electronics today

INTERNATIONAL

OCTOBER 1979

50p

SUPER-FI AMPLIFIER PROJECT

Full details inside

Earth Satellites

Reaction Timer

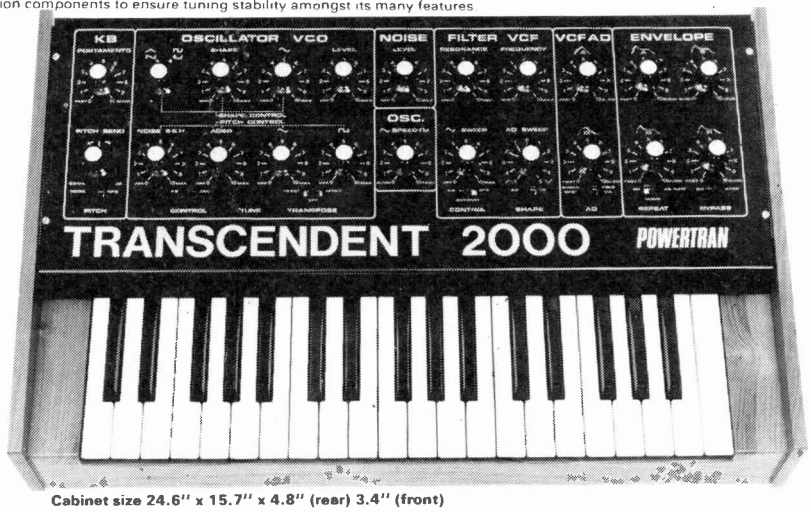
. . . NEWS . . . . PROJECTS . . . . MICROPROCESSORS . . . . AUDIO . . .

TRANSCENDENT 2000
SINGLE BOARD SYNTHESIZER

LIVE PERFORMANCE SYNTHESIZER DESIGNED BY CONSULTANT TIM ORR (FORMERLY SYNTHESIZER DESIGNER FOR EMS LIMITED) AND FEATURED AS A CONSTRUCTIONAL ARTICLE IN ELECTRONICS TODAY INTERNATIONAL.

The TRANSCENDENT 2000 is a 3 octave instrument transposable 2 octaves up or down giving an affective 7 octave range. There is portamento, pitch bending, a VCO with shape and pitch modulation, a VCF with both low and high pass outputs and a separate dynamic sweep control, a noise generator and an ADSR envelope shaper. There is also a slow oscillator, a new pitch detector, ADSR repeat, sample and hold, and special circuitry with precision components to ensure tuning stability amongst its many features.

The kit includes fully finished metalwork, fully assembled solid teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or ½% metal trim!) and it really is complete — right down to the last nut and bolt and last piece of wire! There is even a 13A plug in the kit — you need buy absolutely no more parts before plugging in and making great music! Virtually all the components are on the one professional quality fibreglass PCB printed with component locations. All the controls mount directly on the main board, all connections to the board are made with connector plugs and construction is so simple it can be built easily in a few evenings by almost anyone capable of neat soldering! When finished you will possess a synthesizer comparable in performance and quality with ready-built units selling for between £500 and £700!



Cabinet size 24.6" x 15.7" x 4.8" (rear) 3.4" (front)

COMPLETE KIT ONLY £172.00 + VAT!

Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesizer with nothing more elaborate than a multi-meter and a pair of ears!

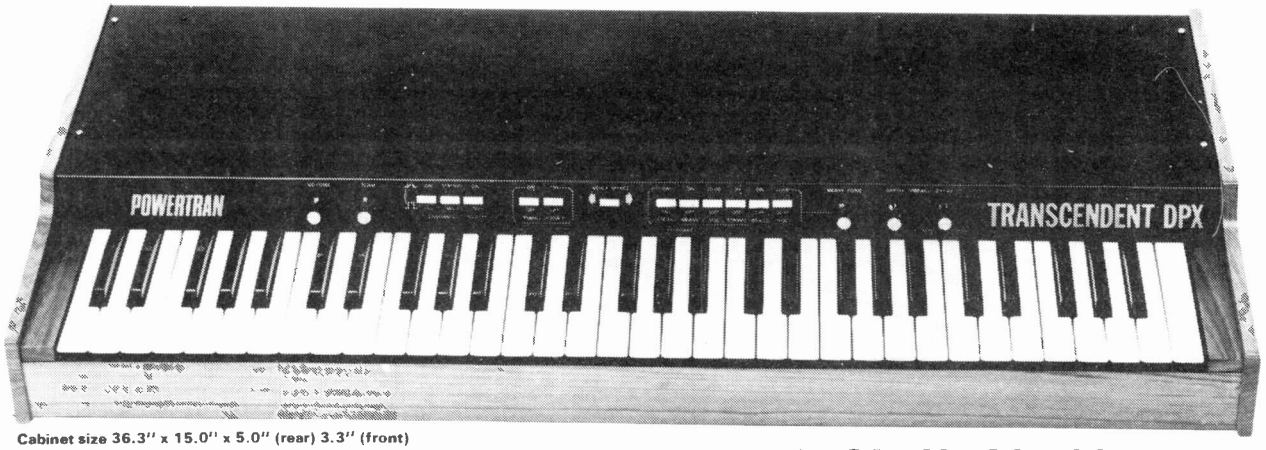
BEING FEATURED IN THIS MAGAZINE!

Another superb design by synthesizer expert Tim Orr!

NEW! TRANSCENDENT DPX

DIGITALLY CONTROLLED, TOUCH SENSITIVE, POLYPHONIC, MULTI-VOICE SYNTHESIZER

The Transcendent DPX is a really versatile new 5 octave keyboard instrument. There are two audio outputs which can be used simultaneously. On the first there is a beautiful harpsichord or reed sound — fully polyphonic i.e. you can play chords with as many notes as you like. On the second output there is a wide range of different voices, still fully polyphonic. It can be a straightforward piano or a honky tonk piano or even a mixture of the two! Alternatively you can play strings over the whole range of the keyboard or brass over the whole range of the keyboard or should you prefer — strings on the top of the keyboard and brass at the lower end (the keyboard is electronically split after the first two octaves) or vice versa or even a combination of strings and brass sounds simultaneously. And on all voices you can switch in circuitry to make the keyboard touch sensitive! The harder you press down a key the louder it sounds — just like an acoustic piano. The digitally controlled multiplexed system makes practical touch sensitivity with the complex dynamics law necessary for a high degree of realism. There is a master volume and tone control, a separate control for the brass sounds and also a vibrato circuit with variable depth control together with a variable delay control so that the vibrato comes in only after waiting a short time after the note is struck for even more realistic string sounds.



Cabinet size 36.3" x 15.0" x 5.0" (rear) 3.3" (front)

COMPLETE KIT ONLY £365.00 + VAT!

To add interest to the sounds and make them more natural there is a chorus ensemble unit which is a complex phasing system using CCD (charge coupled device) analogue delay lines. The overall effect of this is similar to that of several acoustic instruments playing the same piece of music. The ensemble circuitry can be switched in with either strong or mild effects.

As the system is based on digital circuitry digital data can be easily taken to and from a computer (for storing and playing back accompaniments with or without pitch or key change, computer composing etc. etc.) and an interface socket (25 way D type) is provided for this purpose.

Although the DPX is an advanced design using a very large amount of circuitry, much of it very sophisticated, the kit is mechanically extremely simple with excellent access to all the circuit boards which interconnect with multiway connectors, just four of which are removed to separate the keyboard circuitry and the panel circuitry from the main circuitry in the cabinet.

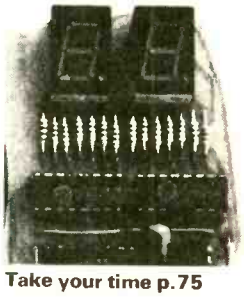
The kit includes fully finished metalwork, solid teak cabinet, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc. even a 13A plug — you need buy absolutely no more parts before plugging in and making great music! When finished you will possess an instrument comparable in performance and quality with ready-built units selling for over £1,200!

POWERTRAN

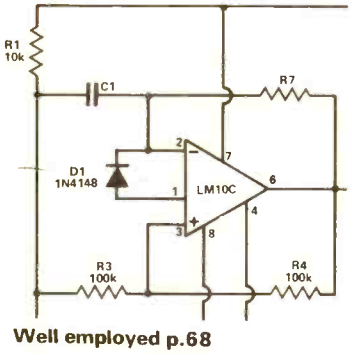
ORDERING INFORMATION AND MORE KITS ON PAGE 8

All kits also available as separate packs (e.g. P.C.B., component sets, hardware sets, etc.). Prices in FREE CATALOGUE.

Super amp project p.55



Take your time p.75



Well employed p.68

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PCB FOIL PATTERNS	100	Get board with ETI.

INTERNATIONAL EDITIONS

AUSTRALIA Collyn Rivers, Publisher; Roger Harrison, Acting Editor

HOLLAND Anton Kriegsman, Editor-in-Chief

CANADA Graham Wideman, Editor

GERMANY Udo Wittig, Editor

ABC

EDITORIAL AND ADVERTISEMENT OFFICE
145 Charing Cross Road, London WC2H 8DEE. Telephone 01 437 1002/3/4/5

Ron Harris, B.Sc	Editor
Ian Graham B.Sc.	Editorial Assistant
Diego M. Rincon	Art Director
Dee Camilleri	Production
Paul Edwards, Tony Strakas	Technical Illustrators
Ray Marston	Project Editor
Keith Brindley, John Fitzgerald	Project Engineer
Steve Ramsahadeo	Project Development
Margaret Hewitt	Administration
Lorraine Stout	Editorial Secretary
Christopher Surgenor (Manager),	Advertising
Sandy Neville	Ad. Production
Steve Rowe	Ad. Representative
Halvor Moorshead	Editorial Director

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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

Order Code: Cap HR + µF + Volts

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

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

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	16
10			10	11	14	15	20
15			11	14	15	20	
22		11	14		16		
33			15	16	20		
47			16	20			
68		16	20				
100		20					

Miniature Low Value

Order Code: Cap 424 / Cap 632 / Cap 630 / Cap 629 + Value

Polystyrene, Axial, ±1% Tol., > 63V D.C. Wkg
Ceramic Plate, Radial, Low K, 1.8pF–8.2pF ±.25pF Tol, 10-330pF ±2% Tol, 100V D.C. Wkg
Ceramic Plate, Radial, Med K, ±10% Tol, 100V D.C. Wkg
Ceramic Plate, Radial, High K, −20% to +80% Tol, 63V D.C. Wkg

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			

Polyester Radial Leads

Order Code: Cap 352 / Cap 360 / Cap PHE280 + Value

Dipped Type, ±20% Tol., ≥ 250V D.C. Wkg. C280/352 Style
Moulded Type, ±10% Tol., ≥100V D.C. Wkg. 10.2mm Pitch Centres
Moulded Type, ±10% Tol., ≥100V D.C. Wkg. 7.6mm Pitch Centres

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		

Trimmers

Order Code

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

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

Order Code

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

.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

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

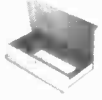
		Order Code
W161, D96, H39 (57)	186	Case BIM1005 OR
W215, D130, H47 (73)	268	Case BIM1006 OR

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

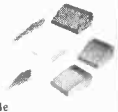
2.5" x 5" .1" pitch Veroboard	59	VERO 21069J
3.75" x 5" .1" pitch Veroboard	66	VERO 21072D
2.5" x 1" .1" pitch Veroboard (5)	70/Pack	VERO 21076C
3.75" x 5" .1" pitch Plain Board	56	VERO 21078E
5.82" x 2.9" .1" pitch V-Q DIP Board	111	VERO 21084E
Spot Face Cutter	89	VERO 21013A
Pin Insertion Tool for .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

Order Code

D.I.L. Sockets

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 20F
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

Order Code

Carbon Film, Fixed

0.25W, E24 Values 1RO-10M, 5% Tol.	1.5 ea.	90p/100 (Mult 10/Value)	£7.90/1000 (Mult 100/Value)	Res RD¼
0.5W, E12 Values 1RO-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, SRI-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

Order Code

Skeleton Presets, Miniature

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

DIGITAL INTEGRATED CIRCUITS

4000 Buffered C-MOS — High Speed

5–15V 'B' Series, Up to 20MHz

HEF4000	14	HEF4046	100	HEF4514	250														
HEF4001	14	HEF4047	87	HEF4515	299														
HEF4002	14	HEF4049	28	HEF4516	90														
HEF4006	95	HEF4050	28	HEF4517	382														
HEF4007	14	HEF4051	69	HEF4518	69														
HEF4008	80	HEF4052	72	HEF4519	55														
HEF4011	14	HEF4053	72	HEF4520	65														
HEF4012	14	HEF4066	37	HEF4521	188														
HEF4013	32	HEF4067	380	HEF4528	99														
HEF4014	84	HEF4068	14	HEF4532	120														
HEF4015	60	HEF4069	14	HEF4534	510														
HEF4016	35	HEF4070	14	HEF4539	110														
HEF4017	55	HEF4071	14	HEF4543	155														
HEF4018	65	HEF4072	16	HEF4555	78														
HEF4019	46	HEF4073	16	HEF4556	78														
HEF4020	88	HEF4075	16	HEF4557	386														
HEF4021	85	HEF4076	85	HEF4585	97														
HEF4022	82	HEF4077	14	HEF4724	171														
HEF4023	14	HEF4078	16	HEF40097	90														
HEF4024	45	HEF4081	16	HEF40098	73														
HEF4025	14	HEF4082	16	HEF40106	62														
HEF4027	32	HEF4085	64	HEF40160	119														
HEF4028	52	HEF4086	64	HEF40161	119														
HEF4029	60	HEF4093	50	HEF40162	119														
HEF4030	46	HEF4094	175	HEF40163	119														
HEF4031	200	HEF4104	166	HEF40174	119														
HEF4035	110	HEF4502	91	HEF40175	119														
HEF4040	68	HEF4505	571	HEF40192	140														
HEF4041	75	HEF4508	51	HEF40193	140														
HEF4042	54	HEF4510	70	HEF40194	119														
HEF4043	79	HEF4511	110	HEF40195	117														
HEF4044	84	HEF4512	98																

7400 T.T.L.

N7400N	9	N7444N	83	N74122N	39	N74190N	60	N74LS28N	32	N74LS138N	85	N74LS253N	105						
N7401N	11	N7445N	65	N74123N	37	N74194N	80	N74LS30N	16	N74LS139N	85	N74LS257N	104						
N7402N	11	N7446AN	62	N74125N	32	N74195N	79	N74LS32N	24	N74LS153N	76	N74LS258N	107						
N7403N	11	N7447AN	51	N74126N	32	N74198N	120	N74LS33N	32	N74LS154N	122	N74LS260N	26						
N7404N	12	N7448AN	44	N74128N	74	N74199N	139	N74LS37N	24	N74LS155N	80	N74LS261N	300						
N7405N	12	N7450N	13	N74132N	46	N74221N	160	N74LS38N	24	N74LS156N	80	N74LS266N	40						
N7406N	25	N7451N	13	N74145N	60	N74279N	116	N74LS40N	22	N74LS157N	54	N74LS273N	130						
N7407N	27	N7453N	15	N74147N	125	N74298N	200	N74LS42N	53	N74LS158N	60	N74LS283N	116						
N7408N	13	N7454N	13	N74148N	83	N74365N	150	N74LS51N	22	N74LS160N	120	N74LS290N	90						
N7409N	13	N7460N	13	N74150N	65	N74366N	150	N74LS54N	16	N74LS161N	78	N74LS293N	100						
N7410N	11	N7470N	26	N74151N	46	N74367N	120	N74LS55N	22	N74LS162N	130	N74LS298N	100						
N7411N	18	N7472N	22	N74153N	55	N74368N	150	N74LS73N	29	N74LS163N	78	N74LS324N	170						
N7412N	17	N7473N	23	N74154N	96			N74LS75N	40	N74LS164N	90	N74LS365N	105						
N7413N	23	N7474N	23	N74155N	53			N74LS76N	33	N74LS170N	200	N74LS366N	105						
N7414N	46	N7475N	28	N74156N	48	74LS		N74LS78N	33	N74LS173N	100	N74LS367N	105						
N7416N	22	N7476N	26	N74157N	49	N74LS00N	15	N74LS83AN	97	N74LS174N	100	N74LS368N	105						
N7417N	23	N7480N	43	N74158N	54	N74LS01N	16	N74LS85N	70	N74LS175N	100	N74LS373N	150						
N7420N	11	N7483N	63	N74160N	74	N74LS02N	16	N74LS86N	33	N74LS181N	320	N74LS374N	150						
N7421N	26	N7485N	65	N74161N	74	N74LS03N	16	N74LS90N	45	N74LS190N	91	N74LS375N	100						
N7425N	27	N7486N	23	N74162N	74	N74LS04N	16	N74LS92N	70	N74LS191N	95	N74LS378N	160						
N7426N	22	N7490N	30	N74163N	74	N74LS05N	23	N74LS93N	45	N74LS192N	128	N74LS386N	35						
N7427N	22	N7491AN	60	N74164N	65	N74LS08N	16	N74LS95BN	65	N74LS193N	130	N74LS390N	170						
N7428N	30	N7492N	33	N74165N	65	N74LS09N	22	N74LS96N	116	N74LS194N	150	N74LS393N	170						
N7430N	11	N7493N	31	N74166N	93	N74LS10N	16	N74LS107N	38	N74LS195AN	120	N74LS395N	180						
N7432N	21	N7494N	74	N74170N	134	N74LS11N	22	N74LS109N	38	N74LS196N	80	N74LS490N	130						
N7433N	30	N7495AN	48	N74173N	111	N74LS12N	23	N74LS112N	40	N74LS197N	110	N74LS670N	170						
N7437N	21	N7496N	46	N74174N	63	N74LS13N	38	N74LS113N	38	N74LS240N	160								
N7438N	21	N74100N	88	N74175N	62	N74LS14N	74	N74LS114N	38	N74LS241N	160								
N7439N	60	N74107N	25	N74180N	80	N74LS15N	24	N74LS125N	40	N74LS242N	160								
N7440N	12	N74109N	42	N74181N	165	N74LS20N	16	N74LS126N	40	N74LS243N	160								
N7442N	40	N74116N	148	N74182N	69	N74LS21N	22	N74LS132N	60	N74LS244N	160								
N7443N	79	N74121N	23	N74192N	65	N74LS22N	24	N74LS136N	37	N74LS251N	90								

LINEAR INTEGRATED CIRCUITS

CA3011	92	NE592K	162
CA3018	75	RC4136	130
CA3020	191	T8A120S	79
CA3028A	86	TCA580	346
CA3046	76	TCA730	450
CA3048	245	TCA740	450
CA3080E	70	TDA1008	326
CA3089E	253	TDA1022	648
CA3130E	90	TDA1028	338
CA3140E	38	TDA1029	338
CA3189E	266	TDA1034B	217
LM301AN	30	TDA2581	266
LM308N	95	TDA2640	292
LM318N	200	TL081CP	75
LM319N	216	TL084CN	140
LM324N	70	UA709CT	46
LM339N	71	UA709CN	40
LM381N	110	UA710CN	41
LM381AN	180	UA711CN	65
LM382	120	UA741CT	42
		UA741CN	18
		UA747CN	50
		UA748CN	35
MC1458N	35		
MC1496N	97	**Voltage Regulators**	
NE531	119		
NE536T	216	LM309DA (K)	108
NE540	225	UA723CN	38
NE555N	25	UA7805CU	65
NE556N	60	UA7812CU	65
NE560N	351	UA7815CU	65
NE561N	427	UA7905CU	86
NE562N	461	UA7912CU	86
NE565N	120	UA7915CU	86
NE566N	155	UA78L05CS	32
NE567N	170	UA78L06CS	32
NE570N	405	UA78L12CS	32
NE571N	459	UA78L15CS	32

OPTO ELECTRONICS

			Order Code
Light Emitting Diodes, Individual			
.125" (3mm)	Red	14	CQY54
	Green	17	CQY95
	Yellow	19	CQY97
Panel Mounting Clip to suit.		3	LED3 Clip
.2" (5mm)	Red	15	CQY24A
	Green	17	CQY94
	Yellow	19	CQY96
Panel Mounting Clip to suit.		5	LED5 Clip
Light Emitting Diodes — 7 Segment Display			
.3" (7.6mm)	C. Anode R.H. Decimal Pt. Red	160	XAN3061
	C. Anode R.H. Decimal Pt. Green	199	XAN3051
	C. Cathode R.H. Decimal Pt. Red, Low current drain	160	XAN3074
.6" (15.2mm)	C. Anode L.H. Decimal Pt. Red	230	XAN6620
	C. Anode L.H. Decimal Pt. Green	230	XAN6520
	C. Cathode L.H. Decimal Pt. Red	230	XAN6640
Photoresistors			
ORP12		90	ORP12
ORP61		90	ORP61
Phototransistors			
OCP71		180	OCP71
BPX25		175	BPX25
BPX29		175	BPX29
Photocoupler			
FCD820		150	FCD820

SWITCHES

				Order Code
Miniature Toggle — Honeywell				
SPDT		2A/250V A.C., 5A/28V D.C.	58	SW 8A1011
SPDT	C/Off		67	SW 8A1021
SPDT	Double Bias To Centre		75	SW 8A1041
SPDT	Single Bias To Centre		75	SW 8A1051
SPDT	Bias		70	SW 8A1061
DPDT			86	SW 8A2011
DPDT	C/Off		92	SW 8A2021
DPDT	Double Bias To Centre		102	SW 8A2041
DPDT	Single Bias To Centre		102	SW 8A2051
DPDT	Bias		96	SW 8A2061
Miniature Push — C & K				
SP	Push To Make, Momentary	0.5A/250V A.C., 1A/28V D.C.	54	SW 8531
SP	Push To Break, Momentary		54	SW 8533
Slide — Switchcraft				
DPDT	Standard Actuator		36	SW 46206
DPDT	Slot Actuator, Voltage Change, Marked 110/240		43	SW 46206F

SEMICONDUCTORS

Diodes

IN827	193	IN4006	7	BB110G	61	OA202	9
IN914	4	IN4007	8	BY127	15		
IN916	5	IN4148	3	BY206	34	**Microwave**	
IN4001	4	IN5402	15	BYX10	19		
IN4002	4	IN5404	16	OA47	10	BAW95D	1091
IN4003	6	BAX13	5	OA90	7	CL8960	2592
IN4004	6	BAY38	27	OA91	7	CXY11C	1280
IN4005	7	BB106(4)	122	OA200	9		

Zener Diodes

400mW C4V7-C33 — 1.3W C7V5-C75

BZY88/BZX79 + Voltage	8	BZX61 + Voltage	16

Transistors

2N929	37	2N4427	206	BC478	24	BSX88	18
2N1893	30	2N4856	158	BC547	12	MJE340	48
2N2218A	28	2N4858	134	BC548	10	MPF102	32
2N2222	21	2N4860	122	BC548B	15	OC28	107
2N2369	19	2N5294	43	BC549	12	OC35	95
2N2369A	20	2N5416	108	BC549B	20	OC45	82
2N2646	42	2N5457	35	BC557	14	OCP71	180
2N2894	49	2N5458	30	BC558	14	TIP29A	41
2N2895	28	2N5459	32	BC559	17	TIP29C	53
2N2904	24	2N6258	432	BCY34	97	TIP30A	44
2N2904A	24	40673	80	BCY70	14	TIP30C	57
2N2905	22	AC188	22	BCY71	14	TIP31A	43
2N2905A	24	AD161	38	BCY72	15	TIP31C	58
2N2906	19	AD162	38	BD131	35	TIP32A	49
2N2907	22	BC107	10	BD132	35	TIP32C	63
2N2907A	25	BC107B	14	BD135	38	TIP41A	59
2N2918	330	BC108	10	BD136	37	TIP41C	69
2N2926G	11	BC108B	14	BD137	38	TIP42A	59
2N3053	17	BC108C	16	BD138	39	TIP42C	69
2N3054	50	BC109	10	BD139	35	TIP2955	68
		BC109B	17	BD140	35	TIP3055	54
2N3055	50	BC109C	18	BF115	28	TIS43	32
2N3055		BC147	7	BF180	37	ZTX109C	14
Full ISB Test	86	BC148	9	BF181	37		
2N3340	30	BC149	8	BF257	35		
2N3442	141	BC157	10	BF258	32		
2N3702	8	BC158	9	BF259	36		
2N3703	11	BC159	11	BFR90	303		
2N3704	8	BC177	15	BFS21	428		
2N3705	9	BC178	15	BFX13	23		
2N3706	9	BC179	18	BFX84	26		
2N3707	9	BC182	10	BFX85	26		
2N3708	9	BC182L	11	BFX86	30		
2N3709	11	BC183	10	BFX87	22		
2N3773	270	BC183L	11	BFX88	26		
2N3819	20	BC184	10	BFY50	15		
2N3820	39	BC184L	11	BFY51	15		
2N3866	97	BC212	10	BFY52	18		
2N3903	20	BC212L	11	BFY90	97		
2N3904	8	BC213	10	BLX65	238		
2N3905	12	BC213L	11	BLY35	1889		
2N3906	12	BC214	10	BLY93A	2706		
2N3962	95	BC214L	11	BPX25	175		
2N4347	227	BC327	17	BPX29	175		
2N4401	20	BC328	15	BRY39	45		
2N4403	20	BC337	16	BSW69	33		
2N4416	86	BC338	14	BSX20	19		

SEMICONDUCTORS

Rectifier Bridges

		Order Code
1A 400V S.I.L.	93	BY179
1.4A 60V S.I.L.	84	BY164
1.5A 100V D.I.L.	33	VM18
1.5A 400V D.I.L.	35	VM48
1.5A 100V	45	W01
1.5A 400V	52	W04
2A 100V	89	VS148
2A 400V	109	VS448
6A 100V	143	VH148
6A 400V	183	VH448
10A 100V	172	VJ148
10A 400V	201	VJ448
15A 100V	215	VL148
15A 400V	226	VL448
30A 100V	242	VK148
30A 400V	260	VK448

S.C.R.'s

4A 400V	54	C106D
12A 400V	108	TIC126D

Triacs

10A 500V	124	BT138-500
15A 500V	177	BT139-500
23A 500V	492	BTW41-500

COMMUNICATIONS INTEGRATED CIRCUITS — PLESSEY

SL360C	242	SL641C	384								
SL362C	302	SL650C	865								
SL610	230	SL651C	786								
SL611C	230	SL652C	329								
SL612C	230	SL680C	230								
SL613C	394	SL701C	220								
SL620C	347										
SL621C	347	SL1610C	166	SL1623C	251	SL1680C	170	SP8629	446	SP8690	907
SL622C	854	SL1611C	166	SL1625C	225	SL6600C	890	SP8630B	1361	SP8760B	680
SL623C	629	SL1612C	166	SL1626C	251	SL6640C	401	SP8655B	1058	SP8790B	454
SL624C	321	SL1613C	193	SL1630C	166	SL6650C	378	SP8657B	1058	SP8794B	454
SL630C	218	SL1620C	225	SL1640C	193			SP8659B	907		
SL640C	384	SL1621C	225	SL1641C	193			SP8660B	907		

MAINS TRANSFORMERS

Order Code

Secondaries may be connected in series or parallel to give wide voltage range
Primaries 0-220, 240V

6VA — Clamp Type Construction

Approx. 18% Regulation. F.C. 54, H36, W35

0-4.5V, 0-4.5V Secondaries	220	Trans 6VA	45
0-5V, 0-6V			60
0-12V, 0-12V			120
0-15V, 0-15V			150
0-20V, 0-20V			200

20VA — Clamp Type Construction

Approx. 16% Regulation F.C. 70, H48, W46

0-4.5V, 0-4.5V Secondaries	335	Trans 20VA	45
0-6V, 0-6V			60
0-12V, 0-12V			120
0-15V, 0-15V			150
0-17.5V, 0-17.5V			175
0-20V, 0-20V			200

55VA — Clamp Type Construction

Approx. 10% Regulation F.C. 92, H64, W57

0-6V, 0-6V Secondaries	540	Trans 55VA	60
0-12V, 0-12V			120
0-15V, 0-15V			150
0-20V, 0-20V			200
0-30V, 0-30V			300

100VA — Frame Type Construction

Approx. 6% Regulation H87, W74, D64

0-25V, 0-25V Secondaries	825	Trans 100VA	250
0-40V, 0-40V			400

STEVENSON
Electronic Components

CMOS

		4020	50p	4050	25p
		4022	50p	4060	80p
		4023	13p	4066	30p
		4024	40p	4068	13p
4001	13p	4025	13p	4069	13p
4002	13p	4026	90p	4070	13p
4007	13p	4027	28p	4071	13p
4009	30p	4028	45p	4072	13p
4011	13p	4029	50p	4081	13p
4012	13p	4040	55p	4093	36p
4013	28p	4041	55p	4510	60p
4015	50p	4042	55p	4511	60p
4016	28p	4043	50p	4518	65p
4017	47p	4046	90p	4520	60p
4018	55p	4049	25p	4528	60p

FULL DETAILS IN CATALOGUE!

TTL

		7473	20p	74141	55p
		7474	22p	74145	55p
7400	10p	7475	25p	74148	90p
7401	10p	7476	20p	74150	55p
7402	10p	7485	55p	74151	40p
7404	12p	7486	20p	74154	65p
7406	22p	7489	135p	74157	40p
7408	12p	7490	25p	74164	55p
7410	10p	7492	30p	74165	55p
7413	22p	7493	25p	74170	100p
7414	39p	7494	45p	74174	55p
7420	12p	7495	35p	74177	50p
7427	20p	7496	45p	74190	50p
7430	12p	74121	25p	74191	50p
7432	18p	74122	35p	74192	50p
7442	38p	74123	38p	74193	50p
7447	45p	74125	35p	74196	50p
7448	50p	74126	35p	74197	50p
7454	12p	74132	45p	74199	90p

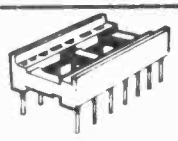
OPTO

LED's	0.125in.	0.2in	each	100+
Red	TIL209	TIL220	9p	7.5p
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

SKTS



Low profile by Texas

8pin	8p	18pin	14p	24pin	18p
14pin	10p	20pin	16p	28pin	22p
16pin	11p	22pin	17p	40pin	32p

3 lead T018 or T05 socket. 10p each
Soldercon pins: 100:50p 1000:370p

PCBS

VEROBOARD

Size in.	0.1in.	0.15in	Vero
25 x 1	14p	14p	Cutter 80p
2.5 x 3.75	45p	45p	
2.5 x 5	54p	54p	Pin insertion
3.75 x 5	64p	64p	tool 108p
3.75 x 17	205p	185p	
Single sided pins per 100	40p	40p	

Top quality fibre glass copper board. Single sided. Size 203 x 95mm. 60p each.
'Dalo' pens. 75p each.
Five mixed sheets of Alfac. 145p per pack.

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 80 PAGE CATALOGUE OF COMPONENTS.

CONTAINS OVER 2500 STOCK ITEMS.

LINEAR

THIS IS ONLY A SELECTION!

		LF356	80p	NE531	98p
		LM301AN	26p	NE555	23p
		LM308	60p	NE556	60p
		LM318N	75p	NE567	100p
		LM324	45p	RC4136	100p
709	35p	LM339	45p	SN76477	230p
741	16p	LM378	230p	TBA800	70p
747	45p	LM379S	410p	TBA810S	100p
748	30p	LM380	75p	TDA1022	620p
7106	850p	LM3900	50p	TL081	45p
7107	900p	LM3909	65p	TL084	125p
CA3046	55p	LM3911	100p	ZN414	80p
CA3080	70p	MC1458	32p	ZN425E	390p
CA3130	90p	MM57160	590p	ZN1034E	200p

TRANSISTORS

				ZTX500	16p
		BCY72	14p	2N697	12p
AC127	17p	BD131	35p	2N3053	18p
AC128	16p	BD132	35p	2N3054	50p
AC176	18p	BD139	35p	2N3055	50p
AD161	38p	BD140	35p	2N3442	135p
AD162	38p	BFY50	15p	2N3702	8p
BC107	8p	BFY51	15p	2N3703	8p
BC108	8p	BFY52	15p	2N3704	8p
BC108C	10p	MJ2955	98p	2N3705	9p
BC109	8p	MPSA06	20p	2N3706	9p
BC109C	10p	MPSA56	20p	2N3707	9p
BC147	7p	TIP29C	60p	2N3708	8p
BC148	7p	TIP30C	70p	2N3819	15p
BC177	14p	TIP31C	65p	2N3820	44p
BC178	14p	TIP32C	80p	2N3904	8p
BC179	14p	TIP2955	65p	2N3905	8p
BC182	10p	TIP3055	55p	2N3906	8p
BC182L	10p	ZTX107	14p	2N4058	12p
BC184	10p	ZTX108	14p	2N5457	32p
BC184L	10p	ZTX300	16p	2N5459	32p
BC212	10p			2N5777	50p
BC212L	10p				
BC214	10p				
BC214L	10p				
BC477	19p				
BC478	19p				
BC548	10p				
BCY70	14p				
BCY71	14p				

DIODES

1N914	3p	1N4006	6p
1N4001	4p	1N5401	13p
1N4002	4p	BZY88 ser	8p

ITT Full spec. product.
1N4148 – £1.40 100. £11 1000

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

SOLDERING IRONS

ANTEX X25 (25W) or ANTEX CX (17W) — 390p each
Reel of solder (39.6M) — 240p each

LOUDSPEAKERS

56mm dia. 8ohms. 70p — 64mm dia. 64ohms. 75p
64mm dia. 8ohms. 75p — 70mm dia. 8ohms. 100p
Magnetic earpiece including 2.5 or 3.5mm plug. 15p each
Crystal earpiece including 3.5mm plug. 30p each

SWITCHES

Subminiature toggle. SPDT 70p. DPDT 80p
Standard toggle. SPST 34p. DPDT 48p.

Slide switches (DPDT) miniature or standard 15p.
Push to make switch. 15p. Push to break switch. 20p.
Wavechange switches: 1P12W, 2P6W, 3P4W, 4P3W. 43p

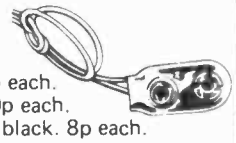
CONTROL KNOBS

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

MISCELLANEOUS

Connection cable available in single or stranded packs of eight colours.

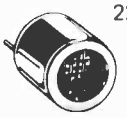
	Single	Stranded
8 metre pack	18p	18p
40 metre pack	85p	80p



BATTERY CLIPS
Battery clips for PP3 with lead. 6p each.
Battery clips for PP9 with lead. 10p each.
Miniature crocodile clips in red or black. 8p each.
Red or black probe clips. 20p each.

HEATSINKS

T018 push to fit heatsink 10p each.
T05 pushfit heatsink 9p each
T0220 twisted vane heatsink 20p each.
T03 twisted vane sink 22p each.

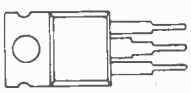


Murata Ultrasonic Transducers.
180p each. 350p pair.

BOXES
Quality black ABS boxes by BIM. All dimensions in mm.

100 x 50 x 25	90p each	150 x 80 x 50	140p each
120 x 65 x 40	125p each	190 x 110 x 60	220p each

REGULATORS



78L05	30p	7805	60p	7905	80p
78L12	30p	7812	60p	7912	80p
78L15	30p	7815	60p	7915	80p

ALL PRICES INCLUDE 15% V.A.T.

We now offer one of the widest ranges of components at the most competitive prices in the U.K. See catalogue for full details. We welcome callers at our shop in College Rd, Bromley, from Mon–Sat, 9am–6pm (8pm on Weds and Fridays). Special offers always available.
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TELEPHONE: 01-464 2951/5770.

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76 College Road, Bromley, Kent BR1 1DE.

news digest.....

MAIDEN STAR CHESS FINALS

Some time ago we received a colourful piece of fluorescent (or is it phosphorescent?) plastic in the post. An eerie green glow pervaded the office as we deciphered the strange hierogrlyphs. They invited us to attend — wait for it — the Galactic, yes Galactic, finals of Star Chess, the TV game guaranteed to give a Grand Master a heart attack in 30 seconds flat.

When we arrived at the festival of cathode ray ballistics, we were instantly and eternally grateful to Colin Wild for designing the costumes which coffee and cream Star Maidens, Carolyn and Beverley, were in great danger of nearly wearing. It's truly amazing how a journalist's attention can wander from a six feet square telly screen so quickly.

Dr. Who's K-9 made a manly (dogly?) attempt at commentating on the final game, but I guess he's more familiar with multi-dimensional, hexagonal games with knobs on, because his speech circuits dried up after the first half dozen moves (thank goodness). The final itself was relatively uneventful, neither player risking anything, his sights firmly set on the first prize of a trip to America (and back, of course). It was won by Peter Bond — one of our men at the Inland Revenue, God Bless him.

The fun began when the game finished, as we embarked on a tour of new games from Videomaster. On our way to the screens we noticed a novel chess set — the pieces were glasses of wine (red versus white) engraved with pawn, rook, etc. When you take a piece, you drain the glass. The two ladies who were deeply engrossed in the game seemed to be basing their strategy on how they could exchange the maximum number of pieces in the shortest possible time.

Meanwhile, we hogged the Videomaster Database—a new programmable TV game, including Black Jack, tank, horse racing, circus and boxing. However, we found the air-sea battle the most compelling. Other systems on show included sportsworld (ten games) and Colourscore 2 (six games). We'll tell you more about them just as soon as we can get hold of samples to play with (it keeps us off the streets).

The 1979 Star Chess Galactic Champion, Peter Bond, clutches his trophy, guarded by K-9 and Star Maidens, Carolyn and Beverley. The gent in the kilt is Cameron Macsween, managing director of Videomaster. The proceedings were overseen by Harry Golombeck, the Times chess correspondent.

'CHIPS AND BUGS'

The Economist has taken two tiny technologies with a big future and combined them in the latest of their excellent booklets.

