. And that of course is exactly when it occurs to you that there is nothing around suitable.

A bench amp is worth its weight in soldering ten times over, and if you DON'T build this you will regret it.

MICROSENSE

MPUs are definitely for you. Oh yes they are, don't give me that old line about them being all covered in mystery and incomprehension. MPUs are nice friendly little chips, and next month we've got the definitive article to prove it. Based on a book by John Miller Kirkpatrick it takes you through the subject from scratch in a thorough but light-hearted manner.

LED AUDIO DISPLAY

A really lovely little design to amaze, astound and hypnotise the entire universe. This project takes the input from your hi-fi or TV or budgie and turns it into a dazzling and bemusing shifting pattern of light upon a LED matrix.

Build it any size you like it'll add a bit of visual spice to the hi-fi rack — or simply keep mother-in-law quiet while you nip off down the local.

LIFE OUT THERE ?

Is there anybody there? Does anyone care? Yes to both. Read on . . .

ABOUT 20 YEARS AGO scientists, realised that their equipment might be able to detect suitably powerful radio emissions from intelligent beings on planets in other solar systems which may be many light years away from us. Attempts to detect Extra-Terrestrial Intelligence (appropriately abbreviated to ETI!) have already been made in the USA, Canada and the USSR without success, but much more work with larger aerials is required to provide workers in this field with a reasonable chance of success.

Apart from the Search for Extra-Terrestrial Intelligence (SETI), drawings and radio signals have been sent into space outside the solar system in the hope that they will eventually be detected and understood by intelligent beings many light years distant. Unfortunately the chances of two way communications with such beings are very remote, since the nearest star is a few light years away and most planetary systems are at much greater distances. Thus anyone sending a message from the earth to anywhere but one of the very nearest of the stars would be dead by the time any reply could be returned to the earth.

Attempts have also been made to detect signs of life within the solar system. In particular, the Viking spacecraft which landed on Mars conducted prolonged tests to try to detect life or the chemicals associated with life. Although no organic molecules that could be the past or present constituents of living things were found and the results were generally rather discouraging, they were certainly not conclusively negative as regards the possibility of life on Mars.

Communication Techniques

It seems likely that there are three possible ways in which we may be able to communicate with intelligent beings from outside the solar system. The first way involves a direct meeting of space vehicles or a landing by them on the earth. Unless the other beings have a longevity which far exceeds that of man, the journey time would make this method quite impossible. Many people do not fully appreciate how much vaster are the distances involved in interstellar space than those within the solar system. Light takes about 8 minutes to reach us from the sun, but about 180 000 years to cross our galaxy and some thousands of millions of years to reach us from the farthest known objects.

As we require something which will convey information quickly, the obvious thing to use is electro-magnetic ▶

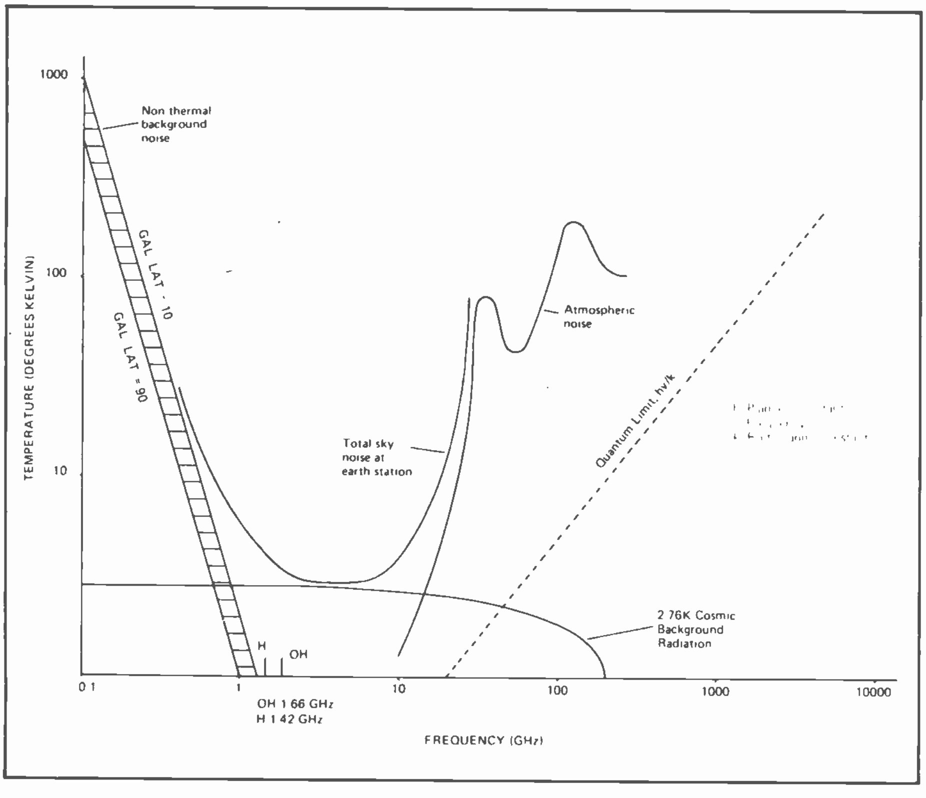


Fig. 1. Some of the most important factors which determine the choice of listening frequency. As signals from other stars would be very weak, it is important to choose a frequency where the natural background noise is relatively small. Most SETI work has been done in the relatively low total noise region of 0.5 to 10 GHz, christened the 'Water Hole', since it contains frequencies strongly associated with water. The favourite frequency is 1.42 GHz, emitted when the electron in a hydrogen atom flips over, reversing its direction of spin.

The noise contributions shown are — the 2.76 K cosmic background radiation (remnants of the big bang), atmospheric noise (as water and oxygen absorb and reradiate energy), quantum noise associated with the arrival of each photon in the atmosphere and synchrotron radiation emitted by particles spiralling round galactic magnetic fields (the level varies with galactic latitude. The extreme lines shown are for galactic latitudes of 10° and 90°).

signals which travel at the speed [illegible]ht. We can only send signals by this technique and n[illegible] material objects, but generally it is far more sensible to send information on how to construct an object rather than to send the object itself over such vast distances. Should one use light, infra-red, radio waves or some other form of electromagnetic radiation? Radio-waves are to be preferred, since the energy required per transmitted photon is relatively low.

The third possible communicating technique involves the acceleration of sub-atomic particles to velocities very near to the speed of light, but as far as is known this technique has not yet been tried. If particles which can travel faster than light (known as 'tachyons') are ever discovered, one can only wonder whether they could be used in an extra-terrestrial communications system if they can be produced relatively easily; however, at the moment such a suggestion is nothing more than pure speculation.

It has been suggested that we should avoid transmitting any signals into space which would inform possibly hostile intelligent beings of our location. It is generally felt, however, that we can take comfort from the fact that any intelligent beings would be more interested in sharing information with us and co-operating with us as far as possible rather than in attacking us as in science fiction stories. In any event, it seems likely that it would take them so long to arrive here that our civilization would be in a very different state by the time they could reach us.

Basic Problems

Let us first consider the basic problems associated with receiving radio signals from outside the solar system, since any of our attempts to send messages are not likely to bring any result for an enormously long time. Any radio signals reaching the earth from outside the solar system are likely to be extremely weak owing to huge distances involved and it therefore follows that SETI projects require the use of the largest radio telescopes in the world.

One is left with decisions to make on the direction in which one should point the telescope, the frequency or frequencies which one should attempt to receive, the bandwidth one should use and perhaps even the time at which one should attempt to receive any transmissions. In the work on SETI which has been performed up to the present time, the telescopes have usually been pointed towards some star in our galaxy which is not excessively distant and which astronomers feel may possibly have a satellite system on which life could have evolved in some form or other.

In general astronomers have concentrated their searches in the regions of stars of the same or similar spectral classes as the sun. It has been felt that if a star has a luminosity much greater than that of the sun, then the lifetime of any planetary system associated with that star is probably too short to have enabled life to have developed to the point where intelligent civilizations have evolved. Stars of luminosity much smaller than that of the sun seem to have rather violent coronal activity which would probably result in any associated planetary system being rather inhospitable to most imaginable forms of life. Other stars have departed from the main sequence as a result of a super-nova or nova explosion and SETI workers have tended to disregard these because it seems doubtful whether any living species could survive the catastrophe event of such an explosion in the star.

Signal Types

What types of signal should we expect to receive from other planetary systems and how could we recognise such signals as originating from intelligent life? The SETI workers are basically searching for coherent signals, possibly modulated. For example, our own radio transmissions have a coherent carrier wave, although the modulation present inevitably involves a finite bandwidth. The presence of this type of signal would almost certainly indicate it is not of natural origin and hence would imply the existence of intelligent life elsewhere in the universe.

There are three basic types of signal from other planetary systems which we may be able to detect. The first type of signal is leakage of a signal into space in just the same way that our own radio and television signals leak away to a greater or lesser extent through our ionosphere. Indeed, a spherical wave of radio signals of a fairly wide range of frequencies has been travelling away from the earth over a period of rather over 50 years. In the case of more highly developed societies, it seems probable that they have been transmitting such signals for a far longer period (although one hopes they have not been stupid enough to destroy themselves by nuclear war).

A second type of signal we may possibly be able to receive is some form of inter-stellar or even inter-galactic communications between highly developed communities. Such reception would be by chance and it must be assumed that highly developed communities would employ very high gain antennae which are unlikely to be pointing towards our solar system. Thus the chances of intercepting such messages cannot be regarded as being very high.

The third type of signal we may hope to receive is an intentional one directed at our solar system by a society in a distant stellar system in order to notify us of their presence. It is also possible that such a society may send signals out isotropically (that is, all directions at equal intensities), but unless they have transmitters of extremely high power, such signals would be so weak at the earth that it is doubtful if we could detect them.

It is difficult to make an estimate of the optimum bandwidth one should select for SETI work. Narrow bandwidth receivers (possibly with a bandwidth of a few Hz) enable very weak signals to be detected, since the narrower the bandwidth of the channel used, the less the external noise which can penetrate into that channel. (Someone once said: "The wider you open the window, the more the amount of dirt that flies in," and this certainly applies to radio bandwidths). Unfortunately if one has a very narrow bandwidth channel, it takes a very long time to examine an appreciable range of frequencies. Modern plans are to use both narrow and wide band search techniques together with spectrum analysers for the simultaneous examination of numerous frequencies by computer techniques.

The Drake Equation

Before spending millions of dollars on SETI programmes, one would like to have some approximate estimate of the number of civilizations which are likely to possess the technology to be able to communicate with us. Such an estimate can be obtained by the use of the Drake equation. Professor Frank Drake is one of the leading SETI workers and is now Director of the National Astronomy and Ionosphere Centre of Cornell University. His equation reads:

$$N=R^{*}f_{p}n_{e}f_{l}f_{i}f_{c}L$$

where

- N is the number of existing civilizations possessing the interest and capability for inter-stellar communications
- R^{*} is the mean rate of star formation averaged over the lifetime of a galaxy
- f_p is the fraction of stars with planetary systems
- n_e is the mean number of planets in each system with an environment favourable for the origin of life
- f_l is the fraction of suitable planets on which life does develop
- f_i is the fraction of life bearing planets on which intelligence together with manipulative abilities appears
- f_c is the fraction of the planets evolving advanced technical civilzation
- L is the lifetime of the technical civilization (perhaps very difficult to estimate!)

The estimate obtained from the use of this equation will obviously vary widely according to the estimated values employed. However, most estimates now place the value of N around one million, these being distributed amongst approximately 500 million stars in our galaxy.

SETI History

Perhaps the first important paper on SETI work appears in *Nature* in 1959 under the title "Searching for Inter-stellar Communications" by Philip Morrison and Guiseppe Cocconi. It is interesting to note that they suggested the use of the 1.420 MHz hydrogen ▶

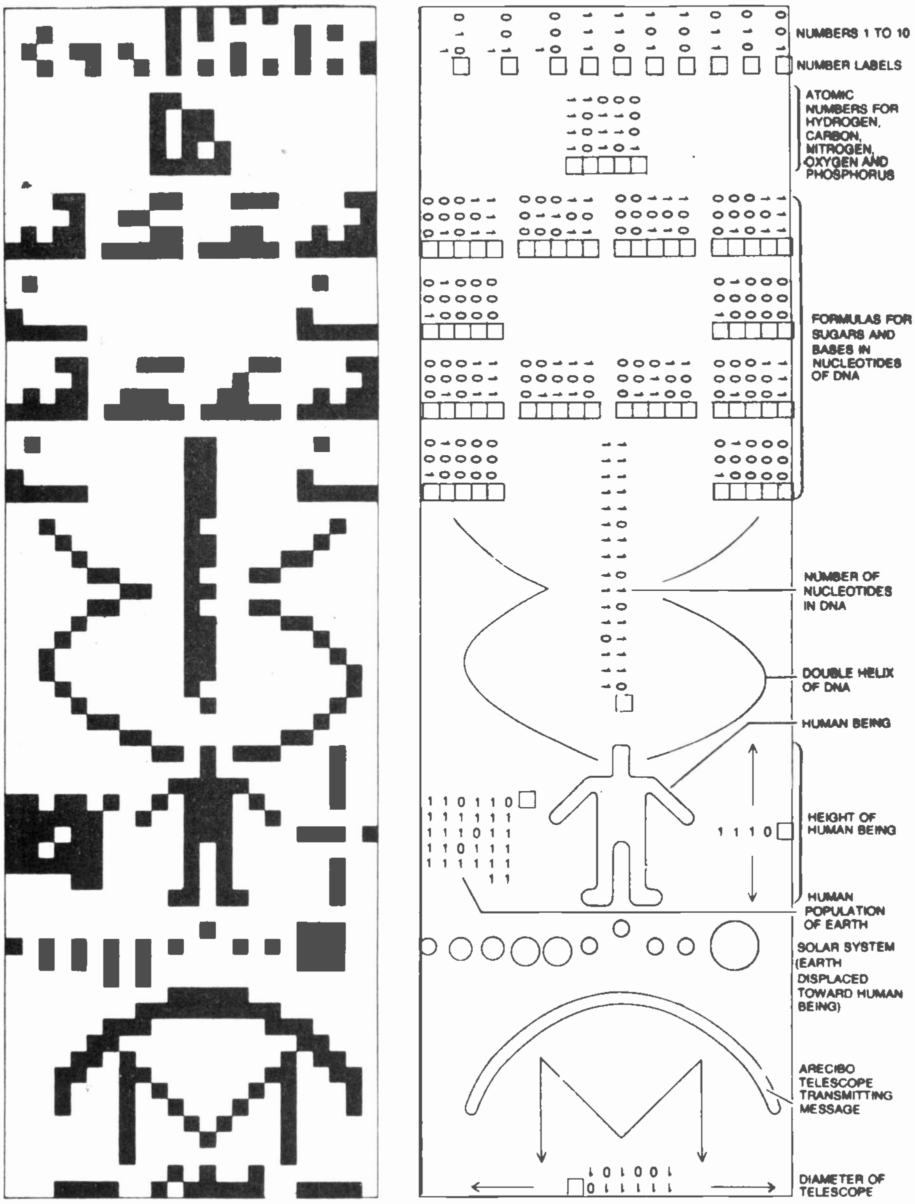


Fig. 2. On November 16th, 1974, the Arecibo telescope was used to transmit a message at 2380 MHz towards the Great Cluster in Hercules, Messier 13, some 25,000 light years away.

The message, 1679 bits long, can be decoded by breaking it into 73 consecutive groups of 23 characters and arranging these groups in sequence under one another as shown. The first piece of information consists of the first ten digits in binary form — the numbering system to be used. It continues with the atomic numbers of five common elements found in living things. Information on sugars and DNA follows, with a sketch of a human being and the solar system, ending with information about the Arecibo telescope.

Encoding information in various types of message poses some interesting problems in order that decoding can be carried out as easily as possible by intelligent remote beings.

frequency, since it is a unique standard frequency which must be known to every observer in the universe.

Eight separate major efforts have been made by US, Canadian and Russian radio astronomers since 1960 to detect extra-terrestrial signals from intelligent beings. Although each search has concentrated on one or more specific frequencies in the range from 600 MHz to 22.2 GHz, the receivers used were those designed mainly for normal radio astronomical work which involves the detection of incoherent naturally produced radiation rather than the coherent radiation the SETI workers were seeking.

Although no confirmed sources of signals from intelligent beings outside the solar system have yet been detected, it has been estimated that the number of stars which have been examined is about 0.1% of the number which would have to be investigated if there is to be a reasonable statistical chance of detecting extra-terrestrial intelligent signals.

Project Ozma

The first SETI work was led by Frank Drake using the 1420 MHz hydrogen frequency. It was named "Project Ozma" after the ruler of Oz — a far away place populated by exotic beings. Drake employed a bandwidth of 100 Hz and aimed his receiver at the two stars Tau Ceti and Epsilon Eridani which are both some 11 light years away from the earth. The observing time was some 150 hours using a 26 m (85 feet) diameter steerable antenna in 1960.

Project Ozma II is a much more extensive one which has also been carried out at the National Radio Astronomy Observatory, Green Bank, West Virginia. In this work some of the largest and most sophisticated radio telescopes in the world have been used; they include the 92 m (300 feet) diameter partially steerable antenna completed in 1962 at a cost of about 1 million dollars (500 000 pounds) and the 43 m (140 feet) diameter equatorially mounted, fully steerable antenna which was completed in 1965 at a cost of some 14 million dollars (£7 million).

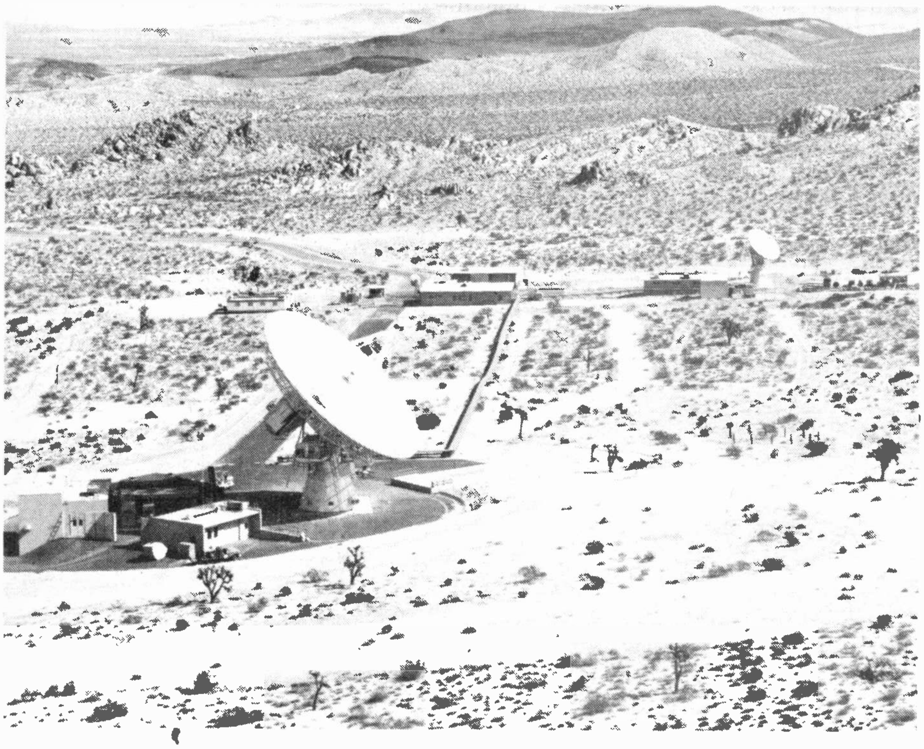
Project Ozma II was commenced in late 1972 under the leadership of Benjamin M. Zuckerman of the University of Maryland and Patrick Palmer, of the University of Chicago, the intention being to run the project for about two years. However, the Observatory made more time available and the project continued until December 1976 with an examination of about 700 stars at distances of up to some 65 light years. The prime targets were main sequence stars of the F5 to K5 class. The observations were carried out at 1420 MHz, each of 384 separate receivers being tuned to a slightly different frequency near to the 1420 MHz hydrogen line. A total bandwidth of 3 kHz was used.

At the end of the Project Ozma II work, about 12 stars showed some unexplained phenomena which were probably due to terrestrial radio interference, but which could have been due to faint signals from intelligent beings. These stars will doubtless be examined very carefully at some later date.

Arecibo

Some SETI work has been carried out using the largest telescope in the world at the Arecibo Observatory in Puerto Rico which has a diameter of 305 m (500 feet) in the air. The reflector panels consist of 38,778 individual panels each a little over 1 m by 2 m in size; each pane, must be positioned with an accuracy of better than 1 mm.

In 1967 a British post-graduate student noticed a mysterious regular pulsing signal from space and there was much speculation as to whether this was a signal from intelligent life beaming a message to earth. The Arecibo antenna was used to show that this signal was coming from the first pulsar to be discovered and that it was in the Crab Nebula.



The Goldstone 26 m Deep Space Network Antenna may be used in an all sky search. (Photo by courtesy of Jet Propulsion Laboratory)

Two of the best known SETI workers, Prof. Frank Drake and Prof. Carl Sagan, have used the Arecibo antenna to examine the radiation from whole galaxies for signs of signals from intelligent life. Although the use of this technique has enabled them to examine many millions of suitable types of stars simultaneously, it would require a signal of very great intensity to enable frequencies of 1420 MHz, 1654 MHz and 2380 MHz, but the time allocated to this work is relatively small.

Canadian Work

Dr. Bridle and Dr. Feldman commenced work at Canada's nationally owned Algonquin Radio Observatory in Algonquin Park, Ontario in 1974. They are using a 46 m (150 feet) diameter telescope to examine many of the nearest sun-like stars, but the frequency employed is 22.2 GHz — the emission frequency of the water molecule — which is much higher than that used by other workers.

Project Cyclops

One of the most ambitious SETI projects yet proposed is known as Project Cyclops. This is intended to be suitable for not merely detecting high power signals (such as those from our own Arecibo antenna), but also to allow eavesdropping on much lower intensity signals which other civilizations use for their own communications (like our radio and television transmitters). In order to be able to receive such signals from stellar systems at distances of a few hundred light years from the earth, enormous antenna systems are required.

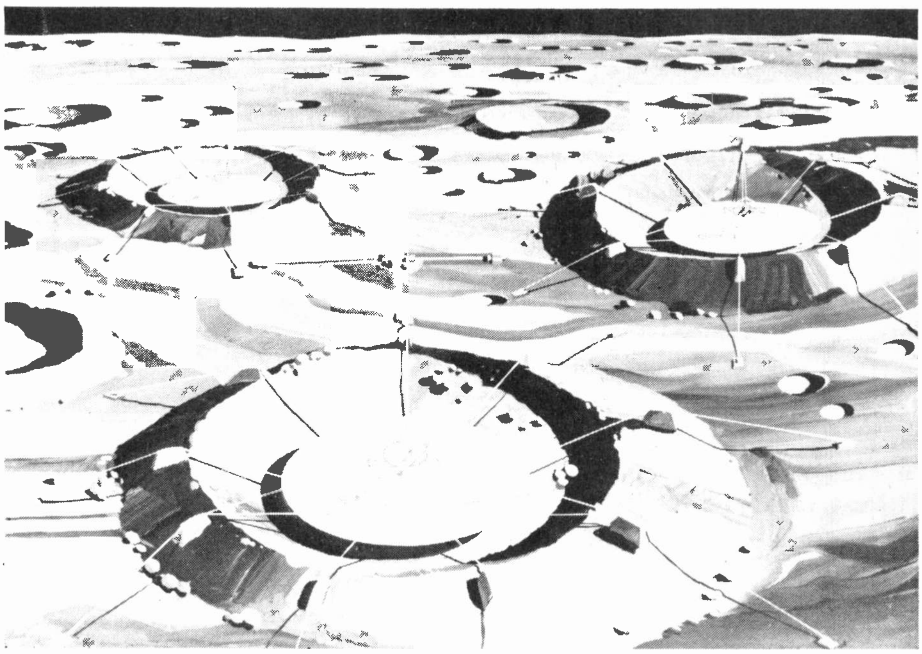
It seems unlikely that it would be a practical possibility to construct a single reflecting dish of adequate size and therefore it has been suggested that the Cyclops project could employ an enormous array of radio telescopes, each of which may be about 100 m in diameter. For example, as many as 1500 such 100 m dishes could be spread out in lines over an area of perhaps 65 km^2 and connected together electrically to provide the same performance as a single dish of enormous dimensions.

Project Cyclops was initiated as a study by the NASA Ames Research Centre and Stanford University in 1971 under the leadership of Dr. John Billingham and Dr. Bernard Oliver. There have been vast improvements since then in solid state memories, microprocessors, wideband maser low-noise amplifiers, etc.

Conclusion

The Search for Extra-Terrestrial Intelligence has not yet been successful, but this is not particularly surprising in view of the small number of star systems which have been examined with high sensitivity equipment. Some people (including many of those who control scientific finance) may feel that the SETI project is rather frivolous and perhaps even a silly one. However, there are many scientists very strongly committed to work in this field — a point which can be demonstrated by the fact that a new journal, *Cosmic Search* devoted entirely to SETI work will be published from January 1979 under the editorship of Dr. Robert S. Dixon who is well-known for his SETI work at the Ohio State University Radio Observatory.

Dr. Frank Drake at times feels somewhat cynical about the cuts in the SETI budgets. Indeed, he has commented that the search for extra-terrestrial intelligence begins with the search for intelligence here on earth! He feels that at the present time there is a very well qualified group of people who are keen to carry out an extensive SETI project and, if no funds are forthcoming for a year or more, it is likely that many of these people will move to other work. If you were paying taxes in a country considering becoming involved in an extensive SETI project, how would you feel about paying an extra amount (far less in total than that to place a man on the moon) in order that the project could proceed? SETI work will doubtless continue, but more funds are required if it is to proceed at a rate which is likely to bring success within the lifetime of most people who are living today. ETI



An artists impression of a complex Cyclops array on the far side of the moon containing 216 large (200 m diam.) reflecting radio telscopes with a control building in the middle of the array. The lunar base is in the middle distance towards the left-hand side and is quite small.
(Photo by courtesy of NASA Ames Research Centre).

ETI BOOK SERVICE

How to order: Make cheques etc payable to ETI Book Service. Payment in sterling only please. Orders should be sent to: ETI Book Service, PO Box 79, Maidenhead, Berks. All prices include P&P.

BEGINNERS

Beginners Guide to **Electronics** Squires £2.65
Beginners Guide to **Transistors** Reddihough £2.65
Electronic Measurement Simplified C. Hallmark £2.20
Electronics **Self Taught** Ashe £4.40
Beginners Guide to **Integrated Circuits** Sinclair £3.15
Principles of Transistor Circuits S. Amos £4.75
Understanding **Electronic Circuits** Sinclair £4.10
Understanding Electronic **Components** Sinclair £4.10
Beginners Guide to **Radio** King £3.15
Beginners Guide to **Audio** Sinclair £3.10

COOKBOOKS

TV Typewriters Cookbook £7.75
CMOS Cookbook £8.20
Active Filters £11.30
IC Timer Cookbook £7.50
IC Op-Amp Cookbook £10.00
Video Cookbook £7.00
TTL Cookbook £7.55

APPLICATIONS

Advanced Applications for **Pocket Calculators** J. Gilbert £4.20
Build Your Own Working **Robot** D. Heisman £3.70
Electronics and **Photography** R. Brown £2.30
Fire and Theft **Security Systems** B. Weis £2.00
How To Build **Proximity Detectors and Metal Locators** J. Shields £3.90
How To Build Electronic Kits Capel £2.10
Linear Integrated Circuit Applications G. Clayton £5.40
Function Circuits Design & Applications Burr Brown £15.95
110 Electronic **Alarm Projects** R. M. Marston £3.45
110 **Semiconductor Projects** for the Home Constructor R. M. Marston £3.25
110 **Integrated Circuit** Projects for the Home Constructor R. M. Marston £3.25
110 **Thyristor** Projects Using **SCRs** R. M. Marston £2.95
Handbook of **IC Circuit Projects** Ashe £2.30
Practical Electronic **Project Building** Ainslie and Colwell £2.45

TV AND HI-FI

Audio Handbook G. King £6.50
Cassette Tape Recorders J. Earl £5.25
Solid State **Colour TV** Circuits G. R. Wilding £6.35
Hi-Fi Loudspeakers and Enclosures Cohen £8.20
How To Build **Speaker Enclosures** Badmateff £3.90
Master Hi-Fi **Installation** King £2.80

LOGIC

Logic Design **Projects** Using Standard ICs J. Wakerly £5.10
Practical Digital Design Using ICs J. Greenfield £12.50
Designing With **TTL Integrated Circuits** Texas Instruments £9.05
How To Use **IC Circuit Logic Elements** J. Streater £3.65
110 **COSMOS** Digital **IC** Projects for the Home Constructor R. M. Marston £3.20
Understanding **CMOS Integrated Circuits** R. Meien £4.00
Digital Electronic **Circuits and Systems** R. M. Morris £3.50
MOS Digital ICs G. Flynn £5.10

COMPUTING

Microprocessors and Microcomputers B. Soucek £18.80
Microprocessors D. C. McGlynn £8.40
Introduction to **Microprocessors** Aspinall £6.40
Beginners Guide to Microprocessors £4.70
Beginners Basic Gosling £3.35

OP-AMPS

Applications of Operational Amplifiers Graeme (Burr Brown) £8.30
110 **Operational Amplifier Projects** for the Home Constructor R. M. Marston £2.95
Experiments With Operational Amplifiers Clayton £3.40
Designing With Operational Amplifiers Burr Brown £16.65
Operational Amplifiers **Design and Applications** G. Tobery (Burr Brown) £7.40
Op-Amp Circuit **Design & Applications** J. Carr £4.00

TEST INSTRUMENTS

The **Oscilloscope** In Use Sinclair £3.10
Test Instruments for Electronics M. Clifford £2.40
Working With the **Oscilloscope** A. Saunders £1.95
Servicing With the **Oscilloscope** G. King £5.60
Radio Television and Audio Test Instruments King £5.90

SERVICING

Electronic **Fault Diagnosis** Sinclair £3.20
Rapid Servicing of Transistor Equipment G. King £2.95
Tape Recorder Servicing Manual Gardner Vol. 1: 1968-70 £8.50
Vol. 2: 1971-74 £8.50
FM Radio Servicing Handbook King £4.80

COMMUNICATIONS

Communication Systems Intro To Signals & **Noise** B. Carlson £7.50
Digital Signal Processing Theory & Applications L. R. Rabiner £23.80
Electronic Communication Systems G. Kennedy £8.50
Frequency Synthesis. Theory & Design Mannassewitsch £23.40
Principles of Communication Systems H. Taub £8.10

THEORY

Introduction to **Digital Filtering** Bogner £10.20
Transistor **Circuit Design** Texas Instruments £9.35
Essential Formulae for Electrical and Electronic Engineers N. M. Morris £1.65
Modern Electronic **Maths** Clifford £6.70
Semiconductor Circuit Elements T. D. Towers £6.40
Foundations of Wireless **Electronics** M. G. Scroggie £4.45
Colour Television Theory Hudson £6.20

REFERENCE

Transistor Tabelle (Includes physical dimensions) £4.10
Electronic Engineers Reference Book (Ed. 4) L. W. Turner £27.70
Solid State **Circuit Guide Book** B. Ward £2.25
Electronic **Components** M. A. Colwell £2.45
Electronic **Diagrams** M. A. Colwell £2.45
Indexed Guide to Modern Electronic Circuits Goodman £2.30
International **Transistor Selector** T. D. Towers £6.00
International **FET Selector** T. D. Towers £4.35
Popular Valve/Transistor Substitution Guide £2.25
Radio Valve and Semiconductor Data A. M. Bell £2.60
Master **Transistor/Integrated Circuit** Substitution Handbook £5.60
World Radio TV Handbook 1978 (Station Directory) £8.00
Radio, TV and Audio **Technical Reference** Amos £24.85
TV Technicians **Bench Manual** (New Ed.) Wilding £5.10

MISCELLANEOUS

Integrated Electronics J. Milman £7.90
Microelectronics Hallmark £3.90
Practical Solid State DC Supplies T. D. Towers £6.20
Practical Triac/SCR Projects for the Experimenter R. Fox £2.25
Printed Circuit Assembly Hughes & Colwell £2.45

Fallen behind recent advances?
Just starting out?
Need a decent reference book?
ETI Book Service provides an easy way of getting your hands on the right title.

TUNER ~ AMPLIFIER

PART TWO: This month we conclude the System 8000 project with the setting up procedure and a description of the digital frequency readout.

THE SETTING UP and alignment must be approached in a systematic fashion.

Procedure

a) Power Supply
b) Power Amp L & R
c) Auxilliary
d) Tone Controls
e) Filter Controls
f) Tape
g) Magnetic pre-amplifier
h) FM sections
I) AM
J) Frequency read out module

Before commencing alignment it is necessary to check that:

i) All wiring has been checked and components are correctly positioned and orientated
ii) That there are no solder bridges
iii) A good multimeter is also required

Power Supply

Remove all fuses except for the mains fuse. Switch on, you should hear the relay click over. Measure from earth to positive and negative on the smoothing capacitors. The voltage should read approximately plus or minus 50V. Check that regulator reads about 30V. Switch off.

Power Amp

Check each power amp in turn, ensure that speakers are switched out. Using a meter, do a resistance check from the case of each power transistor to chassis to ensure that there is no short. Find two high wattage resistors (56R-300R will do) and place in fuse holders of amp being checked.

Switch on volume control (minimum). If there appears to be no problems feel cases of power transistors — should be cool. Switch on speaker. Power transistors may be slightly warm. Now 'Buzz' input pins of the amplifier with your finger. If okay switch off, remove the resistor fuses, insert two amp fuses. Switch on, if everything is okay one can now set RV1.

If you have access to a low distortion audio generator put this on the input and a distortion meter across the speaker sockets using a dummy load. Feed in 100mV sine wave and set for minimum distortion. Without this test equipment set RV1 to mid travel. Repeat for other channel.

Tone and Filters

Insert either an audio generator, or any music source such as a tape-recorder, into the Aux. socket. Select Aux. on switchbank, slowly increase volume, and listen to sound, check that the tone controls are working. To check the high and low filters turn the bass control on full and this will emphasise the rumble filter, likewise the treble control will emphasis the scratch filter.

Tape

If the above is working, check that pressing tape 1 and tape 2 disconnects the Aux. Transfer the tape recorder/audio generator to take 1 and 2 in turn and ensure that ▶

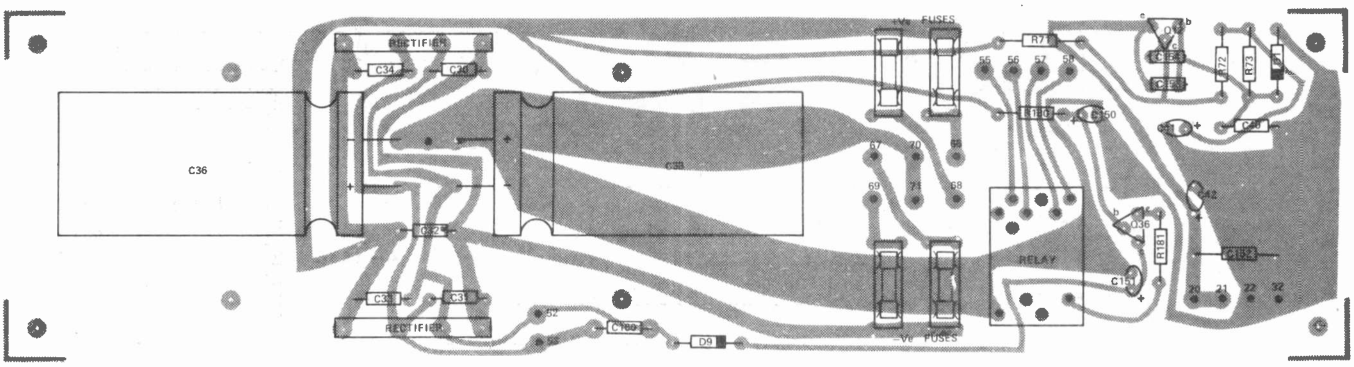


Fig. 1. Component overlay for the power supply board.

pressing the respective switch brings them into circuit. The pre-set resistors are adjusted to match the levels of your own tape recorders otherwise they can be turned full on.

Magnetic
Using a record player with a magnetic cartridge check that everything sounds okay. Excessive hum indicates an earthing fault.

FM
Before aligning this section it may be an advantage to set the frequency counter straight away. However, this is not essential. The tuner head is pre-aligned and will not need adjustment. Tune through the band with an aerial connected — ensure that mute and AFC are off. You should hear a continuous hiss, with stations heard between 88 MHz and 95 MHz. If this is so, tune to an area above 95 MHz without stations and adjust using a non-inductive tool L4 until centre zero needle is centred. This should correspond with maximum hiss level. L3 can only be adjusted ideally if an FM signal generator is used. Generate 100 MHz, attach a distortion meter to pin 6 of the CA3189E, there is a test pin for this, tune for maximum signal strength and adjust L3 for minimum distortion. Re-adjust L4 for centre zero. Adjust L1 for maximum signal level. RV11 is the muting adjustment, and can be set all the way from no mute to absolute quiet between stations — however, do not overset, as the mute may not lift quickly enough when tuning a station.

Move next to the stereo decoder, KB 4437 — either:—tune to a stereo broadcast, set RV6 to the middle of the range that brings the stereo light on, set VC5 and RV7 for mid-way; or:—using a stereo generator, adjust VC5 and RV6 for maximum, set separation at 1 kHz. Observing the 19 kHz component of the multiple signal on a oscilloscope, set RV7 for minimum 19 kHz. This completes the FM.

Amplitude Modulation
The frequency counter can help considerably, and an AM generator is an asset.

MW Tune to minimum volts on varicap line, feed in a 470 kHz signal, peak until there is no improvement, Tune L9 for a 550 kHz station. Move to maximum varicap volts, set CV1 for a 1620 kHz signal. Tune up and down the band checking that 550-1620 kHz is covered without any shifting in noise level. Tune to 600 kHz. Peak L5 and L7 for maximum. Tune to 1400 kHz. Peak CV2 and CV4 for maximum. Repeat until there can be no improvement. RV8 is set to give a satisfactory signal level reading on the meter.

LW Switch to LW. Set CV3 so that minimum varicap volts 175KHz. Tune to 200 kHz (Radio 4) peak L6 and L8 for maximum. If no generator

▶

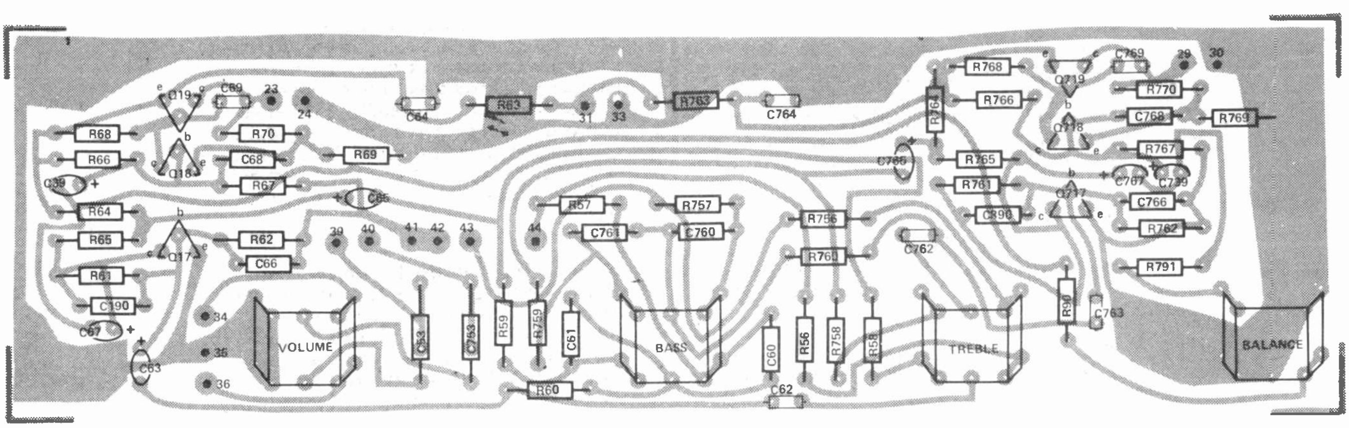


Fig. 2. Component overlay for the tone control board.

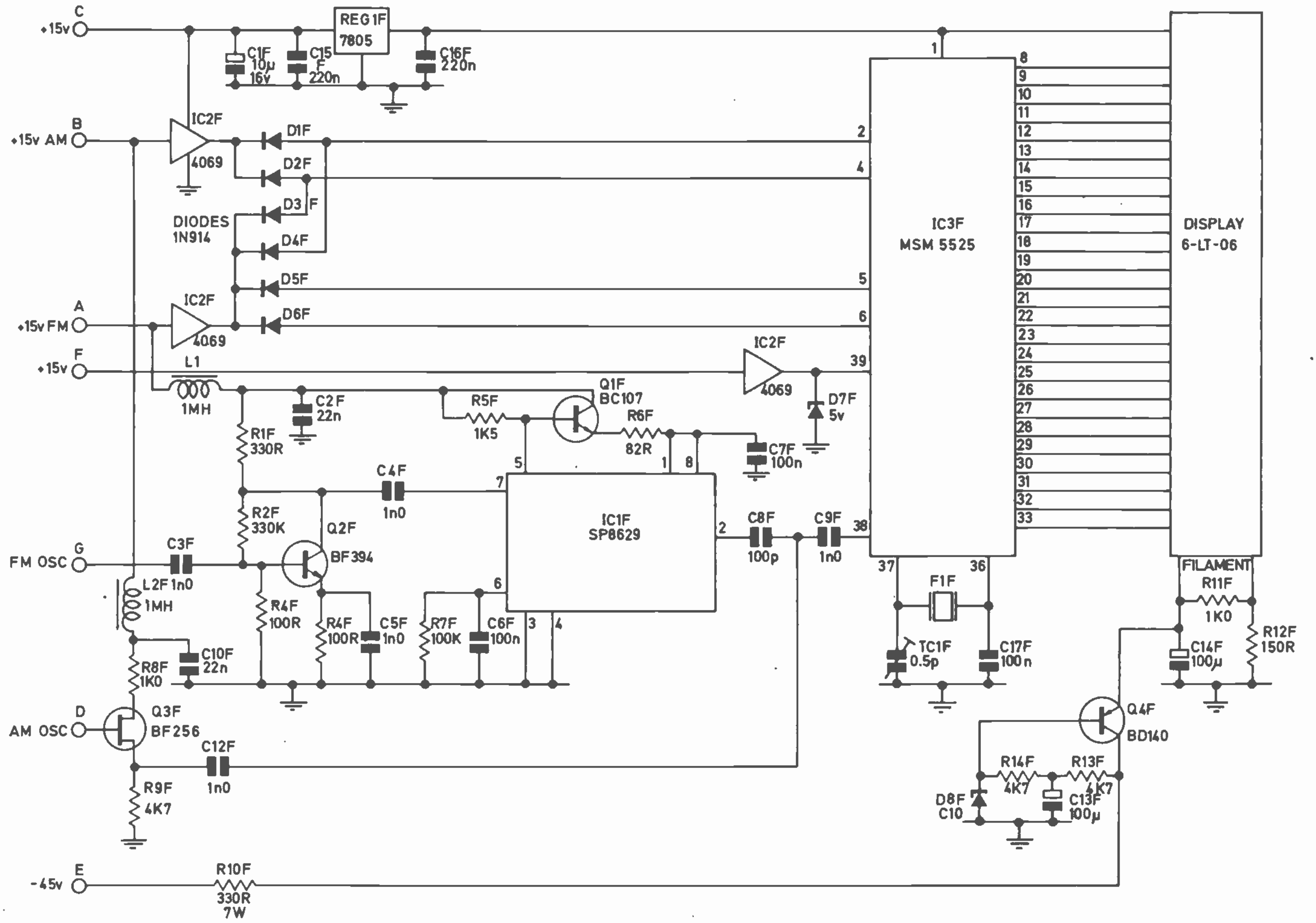


Fig. 3. Circuit diagram of the digital frequency meter.

HOW IT WORKS

A digital frequency readout is both cost effective and an accurate method of displaying the frequency of a radio station. GEM has been developed to interface directly with the tuner sections of the SYSTEM 8000, and most existing AM/FM receivers.

The principle of operation is simple, and is a progression from the many digital clock ICs. Basically, the oscillator of the radio being 'read' is fed (via buffer stages) into the 5525, and converted to digital pulses. These are counted by the IC, for a period determined by the external crystal, and the count is fed to the display.

Allowance is made for the IF offset of the radio — 470 kHz and 10 k7Hz. This offset is externally programmed by the diodes DI-D6.

In this application, the source for switching from AM to FM is obtained from the switch bank of the System 8000, and uses the positive power line. This is converted from a 'Hi' to a 'Lo' signal by IC2, a HEX invertor. The beauty is that the buffer stages for the AM/FM oscillators are also switched off when not in use, and thus cannot cause interference.

Because the display would be running when the tuner is not being used. A section of the hex invertor takes an additional 15V input (F) and uses this to reset the counter and thus give a fixed reading. D7 ensures that this signal cannot accidentally exceed 5V. The unit must be earthed directly to the central earthing point of the system 8000, otherwise noise may be fed back into the system.

The unit may be used independently of course and requires ±12V at least, for operation. If using a supply of lower than ±20V, omit R10. Maximum supply is ±35V. Other IF offsets may also be programmed in. It uses a fluorescent display for a good readibility and gives AM/FM and MHz/kHz indication.