Chips and Bugs, edited by Richard Casement, takes the microprocessor and biotechnology, two apparently unconnected fields, and brings you up to date with the latest developments. In fact they have three things in common. They both rely on studies of microscopic phenomena; they are controversial; and they rely less on building upon past developments than on fundamental discoveries at the frontiers of modern science.

The first half of the twenty page booklet deals with microcomputers — the technology, hardware, software, systems development and the superchips effect on our lives and jobs. The second half takes you from an explanation of the DNA building block to the intricacies of genetic engineering.

'Chips and Bugs' is £2.50 from The Economist Newspaper Ltd, 25 St James's Street, London SW1A 1HG. Hint: If your can get ten or more 'Chips and Bugs' fans together, The Economist will slash the price to £1.50 per copy for bulk orders.

BOSSY LEDS

The BIM 33 and 34 from Boss, who have christened them BIMDICATORS, are front viewing, panel-mounting LED indicators.

Both devices use red, green or amber gallium phosphide LEDs, which have low current, low voltage characteristics, fast switching times and are fully IC compatible.

The BIM 33 has a nickel-plated brass body and is mounted in a 6mm hole, while the BIM 34 has a chromium-placed brass body and is mounted in an 8mm hole.

Further details from Boss Industrial Mouldings Ltd, Higgs Industrial Estate, 2 Herne Hill Road, London SE24 0AU.

BLUE RESEARCH

Your choice of LED colours might include blue in the not so distant future. The new devices, being developed by Siemens, use silicon carbide and are predicted to have a forward voltage drop of 4 V at 50 mA.

CHROMATHEQUE 5000

POWERTRAN

5 CHANNEL LIGHTING EFFECTS SYSTEM

Panel size 19.0" x 3.5". Depth 7.3"

COMPLETE KIT

ONLY

£49.50 + VAT!

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all the lights at a speed dependent upon music level or front panel control or use the internal digital circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward.

Kit includes fully finished metalwork, fibreglass PCB controls, wire, etc. — Complete right down to the last nut and bolt!

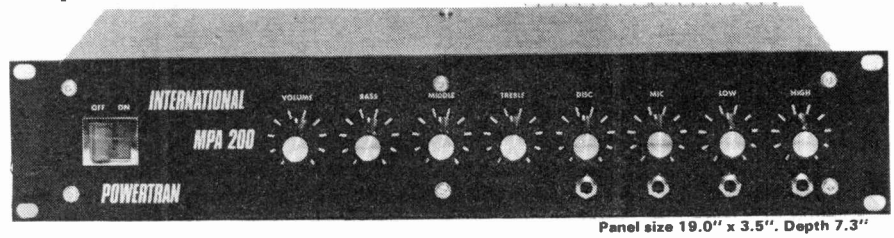
MPA 200 100 WATT (rms into 8Ω) MIXER/AMPLIFIER

COMPLETE KIT

ONLY

£49.90 + VAT!

MATCHES THE CHROMATHEQUE 5000 PERFECTLY!



Panel size 19.0" x 3.5". Depth 7.3"

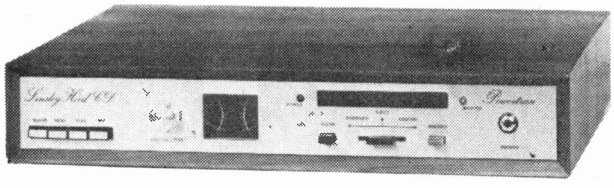
Featured as a constructional article in ETI, the MPA 200 is an exceptionally low priced — but professionally finished — general purpose high power amplifier. It features adaptable input mixer which accepts a wider range of sources such as microphone, guitar, etc. There are wide range tone controls and a master volume control. Mechanically the MPA 2000 is simplicity itself with minimal wiring needed making construction very straightforward.
The kit includes fully finished metalwork, fibreglass PCBs, controls, wire, etc. — complete down to the last nut and bolt.

DE LUXE EASY TO BUILD LINSLEY HOOD 75W STEREO AMPLIFIER £99.30 + VAT

This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in H-Fi News and Record Review and features include rumble filter, variable scratch filter, versatile tone controls and tape monitoring whilst distortion is less than 0.01%.

WIRELESS WORLD FM TUNER £70.20 + VAT

A pre-aligned front-end module makes this Wireless World published design very simple to construct and adjust without special instruments. Features include an excellent a.m. rejection push-button station selection as well as infinitely variable tuning and a phase locked loop stereo decoder, incorporating active filters for "birdy" suppression.



LINSLEY-HOOD CASSETTE DECK £79.60+VAT

This design, published in Wireless World, although straightforward and relatively low cost provides a very high standard of performance. There are separate record and replay amplifiers and switchable equalisation together with a choice of bias levels are also provided. The mechanism is the Goldring-Lenco CRV with electronic speed control.

T20+20 20W STEREO AMPLIFIER £33.10+VAT

This kit, based upon a design published in Practical Wireless, uses a single printed circuit board and offers at very low cost, ease of construction and all the normal facilities found on quality amplifiers. A 30 watt version of this kit (T30+30) is also available for **£38.40** + VAT.

MATCHING TUNERS — SEE OUR FREE CATALOGUE!

COMPLETE KITS: Our complete kits really are complete. All of the projects shown on this page are supplied with fully finished metalwork, ready assembled high quality teak veneer cabinet (last 4 kits on this page), or professional quality rack mounting cabinet (first 2 kits on this page), cables, nuts, bolts, etc., and full instructions — in fact everything!

All of the kits shown on this page are available as separate packs for those customers who wish to spread their purchase or perhaps make their own cabinets or metalwork. Prices are given in our FREE CATALOGUE.

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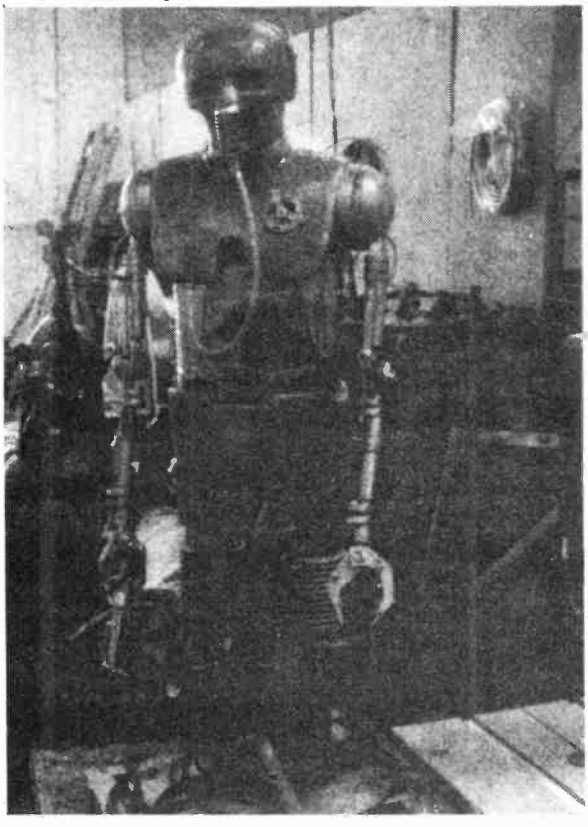
news digest.....

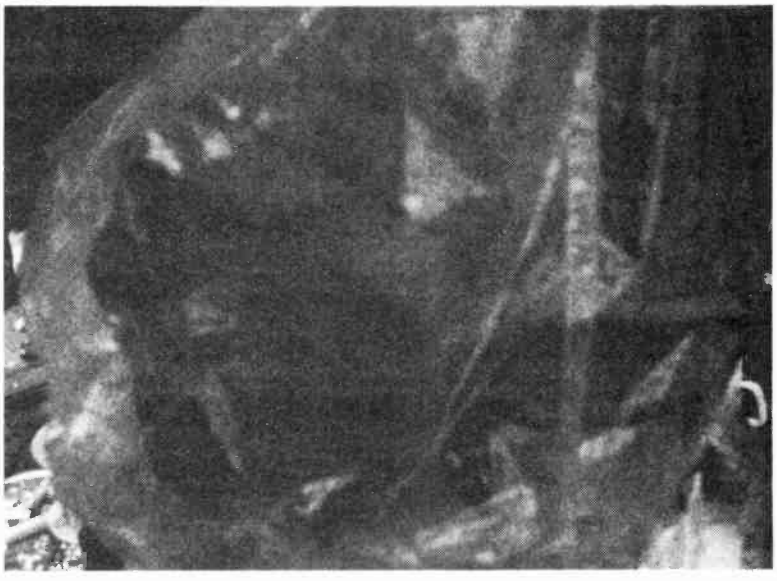
EXCLUSIVE — STAR WARS 2 LEAK

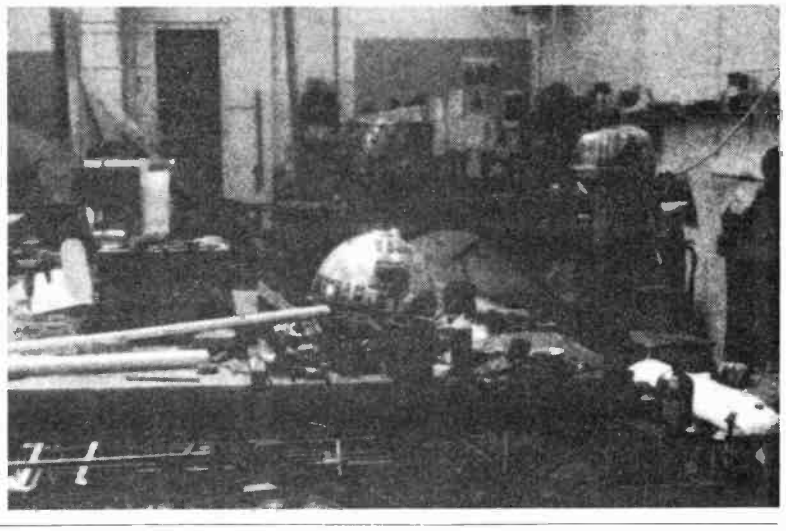
We've just received the first pictures of mechanical men from Star Wars 2, 'The Empire Strikes Back', to escape from their workshop (the pictures, not the mechanical men) somewhere in Hertfordshire. They arrived under plain cover (a brown envelope) by special messenger (GPO) from an, anonymous reader.

R2-D2 peeps over the top of a work bench at the tall, dark handsome medical robot (microphone mouth), while an alien has a snooze in a plastic bag.

Thank you Mr Anonymous, whoever you are. Can we have some more please? How about 'Alien' this time?







ETISKI

As you can imagine we are invited to quite a few Press receptions, lunches, etc. to have a look at new products or meet people in the electronics industry.

This month our invitation-of-the-month award goes without a doubt to Sperry Univac, who are sponsoring the forthcoming first-ever World Water Ski Racing Championships. They decided to see how daft we really are by inviting us to have a bash at walking on water ourselves, while the British team was going through its paces in July. Thankyou Sperry, we would loved to have gone along, if only to see who else was mad enough to turn up and have a go.

The Championships will be held from September 9th to 16th at Whitstable in Kent, Allhallows near the mouth of the Thames and the Welsh Harp Reservoir in London. Sperry Univac will be providing a computerised results service throughout the event.

PROGRAM REACTION

The NRC, the American nuclear watchdog, was happily watching its nuclear dogs when the telephone went.

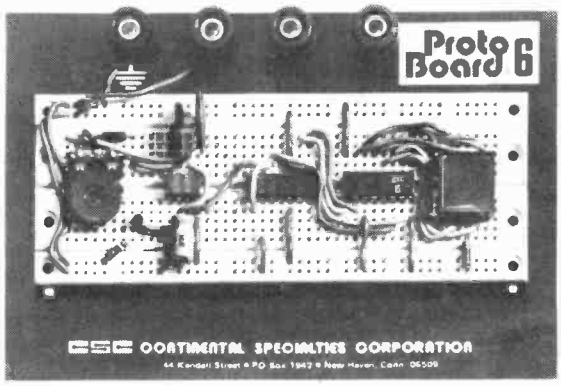
The caller alleged that some nuclear plants were using a flawed design method, piping in the plants had been designed by invalid computer programs.

In March, the NRC closed five plants because it was unhappy about piping design. It is now studying the likelihood of damage due to earthquakes. If reactors remain closed indefinitely, the lights might start switching off in the areas served.

TOP PROJECTS No 7

Have a look at the CCD Phaser circuit diagram on page 26. R31, 32 fix the voltage on IC5 pin 5 at 10V5. However, as they are labelled, pin 5 sits at a puny 1V5. To make IC5 feel better, make R31 10 k and R32 1k5.

news digest .....



CONTINENTAL BREAD

Continental Specialities Corporation aim to get you from circuit diagrams to final designs in the cheapest and easiest way possible with their range of solderless breadboarding systems.

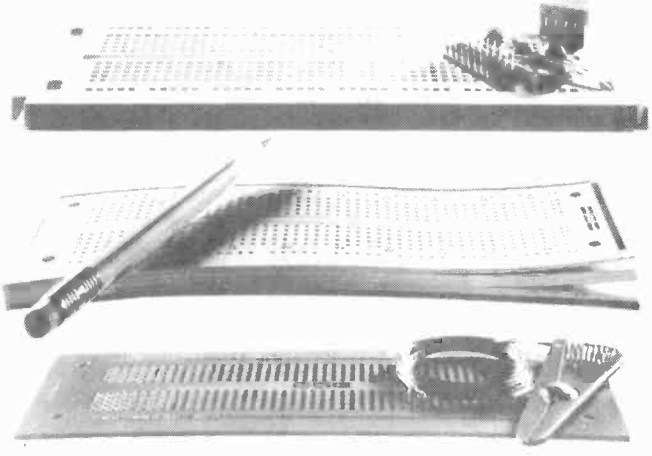
You can take your first plunge into breadboarding without wringing out your wallet, with the CSC Protoboard PB-6. For £9.20, you get a pre-assembled breadboard socket, two solderless bus strips, four 5-way binding posts all on a metal baseplate. Up to six 14-pin ICs can be accommodated on its 630 tie points.

Moving up the range, PB-100 gives you 760 solderless contact points. Other boards in the range also have built-in power supplies.

If you want to build an L-shaped circuit, you want CSC's Quick Test Sockets. Available in various sizes, they can be snapped together in any combination to produce a breadboard of any shape or size. It's as close to instant circuits as you'll get.

The Experimentor series of breadboards will snap together horizontally or vertically, if your circuit layouts are driving you up the wall. The range starts at £3.15 for Experimentor 350, offering 270 contacts. The Experimentor 650, at £3.60, and the 600 are the only breadboards on the market with full 4-terminal fan-out for microprocessors, clock chips, RAMs, ROMs and other large DIL packages. Also in the range, and particularly useful, is the Experimentor scratchboard — a pad of paper with a full-size layout of the hole and connection pattern of the breadboard. Your finished design can then be transferred to the Experimentor Matchboard, already drilled and etched to match the breadboard contact layout.

CSC's new catalogue features their full range of breadboarding equipment and test instruments. Catalogues and further details of products are available from Continental Specialities Corporation, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ.



Top value test equipment from TANDY

LCD DIGITAL MULTIMETER.

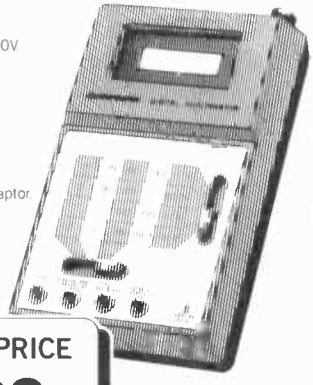
Low-cost hand held digital multimeter with a full 3½ digit LCD display. 0.5% basic accuracy, auto polarity operation. 10 Mohm DC input impedance.
Reading to ± 1999.

Scales:
DC volts:
1mV to 1000V
(1% + 1 digit accuracte)
AC volts:
1mV to 500V
(1% + 2 digits accurate)
DC current:
1μA to 200mA
(1% + 1 digit accurate).
Resistance:
10hm to 20 MOhms
(1.5% + 1 digit accurate)
Power source:
9V battery or AC with optional adaptor.
Size:
155 x 75 x 30 mm.
22–198

PRICE 53.19

LOW–COST LCD MULTIMETER

A portable, compact sized multimeter with a full 3½ digit LCD display. Auto polarity operation, low battery indicator. 10 MOhm Input impedance.



Scales:
DC volts:
2 20 200 1000V
AC volts:
200 500V
DC current:
2 20 200MA
Resistance:
2 20 200
2000 KOHM
Power source:
9V battery or AC adaptor.
Size:
37 x 85 x 130 mm.
22–197

PRICE 39.93

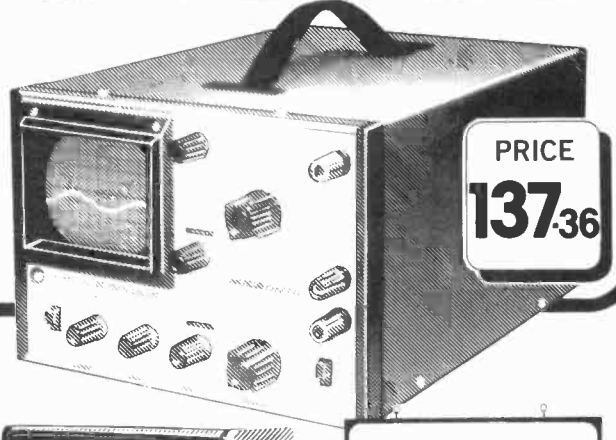
COMPONENTS AND PARTS

CAT. No	DESCRIPTION	PRICE
276–032	LED	4 for 69p
276–033	LED	2 for 48p
276–034	LED	2 for 59p
276–142	Infra-Red Emitter Detector Pair	£1.37
277–1003	12V DC Automotive Digital Clock Module	£17.52
276–9110	6 pin edge connector for 277 1003	40p
276–1373	Power Transistor Mounting Hardware	50p
276–1363	TO 220 Heat Sink	60p
276–1364	TO 3 Heat Sink	81p

AC/DC 8 MHz OSCILLOSCOPE

A new approved 8MHz version of last years' winner! The advance design features of this oscilloscope make it an absolute essential for industrial uses on production lines, in laboratories and schools. Ideal for radio and TV servicing, audio testing, etc.

Specifications:
Horizontal axis: Deflection sensitivity better than 250mV DIV. **Vertical axis:** Deflection sensitivity better than 10mV DIV (1DIV 6mm). Bandwidth 0.8MHz. **Input impedance:** 1MOhm parallel capacitance 35pF. **Time base: Sweep range:** 10Hz 100kHz (4 ranges). Synhronization. Internal ( ) **Size:** 200 x 155 x 300 mm. Supply 220 240 50Hz **22–9501.**



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TANDY

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news digest.....

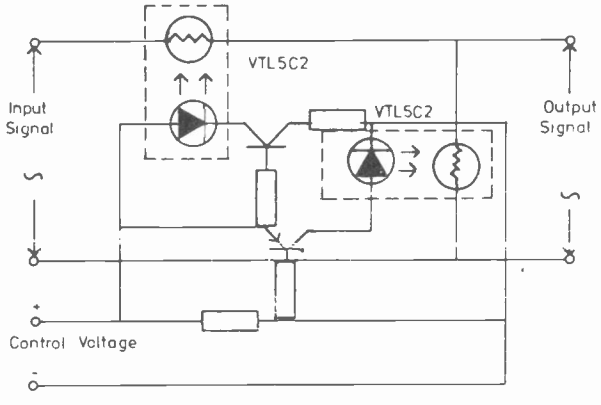
IN-CAR COMPUTING

There's a lot of it about. It's even happening in cars now — microprocessor control, I mean.

General Instrument Microelectronics have developed a clever little car brain based on its PIC 1655 single chip microcomputer. It's designed to replace speedometer, odometer and tripmeter (how far you've travelled since reset) functions. If you want to go mad and computerise everything in sight, there is sufficient on-chip memory to be allocated to other functions, such as water temperature, oil pressure, fuel, tachometer, etc.

Considering the wide variations in current car systems requirements, it's not surprising that GI's system has been designed with a great deal of in-built flexibility. It can drive fluorescent discharge tubes, LED or LCD devices. Distances can be shown in kilometres or miles and pressure, temperature, fluid measures, etc can be displayed in metric or in good, old-fashioned pounds, bushels and inches.

GI claim that the system will save space and weight, and increase reliability and performance. Further details, specification, etc are available from General Instrument Microelectronics Ltd, Regency House, 1-4 Warwick Street, London W1R 5WB.



NEVER SAY DIE

Norbain claim that if you use their Vactrols properly (within their ratings) they have virtually unlimited life expectancy — the Vactrols, not Norbain.

Sounding like the baddie in a Sci-Fi saga, a Vactrol consists of an LED and a photoresistor in a common package. It provides high input-output isolation and low coupling capacitance (about 0.5 p).

One of the several types of audio attenuators possible is shown. The degree of attenuation is varied by adjustment of the control voltage.

The distortion level for Norbain's VTL5 Vactrols is about 0.5% at IV rms, for a cell resistance of 3k, when using VTL5C4 or 7 types. It is reduced to less than 0.1% with a VTL5C2 and can be further reduced when using the VTL5C3 and 6 types under the same conditions.

Maximum attenuation with a single cell is 40 to 60 dB. Higher values can be achieved by cascading several stages.

For more information contact Norbain Electro-Optics Division, Norbain House, Arkwright Road, Reading, Berkshire RG20LT.

TTLs by TEXAS

7400	11p
7401	12p
7402	12p
7403	12p
7404	12p
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	60p
7442A	60p
7443	112p
7444	112p
7445	100p
7446A	93p
7447A	50p
7448	80p
7450	17p
7451	17p
7453	17p
7454	17p
7460	17p
7470	36p
7472	30p
7473	34p
7474	24p
7475	30p
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	100p
74167	200p
74170	240p
74172	450p
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	90n
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
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74393	180p
74490	225p

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74LS08	22p
74LS10	20p
74LS11	40p
74LS13	36p
74LS14	55p
74LS20	20p
74LS21	40p
74LS22	28p
74LS27	38p
74LS30	22p
74LS32	27p
74LS42	95p
74LS47	70p
74LS55	30p
74LS73	50p
74LS74	32p
74LS75	40p
74LS76	45p
74LS83	90p
74LS85	100p
74LS86	40p
74LS90	60p
74LS92	72p
74LS93	60p
74LS96	75p
74LS107	45p
74LS109	60p
74LS112	100p
74LS113	50p
75LS123	65p
74LS124	180p
74LS125	80p
74LS126	90p
74LS132	95p
74LS133	60p
74LS136	55p
74LS138	60p
74LS139	60p
74LS147	220p
74LS148	180p
74LS151	100p
74LS153	60p
74LS154	200p
74LS155	100p
74LS156	100p
74LS157	50p
74LS158	90p
74LS160	130p
74LS161	100p
74LS162	140p
74LS163	100p
74LS164	120p
74LS165	160p
74LS166	180p
74LS173	110p
74LS174	90p
74LS175	110p
74LS181	320p
74LS190	90p
74LS191	90p
74LS192	90p
74LS193	90p
74LS194	90p
74LS195	140p
74LS196	120p
74LS221	140p
74LS240	175p
74LS241	175p
74LS242	170p
74LS243	170p
74LS244	195p
74LS245	250p
74LS251	140p
74LS253	140p
74LS257	120p
74LS258	250p
74LS259	160p
74LS266	50p
74LS273	130p
74LS279	140p
74LS283	120p
74LS298	249p
74LS324	200p
74LS348	200p
74LS365	100p
74LS367	100p
74LS368	100p
74LS373	180p
74LS374	195p
74LS377	180p
74LS378	200p
74LS390	160p
74LS393	160p

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4006	95p
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4009	40p
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4013	50p
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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
4078	107p
4081	22p
4082	22p
4093	80p
4094	175p
4096	120p
4097	300p
4098	120p
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4502	120p
4503	70p
4507	55p
4510	99p
4511	150p
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4520	90p
4528	120p
4532	140p
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4543	180p
4553	450p
4566	90p
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MC1489	100p
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75154	175p
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75322	275p
75324	375p
75325	375p
75451	72p
75491/2	96p
BT26	250p
BT28	300p
BT95	160p
BT97	200p
81LS95	140p
81LS96	140p
81LS97	140p
81LS98	140p
9601	140p
9602	220p
9603	60p

93 SERIES

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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

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AY1-1313	668p
AY1-1320	320p
AY1-5050	160p
AY5-1224A	240p
AY5-1315	600p
AY5-1317A	775p
CA3019	80p
CA3046	70p
CA3048	225p
CA3080E	22p
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
LM10C	425p
LM301A	30p
LM311	120p
LM318	200p
LM319	250p
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
LM2917	250p
LM3302	80p
LM3900	70p
LM3911	130p
LM3914N	250p
LM4136	120p
MC1310P	150p
MC1458	55p
MC1495L	350p
MC1496	100p
MC3340P	120p
MC3360P	120p
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ZN425E	400p
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VOLTAGE REGULATORS — Fixed Plastic TO-220

+ve			−ve	
1A				
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12V	7812	70p	7912	75p
15V	7815	70p	7915	75p
18V	7818	70p	7918	75p
24V	7824	70p	7924	75p
100mA		TO-92		
5V	78L05	30p	79L05	80p
12V	78L12	30p	79L12	80p
15V	78L15	35p	79L15	80p

OTHER REGULATORS

LM309K	135p	LM320T-12	75p
LM317T	200p	LM340T-12	70p
LM323K	575p	78H05KC	625p
LM723	37p	78MGT2C	135p
78HGKC	675p	78P05KC	900p

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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	FND507	120p
DL704	140p	MAN3640	175p
DL707 Red	140p	TIL311	600p
707 Gr	140p	TIL312/3	110p
DL747 Red	225p	TIL321/2	130p
747 Gr	225p	TIL330	140p
FND357	120p	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-		
0-12 0-12	500mA	280p+	20-24-30	1A	340p+
			15-0-15	1A	265p+

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

VEROBOARD 0.1 (copper clad) 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"	200p	180p
3¾ x 17"	260p	220p
4¾ x 17"	310p	—
Pkt of 35 pins		30p
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Pin insertion tool		99p

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

TRANSISTORS

AC126	25p	BFR39	25p	TIP31A	58p
AC127/8	20p	BFR40	25p	TIP31C	62p
AC176	25p	BFR41	25p	TIP32A	68p
AC287/8	25p	BFR79	25p	TIP32C	82p
AF116/7	30p	BFR80	25p	TIP33A	90p
AD149	70p	BFR81	25p	TIP33C	114p
AD161/2	45p	BFX29	30p	TIP34A	115p
AU107	200p	BFX30	34p	TIP34C	160p
BC107/8	11p	BFX84/5	30p	TIP35A	225p
BC109	11p	BFX86/7	30p	TIP35C	290p
BC109C	13p	BFX88	30p	TIP36A	270p
BC117	20p	BFW10	90p	TIP36C	340p
BC147/8	9p	BFY50	22p	TIP41A	65p
BC149	10p	BFY51/2	22p	TIP41C	78p
BC157/8	10p	BFY56	33p	TIP42A	70p
BC159	11p	BFY90	90p	TIP42C	82p
BC169C	12p	BRY39	45p	TIP120	100p
BC172	12p	BSX19/20	20p	TIP122	110p
BC177/8	17p	BU104	225p	TIP2955	78p
BC179	18p	BU105	190p	TIP3055	70p
BC182L	10p	BU108	250p	TIS43	34p
BC182/3	10p	BU109	225p	TIS93	30p
BC183L	10p	BU205	200p	ZTX108	12p
BC184L	11p	BU208	200p	ZTX300	13p
BC187	30p	BU406	145p	ZTX500	15p
BC212L	11p	E300	50p	ZTX502	18p
BC212/3	11p	E304	50p	ZTX504	30p
BC213L	11p	E308	50p	2N457A	250p
BC214L	12p	E310	50p	2N696	35p
BC327	16p	MJ2501	225p	2N697	25p
BC337	16p	MJ2955	100p	2N698	45p
BC338	16p	MJ3001	225p	2N706A	20p
BC461	36p	MJE340	65p	2N708	20p
BC477/8	30p	MJE2955	100p	2N918	45p
BC516/7	50p	MJE3055	70p	2N930	18p
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BC548C	16p	MPF103/4	40p	2N1613	25p
BC549C	18p	MPF105	40p	2N1711	25p
BC557B	16p	MPS6531	50p	2N2102	60p
BC558B	16p	MPS6534	50p	2N2160	300p
BC559C	18p	MPSA06	30p	2N2219A	22p
BCY70	18p	MPSA12	50p	2N2222A	20p
BCY71/2	22p	MPSA13	50p	2N2369A	16p
BC131/2	50p	MPSA20	60p	2N2484	30p
BD135/6	54p	MPSA43	70p	2N2646	50p
BD139	56p	MPSA56	32p	2N2904/5A	25p
BD140	60p	MPSU06	63p	2N2906A	24p
BD241B	70p	MPSU56	78p	2N2907A	30p
BD242	70p	OC28	130p	2N2926	9p
BDY56	200p	OC35	130p	2N3053	22p
BF200	32p	R2008B	200p	2N3054	65p
BF244B	35p	R2010B	200p	2N3055	48p
BF256B	70p	TIP29A	40p	2N3442	140p
BF257/8	32p	TIP29C	55p	2N3553	240p
BF259	36p	TIP30A	48p	2N3565	30p
		TIP30C	60p	2N3643/4	48p

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2N3704/5	12p
2N3706/7	14p
2N3708/9	12p
2N3773	300p
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2N3820	50p
2N3823	70p
2N3866	90p
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2N3905/6	20p
2N4036	65p
2N4058/9	12p
2N4060	12p
2N4061/2	18p
2N4123/4	27p
2N4125/6	27p
2N4289	20p
2N4401/3	27p
2N4427	90p
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2N5172	27p
2N5179	90p
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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
25C1172Y	150p
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3N140	100p
3N141	110p
3N201	110p
40290	250p
40360	40p
40361/2	45p
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4A 400V	100p
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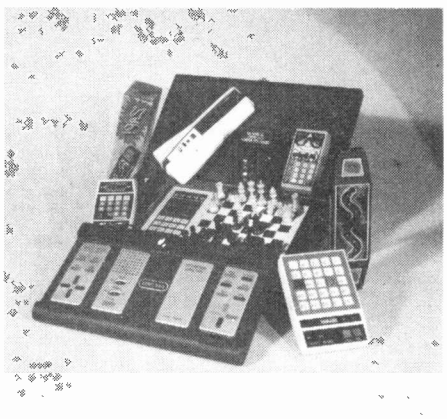
Next Month

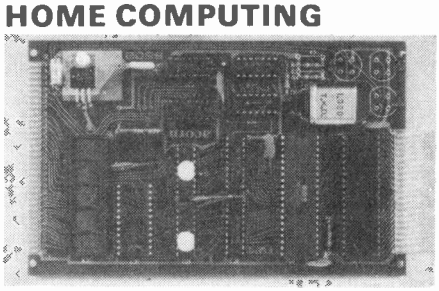
Hobby Electronics

ELECTRONIC GAMES



With one eye on Christmas we proudly present the HE review of electronic games. (We enjoy playing with them too). .From the humblest hand-held to the most sophisticated video computer, the latest chess playing micros, they're all here next month.

HOME COMPUTING

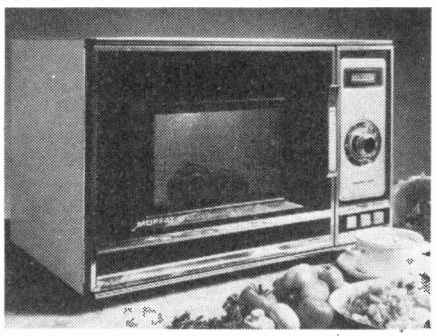


Sorry about the distinct lack of Computing this month, not to worry though, our resident computer expert Pete Howells takes a personal look at the current computer scene, what it's all about, what's happening now and what we can expect in the very near future.

COMPETITION

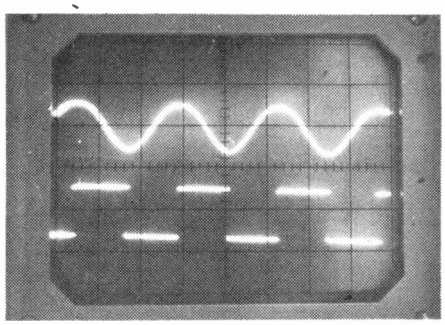
We hope we will be able to bring you the results of our August picture competition in next month's HE.

MICROWAVE COOKING



What's all the fuss about? Chances are it's because most people don't understand Microwave cookers, they've never gained the wide acceptance they deserve in this country. Next month one of the countries leading authorities on microwaves looks at what makes them tick, just how can a Chicken cook in 30 minutes, or a Hamburger in 5? Find out next month.

AUDIO ANALOGUE FREQUENCY METER



Some people seem to think that unless its got a digital its old-fashioned. We will proove them wrong with this beautifully designed piece of test equipment. The circuit is extremely simple to build yet will give a highly accurate readout of frequencies within the audio range.

If built and calibrated correctly this very useful piece of test equipment should prove to be invaluable for servicing, troubleshooting and experimental purposes. No need to guess anymore.

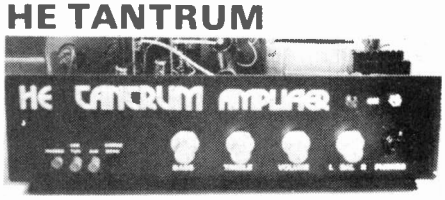
HOBBYTUNE

We sat around for ages trying to think of a name for this musical project, nothing seemed to do it justice. See what you think about this stylus operated, miniature organ. We won't promise it'll turn you into a virtuoso overnight but we would be surprised if you're not playing tunes in just a couple of minutes. The HOBBYTUNE has many of the features found on instruments costing three or four times as much to buy, a great project for the kids, it must be better than buying them a drum for Christmas.

MULTI OPTION SIREN

Yes folks, it's annoy the neighbours time again. Now you can plague them with a variety of different siren noises, yes before you ask, it will sound like an American police siren, but not only that, like a lot of other sirens too. Not recommended for people of a nervous disposition.

HE TANTRUM



We think the wait will be worthwhile, the Tantrum is a really superb piece of design work. We've incorporated a facility for remote control, (coming up soon) so not only will you be able to enjoy your favourite music from the comfort of your amrchair you'll be able to control it as well. Again apologies for its absence this month, they do say it makes the heart grow fonder.

The October issue will be on sale September 14th

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

Arresting Motion

As the name suggests, a satellite in a geostationary orbit appears to hold its position in the sky over the same spot on the Earth's surface. It is, of course, orbiting the Earth as any other satellite does, but at an altitude of nearly 36000 km, in a circular orbit, it keeps pace with the Earth's rotation and so appears to be stationary.

Around The World In 90 Minutes

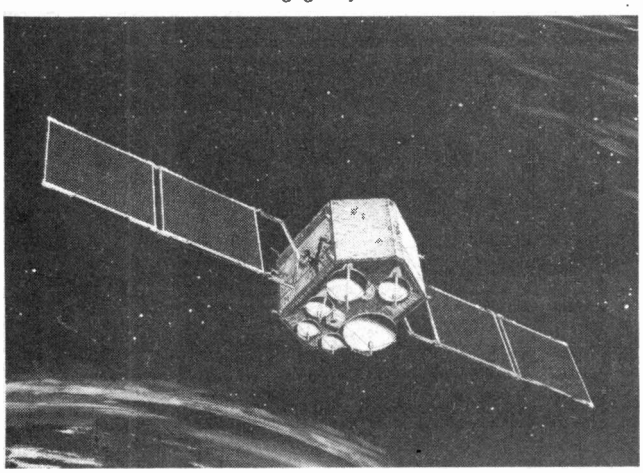
From TIROS-9 onwards satellites have also been launched into polar orbits, with a period of 1½ to 2 hours. The satellite orbits in the same plane, with the Earth rotating beneath it. The ground track of each orbit is some 28 degrees to the west of the previous one. Each spot on the Earth's surface is overflown twice a day, once at night and once during daylight hours. Two imaging systems are used. Visible light pictures are taken during daylight and infra-red at night.

Clearly IR

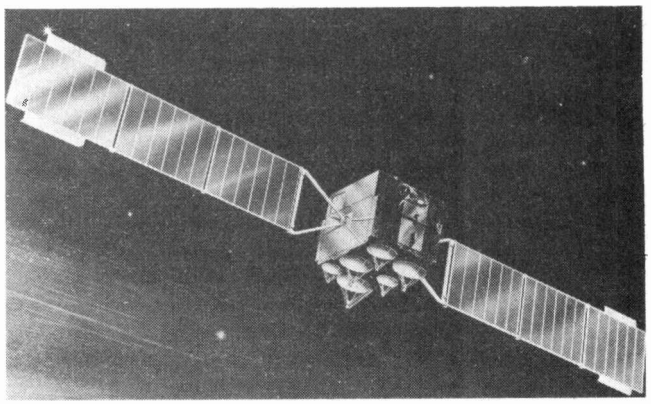
Infra-red sensors on the spacecraft can monitor temperatures from sea level up to the highest cloud. High cloud is the coldest and tropical sea the warmest. Light grey or white patches on the familiar black and white weather pictures of the UK, now a regular feature of television weather forecasts, are the colder cloud areas. Darker areas are the warmer land and sea masses. Coastlines will show clearly if there is sufficient difference in temperature between land and sea. In general, infra-red pictures show more detail than those taken by visible light, as they successfully avoid the problems of reflected glare from cloud tops and ground shadows from thick cloud.

Communications — The Early Days

It all started with Telstar in 1962. During each orbit of about five hours, Telstar and the succeeding Relay could only provide simultaneous visibility from both sides of the Atlantic for about 45 minutes. The Syncom series of satellites in 1963 explored the possibility of building a system from a small number of satellites in geostationary orbits. Syncom also showed that minor perturbations in a satellite's orbit, due to the non-uniformity of the gravitational sea in which it floats, could be rectified by the use of small correcting gas jets.