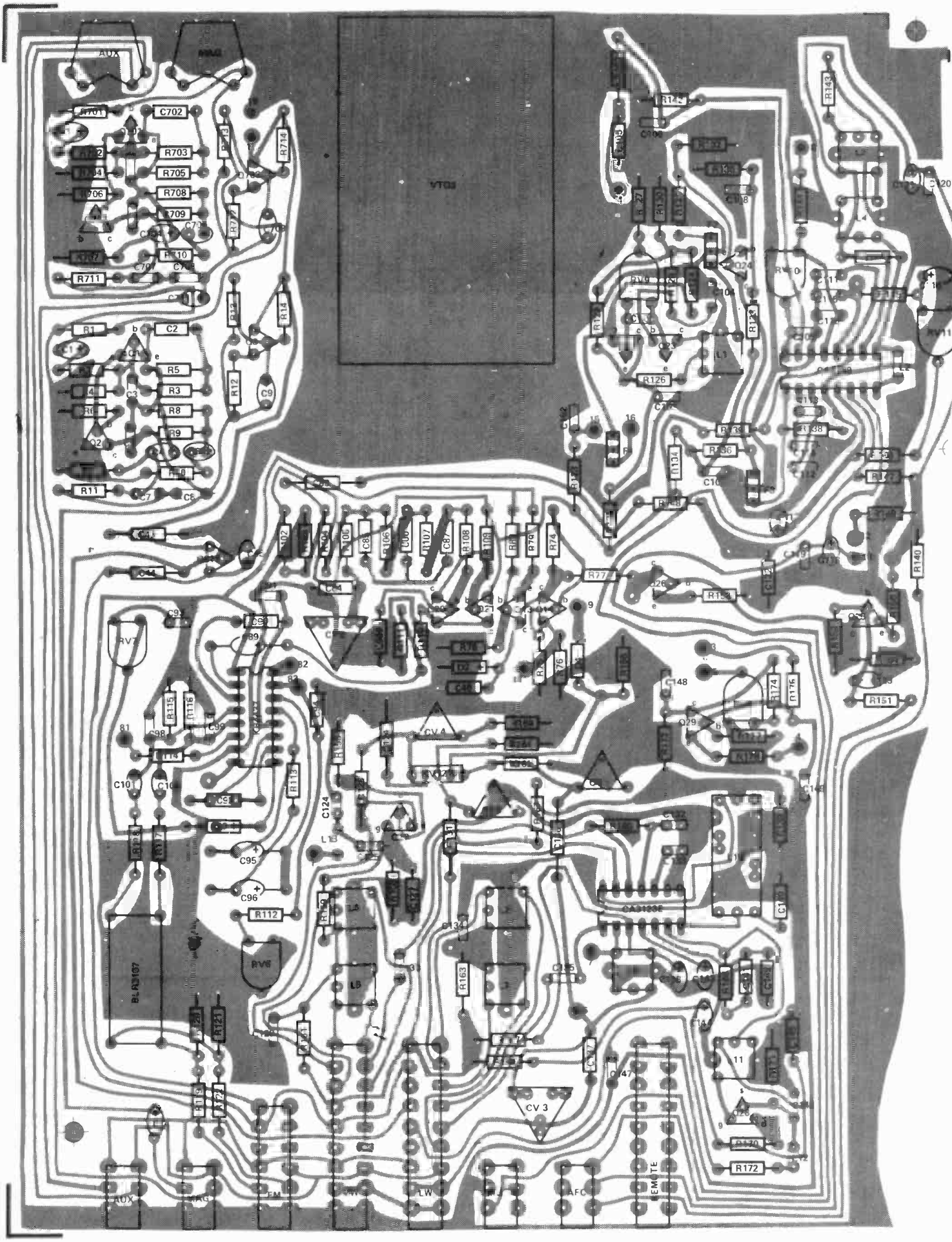
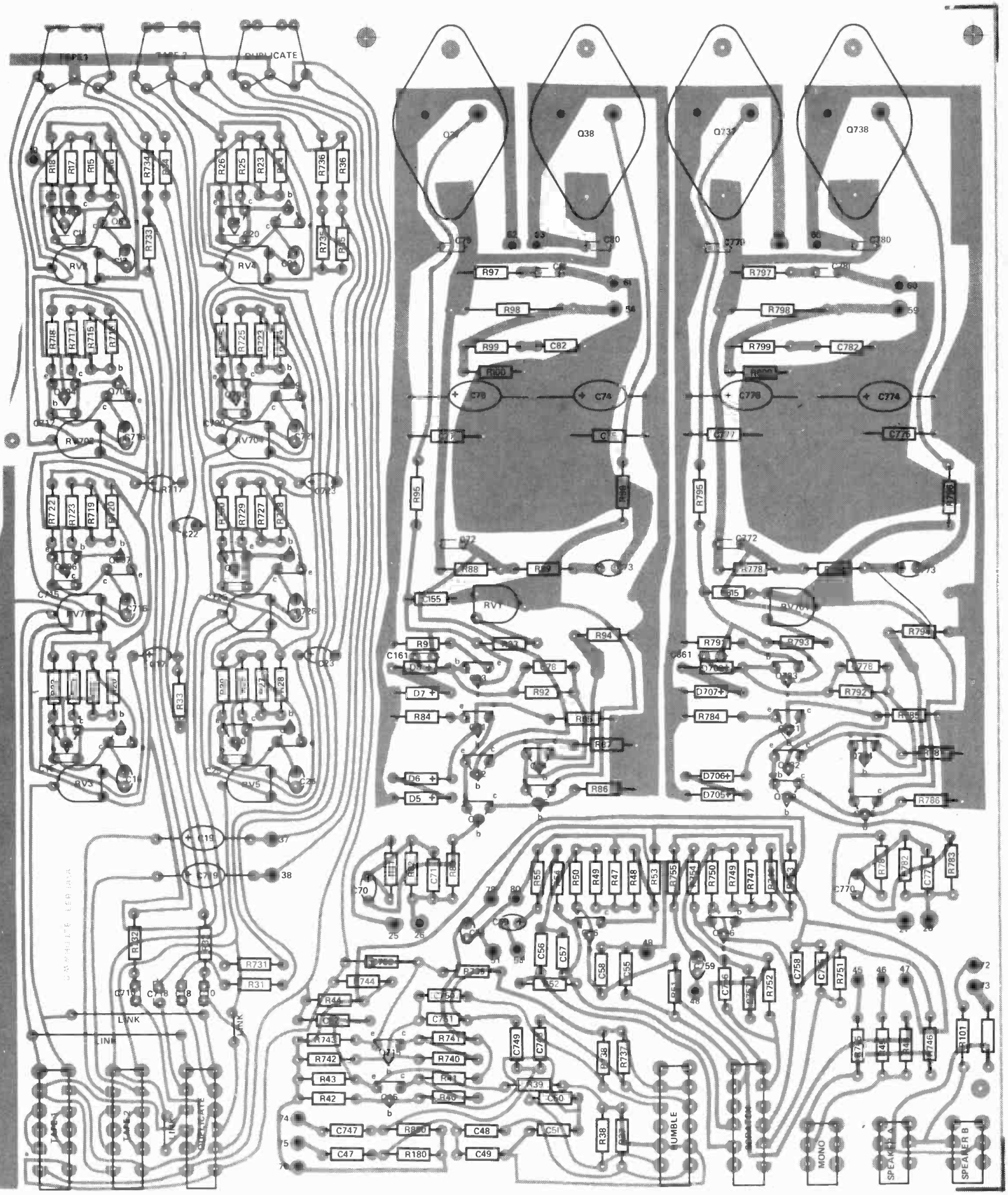


Fig. 4. Component overlay for the System 8000 main board. Check this board very carefully before you switch on, particularly capacitor and diode polarity and transistor connections.


DUPLICATE
Q38
Q738
R97
R98
R99
C82
R797
R798
R799
C782
C74
C774
R95
R795
R88
R778
C155
RV1
R94
R794
R92
R84
R784
R86
R786
D7
D6
D5
D707
D706
D705
C19
C719
R731
R31
LINK
C747
C47
R180
C48
C49
C51
R42
R43
R742
R743
R740
R741
C749
R38
R737
RUMBLE
MONO
SPEAKER A
SPEAKER B

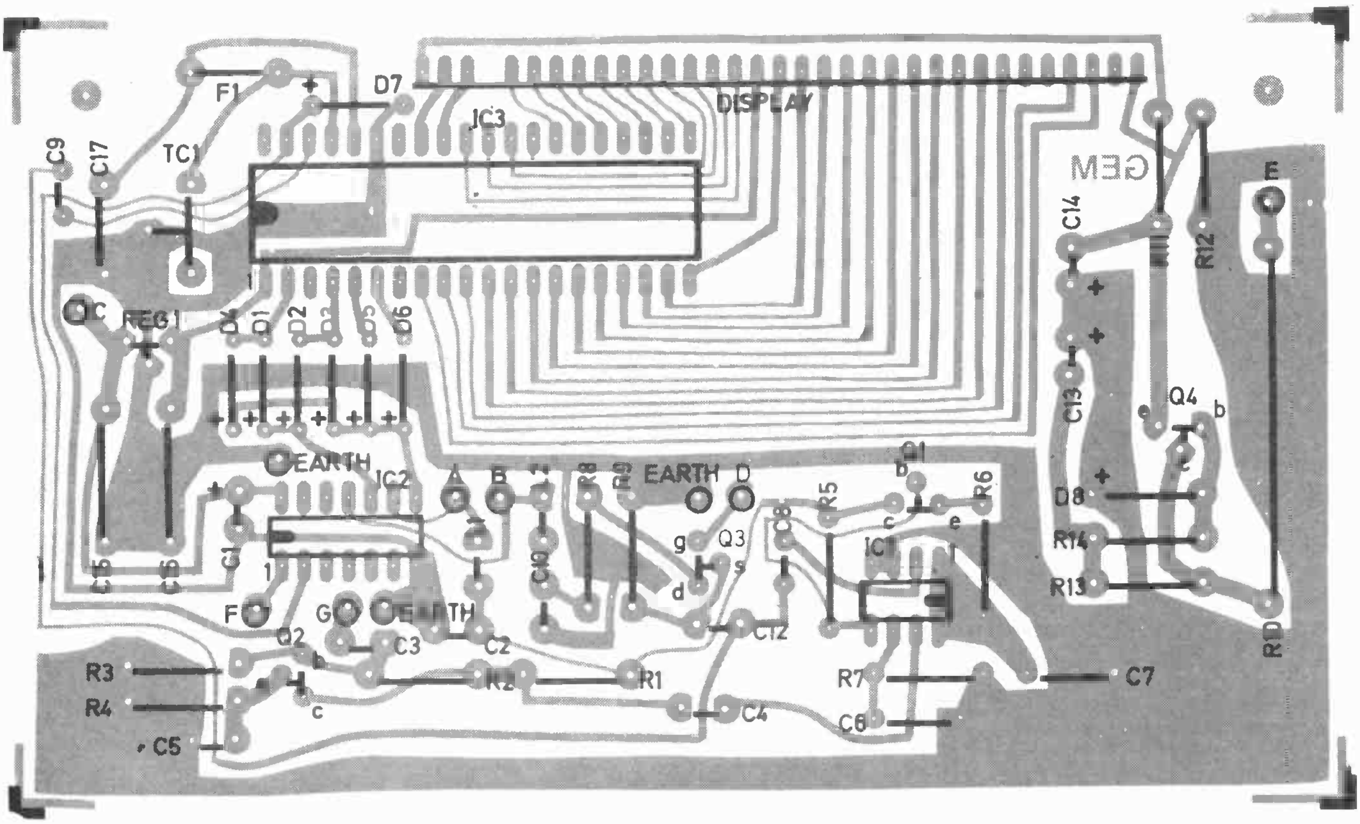
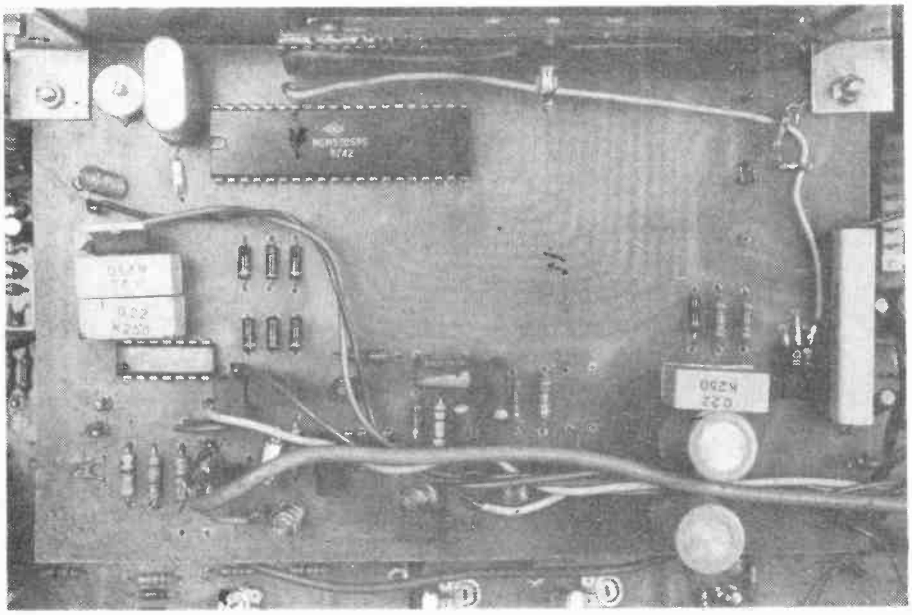


Fig. 5. Component overlay for the digital frequency meter board.

(Below) The digital frequency meter display and driver board.



is available, the digital frequency counter can be peaked. L11, L10, can be set for maximum output (be careful — small adjustment only).

Readout

The frequency counter should need no adjustment, however, if another frequency counter is available, the crystal input should be tuned to precisely 6553k6Hz with TC1.

NB: It has been found in practice that two laminated transformers give excellent regulation and a low hum field, also low voltage taps are available to power the centre zero and signal meter. The metal case will take both torroidal and conventional transformers.

ETI

PARTS LIST

RESISTORS (all ½W 5%)

R1, 10	330R
R2	330k
R3	1M
R4	100R
R5	1k5
R6	82R
R7	100k
R8, 11	1k
R9, 13, 14	4k7
R12	150R

CAPACITORS

C1, 14	10u 16V electrolytic
C2, 10	22n polyester
C3, 4, 5, 9, 12	1n polyester
C6, 7	100n polyester
C8	100p ceramic
C13	100n 45V electrolytic
C14, 15	220n polyester
C17	22p ceramic

SEMICONDUCTORS

Q1	BC107
Q2	BF394
Q3	BF256
Q4	BD140
IC1	5525
IC2	4069
IC3	SP8629
D1-6	1N914
D7	5V 400mW zener
D8	10V 400mW zener
Reg.	7805

INDUCTORS

L1 2	1mH

MISCELLANEOUS

TC1-0-50p, F1—6553k6 H7 X71, 6LT06 display, PCB

Pin Wiring for PCBs

1/ AM Aerial
2/ }
3/ } —Link
4/ To +Ve of signal level
5/ To —Ve of signal level and pin (8)
6/ Output to D.F.D.
7/ Test Point
8/ To pin (5)
9/ of Varicap pot
10/ +12V end of Varicap pot
11/ +1V end of Varicap pot
12/ }
13/ } —Link
14/ to (3) on Tunerhead
15/ to (6) on Tunerhead
16/ to (8) on Tunerhead
17/ to pin (19), and pin 20 (on Power Board)
18/ to pin 22 (on power board)
19/ to pin (17)
20/ to pin (19)
21/ to pin ((31) (on Tone Board)
22/ to pin (18)
23/ to pin (25)
24/ to pin (26)
25/ to pin (23)
26/ to pin (24)
27/ to pin (29)
28/ to pin (30)
29/ to pin (27)
30/ to pin (28)
31/ to pin (31)
32/ }
33/ } to pin (33)
34/ to pin (37)
35/ Earth
36/ to 38 pin
37/ to pin (34)
38/ to pin (36)
39/ to pin (45)
40/ to pin (46)
41/ to pin (47)
42/ Earth pin 49 and 51
43/ pin 48
44/ pin 50
45/ pin 39
46/ pin 40
47/ pin 41
48/ pin 43
49/ Earth pin 42
50/ pin 44
51/ Earth pin 42
52/ }
53/ } to 56V winding of Transformer
54/ }
55/ } Connect
56/ to speaker switch L
57/ to speaker switch R
58/ }
59/ } Connect
60/ pin 70
61/ pin 71
62/ +45V fuse 66
63/ —45V fuse 67
64/ +45V fuse 68
65/ —45V fuse 69
66/ to 62
67/ to 63
68/ to 64
69/ to 65
70/ to 60
71/ to 61
72/ }
73/ } —to L and R of Head-Phones
74/ —L
75/ —R to FM switch
76/ Earth
77/ on FM switch, to mono switch
78/ +15V
79/ on mono switch, to stereo. LED anode
80/ Earth
81/ to stereo LED
82 }
83/ } mono options, disconnected

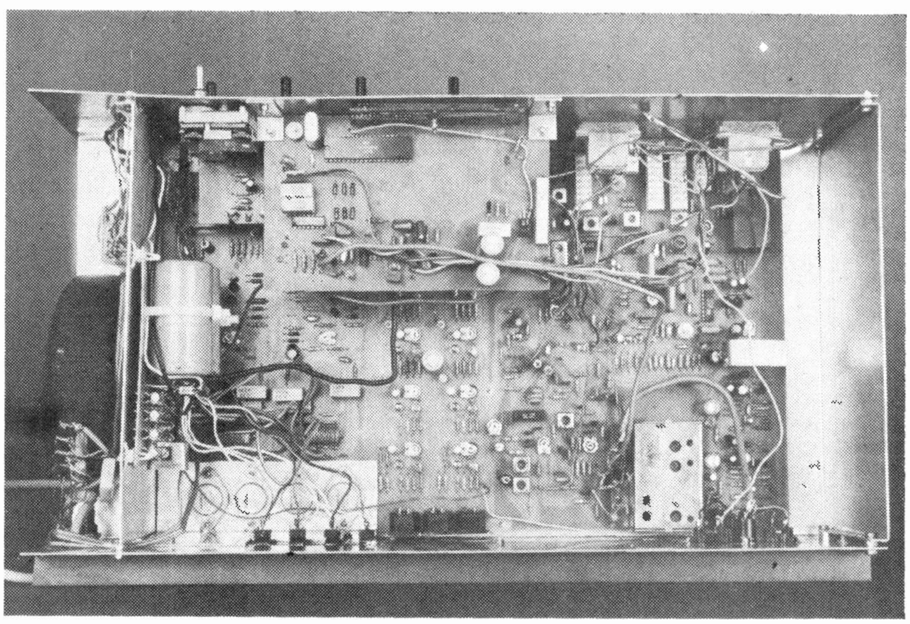
All other earth connections to tabs of power board—including centre-tap of transformer.

CORRECTIONS FOR DIGITAL FREQUENCY DISPLAY
pin 7—(FM tuner lead) to pin 100
pin (6) —to pin 101

Uni-Electric have sent us the following list of corrections to the parts list and circuit diagrams published last month.

C105 in 100n.
Circuit diagram shows a short from output of 7815 to earth. Omit indicated line.
Switch marked 'rumble' is tape switching.
'Mono' switch, left channel shown connected to earth, via a 470k resistor. This should be connected to Mono switch via a 1k resistor.
C67 and C150 are 10 uf capacitors.
C136 is 470p. C137 is 330p. 10n capacitor omitted from pin 7 to CFU050D. C147 is 10n. R171 is 10k.
R120 are R121 are 47k. Base of Q20 is shown shorted to earth — should be a 47p capacitor here.
R10 is shown connected to the base of Q2, and Q2 connected to earth. This is wrong, R10 goes to earth and not to Q2, R3 is 47R, not 47k.
Mast head preamp uses 2 not 5 Mosfets.
AM coverage is 2 band not 5 band.
Sensitivity is 1.0 uV not 10 V.

In Buylines, the complete kit with metalwork is £165. Uni-Electric will align the RF sections and check finished mother boards for £15.00.



An internal view of the complete unit, ready for the setting up procedure. The digital frequency meter board is top centre.

STEVENSON
Electronic Components

REGULATORS

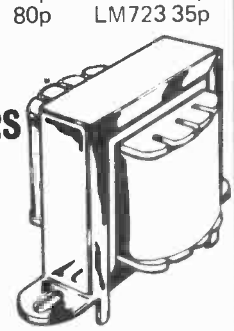
78L05	30p	7805	60p	79L05	70p	7912	80p
78L12	30p	7812	60p	79L12	70p	7915	80p
78L15	30p	7815	60p	7905	80p	LM723	35p

HARDWARE

MINIATURE TRANSFORMERS

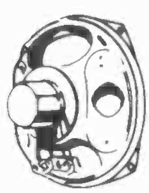
240 Volt Primary

Secondary rated at 100mA.
Available with secondaries of:
6 - 0 - 6, 9 - 0 - 9 and
12 - 0 - 12. 92p. each.



LOUDSPEAKERS

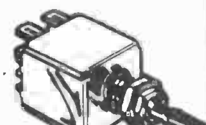
56mm dia. 8 ohms	70p
64mm dia. 8 ohms	75p
64mm dia. 64 ohms	75p
70mm dia. 8 ohms	100p
70mm dia. 80 ohms	110p



TERMINALS

Rated at 10A. Accepts 4mm plug, black, blue, green, brown and red . . . 22p

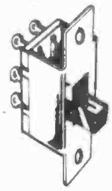
SWITCHES



Subminiature toggle. Rated at 3A 250V.
SPDT 70p SPDT centre off 75p
DPDT 80p DPDT centre off 95p

Standard toggle
SPST 34p DPDT 48p

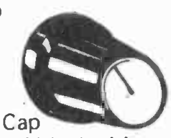
Wavechange switches.
1P12W, 2P6W, 3P4W or 4P3W all 43p ea.



Miniature switches (non-locking)
Push to make 15p Push to break 20p

Slide switches (DPDT)
Miniature 14p Standard 15p

CONTROL KNOBS



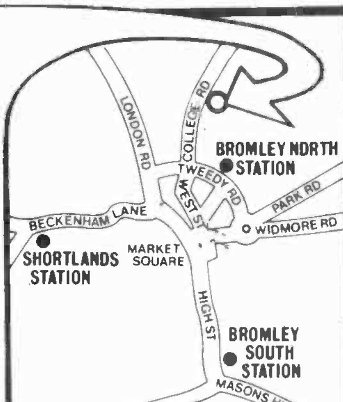
Ideal for use on mixers etc. Push on type with black base and marked position line. Cap available in red, blue, green, grey, yellow and black. 14p

WHY NOT VISIT OUR

NEW SHOP

We welcome callers at our new premises at the address below (5 mins. from High St.) We are open Mon - Sat, 9am - 6pm. Special offers available.

**Express telephone order service. Orders received before 5pm. are shipped first class on that day. Contact our Sales Office now!
Tel: 01-464 2951/5770.**



ORDERS DESPATCHED BY RETURN POST

Quantity discounts on any mix TTL, CMOS, 74LS and Linear circuits: 100+ 10%, 1000+ 15%. Prices VAT inclusive. Please add 30p for carriage. All prices valid to April 1980. Official orders welcome.

BARCLAYCARD & ACCESS WELCOME.

TRANSISTORS

				ZTX109	14p
				ZTX300	16p
				2N697	12p
				3N1302	38p
AC127	17p	BCY71	14p	2N2905	22p
AC128	16p	BCY72	14p	2N2907	22p
AC176	18p	BD131	35p	2N3053	18p
AD161	38p	BD132	35p	2N3055	50p
AD162	38p	BD135	38p	2N3442	135p
BC107	8p	BD139	35p	2N3702	8p
BC108	8p	BD140	35p	2N3704	8p
BC109	8p	BF244B	36p	2N3705	9p
BC147	7p	BFY50	15p	2N3706	9p
BC148	7p	BFY51	15p	2N3707	9p
BC149	8p	BFY52	15p	2N3708	8p
BC148	9p	MJ2955	98p	2N3819	22p
BC177	14p	MPSA06	20p	2N3904	8p
BC178	14p	MPSA56	20p	2N3905	8p
BC179	14p	TIP29C	60p	2N3906	8p
BC182	10p	TIP30C	70p	2N4058	12p
BC182L	10p	TIP31C	65p	2N5457	32p
BC184	10p	TIP32C	80p	2N5458	30p
BC184L	10p	ZTX107	14p	2N5459	32p
BC212	10p	ZTX108	14p	2N5777	50p
BC212L	10p				
BC214	10p				
BC214L	10p				
BC477	19p				
BC478	19p				
BC479	19p				
BC548	10p				
BCY70	14p				

DIODES

1N914	3p	1N5401	13p
1N4001	4p	BZY88ser.	8p

Full spec. product.
1N4148 £1.40/100. £11/1000

LINEAR

THIS IS ONLY A SELECTION!

		CA3140	38p	NE555	21p
		LM301AN	26p	NE556	50p
		LM318N	85p	NE565	85p
		LM324	45p	NE567	170p
		LM339	45p	SN76003	200p
709	28p	LM380	75p	SN76013	140p
741	16p	LM382	120p	SN76023	140p
747	40p	LM1830	150p	SN76033	200p
748	30p	LM3900	50p	SN76477	220p
CA3046	55p	LM3909	65p	TBA800	70p
CA3080	70p	MC1496	60p	TDA1022	650p
CA3130	90p	MC1458	32p	ZN414	75p

CAPACITORS

TANTALUM BEAD each

0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 & 2.2uF @ 35V	8p
4.7, 6.8, 10uF @ 25V	13p
22 @ 16V, 47 @ 6V, 100 @ 3V	16p

MYLAR FILM

0.001, 0.01, 0.022, 0.033, 0.047	3p
0.068, 0.1	4p

POLYESTER
Mullard C280 series

0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1	5p
0.15, 0.22	7p
0.33, 0.47	10p
0.68	14p
1.0uF	17p

CERAMIC
Plate type 50V. Available in E12 series from 22pF to 1000pF and E6 series from 1500pF to 0.047uF . . . 2p

RADIAL LEAD ELECTROLYTIC

63V	0.47	1.0	2,2	4.7	10	5p
			22	33	47	7p
	100					13p
			220			20p
25V	10	22	33	47		5p
	100					8p
		220				10p
				470		15p
	1000					23p

CONNECTORS

JACK PLUGS AND SOCKETS

	screened	unscreened	socket
2.5mm	9p	13p	7p
3.5mm	9p	14p	8p
Standard	16p	30p	15p
Stereo	23p	36p	18p

DIN PLUGS AND SOCKETS

	plug	chassis socket	line socket
2pin	7p	7p	7p
3pin	11p	9p	14p
5pin 180°	11p	10p	14p
5pin 240°	13p	10p	16p

1mm PLUGS AND SOCKETS
Suitable for low voltage circuits, Red & black. Plugs: 6p each Sockets: 7p each.

4mm PLUGS AND SOCKETS
Available in blue, black, green, brown, red, white and yellow. Plugs: 11p each Sockets: 12p each

PHONO PLUGS AND SOCKETS

Insulated plug in red or black	9p
Screened plug	13p
Single socket . 7p Double socket	10p

74LS

		LS73	25p	LS156	60p
		LS74	25p	LS157	48p
		LS75	30p	LS164	65p
LS00	13p	LS76	25p	LS174	48p
LS01	13p	LS78	35p	LS175	48p
LS02	13p	LS83	35p	LS190	62p
LS03	13p	LS85	70p	LS192	60p
LS04	13p	LS86	30p	LS193	60p
LS08	15p	LS90	36p	LS196	60p
LS10	13p	LS93	38p	LS251	50p
LS13	28p	LS95	45p	LS257	50p
LS14	45p	LS123	70p	LS258	50p
LS20	13p	LS125	38p	LS266	30p
LS30	13p	LS126	38p	LS283	60p
LS32	16p	LS132	60p	LS290	60p
LS37	24p	LS136	28p	LS365	40p
LS40	17p	LS138	50p	LS366	40p
LS42	40p	LS139	50p	LS367	40p
LS47	90p	LS151	50p	LS368	40p
LS48	70p	LS153	50p	LS386	35p
LS54	15p	LS155	55p	LS670	140p

TTL

		7454	12p	74132	45p
		7473	20p	74141	55p
		7474	22p	74148	90p
		7475	25p	74150	55p
7400	10p	7476	20p	74151	40p
7401	10p	7485	55p	74156	40p
7402	10p	7489	135p	74157	40p
7404	12p	7490	25p	74164	55p
7408	12p	7492	30p	74165	55p
7410	10p	7493	25p	74170	100p
7413	22p	7494	45p	74174	50p
7414	39p	7495	35p	74177	50p
7420	10p	7496	45p	74190	50p
7427	20p	74121	25p	74191	50p
7430	10p	74122	38p	74192	50p
7442	38p	74123	38p	74193	50p
7447	45p	74125	35p	74196	50p
7448	50p	74126	35p	74197	50p

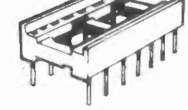
CMOS

		4018	55p	4050	25p
		4023	12p	4066	35p
		4024	40p	4068	18p
4001	12p	4026	90p	4069	12p
4002	12p	4027	30p	4071	12p
4007	12p	4028	48p	4081	13p
4011	12p	4029	50p	4093	45p
4013	28p	4040	60p	4510	65p
4015	50p	4042	50p	4511	65p
4016	30p	4046	90p	4518	65p
4017	48p	4049	25p	4520	60p

FULL DETAILS IN CATALOGUE!

SKTS

Low profile by Texas



8 pin	8p	16 pin	11p	28 pin	22p
14 pin	10p	24 pin	18p	40 pin	32p

Soldercon pins: 100:50p. 1000:370p

OPTO

LED's	0.125in.	0.2in	each	100+
Red	TIL209	TIL220	9p	8p
Green	TIL211	TIL221	13p	12p
Yellow	TIL213	TIL223	13p	12p
Clips	3p	3p		

DISPLAYS

DL704	0.3 in CC	130p	120p
DL707	0.3 in CA	130p	120p
FND500	0.5 in CC	100p	80p

RESISTORS

Carbon film resistors. High stability, low noise 5%.

E12 series. 4.7 ohms to 10M. Any mix:

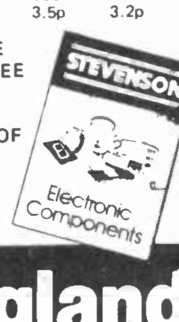
	each	100+	1000+
0.25W	1p	0.9p	0.8p
0.5W	1.5p	1.2p	1p

Special development packs consisting of 10 of each value from 4.7 ohms to 1 Megohm (650 res) 0.5W £7.50. 0.25W £5.70.

METAL FILM RESISTORS
Very high stability, low noise rated at ¼W 1%. Available from 51ohms to 330k in E24 series. Any mix:

	each	100+	1000+
0.25W	4p	3.5p	3.2p

PLEASE WRITE FOR YOUR FREE COPY OF OUR NEW 64 PAGE CATALOGUE OF COMPONENTS. CONTAINS OVER 2500 STOCK ITEMS.



Mail orders to: STEVENSON (Dept ET)

76 College Road, Bromley, Kent, England

DESIGNER'S NOTEBOOK

A monthly look at the notebook of ETI's chief design engineer, project editor Ray Marston.

AUNTI IRIS (the one with the big eyes) says that the ETI gremlins loved last month's "Notebook." They gobbled up the original figure 1 (a method of precision gating a 555 astable) and left a copy of Fig 4 (a 555 pulse expander) in it's place. To set the record straight, this month's Fig 1 shows what last month's Fig 1 should have looked like. I hope aunti Sible approves.

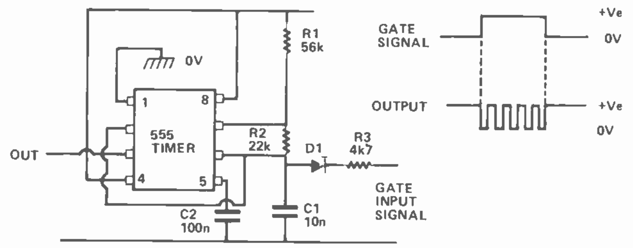


Fig. 1. Here it is in all its glory, the missing link, Fig 1 from last month — a precision gated astable.

Who Loves Yer, Baby?

Regular readers of ETI will have noticed that the design team has a particular love of the CD4017 IC. This modestly priced (about 80 pence in 1 off quantities) little device glories in the title of a "decade counter/divider with ten decoded outputs." It's the "ten decoded outputs" bit of the title that makes us really like the device, because those outputs can be used to do a lot of useful things.

The ten decoded outputs of the B-series 4017 can be used to directly drive a bank of LED's to make pretty displays, or to switch tone generators to create pretty tunes. Alternatively, outputs can be coupled back to the devices control terminals to make the IC count to, or divide by, 'n' (any number from 2 to 9) and then either stop or recycle. Numbers of 4017 IC's can readily be cascaded to give either multi-decade division, or to make counters with any desired number of decoded outputs. Let's take a closer look at the device.

4017 Basics

Figure 2 shows the outline and pin designations, the functional diagram, and the basic timing diagram of the CD4017, which incorporates a 5-stage Johnson counter. The device has clock, reset, and clock inhibit input terminals.

The counters are advanced one count at each positive transition of the clock signal when the clock inhibit and reset terminals are low. Nine of the ten decoded outputs are low, with the remaining output high, at any given time. The outputs go high sequentially, in phase with the clock signal, with the selected output remaining high for one full clock cycle. An additional carry out signal completes one cycle for every ten clock input cycles, and can be used to ripple-clock additional 4017's in multi-decade counting applications.

The 4017 counting cycle can be inhibited by setting

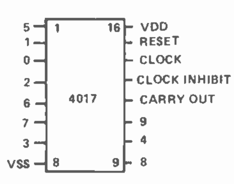


Fig. 2a. Outline and pin designations of the CD4017

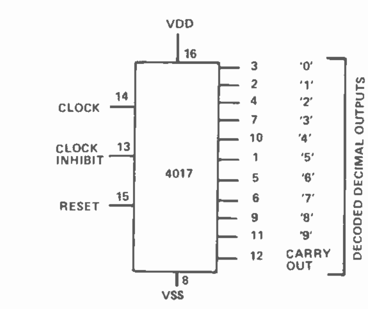


Fig. 2b. Functional diagram and data for the CD4017.

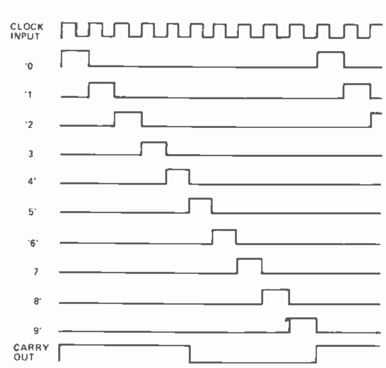


Fig. 2c. Waveform timing diagram of the CD4017, with its RESET and CLOCK INHIBIT terminals grounded.

the clock inhibit terminal high. A high signal on the reset terminal clears the counter to zero and sets the 'O' output terminal high.

4017 Applications

Figures 3 to 7 show a few ways of employing the decoded outputs of a single B-series 4017.

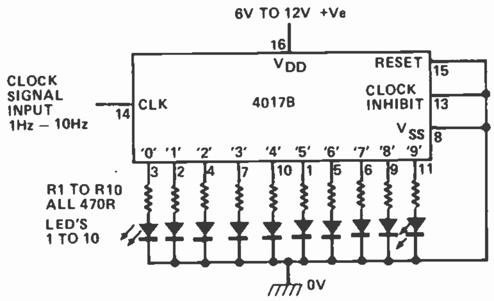


Figure 3: the circuit of a 10-stage sequential LED flasher or chaser, in which one LED is on and the other nine are off at any given time, and the on LED moves one step up the line each time a clock pulse arrives. An alternative action, in which nine LED's are on and one is off at any given time, can be obtained by reversing the polarity of all LED's and taking their common point to the positive supply line.

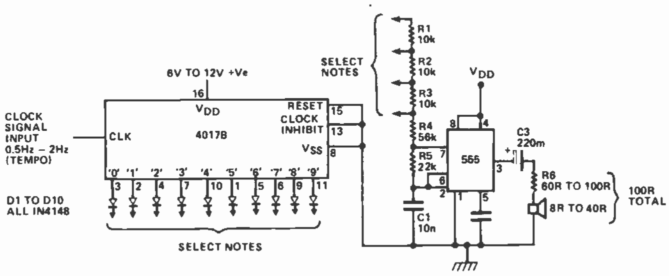


Figure 4: the circuit of a 10-stage 4-note musical sequencer, that can be used to generate simple tunes or melodies. The number of available notes can be increased by adding more resistors to the R1-R2 component chain.

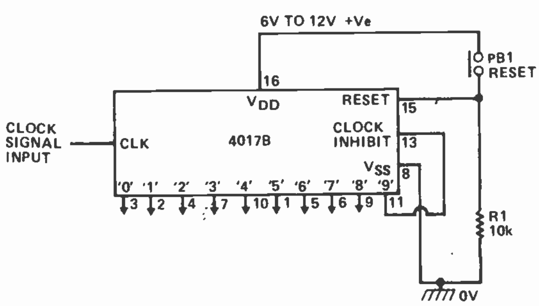


Figure 5: how to connect the 4017 so that it stops operating after completing a pre-determined counting sequence. Here, the counter is set to stop when it's clock inhibit terminal is driven high by the '9' output. The count sequence can be restarted by pressing reset button PB1.

Note in the figure six and seven circuits the counter can be made to divide by any number simply by taking the "free" terminal of the circuit's multi-vibrator to the Nth output terminal of the counter.

Greater than 10

There are times when ten stages of counting/decoding aren't enough for a particular task. Examples that spring to mind are complex remote control coders and decoders

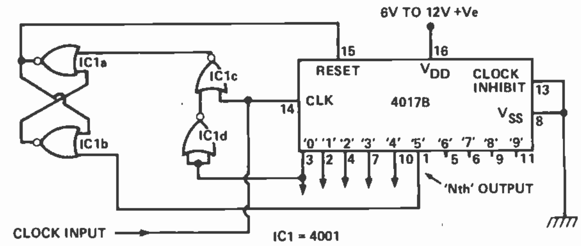


Figure 6: one way of connecting a 4017 as a divide-by-N (2<N<9) counter with N decoded outputs. This circuit is set to divide by 5. The circuit operation here is such that the Nth output of the counter momentarily goes high on the positive transition of the Nth clock pulse, and immediately causes the IC1a-IC1b flip-flop to change state and apply a reset command to pin 15 of the 4017, which in turn causes it's 'O' output to go high and feed a low signal to one terminal of NOR gate IC1c. When the negative transition of the Nth clock pulse arrives, it places a low signal on the remaining terminal of the IC1c NOR gate, which therefore feeds a high signal to IC1a and causes the flip-flop to again change state and remove the reset command from pin 15 of the 4017. The 4017 is then free to count again.

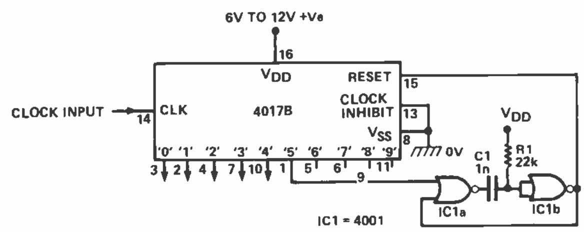


Figure 7: an alternative way of obtaining divide-by-N operation. Here, the Nth output (the 5th in this diagram) momentarily goes high on the arrival of the positive transition of the Nth clock pulse and causes the IC1a-IC1b monostable to generate a 15 uS pulse that immediatley resets the counter to the 'O' or empty state, ready for the arrival of the positive transition of the next clock pulse.

that may require as many as nineteen sequential stages, simple music or tone sequencers that may require more than twenty stages, and LED-driving electronic games such as roulette which may require up to thirty-eight sequential stages. In such cases it is a fairly simple matter to interconnect a number of 4017 IC's to obtain any required total of decoded output stages.

Note in the Fig 9 circuit that the 1 counter gives nine useful outputs, and that all succeeding stages give eight useful outputs. The basic circuit can be expanded to incorporate any number of 4017 stages by simply adding slightly modified IC2-IC4a-IC4b stages between IC1 and the final two stages of the system.

Rabbiting on

You may be wondering why I've chosen this precise moment of history to rabbit on about applications of the 4017. The fact is, I'm presently playing with some rather unusual 4017-based multi-channel remote control systems for possible future projects, and all the stuff that I've crammed into this month's Notebook is spin-off from that development work. I'll tell you more about these next month.

In the meantime, if you want to play with the 4017 circuits that I've already described, you may find the Fig 11 clock generator circuit useful. It uses only one quarter of a CD4093 Schmitt, but generates beautifully clean and interference-free clock pulses.

You can fiddle with the R1 and C1 values to get any

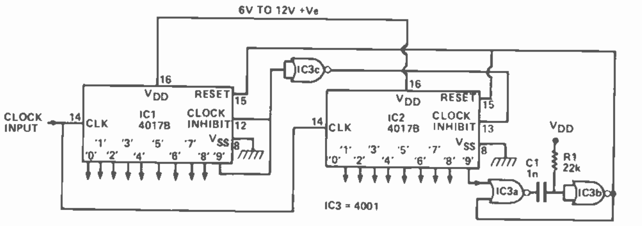


Figure 8 how to interconnect a pair of 4017's to make a 10- to 17-stage counter/decoder. The circuit is shown set for divide-by-17 operation.

The clock input signal is parallel-fed to IC1 and IC2. When, however, the count is below 9, the '9' output of IC1 is low and causes the clock inhibit terminal of IC2 to be set high via IC3c, so IC2 is not influenced by the clock signals. As soon as the 9th clock pulse arrives the '9' output of IC1 goes high and inhibits IC1 from further clocking action, and simultaneously drives the clock inhibit terminal of IC2 low via IC2c and enables IC2 to respond to subsequent clock signals.

Eventually, on the arrival of the 17th clock pulse, the '9' output of IC2 goes momentarily high and triggers the IC3a-IC3b 15 uS monostable, which in turn resets both counters to the empty or '0' states. The counting sequence then repeats.

Note that the '9' output of IC1 and the '0' and '9' outputs of IC2 are "lost" in the counting action, so the circuit provides a maximum of 17 usable counter/decoder stages. The circuit can be made to count by any number in the range 10 to 17 by connecting the "free" input terminal of IC2a to the appropriate output terminal of IC2.

clock frequency that you want. C1 can have any value from 100p to 10u, and R1 can have any value from 10k to 10M. Values of 10n and 100k give a clock frequency of about 1 kHz.

Smarter than the average bear

Does your cranium tend to inflate ever-so-slightly each time that you develop a particularly clever little circuit? If so, imagine how Robert J. Widlar must feel. He's the guy who, virtually single handed, designed the original 709 op-amp. And the 710, the 711, the LM101, the 108, the 109, and the 111. On top of that, he either owns or shares patents on the band gap reference and the super beta transistor.

Old smarty boots has done it again, and designed an opamp called the LM10. The LM10 is reckoned to represent one of the most important developments in IC op-amp technology in recent years. Amongst other things it can operate over the supply voltage range 1V1 to 40V, drawing only 270 uA of current in all cases. Its output can swing within 15 mV of the supply terminals, or will deliver 20 mA of output current with 400 mV saturation.

We plan to give full details of the LM10, complete with extensive applications information, in the near-future. Meantime, it really *does* seem that Robert J. Widlar is a lot smarter than your average bear. ETI

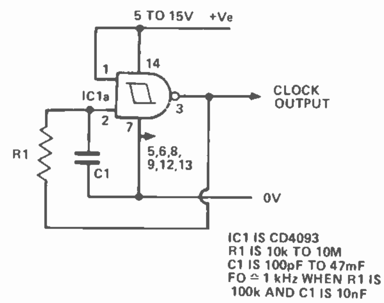


Fig. 11. This simple circuit makes an excellent clock generator for driving 4017 circuits.

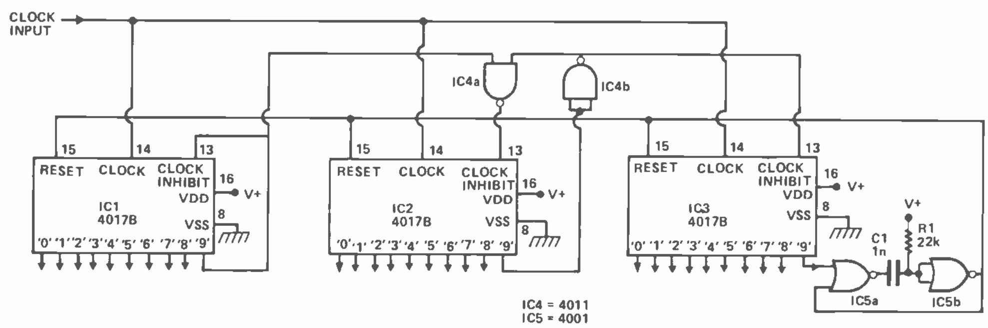


Figure 9 shows the connections for making an 18- to 25-stage counter/decoder from three 4017's. In this case IC3 is inhibited via IC4b and the low output '9' of IC2, and IC2 is inhibited via IC4a and the low output '9' of IC1, up to the 9th clock pulse. IC1 is inhibited via it's high '9' output, and IC3 is inhibited via IC4b and the low output '9' of IC2, between the 10th and 17th clock pulses.

Finally, IC1 is inhibited via it's high '9' output, and IC2 is inhibited via the high '9' outputs of IC1 and IC2 via IC4c between the 18th and 25th clock pulses, and the entire circuit is reset to the '0' stage via the IC5a and IC5b monostable on the 25th-plus-one clock pulse.

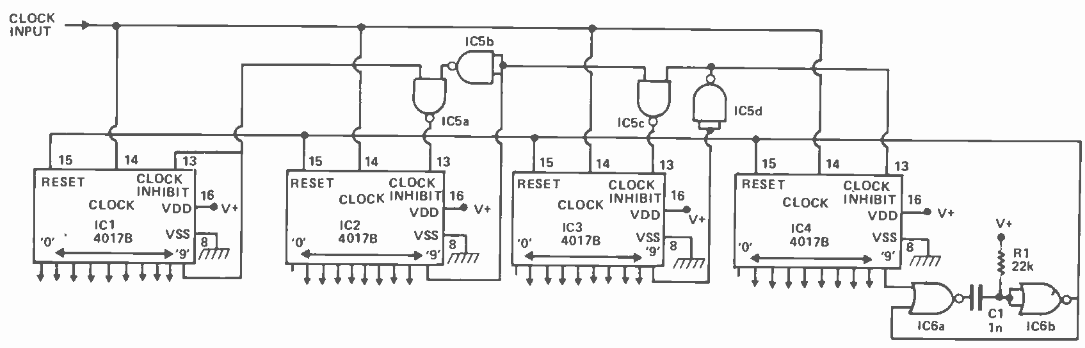


Fig. 10. A 26- to 33-stage counter/decoder set for divide-by-33 operation. This circuit can be expanded to give any number of decoded output stages by interposing additional IC2-IC52-IC5b stages between IC2 and IC3. Each additional 4017B stage makes an extra eight decoded outputs available.

Make your hobby more Constructive and Profitable!

Become an Electronics Engineer or a Technical Engineer. At PNL we offer two interesting, full-time courses.

B.Sc. in Electronic and Communications Engineering

Two "A" levels, usually Maths and Physics, could qualify you for this three-year full-time degree. Specialise in Acoustics, Digital Electronics and/or Radar and Microwaves in the final year.

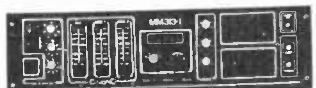
Technician Engineer Certificate

Three "O" levels, usually Maths, Physics and English, are the entry requirements for this two year full-time certificate, specialising in Computer Engineering, Sound Studio Engineering and Radar Microwaves.

Details from: Secretary, DECE, PNL, Holloway Road, London N7 8DB.

The Polytechnic of North London

Now, complete your system!



Citronic MM313 Mixer

Ideal for the DIY enthusiast building up a complete disco system 4/6 ch mono. inc. LED indicators, connections via phono sockets at rear. Bargain price, including PSU £84.24.

The ultimate range of speakers

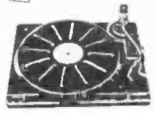
We carry a good selection of high quality chassis for the DIY speaker constructor: 12" or 15" Bass speakers and Dual Concentrics. Exponential horns from £13.77, or our fabulous Piezo Horns which handle a 5K—20K frequency range in any PA system up to 100W (No X over required) and cost only £6.18. each

Projectors

Come and see our specially selected projectors from £42.12 (Squire Multi-fect 150) to £94.50 (Tutor 11E) plus the widest array of projector attachment and effects that you'll ever see on continuous demonstration.

Ropelights

Great effect at discos. 7 metres long. Multiway connectors. 4 channel. £43.20 (Inc.pack of spare bulbs)



Turntables

Our unsurpassed Disco experience has enabled us to select the best turntables for your requirements. For example the new BSR P200 belt drive. ONLY £28.12.

Bulgin Octal plugs and sockets

There's always hundreds of Bulgin Octal multiway plugs and sockets in stock at Roger Squire's. Each pin rated 6A. Perfect for your Sound to Light System. P552 SOCKET £0.65. P551 PLUG £1.94.

Many disco accessories

All Roger Squire's shops have a service department which carries large stocks of DISCO SPARES & ACCESSORIES.

Multiway Cables
4 core (6A) 59p/metre
5 core (6A) 73p/metre
6 core (6A) 86p/metre

ALL SHOPS OPEN TUE-SAT.
LATE NIGHT WED.
(UP TO 8 PM)

PERSONAL CALLERS ONLY

Roger Squire's Disco Centres

LONDON 176 Junction Road, N19. 50yds Tufnell Park Tube Station. Tel: 01 272 7474

BRISTOL 125 Church Road, Redfield (Near St. George) 1 mile from end of M32 Tel: 0272 550550

MANCHESTER 251 Deansgate 3, 15 mins from City Centre Tel: 061 831 7676

GLASGOW 1 Queen Margaret Road (off Queen Margaret Drive) Kelvinside 20, just behind the BBC. Tel: 041 946 3303

SINCLAIR PRODUCTS★

PFM200 **£49.48**, case **£3.24**, adaptor **£3.24**, connector kit **£10.58**. Microvision TV UK model **£89.95**, mains adaptor **£6.73**. PDM35 **£28.95**, mains adaptor **£3.19**, case **£3.19**, 30kV probe **£18.90**. DM350 **£68.95**, DM450 **£97.95**, DM235 **£49.45**. Accessories for all 3 models.— rechargeable batteries **£7.50**, mains adaptor/charger **£3.70**, case **£8.45**, 30kV probe **£18.90**. Enterprise prog calculator with accessories **£22.95**. Cambridge prog calculator **£12.13**. Prog library **£4.45**, adaptor **£3.20**.

CALSCOPE OSCILLOSCOPES★

Send sae for details or see the Calscope advert in this magazine. Super 6: 6MHz single beam 60ns rise time **£174**. Super 10: 10MHz dual trace 35ns rise time **£236**.

COMPUTER GAMES★

Chess challenger 7 **£79**. Chess challenger 10 **£167**. Checker challenger 4 **£84**. Checker challenger 2 **£50**. Atari videocomputer **£138**. Cartridges **£13.45**. Star chess **£59**.

CONTINENTAL SPECIALITIES PRODUCTS★

EXP300 **£6.21**. EXP350 **£3.40**. EXP325 **£1.73**. EXP600 **£6.80**. EXP650 **£3.89**. EXP4B **£2.48**. PB6 **£9.94**. P8100 **£12.74**. LM1 **£30.99**. LP1 **£33.48**. LP2 **£19.44**. MAX100 **£75.40**.

TV GAMES

Tank battles kit **£5.95**. AY-3-8500 chip **£4.95**, kit **£4**. Stunt cycle AY-3-8760 chip **£11.70**, kit **£4**. 10 game paddle 2 AY-3-8610 chip **£8.90**, kit **£6.60**. Racing car chip AY-3-8603 **£8.90**. Modified shoot kit **£4.96**. Rifle kit **£4.95**. Colour generator kit **£8.50**. Joystick 220K **£1.69**.