OTS-2, the forerunner of the European Communications Satellite, is intended to provide pre-operational capacity until ECS begins operations in 1981/2.



The European Communications Satellite (ECS) will carry a large proportion of European telephone, telex and television traffic.

Delay Fears

One fear, which never materialised, was that the increase in transmission time when bouncing telephone conversations off high altitude satellites would be unacceptable. The one way delay is a little over a quarter of a second. In 1964, Early Bird (later to become known as Intelsat 1) showed that the delay, inherent in the system, was not a serious problem.

Intelsat is an important name in the short history of communication satellites. In 1969, three Intelsat-3 satellites established the first global communications network. Even before the launch of Telstar, the Earth to satellite (uplink) and satellite to Earth (you guessed it — downlink) frequencies had been carefully selected. Below about 1 GHz (10^{12}Hz) galactic background noise is a significant factor. Below about 0.5 GHz it exceeds atmospheric noise. Above 10 GHz atmospheric noise rises steeply, moreso in heavy rain. The frequencies chosen then and adopted for the Intelsat programme were, therefore, between 1 and 10 GHz — 6 GHz for the uplink, 4 GHz for the downlink.

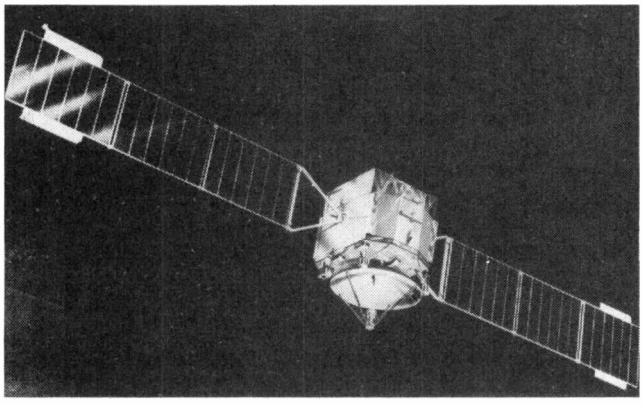
Britain is playing a particularly active role in satellite communications. British contractors contributed to the Intelsat 3, 4 and 4A programmes and British Aerospace is currently involved in the Intelsat 5 system, due to become operational in 1980.

European Communications

In May 1978, the European Space Agency's Orbital Test Satellite (OTS) was launched. It will test transmission techniques and prove the performance and reliability of on-board equipment in space. This is the forerunner of its operational successor, the European Communications Satellite (ECS) — a regional satellite communications system. It will be capable of carrying a significant proportion of future European telephone, telex and television traffic. OTS-2 will also provide adequate pre-operational traffic capacity. Two ECS spacecraft should become operational in 1981/82. Two maritime versions of ECS, to be known, not surprisingly, as MARECS, are also scheduled for launching in 1981/82. MARECS is planned to provide direct telephone and telex links between ships and shore stations in the UK and elsewhere.

Radio Piggy Back

In October 1978, the 1045th Cosmos satellite was placed in Earth orbit. It carried two smaller satellites called Radio 1 and 2, designed and built by radio hams.



MARECS, a marine version of ECS, is intended to provide communications links between ships and shore stations.

Radio 1 and 2 use frequencies in the two and ten metre amateur bands and are intended for use by both American and Soviet radio hams, complementing the service already provided by America's Orbiting Satellite Carrying Amateur Radio (OSCAR) satellites.

Active Limits And Passive Freedom

There are two basic types of navigational system — active and passive. In an active system, the user has to interrogate the satellite(s) to determine his position. That necessarily limits the number of people who can use the system, because each satellite has a finite number of communications channels available at any time.

A passive system, however, relies on ground stations receiving continuously transmitted signals from the satellite(s) and then calculating position from them. It has the advantage that there is no limit to the number of users who can listen in to the satellite transmissions.

The capacity to fix position continuously is not available with the US Navy's Transit system, even with six satellites in operation. Transit is, therefore, not suitable for air traffic control, as an aircraft could travel a considerable distance between fixes. Also, as Transit uses a Doppler technique, the speed of an aircraft affects the measurement of the frequency shift.

Throughout the seventies, the system has been updated and improved. However, expansion of Transit has been dropped in favour of a new system, NavStar, which should be fully operational by about 1985 and will be suitable for use by aircraft.

Home Sweet Home

A major part of Earth satellite applications is concerned with turning the cameras and sensors back towards mother Earth to find out more about this lump of rock that is our home. This field of self-interest can be split into two related and overlapping areas — Earth resources and research satellites.

On the 26th of April 1978, an Applications Explorer Mission satellite (AEM-1) was launched from Vandenberg to measure day and night temperature differences on the Earth's surface. This is the first of NASA's Explorer missions. The second, AEM-2, followed it into orbit on February 18th, 1979. The spacecraft were both of a modular design to keep costs down.

AEM-1, the Heat Capacity Mappint Mission (HCMM), will determine the feasibility of using data from thermal infra-red sensors for:

—discrimination of rock types and possibly location of minerals
—monitoring surface soil moisture changes
—measuring plant canopy temperatures
—measuring urban heat islands
—measuring land and sea surface temperature changes
—predicting water run-off from snow field information

The results will also be correlated with Landsat data and ground observations.

Military Embryo

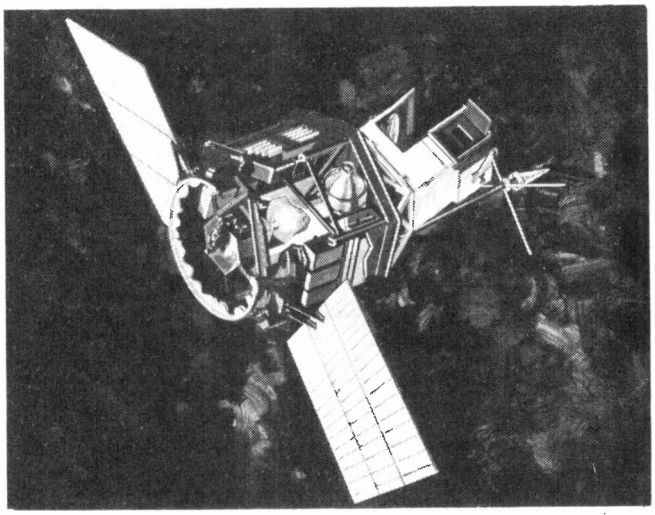
The early development of the American satellite programme was *entirely* in military hands, for obvious reasons. The motivation then was a belief in the axiom of conventional warfare that says, 'he who holds the high ground, controls the battlefield.' The military objective was the high ground — Earth orbit.

The Spy In The Sky

Satellites have been used for military reconnaissance since 1959, with the launch of the first of the Discoverer series, designed by Lockheed. In addition to the use of visible light photography to monitor ground operations, infra-red sensors can be used to detect, for example, heat from aircraft engines or local changes in sea temperature caused by submarines manoeuvring close to the surface or by surface craft manoeuvring at night.

It's difficult to estimate how many Soviet satellites are launched for military reconnaissance purposes, as most go by the 'family' name of Cosmos, whatever their application. However, information about their orbits and duration of flight can be used to deduce their possible applications.

In June 1971 a Titan 3D launch vehicle, capable of putting over 13 tonnes into a polar orbit, lifted a 'Big Bird' low altitude surveillance platform into a Sun-synchronous orbit. The Sun-synchronous orbit ensures that when the spacecraft overflies the target again and again, the Sun angle is always the same. That makes it much easier to compare photos of the same site and detect movements of troops, vehicles, missile launching sites, etc. ▶



An engineer's conception of AEM-1, a heat capacity mapping mission (HCMM) spacecraft and the first of the NASA's Applications Explorer Missions. The hexangular shaped base module for this spacecraft, launched in April 1978, was built for the NASA/Goddard Space Flight Center by the Boeing Aerospace Company of Seattle, Washington.

Soviet satellites are generally recovered intact and the film removed on the ground, but American satellites remain in orbit, while a number of film magazines in protective capsules are ejected. They re-enter the Earth's atmosphere and begin their descent to the surface on parachutes but, long before they get there, they are collected by specially equipped military aircraft.

In the early years of military satellites, once a spacecraft reached its position in Earth orbit, it was relatively safe. However, recent years have seen the development of hunter-killer spacecraft. Search and find craft have been used before to locate targets for photoreconnaissance. More sinister is the hunter-killer craft, which manoeuvres close to a target spacecraft and then explodes. Just how many of these are active and already in Earth orbit is a matter for conjecture. There have also been reports of spy satellite cameras being 'blinded' by intense flashes of laser light. As they say, 'all's fair in love, war and spying.'

Outward To Deep Space

If the sensors can be pointed down towards Earth, they can equally be pointed out into space. The greatest contribution of the satellite to near-Earth research has been the capacity to make on-the-spot measurements of parameters which previously could only be estimated by indirect means.

Britain has been particularly active in this field with the Ariel series. The satellites were called UK 1, 2, etc. until they achieved successful operational orbit, when they were renamed Ariel 1, 2, etc. Ariel 1 and 2, launched in 1962 and 1964 respectively, had substantial American involvement, but Ariel 3, launched in 1967, was the first satellite to be entirely designed and built in Britain. It was a very successful system, which operated for two years — twice its designed lifetime. British Aerospace was the principle contractor.

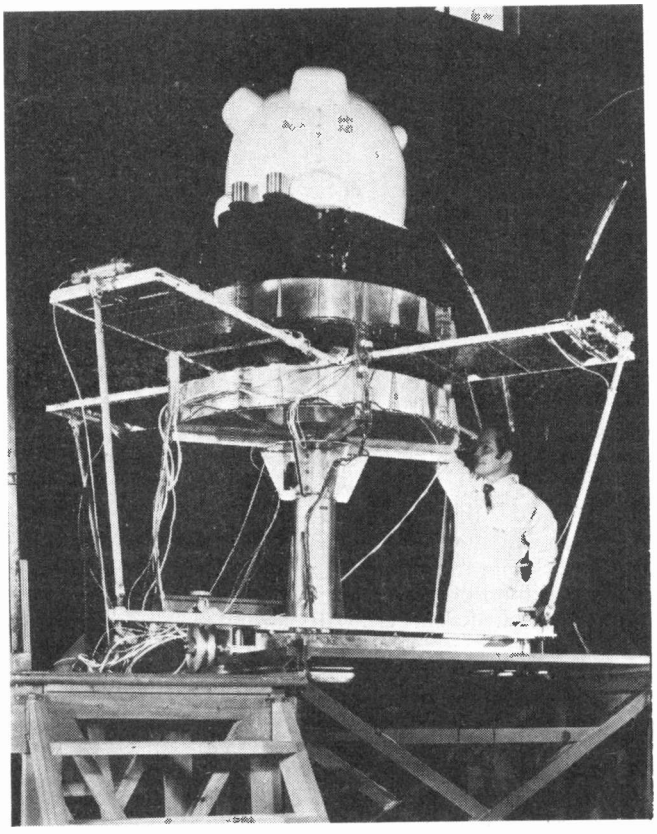
The latest of the series, Ariel 6, was successfully launched in June this year.

The X-Ray Sky

NASA has focused its attention on X-ray sources in the sky with its high energy astronomy programme. The first High Energy Astronomy Observatory (HEAO-1) made a general X-ray sky survey and identified approximately 1500 sources. Precise altitude control is essential for astronomical observations. HEAO-1's mission came to an end, therefore, when its supply of altitude control gas ran out in January this year. HEAO-2, launched in November 1978, can be pointed at selected X-ray sources. A third HEAO is scheduled for launch this year. The satellites are placed in low circular orbits, but their altitude allows them to detect radiation which would not reach the Earth's surface.

The Future

The immediate future should bring improved communications and navigation by satellite as more powerful systems are launched to give global coverage. The, by now familiar, sight of a launch rocket slowly lifting off a pad, carrying its payload towards Earth orbit will inevitably become much rarer. The Space Shuttle will be the first of a generation of reusable spacecraft, which will gradually replace 'one-off' rockets.



Ariel 6 will spend the next two years orbiting the Earth every 96 minutes, studying the ultra-heavy component of cosmic radiation and investigating X-ray sources.

Power From Orbit

When the oil wells finally dry up, we may supplement our energy requirement by building huge solar arrays in orbit and transmitting the collected power to Earth by microwave. The transmission of power by microwave has already been proven over short distances. You'll find more about power satellites in the August edition of Hobby Electronics.

Whatever the future *does* hold for satellites and their applications, it boils down to how much money governments are prepared to spend on space research. That begs the question — how do you value the returns from space? What price do you put on better weather forecasting, clearer and easier communications, improved air traffic control, etc? As if that wasn't a complex enough question, it doesn't stop there. Whether or not to embark on or continue an existing satellite programme is also inextricably tied up with national prestige, international relations, employment, high technology experience which can be translated to other fields of engineering and electronics . . . . . shall I go on? In the long term, your crystal ball is as good as mine. ETI

I would like to express my thanks to the following for their assistance in preparing this article:
British Aerospace
The Boeing Aerospace Company, Seattle

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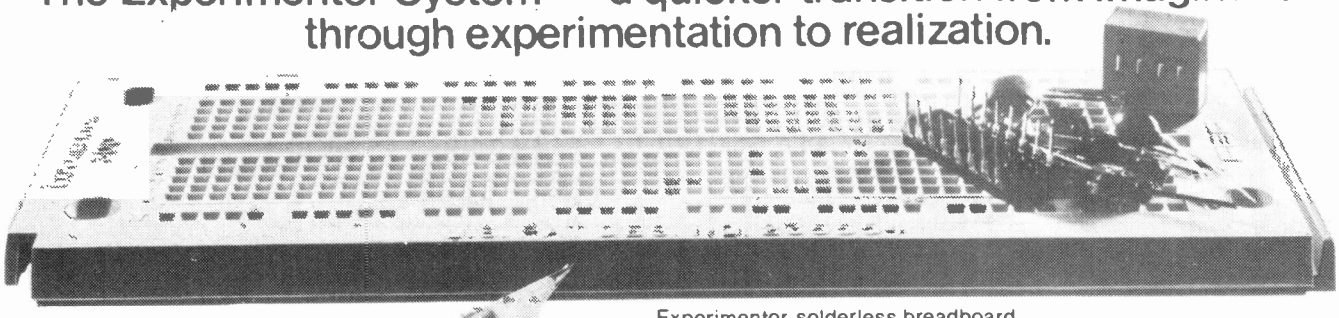
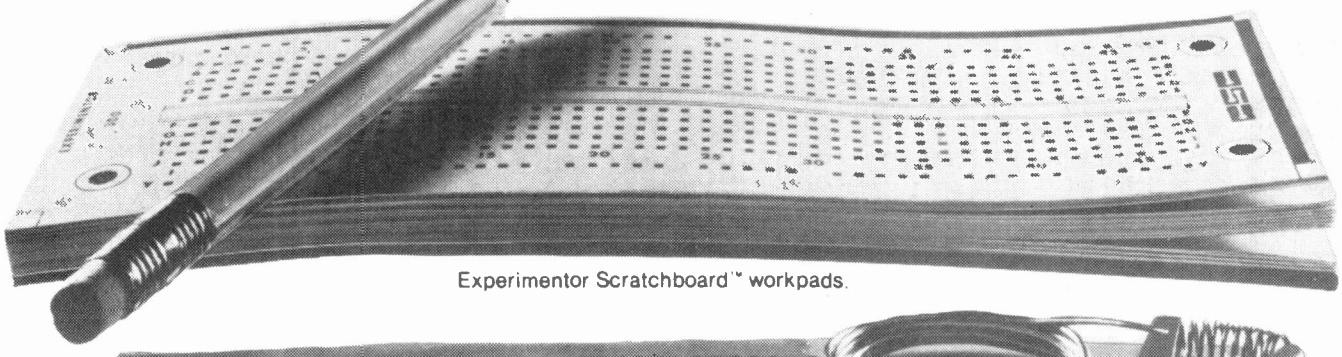
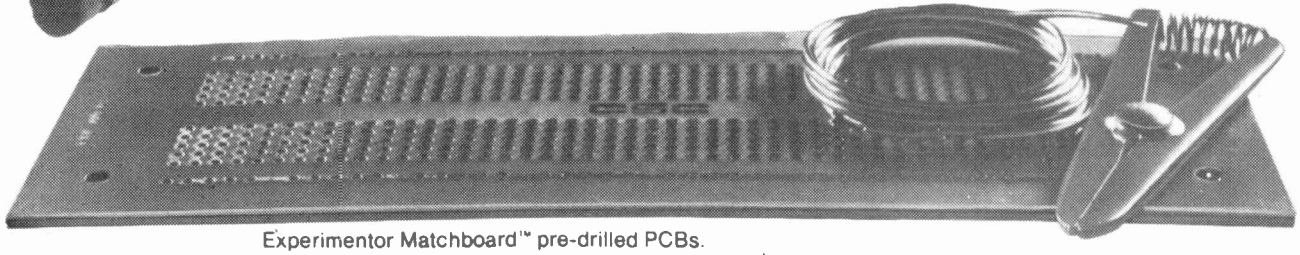


Experimentor solderless breadboard.



Experimentor Scratchboard™ workpads.



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There's even a letter-and-number index for each hole, so you can move from breadboard (where they're moulded) to Scratchboard™ (where they're printed) to Matchboard™ (where they're silkscreened onto the component side) and always know where you are.

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BC107C	£0.12	BC441	£0.35	BFY50	£0.18	TIP42B	£0.52	2N3707	£0.09
BC108A	£0.09	BC460	£0.44	BFY51	£0.18	TIP42C	£0.56	2N3708	£0.08
BC108B	£0.11	BC461	£0.44	BFY52	£0.18	TIP2955	£0.69	2N3709	£0.08
BC108C	£0.12	BC477	£0.23	BIP19	£0.44	TIS43	£0.25	2N3710	£0.08
BC109A	£0.09	BC478	£0.23	BIP20	£0.44	TIS90	£0.20	2N3711	£0.08
BC109B	£0.10	BC479	£0.23	BIP19		UT46	£0.23	2N3819	£0.21
BC109C	£0.12	BC547	£0.12	20MP	£0.92	ZTx107	£0.11	2N3820	£0.40
BC147	£0.08	BC548	£0.12	BRY39	£0.51	ZTx108	£0.11		

74 SERIES TTL

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0.10	7427	£0.27	7472	£0.23	74105	£0.43	74163	£0.71
7401	£0.12	7428	£0.29	7473	£0.28	74107	£0.27	74164	£0.78
7402	£0.12	7430	£0.12	7474	£0.28	74110	£0.41	74165	£0.78
7403	£0.12	7432	£0.25	7475	£0.33	74111	£0.66	74166	£0.89
7404	£0.12	7433	£0.34	7476	£0.28	74118	£0.92	74174	£0.74
7405	£0.12	7437	£0.25	7480	£0.50	74119	£1.36	74175	£0.71
7406	£0.25	7438	£0.24	7481	£0.97	74121	£0.27	74176	£0.66
7407	£0.25	7440	£0.13	7482	£0.78	74122	£0.44	74177	£0.66
7408	£0.14	7441	£0.57	7483	£0.66	74123	£0.46	74180	£1.72
7409	£0.14	7442	£0.48	7484	£1.01	74136	£0.89	74181	£0.66
7410	£0.12	7443	£0.80	7485	£0.78	74141	£0.63	74182	£0.80
7411	£0.19	7444	£0.80	7486	£0.25	74145	£0.63	74184	£0.80
7412	£0.17	7445	£0.74	7489	£1.95	74150	£0.78	74190	£0.78
7413	£0.27	7446	£0.89	7490	£0.36	74151	£0.56	74191	£0.71
7414	£0.57	7447	£0.55	7491	£0.73	74153	£0.56	74192	£0.89
7416	£0.26	7448	£0.64	7492	£0.40	74154	£0.94	74193	£0.66
7417	£0.26	7450	£0.12	7493	£0.34	74155	£0.57	74194	£0.71
7420	£0.12	7451	£0.12	7494	£0.88	74156	£0.57	74195	£0.69
7421	£0.23	7453	£0.12	7495	£0.57	74157	£0.57	74196	£1.20
7422	£0.18	7454	£0.12	7496	£0.67	74160	£0.66	74197	£1.20
7423	£0.24	7460	£0.12	74100	£0.97	74161	£0.71	74198	£2.12
7425	£0.21	7470	£0.28	74104	£0.44	74162	£0.71	74199	£2.12
7426	£0.28								

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.16	CD4015	£0.87	CD4026	£1.38	CD4043	£1.01	CD4070	£0.19
CD4001	£0.17	CD4016	£0.48	CD4027	£0.57	CD4044	£0.94	CD4071	£0.19
CD4002	£0.18	CD4017	£0.86	CD4028	£0.78	CD4045	£1.61	CD4072	£0.19
CD4006	£1.05	CD4018	£0.97	CD4029	£0.97	CD4046	£1.49	CD4081	£0.19
CD4007	£0.19	CD4019	£0.48	CD4030	£0.55	CD4047	£1.00	CD4082	£0.20
CD4008	£1.05	CD4020	£1.03	CD4031	£2.30	CD4049	£0.48	CD4510	£1.13
CD4009	£0.51	CD4021	£0.94	CD4035	£1.15	CD4050	£0.48	CD4511	£1.09
CD4010	£0.55	CD4022	£0.94	CD4037	£1.09	CD4054	£1.26	CD4516	£1.15
CD4011	£0.17	CD4023	£0.17	CD4040	£1.01	CD4055	£1.16	CD4518	£1.16
CD4012	£0.18	CD4024	£0.74	CD4041	£0.87	CD4056	£1.55	CD4520	£1.15
CD4013	£0.46	CD4025	£0.17	CD4042	£0.82	CD4069	£0.19	CD4014	£0.92

LINEAR

Type	Price			Type	Price	Type	Price	Type	Price
CA3011	£8.92	CA3130	£1.06	MC1350	£1.38	UA710C	£0.46	SN76115	£218
CD3014	£1.55	CA3140	£0.80	MC1352	£1.61	72710	£0.34	SN76660	£0.86
CA3018	£8.74	LM301	£0.33	MC1469	£3.58	UA711C	£0.36	SL414A	£2.24
CA3020	£1.95	LM304	£1.84	MC1496	£1.03	72711	£0.36	TAA550B	£0.40
CA3028	£0.92	LM308	£1.15	NE536	£3.05	UA723C	£0.52	TAA621A	£2.30
CA3035	£1.61	LM309	£1.72	NE550	£1.09	72723	£0.52	TAA621B	£2.87
CA3036	£1.15	LM320-5V	£1.72	NE555	£0.27	UA741C	£0.27	TAA661	£1.72
CA3042	£1.72	LM320-12V	£1.72	NE556	£0.69	72741	£0.27	TAD100	£1.49
CA3043	£2.12	LM320-15V	£1.72	NE565	£1.38	741P	£0.23	TBA540	£2.41
CA3046	£0.80	LM320-24V	£1.72	NE566	£1.38	UA747C	£0.69	TBA810S	£0.86
CA3052	£1.84	LM380	£0.97	NE567	£1.95	72747	£0.69	TBA810	£1.12
CA3054	£1.26	LM381	£1.66	UA702C	£0.52	UA748	£0.40	TBA820	£0.80
CA3075	£1.72	LM3900	£0.66	72702	£0.52	72748	£0.40	TBA9200	£2.87
CA3081	£1.72	MC1303L	£0.97	UA703	£0.28	748P	£0.40	TCA270S	£2.30
CA3089	£2.30	MC1304	£2.18	UA709	£0.28	SN76013N	£2.01	TBA800	£0.92
CA3090	£4.14	MC1310	£1.09	72709	£0.52	SN76023	£2.01		
CA3123	£2.16	MC1312	£2.16	709P	£0.28	SN76110	£1.72		

THYRISTORS

Volts No	Price	Volts No	Price
50 THY1A/50	£0.29	50 THY7A/50	£0.55
100 THY1A/100	£0.32	100 THY7A/100	£0.58
200 THY1A/200	£0.36	200 THY7A 200	£0.65
400 THY1A/400	£0.43	400 THY7A/400	£0.71
600 THY1A/600	£0.51	600 THY7A/600	£0.89
800 THY1A/800	£0.66	800 THY7A/800	£1.05
Volts No	**Price**	**Volts No**	**Price**
50 THY3A/50	£0.32	50 THY10A/50	£0.58
100 THY3A/100	£0.34	100 THY10A/100	£0.65
200 THY3A/200	£0.37	200 THY10A/200	£0.71
400 THY3A/400	£0.48	400 THY10A/400	£0.80
600 THY3A/600	£0.57	600 THY10A/600	£1.13
800 THY3A/800	£0.74	800 THY10A/800	£1.40
Volts No	**Price**	**Volts No**	**Price**
50 THY5A 50	£0.41	50 THY16A/50	£0.62
100 THY5A/100	£0.51	100 THY16A 100	£0.86
200 THY5A/200	£0.57	200 THY16A/200	£0.71
400 THY5A/400	£0.65	400 THY16A/400	£0.88
600 THY5A/600	£0.79	600 THY16A/600	£1.03
800 THY5A 800	£0.93	800 THY16A/800	£1.59

SILICON RECTIFIERS

200MA		**10 Amp**	
IS920 50v	£0.07	IS10/50 50v	£0.21
IS921 100v	£0.08	IS10/100 100v	£0.24
IS922 150v	£0.09	IS10/200 200v	£0.28
IS923 200v	£0.10	IS10/400 400v	£0.40
IS924 300v	£0.11	IS10/600 600v	£0.48
1 Amp		IS10/800 800v	£0.58
IN4001 50v	£0.05	IS10/1000 1000v	£0.69
IN4002 100v	£0.05	IS10/1200 1200v	£0.79
IN4003 200v	£0.07	**30 Amp**	
IN4004 400v	£0.08	IS30/50 50v	£0.64
IN4005 600v	£0.09	IS30/100 100v	£0.79
IN4006 800v	£0.10	IS30/200 200v	£1.06
IN4007 1000v	£0.11	IS30/400 400v	£1.43
1.5 Amp		IS30/600 600v	£2.02
IS015 50v	£0.10	IS30/800 800v	£2.23
IS020 100v	£0.11	IS30/1000 1000v	£2.65
IS021 200v	£0.12	IS30/1200 1200v	£3.31
IS023 400v	£0.14	**60 Amp**	
IS025 600v	£0.16	IS70/50 50v	£0.86
IS027 800v	£0.18	IS70/100 100v	£0.96
IS029 1000v	£0.23	IS70/200 200v	£1.38
IS031 1200v	£0.28	IS70/400 400v	£2.01
3 Amp		IS70/600 600v	£2.58
IN5400 50v	£0.16	IS70/800 800v	£2.87
IN5401 100v	£0.17	IS70/1000 1000v	£3.45
IN5402 200v	£0.18		
IN5404 400v	£0.19		
IN5406 600v	£0.24		
IN5407 800v	£0.28		
IN5408 1000v	£0.34		

AUDIO MODULES

Amplifiers

AL20 5 watt amplifier module **£3.73**

AL30A 7-10 watt amplifier module **£4.35**

AL60 15-25 watt amplifier module **£5.39**

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PA200 Stereo pre-amplifier module **£19.07**

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PS12 Power supply (24 volts DC) **£1.72**

SPM80 Stabilised power supply (33v) **£5.06**

SPM120/45 Stabilised power supply (45v) **£6.67**

SPM120/55 Stabilised power supply (55v) **£6.67**

SPM120/65 Stabilised power supply (65v) **£6.67**

SG30 Power supply for equaliser **£4.37**

Miscellaneous

MPA30 Stereo magnetic cartridge pre-amp **£4.42**

S.450 Stereo tuner **£26.72**

Stereo 30 complete 7 watt stereo amplifier board **£22.66**

BP124 Siren alarm module 5 watts **£4.02**

GE100MKII 10 channel mono graphic equaliser **£23.00**

LEDs

D/no.	Size	Colour	Price
1501	125	RED	£0.11
1502	125	GREEN	£0.21
1503	125	YELLOW	£0.21
1504	2	RED	£0.11
1505	2	GREEN	£0.21
1506	2	YELLOW	£0.21
1509	2	CLEAR (III. Red)	£0.12
SUPER 'Hi-Brite' Type			
1521	125	RED	£0.11
1522	2	RED	£0.11
1514	ORP12	Light dependent resistor	£0.63
1520	OCP71	Photo transistor	£0.40

CLIPS

1508/125 pack of 5 — 125 clips **£0.17**
1508/2 pack of 5 — 2 clips **£0.20**

DISPLAYS

OL303 RED 7 segment D P left (.30" height) common anode single digit O/NO 1523 **£0.80**

DL707 RED 7 segment D P left (0.3" height) common anode single digit O/NO 1510 **£0.92**

OL527 RED 7 segment D P left (.50" height) common anode Two-digit reflector O/NO 1524 **£1.95**

DL727 RED 7 segment D P right (.510" height) common anode Two-digit light pipe O/NO 1521 **£2.53**

DL747 RED 7 segment D P left (.630" height) common anode Single-digit light pipe O/NO 1511 **£1.72**

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CILD74 Multi-channel 8 pin DIP two isolated channels O/NO 1498 **£1.15**

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1612	14 pin DIL	£0.11
1613	16 pin DIL	£0.12
1720	18 pin DIL	£0.18
1721	20 pin DIL	£0.20
1722	22 pin DIL	£0.22
1614	24 pin DIL	£0.24
1615	28 pin DIL	£0.26
1723	40 pin DIL	£0.34
1616	TO18 transistor	£0.13
1617	TO3 transistor	£0.37
16117	TO5 transistor	£0.13
1724	14 pin DIL Wire wrap gold plated Cambion	£0.25

G.P. SWITCHING TRANSISTORS

TO18sim to 2N706/8 BSY27/28 95A ALL usuable devices no open and shorts ALSO available in PNP sim to 2N290/BCY70
20 for **57p;** 50 for **£1.15;** 100 for **£2.07;** 500 for **£9.20;** 1 000 for **£16.10;** when ordering state NPN/PNP

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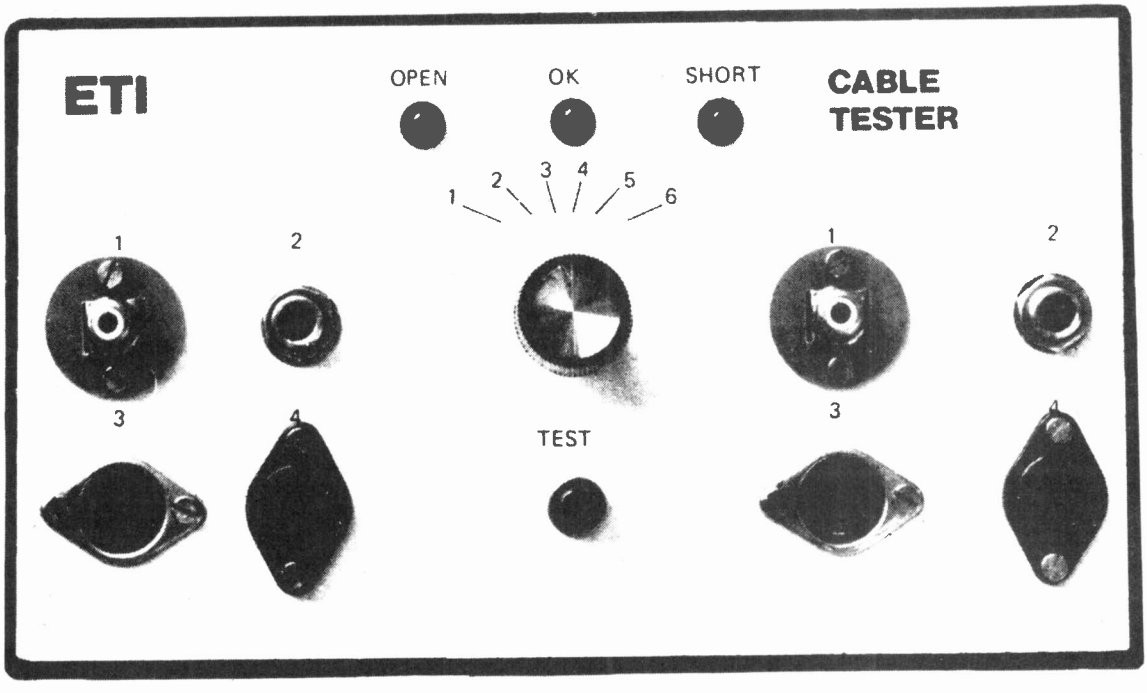

ALMOST ALL THE faults in an audio system are caused by cables. Have you ever tried to find which cable is broken among the many connections in a stage audio system, especially with anxious people looking over your shoulder?

The answer is to check each cable before the performance, a rather tedious business.

This Cable Tester checks each wire in turn for both open circuits and short circuits to earth. Each cable can then be thoroughly tested before use and hopefully faults can be found before they cause problems.

The circuit makes cunning use of a 7474 dual D flip flop to light one of three LED's after the test switch is pushed, indicating short, open or OK.

Construction

The unit is mounted on a standard plastic box measuring 196 x 113 x 60 mm. If it is to be used on-stave, then use the strongest box you can find, such as diecast aluminium.

Wiring the switch is the only difficult part of the construction. Note that some of the switch contacts are linked together as shown in Table 1.

The transformer we used is a commonly available Ferguson PCB mounting type.

The sockets we have chosen for the prototype are the most common type, however there is no reason why others can't be substituted. The jack plugs, SK7, 8 and the phono sockets SK1, 2 must be insulated from the metal front panel, or the earth connections will be permanently connected together through the panel. Phono sockets are available with insulating mountings, while insulating washers can be made from plastic sheet for mounting the jack sockets. ▶

HOW IT WORKS

IC1 is a 7474 dual D flip-flop with its clock (CLK) and D inputs held at 0V.

First let's assume an open circuit cable. ZD1 conducts, as it has 12 V across it, and turn on Q2, which hold the preset (PR) input on IC1a low. The PR input of IC1b remains high because ZD2 is not biased. When the test switch is pressed, putting a 0 on the CLR input, the outputs of IC1a become: Q, high; Q low. When the test switch is released, leaving both the CLR inputs high, the following outputs are obtained: IC1a-Q, high; Q, low; IC1a/b-Q, low; Q, high. Since the output of Q, IC1a is low, Q3 is turned off. Therefore LED1 is on, LED2 is off, and LED3 is off.

Now let's look at the 'short to earth' condition. The 12 V rail is shorted to earth through D1 (exit one diode). Q2 is turned off leaving the PR input of IC1a high. The PR input of IC1b is held low. When the test button is pressed the outputs of IC1a go: Q, low; Q, high. When the button is released, placing a high on the CLR inputs, these outputs remain the same. The outputs of IC1b are: Q, high; Q, low. Therefore LED1 is off, LED2 is off because the base of Q3 is held low by IC1b, and LED3 is on, indicating a short.

Finally, if the cable is OK, the voltage across ZD1 is held at 3V3 by ZD2. Q2 is off because ZD1 6V8 is not conducting. The PR input of IC1a is left high and the PR input of IC1b is also high. When the test button is released the outputs of IC1a go: Q, lowl Q, high. The outputs of IC1a go: Q, low Q, high, when the button is pushed and remain the same when it released. Both the Q outputs are low so LEDs 1 and 3 are off and the Q outputs are high so Q3 is conducting and LED2 is on.

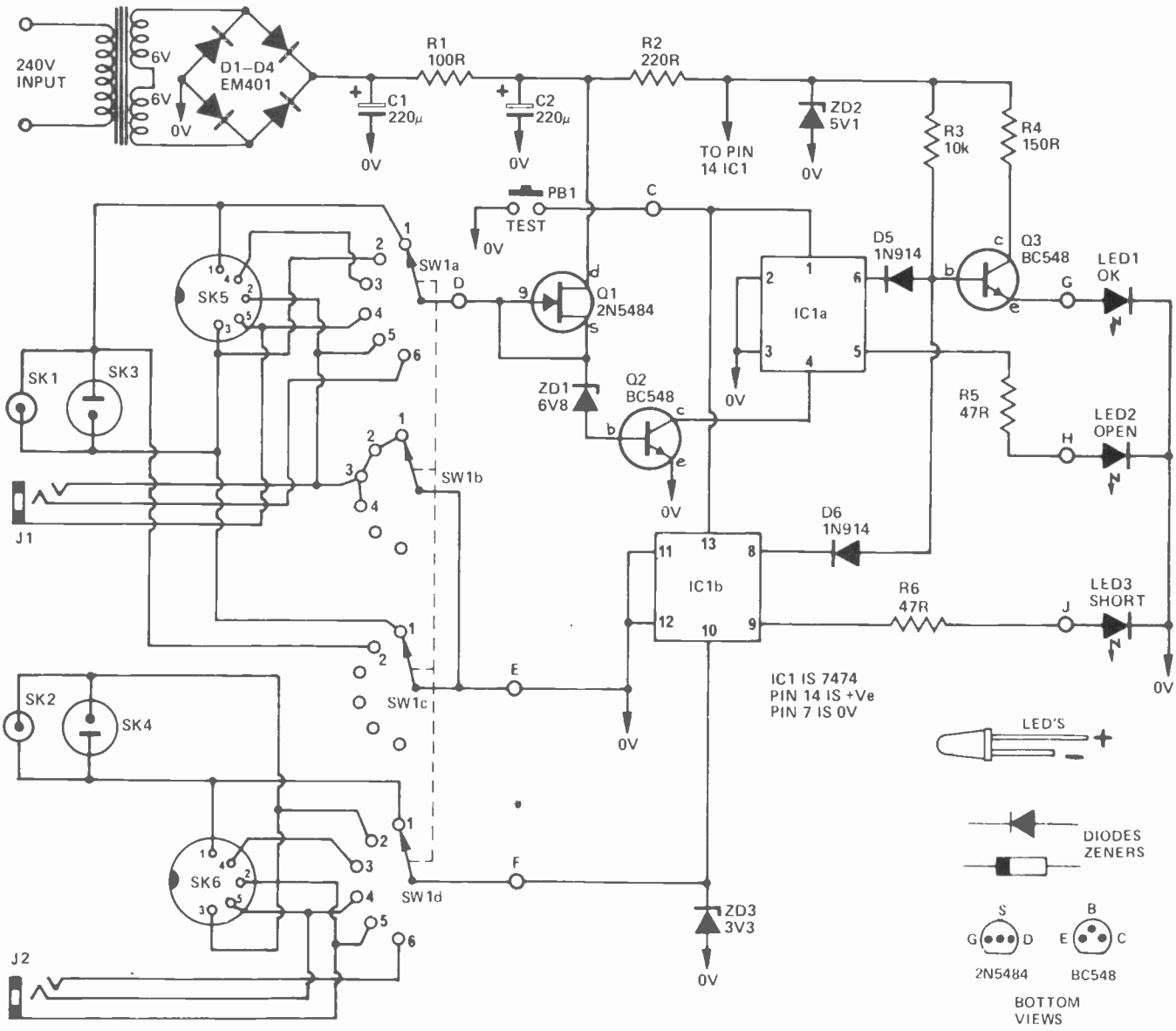

Fig. 1. Final circuit of the Tester.

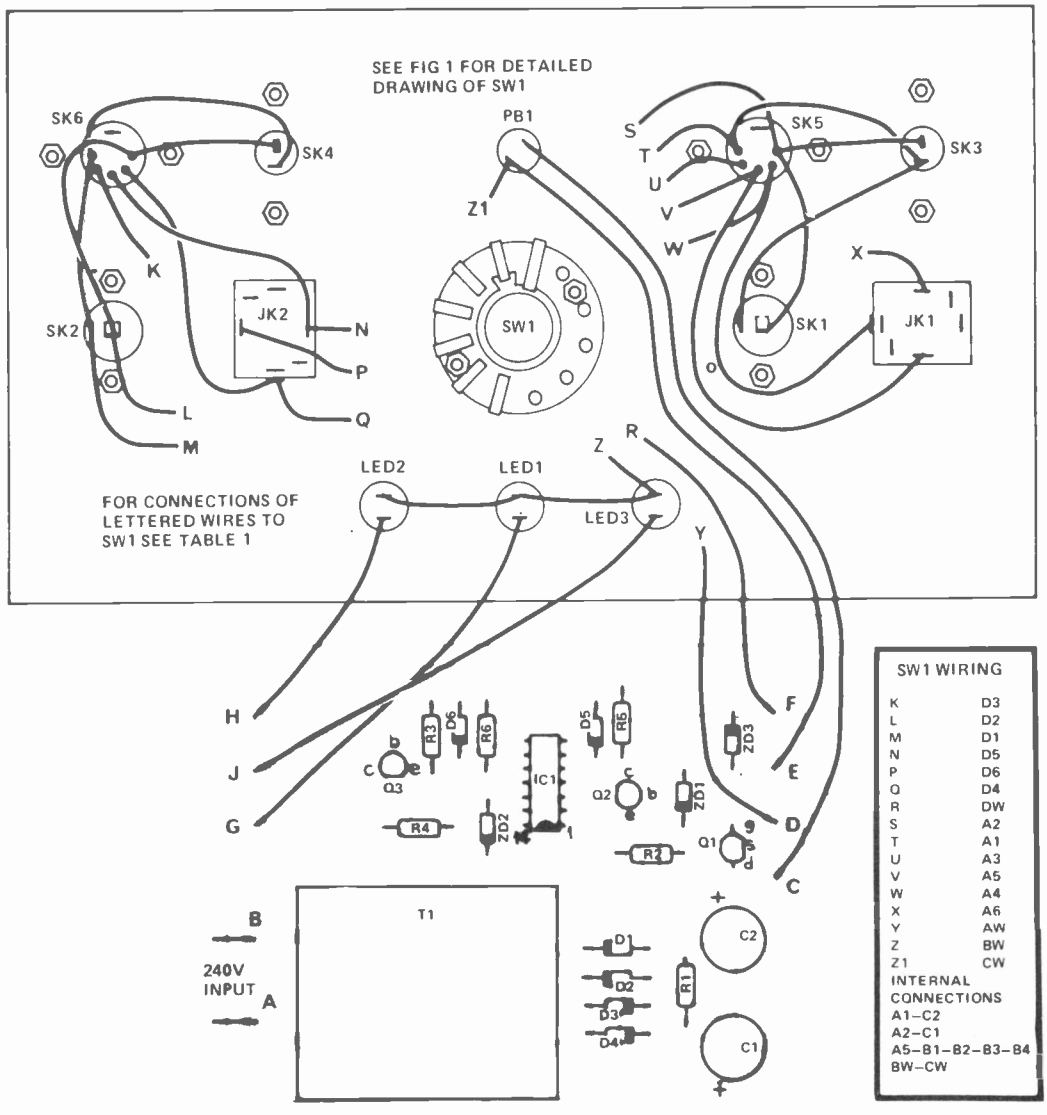

Fig. 2. Component overlay and front panel connections.

PARTS LIST

RESISTORS	all ¼W 5%
R1	100R
R2	220R
R3	10k
R4	150R
R5, 6	47R
CAPACITORS	
C1, 2	220 25V electrolytic
SEMICONDUCTORS	
IC1	7474
Q1	2N5484
Q2, 3	BC548
D1-4	1N4001
D5, 6	1N914
ZD1	6V8 400mW
ZD2	5V1 400mW
ZD3	3V3 400mW
LED1-3	TIL 209 or similar
SOCKETS	
SK1, 2	phono skt
SK3, 4	2pin DIN
SK5, 6	5pin DIN
SK7, 8	stereo jack
MISCELLANEOUS	
SW1	4p 6way
T1	6-0-6V 500mA
PB1	push to make

Box to suit, pcb, power lead, etc.

BUYLINES

None of the electronic components in this project will be difficult to get hold of, and the mechanics depend on the application. For stage use a couple of Cannon sockets could be added and wired in accordingly. The switch SW1 should be break before make.

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4. Advanced	1:20 Minutes
5 Superior	2:20 Minutes
6. Tournament Practice	3 Minutes
7. Tournament Teacher	3 Minutes
8. Excellent	20 Seconds
9. Expert	6 Minutes
H. Infinite	11 Minutes
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   E. Book openings teaches opening game.
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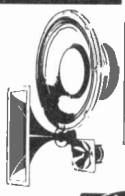

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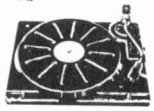

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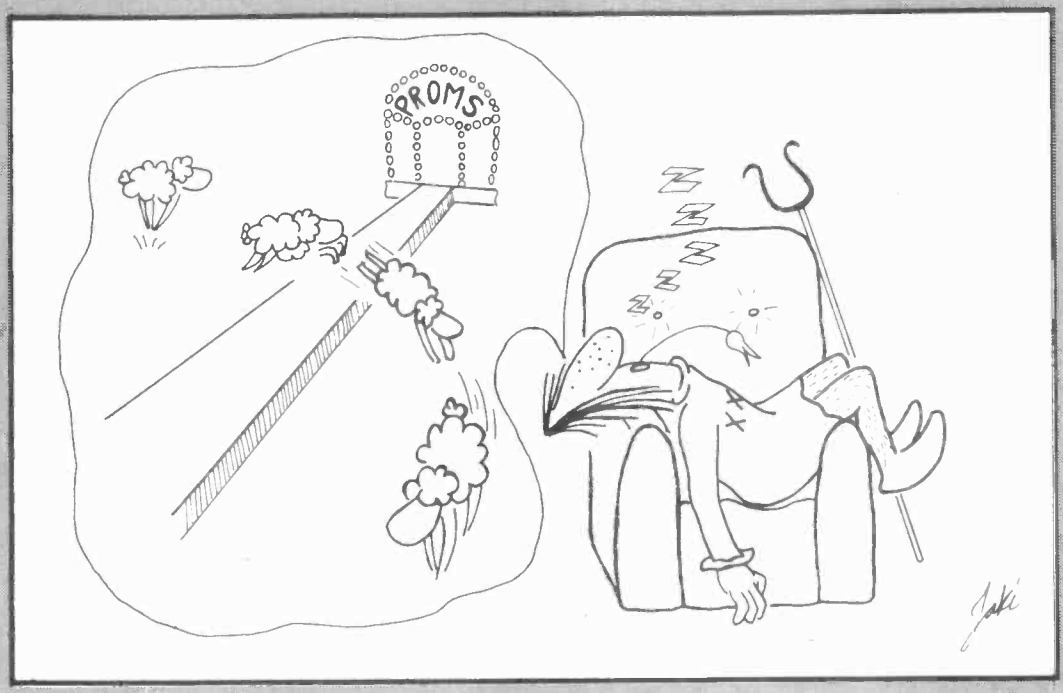


RAMS and PROMS are MEMORIES

MICROPROCESSOR systems are made up from two distinct parts called Hardware and Sodtware, the Software is the program which is run on the system, the Hardware is the physical components which go to make up such a system. We will assume that you are able to differentiate between resistors, capacitors and diodes which apart from the crystal and PCB (Printed Circuit Board) leaves only the mysterious ICs and sockets.

An IC looks like a lump of black plastic or similar material with numerous pins sticking out on each side, each IC should have a socket associated with it. For ease of testing and replacement the sockets are soldered into the PCB and the ICs plugged into the sockets. The important things to remember about inserting or removing ICs from the sockets are.

1. Make sure that no power is applied to the PCB.
2. Make sure it is the correct IC for that location.
3. Make sure it is the correct way round.
4. Ensure that all of the pins are correctly sitting in the socket.

Each IC is identified by a number printed on the top surface of the package, pin 1 of each IC is marked either with a dot, indentation or horseshoe groove near pin 1. If the IC is held with the pins downward and the dot or horseshoe away from you then pin 1 is always the furthest pin on the left.

SCRUMPI contains several ICs which may be broken down into the following categories.

Main Control Chip. This is the SC/MP microprocessor chip.

Buffers and encoders, etc. These ICs typically have a code such as 74LS xx or 81LS xx and are used to handle control of counting, device address decoding, latching or buffering the address bus and data bus.

RAMS. Random Access Memories. The theory of the insides of these ICs can be likened to a chessboard or a set of 'pigeon holes.' The data in the MM2112 RAM chips is organised as 256 locations each of four bits, if we use two M2112 chips in parallel it is possible to have an organisation of 256 locations each of 8 bits (or 1 byte). Each of the 256 locations can be accessed directly by the MPU chip and the data at that location copied onto the data bus or the ▶

data on the data bus copied into the selected location. The data in such a memory will remain there until the supply voltage is removed. When first powered-up each time, the contents of a RAM are random and variable.

RAMs can be used for storage of programs or data for the program to be operated upon, under some circumstances even a program can be considered to be data.

PROMs, ROMs, tec. There are a second type of memory device similar in concept to the RAM except that the program or data stored in the device remains even if the power supply is removed. They are thus suitable for holding the fixed programs and data and are a convenient method of shipping such data from one installation to another.

ROM stands for READ ONLY MEMORY and it is usually assumed that the data in a ROM is installed at the time of manufacture of the chip and as such can be referred to as Mask programmed ROMs. PROMs and EPROMs on the other hand are programmed after manufacture and are thus referred to as Programmable Read Only Memories. The E in EPROM shows that the data in the PROM can be erased by exposing the inside of the chip to intense UV radiation, this is usually accomplished through the transparent quartz window let into the top of these devices.

The type of Read Only Memory used in SCRUMPI is the MM5204Q EPROM, this can be replaced with either of the following pin compatible devices —

MM5214 Mask Programmed ROM
Field Programmable ROM

The alternatives offer the advantages of large volume/low cost and/or simplification or power supply to 5V only (no —12V supply is required).

Ports are the method that an MPU uses to communicate to the external world. A port is simply an integrated circuit whose function is to interface the MPU data bus in whole or only in part to devices which cannct interface directly to the MPU system. There are several reasons why external devices cannot be directly coupled to the MPU data bus.

Firstly the devices may not be TRI-STATE output devices which means that they could not be connected to the data bus otherwise their outputs would always be in the logic 1 or logic 0 state and not in the high impedance TRI-STATE mode required. Alternatively the external devices may operate too fast for the MPU, or too slowly, or require buffering so as not to unduly load the drive capabilities of the MPU data bus. The INS8154 is a single chip device containing the logic required to operate 16 of its pins as PORTs, the 16 pins can be operated as two 8 bit ports or as individual Input/Output lines. Each pin can operate in either Input mode or Output mode the choice being made by Software selection, each pin is also capable of latching the data on that pin at either input or output time. In addition to the two 8 bit ports the INS8154 also contains 128 bytes of RAM which is sufficient as a working storage RAM in most applications.

The effects of Scrumpi

If you study the circuit diagram of SCRUMPI you will quickly see that all of the major signals to and from the SC/MP chip are available at one of the two edge connectors so that SCRUMPI is able to communicate with other electronic devices. It can thus be used as the heart of many electronic circuits and can be used in this form to help with the design and debugging of projects by the electronics engineer or by the amateur constructor.

The single-step circuitry shown as IC's 2, 3 and 4 allow the SC/MP to be run at a very slow speed (down to 1 step per hour if necessary), this slow single step speed is useful in checking the effect of each instruction as it is executed. The actuation of the STEP switch causes a single pulse output from IC 4. This pulse sets a Flip-Flop (a simple electronic switch) at IC3 and thus drives the NHOLD line to a positive voltage which instructs the SC/MP to execute an instruction. During this instruction the SC/MP outputs a pulse on the NADS (Address Strobe) output, this pulse

RESETs the Flip-Flop which in turn puts the NHOLD input low and thus stops the SC/MP from executing any further instructions. The next instruction will only be executed after the next actuation of the STEP switch.

A similar situation exists with the single-step switch in the FAST position excepts that here IC 4 will generate a pulse automatically at a rate which is dependent on the value of C1 (usually about 5 pulses per second). This mode can be used to step through a program faster than single-stepping but not at the maximum possible speed.

If CS 4 is put into the RUN position then the SC/MP will execute the program at the maximum speed. Between this mode and the FAST single-step mode is the HALT mode which can be used to stop execution of the program at predetermined points. Here the pulse for the Flip-Flop is generated whenever the SC/MP executes a HALT (×'00') instruction, this pulse RESETs the Flip-Flop and thus terminates execution until the next actuation of the STEP switch. The data bus is connected to a set of switches which can be used either in the DIRECT mode to enter a logic 1 or 0 onto the data bus at any time or in the ADDRESSED mode only when addressed by the SC/MP. This allows the switches to be used to program the memory in the single step mode or to enter data when required by a program.

Both the data bus and the address bus are connected via wire links to LED lamps. The LED lamps thus show the status of these buses at any stage of the program, the branching and data addressing of the program can thus be checked easily. Alternatively the LED lamps can be linked to other signal lines by redirecting the wire links, they can then be used to show the status of an output device.

A typical input-output device is shown as IC's 15 and 16, two 74C173 latches. These ICs can latch the status of a signal on the inputs so that the outputs carry a copy of that status at a given time even after the original status has disappeared. In the output from SCRUMPI 2 mode the latch can store the data on the data bus at the time that the latch was addressed by the SC/MP. Any data written to the latch will appear on the data bus at the same time as a strobe pulse is output at point 'P' or 'Q'. If the data bus is connected to the inputs of the latch and the pulse used as the clocking strobe to the latch then the data will appear at the outputs of the latch and stay there until the next write to the latch. As an example, some of the LED lamp drivers could be connected to the latch outputs to indicate a particular data output to the operator.

Using the latch for input is a similar operation except that the latch is used the other way round. The outputs are connected to the data bus and the address strobe ('P' or 'Q') is used as the OUTPUT ENABLE control to the latch. Any data in the latch will be read onto the data bus when 'P' or 'Q' is strobed, the data enters the latch via the inputs when the clocking input is pulsed with a logic 0.

The P and Q strobes mentioned above are output from the device decoding circuitry at IC's 17, 18, 19, 20 and 22. This circuitry decodes the addresses specified by the address bus and produces a set of strobes which enable or disable the devices connected to the data bus. Three enable strobes are output to the RAM memories at ICs 5-10, each pair of IC's being enable for Read or Write operation. One enable strobe can be used to enable the outputs from a MM5204 PROM if there is such a PROM at IC21. Output 'P' is enabled if an address in the range × '500' — × '5FF' is addressed, similarly 'Q' is enabled for the × '600' range, either of these strobes can be used to strobe either of the latches for input or output. Strobed output V is normally connected to the ADDRESSED mode of the data switches which means that any data on the switches will be input to the SC/MP when any address in the × '700' range is read.

Examples of microprocessor interfaces to other equipment can be seen in most of the associated hobby magazines and in the 'SC/MP Applications Guide' published by National Semiconductor. ▶

Teaching Your Scrumpi to talk to Outsiders

Some microprocessors are used solely for writing, checking and executing programs, this type is usually to be found in offices handling accounts or stock control. Other microprocessors control equipment and machinery with complex testing and control interface, usually this type of MPU system can be found in vending machines, production lines, complex timing systems, etc. The same microprocessor chip may be found in both types of application but the interfaces to the outside world will be different. In the first type the interfaces will be to printers, keyboard large VDU, floppy disks, etc to handle the collection, sorting and printing of, for example, account details. In the second type the interfaces will be to switches, motors, lamps and buzzers to handle the input of data from various sensors and control machinery accordingly.

Thou Art a You Art

The Universal Asynchronous Receiver/Transmitter is better known as a UART (pronounced You Art) for obvious reasons. Its basic function is to translate the 8 bit data available on the data bus from parallel form to a serial form and vice-versa. The advantage of this idea is that data can thus be transmitted along a single pair of wires rather than the dozen or so wires which would be needed for parallel transmission. Many interfaces to other equipment such as printers, TTYs and telephone use serial transmission to save on wire costs or for convenience if the remote unit is any considerable distance from the MPU.

A transmission starts with the output of the UART at a logic 1 state which is referred to as a MARK condition. Data is written from the data bus into the UART by enabling the Data Strobe input, this immediately signals back to an internal Flip-Flop that the UART transmitter is BUSY and cannot receive any more parallel data at present, in normal practise this Flip-Flop is tested by the MPU software before any attempt to write to the UART; the program loops until the Flip-Flop is reset at the end of the data transmission.

Once the UART has some data to transmit it shifts to the SPACE condition by changing the UART output to a logic 0, this START signal is one bit time long. The time taken to transmit each bit is defined by the rate of the 16x clock input. The frequency input at this pin is divided by 16 to give the bit transmission rate or BAUD RATE.

After sending the START BIT the UART sends each of the data bits in sequence as a MARK or a SPACE condition for 1 bit time each. To ensure that the START BIT of the following byte of data will be recognised by a receiving UART the transmitter now outputs two STOP BITS which are denoted by a MARK condition for two bit times, thus the total number of bits transmitted is not 8 but 11 made up from the 8 bits of data plus a START and two STOP bits.

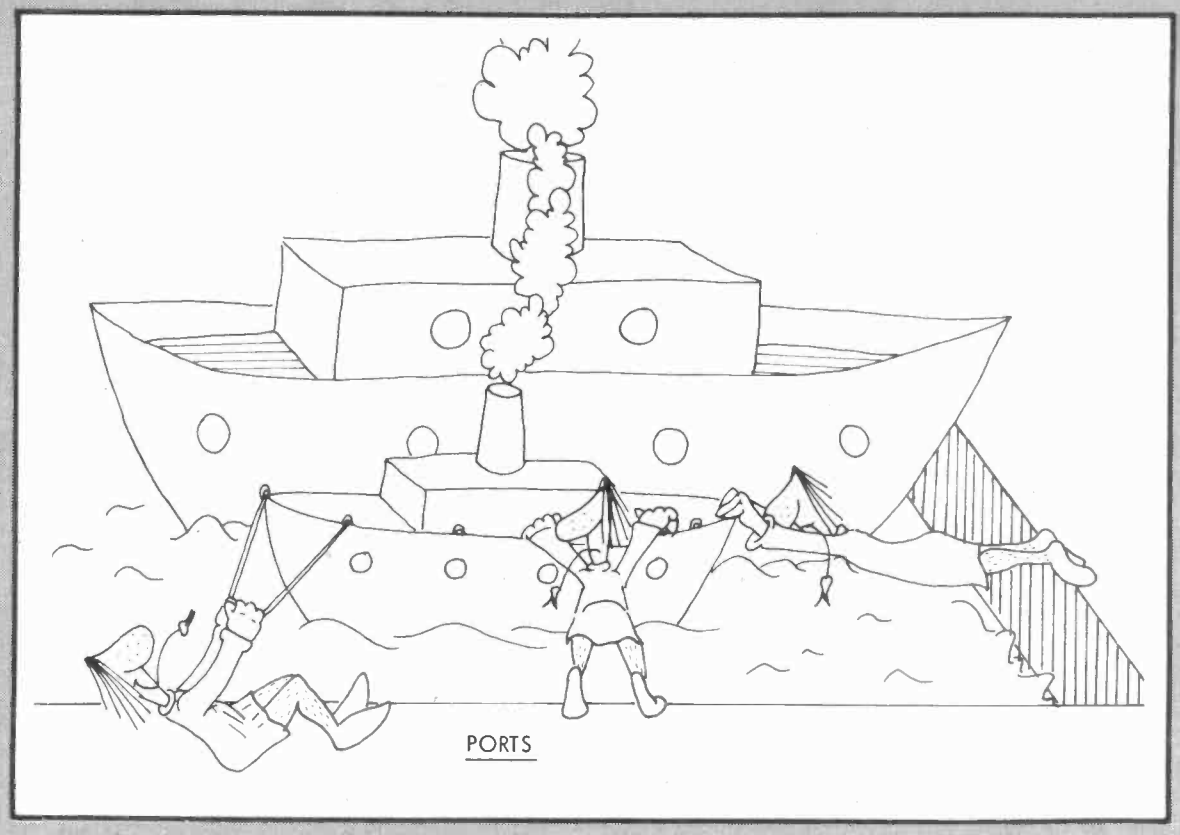
In the receive mode the UART looks at its input pin continuously and waits for it to go from MARK to SPACE condition to indicate a START bit. After doing various checks to ensure validity the UART will then read in the 8 data bits and verify the presence of at least one STOP bit. On receipt of the first STOP bit the Data Available Flip-Flop is set to indicate to the MPU that parallel data is available, the MPU can now read this data and release the receiver by Resetting the Data Available (RDAV) Flip-Flop.

The UART thus handles most of the data shifting, verification transmitting and receiving. The UART is even clever enough to handle both transmitting and receiving at the same time — this is referred to as FULL DUPLEX MODE, using a UART solely for either transmission or reception is known as SIMPLEX MODE.

Serial Standards

There are a set of standards associated with serial data transmission and used by many manufacturers in peripheral equipment. The usual one is the 'Teletype' TTY interface working at 110 Baud over a 20 mA current loop. The 110 baud refers to the bit transmission rate of 110 bits per second, when a UART is used, this rate will transmit 80 data bits or 10 bytes per second. The 20 mA current loop refers to an interface system in which the presence or absence of a current loop defines whether a MARK or SPACE is being transmitted, a lot of TTY equipment still uses relays and switches as an interface where thus the circuit is either open or completed, the current loop is inherited from this type of equipment.

An external printer might require a 1200 Baud RS232 interface, again the 1200 baud refers to the bit transmission rate of approximately 100 bytes per second. The RS232 interface is based on voltage levels and is usually something simple such as MARK = +3v and SPACE = —3v with respect to a common ground wire.



London, Liverpool and TTL

Just as London and Liverpool are ports allowing goods to enter and leave the country so an MPU port allows data to enter and leave the MPU. A port is usually assumed to be 8 bits wide, that is it will carry 8 parallel bits of data into out of the MPU and in the case of the usual 8 bit MPU the port interface directly to the data bus.

To the MPU the port looks like a single address location at which it can read or write data, the MPU addresses the port physically by decoding a unique address strobe from the address bus. Any time that this address is accessed the strobe will become active and thus inform the port that it is being accessed and should thus take appropriate action.

To the engineer and to external equipment the port looks like an 8 bit TTL latch. When used for output the data on the MPU data bus is latched into the port and thus appears latched at the port output pins, from here onwards these outputs can be assumed to have come from any similar TTL type of device. When used for input the port becomes an 8 bit latch presenting its inputs to the external circuitry, usually one of the inputs or an additional control pin acts as the clocking input. Data is presented to the port inputs and latched by strobing the clock input, the data at the inputs can now be released as the data is now held in the port. At ther same time the MPU is informed (or finds out for itself) that there is new data in the port, it can thus 'read' the port address which will enable the port output to deposit their data onto the data bus and thus into the MPU chip. In applications of this type the MPU would then signal to the port that it had read the data and that the port could now input some more, this sequence of ''I've got some data for you'' ''thank you, I've read it'' is called 'Handshaking'.

The two theoretical ports described above are assumed to work in only one direction in each circuit. Some of the newer port chips are bi-directional which means that under software control they can either read data from external devices or write to external devices. The latest port chips allow individual bits to be specified as input or output by the software and can thus be changed halfway through a program. ETI

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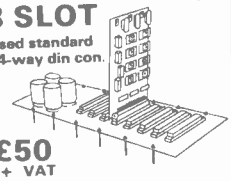

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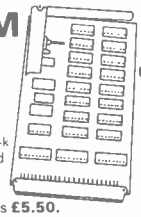

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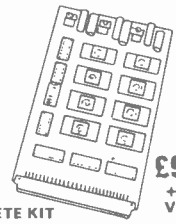

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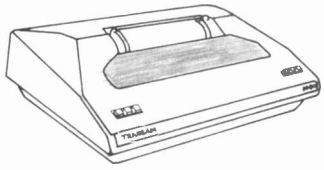

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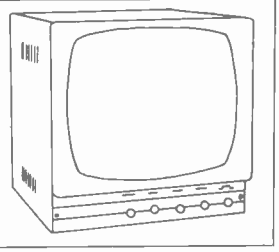

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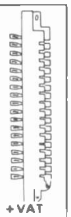

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L4 1 Listing + listing of 1k monitor + 2k tiny basic	£4.20
L5 1 user documentation on level 5-1 firmware	£1.20
L5 1 Listing + listing of 1 5k monitor and 2 5k basic	£5.20
L6 1 User documentation on 7k basic interpreter	£1.70
Motherboard, 8k Ram and 8k Eprom constructional details	£5.00

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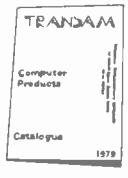

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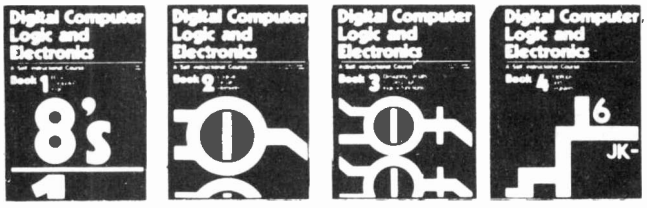

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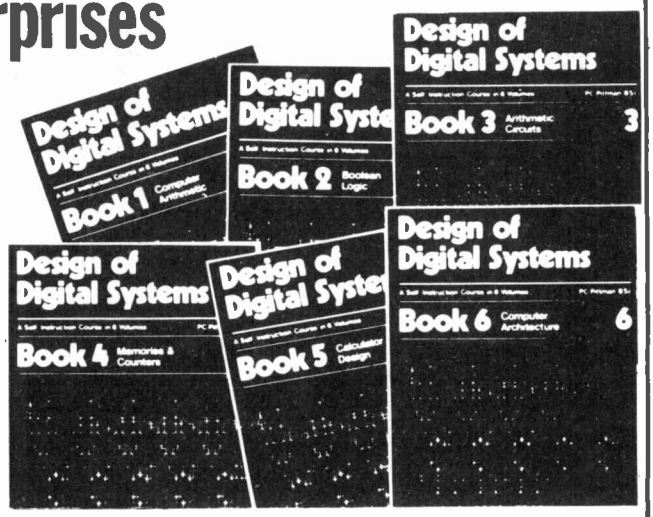

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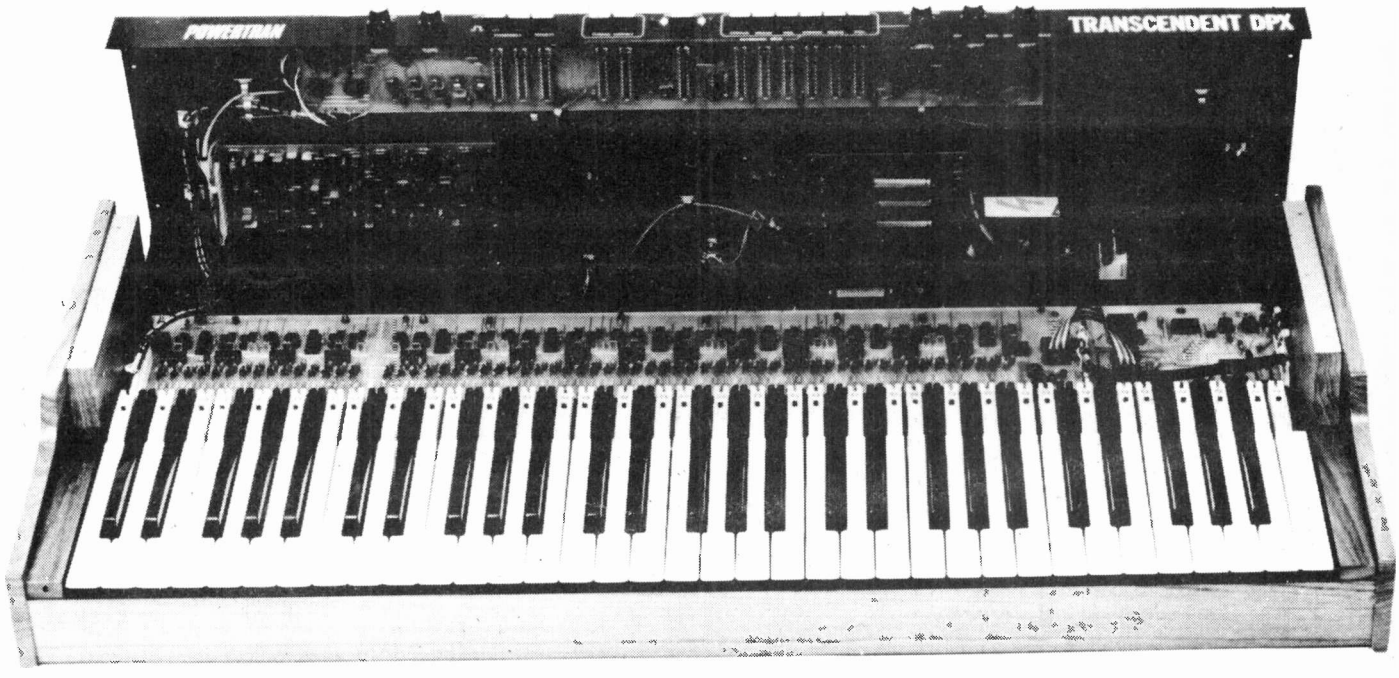
STRING THING



We continue this month with Part 3 of the String Thing Saga (Son of Part 2 from Tim Orr. For those of you who missed Part 2, String Thing, otherwise known as the Transcendent DPX, is a digital, polyphonic, multi-voice keyboard instrument. (We suspect it probably makes marvellous coffee too.)

Voicing is one of the stronger parameters that goes to characterise generated sound structures. The sounds in the DPX are built out of the same basic components, asymetric squarewaves. The envelope contour is different for each type of instrument and vibrato can be added to emphasise the 'string' sound. However, all the voices, if they were left unfiltered would sound very much the same. But, by filtering the signals, it is possible to add a great deal of information to the sound structure. It must be remembered that natural instruments always sound very different from electronically produced ones, this being due to the incredibly complex structure of most instruments. If you have the opportunity to observe the low notes of a piano on an oscilloscope you will be amazed at the complexity of the signal.

BUYLINES

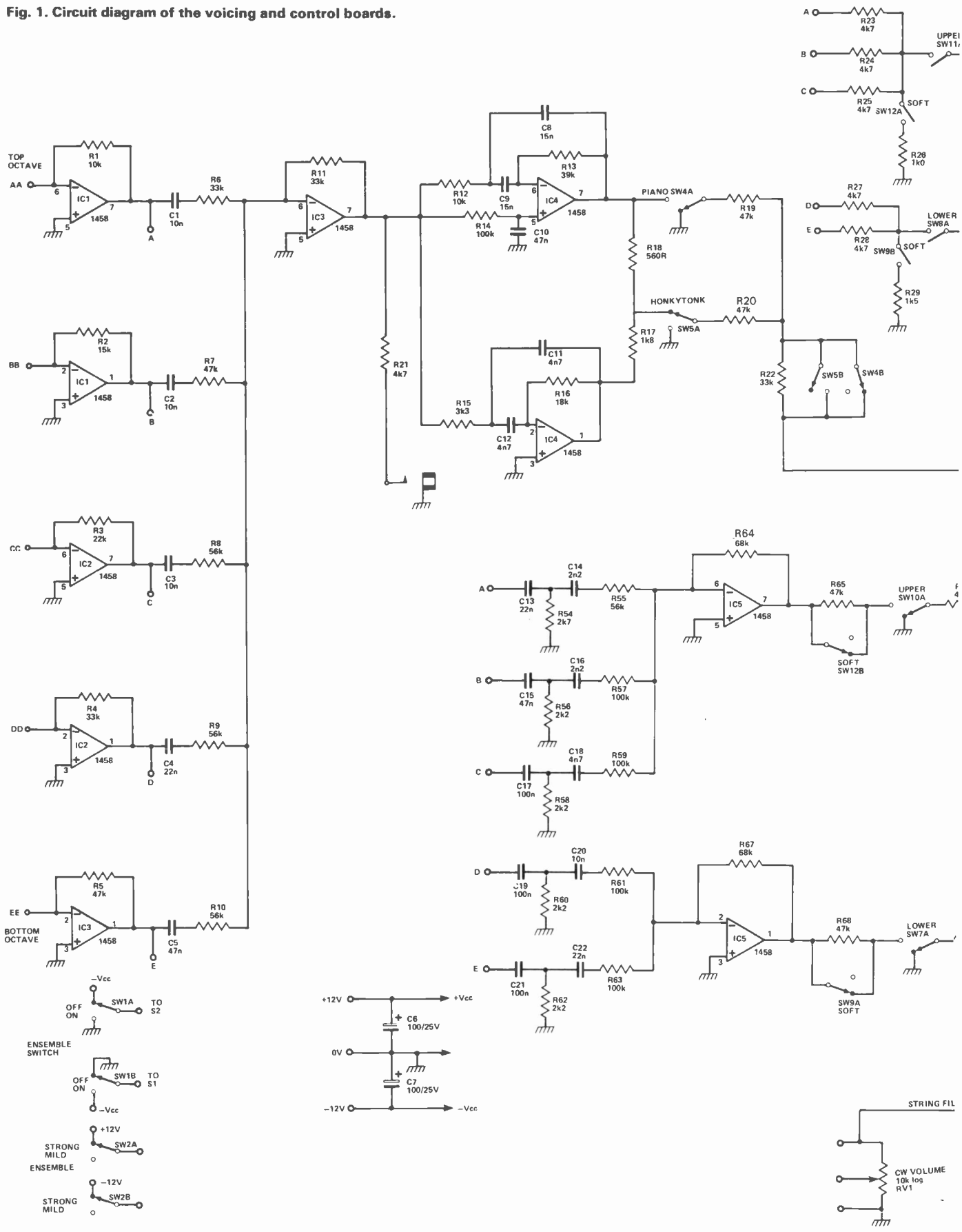
Powertran Electronics are supplying a complete kit of parts for this project at £365+15% VAT. Delivery by Securicor is £2.50 extra. Everything is included in the kit, down to the last nut and bolt. They even give you a plug.

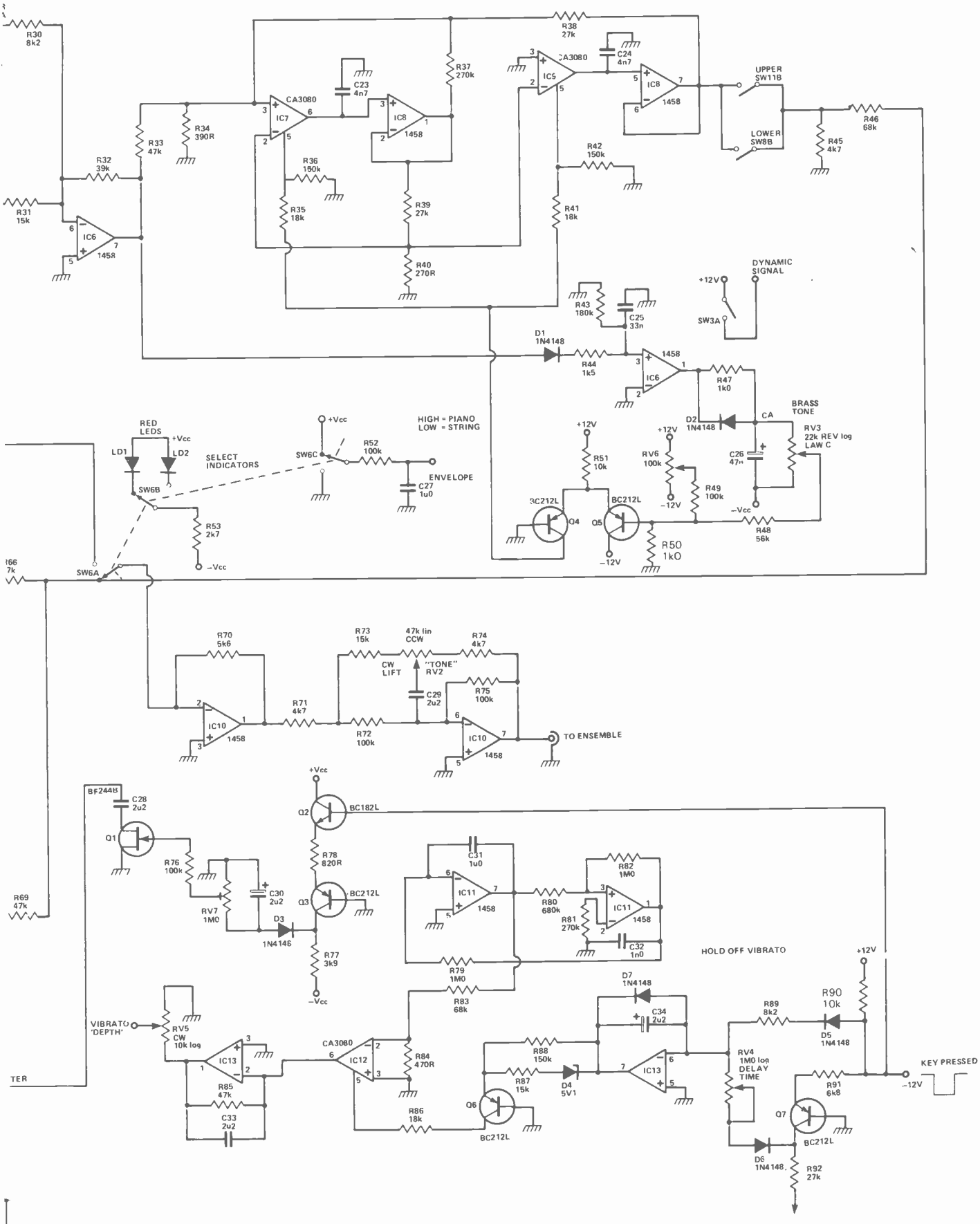
Powertran will also supply components, boards, etc separately. Please send an sae for details.