MAINS TRANSFORMERS

6-0-6V 100ma **74p**, 1½a **£2.35**. 6.3V 1½a **£1.89**. 9-0-9V 75ma **74p**, 1a **£1.99**, 2a **£2.60**. 12-0-12V 50ma **74p**, 100ma **90p**, 1a **£2.49**. 13V ½a **95p**. 15-0-15V 1a **£2.79**. 30-0-30V 1a **£3.59**.

JC12 AND JC20 AMPLIFIERS

Integrated circuit audio amplifier chips supplied with free data and printed circuits. JC12 6 Watts **£1.60**. JC20 10 Watts **£2.95**. We also stock a range of matching preamp and power kits.

FERRANTI ZN414

ic radio chip **£1.05**. Extra parts and pcb for radio **£3.85**. Case **£1**.

PRINTED CIRCUIT MATERIALS

PC etching kits: Economy **£2.18**, standard **£4.10**. 40 sq ins pcb **60p**. 1lb FeC1 **£1.13**. Etch resist pens: Economy **45p**, dalo **79p**. Small drill bits 1/32ins or 1mm **23p** each. Etching dish **68p**. Laminate cutter **75p**.

S-DECS AND T-DECS★

S-Dec **£3.80**. T-Dec **£4.02**. u-DecA **40p**. u-DeCB **£6.73**.

BATTERY ELIMINATORS

3-way types with switched output and 4-way mutli-jack: 3/4½/6v 100ma **£2.71**. 6/7½/9v 300ma **£2.95**. 100ma radio types with press-stud connectors 9v **£3.35**, 6v **£3.35**, 4½v, **£3.35**, 9+9v **£4.50**, 6+6v **£4.50**, 4½+4½v **£4.50**. Cassette recorder mains unit 7½v 100ma with 5 pin din plug **£3.35**. Fully stabilised type 3/6/7½/9v 400ma **£5.30**. Car convertors 12v dc input output 9v 300ma **£1.50**, output 7½v 300ma **£1.50**. Output 3/4½/6/7½/9/12v 800ma **£2.50**.

BATTERY ELIMINATOR KITS

100ma radio types with press-stud connectors 4½v **£1.40**, 6v **£1.40**, 9v **£1.40**, 4½+4½v **£1.80**, 6+6v **£1.80**, 9+9v **£1.80**. Cassette type 7½v 100ma with din plug **£1.40**. Heavy duty 13-way types 4½/6/7/8½/11/13/14/17/21/25/28/34/42v 1A **£4.65**, 2A **£7.25**. Transistor stabilized 8-way types for low hum 3/4½/6/7½/9/12/15/18v 100ma **£2.80**, 1Amp **£6.40**. Variable voltage stabilized models 2-18v 100ma **£2.80**. 2-30v 1A **£6.95**. 2-30v 2A **£10.95**. Car convertor 12v dc input. Output 9/7½/6v 1A stabilized **£1.35**.

BI-PAK AUDIO MODULES

AL30 **£3.95**. PA12 **£7.60**. PS12 **£1.39**. T538 **£2.65**. S450 **£23.51**. AL60 **£4.86**. PA100 **£16.95**. SPM80 **£4.47**. BMT80 **£5.95**. Stereo 30 **£20.12**. MA60 **£35.44**.

COMPONENTS

1N4148 **1.4p**. IN4002 **2.9p**. 741 8 dil **15p**. 723 14 dil **29p**. NE555 8 dil **23p**. bc182b, b183b, bc184b, bc212b, bc213b, bc214c, bc547, bc548, bc549, **4.5p**, tip31c, tip32c **34p**, tip41c, tip42c **45p**, bdl31, bdl32 **31p**. Plastic equiv bc107 **4.8p**. Fuses 20mm x 5mm cartridge 15, .25, .5, 1, 2, 3, 5Amp quickblow 1p, anti-surge **3.4p**. Resistors 5% ¼W E12 10R to 10M 1p, **0.8p** for 50+ of one value. Polyester capacitors 250v .015, .068, .1mf 1.5p, .01, .033, .33mf **2.7p**, .022, .047mf **3.2p**, .22, .47mf **4.8p**. Polystyrene capacitors E12 63v 10 to 10000pf **3p**. Ceramic capacitors 50v E12 22 to 1000pf **2p**, E6 1n5 to 47n **2p**. Electrolytic capacitors 50v. .5, 1, 2mf **5p**, 25v 5, 10 **5p**, 16v 22, 33, 47, 68mf **5p**, 100mf **6p**, 220mf **7.5p**, 330, 470mf **9p**, 1000mf **10p**. Zeners 400mW E24 2v7 to 33v **7p**. Preset pots subminiature 0.1W horiz or vert 100 to 4M7 **6.8p**. Potentiometers ¼W 4K7 to 2M2 log or lin single **26p**, dual **76p**. ⅛" red LEDS **9.1p**.

SWANLEY ELECTRONICS

DEPT. ETI, 32 GOLDSEL ROAD, SWANLEY, KENT BR8 8EZ

Mail order only. Please add 30p to the total cost of order for postage. Prices include VAT. Lists 20p post free. Overseas customers deduct 7% on items marked ★ and 11% on others. Official credit orders welcome. If VAT rate is changed in budget please adjust prices.

Codespeed Electronics

P.O. BOX 23, 34 SEAFIELD ROAD, COPNOR, PORTSMOUTH PO3 5BJ

2 CALCULATOR KEYBOARDS for £1.00
Lots of uses for these neat multi-function keyboards.
Order catalogue No. 101.

DIGITAL MULTIMETER CHIP
Build a highly accurate digital volt-meter or panel meter with this MM5330 integrated circuit. Requires additional circuitry but can be built for half the cost of a ready built D.V.M.
£3.95 each (with data)
Order catalogue No. 404.

4-DIGIT L.E.D. DISPLAY
A 4-digit non-multiplexed LED display with centre colon. Ideal for digital clock (and other) Projects. Digits are 0.8" high and the display is common cathode.
£4.95 each (with data)
Order catalogue number 204.

DIGITAL ALARM CLOCK MODULE
A ready built and tested 12-hour alarm clock module with built-in LED display (0.8" digits). Only requires a mini mains transformer and time setting switches to make a fully functional clock. Supplied with full data.
£6.50 each
Order catalogue number 205.

CALCULATOR TOPS
(Untested, so no guarantees).
Contains the upper half of two hand held calculators with built-in key-board. These are ex-equipment but are believed to be o.k..
Only 50p the pair
Order catalogue number 105.

4-DIGIT LCD
A 4-digit, non-multiplexed Liquid Crystal display with 0.5" high digits (black digits on grey background).
Supplied with data, £6.95.
Order catalogue number 206.

MM5314 CLOCK CHIP BONANZA
Offered at the unbelievable price of only £1.90 each.
All brand new and fully guaranteed. Supplied with data sheet. Can be interfaced with either LED or gas discharge displays.
Order catalogue number 207.

FACTORY-REJECT CALCULATORS
Production line reject LED calculators with lots of accessible goodies inside (calc chip, display, keyboard, etc.). Ideal for breaking for spares (some could be repairable and we include a reprint of an article on repairing calculators). £2.50 each.
Catalogue No. 104.

9-DIGIT GAS DISCHARGE DISPLAY
A super bright 9-digit display with 0.25" high digits. Requires 180v dc anode volts but this is easily achieved in mains operated projects. Supplied with data sheet and edge connector socket. 75p each.
Order catalogue number 310.

6-DIGIT MINI LED DISPLAY
A common cathode multiplexed display with 6 bright 0.1" high digits. Also has leading minus sign. The display is built on to a mini pcb with 0.1 inch edge connections.
Only £1.00
Order catalogue number 306.

PROGRAMMABLE UNIJUNCTION TRANSISTORS
Four MEU21 P.U.T.s (electrically similar to 2N6027). Used for long delay timers, oscillators and much more. Supplied with data and applications sheet.
Four for 50p.
Order catalogue number 402.

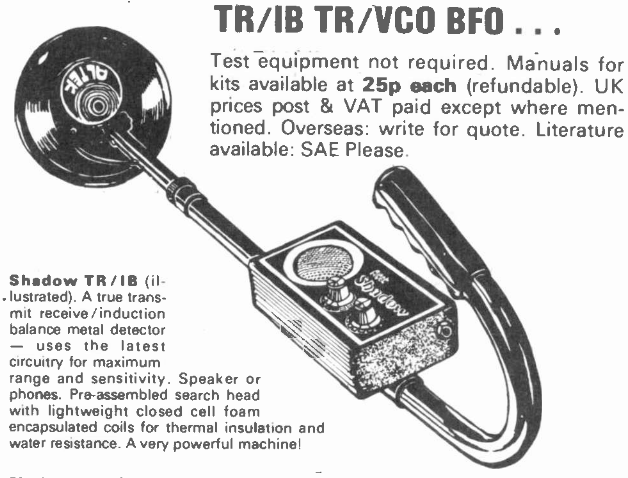
POLARISING FILTER MATERIAL
A lightly tinted 0.006" thick plastic polarising film made by Polaroid. Any size cut from 1 sq. inch to a maximum size of 19" by 250 feet.
Only 22p per square inch.
(State dimensions required).
Order catalogue No. 701.

10 HYBRID CIRCUITS
Each of these hybrid circuits contain 8 resistors and 8 capacitors. Useful values for use in transistor circuits. Ideal for miniaturising home-made pcbs.
10 hybrid circuits for 50p with data.
Order catalogue number 801.

2102L-1 STATIC RAMs
These 2102 static rams are offered at an amazingly new low price.
Features include single 5v. supply, fully static protected, high speed, ttl and dtl compatible, and more besides.
Supplied with data, only 90p.
Order catalogue number 102.

A full refund guarantee on all items.
Post and Packing please add 25p (Overseas orders add 60p)
Lots more goodies in our catalogue. Send a medium sized SAE for your free copy.

BUILD YOU OWN METAL DETECTOR TR/IB TR/VCO BFO . . .



Test equipment not required. Manuals for kits available at **25p each** (refundable). UK prices post & VAT paid except where mentioned. Overseas: write for quote. Literature available: SAE Please.

Shadow TR/IB (illustrated). A true transmit receive/induction balance metal detector — uses the latest circuitry for maximum range and sensitivity. Speaker or phones. Pre-assembled search head with lightweight closed cell foam encapsulated coils for thermal insulation and water resistance. A very powerful machine!

Shadow TR/VCO. An advanced version of the above detector, use it as a sensitive TR/IB machine or switch to VCO mode when the depths achieved approach the maximum "in air" range. Low power requirement: runs on standard 9 volt batteries. The most sophisticated detector available as a kit.
Shadow TR/IB kit **£22.50** (£29.95 assembled). Shadow TR/VCO kit **£27.50** (£36.95 assembled).
Padded stereo headphones suitable for 'Shadow' detectors **£5.50.**
Designing your own detector? Then we can supply the (hard to obtain) hardware "shell" including fully adjustable shaft with handle, search head moulding with hinge assembly, special clips to mount your own control housing (any box is suitable), completely non-metallic: suitable for any type of detector (TR-PI-VLF-BFO etc.). Supplied undrilled as a kit with full instructions (as used on our Shadow range).
Detector Shell kit **£8.50.**
Low cost BFO detector. 200mm (8") annular search head gives wide scan with easy pinpointing. Simple high efficiency circuit draws <3mA. Extra lightweight 300gms (10.5ozs) **with battery.** Very detailed construction manual: ideal as a first project. Absolutely everything supplied including pre-assembled search head, tuning coil and earpiece. ALT3 detector (kit) — **£13.95.** Padded high Z headphones for ALT3: **£4.90.**
Order by post or phone (24 hours) — for quickest delivery quote credit card number. Callers by appointment only please!

ALTEK
Dept. ETD, 1 Green Lane
Walton-on-Thames, Surrey
Phone (093 22) 44110

PETALECT

ELECTRONIC SERVICING LTD.

PET 2001/8 micro-computer

£550 + V.A.T.

WHY BUY A MICRO COMPUTER FROM US?
BECAUSE:

1) Established Company trading since 1971.
2) Electronic servicing is our speciality.
3) We have in house programmers/systems analysts.
4) We have our own service engineers.
5) We will demonstrate the PET at your premises.
6) We can customise the PET to your requirements.
7) We can arrange finance.
8) We offer, after the three month warranty, an annual service contract from £69.50.
9) You benefit from our experience of having sold over 150 Micro Computers to industrial, educational and business, personal users.

VISIT OUR SHOWROOM AT:
34 Chertsey Road, Woking, Surrey

We supply the full range of C.B.M. PET Micro-computers. We also supply:

Dual Floppy Disks	**£840**
24K Memory Boards	**£320**
All types of Printers	from **£450**

All types of Printer Interfaçes, Electronic balance Interfaces, Programs from C.B.M., Petsoft, Gemsoft. We also offer a full consultancy and programming service.
We are developing a number of our own business packages for all applications.
Books on Basic, Programming, Interfacing, etc.
Full range of KIMs available.
Tandy and ITT 2020 available.
Maintenance, Hire Purchase facilities as well as ACCESS and BARCLAYCARD available.

Factory: Telephone WOKING 69032/68497/20727. Shop: Telephone: WOKING 23637.

BATTERY INDICATOR

Ever been caught by a battery that went flat at an embarrassing moment — like when you've just offered a friend a lift? The conversation goes a little flat when you're both riding the bus to work, 20 minutes late. Jonathan Scott found a solution . . .

THE OLD, RELIABLE lead-acid battery may be way ahead of what ever is in second place for vehicle electrical systems, but they do need a 'weather eye' kept on them. Particularly if they're out of warranty. The same applies to 'reconditioned' batteries, so often found in secondhand vehicles of some age.

That's the problem with cars — running out of petrol and running out of battery produces the same heart-rending result. Immobility.

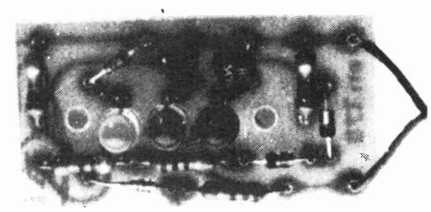
Most vehicles have a petrol gauge. Few have an equivalent for the battery. Many 'older' cars included a 'charging current' meter. This told you something about the car's generator-regulator and required some interpretation to figure out whether the battery was in good health.

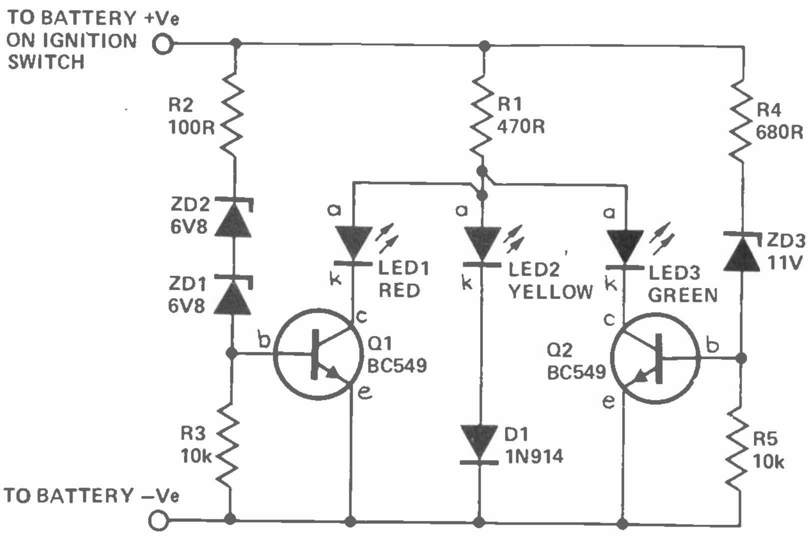
Probably the best way to check on the state of your battery is to use a hydrometer. However, hydrometers have a number of drawbacks. Being made of glass, they're fragile and can't be used while a car is in motion. The small amount of battery acid that remains on them presents a storage problem — the drips and fumes attack most metals and materials. They're okay for the corner garage but justifying their cost, for the occasional use they get in home workshops, is not always possible.

Another method of testing battery condition is by checking the voltage 'on load'. A lead-acid vehicle battery in a reasonable state of charge will have a terminal voltage under normal working load somewhere between 11.6 and 14.2 volts. When a battery shows a terminal voltage below 11.6 volts its capacity is markedly decreased and it will discharge fairly quickly. Like as not, it won't turn the starter motor for very long! On the other hand, if the voltage on load is above 14.5 volts then the battery is definitely fully charged! However, if it remains that way for any length of time while the car is on the road, the vehicle's alternator-regulator system is faulty and the battery may be damaged by overcharging.

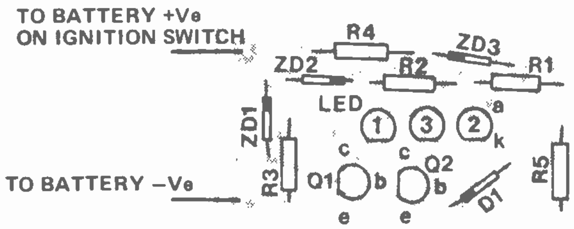
Reading the battery voltage can be done in a number of ways. You could use a digital panel meter, set up as a voltmeter. Their drawback is that they cost nearly ten times as much as a hydrometer! The next best method is to use an 'expanded-scale voltmeter'. Reading the voltage range between 11 and 15 volts on a meter face calibrated 0-16 volts is a squint-and-peer exercise. On a 0-30 volts scale, as used on many modern multimeters, it's worse. A meter which reads between 11 volts at the low end of the scale and 16 volts at the high end is ideal. Hence, the term 'expanded-scale'.

However, you don't want to be peering at a meter on the dash board when you're driving through traffic. The range of voltage over which your battery is healthy is some two volts. An indicator which simply requires the





The circuit diagram and component overlay (below). During construction, make sure all of the diodes and LEDs are the right way round.



HOW IT WORKS

This circuit depends for its operation upon the different voltage drops across different colour LEDs.

At 20 mA the voltage drops across red, yellow and green LEDs are typically 1.7, 3.0 and 2.3 volts respectively. When the vehicle battery voltage is too low to cause either ZD1/ZD2 or ZD3 to conduct, Q1 and Q2 are held off by R3 and R5. Under these conditions the yellow LED is forward biased and conducts via D1 producing a potential of about 3.7 volts at point A (see circuit diagram). When the supply rises above about 11.6 volts ZD3 conducts, biasing Q2 on. By virtue of its lower voltage requirements the green LED conducts, reducing the voltage at point A to approximately 2.6 volts. This is not enough to bias D1/LED3 on, so the yellow LED goes off. The green LED 'steals' the bias from the yellow LED. When the supply rises above about 14.2 volts, Q1 is biased on and the red LED 'steals' the bias from the green. The potential at point A falls to two volts and only the red LED conducts.

R1 limits the current through the LEDs. R2 and R4 limit the base currents into Q1 and Q2.

PARTS LIST

Resistors all ¼W, 5%

R1	470R
R2	100R
R3, R5	10k
R4	680R

Semiconductors

D1	1N914
ZD1, ZD2	6V8 400 mW zener
ZD3	11V 400 mW zener
Q1, Q2	BC547,8,9 or BC107, 8, 9 or common silicon NPN type

Miscellaneous

pcb
Aluminium angle bracket for under-dash mounting.

BUYLINES

Nothing to worry about here really, but make sure the LEDs are the correct colours, otherwise the voltage drops will not be correct!

occasional glance, and needs no 'interpretation', is what is really needed.

With this project, that's exactly what we've done.

Go, caution, stop

We have devised a simple circuit that indicates as follows:

Yellow:	battery 'low'
Green:	battery okay
Red:	battery overcharging

When the battery voltage is below 11.6 volts, a yellow indicator lights. This indicates the battery is most likely undercharged or a heavy load (such as high power driving lights) is drawing excess current. When it is between 11.7 and about 14.2 volts the green indicator lights, letting you know all is sweet. If the red indicator lights, as it will if the voltage rises above 14.2 volts, maybe the vehicle's voltage regulator needs adjusting or there is some other problem.

The circuit

The circuit is ingeniously simple, having barely a handful of parts. Reliability should be excellent.

We actually started out with a somewhat complex circuit. It used only two indicators and required you to 'interpret' what was happening. In trying to convert that to a yellow-green-red style of indication it sort of grew like topsy. This circuit had four transistors, a dozen resistors etc and didn't look at all attractive as a simple project that the average hobbyist or even handyman could build one Saturday afternoon and get going immediately. A rival circuit was devised by another staff member using a common IC. This sparked a controversy as to which was the better! Certainly, both did the job required . . . but maybe there was a simpler method.

It was discovered that different coloured light emitting diodes (LEDs), which we had decided to use for the indicators in the project, had different voltage drops when run at the same current. Seizing on this idea, the original circuit (four transistors, a dozen resistors . . .) was modified to exploit this characteristic and the simple circuit you see here was the result.

Construction

Construction is straightforward. If you haven't soldered electronic components before — and this project was designed for the motorist/handyman as well as electronics enthusiasts — then we suggest you practice on something before tackling this project. Soldering is one of those things like swimming or riding a bicycle, or sex — it's okay once ▶

you've done it once or twice but you don't practice out on the street!

We recommend you use the printed circuit board designed for this project. The actual layout of the components themselves is not critical but a printed circuit board reduces the possibility of errors.

It is best to mount and solder the resistors first. Follow this by soldering in the diodes D1 and the zener diodes ZD1, ZD2 and ZD3. Carefully follow the accompanying component overlay making sure the diodes are all inserted the correct way around. Next, mount the transistors, again referring to the overlay, checking to see they are inserted correctly before soldering.

Finally, mount the light emitting diodes. These too may only be inserted one way. Check with the component overlay and connection diagrams. Make sure they are in the correct sequence. On the component overlay, LED 1 is the red LED, located at the left. The yellow LED is on the right, marked with a '2'. The green LED, marked '3' is between them.

The circuit could be tested at this stage if you have a variable power supply, or access to one. Simply vary the voltage across the range between 11 and 16 volts and note whether the LEDs light up in the correct sequence and close to the voltages indicated.

Mounting

As vehicles vary so much in dash panel layout, we can only make general suggestions.

Clearly, the indicator should be mounted such that the three LEDs are not in direct sunlight. A low part of the dash, but make sure it's readily visible from your normal driving position, will pretty well ensure the display may be easily read during the daytime. Alternatively, if you have an 'overhung' dash, or a portion which overhangs (usually where the instruments are mounted anyway), then a suitable position will generally suggest itself.

Exact mechanical details will have to be determined according to your particular situation. Two holes are provided in the board for mounting bolts. Alternatively, the whole assembly may be mounted from the LEDs. Three LED holders inserted through part of the dash panel, or an escutcheon plate mounted on the dash, will hold the LEDs quite securely. Providing the leads on the LEDs are fairly short, the board will place little strain on them and the assembly should be mechanically secure.

Connection

The indicator may be installed in vehicles having positive or negative earth electrical systems.

The component overlay shows the connection for a **negative** earth vehicle. The 'battery +ve' lead goes to the ignition switch — the indicator only operates when the vehicle is being used — the battery negative lead should be taken to a good 'earth' point on the vehicle frame.

For a **positive** earth vehicle, the lead marked 'battery —ve' goes to the ignition switch connection, while the 'battery +ve' lead goes to the vehicle frame.

ETI

microfile

Henry Budgett wandered across the States in the name of Microfile. This is his report, and other small world shattering items that happened to crop up while he was away.

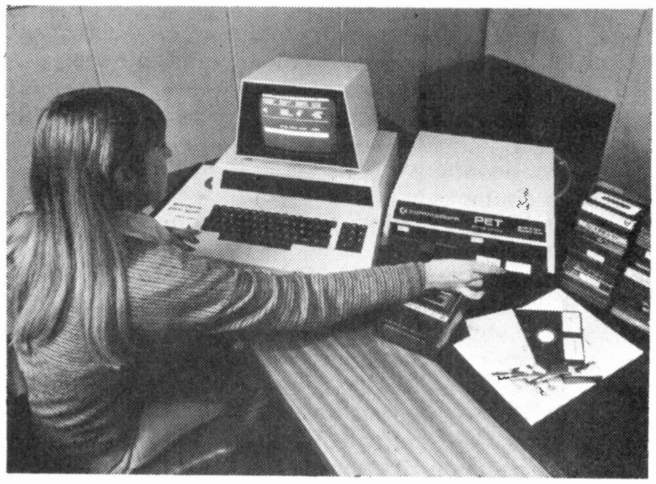
Pets In Business

THE LONG AWAITED PET add-on's have arrived at last, honest! Launched at a Cafe Royal press conference was a new PET based business system with a price tag of £2,500 excluding software. Utilizing the new, large-keyboard 32K machine with Commodores own dual disk drive and tractor-fed printer it forms the cheapest small business system yet available. The software is being written by a new division of ACT, Petsoft's parent company, called PETACT and will cost between £225 for a single package to about £800 for a complete suite of programs. It will be available in either disk or cassette format and is the first business software for a micro to be written by a professional software house. The software price also includes a day's training for an employee.