Part 3: This month we bring you details of the String Thing's control circuitry and inter-board wiring.

Part 4: Next month we conclude String Thing (no, we really mean it this time) with details of the power supply and dynamics boards, and the final constructional details to sort out your nuts and bolts.

Fig. 1. Circuit diagram of the voicing and control boards.




R30 8k2
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R45 4k7
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CA3080 IC7
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R42 150k
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C26 47u
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BC212L Q5
R49 100k
-12V
-Vcc
R48 56k
R50 1kO
R70 5k6
R73 15k
47k lin CCW
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IC10 1458
R71 4k7
R72 100k
IC10 1458
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BF244B
C28 2u2
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R78 820R
Q3 BC212L
R76 100k
RV7 1M0
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D3 1N4148
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-Vcc
R69 47k
C31 1u0
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R82 1M0
R80 680k
R81 270k
IC11 1458
C32 1n0
R79 1M0
R83 68k
HOLD OFF VIBRATO
+12V
D7 1N4148
C34 2u2
R89 8k2
R90 10k
D5 1N4148
VIBRATO 'DEPTH'
RV5 CW 10k log
IC13
CA3080 IC12
R84 470R
R88 150k
R87 15k
D4 5V1
IC13
RV4 1M0 log DELAY TIME
KEY PRESSED
R91 6k8
-12V
R85 47k
C33 2u2
R86 18k
Q6 BC212L
Q7 BC212L
D6 1N4148
R92 27k

HOW IT WORKS

Each octave of the keyboard is mixed together on the main note generating board. These five octave blocks of signals are fed into virtual earth amplifiers (IC1,2,3) which serve to correct the signal amplitudes. By careful circuit design and layout it is possible to reduce this breakthrough to 70 or 80 dB down on the individual note generating circuits, but the overall effect of 61 circuits, each contributing a slight amount, makes the overall background chorus much worse. Some organs are particularly bad with a performance of about 30 to 40 dB.

The signals from the input amplifiers are then split up and sent to various voicing circuits. The piano/honky-tonk section doesn't have a split keyboard option and so it is driven directly by the sum of all the octave signals. The piano voicing (IC4, pins 5,6,7) is a bandpass filter with a centre frequency of 500 Hz and a Q factor of 1. A slight low frequency lift has been added via R14,C13. This provides moderately pure sinusoids at the top end of the keyboard and much richer sounds at the low end. To obtain the honky-tonk sound, a second resonance is added (IC4, pins 1,2,3) at 5 kHz. This makes the sound much brighter.

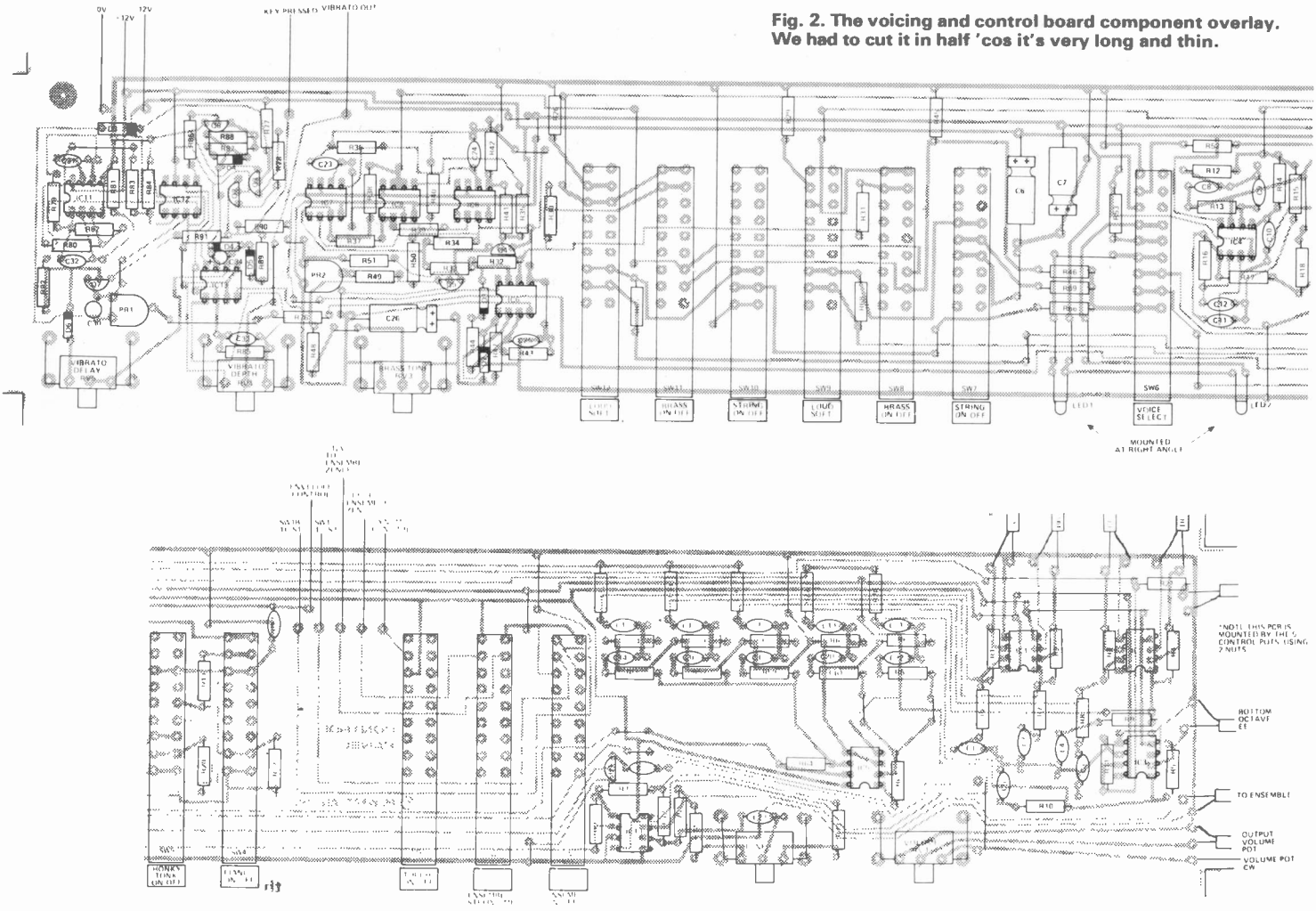
The brass voice is a peaky low pass filter (IC6,7,8,9). The filter is swept up in resonant frequency when a note is played, which greatly helps to characterise the brass sound. A tone control (RV3) determines the depth of the sweep. Switches SW11a and SW8a select the upper and lower sections of the keyboard and switches SW12a and SW9b attenuate the signal level when the 'SOFT' mode is selected. The filter is tuned with a pair of CA3080's. As the current into their control input (pin 5) is increased, the resonant frequency of the filter is also increased. This current is generated by IC6, pins 1,2,3. When a note is played, the output of the op amp goes high, which is lowpass filtered by R47,C26. This voltage is used to sweep the brass filter via the common emitter pair Q4,Q5. PR2 is adjusted so that the filter sweep sounds correct.

The string voice (IC5) is composed of a set of high pass filters. The string sounds can be selected on upper and lower manuals (SW10a, SW7a), and there are also soft mode switches (SW12b, SW9a).

To reduce the effects of background and chorus/ensemble noise, a FET switch (Q1) is used to mute the output signal. When a note on the keyboard is pressed, the key-pressed signal goes low. This causes the collector of Q3 to fall to —12 V which turns off Q1. In this state the output signal is not muted.

When the note is released, the collector of Q3 goes high. D3 is then reverse biased and the voltage on the gate of Q1 moves towards 0 V with a time constant of C30. PR1, which is selected to be slightly longer than the longest time constant of any note on the keyboard. As the gate voltage of Q1 approaches 0 V, Q1 turns on and mutes the output signal. RV1 is adjusted so that, with a key pressed, no attentuation is produced by Q1. The key-pressed signal is also used to start the hold-off vibrato circuit. IC11 is a Schmitt trigger/integrator oscillator which produces a low frequency triangle waveform (pin 7). This signal is fed into a CA3080 (IC12) which distorts the triangle by bending it into a sinewave shape. A buffer (IC13) is used to amplify and filter the 'sinewave' which is then used to modulate the master oscillator. The size of the sinewave is controlled by the current flowing into pin 5 of IC12. This current has a delay time constant which is determined by RV5. When a key is pressed, the collector of Q6 goes low and so C34 is charged up via RV5. The voltage on the end of C46 determines the current flowing into pin 5 of IC12. When the key is released, the collector of Q6 goes high and so C34 is discharged via R89,D5.

Fig. 2. The voicing and control board component overlay. We had to cut it in half 'cos it's very long and thin.



PARTS LIST

RESISTORS all ¼W 5%

R1, 12, 51, 90	10k
R2, 31, 73, 87	15k
R3	22k
R4, 6, 11, 22	33k
R5, 7, 19, 20, 33, 65, 66, 68, 69, 85	47k
R8, 9, 10, 48, 55	56k
R13, 32	39k
R14, 49, 52, 57, 59, 61, 63, 72, 75, 76	100k
R15	3k3
R16, 35, 41, 86	18k
R17	1k8
R18	560R
R21, 23, 24, 25, 27, 28, 45, 71, 74	4k7
R26, 47, 50	1k0
R29, 44	1k5
R30, 70, 89	8k2
R34	390R
R36, 42, 88	150k
R37, 81	270k
R38, 39, 92	27k
R40	270R
R43	180k
R46, 64, 67, 83	68k
R53, 54	2k7
R56, 58, 60, 62	2k2
R77	3k9
R78	820R
R79, 82	1M0
R80	680k
R84	470R
R91	6k8

POTENTIOMETERS

RV1, 4	10k log
RV2	47k lin
RV3	22k log
RV5	1M0 log
PR1	1M0 preset horiz.
PR2	100k preset horiz.

CAPACITORS

C1, 2, 3, 20	10n polyester
C4, 13, 22	22n polyester
C5, 10, 15	47n polyester
C6, 7	100u 25V electrolytic
C8, 9	15n polyester
C11, 12, 18, 23, 24	4n7 polystyrene
C14, 16, 29	2n2 polystyrene
C17, 19, 21, 27, 31	100n polyester
C25	33n polyester
C26	47u 25V electrolytic
C28, 33	220n polyester
C30	22n 35V tantalum
C32	1n polystyrene
C34	2u 2 35V tantalum

SEMICONDUCTORS

IC1-6, 8, 10, 11, 13	1458
IC7, 9, 12	C43080
Q1	BF244B
Q2	BC182L
Q3-7	BC212L
D1-3, 5, 6, 7	1N4148
D4	5V1 zener
LED1, 2	0.2 inch red

MISCELLANEOUS

PCB, PCB-mounting push-switches (12 off), 8-pin DIL sockets (13 off)

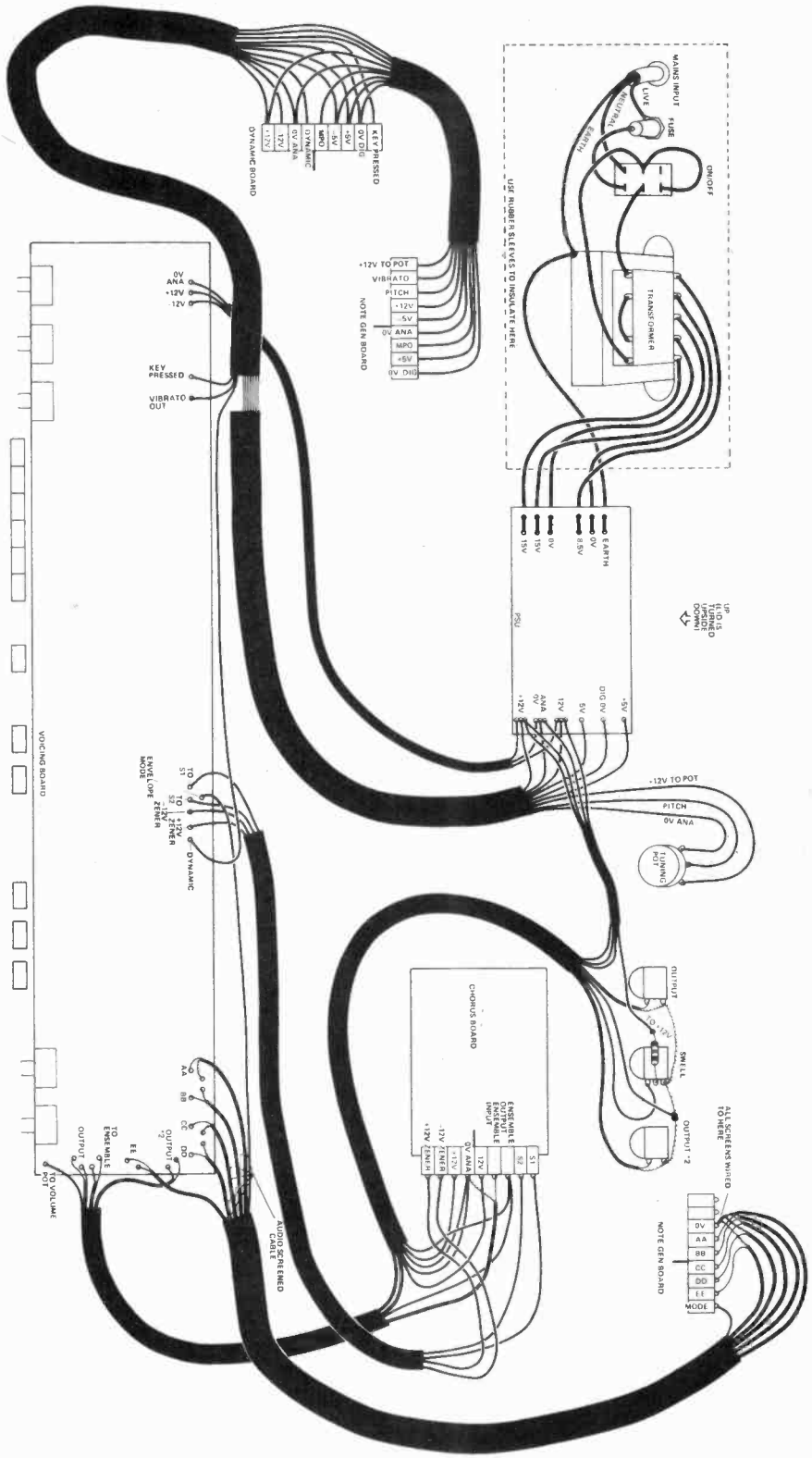


Fig. 3. When you've got your boards finished, this is how they go together.

ETI MARKET PLACE

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This is no ordinary watch. It's a slim, multi-function, dual time LCD alarm chronograph.
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RAVEN ON...

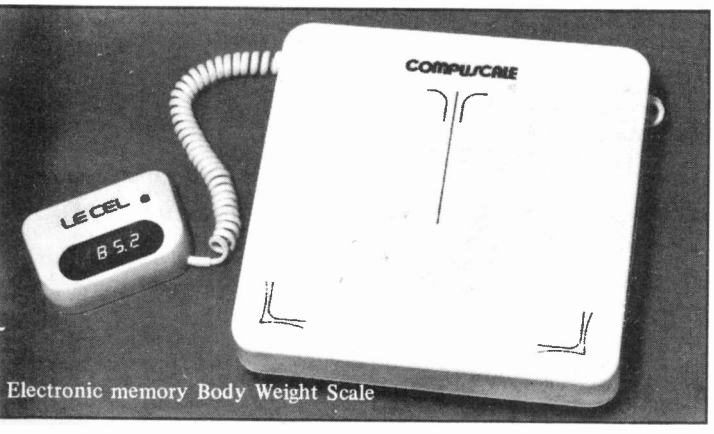
This month's little ramble takes us through foam backed carpets into flat tellys by Sinclair and the best LCD displays in the world — British!

PREDICTIONS OF the effect microprocessors will have in the home are still being made. However, it looks as though 1979 will see the first really domestic products starting to appear. Home Computing is now well established among electronics hobbyists, but the effect of MPU's is not so obvious to people outside the electronics arena. As with the other new technologies the novelty attractions are the first areas to be exploited. Calculators and LED watches were the first to appear using an LSI it has taken a further three to four years of serious product design to incorporate devices into industry.

Open Door

On the market in time for Christmas we shall see a whole new range of products that are only possible because of microprocessors. The now familiar twenty four tune door bells are being manufactured in Hong Kong along with new programmable TV Games that function like flight or vehicle simulators, coming complete with steering wheel. Hand held electronic pocket games, remote control cars and robots also the very sophisticated watches like the Seiko Memory Bank.

One further consumer product now available because of MPU's is the electronic bathroom scale.



Electronic memory Body Weight Scale

This is of particular interest to me since I demonstrated a prototype to my Bank Manager back in 1975, when I had illusions of building a manufacturing complex the size of Plessey. The instrument was an adaption of a small capacitance meter my company was manufacturing and used a novel form of transducer.

It comprises of layers of foam backed carpet separated by layers of tin foil. The capacitance changed quite linearly when the mat was stood upon however I have no doubt that it may not have stood the test of time. The Bank Manager was very impressed but there was a noticeable lack of enthusiasm when it was suggested that he invest the bank's money in the project. With hind-sight he was a very sensible chap since it is unlikely he would have won the support of his own boss in backing the project with the kind of money necessary to launch such an enterprise.

This major difficulty that companies experience in the UK is the main reason that new high volume consumer products are eventually manufactured in the Far East where large sums of development capital exists and also the huge export markets which soak up the bulk volume of these products.

Thousands of words have now appeared in print about minicomputers and the uses of MPU'S.

In fact you could quite easily form the impression that the only new developments taking place in electronics was associated with logic applications. This of course is nonsense and is a misconception that has arisen due to the fashionable use of words in science. One immediate consequence of these trends is that unless a scientist or development engineer can some how design a microprocessor into his proposals then he has less chance of winning the support of financial backers.

Material Gain

Electronics enthusiasts generally know about silicon (or the ''silicon chip'' as they say on telly) but you never hear Robin Day or Angela Ripoff talk about, Zinc Selenide on Germanium chips, Gallium Arsenide chips or silicon on saphire chips.

Gallium Arsenide is an important semiconductor material. It is not particularly new since its been in use for making devices since the early sixties, Gunn Diodes, Light Emitting Diodes, Varactor Diodes and Field Effect Transistors.

FET's are probably the most exciting development coming from Gallium Arsenide since these transistors can operate at very high frequencies and are increasingly being used in satellite and space communications. Gallium Arsenide FET's (GaAs FET's) have been around for several years the first devices were made by Plessey ten years ago and it has taken all this time to establish the technology to a sufficient level for volume production. Many other companies around the world are also making GaAs fets now and you would currently have to pay in the region of £100 for a FET that will operate at about 18 GHz., (Imagine how it feels to blow one up). The likely effects of GaAs FET's in the next few years are to be seen in the communications field. Computer controlled cars with microwave eyes which can see in all weathers, C.B. Radio using satellites for communications, Digital watches or calculators with CB Radio why not?

Switch Called For?

One area of computerisation I am aprticularly looking forward to is a computer controlled electronic switchboards. Telephone calls to companies out of office hours

quite frequently result in the callers being talked to by a phone answering machine. The recording is usually a flat monotone voice which immediately makes the caller feel uncomfortable and results in the phone being hung up. One answering machine story I know was a farmer who because he couldn't get a sensible reply from the recorder shouted a stream of abuse down the telephone and cancelled his contract for fuel oil, with the unsuspecting supplier. To tackle just such problems as abusive farmers there is now a computer controlled switchboard that can answer up to eight telephones lines at once. The computer has a voice recognition system and also a small vocabulary for replies.

A comparison method technique based on statistical analysis of spoken words is used. The machines vocabulary is assembled by taking 500 samples of one word spoken in different dialects from male and female speakers. Each word is sampled 12 times and each sample's overall amplitude is measured and its frequency spectrum plotted at 31 points between 300 and 3k3 hertz. This produces 384 numbers, or elements that describe the word.

The elements resulting from all 500 speakers saying the same word are combined to produce a set of 384 mean values and standard deviations, which are stored in the system as the reference for that word, the incoming unknown word is similarly sampled, analysed and compared element by element with reference words using an algorithm that finds the probability density function for the unknown word. When this probability density is above a certain threshold — which can vary from word to word or system to system — the system declares the word recognised

Sinclar Flat Telly

More information is now available on the flat screened television mentioned in the September edition of ETI. The technology used is that of the conventional CRT and not liquid crystal that the Japanese are going for. The method described is a conventional cathode ray tube which is flat since the beam is projected at right angles to the screen instead of from the back as in a conventional TV.

Glassy Eyed

Two sheets of glass form the front screen and a vacuum formed backing plate. The interior of the backing plate is coated with phosphor and is viewed through the front face from the same side as the electrons strike. The result is that the brightness is more than double that of a conventional CRT. Electrostatic deflection plates in the gun assembly provide horizontal and vertical scanning, and a third set between the phosphor screen and front-face bends the electron beam toward the screen. Without this additional focussing field, the angle of beam incidence would vary across the screen, spreading the beam spot into an ellipse. The focussing electrode is formed on the front face by a transparent tin-oxide coating.

The electron gun is set to one side of the screen with its axis parallel to the screen.

Folding the electron optics would normally distort the raster scan to produce a wedge shape with curved vertical edges, however, by using optical techniques corrections for distortion can be made.

Screen Test

The screen height is reduced by half but the width is kept constant. This narrows the angle subtended by the electron beam onto the screen reducing distortion and deflection power. The picture height is restored by use of a Fresnel lens which is formed in a flat plastic face plate.

The assembly techiques used in producing the new CRT lend themselves to mass production and it is aimed by Sinclair's to set up a new factory for this purpose.

Coincidently, news of a new imaging system with potential for use as a flat screen TV has been patented in Britain.

New Visions

This system uses techniques not unlike those described in this column in September ETI and consists of liquid crystal technology. Two flat screens contain arrays of very thin parallel stripes placed at right angles to each other.

With a electroluminescent or other type of translucent panel behind the liquid crystal screens, light would only be visible at the intersections of the stripes, if these were switched accordingly.

By switching at a very high speed a scanning effect could be achieved as in a conventional TV.

Light could be modulated by altering the intensity of the light panel or by polarising the screens. Filters could also be incorporated for colour operation. ETI

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C3.9	.11	1N4733A 5.1	.23	C12	.67	C180	.92
C4.3	.11	1N4734A 5.6	.23	C13	.67	C190	.92
C4.7	.11	1N4735A 6.2	.23	C15	.67	C200	.92
C5.1	.11	1N4736A 6.8	.23	C16	.67		
C5.6	.11	1N4754A 39	.25	5 WATT	BZV40	20 WATT	BZY93
C6V2	.11	1N4755A 43	.25	C10	.83	C10	1.05
C6V8	.11	1N4756A 47	.25	C11	.83	C11	1.05
C7V5	.11	1N4757A 51	.25	C12	.83	C12	1.05
C8V2	.11	1N4758A 54	.25	C13	.83	C13	1.05
C9V1	.11	1N4759A 62	.25	C14	.83	C15	1.05
C10	.11	1N4760A 68	.25	C15	.83	C16	1.05
C11	.11	1N4761A 75	.25	C16	.83	C18	1.05
C12	.11	1N4762A 82	.25	C17	.83	C20	1.05
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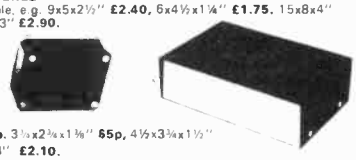

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2N2411	.80	2N2905	.31	2N3134	.85	40361	.55	40513	1.60	BC322	.19	BD243A	.65	BF178	.27
2N2412	.80	2N2905A	.31	2N3135	.72	40362	.55	40514	1.60	BC327	.20	BD243C	.87	BF179	.33
2N2477	1.10	2N2906	.25	2N3136	.91	40363	1.45	40557	.66	BC328	.20	BD244A	.70	BF180	.37
2N2483	.30	2N2906A	.25	2N3232	1.50	40364	1.45	405a3	1.50	BC337	.20	BD244C	.87	BF181	.37
2N2484	.30	2N2907	.25	2N3242	.68	40372	1.15	40s59A	.50	BC338	.20	BD245A	.69	BF182	.37
2N2491	2.40	2N2907A	.25	2N3242A	.90	40373	1.65	BC256/A/B	.29	BC347	.11	BD245C	.85	BF183	.44
2N2613	.90	2N2920	3.30	2N3250	.33	40374	1.65	BC257/A/B	.18	BC350	.11	BD246A	.72	BF184	.41
2N2614	.70	2N2923	.17	2N3251	.39	40389	.70	BC258/A/B/C	.18	BC382	.21	BD246C	.93	BF185	.37
2N2613	.90	2N2924	.17	2N3300	.45	40390	1.05	BC259/B/C	.19	BC382L	.21	BD249A	2.40	BF194	.16
2N2614	.70	2N2925	.19	2N3301	.45	40391	.90	BC260	.17	BC383	.19	BD249C	3.00	BF195	.16
2N2646	1.70	2N2926	.17	2N3302	.39	40392	.70	BC261 A/B	.25	BC383L	.19	BD250A	2.75	BF196	.16
2N2647	1.55	2N3010	1.10	2N3367	1.35	40394	.90	BC262/A/B/C	.26	BC384	.21	BD250C	3.40	BF197	.18
2N2696	1.35	2N3011	.37	2N3390	.50	40395	1.45	BC263/B/C	.26	BC384L	.21	BD433	.44	BF198	.19
2N2711	.30	2N3012	.37	2N3391	.40	40396	1.45	BC264	.65	BC407	.27	BD434	.46	BF199	.19
2N2712	.18	2N3013	.37	2N3391A	.45	40406	.73	BC266/A/B	.34	BC408	.27	BD435	.46	BF200	.38
2N2713	.25	2N3015	.47	2N3392	.17	40407	.57	BC300	.43	BD236	.44	BD436	.46	BF224J	.22
2N2714	.22	2N3019	.55	2N3393	.17	40408	.82	BC301	.43	BD237	.44	BD437	.55	BF225J	.27
2N2848	1.10	2N3020	.75	2N3394	.17	40409	.82	BC302	.37	BD238	.44	BD438	.55	BF238	.55
2N2865	2.20	2N3053	.25	2N3395	.19	40410	.82	BC303	.54	BD239A	.44	BD441	.44	BF240	.24
2N2890	2.50	2N3054	.72	2N3396	.19	40411	3.10	BC304	.60	BD239C	.59	BD442	.44	BF241	.24
2N2891	2.50	2N3055	.75	2N3397	.19	40412	.68	BC307/A/B	.16	BD240A	.49	BD529	.49	BF244A	.38
2N2892	10.00	2N3107	.55	40326	.60	40414	4.99	BC308/A/B	.16	BD240C	.59	BD530	.55	BF244B	.33
2N2894	.50	2N3108	.75	40327	.73	40422	2.20	BC309/A/B/C	.16	BD241A	.49	BD535	.70	BF245A	.44
2N2903	1.60	2N3109	.80	40348	1.10	40440	.70	BC317	.15	BD241C	.65	BD536	.70	BF245B	.44
2N2904	.31	2N3119	4.00	40349	1.45	40467A	1.05	BC318	.14	BD242A	.55	BD537	.74	BF246A	.82

BF246B	.82	BSX61	.53	ME1100	.22										
BSX76	.60	ME1120	.27												
BSX77	.60	ME3002	.27												
BSY10	1.10	ME4001	.16												
BSY24	.52	ME4002	.16												
BSY25	.65	ME4003	.16												
BSY26	.55	ME4101	.11												
BSY27	.55	ME4102	.11												
BSY28	.44	ME4103	.11												
BSY29	1.10	ME4104	.11												
BSY38	.33	ME6001	.16												
BSY39	.33	ME6002	.16												
BSY51	.33	ME6003	.16												
BSY52	.33	ME6101	.22												
BSY53	.33	ME6102	.22												
BSY54	.36	ME8001	.22												
BSY65	.45	ME8002	.22												
BSY78	1.00	ME8003	.22												
BSY79	1.42	ME9001	.22												
BSY95A	.37	MR9002	.22												
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ME0461	.27	MJ430	1.45												
ME0462	.27	MJ481	1.70												
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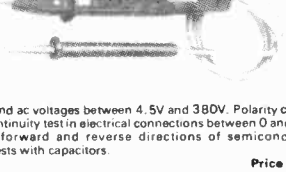

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	Burglar Alarm	
	GSR Monitor	
015	UFO Detector	July 78
	Torch Finder (twice)	July 78
	Etiwet (twice)	Aug 78
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017	Complex Sound Gen	Oct 78
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018	RF 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
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	Tape Noise Limiter	
	Light Tacho	
022	Logic Trigger	Mar 79
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	Headlight Delay (x2)	
023	Click Eliminator	
	Guitar Effects Unit	
	(2 boards)	
023A	Wind Speed Indicator	April 79
024A	Ambush (Boards 2 & 3)	April 79
	Car Immobiliser	May 79
024B	Ambush (Board 1)	
	Headphone Amplifier	May 79
	Double Die	
025	Metronome	June 79
	Mains Seeker	
	Triton 8K Eprom Card	
026	Motor Speed Controller	
	(2 Boards For Controller)	July 79
	Battery Indicator	
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	Rev. Monitor	
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	Bench Supply, Oscillator	
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	Ultrasonic Switch (2 boards)	
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	(topside pattern)	
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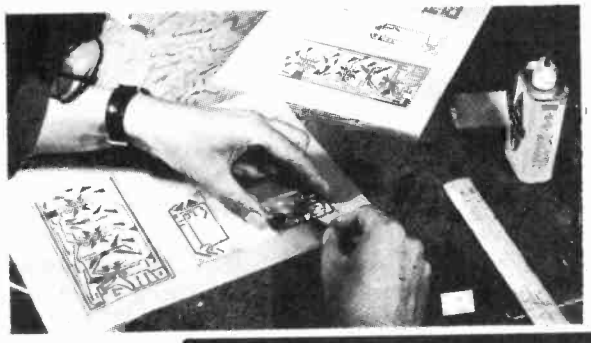

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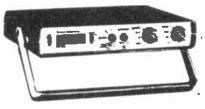


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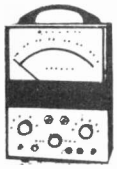
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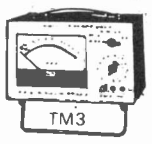
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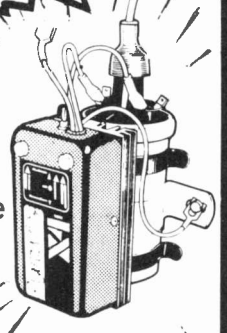

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AUDIO COMPRESSOR

Increase your talk power and improve legibility with this ETI Project team design that avoids the complication of RF clipping!

THE HUMAN VOICE varies considerably in level, even when one is speaking in a normal conversational voice. The peaks are considerably higher than the lower levels, which can give rise to problems when the speech waveform is being modulated onto a carrier by a transmitter. For example, if the mic gain control is set so that the peaks are just giving 100% modulation, then soft sounds can barely be heard, whereas if the gain is turned up to give a higher level on vowel sounds, etc., then plosives (p-sounds) will give overmodulation and consequent splattering and poor speech quality.

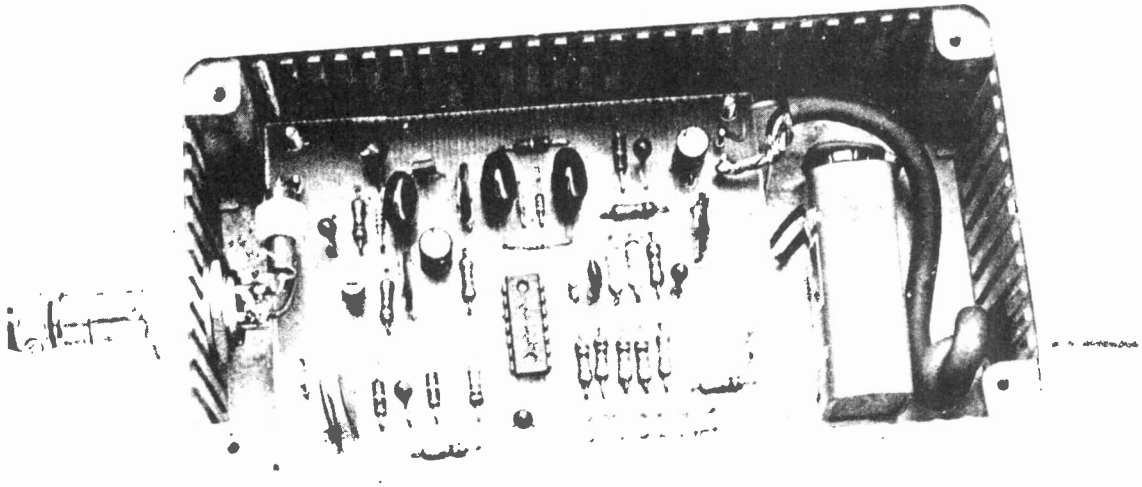
A higher ratio of average power to peak voltage can be achieved by several methods, including compression or clipping of the audio signal and compression or clipping of the radio frequency signal. Radio frequency compression or ALC (automatic level control) is often used in the final states of SSB transmitters.

Radio frequency clipping is the most effective method of increasing the average power; however it requires complex circuitry, since it is necessary to generate an SSB signal, clip, and then insert this signal into the transmitter IF chain.

Almost as effective as RF clipping is a combination of audio compression, clipping and filtering, which is relatively simple and can realise an improvement in signal to noise ratio of up to 5 dB on weak signals.

Compression

When speaking into a microphone it is desirable to keep the voice level as constant as possible. This can be quite difficult as any change in the distance to the microphone will cause a drastic change in its output. To overcome this a variable gain amplifier can be used which senses the average speech level and adjusts its gain accordingly for a constant output voltage. The compressor operates with a fast attack (gain reduction) and a slow decay (gain increase), to quickly respond to the voice while remaining at this level to prevent amplification of background noise during speech pauses. ▶



Inside view of the Processor. The RF choke should be mounted as close as possible to the input socket.

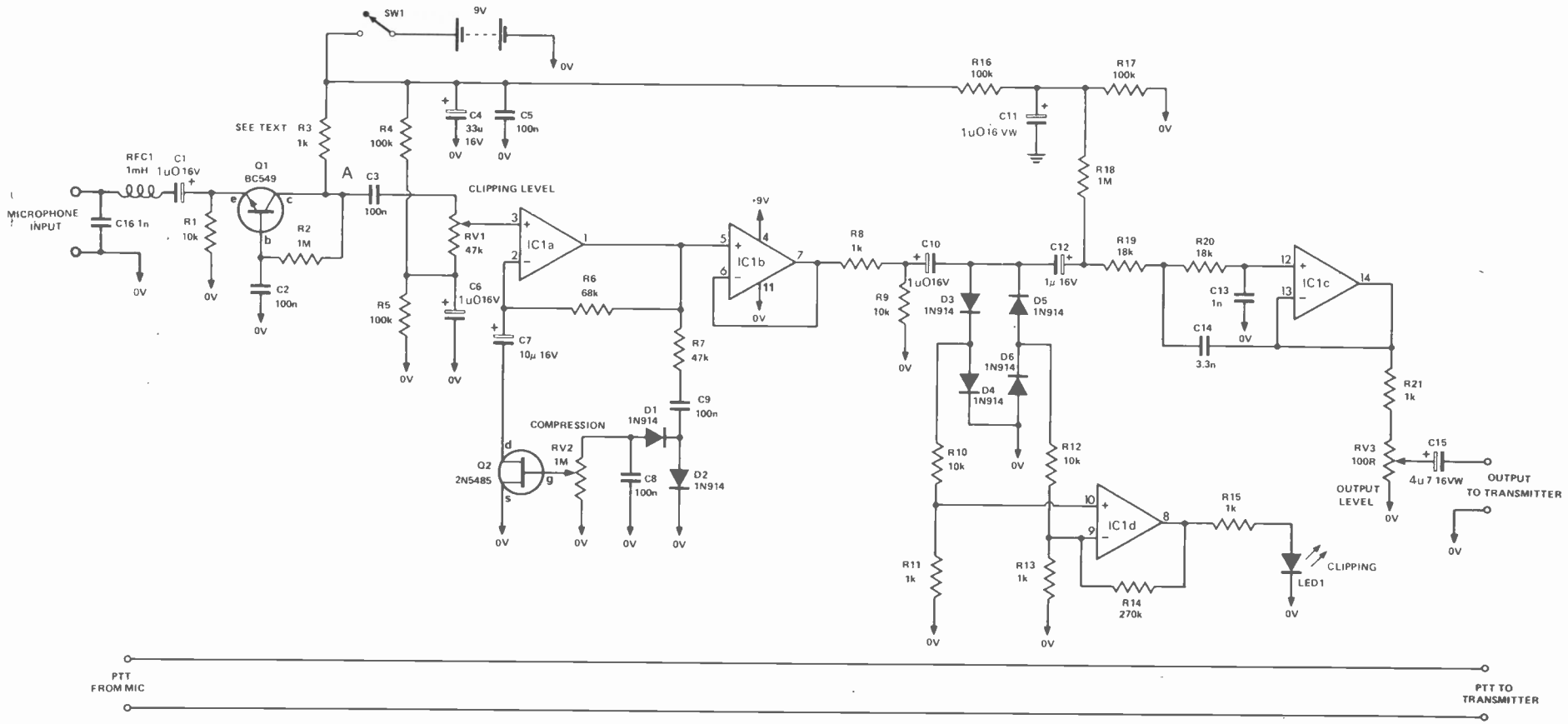


Fig. 1. Circuit of the speech processor.