We rather thought that the printer was never going to arrive as it was trapped at Heathrow in customs but it surfaced during the Champagne and Orange cocktails and appeared to be of high quality. The second reason for the Press reception was to announce the forming of an "endorsement" scheme for non-Commodore produced PET add-on's, the PETACT software being the first product to be launched under the scheme.

Deliveries of the new style PET's have started and should be available in most areas now, the disks and printers will start to appear in mid-May at some of the 100 dealers and will hopefully be generally available within a couple of months. Chuck Peddle the father of the PET and KIM was at the reception and gave a strong indication that new and exciting things were on the way in connection with both machines, memory expansion being one possibility.

On a final note the sales of the UK machine were around 3000 during 1978 and this figure had been reached by the end of April of this year, the market is still growing.



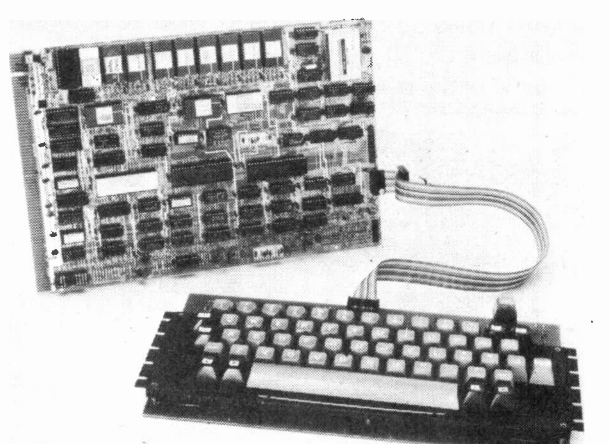
Above and below: the new bits for PET.

NASCOM With Added Plus

After the phenomenal success of the NASCOM I (150,000 sales worldwide) the company have announced a new single board machine called NASCOM II.

Although it is physically the same size as the 'I' and uses the same bus structure it is not intended as a simple upgrade but rather as a new starting point in the home computing market. Based on the Z80A it offers a 75% increase in processing speed along with an 8K Microsoft BASIC in ROM. Several new features are included on the machine, a new 2K monitor with many improvements over the T4, A CUTS cassette interface, 8K of user RAM and a new extended keyboard. The interfaces supplied include an on-board UART for the RS232 or the cassette interface, capable of running at 300 or 1200 Baud, and an uncommitted P10 for two 8 bit ports. The video is run from a 1KA RAM with a 2K character generator, an optional socket is supplied for another 2K graphics ROM which is software selectable. ▶

Below: the new more powerful NASCOM.



Both the new monitor and the BASIC can be used with the 'I' and all the peripherals for the 'I' can be used with the 'II' making it the basis of a very nice OEM system. The circuit board is of the usual superb quality and the kit will be available from June at £295 ex VAT. We hope to get our hands on one to review soon and this will be published in CT as close to the release date as possible.

Clubbing Together

A couple of new clubs have sent us details of themselves this month. The first is the Sorcerer Programme Exchange Club, SPEC, which has been formed to promote the Exidy Sorcerer. Rather than having an actual club they are aiming to become an information exchange on useful hints and programs for the machine and would be most grateful for anyone who has some to send them in. The people to contact are Mr G. F. Counsell and Mr M. P. Hannaby at 65 Trafalgar Road, Birkdale, Southport, Merseyside.

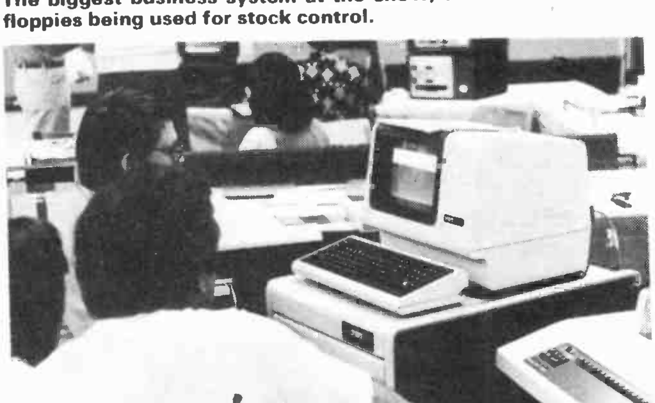
The second club is the South Yorkshire Personal Computing Group, SYPCG, who are appealing to people in the area interested in do-it-yourselr computing. They hope to meet on the second Wednesday of each month with a variety of topics under discussion. Membership is £3 for 1979 and the meetings will be held at 7.00pm in the University of Sheffield. For further information you should contact the Secretary, Mr Tony Rycroft, at 88 Spinneyfield, Moorgate, Rotherham, S. Yorkshire.

Showing It Off USA Style

I spent a pleasant weekend in Orlando, Florida, last month at a micro-show. It really was a micro-show, dealing with the machines and also being very small. However this was really an advantage as it allowed free and personal access to the exhibitors rather than the situation which arises at some of the UK exhibitions. The variety of machines was impressive, ranging from an IAM65 to an LSI 11, but there were no PET's, KIM's or Superboards which was rather surprising. The only new machine there was an Z80 based S100 system called Informer which also used an SC/MP for keyboard and video control. Supplied either with or without an integral floppy it looked impressive but is unlikely to appear on this side of the Atlantic.

The show also featured a siminar programme, again on a very informal and personal level which resulted in a most entertaining question and answer forum. The whole show was most professionally run and I only wish that some of the UK shows could adopt a similar attitude and become smaller and more personal instead of bigger and unhelpful. ETI

The biggest business system at the show, an LSI II with dual floppies being used for stock control.



The familiar Apple II with a speech recognition board installed. It worked remarkably well and 'echoed' back your word through a synthesizer.

New TRS 80 printer. Will it reach us, we wonder.

A Texas system with dual floppies and integral thermal printer as well as a Centronics 702 on-line. It played a mean game of Star Trek!

tech tips — Calculator Special

Mine Sweeper

E. A. Johnson

The object of the game is to locate and destroy a moving minesweeper. The ship moves along a set course, but, to avoid destruction it can deviate slightly from the course and alter its speed.

Playing the game

The game is started by entering a number (in the range 0 to 1) into register E, to set the initial position of the minesweeper through a random number generator. A shot is made by entering the xy co-ordinates (into the A and B registers respectively) of the square where the ship is believed to be. The calculator determines the position of the ship and displays the distance by which the shot missed. If the shot is within five units of the ship, damage occurs which slows the ship down in proportion to the nearness of the shot. When the ship is destroyed the display flashes.

After the ship has been destroyed, the number of shots used can be displayed by pressing 'C', and a new game can be started by pressing 'D'.

Method of calculation

The initial value of Θ, which determines the ship's position is determined using the calculator's random number package. The ship's co-ordinates are then calculated by the following equations:

$$x = (50 + 45 \cos 3\Theta) + RNUMX$$
$$y = (50 + 45 \sin 2\Theta) + RNUMY$$

where RNUMX and RNUMY are random numbers (in the range of –3 to +3) to give the ship its avoiding action.

The distance of the shot from the ship is calculated using pythagoras and displayed in integer mode.

The next value of Θ is then given by

$$\Theta = \Theta + \Theta INCR$$

where ΘINCR is originally set to 5, the calculator then determines the new co-ordinates of the ship.

When the distance of the shot from the ship is less than five units, the value of ΘINCR is reduced to slow the ship down. The new value is given by ΘINCR = ΘINCR – (5 ÷ distance).

The above procedure continues until ΘINCR ⩽ 0 when the ship is destroyed.

A new game, if required, is started by automatically generating a new random initial value of Θ.

MINESWEEPER PROGRAM FOR TI 58 & 59

LOC	CODE	KEY
000	43	RCL
	01	1
	44	SUM
	00	0
	43	RCL
	02	2
	91	R/S
	76	Lbl
	33	X
	65	x
010	04	4
	05	5
	85	+
	05	5
	00	0
	85	+
	36	Pgm
	15	51
	71	SBR
	88	D.MS
020	65	x
	06	6
	75	–
	03	3
	95	=
	33	X
	92	INV SBR
	76	Lbl
	15	E
	42	STO
030	09	9
	76	Lbl
	14	D
	05	5
	42	STO
	01	01
	00	0
	42	STO
	03	3
	58	Fix
040	00	0
	36	Pgm
	15	15
	71	SBR
	88	D.MS
	65	X
	03	3
	06	6
	00	0
	95	=
050	42	STO
	00	0
	25	CLR
	91	R/S
	76	Lbl
	11	A
	69	Op
	23	23
	75	–
	53	(
060	53	(
	43	RCL
	00	0
	65	x
	03	3
	54	)
	39	cos
	71	SBR
	33	X
	32	x▶◀t
070	00	0
	91	R/S
	76	Lbl
	12	B
	75	–
	53	(
	53	(
	43	RCL
	00	0
	65	x
080	02	2
	54	)
	38	som
	71	SBR
	33	X
	85	+
	05	5
	32	x▶◀t
	95	=
	34	√x
090	42	STO
	02	2
	77	x≥t
	00	0
	00	00
	55	÷
	32	x▶◀t
	95	=
	35	1/x
	22	INV
100	44	SUM
	01	1
	29	CP
	43	RCL
	01	1
	77	x≥t
	00	0
	00	00
	25	CLR
	35	1/x
110	22	INV
	58	Fix
	91	R/S
	76	Lbl
	13	C
	25	CLR
	43	RCL
	03	3
	91	R/S

Example Game

Comment	Enter	Display
Enter a number between 0 & 1	0.258 E	0
Enter guess for x co-ordinate	50 A	0
Enter guess for y co-ordinate	11 B	65 (Distance)
x co-ordinate	84 A	0
y co-ordinate	70 B	62
x	40 A	0
y	85 B	7
x	43 A	0
y	87 B	3
x	51 A	0
y	89 B	3
x	54 A	0
y	90 A	9.9999999 99 (Flashing)
To display number of shots	C	6
To start a new game	D	0
x co-ordinate	50 A	0
y co-ordinate	11 B	42
ETC.		

Lunar Landing

Sarah J. Owen.

This program was devised for use on the Commodore PR.100 calculator, but is easily adapted for use on any other programmable ones. Imagine you are the Astronaut controlling the final descent of a lunar module, at regular intervals the speed of descent is displayed, the period of burn of the retro–rocket has to be calculated, after allowing for the reducing weight of the fuel on board. . . . . Five speed corrections are allowed, after which the final impact velocity is displayed. If an error is made and all fuel is used, there is just time to transmit an urgent S.O.S. message before destruction on the lunar surface. . . . . . . Due to the lack of program space, the method of selecting the initial random speed is unusual, but ranges between 20 and 100 m.p.h.

Recommended periods for Retro–rocket firing

SPEED	BURN	SPEED	BURN
5	1.6	180	5.2
7	1.9	200	5.3
10	2.3	220	5.4
15	2.7	250	5.5
20	3.0	270	5.6
30	3.4	300	5.7
40	3.7	330	5.8
50	3.9	365	5.9
60	4.1	400	6.0
70	4.2	450	6.1
80	4.4	500	6.2
90	4.5	550	6.3
100	4.6	600	6.4
110	4.7	660	6.5
120	4.8	730	6.6
130	4.9	800	6.7
150	5.0	900	6.8
160	5.1	1000	6.9

Result of impact speed:–

0 – 5 m.p.h.	PERFECT LANDING	
6 – 10 m.p.h.	SLIGHT DAMAGE, LIFT OFF DELAYED.	
11 – 15 m.p.h.	STRUCTURAL DAMAGE LIFT–OFF DOUBTFUL	
16 – 25 m.p.h.	SEVERE DAMAGE & INJURY – USE SUICIDE PILL.	
ABOVE 25 m.p.h.	MODULE & ALL LIFE DESTROYED . . .	

SET UP:–

F–CA–F–FP–8–GOTO–00

Mode switch to load – enter program – mode switch to run – goto – 00 enter any two or more numbers (date etc.) Each followed by Xn key. Press R/S – speed of descent displayed.

Allow for weight of fuel remaining, enter period (in seconds) of rocket burn to reduce speed, press R/S – new rate of descent displayed, correct as before. After five speed corrections, impact speed will be displayed. If fuel in excess of 20 seconds is used, module transmits an urgent message before destructing.

Press R/S to re – start.

PROGRAM

Memory 1 – Seconds of fuel left
Memory 0 – Accurate descent speed

N.B. Adjust burn period for weight of fuel, allow 1 m.p.h. for each Second of fuel remaining (approx)

LOC	CODE	KEY	LOC	CODE	KEY
00	21	F	36	85	–
01	63	S	37	52	MR
02	21	F	38	81	1
03	51	FRAC	39	85	–
04	74	X	40	52	MR
05	81	1	41	91	0
06	91	0	42	74	X
07	95	=	43	95	=
08	51	M	44	35	x
09	91	0	45	51	M
10	53	Xn	46	91	0
11	82	2	47	52	MR
12	91	0	48	81	1
13	51	M	49	94	+/–
14	81	1	50	15	SKIP
15	71	4	51	14	GOTO
16	51	M	52	73	6
17	82	2	53	63	9
18	52	MR	54	52	MR
19	91	0	55	82	2
20	74	X	56	85	–
21	62	8	57	81	1
22	84	+	58	95	=
23	52	MR	59	15	SKIP
24	81	1	60	14	GOTO
25	95	=	61	81	1
26	51	M	62	73	6
27	91	0	63	52	MR
28	21	F	64	91	0
29	52	INT	65	13	R/S
30	13	R/S	66	14	GOTO
31	21	F	67	91	0
32	85	M–	68	91	0
33	81	1	69	72	5
34	21	F	70	91	0
35	32	e^x	71	72	5

BUILD THE 12,000 ALREADY SOLD NASCOM I COMPUTER

NEW LOW PRICE **£165** + 8% VAT POST FREE

WE ARE THE SOLE APPROVED LONDON STOCKIST & NATIONAL DISTRIBUTOR

KITS IN STOCK:

● BRITISH DESIGN ● U.K. BEST SELLING KIT

FULL AFTER SALES SERVICE & GUARANTEE

FEATURES:

- ★ Free B-Bug and Modulator
- ★ Supplied in kit form for self-assembly.
- ★ Full documentation supplied.
- ★ Fully screened double-sided plated through hole printed circuit board.
- ★ Full 48 key keyboard included.
- ★ 2K x 8 Ram.
- ★ IK x 8 monitor program providing
- ★ Powerful Mostek Z80 CPU.
- ★ 16 x 48 character display interface to std un-modified T V.
- ★ T.V display memory mapped for high speed access.
- ★ On board expansion to 2K x 8 Eprom.
- ★ On board expansion for additional 16 I/O lines.
- ★ Memory may be expanded to full 60K.

SOFTWARE

- ★ IK x 8 monitor program providing
- ★ 8 operating commands, supporting Mem examine/modify, tabulate, copy, break, single step execute tape load, tape dump.
- ★ Reflective monitor addressing for flexible monitor expansion through user programs.
- ★ Monitor sub-routines include — delay ASCII coding, binary to hex conversion, clr screen, scroll up, string print, cursor shift and many others.

EXPANSION

★ Expansion buffer board	£32.50
MEMORY KITS (inclusive all hardware)	
8K	£85.00
16K	£140.00
32K	£200.00
★ I/O board with decoders and all hardware except ICS	£35.00

Will accept up to 3 PIOs, 1 CTC and 1 UART.

OTHER HARDWARE

★ 3A power supply for up to 32K expansion	£19.90
★ 3A power supply for up to 32K expansion MKII	£24.50
★ 8A power supply for larger than 32K expansion	£60.00
★ Expansion card frame	£29.50
★ E Prom Programmer	£40.00
★ E from Eraser	£25.00
★ keyboard Cabinet	£3.50
★ Programming Manual	£4.00

NEW T-4 Operating System in (2) 2708 EPROMS upwards compatible from T2 & B-Bug	£25.00
TINY BASIC	£25.00
SUPER TINY BASIC (with Editor & Machine Utility routined)	£35.00
ZEAP ASSEMBLER EDITOR	£32.00

● VAT 8% all items except books ● Demonstrations continuous daily. We welcome export — Educational and Industrial Enquiries.

FREE BROCHURE — SEND S.A.E. 9½ x 6½ STAMP 12½p.

HENRY'S

Phone (01) 723 1008

All mail to:
Henry's Radio
404 Edgware Road
London W2

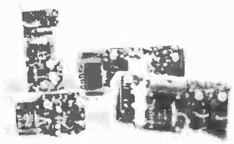
BARCLAYCARD

Access — Buy it with Access

POWER-ONE

D.C. POWER SUPPLIES

Now, like Intel, Motorola and National you can buy Power-One open frame power supplies and enjoy quality and reliability at LOW LOW prices. Over 70 different models to choose from including floppy disc drive supplies as well as single, double, triple and quad output.



Floppy Disc Drive Supplies

— with connectors and cables for Shugart drives if required.

CP-249 — drives one mini drive	£33.00
CP-323 — drives two mini drives	£60.00
CP-205 — drives one Shugart SA800 or equivalent 8" drive	£58.00
CP-206 — drives two SA800	£76.00

Single Output

5V at 2.7A w/OVP	£19.50
5V at 5.4A w/OVP	£41.50
12V at 6A	£67.50
15V at 5.4A	£67.50

Dual Output

±12 to 15V at 1.5A	£41.00
±18 to 24V at 0.4A	£32.50
± 5V at 5.4A w/OVP	£78.00

Triple Output

5V, 9-15V, -5, -12, -15V at 1.8A to 10.8A
From £41.00 to £137.00

Discount available to bona-fide educational establishments. Quantity discounts start at five units. Trade enquiries welcome.
Send large SAE for full catalogue and price list.

HAL COMPUTERS LTD.,
133 Woodham Lane, New Haw, Weybridge, Surrey
KT15 3NJ. Telex. 8813487.

TUNER AMPLIFIER SYSTEM 8000

"Probably the best tuner amplifier ever designed in the UK."

The system 8000 Receiver is available now from Unielectric Ltd. The ultimate HIFI kit using the latest circuit techniques, its specification is equal to commercial units costing twice its price. The system 8000 marks a significant advance in HIFI, the sole criterion in its design has been overall performance. Unielectric's design and buying power with your labour means a real advantage over similarly priced commercial units.

- ★ VMOS OUTPUT
- ★ FM sensitivity below 1 μV
- ★ 50dB stereo separation on FM
- ★ Digital Readout
- ★ Multi inputs

PRICES

1. Metal work kit is £32.40 plus VAT at 8% **£35.00**
   Includes knobs, fascia, nut, bolts.
2. Set of PCBs is £13.43 plus VAT at 8% **£14.50**
3. Complete kit of parts including Metal Work is £146.67 plus VAT at 12.5% **£165.00**

(Postage on 1 and 2 is included) (Securicor delivery £5 on item 3) (VAT RATES MAY CHANGE DURING THE BUDGET)

4. A full alignment service for the Mother board is available.

UNIELECTRIC LTD.

182-184 Addington Road, South Croydon, Surrey

Mastermind

P. R. Kemble B.Sc.

This program enables the popular game Mastermind to be played on a Hewlett–Packard HP29C calculator.

A five digit number (no two digits the same) is set by one player, and then the second player must deduce what it is. There are 30,240 possibilities.

After each guess the calculator indicates how many digits in the guess were correct and in the right position, and how many were correct but in the wrong position.

To play:

Player A enters a 5 figure number and then presses GSB 1.

Player B enters his guess and presses R/S. After several seconds calculation the display shows a number such as 1.2 which means 1 digit in the right place and 2 more correct figures but in the wrong position.

Player B then enters another guess and presses R/S, etc. until he achieves a score 5.0.

For cheats (!) or if the number set has been forgotten, it is held in STO .5.

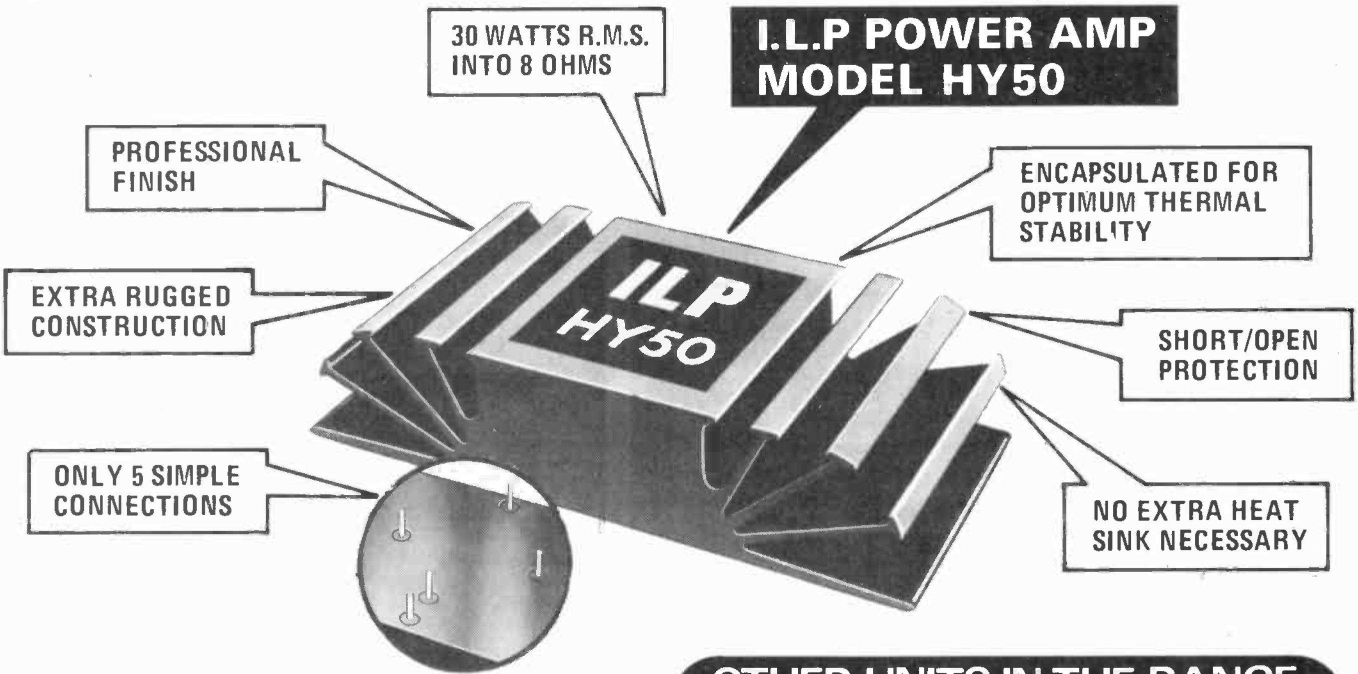
The use made of the calculators stores is shown below.
If the number set was ABCDE, and the guess is FGHIJ, then:

STO	0	Used
	1	J
	2	I
	3	H
	4	G
	5	F
	6	Used
	7	Used
	8	Used
	9	Used
	.0	E
	.1	D
	.2	C
	.3	B
	.4	A
	.5	ABCDE

STEP	INSTRUCTION
01	gLBL1
	fFIX1
	STO.5
	1
	4
	CHS
	GSBO
	gLBL9
	0
10	STO7
	STO8
	R
	R/S (Enter guess)
	5
	CHS
	GSBO
	1
	STOO
	gLBL5
20	RCLi
	9
	STO+0
	x≷y
	RCLi
	—
	gx = 0?
	GSB3
	8
	STO–0
30	RCL0
	6
	fx = y?
	GTO4
	GTO5
	gLBL3
	1
	STO+7
	RTN
	gLBL0
40	STO 0
	x ≷ y
	EEX
	4
	÷
45	gLBL2
	fINT
	STO i
	fLAST x
	gFRAC
50	1
	0
	x
	gISZ
	GTO 2
	RTN
	gLBL 4
	1
	4
	STO 9
60	gLBL6
	RCL 9
	STO 0
	RCL i
	STO 6
	5
	STO 0
	gLBL 7
	RCL i
	RCL 6
70	—
	g x = 0?
	GSB 0
	gDSZ
	GTO 7
	1
	STO–9
	RCL 9
	9
	f x ≠ y?
80	GTO 6
	RCL 7
	STO–8
	1
	0
	STO÷8
	x ≷ y
	RCL 8
	+
	GTO 9
90	gLBL 0
	1
	STO+8
	RTN

Simply ahead!