HOW IT WORKS

The input is fed to a common base amplifier (Q1) and then to the gain control, RV1. The signal is then further amplified by IC1a. Some of the output from IC1a is rectified and negatively charges C8. This voltage is then fed to Q2, a depletion mode N — channel FET. As the output of IC1a increases the voltage on the gate increases negatively and the impedance of Q2 increases. This increases the ratio of the feed back signal applied to the negative input of IC1a and the overall gain is reduced. The attack time is set by the time constant of R7 and C8, while the decay time is set by RV2 and C8.

IC1a is a buffer to isolate the peak limiter from the compressor input. R8 limits the output current of IC1b on peaks while R9 provides output bias current to prevent crossover distortion in the LM324 when driving capacitive loads. The diodes D3-D6 form the peak limiter by shorting any signal over about 1V5. When clipping occurs the voltage across D4 and D6 rises to OV7. This voltage is used to turn on IC1c to give an indication of clipping by lighting LED 1.

The active low pass filter, IC1d, removes the unwanted harmonics produced by clipping. RV3 sets the output level. The low frequency response is limited by the value of the coupling capacitors and C2.

BUYLINES

All the components here are standard items, and even the RF choke will be easily obtained. Keep the box size as close to the PCB size as possible, and the wiring as short as you can. The Norman range of metal boxes is sutiable, or indeed any of the West Hyde cases which will accept the PCB.

Filtering

When a waveform is clipped high order harmonics are produced which, if allowed to reach the transmitter, would cause splatter and interference to neighbouring stations. A filter must be used after the clipper to rapidly attenuate all frequencies above 3kHz, which are unnecessary for intelligibility. This is achieved by using an active filter with 12 dB/octave attenuation above 2k5 Hz.

Clipping

The average power contained in a speech waveform is quite low compared to the peak voltage, and much less than the average power of a sine wave of the same amplitude. If the low energy high voltage peaks are cut off at a preset level the remaining signal can be increased without overdriving the transmitter. The average power is therefore increased. Clipping will slightly change the sound of the voice but will increase the intelligibility of a weak signal, as well as preventing the transmitter form being overdriven by limiting the maximum signal voltage.

Construction

The speech processor is mounted in a diecast aluminium box to guard against feedback which can be caused by strong RF fields. Our box measured 150 mm x 80 mm x 50 mm deep. Either an internal 9V battery or the 12V transceiver supply can be used. The processor is designed to be used in the line from the microphone to the transmitter without any modification to either. A matching socket to the mic plug is used for the input and the output taken via a lead with a matching plug. The connections for the plug and socket vary between makes of transceivers and will have to be taken from the circuit diagram to the transceiver. The clipping indicator (LED 2) and the power switch are mounted on the front panel.

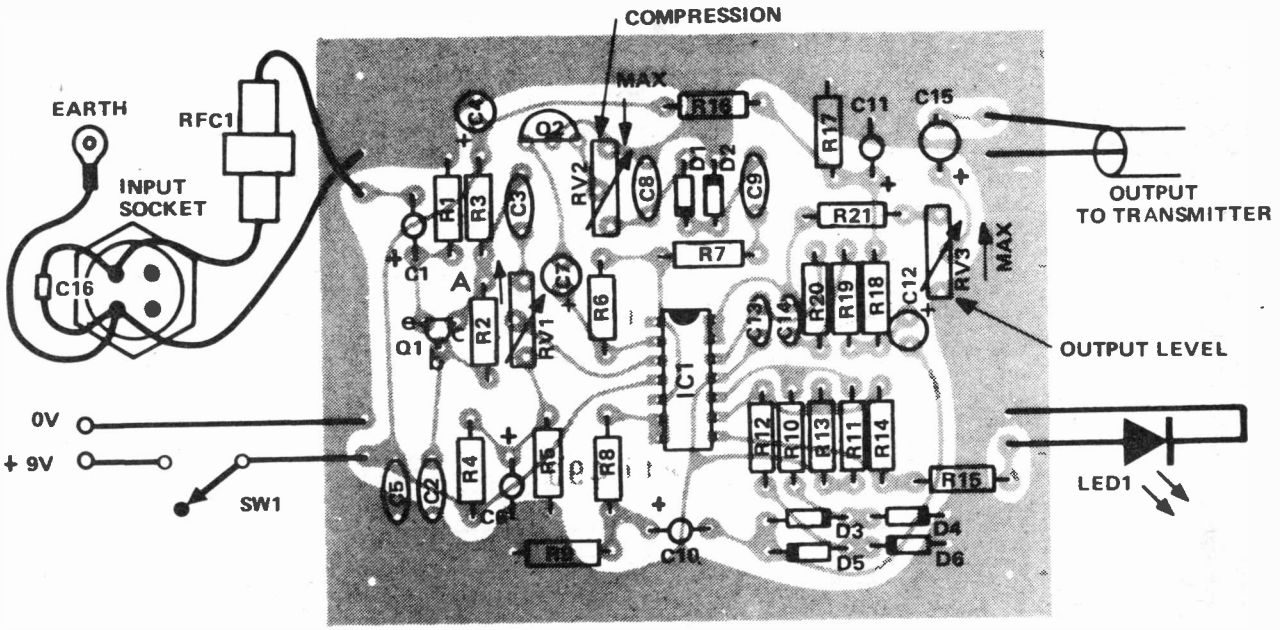


Fig. 2. Component overlay of the speech processor. Note the RF choke and capacitor mounted between the PCB and input socket.

Setting Up

Turn the compressor control to maximum and speak into the microphone at the greatest distance you are likely to use (say 30 cm-. Increase the gain control until the clipping LED flashes. If this point cannot be reached decrease the compression control and try again. The setting of these two controls is best determined by on-air tests. The output level control should be set so the RF indicator on the transmitter reaches the same peak as with only the microphone plugged in.

For high output, high impedance microphones, such as crystal types, Q1 can be omitted, RV1 replaced with a 1M trimpot and the input fed to point A on the circuit.

The gain of Q1 is proportional to the value of R3. Increasing its value increases the gain. To guard against feedback the lowest value possible should be used. ETI

PARTS LIST

RESISTORS all ¼W 5%
R1, 9, 10, 12 10k
R2, 18 1M
R3, 8, 11, 13, 15, 21 1k
R4, 5, 16, 17 100k
R6 68k
R7 47k
R14 270k
R19, 20 18k

POTENTIOMETRES
RV1 47k lin trimmer
RV2 1M lin trimmer
RV3 100k lin trimmer

CAPACITORS
C1, 6, 10-12 1u 16V electrolytic
C2, 3, 8, 9 100n Polyester
C4 33u 16V electrolytic
C5 100n ceramic
C7 10u 16V electrolytic
C13 1n polyester
C14 3n3 polyester
C15 4u7 16V electrolytic
C16 1n ceramic

SEMICONDUCTORS
Q1 BC549
Q2 2N5485
IC1 LM324N

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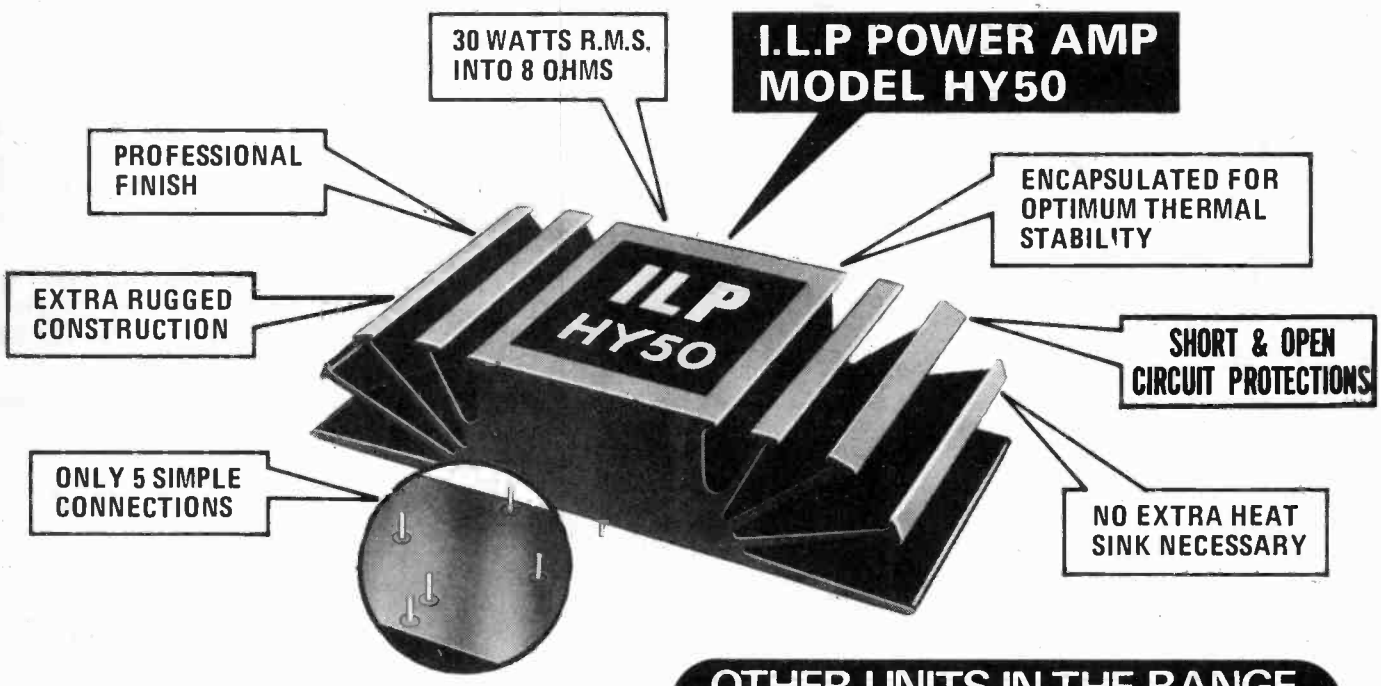

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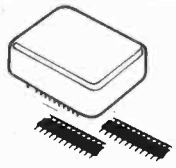

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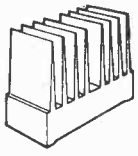

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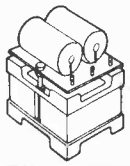

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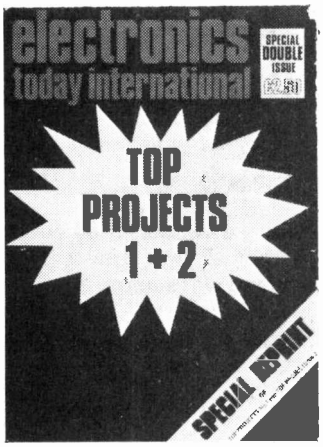

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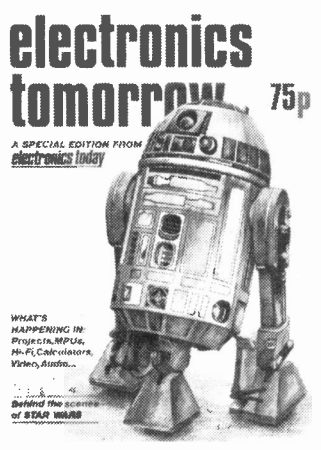

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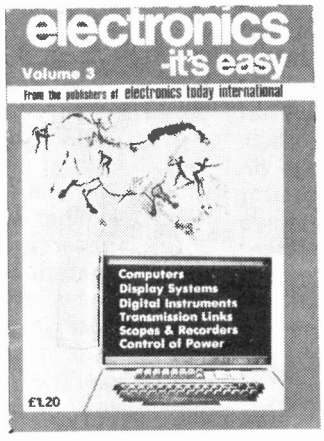

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Henry Budgett, our busy micro-man, takes you on a tour of the latest shows and brings you up to date with the latest developments. Need a toolkit for your Pet?

IT'S BEEN one of those months,, if you know what I mean. You don't? Well the summer just seems to explode with things to do and places to go, so some of the items covered in this month's column are gust a little late. Taking things chronologically, it helps. I shall start with the Microcomputer show. One short sentence can describe the overall situation. It was very hot and very busy!

Apparently the air conditioning had broken down on the Thursday but, despite repairs, it was still sweltering hot on the Friday morning. Nothing really spectacular was launched at the show but a large number of old friends were to be found. My first port of call was Technalogics, the Teletext/Prestel/BASIC system people, who were awaiting final PO approval. Well, as I mentioned briefly last month, they now have that approval and will commence delivery in September. They also had one of the rack mounting versions on display, complete with mini floppy. After breakfast at their stand, a quick pint, I moved round the hall to see Julian Allason at Petsoft. Trade there was so brisk that they had to send a truck back up to Brum twice for fresh stocks of software. Also there was Harry Saal, the man who brought you Cluster One, the distributed processing system.

Lunch Break

Very thirsty work these shows, so after yet another pint in the company of a couple of my ex-colleagues who own a Research Machines, I carefully negotiated the rest of the hall. The Nanocomputer was there. A lot of people seemed to be very interested on the educational side. The Nascom stand was overflowing as usual, they even sell T-shirts now. Apparently the '2' has gone into production at last, I wonder when we will see our review machine (gentle hint to Kerr).

The other main centre of interest was around the UK101. This is the redesigned Superboard II about which much rumour has been flying concerning legal action over software, PCB, etc. Nothing seems to have happend yet and the stand was certainly busy with interested people making up their minds to buy one.

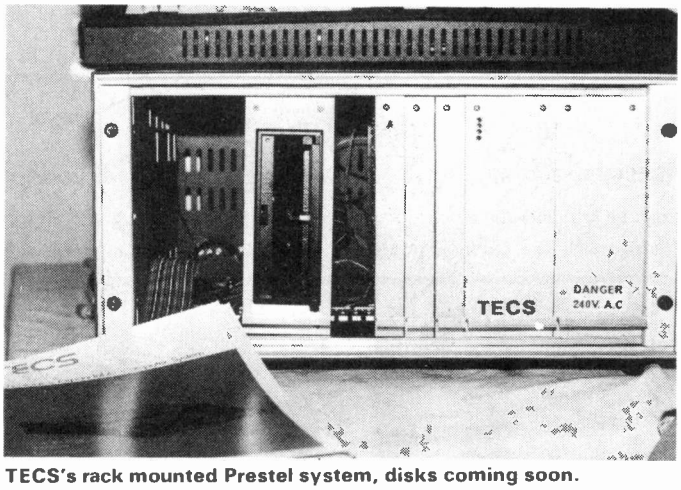
The last laugh at the exhibition went to Online, the organisers. A friend of mine asked one of their staff where the nearest Tube was. "Thirty feet straight down" came the reply, nice one.

Words On Words

Next in my crowded calendar comes the Word Processing Conference, held at Wembley. The Electronic Office seminar session that I attended was highly amusing. Presentations were given on the how's, why's and wherefore's of office systems by a number of companies, both British and American. However, the prize must go to the gentleman who floored the chair with some embarrassing comments on machine reliability after the Wang audio-visual extravaganza. After several seconds of embarrassed silence they decided to break for lunch. England 1, USA 0.

The companies on show all seemed to be vying for the most far out stand, the prettiest girls, etc. and overall I was left with the feeling that everyone had gone just a little over the top. Among the companies there were such giants as IBM and ICL as well as Wang and Wordplex among many others. It seems to me that the

Is it? No its a UK101. Nearly the same though!



TECS's rack mounted Prestel system, disks coming soon.

WP field is really trying to exploit a market that is just not ready. Even the most sophisticated system will fall foul of a naive user and then the system gets the blame.

Once again thanks are due to Online, especially to the young lady who found me a set of conference notes after much hunting around.

Northward Bound

Stage three of the month's travalogue takes place not a stone's throw from the Mersey. Liverpool, home of the music of the sixties and sit-coms, is also the home of Microdigital, who are not connected with either. They are, however, connected with microcomputers, and very seriously at that. They are one of the few UK computer shops to provide a full backup service in both hardware and software. Bruce Everiss, my host for the day, is justly proud of his achievements over the past year. They have expanded from shop to hire company and along the road have collected a software engineer, two hardware designers and the largest range of computer books in the country.

The software that they produce is mainly for local clients and is business orientated. The sample I tried, albeit only half developed, was very high quality indeed. The hardware team are currently working on a series of boards for the Nascom. The first, a relay board will be ready soon and the next one, an analogue input board is currently under design.

Go West Young Man

Well, West was about the only direction left so I pointed my trusty vehicle in the direction of Newbury and went. The reason? To see the man who has probably done more to make the word software a household name than anyone, Julian Allason.

Despite the fact that Petsoft is now owned by ACT he has stayed on as a director and is actively engaged in finding software from any number of sources. His latest acquisition is the PET Programmers Toolkit, the goodie for PET that I mentioned earlier. Brought over from the States by Harry Saal and shown very briefly at the Microcomputer show it will so impressive that I went to see more.

It is really a piece of firmware, machine code program stored in a 2K PROM that plugs onto the PET expansion port. If you have a new ROM PET you only need the IC as it will plug inside your machine. Apart from plugging it in no modifications are required and you have a vast increase in useability. If you have ever wished for built-in utility programs then this will provide them, it replaces about six cassette programs with single commands. I borrowed one of the only two samples to do a report for CT, but here are the available commands in a brief resumé.

AUTO:	Automatic line numbering, any start, any step.
DELETE:	Bulk line deletion, lines specified only.
RENUMBER:	Any start, any step.
HELP:	Displays just what caused that syntax error.
TRACE:	Displays the last six program steps continuously, can be stopped and started at any time during run.
STEP:	Single step version of TRACE.
APPEND:	Compile programs from subroutine libraries on tape.
DUMP:	Displays all variables and strings used in program.
FIND:	Finds all occurences of specified character string in the program.

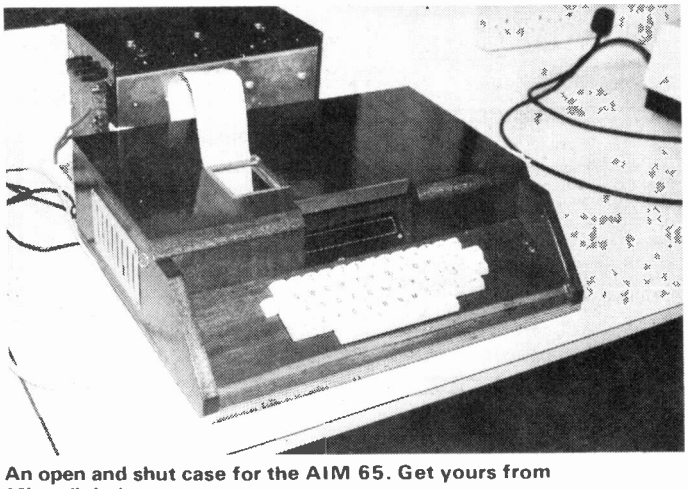
The cost of this little gem is a mere £75 for the plug on version, £55 for the IC.

Micro Coup

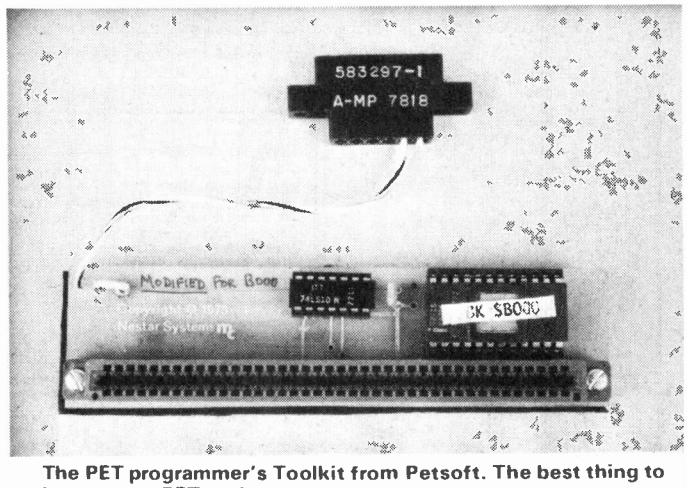
The latest coup for the firm is the acquisition of an American single board computer. Called the ACFA, it is based on the 6808, hopefully the 6809 soon, and has an impressive list of features. Complete with an 8K BASIC on cassette, it has 16K RAM, expandable to 48K RAM on-board, colour graphics using 4K of RAM, ASCII keyboard, Kansas City cassette and an RS232 interface. It will be supplied as a kit complete with PSU and case. The manuals supplied with the system are really a computer course on their own and have been prepared by Dr Veronis, a well-known American author.

The Final Word

The University of Salford have asked us to let you know about their forthcoming series of microprocessor courses. They are all one day courses and are being held in September. Preparing for the Microprocessors Age (Sept 24 £40), Fundamentals of Microprocessors (Sept 25 £60) and Microprocessor Systems (Sept 26 £60). A 10% discount is being allowed if more than one course is attended. For further details please contact Mrs Sumners, Room 110, University of Salford, Salford M5 4WT or ring 061-736 5842 extn 449. ETI



An open and shut case for the AIM 65. Get yours from Microdigital.



The PET programmer's Toolkit from Petsoft. The best thing to happen to a PET yet!

QUARTZ LCD
5 Function

Hours, mins., secs., month, date, auto calendar, back-light, quality metal bracelet.

£6.65

Guaranteed same day despatch.

Very slim, only 6mm thick.

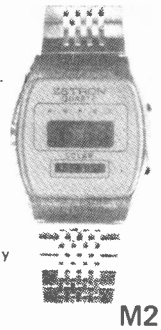
M1

SOLAR QUARTZ LCD
5 Function

Genuine solar panel with battery back-up.
Hours, mins., secs.
Day/date.
Fully adjustable bracelet.
Back-light.
Only 7mm thick.

£8.65

Guaranteed same day dispatch.



M2

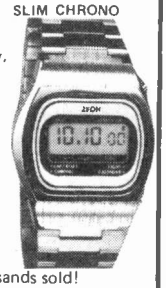
QUARTZ LCD
11 Function SLIM CHRONO

6 digit, 11 functions.
Hours, mins., secs., day, date, day of week.
1/100th, 1/10th, secs., 10X secs., mins.
Split and lap modes.
Back-light, auto calendar. Only 8mm thick.
Stainless steel bracelet and back.
Adjustable bracelet.

Metac Price

£10.65 Thousands sold!

Guaranteed same day dispatch



M3

QUARTZ LCD
ALARM 7 Function

Alarm
Hours, mins., secs.
Month, date, day.
6 digits. 3 flags plus continuous display of day and date or seconds.
Back-light.
Only 9mm thick

£12.65

Guaranteed same day dispatch

M4

MULTI ALARM
6 Digits
10 Functions

- ★ Hours, mins., secs.
- ★ Month, date, day
- ★ Basic alarm.
- ★ Memory date alarm.
- ★ Timer alarm with dual time and 5 country zone.
- ★ Back light.
- ★ 8mm thick.

£18.65

M5

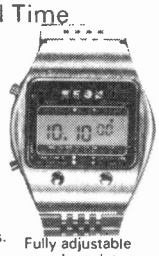
FRONT-BUTTON ALARM
Chrono Dual Time

6 digits, 5 flags, 22 functions.
Constant display of hours and mins. plus optional seconds or date display.
AM/PM indication.
Month, date.
Continuous display of day.
Stop-watch to 12 hours 59.9 secs. in 1/10 second steps.
Split and lap timing modes.
Dual time zones.
Only 8mm thick.
Back-light.

Fully adjustable open bracelet.

£22.65

Guaranteed same day dispatch.



M6

SOLAR QUARTZ LCD
Chronograph with Alarm
Dual Time Zone Facility

6 digits, 5 flags, 22 functions.
Solar panel with battery back-up.
6 basic functions stop-watch to 12 hours 59.9 secs. in 1/10 sec. steps.
Split and lap timing modes.
Dual time zones.
Alarm.
9mm thick.
Back-light.
Fully adjustable bracelet.

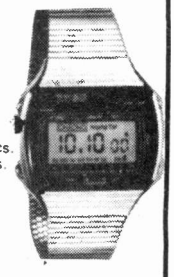
£27.95

M7

ALARM CHRONO
with 9 World Time Zones

- ★ 6 digits, 5 flags.
- ★ 6 basic functions.
- ★ 8 further time zones.
- ★ Count-down alarm.
- ★ Stop-watch to 12 hours 59.9 secs. in 1/10 sec. steps.
- ★ Split and lap timing modes.
- ★ Alarm.
- ★ 9mm thick.
- ★ Back-light.
- ★ Fully adjustable bracelet.

£29.65



M8

SOLAR QUARTZ LCD
Chronograph

Powered from solar panel with battery back-up.
6 digit, 11 functions.
Hours, mins., secs., day date, day of week.
1/100th, 1/10th secs.
10X secs., mins.
Split and lap modes.
Back'light. Auto calendar. Only 8mm thick.
Stainless steel bracelet and back.
Adjustable bracelet.

Metac Price

£12.65

Guaranteed same day dispatch.

M9

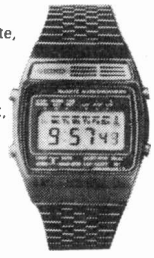
SEIKO Alarm Chrono

LCD, hours, mins., secs., day of week, month, day and date, 24 hour Alarm, 12 hour chronograph, 1/10th secs., and lap time. Back light, stainless steel, HARDLEX glass.

List Price £130.00

METAC PRICE

£105.00



M10

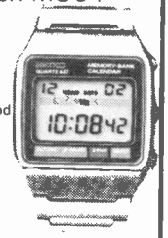
SEIKO MEMORY BANK
Calendar Watch M354

Hours, mins., secs., month, day, date in 12 or 24 hour format all indicated continuously.
Monthly calendar display, month, year and all dates for any selected month over 80-year period.
Memory bank function.
Any desired dates up to 11 can be stored in advance.
2-year battery life.

List Price £130

Metac Price £79.50

Water resistant.



M11

Dual Time-Alarm
Chronograph

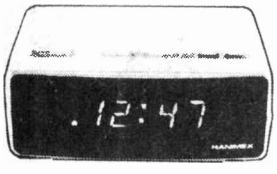
Mineral glass face
Battery hatch for DIY battery replacement.
Top quality finish with fully adjustable bracelet.

Spec same as M6

£35.00

M12

HANIMEX
Electronic
LED Alarm Clock



Features and Specification
Hour/minute display. Large LED display with p.m. and alarm on indicator. 24 Hours alarm with on/off control. Display flashing for power loss indication. Repeatable 9-minute snooze. Display bright/dim modes control. Size 5.15" x 3.93" x 2.36" (131mm x 11mm x 60mm)
Weight 1.43 lbs (0.65 kg)

£9.65 Thousands sold!

Mains operated.

Guaranteed same day despatch.

M13

HANIMEX
Portable LCD
Clock Radio

- ★ Back-light.
- ★ Batteries supplied free.
- ★ Quartz crystal controlled.

£17.95

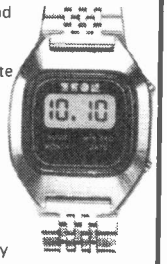
M14

QUARTZ LCD
Ladies 5 Function

Only 25 x 20mm and 6mm thick.
5 function. Hours, mins., secs., day, date and back light and auto calendar.
Elegant metal bracelet in silver or gold.
State preference.

£9.95

Guaranteed same day despatch.



M15

PRICE BREAKTHROUGH ONLY

£18.95

OUTSTANDING FEATURES

- **DUAL TIME:** Local time always visible and you can set and recall any other time zone (such as GMT). Also has a light for night viewing.
- **CALENDAR FUNCTIONS** include the date and day in each time zone
- **CHRONOGRAPH/STOPWATCH** displays up to 12 hours, 59 minutes, 59.9 seconds.
- On command stopwatch display freezes to show **intermediate (split/lap) time** while stopwatch continues to run. Can also switch to and from timekeeping and stopwatch modes without affecting either's operation.
- **ALARM** can be set to any time within a 24-hour period. At the designated time, a pleasant, but effective buzzer sounds to remind or awaken you!

Guaranteed same day dispatch.

M16

HOW TO ORDER

Payment can be made by sending cheque, postal order, Barclay, Access or American Express card numbers. Write your name, address and the order details clearly, enclose 30p for post and packing or the amount stated. All products carry 1 year guarantee and full money back 10 day reassurance. Battery fitting service is available at our shops. Also Electronic Calibration Service. All prices include VAT.

Metac Wholesale:

Trade enquiries: Send for a complete list of trade prices and minimum order details

Telephone Orders: Credit card customers can telephone orders direct to Daventry or Edgware Rd., 24 hour phone service at both shops: 01-723 4753 03272-76545.

CALLERS WELCOME
Shops open 9.30 - 6.00.

Metac ELECTRONICS & TIME CENTRES

North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

South of England
327 Edgware Road
LONDON W.2
Telephone: (01) 723 4753

HIGH QUALITY AUDIO AMPLIFIER

If you're in the market for a true hi-fi amplifier, this is the place to start. A superb design which offers a reproduction quality equal to the very best around today.

IT HAS BEEN some time since we featured a complete stereo amplifier design in ETI — receivers and power amps yes, but not a full hi-fi set-up. When considering putting this right, we wanted to produce a design that could stand with the best commercial units of the day, and yet offer a considerable price saving over such designs in return for the effort of "doing it yourself."

We believe our Audiophile 4000 fulfills these aspirations nicely.

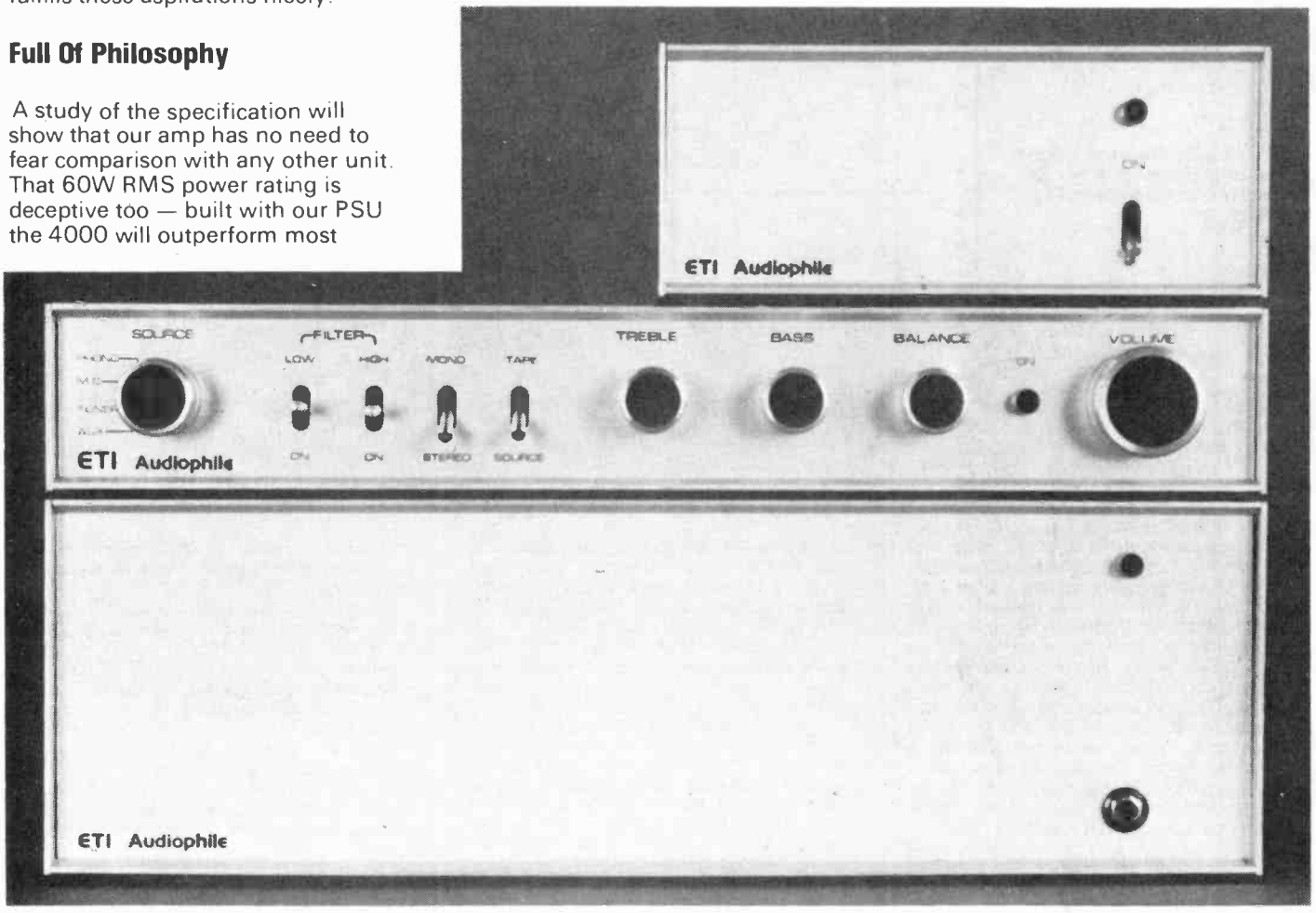
Full Of Philosophy

A study of the specification will show that our amp has no need to fear comparison with any other unit. That 60W RMS power rating is deceptive too — built with our PSU the 4000 will outperform most 100W rated commercial designs in terms of transient delivery, bass quality and sheer 'dynamics'.

Listening tests played a large part in determining the final design, and particular stress was placed upon delivery of detail and elimination of TID.

Construction is modular, and we have housed the system in THREE cases. Pre-amp, power amps and pre-amp PSU. You can of course ignore our suggestions and build the whole thing in one box using one PSU for everything. You can *also* expect degraded performance if you do! Separate power supplies for each channel of the power amp should not be considered optional — they are very important to the final specification.

The three case approach has several advantages — not least of which is hum reduction. Casing it ▶



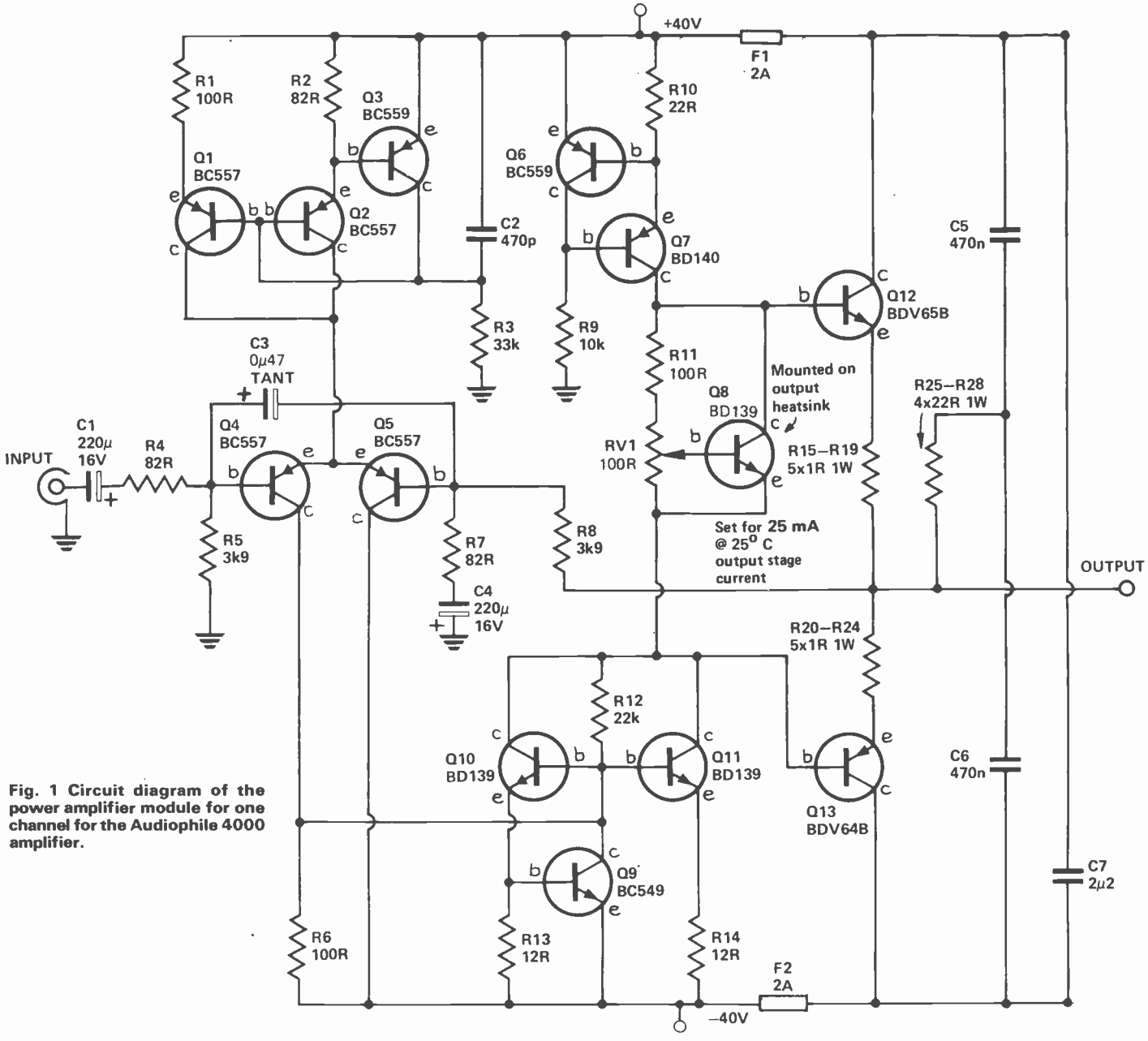


Fig. 1 Circuit diagram of the power amplifier module for one channel for the Audiophile 4000 amplifier.