HIGH PERFORMANCE MODULAR UNITS
BACKED BY NO-QUIBBLE 5 YEAR GUARANTEE



Of all the purpose-built power amplifier modules by I.L.P., the HY50 is understandably the most popular with those wanting to build new or up-grade an existing hi-fi system, run a small high quality P.A. system, amplify a musical instrument (say for practice or small range use) or use it for lab work. Its useful 30 watts RMS output into 8 ohms, its rugged construction and freedom from heatsink worries make it the ideal all-purpose quality power amp — and it is unconditionally guaranteed for five years! Tens of thousands are in regular use throughout the world.

. . . .and a spec that means what it says!

Encapsulated power amp with integral full-rated heatsink.
Input — 500mV.
Output 30 watts RMS/8Ω.
Load Impedance — 4 to 16Ω.

S/N Ratio 75dB
Distortion — 0.02% from 100mW to 25 watts at 1KHz into 8Ω.
Supply Voltage ± 25V. Size 105 x 50 x 25mm.
Inc. VAT and postage in U.K.

£8.15

Nothing has been overlooked in the design and manufacture of I.L.P. Modular Units. Heavy duty heatsinks, encapsulated circuitry, no-compromise production standards and true professional finish ensure world leadership in their field for I.L.P. Now we have ***up-graded*** output ratings and ***down-graded*** prices to bring I.L.P. within easier reach of all who want the best with which to build with. Prices reduced by an average around 20%.

Guaranteed 7-day dispatch on all products

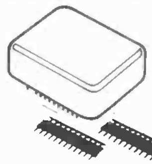
FREE POST — No stamp required when sending your order or enquiry for information sheets.

ILP ELECTRONICS LTD.

FREEPOST 4, Graham Bell House, Roper Close, CANTERBURY Kent CT2 7EP. Phone (0227) 54778. Telex: 965780

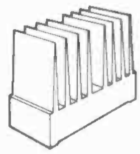
OTHER UNITS IN THE RANGE

All prices inc. VAT and postage in the U.K.



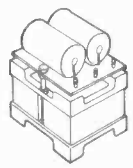
HY5 PRE-AMPLIFIER
Compatible with all I.L.P. power amps and P.S.U.s. In a single pack, needs external pots and switches. Multi-function equalization. Mag./Ceramic/Tuner/Mic./Aux. inputs. High overload margin. Active tone controls; 500 mV out. Distortion at 1 KHz — 0.01%. Two HY5s connect easily for stereo.

£5.22



THE POWER AMPS
With heatsinks, full load line and thermal protection. ***Distortion typically 0.05% at 1 KHz.***

HY120	60 Watts RMS/8 Ω	114 x 50 x 85mm	**£16.42**
HY200	120 Watts RMS/8 Ω	114 x 50 x 85mm	**£19.92**
HY400	240 Watts RMS/4 Ω	114 x 100 x 85mm	**£29.89**



THE POWER SUPPLY UNITS
(Split line outputs to suit I.L.P. power units and HY5).

PSU 50	for 1 or 2 x HY50	**£9.11**
PSU 70	for 1 or 2 x HY120	**£14.70**
PSU 90	for one HY200	**£14.70**
PSU180	for one HY400 or 2 x HY200	**£24.86**

★ NOW-PRICES DOWN BY 20%

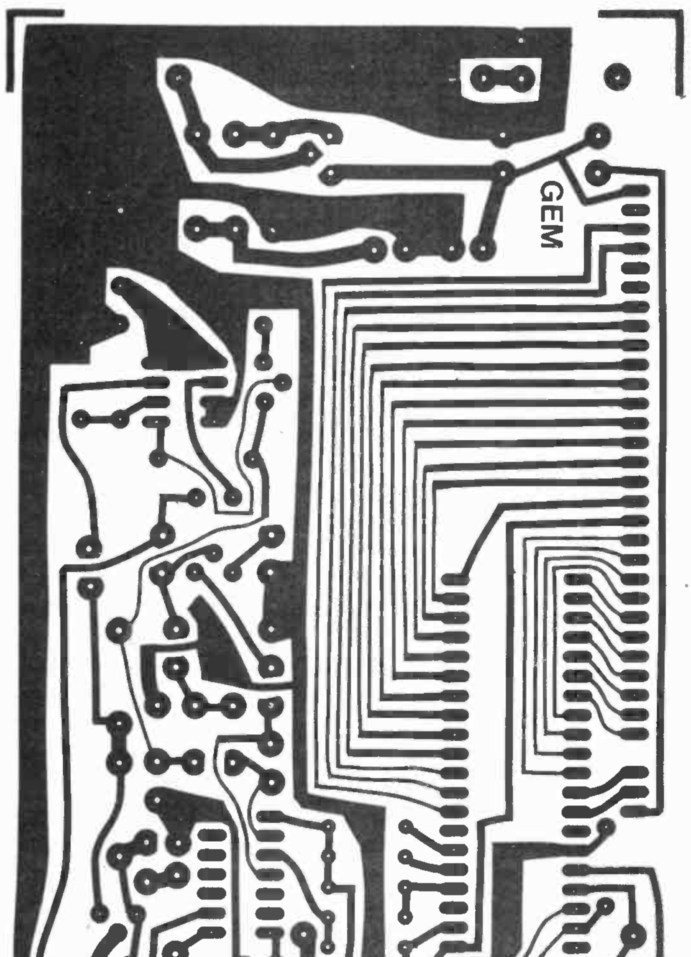
Please supply . . . .
Total Purchase Price . . . .
I enclose Cheque ☐ Postal Orders ☐ Money Order ☐
Please debit my Access/Barclaycard Account number.
Name and address . . . .
. . . .
Signature . . . .
F.P.47

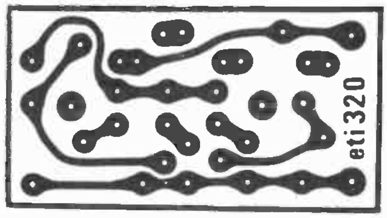
PCB FOIL PATTERNS

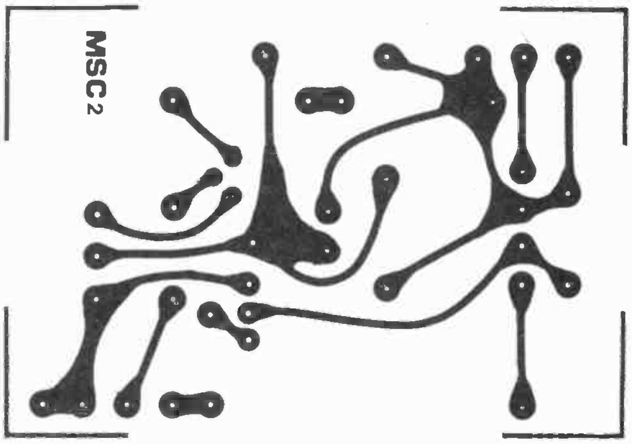
GATHERED HERE are all the PCBs for this month's projects.

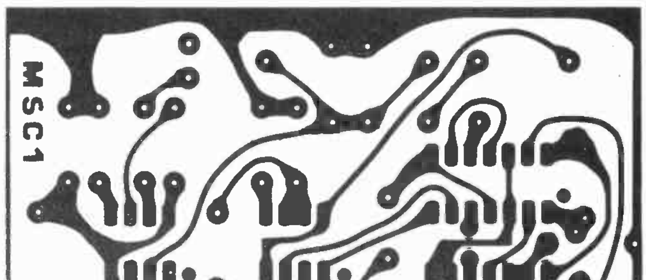
All are shown foil side up, and full size. Companies wishing to produce these for sale as ready made PCBs should note that where the board carries a copyright symbol, the designer retains that copyright to himself, so his company, and that particular board may not be produced on a commercial basis.

These pages form the basis of our ETIPRINT sheets, which are etch resistant transfers of the foil patterns, designed to simplify one-off PCB production.









"ALLY PALLY"
hursday-Saturday
28th-30th June.

Come to the Great British Electronics Bazaar

FREE!

(AND WAIT TILL YOU SEE OUR SEMINAR PROGRAMME)

The Great Big 'Bazaar' for the hobbyist, amateur, and small buyer.

There's never been an event like this before.

First, the very scale of the exhibition is huge. Virtually all the companies you're used to hearing about (and buying from) will be there. Companies like Fluke and Gould showing off their low cost multimeters; smaller but important manufacturers like Lektrokit and Chromasonics; and even the R.S.G.B. who will have a station 'on the air' throughout the 'Bazaar.'

Then there are the suppliers of low-cost components and equipment. Plus almost all the journals in the business. Plus, oh, so many more interesting people catering for your needs (including computer kits!).

And you get in FREE if you send an s.a.e. (see alongside).

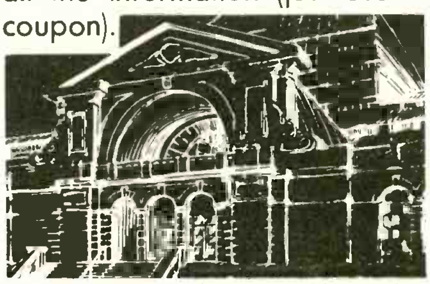
THE GREAT BRITISH ELECTRONICS BAZAAR

Our Symbol. We think it tells you just what the Bazaar is all about.

The Seminars.

If you would like to hear just what the experts have to tell you, a *season ticket* for three whole days can be yours for only £1.50.

Send an s.a.e. and we'll give you all the information (just use the coupon).



Our home for three days – Alexandra Palace, where it all began. (Our seminars are sited alongside the organ – for those who know this unique hall.)

SEMINAR TICKETS

£1.50.

I'd like to sit in at your seminars. (And like a free ticket to the exhibition.) Send me full details, please, and I enclose a large-ish s.a.e.

Name: ....

Address: ....

....

....

Post to: 'The Bazaar,' 34/36 High Street, Saffron Walden, Essex.

When?

Between Thursday to Saturday 28th–30th June.

You'll be in very good company; some ten thousand enthusiasts – and over a hundred stands displaying all that you want to see.

You'll come?

Eyes down for the appropriate coupon.

ADMISSION FREE

(or 50p on the door).

I'd like to see 'The Bazaar' FREE. I enclose a large-ish s.a.e. and will receive by return a ticket and full information.

Name: ....

Address: ....

....

....

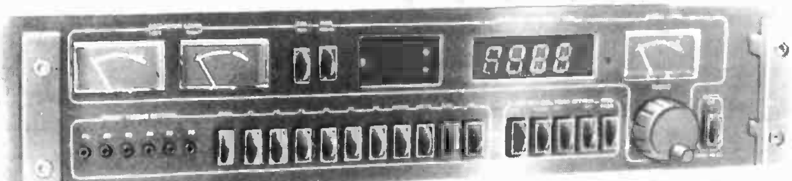
Post to: 'The Bazaar,' 34-36 High Street, Saffron Walden, Essex. If you'd rather just pay 50p, go to Wood Green Tube Station and take a bus (every 3 minutes) to Alexandra Palace. We're open 10 am-6 pm daily, Thursday to Saturday, 28th–30th June.

Tecknowledgey for sale.

The Mark III FM Tuner

DIY Hi-Fi will never seem the same again. Ambit's Mark III tuner system is electrically & visually superior to all others. Some options available, but the illustrated version with reference series modules: £149.00 + £18.62 VAT

With Hyperfi Series modules £185.00 + £23.12



ALL TUNER KITS £3 carriage

Features of the system.

- Precision construction & design of all parts
- Time frequency display
- State of the art performance with facilities for updates, using modular plug in systems.
- Deviation level calibrator for recording
- All usual tuner features

Digital Dorchester All Band Broadcast Tuner: LW/MW/SW/SW/SW/FM stereo

A multiband superhet tuner, constructed using a single IC for RF/IF processing - but with all features you would expect of designs of far greater complexity. The FM section uses a three section (air gang) tuned FET tunerhead, with ceramic IF filters and interstation mute; AM employs a double balanced mixer input stage, with mechanical IF filters - plus a BFO and MOSFET product detector for CW/SSB reception. Styled in a matching unit to the Mark III FM only tuner, employing the same degree of care in mechanical design to enable easy construction. MW/LW reception via a ferrite rod antenna.

Electronics only (PCB and all components thereon) £33.00 + £4.12 VAT
Complete with digital frequency readout/clock-timer hardware £99.00 + £12.37 VAT
Complete with MA1023 clock/timer module with dial scale £66.00 + £8.25 VAT

Hardware packages are available separately if you wish to house your own designs in a professional case structure. Please deduct the cost of electronics from complete prices.

LW/MW/FM LCD Digital Frequency Display - July PW feature

Update your old radio, or build this into a new design. Or use it as a servicing aid - this low power unit with LCD display reads direct frequency in kHz/MHz, or with usual AM/FM IF offsets for received frequency. Low power LCD means no RFI - 15-20mA at 9v even with the divide by 100 prescalar. FM resolution is 100kHz, AM 1kHz. Sensitivities better than 10mV

Complete kit £19.50 +*£1.56 VAT. Built and tested version £24.00 +*£1.92 VAT

Various other DFM systems described in our catalogue part 2 - including a one chip solution to providing digital display of FRG7 kHz dial, combined with clock/timers etc.

PW SANDBANKS PI METAL LOCATOR

Maintaining our professional approach to home constructor kits, we offer the pulse induction 'Sandbanks'. Now with injection molded casing for greatly improved enviromental sealing. £37.00+ *£2.96vat.

VHF MONITOR RX WITH PLESSEY IC

4/9 channel version of the PW design - but using standard 3rd OT crystals, and TOYO 8 pole crystal filter with matching transformers. Coil sets from our standard range to cover bands from 40 to 200MHz. Complete module kit £31.25 +£3.90vat

ETI - REMCON RADIO CONTROL

A tried and tested RC system with a full set of supporting hardware from a well known manufacturer. Please send for details - and watch our ads for further news of developments in RC products.

Radio and Audio Modules : The biggest range/ best specs:

EF5801/3/4 6 stage varicap tunerheads with LO feed and various levels of sophistication. New 5804 include pin AGC loop 'on board'. 5801:£17.45+£2.18vat - 5803:£19.75+£2.47vat 5804:£24.95 +£3.18vat. *Frequencies in 40-180MHz on appcn.*

EF5402 4 stage varicap with TDA1062, compound FET/Bipolar input stage, low noise, balanced mixer, pin agc, osc output. A worthy successor to the 5400. £10.75+£1.34vat

The 5402 is available centred on a wide range of frequencies from 30MHz to 180MHz. Non standard units £14.75+£1.84 - 3 weeks.

8319 4 stage varicap tunerhead from Larsholt using MOSFET RF and mixer stages. New temperature compensated oscillator for wide ranges of ambient temperature £13.45+£1.68vat

7252 Complete Larsholt FM tuner less stereo decoder. £26.50+£3.31vat

7253 Stereo FM tunerset from Larsholt with FET head. (as 7252)

944378 Hyperfi stereo decoder. The very best. £19.95+£2.49vat

911223 Pilot cancel stereo decoder, priced to make the MC1310 as obsolete as it now deserves to be.£12.50+£1.56vat

Inotec 1 A fully DC tuned and switched LW/MW/FM stereo tuner to interface with synthesiser control etc.A first! Details OA

COMPONENTS for Radio and Audio ICs, HMOS etc.

The list is too long to attempt here, but AMBIT specializes in all types of semiconductor for radio reception, including devices operating from DC to 5GHz. New low cost SBL1 diode ring mixers (equiv case MD108 etc) -first with HMOS fets, now with a PCB for DC amplifier, and offset sense and protection relay for speakers. See catalogue and updates for most info, pse send an SAE for information on anything you cannot find in catalogues.

Radio ICs	cost + vat		Stereo ICs	cost + vat		AF power ICs	cost + vat	
CA3089E	1.94	24	MC1310P	1.50	19	LM380N	1.00	12
CA3189E	2.45	30	uA758	2.20	27	TBA810AS	1.09	14
HA1137W	2.20	27	CA3090A	2.75	34	TDA2002	1.95	24
SN76660	0.75	9	HA1196	3.95	49	TBA820M	0.75	9
TDA1090	3.35	42	HA11223	4.35	54	from the general list:		
TDA1083	1.95	24	KB4437	4.35	54	LEDs:all colours and		
TDA1220	1.40	17	KB2224	2.75	34	low prices		
SL6640	2.75	34	Preamp ICs/switches			2SJ48/2SK134 HMOS		
MC3357	3.12	39	TDA1028	3.50	44	9.90 +£0.80 vat(Pair)		
HA1197W	1.40	17	TDA1029	3.50	44	Signal fets/transistors and		
MC1496	1.25	16	TDA1074	4.14	52	TOKO COILS & FILTERS!		
LM373/4	3.75	49	KB4438	2.22	28			

OSTS: Remember all OSTS stocks are obtained from BS9000 approved sources - your assurance that all devices are very best first quality commercial types. Some LPSN TTL is presently in great demand, so please check by phone before ordering.

TTL:Standard AND LP SchottkY

All prices listed in pence *

	'N'	'LSN'
7400	13	20
7401	13	20
7402	14	20
7403	14	20
7404	14	24
7405	18	26
7406	38	
7407	38	
7408	17	24
7409	17	24
7410	15	24
7411	20	24
7412	17	
7413	30	
7414	51	
7415		24
7416	30	
7417	30	
7420	16	24
7421	29	24
7422	24	24
7423	27	
7425	27	
7426	36	27
7427	27	29
7428	35	32
7430	17	24
7432	25	24
7433	40	32
7437	40	24
7438	33	24
7440	17	24
7441	74	
7442	70	99
7443	115	
7444	112	
7445	94	
7446	94	
7447	82	89
7448	56	99
7449		99
7450	17	
7451	17	24
7453	17	
7454	17	24

	'N'	'LSN'
7455	35	24
7460	17	
7463		124
7470	28	
7472	28	
7473	32	38
7474	27	38
7475	38	40
7476	37	38
7478		38
7480	48	
7481	86	
7482	69	
7483A		110
7484	97	
7485	104	99
7486		40
7489	205	
7490	33	90
7491	76	110
7492	38	78
7493	32	99
7494	78	
7495A	65	99
7496	58	120
7497	185	
74100	119	
74104	63	
74105	62	
74107	32	38
74109	63	38
74110	54	54
74111	68	
74112		38
74113		38
74114		38
74116	198	
74118	83	
74119	119	
74120	115	
74121	25	
74122	46	57
74123	48	73
74124		137
74125	38	44

	'N'	'LSN'
74126	57	44
74128	74	
74132	73	78
74133		29
74136		40
74138		60
74139		60
74141	56	
74142	265	
74143	312	
74144	312	
74145	65	97
74147	175	
74148	109	191
74150	99	
74151	64	84
74153	64	54
74154	96	
74155	54	110
74156	80	110
74157	67	55
74158		60
74159	210	
74160	82	130
74161	92	78
74162	92	130
74163	92	78
74164	104	130
74165	105	
74166		
74167	20	
74168		
74169		200
74170	230	200
74172	625	
74173	170	
74174	87	120
74175	87	110
74176	75	
74177	78	
74180	85	
74181	165	150
74182	160	
74183		210
74184	135	

	'N'	'LSN'
74185	134	
74188	275	
74190	115	92
74191		
74192	105	180
74193	105	180
74194	105	187
74195	95	137
74196	99	110
74197	85	110
74198	150	
74199	160	
74247		90
74248		90
74249		93
74251		90
74253		105
74257		108
74258		153
74259		420
74260		153
74261		353
74266		40
74273		124
74275		312
74279		52
74283		120
74290		90
74293		95
74295		120
74298		100
74324		157
74325		242
74326		247
74327		237
74352		100
74353		100
74362		715
74365		49
74366		49
74367		43
74368		49
74373		77
74374		77
74375		60

	'LSN'
74377	124
74378	93
74379	130
74368	37
74390	140
74393	140
74395	139
74396	133
74398	180
74399	150
74445	92
74447	90
74490	140
74668	110
74670	249

VOLTAGE /PSU REGULATORS

7800 series	95p
7900 series	£1
78M series	90p
(TO220 pack)	
78LCP series	35p
78MGT2C	175p
79MGT2C	175p
723C	65p
NE550A	73p
L200	195p

MAINS FILTERS

1Amp IEC	4.83
6Amp IEC	5.83
5A wired	3.87
All BS approved	

Requests for the next issue of the catalogue now being "booked" for dus patch immediately it is ready (about November) Please send 50p to reserve a copy (Part 3)

IMPORTANT: ALL OSTS PRICES EXCLUDE VAT - CURRENTLY 8% - BUT MAY BE CHANGED BY THE TIME YOU READ THIS. PLEASE REMEMBER TO ADD VAT, and 25p POSTAGE !!

CD4000 CMOS

4000	17p	4059	563p	4522	149p
4001	17p	4060	115p	4527	157p
4002	17p	4063	109p	4528	102p
4006	109p	4066	53p	4529	141p
4007	18p	4067	400p	4530	90p
4008	80p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4014	95p	4075	20p	4541	141p
4016	52p	4076	90p	4543	174p
4017	80p	4077	20p	4549	399p
4018	80p	4078	20p	4553	440p
4019	60p	4081	20p	4554	153p
4020	93p	4082	20p	4556	77p
4021	82p	4085	82p	4557	386p
4022	90p	4086	82p	4558	117p
4023	17p	4089	150p	4559	388p
4024	76p	4093	50p	4560	218p
4025	17p	4094	190p	4561	65p
4026	180p	4096	105p	4562	530p
4027	55p	4097	372p	4566	159p
4028	72p	4098	110p	4568	281p
4029	100p	4099	122p	4569	303p
4030	58p	4160	90p	4572	25p
4031	250p	4161	90p	4580	600p
4032	100p	4162	90p	4581	319p
4033	145p	4163	90p	4582	164p
4034	200p	4174	104p	4583	84p
4035	120p	4175	95p	4584	63p
4036	250p	4194	95p	4585	100p
4037	100p	4501	23p		
4038	105p	4502	91p		
4039	250p	4503	69p		
4040	83p	4506	51p		
4041	90p	4507	55p		
4042	85p	4508	248p		
4043	85p	4510	99p		
4044	80p	4511	149p		
4045	150p	4512	98p		
4046	130p	4513	206p		
4047	99p	4514	260p		
4048	60p	4515	300p		
4049	65p	4516	125p		
4050	55p	4517	382p		
4051	65p	4518	103p		
4052	65p	4519	57p		
4053	65p	4520	109p		
4054	120p	4521	236p		
4055	135p				

Micromarket

6800 series					
6800P	6.50	8216	1.95	2114	£10
6820P	£6	8224	3.50	2708	£
6850P	2.75	8228	4.78	**Development**	
6810P	£4	8251	6.25	MI K6800	£220
6852	3.65	8255	5.40	1K80	£306
8080 series		**MEMORIES**		AMI, Signetics	
8080	6.30	2102	£1.70	TI, Intersil,	
8212	2.30	2112	£3.40	Harris etc OA	
		2513	£7.54		
		4027	£5.78		

MISC. LSI/Scalars/DVMs

NE555 30p NE556 78p NE558 180p
LM3909 72p 95H90DC /320MHz 7.80p
11C90DC /650MHz £14.00
ICM7216BIPI 8 decade 10MHz DFM/timer with direct LED drive and all counter features £19.82
ICM7217AIBI 4 decade programmable cntr £9.50
ICM7207 clock pulse generator IC £4.95
ICM7208 7 decade counter/display drive £14.95
ICM7106CP LCD DVM IC (3½ digit) £9.55
ICM7106CPK LCD DVM KIT £24.80
ICM7107CP LED DVM IC £9.55
ICM7107CPK LED DVM KIT £20.65
SP8629 divide by 100/200MHz scalar £4.20
MSL2318 divide by 100 to 175MHz min divide by 10 to 45MHz min £4.20

PLEASE REMEMBER TO ADD 8% VAT TO ITEMS LISTED UNDER OSTS

LINEARS non-consumer

BIMOS		LM324N	71p
CA3130E	84p	LM339N	66p
CA3130T	90p	LM348N	186p
CA3140E		LM3900N	60p
CA3140T	72p	709HC to5	64p
CA3160E	90p	709PC dil	36p
CA3160T	99p	710HC to5	65p
Op amps		710PC dil	59p
LM301AH	67p	723CN	65p
LM301AN	30p	741CH to5	66p
LM308H	121p	741CN 8dil	27p
LM308N	97p	747CN	70p
LM318H	279p	748CN	36p
LM318N	224p	NE531T	120p
		NE531N	105p

OPTO 7 seg displays

0.43" High Efficiency HP:

5082 7650 red CA
5082 7653 red CC
5082 7660 yellow CA
5082 7663 yellow CC
5082 7670 green CA
5082 7673 green CC
} 233p

0.3" Standard HP

5082 7730 red CA
5082 7740 red CC
} 147p

0.5" Fairchild

FND500 red CC 150p
FND507 red CA 150p

Current news: We work continues apace on our HMOS PA kit, and by the time this is published - we expect to be about to launch the product in a style that matches the Mark III system. The unit uses separate transformers and power supplies, and includes a DC offset sensing circuit combined with slow switch-on using a relay. We introduce the HyperFi FM IF with this advert - and a separate leaflet is available on request with an SAE. All new pricelist revision also available with an SAE. The Mullard DC controlled tone/volume and switch ICs with a 'more than HiFi' specification are in stock at last - together with reams of data (over 50 pages now). Also, RC enthusiasts will be interested to learn that we are supplying parts for various kits now.