HOW IT WORKS

The input stage of the amplifier consists of an emitter coupled differential pair (Q4, Q5) with a constant current source (Q1, Q2 and Q3). The use of a constant current source reduces distortion, as well as the possibility of high frequency oscillation and prevents any ripple on the positive supply from unduly affecting the input stage. Unequal emitter resistors (R1, R2) allow the currents in Q4 and Q5 to be optimised. Input lag compensation is provided by C3, limiting the slew rate of the amplifier to reduce high frequency intermodulation. The gain of the differential pair, driving Q10 and Q11, is very low.

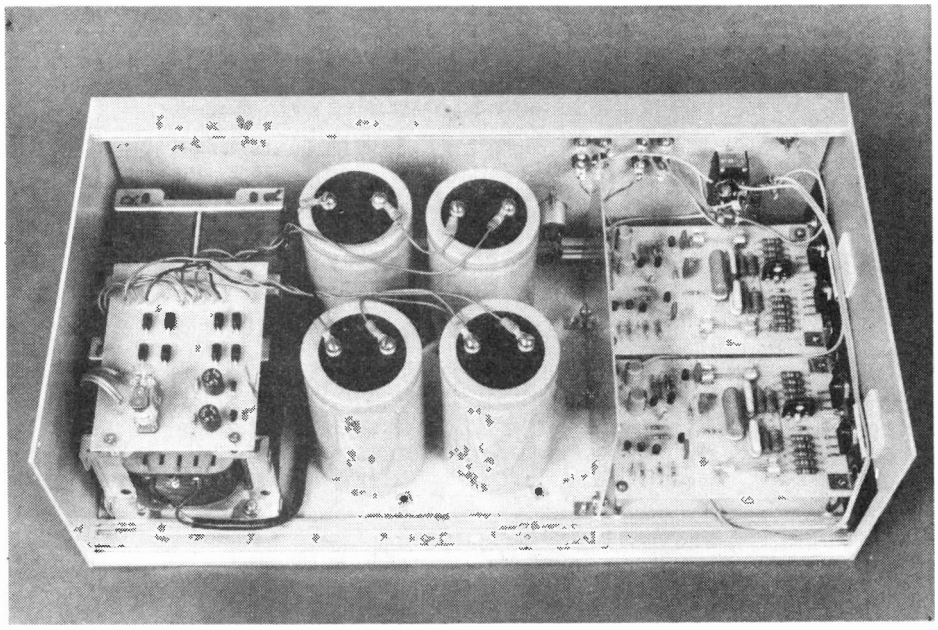
Almost all the gain of the amplifier is obtained from the parallel pair Q10 and Q11. They are operated with series (R13, R14) and shunt (R12) feedback, and a constant current source (Q6, Q7). This results in a highly linear stage.

Q9 protects Q10 and Q11 from high peak currents or damage should a fault occur. When the current through R13 exceeds the safe limit, Q9 conducts and shorts out the drive to Q10 and Q11.

Bias from the output stage is set by RV1 and a shunt regulator (Q8). Q8 is mounted on the same heatsink as the output stages and stabilises the output bias current against heatsink temperature rise. Resistors R15-R24 in the emitters of the output Darlingtons, Q12 and Q13, maintain operation in their safe region as well as reducing the chance of thermal run away.

Protection against ultrasonic oscillation is provided by C7 and the network consisting of R25-R28 and C5, C6.

Both DC and AC feedback is taken from the output, via R8, to the negative input of the differential pair, the amount of feedback being set by the ratio of R8 to R7. C4 increases the feedback, and therefore decreases the overall gain, at very low frequencies. The feedback also automatically holds the DC output voltage at close to zero volts.



Inside the power amplifier case. The power supply for each channel sits on the right of the enclosure, and the rectifier board and de-thump board sits on top of the transformers. Note the screen between channels and the screening between modules and PSUs. Don't be tempted to use a single PSU for both amps — this will degrade transient performance to a considerable degree.

SPECIFICATION - POWER AMP

Power Output . . . . . 60 watts into 8 ohms (∓40V supply)

Frequency Response . . . . . 10 Hz to 100 kHz ∓0.5 dB

Input Sensitivity . . . . . 500 mV rms for 60 W output

Hum and Noise . . . . . better than −110 dB on full output (dependent on power supply)

Feedback Ratio . . . . . 35 dB

Distortion . . . . . at 1 kHz, 30 V p-p output into 8 ohms,
Closed Loop . . . . . 0.04 %
(open loop 1 %)

Stability: The amplifier was found to be completely stable when operated into reactive loads consisting of R + C, L + C and pure L

Intermodulation (calculated values) . . at 1kHz, 30 V p-p output into 8 ohms,
3rd order . . . . . less than 0.015 %
5th order . . . . . less than 0.0023 %
(Intermodulation reduces with reduced power)

this way is a good 6dB better than the cheaper alternative is likely to be. Separate PSUs for the power and preamp also avoids LF instability caused by supply line droop when the output pair draw heavy currents.

Preamp Pondered

The requirements for the control section of the system were set down after many hours of office discussion. In fact it would be fair to say that it evolved rather than was conceived.

There is still much discussion around the subject of tone controls and filters in amplifiers. A strong lobby exists to dispose of them completely, indeed in *systems* of the highest quality and in good listening conditions they have little to do with accurate sound replay.

However as most (nearly all) hi-fi falls far short of this level we have included them on our PCB. Also present are loudness, mute, low cut and high cut filters — the latter being of low phase shift variety at sensible turnover frequencies. These can be omitted from the final unit as you will. On our prototype, no loudness or mute facility was included, as you can see from the photos.

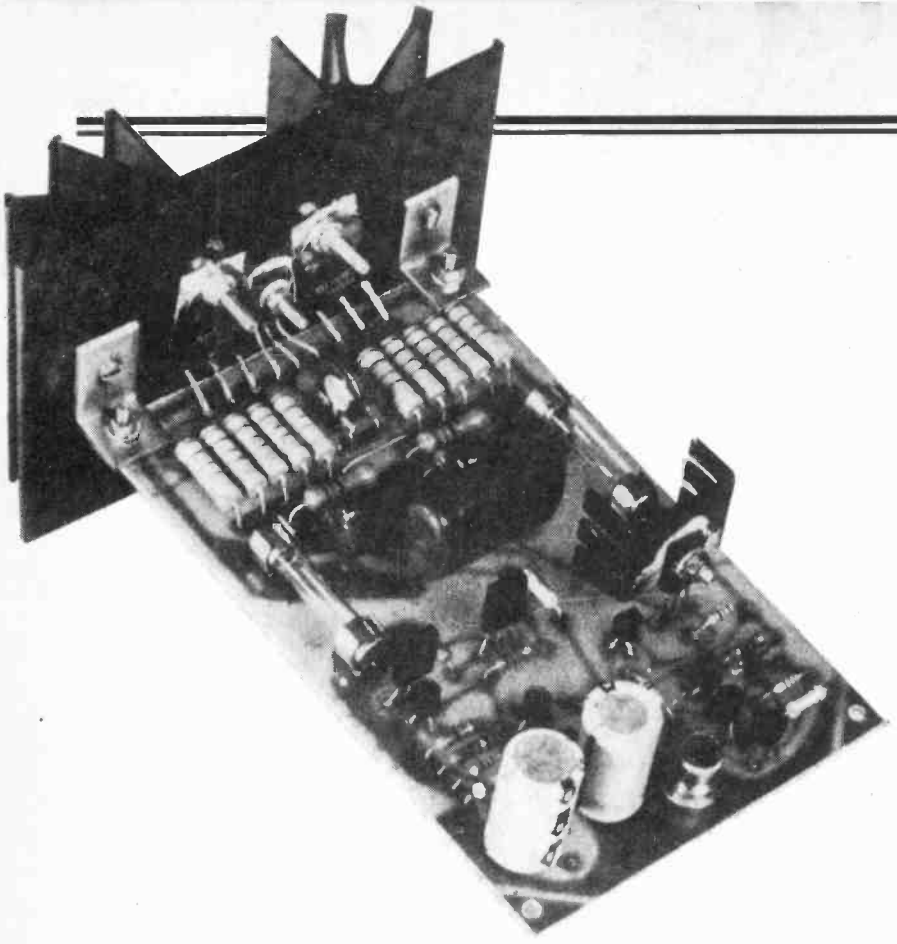
The MC input is in fact not RIAA equalised, to allow for connection of a head amplifier, one of which would almost certainly accompany the cartridge. We are working on a design for a mains powered unit ourselves and will present this at a later date, in a style to match the Audiophile.

The disc pre-amp section of an amplifier must be capable of handling very high input signals before clipping to preserve dynamic range — especially when used with head amps — and ours can take 400mV ptp before clipping. Dynamic range > 100dB).

Powerful Discussion

This power amplifier offers a significant improvement in specifications and ease of construction over most kit amplifiers offered to date. It has been designed particularly with low transient intermodulation distortion in mind.

Although a difficult parameter to measure, transient intermodulation distortion is an inherent characteristic of many amplifier designs — especially those which incorporate large amounts of feedback to even out frequency response and reduce



A completed module — fitted with phono socket input. This is optional, and if omitted wire direct to the foil side of the board. Below: — Fig. 2. Component overlay for the amplifier module.

PARTS LIST

POWER AMPLIFIER (each channel)

RESISTORS all ¼W 5% unless marked

R1, 6, 11	100R
R2, 4, 7	82R
R3	33k
R5, 8	3k9
R9	10k
R10	22R
R12	22k
R13, 14	12R
R15-R24	1R 1W
R25-R28	22R 1W

POTENTIOMETERS

RV1	100R trimmer

CAPACITORS

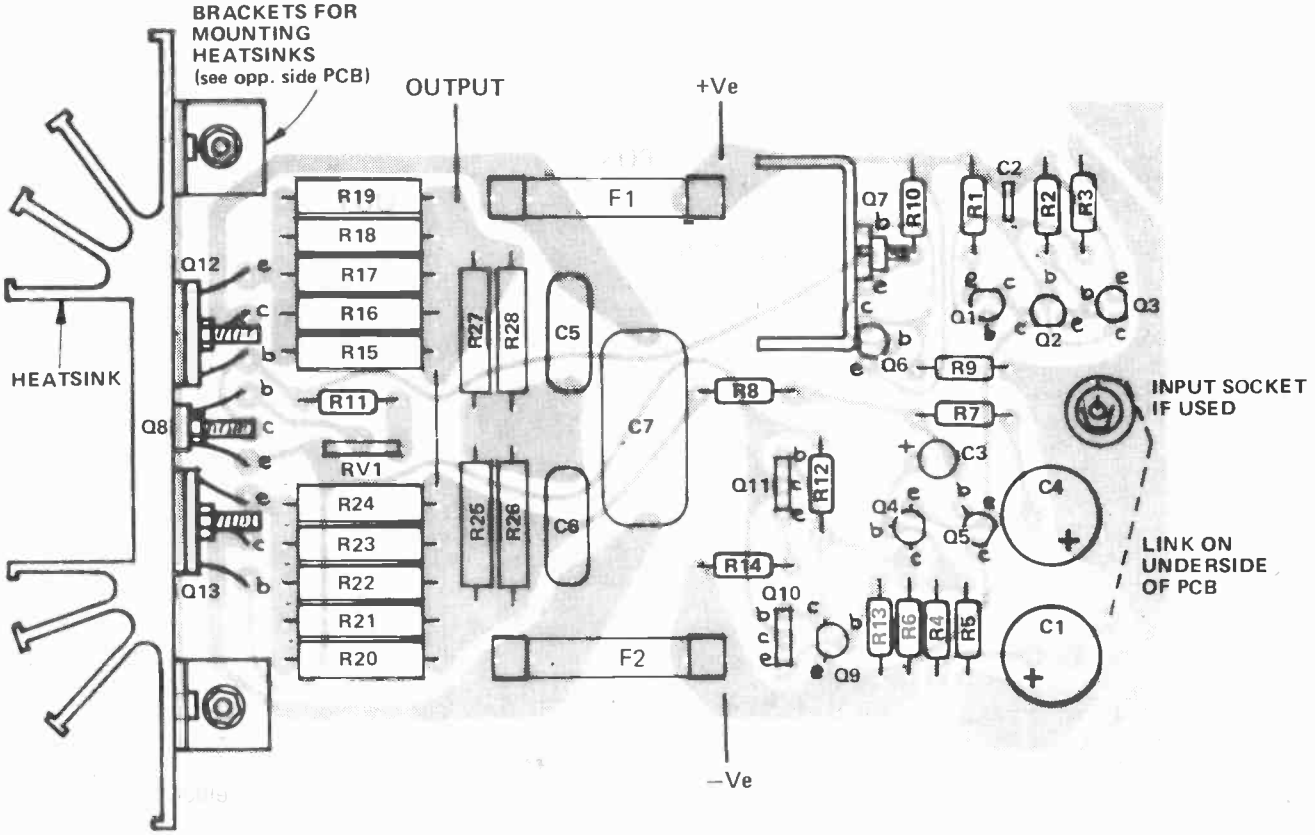
C1, 4	220u 16V
C2	470p ceramic
C3	470n tantalum
C5, 6	470n polyester
C7	2u2 polyester

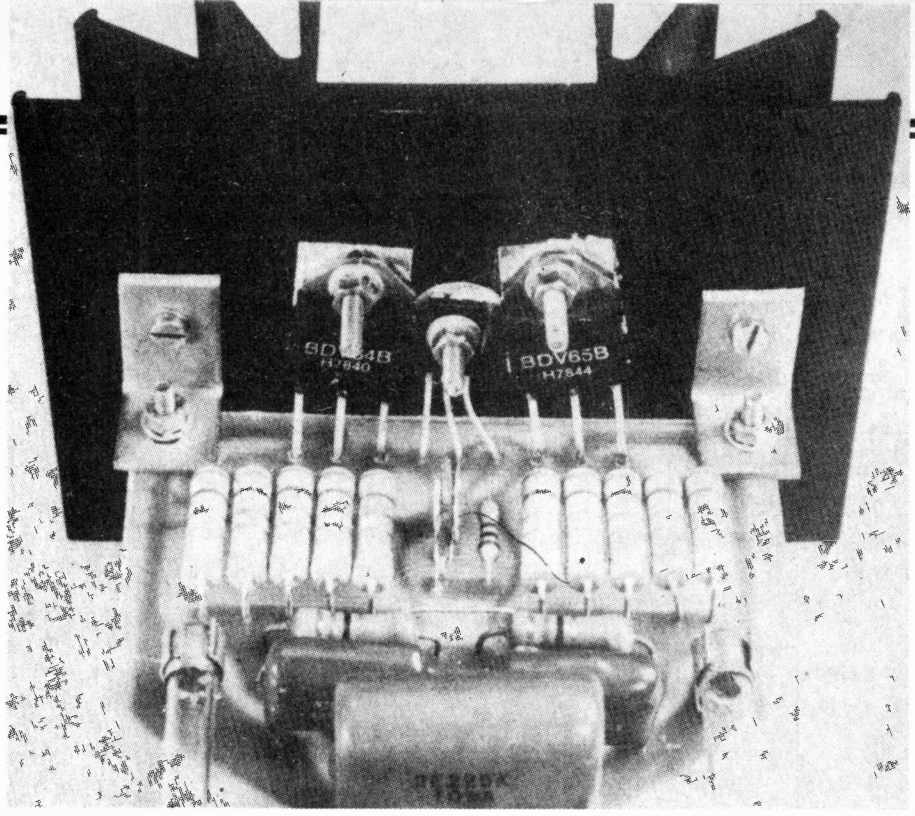
SEMICONDUCTORS

Q1, 2, 4, 5	BC557
Q3, 6	BC559
Q7	BD140
Q8, 10, 11	BD139
Q9	BC549
Q12	BDV65B or TIP142
Q13	BDV64B or TIP147

MISCELLANEOUS

2A Fuse (2 off) with holders, insulating kits for Q8, 12, 13 heatsinks, brackets, spacers, PCB





WHY LOW TID?

Looking at the circuit and a quick glance at the specifications, there's little in the circuit that looks outstandingly different from others. So what makes this amplifier special?

The difference in concept that makes this amplifier unique is the use of a very linear, high gain driver stage (Q10, Q11), with a constant current source (Q6, Q7), so that the gain of *this* stage is dependent upon the input impedance of the output transistors. However, *their* input impedance is dependent upon their gain, and therefore *the gain of the amplifier stage is dependent solely upon the characteristics of the output devices.*

Series and shunt feedback is used with Q10 and Q11 which results in a highly linear stage with a very low input impedance (about 28 ohms). The gain of the differential pair when fed into this low impedance is close to unity, so almost all the gain of the amplifier is concentrated in Q10 and Q11.

Provided the phase shifts in the differential pair and the gain stage are negligible the feedback loop is unconditionally stable.

There are two other design features which result in low TID.

The total open loop (feedback disconnected) distortion is only 1% at 30 V p-p output. So, very little feedback is necessary to reduce this to an acceptable level.

Protection of the output transistors is done by fuses, rather than electronically, and very high transient currents can be fed to the speaker without being affected by the (inevitably) non-linear impedance of an electronic protection circuit.

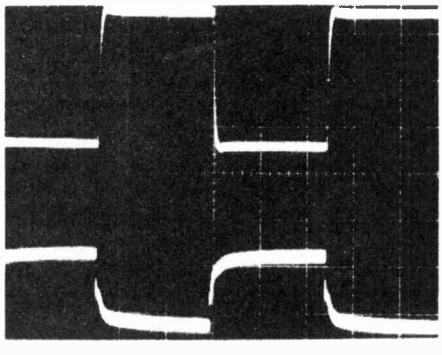
PULSE TESTING

Operation into severely reactive loads was examined by looking at the ac component of the Vbe of Q10 as a measure of the 'overshoot' of the loop and to see if transient overload occured.

f = 1 kHz. CRO is 0.2 mS/div. Output is 30 V into 8 ohms.

Upper trace 10 V/div. Output into 8 ohms.

Lower trace 10 mV/div. Vbe of BD139 gain stage. *No evidence of transient overload was visible.*



harmonic distortion. The heavy feedback 'school' of design produces an impressive list of specifications — but the difference *to the ear* between such an amplifier and one designed for low TID has to be heard to be believed.

The design of the power supply can mean the success or failure of an otherwise well-designed amplifier. The supply voltage should be well-regulated, varying less than 10% from no load to full load, and be able to supply high peak currents.

However, if a voltage regulator is employed it too must be capable of delivering the very high peak currents occasionally demanded. This necessitates an expensive regulator device and large, expensive filter capacitors.

The alternative is to use a fairly large transformer and large value filter capacitors on a capacitor-input bridge rectifier. This is what we chose.

Powering Supplies

The circuit given here shows a power supply suitable for supplying a stereo amplifier using two of these modules. The filter capacitors C8 and C9 consist of two 15000 uF, 60 volt electrolytic capacitors. This is the minimum value we would recommend.

The power supply output should be limited to a peak DC voltage of about 40 volts (for 60 W output). A C-core transformer will generally improve the hum and noise output figures apart from having a reduced field, thereby reducing possible hum pickup problems.

If the amplifier module is to be used with a 4-ohm speaker system the supply voltage must be limited to about 30 volts maximum, otherwise the output devices will attempt to deliver 100 watts followed by rapid self destruction!

Adventurous constructors may wish to try adding a second set of Darlington output devices, with their own emitter resistors as per the circuit, connected in parallel with the original pair. This combination may supply 100 watts or more into a four ohm speaker load. This technique is also recommended if you are contemplating driving highly reactive loads such as electrostatic loudspeakers. ▶

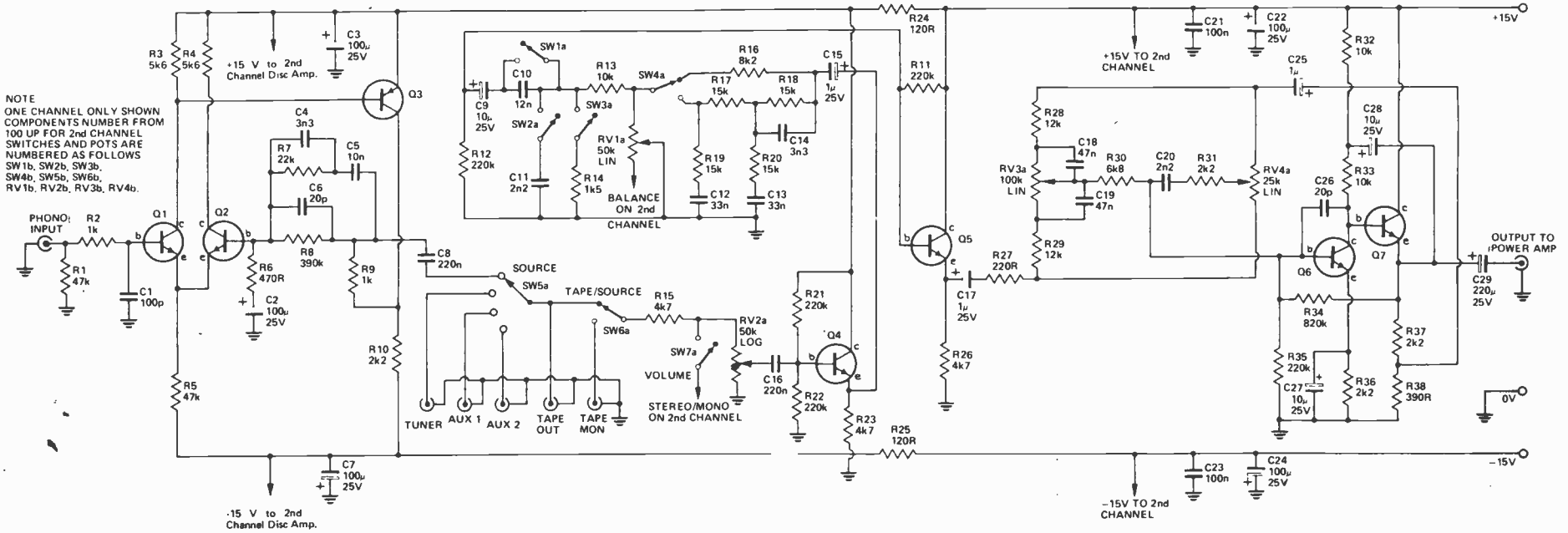


Fig 3. Circuit diagram of one channel of the preamp. Add 100 to all component numbers for second channel.

HOW IT WORKS

The signal from a magnetic cartridge is fed to the base of Q1 via a low pass filter (R2 and C1) for attenuation of radio frequencies. Q1 and Q2 form a differential pair, each half operating at low collector current to minimise noise. The output of the differential pair is taken from the collector of Q1 and further amplified by Q3. Feedback is taken to the base of Q2, the negative input of the differential pair, through the RIAA equalisation network. Overall gain of the phono stage is set by the ratio of the feedback network impedance to the value of R6.

Subsonic bass roll-off of 6 dB/octave, to conform to the new IEC 65 specification, is achieved by a high pass filter consisting of C8 and RV2.

Output from the disc preamplifier is then fed via the Source Switch (SW5), Tape-Source switch (SW6), R15 and the volume control (RV2), to an emitter follower, Q4. This emitter follower presents a high impedance for the aux inputs and a constant impedance for driving the filters.

SPECIFICATION - PREAMP

Distortion	0.015% at 1 kHz 0.015% at 10 kHz (For all inputs, with 500 mV RMS output – distortion is mainly 2nd harmonic).
Hum and Noise	83 dB unweighted (With respect to 10 mV phono input).
Frequency Response	Phono: Within 0.5 dB of RIAA from 20 Hz to 20 kHz (Follows new IEC curve). Other inputs: 20 Hz to 20 kHz ± 0.5 dB Subsonic rolloff: 6 dB/octave below 20 Hz
Output	7 V p-p before clipping
Tape output	150 mV RMS
Sensitivity	For 500 mV RMS output phono: 3 mV RMS other: 150 mV RMS (Phono overload level is 400 mV p-p).
Tone controls	Bass: ± 13 dB at 50 Hz Treble: ± 11 dB at 10 kHz
Filters	High: 6 dB/octave, –3 dB at 5 kHz Low: 6 dB/octave, –3 dB at 100 Hz
Loudness	8 dB boost at 15 kHz and 10 kHz.
Mute switch	20 dB attenuation

When switched in, the loudness network boosts the high and low frequencies with respect to the midrange. In actual fact, all frequencies are attentuated but the midrange is attenuated more. When the loudness is switched out, R16 approximates the impedance of the network.

Muting is achieved by switching R14 to earth. The ratio of R14 to R13 sets the attentuation to 20 dB. C11 shunts high frequencies to earth for high cut, while C10 reduces low frequency content when switched in, providing low cut.

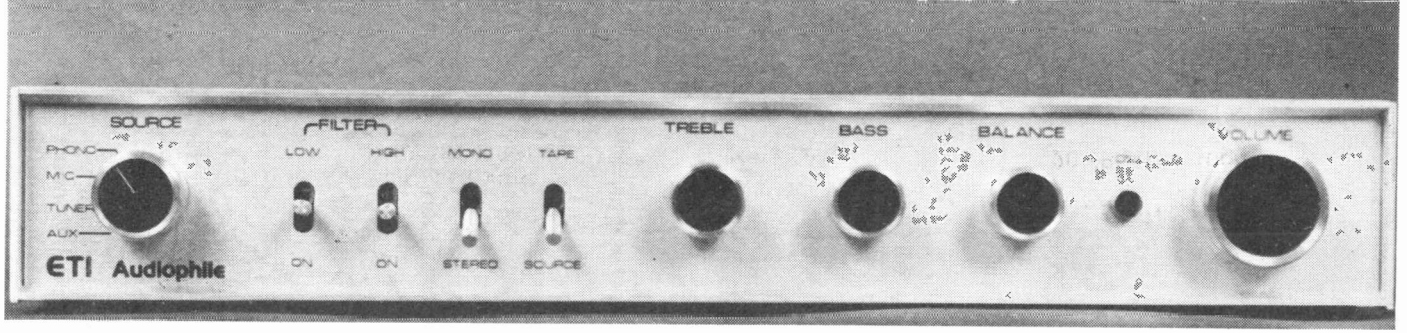
A second emitter follower, Q5, presents a constant impedance source to the tone control stage.

A Baxandall tone stage is used here, a common circuit in many designs. Q6 is a gain stage with a bootstrapped collector load, via C28, to the output. Bootstrapping increases the gain by increasing the effective collection load impedance. Q7 is an emitter follower connected directly to the collector of Q6. This provides a very low output impedance. DC bias for Q6 is taken from the output.

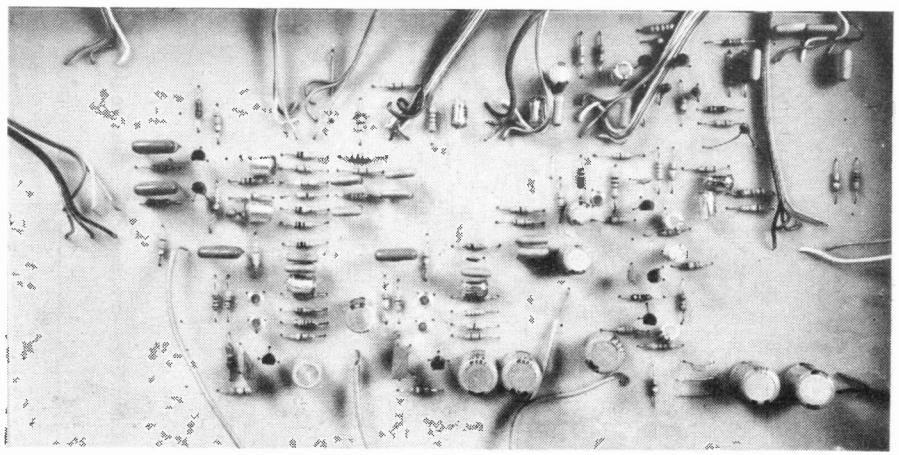
Some of the output signal is fed back to the tone controls and split into high and low frequencies by RV3 and RV4. By adjusting the controls the percentage of the input to the negative feedback signal appearing at the base of Q6 can be varied, thereby varying the overall gain of the amplifier at either high or low frequencies. The gain of the tone stage is set by the ratio of R37 to R38. As R38 is reduced in value the negative feedback is reduced and therefore the overall gain is increased.

To preserve the very low output impedance of the pre-amplifier the balance control is placed ahead of, rather than after, the tone stage.

Power supply filtering and decoupling is provided by 1000u capacitors and resistors in each rail.



Above: the finished preamplifier unit.
Below: the PCB some way into construction.



Construction — Preamplifier

Assemble the PCB as per the overlay, checking carefully the polarity of all semiconductor and polarised components. Only attempt to wire the board to the chosen controls once you are satisfied that all is well. Check VERY thoroughly as mistakes now will cause quite a few headaches.

Use only good quality screened audio cable for wiring between controls and board and keep the runs as short as you can. As there is no mains within the enclosure hum should not be a problem.

The PSU similarly is relatively simple to put together, but watch that mains wiring and make SURE the case is earthed. We used cannon connection for DC output. If you wish to fit mains outlets to power ancillary units, add them to this box, but watch the rating of the switch if it is to control everything.

When switching on don't forget the 'de-thump' circuit which will cause an agonising silence for several seconds after switch on!

Construction — Power Amps

All components are mounted on a PCB — including the output devices. This method of construction is recommended. The module has been designed so that it is mechanically simple to assemble, much simpler than our ETI 480 module.

Firstly, assemble and solder all the components on to the printed circuit board with the exception of Q12, Q13 (the output Darlingtons) and Q8. Carefully observe the polarity of all the electrolytic capacitors and orientation of the transistors.

The board is mounted hard against the heatsink using small right-angle brackets. Be careful to avoid shorting the ends of the one ohm emitter resistors, R15-19 and R20-24, to the brackets.

If the module is to be mounted in a chassis the bottom (copper) side of the board should be 25 mm above the bottom of the heatsink. This will allow the use of 25 mm spacers to support the 'input' end of the board (furthest from the heatsink).

Once the board is attached to the heatsink the output Darlingtons, Q12 and 13, and Q8 may be mounted. Insert them in the board and then press them back against the heatsink to form their leads to the right shape. Do not solder their leads yet.

Smear heat conducting compound on either side of the mica insulators (don't use too much though) and insert these between the devices and the heatsink.

Assemble the washers and mounting bolts for these, finally checking with an ohm-meter that there is not a short circuit between the metal tags (collectors) of the devices and the heatsink.

The input connection to the module is via a length of shielded cable soldered directly between C1 and the board common.

The power supply and speaker connection are soldered directly to ▶

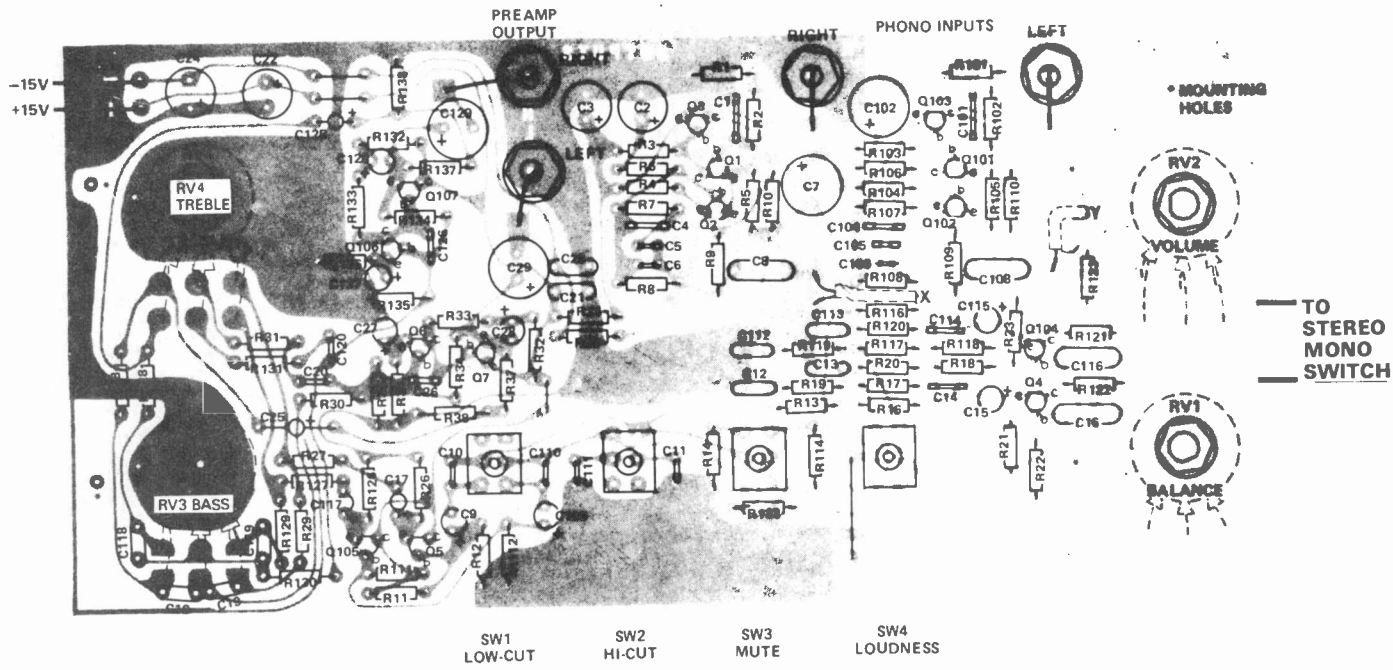


Fig 4. Component overlay for the pre-amp section of the 4000. Links X and Y are screened cable links to the 'phono' input of the selector.

PARTS LIST

Preamplifier

RESISTORS — all ¼W 5%

R 1, 5	47k
R2, 9	1k
R3, 4	5k6
R6	470R
R7	22k
R8	390k
R10, 31, 36, 37	2k2
R11, 12, 21, 22, 35	220k
R13, 32, 33	10k
R14	1k5
R15, 23, 26	4k7
R16	8k2
R17-20	15k
R24, 25	120R
R27	220R
R28, 29	12k
R30	6k8
R34	820k
R38	390R

POTENTIOMETERS

RV1	50k lin
RV2	50k dual log
RV3	100k dual lin
RV4	25k dual lin

CAPACITORS

C1	100p ceramic
C2, 3, 7, 22, 24	100u 25V
C4, 14	3n3 polyester
C5, 10	10n polyester
C6, 26	22p ceramic
C8, 16	220n polyester
C9, 27, 28	10u 25V
C11, 20	2n2 polyester
C12, 13	33n polyester
C15, 17, 25	1u 25V tantalum
C18, 19	47n polyester
C21, 23	100n polyester
C29	220u 25V

SEMICONDUCTORS

Q1, 2, 4-7	BC109, BC549
Q3	BC179, BC559
LED	TIL 220 or similar

SWITCHES (see text)

SW1-4, 6	DPDT toggle
SW5	2 pole 4-way rotary (screened)
SW7	SPDT toggle

MISCELLANEOUS

PCB, case, phono sockets, screened cable, spacers nuts and bolts etc.

Add 100 to component numbers for other channel

Note: the PCB foil patterns for this project can be obtained from ETI offices at 145 Charing Cross Road, London WC2. The pre-amp PCB is far too large to print. The power and module appears with the rest of the foil patterns later in the issue.

the appropriate copper lands on the underside of the board.

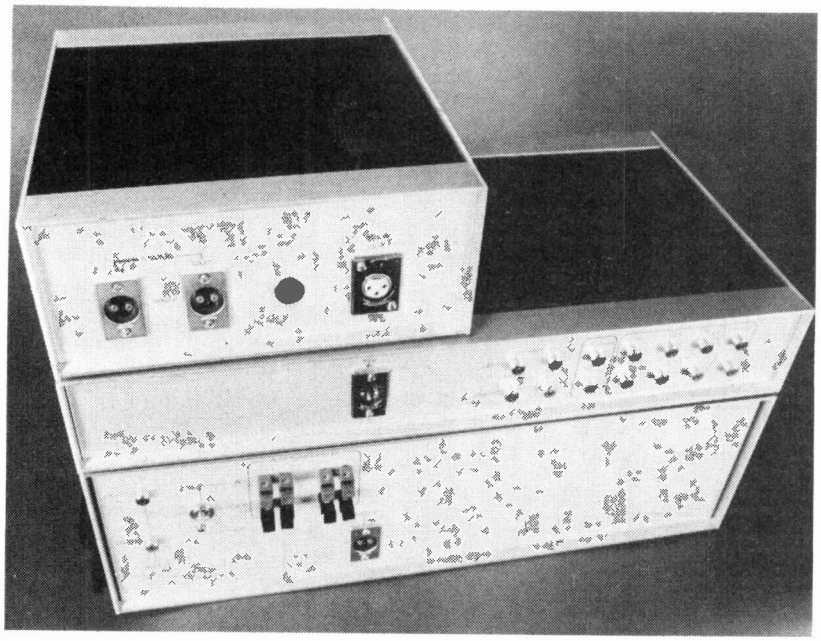
The 'earthy' side of the speaker must be returned directly to the zero volt connection of the power supply, as close to the filter capacitors as possible (preferably direct to the negative terminal). Do not connect this side of the speaker to the amplifier board.