Terms: CWO please. Account facilities for commercial customers OA. Postage 25p per order. Minimum credit invoice for account customers £10.00. Please follow instructions on VAT, which is usually shown as a separate amount. Overseas customers welcome - please allow for postage etc according to desired shipping method. Access facilities for credit purchases.

Catalogues: Ambit: Part 1 45p. Part 2 50p 90p pair. TOKO Euro shortform 20p. Micrometals toroid cores 40p. All inc PP etc. Full data service described in pricelist supplements.

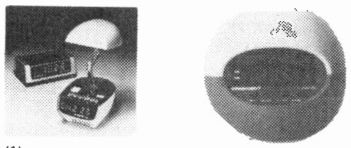
Hours/phone: We are open from 9am -7pm for phone calls. Callers from 10am to 7pm. Administrative enquiries 9am to 4.30pm please (not Saturdays). Saturday service 10am to 6pm.

AMBIT catalogues are guaranteed to contain the most up-to-date and best informed comment on modern developments and advances in the field of radio and audio. There is no competetive publication that even approaches the broad range of parts/information on modern techniques.

ambit international ® 2 Gresham Road, Brentwood, Essex.

MINI-ADS & CLASSIFIED

BARGAINS FOR THE ELECTRONIC HANDYMAN BRANDED LED DIGITAL ALARM CLOCKS



(1) (2) (3)

Returned to Service Department within guarantee period.

(1) With alarm repeat — S.R.S.P. of £17.00 offered at **£3.95** inc VAT.
(2) With luxury lamp and repeat alarm as featured in most major U.K. Mail Order catalogues, S.R.S.P. £31.00 — offered at **£6.95** inc. VAT.
(3) With integral luxury light and repeat alarm also as featured in most major U.K. Mail Order catalogues, S.R.S.P. of £32.00 — offered at **£6.95** inc VAT.

These will be sold as received from our customers with the existing fault(s) and without guarantee.

Discounts available on large bulk purchases

PRESCOTT CLOCK AND WATCH COMPANY LIMITED
Prescott House, Humber Road, London NW2 6ER

AF/RF SIGNAL INJECTOR £3.50. AF/RF Signal Tracer £3.75. Also Transistor Tester, uses your meter, £5.50. Send SAE for leaflets. G. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

Carbon Film Resistors and 1N4148 equivalent silicon diodes supplied from ½p each. Free details and generous samples from D. Johnston, 12 Balgillo Road, Dundee DD5 3LU.

CIRCUIT DESIGN, Prototype construction, Analogue or Digital, Single Circuits or Complete Instruments/Systems. Write A. J. ATTWOOD, C.Eng., MIERE, Heathercote, Heatherton Park, Taunton, Somerset, TA4 1ET or Phone Bradford-on-Tone (082-346) 536.

PRINTED CIRCUITS and HARDWARE

Comprehensive range Constructors Hardware and accessories

Selected range of popular components
Full range of HE printed circuit boards normally ex-stock same day despatch at competitive prices
P C Boards to individual designs
Resist-coated epoxy glass laminate for the d i y man with full processing instructions (no unusual chemicals required)

Alfac range of etch resist transfers and other drawing materials for p c boards

Send 15p for catalogue.

RAMAR CONSTRUCTOR SERVICES
MASONS ROAD
STRATFORD-ON-AVON
WARWICKS. Tel. 4879

FOR NASCOM 1 IN SCOTLAND SEE STRATHAND

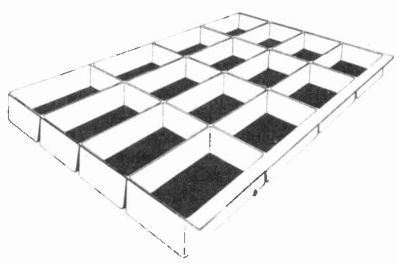
In stock now:
Nascom 1
Buffer Boards
8, 16, 32K Ram Boards
Super Tiny Basic
Zeap on tape

Please note it is not our policy to advertise Nascom products which are not currently available.

STRATHAND
44 St. Andrew's Sq.
Glasgow G1 5PL
041-552 6731 or 2

Access and Barclaycard sales welcome
Callers welcome 9-5 Monday to Friday

THE LOW-COST WAY TO ORGANISE YOUR COMPONENTS



COMTRAYS

Store resistors, capacitors, IC's, screws, etc Ideal for organising your project components — saves all that searching around while constructing. Plastic trays with 16 compartments, each compartment 3¼ x 2 x 1½ins. deep

£1.60 each, including p.p. and VAT
Four for **£5.90** (64 compartments)
Eight for **£10.90 (128 compartments)**

Cheque or P.O. to:
HELISTAR SYSTEMS LTD.
150 WESTON ROAD
ASTON CLINTON
AYLESBURY, BUCKS HP22 5EP
Tel. Aylesbury 630364

MAINS TRANSFORMERS 240 V Pri two separate secs. Each 7V at 500 mA. £1.10 each+35p P&P. P.C.B. with LM300 2-20 V Precision voltage regulator, 741 14pin, 1 amp bridge rect./X med. power transistors, 'X SJE 5039+6 other transistors, 2N5061 Thyristor+7 caps, 35 res. 90p each+15p P&P. D. Nicholls, Lyndale, Church Lane, Flax Bourton, Bristol.

INTRODUCTION TO MICROPROCESSORS AND COMPUTING. 50 pages of diagrams and explanation to get you started. Price £2.30 + 45p postage.
EDUCATIONAL DATA AND TECHNICAL SERVICES
59 Station Road, Cogenhoe, Northampton NN7 1LU

Road Runner

ROADRUNNER WIRE THREADING SYSTEM

Introkit £9.88, Wiring Pencil with full Bobbin £2.44, Distribution Strips glue fix 20/pkt. 6" long £2.80 pkt., press fix 20/pkt. 2" long fit Vero/RS Bds. £2.92 pkt., Bobbins of "Q.S.E." wire 4 of 1 col./pkt. green, blue, copper, pink £2.12 pkt.

SPECIAL OFFER: Oryx 50 temp. cont. iron & stand £12.50 (rec. price £13.25), Microshear Cutters £3.15 pair, Conductive Paint £2.35, DIL Breadboards + & Gnd. Bus, 20 Ic Posns, Decouplers, C-Fingers £1.50 ea.

Prices include P&P. Please add 8% VAT.

T. J. Brine Associates
Blackdown Rural Inds.
Haste Hill
Haslemere, Surrey

COLOUR MODULATOR

Kit **£6.95** inc. UHF Modulator

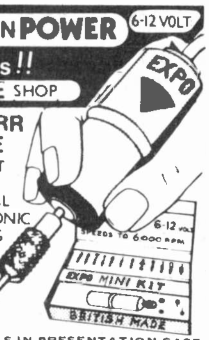
FOR ALL TV GRAPHICS!

Red, Green, Blue inputs (can be mixed). SUPER EXPLOSION FLASH EFFECT FOR TANK BATTLE. FREE INTERFACE DETAILS.

WILLIAM STUART SYSTEMS
Dower House, Billericay Road, Herongate, Brentwood, Essex CM13 3SD Tel (0277) 810244
Barclaycard/Access welcome

NEW QUALITY STEREO AMP CHASSIS. 60w (RMS) Silicon Power Modular System. Protected 3Ω min. 0.03% Thd. 12/30v. Wkg. din socks, controls select v/c, etc., Boxed, data £9.95 (inc.). Available with P.s.u. £12.50.
K. Lawrence, 1 Regent Road, Ilkley, W. Yorks.

SAFE PRECISION POWER 6-12 VOLT
at your fingertips!!
POCKET **MACHINE** SHOP



★ **DRILL, GRIND, BURR**
★ **ENGRAVE, CARVE**
★ POLISH & SHAPE! BEST
★ MODELLING TOOL WE
★ HAVE EVER USED IDEAL FOR LAPIDARY, ELECTRONIC AND MODEL ENGINEERING
CAMERA REPAIRS, OPTICIANS, THOUSANDS OF USES.

RELIANT MINI KIT **£14.25** POST PAID

WITH 20 HIGH SPEED TOOLS IN PRESENTATION CASE

OR

MORE POWERFUL TITAN MINI KIT WITH 20 TOOLS **£17.55** POST PAID SAME CASE

Full range of accessories available from stock.

"FREE" WITH ANY KIT PURCHASED, THIS SUPERB CUTTING SET CONSISTING OF STEEL MANDRELL & 5 FINE GRIT CUTTING DISCS: .020 Thick X 7/8" Dia. VALUE: £1.00.

ELLIOTTS CAMERACRAFT LTD
31 QUEENSWAY SOUTHAMPTON.HANTS
Tel. 25944

THIS SECTION IS A PRE-PAYMENT SERVICE ONLY

MINI-ADS: 31/4" x 21/8", 1-3 £38, 4-11 £36, 12 or more £34 per insertion. CLASSIFIED DISPLAY: 19p per word. Minimum 25 words. Boxed classifieds are £6.33 per col. centimetre. No P.O. Box Numbers can be accepted without full address.

Enquiries to: Advertising Department, 01-437 5982. 25-27 Oxford Street, London W1R 1RF

E.T.I. P.C.B's

Buy it with Access

BARCLAYCARD

Available for all ETI projects from day one of ETI, 'phone your order

SPECIAL OFFER—Single sided Pax PCB mat, four off, 4¾" x 6½", 99p all up

CROFTON ELECTRONICS LIMITED

35 GROSVENOR ROAD, TWICKENHAM MIDDLESEX TW1 4AD · Tel: 01-891 1923

TIRRO's new mail order price list of electronic components now available on receipt of SAE. TIRRO Electronics, Grenfell Place, Maidenhead, Berks.

SITS~VAC

ELECTRONIC BLOKE — WILLESDEN

To work with two slightly mad engineers on all service aspects of analogue and digital gear (coin operated video games). Opportunities for further training. Ring 01-459 2236 — ask for Derek Morgan.

LAB TECHNICIAN — WILLESDEN

To assist prototype electrical and electronic manufacture. General PCB, wiring, metalwork, woodwork etc. Capable of reading circuit diagrams including digital. Ha-porth of common sense essential. Apply 01-459 2236 — ask for Derek Morgan.

We are leading specialists in computer numerical control systems for machine tools — an expanding firm in an expanding technology. We are currently building larger premises and adding to our workforce to meet increasing sales.

TEST ENGINEER

To test for and repair faults, down to component level, in our C.N.C. systems; and to construct and maintain associated test equipment. Applicants should be of H.N.C. standard, and have substantial test experience in a logic-based electronics industry (ideally with involvement in microprocessor applications).

PROTOTYPE WORKERS

For assembly and wiring consoles and control panels, and in-house test equipment, working from circuit diagrams, plus preparation of associated wire-run sheets, etc. Applicants should be experienced in prototype work on P.C.B.'s and wiring in cabinet enclosures; ideally with O.N.C./C & G electronic engineering.

We can offer excellent conditions and career prospects for the right men and women. Why not ring Alison Peirson on Basingstoke 29303 for full details?

POSIDATA LTD.

Rankine Road, Daneshill Basingstoke, Hants. RG24 0PP

VMOS POWERFETS

(with free data and ideas sheet)

VN67AF (60v, 2A, 15W, TO202) **85p**
VN10KM (60v, ½A, 1W, TO92 tab) **60p**
Latest VMOS Powerfet Design Catalog (96 pages, data and ideas) **45p**

Selected Powerfets also available with lower maximum ON resistances, for reduced I^2R power losses

Select VN67AF **95p**
(2.5Ω max. instead of 3.5Ω @ I_D=2A, V_{GS}=10v)

Select VN10KM **70p**
(4Ω max. instead of 5Ω @ I_D= ¼A, V_{GS}= 10v)

BIFET OPAMPS

(free data ideas sheet)

TL081CP (single opamp) **29p**
TL074CN (quad opamp) **120p**

(BIFET opamps, superior to bipolar types, even have a few advantages over BIMOS types. Most obvious is their lower cost. Less obvious is the lower noise and greater stability of their input stages.) The TL074CN (incidentally) is a quad BIFET with particularly low noise and distortion suitable for hi-fi applications.

P&P 20p. Mail Order only

S.a.e. for latest informative lists

J. W. RIMMER
367 Green Lanes, London N41DY

COMPONENTS TEST EQUIPMENT. CCT boards, anything electrical/electronic purchased for cash. "Q" Services Electronic (Cambridge) Ltd., 29 Lawford Crescent, Yateley (0252) 87148, Camberley, Surrey.

CM2506 DIGITAL CAPACITANCE METER 1pf-2µf, 2½ digits, acc 1%. Introductory price £24.99 + 8% VAT. Return in 8 days if unsatisfied. Allow 28 days for delivery. Precision Measurements, 8 St. Stephen's Court, Canterbury.

Ultrasonic Transducers. £2.85 per pair + 25p p&p. DATAPLUS DEVELOPMENTS, 81 Cholmeley Road, Reading, Berkshire.

SECURITY PRODUCTS

Designed for the Do-It-Yourself market. Easily installed Full instructions supplied As supplied to the trade.

Magnet and Reed Switch	Flush	**85p**
	Surface	**85p**
Pressure Mats	Large	**£2.10**
	Stair	**£1.35**
6" Heavy Duty Bells		**£10.50**
Sirens 12v 84dB @ 10'		**£7.05**
Bell Covers		**£8.05**
Window Foil Self-Adhesive		**£3.20**
Foil Blocks		**20p**
Door Loops, complete		**£1.10**
Key Switches, top grade		**£4.00**
Control Panels from		**£29.50**

Radar, Infra-Red, and many other items available. Price list supplied free

Please note that our prices now **INCLUDE** VAT at 12½% + P&P

SECURITY CATALOGUE

Giving details of current professional alarm techniques — £1 (refundable on orders over £10)

Access and Barclaycard Sales welcome

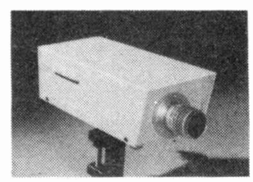
We also sell Nascom 1

STRATHAND SECURITY

44 St. Andrew's Sq., Glasgow G1 5PL
041-552 6731 or 2

COMPONENT PACKS. 100 Mixed Resistors 70p. 25 Polyester capacitors 60p. 10 Micro-switches, ex equip. 80p. 100 Components (mixed) 100p. 10 Mains neons 50p. 10 Cable Ties 15p. 100 Connectors, Spades, Tags, Eyelets etc. 100p. 10 BC108 95p. 10 BC109 95p. c60 Cassettes 49p. C90 Cassettes 59p. Add 20p P&P. Durrants (Components), 9 St Mary's Street, Shrewsbury.

ETI FOR SALE. Complete set from No. 1, 87 issues, mint condition. Offers to: B. Dawson, School House, St Michaels Road, Sutton Coldfield B73 5SY.



CCTV CAMERA

£99·99 Total £110·64 inc. p/p & VAT

BEST OFFER EVER

Camera Kit, Lens, Vidicon & Modulator

CROFTON

Tel: 01-891 1923 For full details

VIDEO MUSIC

Videograph II links to the aerial socket of your tv and provides a full colour GIANT oscilloscope display. A must for hi-fi, home entertainment, discos, organs etc.

New — signal invert control, integral square wave generator. **Plus** — full details for testing your audio system for transient distortion, crosstalk etc.

Complete Kit only £19·95 **Luxury cabinet and controls £9·95**

READY BUILT UNIT £39 95 + £1 00 P&P

WILLIAM STUART SYSTEMS Ltd ower House, Billericay Road Herongate, Brentwood Essex CM13 3SD Telephone Brentwood (0277) 810244

ADVERTISEMENT INDEX

INTERESTED IN HOME COMPUTING?

EX STOCK

FREE B BUG
valued at £23.00
plus 10 x C12 cassettes
valued at £4.00
plus Standard Modulator
valued at £2.25
WITH EVERY NASCOM

Start now and don't get left behind THE NASCOM 1 is here Ex-stock with full technical services

Plus the opportunity to join the fastest moving club of personal computer users enabling you to get the most our of your computer. You can OBTAIN and EXCHANGE programs and other software – many now available.

The Powerful Z80 Microprocessor
Professional Keyboard
1 Kbyte Monitor in EPROM
2 Kbyte RAM (expandable)
Audio Cassette interface
Plugs into your domestic TV
Easy construction from straightforward instructions
– no drilling or special tools
– Just neat soldering required.

SAVE £60

Only ~~£197.50~~ + 8% VAT (includes p & p + insurance)

Manuals seperately	2.95
Z80 programming Manual	6.90
Z80 Technical Manual	2.95
PIO Technical Manual	2.95
(All prices add 8% VAT)	

NEW LOW PRICE £165

Power supply suitable for NASCOM 19.90

NASCOM AO ONS – Nascom improved monitor B Bug (2K) featuring – *Four times tape speed *Direct text entry without ASCII *Extended keyboard facility *Additional useful subroutines £23.00

Nascom Vero Case £22.50

Nascom Joy Stick Kit £14.90

Nascom Music Box Kit £9.90 *(write your own tunes and play them on your Nascom. Complete with full documentation).*

GRAPHICS ADD ON BOARD £9.90
Complete kit to upgrade your NASCOM for graphics capability includes full documentation and demonstration program.

NEW! AT LAST 8K BASIC FOR NASCOM 1

Complete on S100 Board

£160 + VAT
EX-STOCK

THE EXIDY SORCERER.

SAVE £100

SORCERER COMPUTER SYSTEM

CPM NOW

The Sorcerer Computer is a completely assembled and tested computer system. Standard configuration includes 63-key typewriter-style keyboard and 16-key numeric pad, Z80 processor, dual cassette I/O with remote computer control at 300 and 1200 baud data rates, RS232 serial I/O for communications, parallel port for direct Centronics printer attachment, 4K ROM operating system, 8K ROM Microsoft BASIC in Rom PacTM cartridge, composite video of 64 char/line 30 line/screen, 128 upper/lower case ASCII set and 128 user-defined graphic symbols, operation manual, BASIC programming manual and cassette/video cables, connection for S-100 bus expansion.

EX STOCK

LOOK!
*32K RAM on board
*RS232 interface *8K BASIC ROM
*CUTS interface *4K MONITOR
*KANSAS CITY interface *S100 BUS
*User defined graphic symbols *Z80 cpu

16K ~~£860~~ £725* 32K ~~£950~~ £790* Credit facilities available. *+ VAT

MODULATORS UHF Channel 36

Standard 6 meg band width £2.25
High Quality 8 meg band width £4.90
EX-STOCK

SHORT C12 CASSETTES

EX-STOCK

FOR COMPUTER PROGRAMMES
10 for £4.00

PET COSTS LESS AT COMP and it's a pedigree

RRP £550

EX STOCK

The No. 1 Personal Computer in the U.K. Affordable £499 8K + VAT SAVE £50
for the first time user and the professional check out the PET, the world's most popular personal computer.

Also 16K big professional keyboard £625 + VAT

NEW! THE ITT APPLE (2020)

£827 + VAT

EX-STOCK 4K

16K £49 + VAT

LOW PRICE MEMORY UPGRADE PURCHASED AT TIME OF ORDER

* Full colour · UHF output * Audio cassette tape interface * Up to 48K RAM on board * BASIC in ROM (graphics commands include COLOUR = VLIN, HLIN, PLOT and SCRN) * Built in Loudspeaker *Buckets of software already available *disk system (110 K byte per drive – includes controller) only £425 + VAT

EX-STOCK

THE TRS-80 *(SPECIAL SCOOP)*
Low Priced, Ready to Go!

Use your own cassette

Level-II with 4K RAM
Improved graphics, print formatting, and a faster cassette transfer rate are features of Level-II BASIC.

£399 + VAT

EX STOCK

PLUGS INTO YOUR OWN TV

Level-II with 16K RAM
A combination of 16K RAM and the powerful Level-II BASIC produces a system capable of handling most demands.

£499 + VAT

KEY BOARD ONLY | COMPLETE WITH UHF MODULATOR

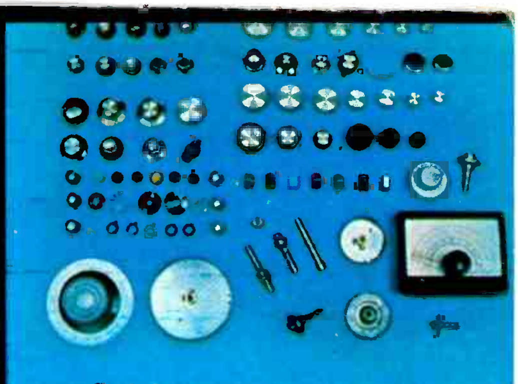
UK POWER SUPPLY — £9.90 + VAT

All prices include VAT except where shown. Orders over £5 post and packing free otherwise add 20p. Please make cheques and postal orders payable to COMP, or phone your order quoting BARCLAYCARD or ACCESS

OPEN — 10am to 7pm — Monday to Saturday
CREDIT FACILITIES ARRANGED

A quality range of British made electrical accessories plus a How to book. Do your own home electrical work with complete confidence. See cat. pages 129 to 134.

The superb organ — build the first working section for just over £100. Full specification in our catalogue



A range of highly attractive knobs is described in our catalogue. Our prices are very attractive too!

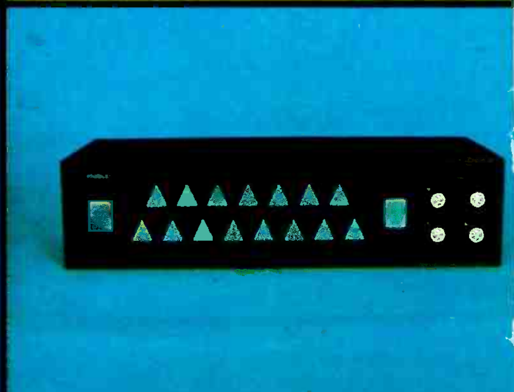
Mobile amateur radio, TV and FM aerials plus lots of accessories are described in our catalogue

A pulse width train controller for smooth slow running plus inertia braking and acceleration. Full construction details in our catalogue

A wide range of disco accessories at marvellous prices. Our catalogue has all the details

Add-on bass pedal unit for organs. Has excellent bass guitar stop for guitarists accompaniment. Specification in our catalogue

The 3800 synthesiser, build it yourself at a fraction of the cost of one ready-made with this specification. Full details in our catalogues



Touch operated rhythm generator "the Drumsette". Construction details 25p (Leaflet MES49). Specification in our catalogue

MAPLIN

ELECTRONIC SUPPLIES LTD

All mail to:–
P.O. Box 3, Rayleigh, Essex SS6 8LR.
Telephone: Southend (0702) 554155.

Shop: 284 London Road,
Westcliff-on-Sea, Essex.
(Closed on Monday).

Telephone: Southend (0702) 55400

A superb technical bookshop in your home! All you need is our catalogue. Post the coupon now!

An attractive mains alarm clock with radio switching function and battery back u
Complete kit with case only £13.88 (incl. VAT & p&p) MA1023 module only £8 4
(incl. VAT)

A massive new catalogue from Maplin that's even bigger and better than before. If you ever buy electronic components, this is the one catalogue you must not be without. Over 280 pages – some in full colour – it's a comprehensive guide to electronic components with hundreds of photographs and illustrations and page after page of invaluable data.

Our bi-monthly newsletter contains guaranteed prices, special offers and all the latest news from Maplin.

A 63-key ASCII keyboard with 625-line TV interface, 4 page memory and microprocessor interface. Details in our catalogue

Post this coupon now for your copy of our 1979–80 catalogue price 75p.

Please send me a copy of your 280 page catalogue. I enclose 75p but understand that if I am not completely satisfied I may return the catalogue to you within 14 days and have my 75p refunded immediately. If you live outside U.K. send £1 or ten International Reply Coupons.

NAME ______________________________

ADDRESS ______________________________

____

ETI 7 79