Setting Up

Once the amplifier has been assembled and carefully checked, the bias current for the output devices must be set. Remove the fuses, F1 and F2 and connect a 100 ohm resistor across each fuse holder. Remove any input signal. Connect the power supplies and measure the voltage drop across each of these resistors. Adjust the trim pot RV1 for a reading of 2V5 across each resistor. This corresponds to a bias current of 25 mA. The reading should be nearly the same across each resistor. Next check that there is no DC voltage across the output terminals.

If the reading across each of the resistors cannot be adjusted, or if there is a DC voltage across the output greater than one volt then there is a fault and the fuses should not be inserted.

If all is well, remove the two resistors and insert the fuses. Connect the speaker and away you go.



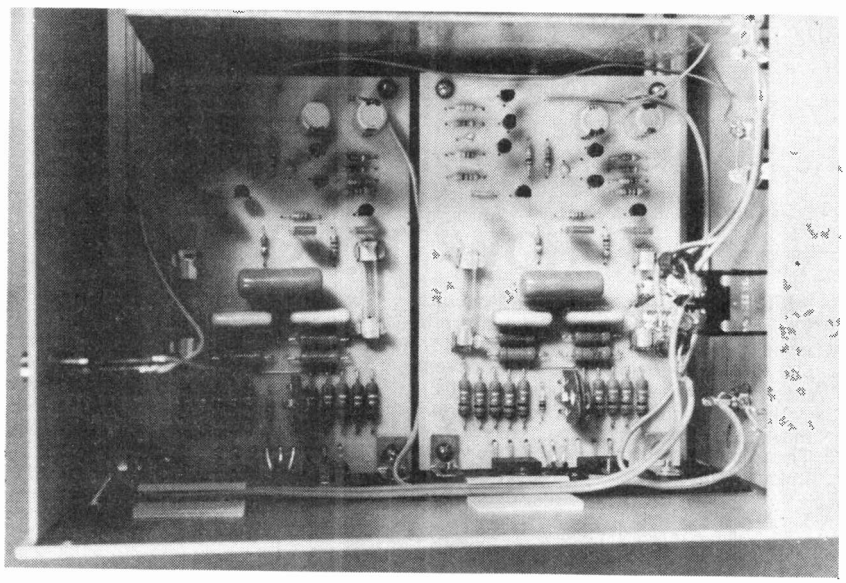
Above: the rear end of the 4000 system. Note the use of Cannon connectors for power.

Power Supply

A completely separate PSU is used for each channel, as the performance is thus greatly improved at what amounts to a small cost increase.

Assemble both the PSUs first and test thoroughly *before* connection to the power amps. Make sure that within the common enclosure the actual amplifiers are well screened from the mains carrying circuits. See photos for guidance.

DO NOT use DIN loudspeaker plugs for the output. Screw down terminals are all we would recommend, fastened as tightly as your fingers will allow! The amplifier itself is stable into any load, and so special cable *CAN* be used, but quite frankly RS 20A is just as good subjectively and neither as expensive nor as awkward to drive. A better deal all around. ▶



Right: fitting the power amps into the case. Here phono sockets have not been used, and stand-off pillars are employed to match up to the heatsinks cut into the side of the case.

BUYLINES

The cases chosen for the Audiophile amplifier was obtained from West Hyde Development (see below for address) from their CLASSIC 2 range, order as CL2 CDL (preamp case), CL2 CGL (amplifier case), CL2 AES (preamp PSU case).

The following items are available from Watford Electronics:—

TIP 142, TIP 147.

Hi-fi type switches, type TS14, TS15.

Preamp transformer 15-0-15 type 749. Amplifier module transformer 30-0-30 at 2A (also available from Electrovalue, type GP602).

All other components used are readily available from major stockists that advertise in this issue.

West Hyde Development, Unit 9, Park St., Industrial Estate, Aylesbury, Bucks. HP20 1ET.

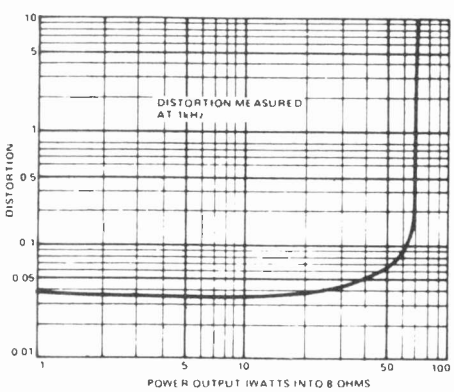


Fig 5. (Above) power output distortion for the Audiophile 4000 power amplifier.

Right: inside story of the pre-amp supply casing

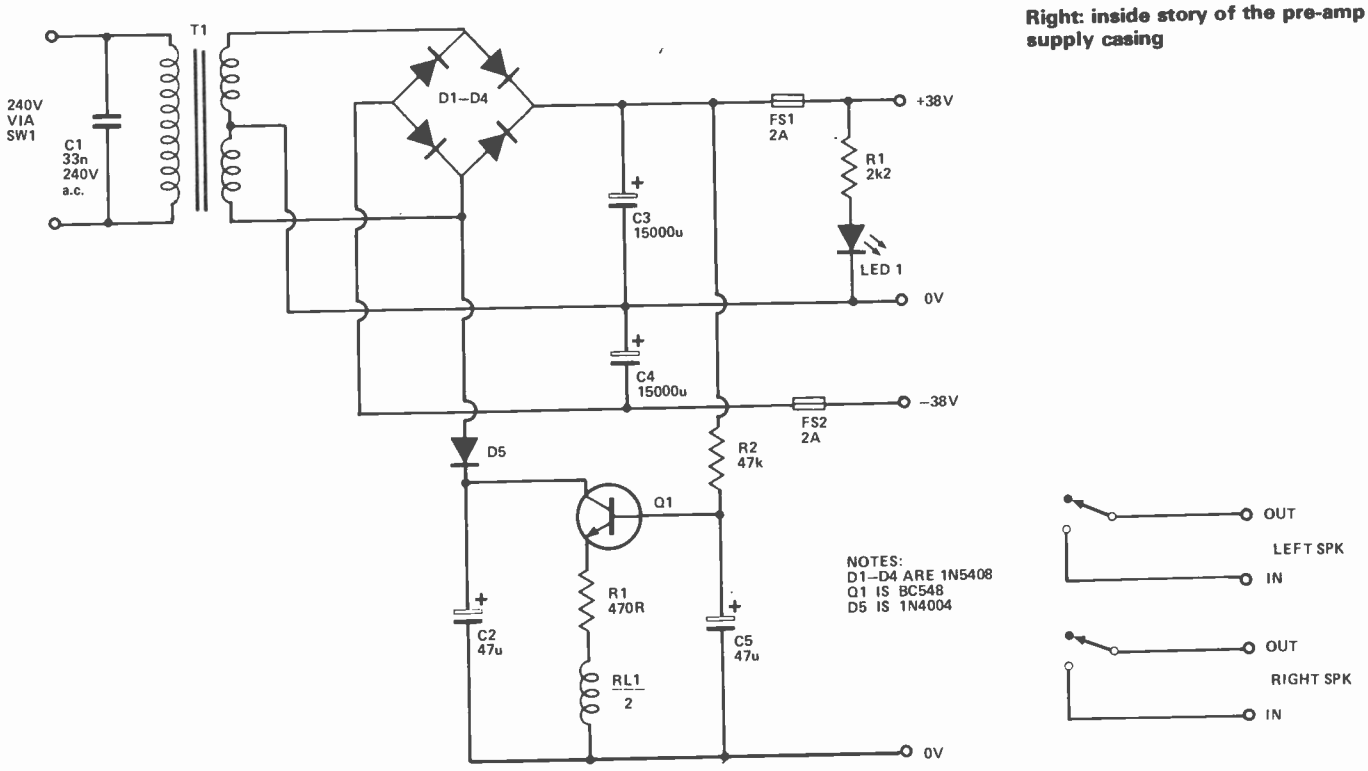


Fig 6 (above) circuit diagram for the power amplifier and de-thump sections of the Audiophile

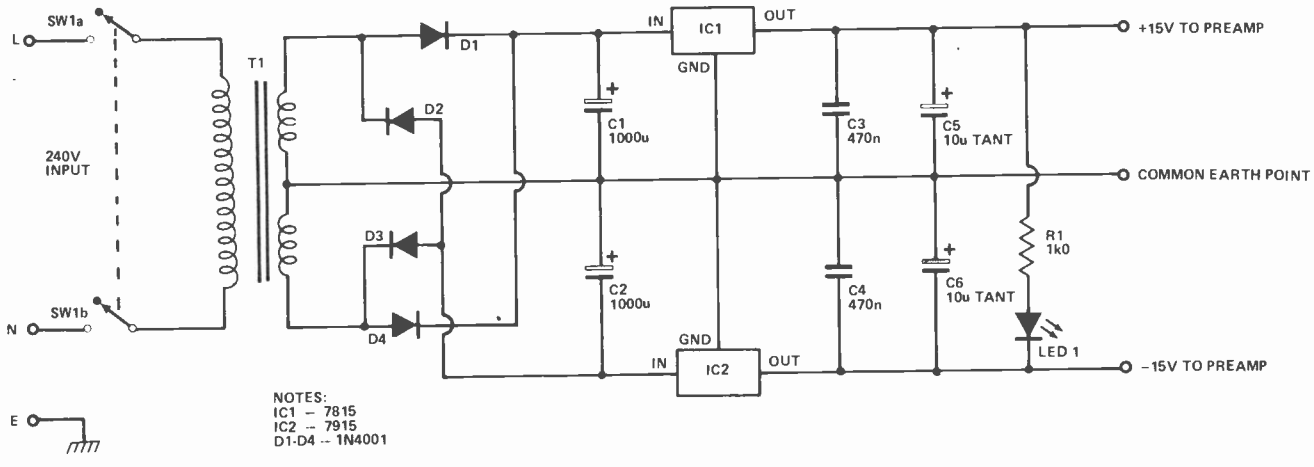
HOW IT WORKS

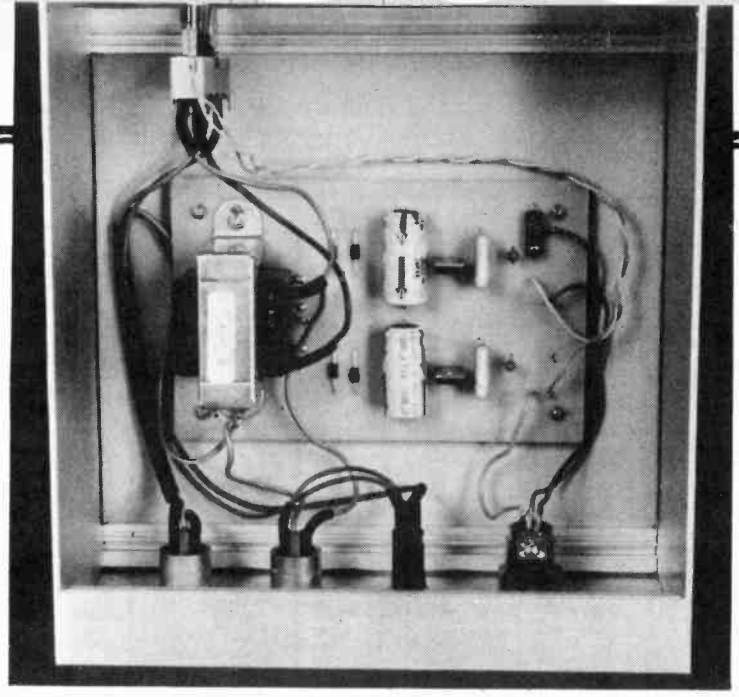
Both supplies are fairly standard circuits. The pre-amp PSU uses IC regulators to achieve good stabilisation. The capacitors C3, C4 on the output arc to prevent interference reaching the pre-amp rails.

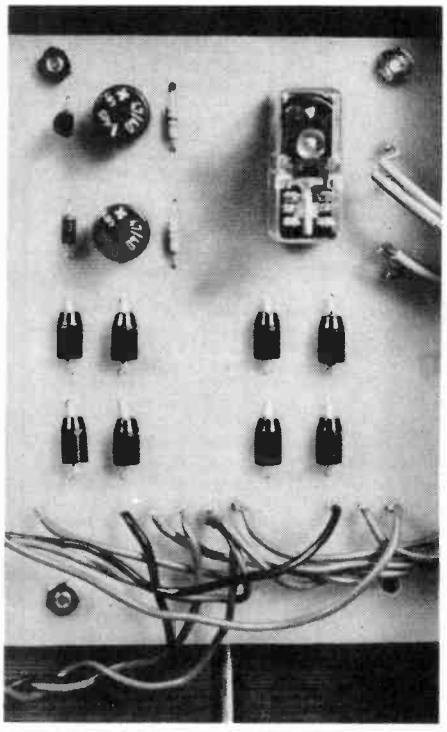
The power amp PSU incorporates two massive smoothing capacitors C3, 4. These should *not* be reduced in value. Indeed if the case chosen — and budget — will allow higher values will show advantages in sound output.

The transistor Q1 is part of an 'anti-thump' circuit which functions thus: as the power rails come up toward voltage, capacitor C5 charges via R2. Q1 conducts and pulls in RLA1 thereby connecting the loudspeakers.

Fig 7 (below) pre-amp power supply circuit.







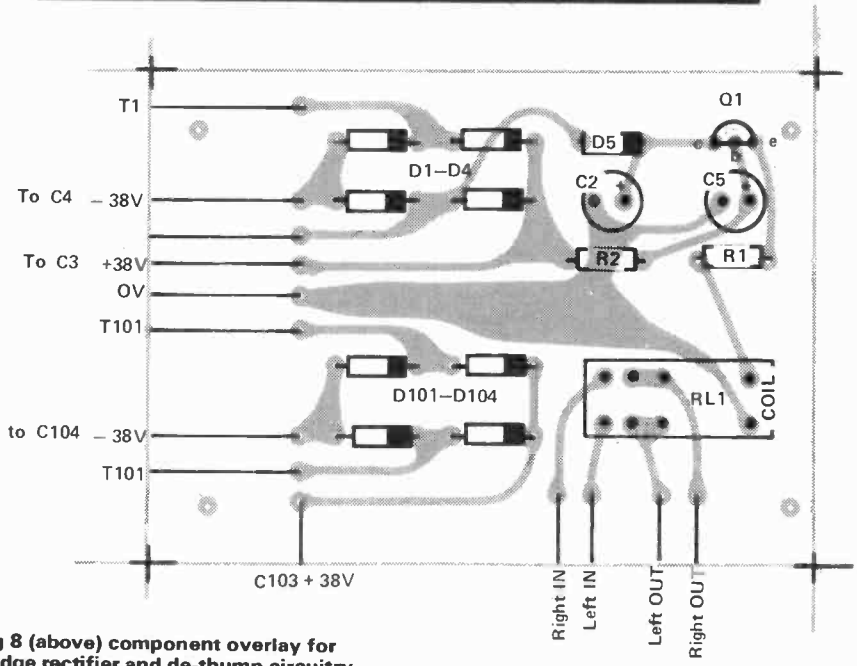
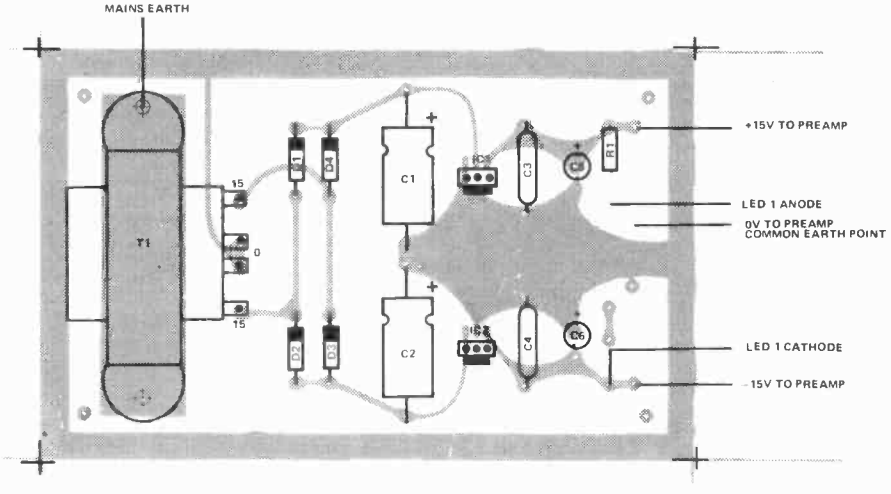


Fig 8 (above) component overlay for bridge rectifier and de-thump circuitry. Above right: the finished article
Fig 9 (below) component overlay for the pre-amp supply.



PARTS LIST

PRE-AMP SUPPLY

CAPACITORS

C1, 2	1000u 35V
C3, 4	470n polyester
C5, 6	10u 25V tantalum

SEMICONDUCTORS

D1-4	1N4001
IC1	7815
IC2	7915
LED	TIL220

MISCELLANEOUS

SW1	DPDT mains
FSI	500mA
TRI	20-0-20V secondary
PCB and hardware, case etc	
R1	1k ¼W

POWER AMP SUPPLY

CAPACITORS

C1	33n	240V AC
C2, 5	47u	63V
C3, 4	15000	63V

SEMICONDUCTORS

D1-4	1N5408
D5	1N4004
Q1	BC548
LED	TIL220

MISCELLANEOUS

R1 470R 1W, R2 47k ¼W,, T1 30-0-30 secondary, FS1 / 2 2A quick blow. RLA1 2 pole changeover 12V coil 2A contacts, R3 2K2 1W.

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SUPERSAVER 2 Hybrid Systems DAC 371-8 (8-bit) DIL packaged + data, ideal MPU users, brand new £2 price smash! now £1.75 each (fraction of original cost) P&P 20p.

SUPERSAVER 3. LM 323K Voltage regulator, 5v at 3-amp, £3.50 each. P&P 20p.

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CMOS

These cut prices for Amateur Users and Export. Note: industrial users — quantity prices available. Mostly Motorola, RCA

4000	15p	4042	75p	4089	£1.50	4419	£2.68	4531	£1.45		
4001	17p	4043	94p	4093	63p	4422	£5.00	4532	£1.27		
4002	17p	4044	90p	4094	£1.90	4431	TBA	4534	£5.13		
4006	£1.05	4045	£1.45	4095	£1.05	4433	£11.32	4536	£3.69		
4007	18p	4046	£1.28	4096	£1.05	4435	£7.93	4537L	£13.23		
4008	87p	4047	87p	4097	£3.72	4440L	£11.58	4538	£1.25		
4009	50p	4048	58p	4098	£1.10	4450	£2.67	4539	91p		
4010	50p	4049	48p	4099	£1.45	4451	£2.67	4541	£1.14		
4011	18p	4050	48p	40061	N/S	4452	TBA	4543	£1.59		
4012	18p	4051	72p	40100	£2.50	4461	£2.18	4549	£3.69		
4013	42p	4052	72p	40101	£1.61	4462	£2.42	4552	£10.55		
4014	86p	4053	72p	40102	£2.12	4490FP	£8.54	4553	£3.87		
4015	89p	4054	£1.10	40103	£2.12	4490VP	£3.48	4554	£1.19		
4016	45p	4055	£1.28	40104	£1.09	4500	£6.95	4555	78p		
4017	89p	4056	£1.34	40105	£1.06	4501	17p	4556	78p		
4018	89p	4057	£25.70	40106	61p	4502	91p	4557	£3.86		
4019	48p	4059	£4.80	40107	68p	4503	69p	4558	£1.14		
4020	99p	4060	£1.15	40108	£5.36	4505	£5.71	4559	£3.69		
4021	91p	4061	£15.67	40109	£1.02	4506	51p	4560	£1.84		
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SPECIAL: Z80 DATA PACK £14.95
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c90-page Z80 CPU Technical Manual	
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What to look for in the November issue: on sale October 5th

TECH TIPS SPECIAL

Tech Tips has always been one of the most popular features of ETI. We're certainly not short of contributions. We thought it was about time we gave Tech Tips the deluxe treatment it deserves. Next month we have an 8-page Tech Tips Special — 8 pages of your ingenious suggestions for circuit designs.

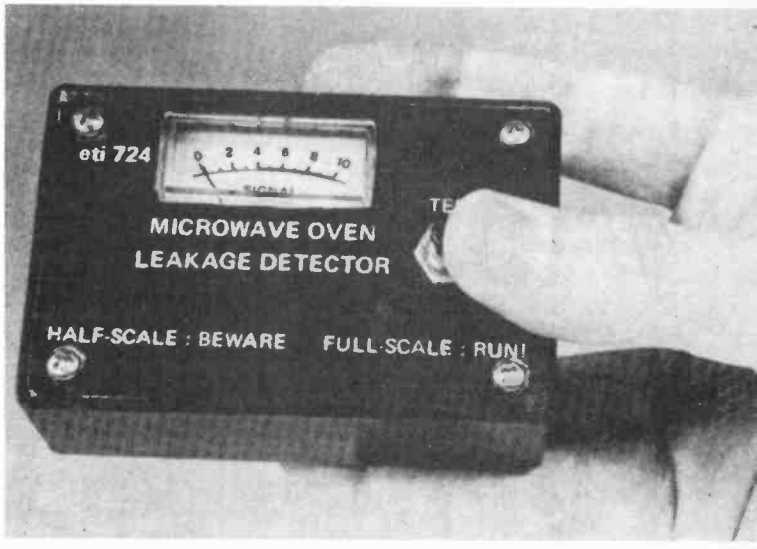
TV GAMES UNIT

Hooked on telly tennis or football? We've been carrying out some in-depth testing of (playing with) a TV games unit for you to build.

You can play pin-ball, break-out and solo target basketball. The target basketball game is particularly difficult as you not only have to stop the ball falling off the bottom of the screen, but also press a button to shoot it up towards the target at the same instant as it hits your bat.

Break-out proved to be the star of the system. You gradually knock bricks out of the wall until your ball breaks through and hits the rear wall. It bounces back at break-neck speed and — shock, horror — your bat has shrunk to half size. If you manage to clear the screen, another wall springs up.

The sneaky part is that when you reset the unit, the last score is also displayed on the screen along with your current score. So, of course you have to beat your last score — even if you have to play all night. It's addictive.



GOT A LEAKY MICROWAVE OVEN?

You don't know, do you. If you use a microwave oven a lot, you'll naturally want to know how much radiation is leaking out to your kitchen. If you glow in the dark, you've got a good idea already.

To put your mind at rest, build our microwave oven leak detector. It couldn't be simpler.

KEEP YOUR ROLLING STOCK UNDER CONTROL

We present the ultimate in train controllers. Need something to do on the long winter nights? Do your train set proud with the latest miracle from our design team's secret development lab. — somewhere in Charing Cross Road.

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OK, so now you've got the train trundling along on gleaming rails, but how do you tell it where to go? A capacitor discharge unit allows you to control up to 16 sets of points or relays.

If you prefer to put your feet up while bringing the 8.10 to a graceful halt, there's even a two-wire hand controller that lets you control four complete systems (tracks) and shows you which set of points is selected for switching.

Full details of this major model railway project will be in the November issue of ETI.

THE LM10 ~ APPLICATIONS

Following on from last month's introduction, Ray Marston takes a closer look at the revolutionary LM10 amplifier, and comes up with a whole stack of practical applications.

THE LM10 IS A REVOLUTIONARY new type of operational amplifier device that is capable of operating from single ended supplies with voltages as low as 1V1 to as high as 40V. As can be seen from Figure 1, the device contains an op-amp, a precision 200 mV band-gap voltage reference, and a reference amplifier, all housed in an 8-pin package. We introduced basic details of the LM10 in the last edition of ETI.

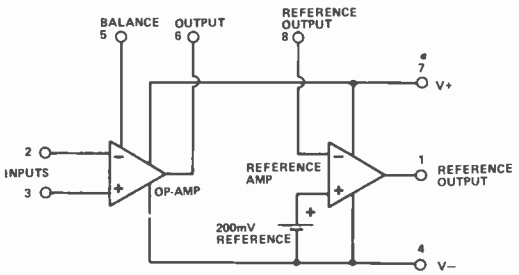


Fig. 1. connections.

In this month's article we take a look at a whole stack of practical application circuits of the LM10.

Voltage Regulator Circuits

The LM10 is, because of it's built-in precision voltage reference and op-amp, ideally suited to use in voltage regulator applications. Figures 2 to 9 show a few practical circuits of this type.

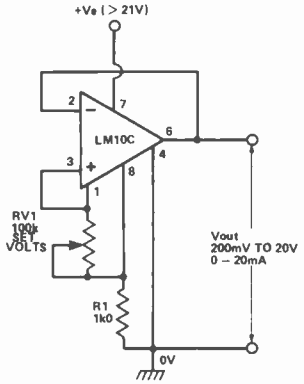


Fig. 2. The built-in reference and amplifier are used to generate a 200 mV to 20 volt potential that is fed to the input of the op-amp, which is configured as a voltage follower and boosts the available output current to about 20 mA.

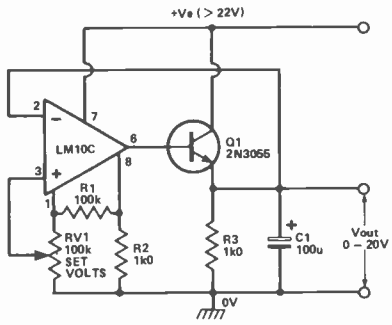


Fig 3: the reference and amplifier produce a fixed 20 volts, which is fed to pot RV1. The op-amp and Q1 are configured as a voltage follower, which boost the 0-20 volts output to current levels up to several hundred milliamps.

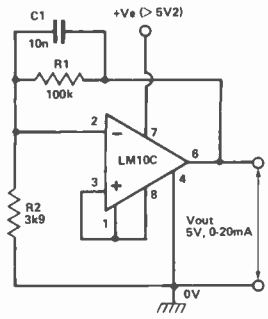
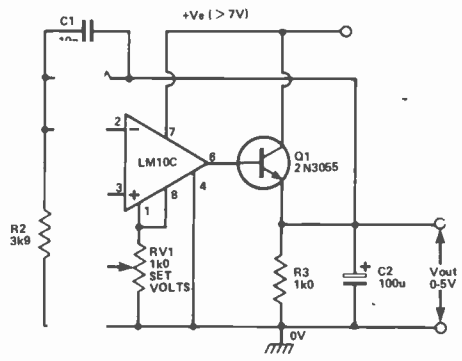
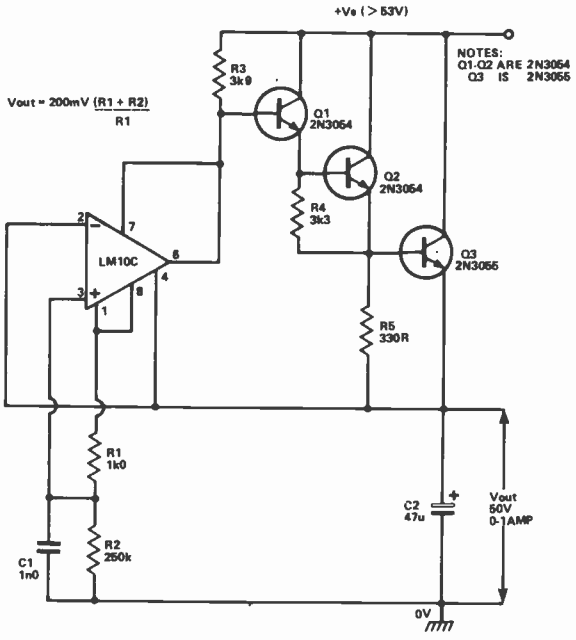
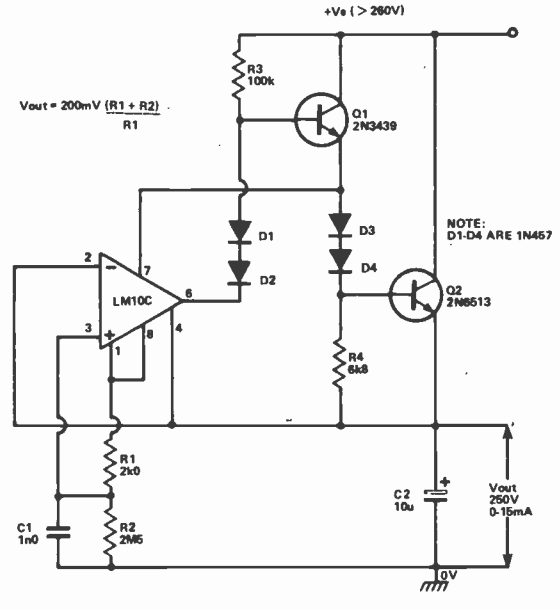


Fig 4: the op-amp input is derived directly from the 200 mV reference, to give a 5 volt output. Fig 5: the op-amp input is derived from a 0-200 mV reference, to give a 0-5 volt output.





Figures 6 and 7 show how the LM10 can be used in the 'floating' mode, to generate high output voltages. Note in both of these circuits that the IC is used in the 'shunt' mode, with load resistor R3, and that only a few volts are developed across the LM10 itself.



The LM10 can be used in a wide variety of voltage, current, and resistance-sensitive fault-indicator circuits with audible or visual outputs. Figures 10 to 23 show examples of circuits of this type.

In Figures 10 to 17 circuits, the op-amp is used as a simple voltage comparator, with its output feeding to either a LED indicator or an audible warning device via a suitable current-limiting resistor.

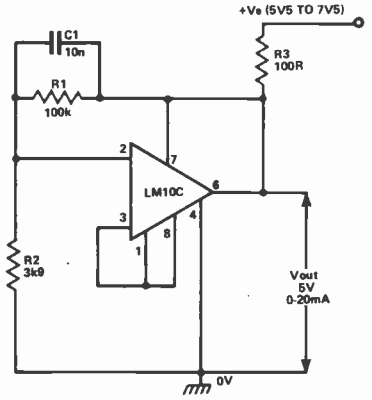
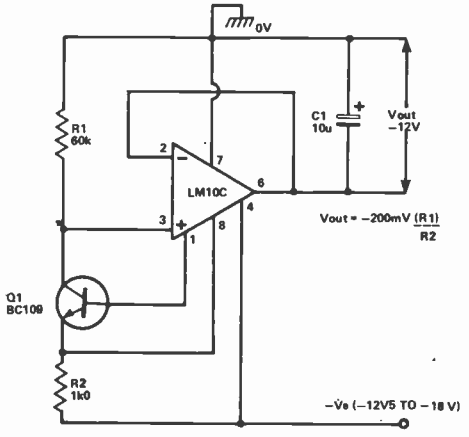


Figure 8: a simple example of the use of the LM10 as a 5 volt shunt regulator. Fig 9: how the IC can be made to act as a negative voltage regulator.



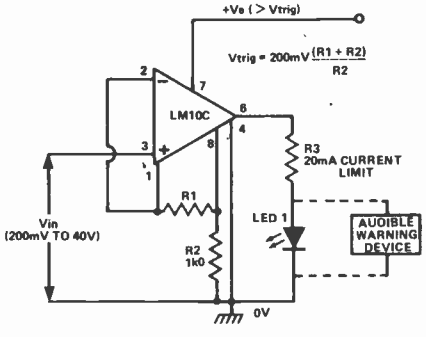


Fig 10: over-voltage indicator circuit, the test voltage is fed to the non-inverting terminal of the op-amp, and the trigger reference voltage is produced by the LM10's voltage reference and reference amplifier and is fed to the non-inverting terminal of the op-amp. ▶

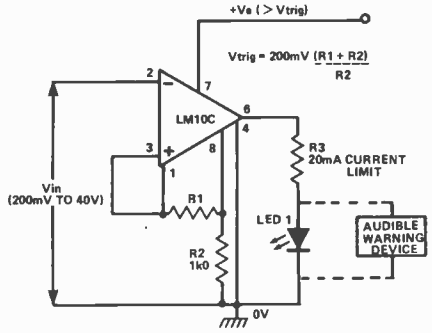


Fig 11: An alternative approach is used in the over-voltage circuit here. A 200 mV reference is fed to one input terminal of the op-amp and a potential-divided version of the test voltage is fed to the other.

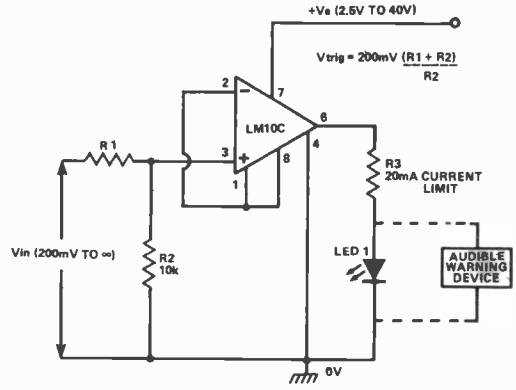


Fig. 12: under-voltage circuit is similar, except that the op-amp input connections are transposed. A feature of both of these circuits is that the LM 10 supply voltage must be greater than the required trigger voltage.

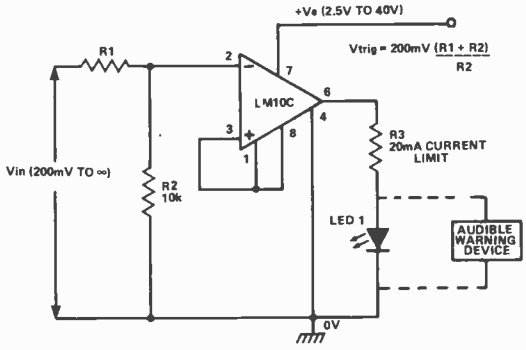
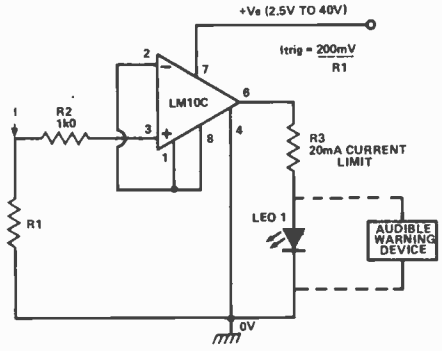


Fig 13 (above): precision under voltage indicator with LED or audible warning. Input sensitivity ≈50k/v.
Fig 14 (below): precision over voltage indicator with LED or audible warning.



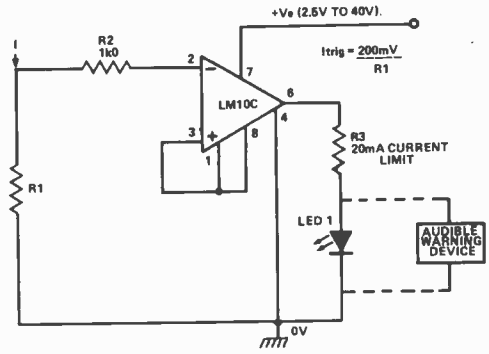
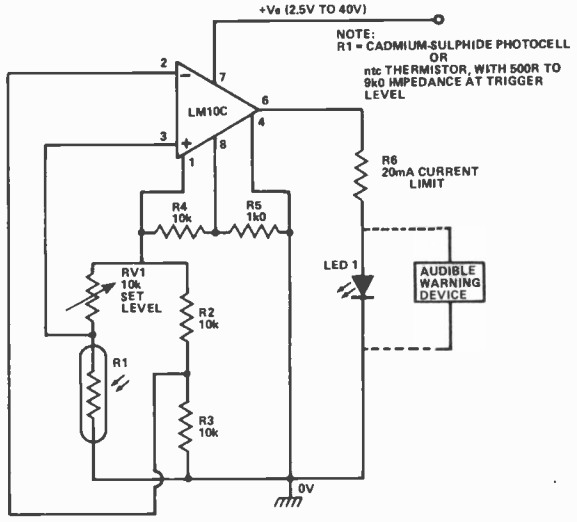
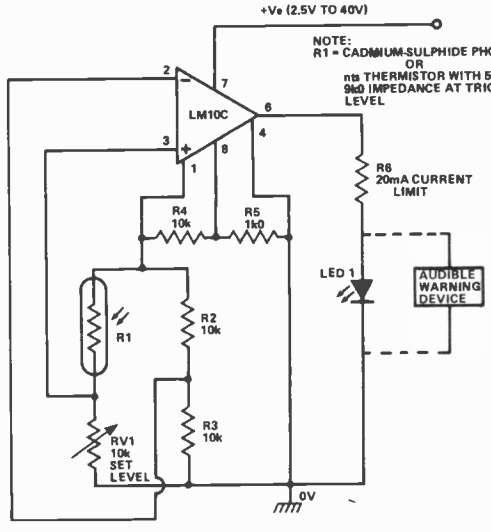


Fig 15 (above): precision under current indicator with LED or audible warning device output.



Figures 16 and 17 show precision circuits that can be triggered by any paramters, such as light or temperature levels, that can be sensed by a resistive element. In these circuits, the resistive element forms part of a Wheatstone bridge that is powered from the LM10's voltage reference amplifier, and the output of the bridge is used to activate the comparator-connected op-amp. In the examples shown, the bridge is powered from a 2V2 source.



Remote Amplifiers And 2-Wire Transmitters

One of the most interesting aspects of the LM10 is its suitability for use in remote-amplifier and 2-wire transmitter applications. The device has an output current drive capacity that is a couple of orders of magnitude greater than the devices quiescent current value, and has excellent supply-rejection characteristics. Consequently, the device can operate quite happily with its output terminal shorted to one or other of it's supply terminals, in which case the supply leads can be used to carry both supply and output signal currents.

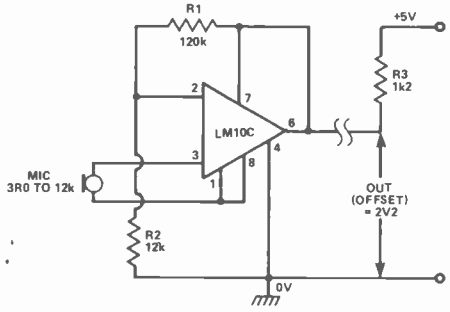


Fig 18 (above): remote 20dB voltage amplifier for use with inductive or magnetic input devices.

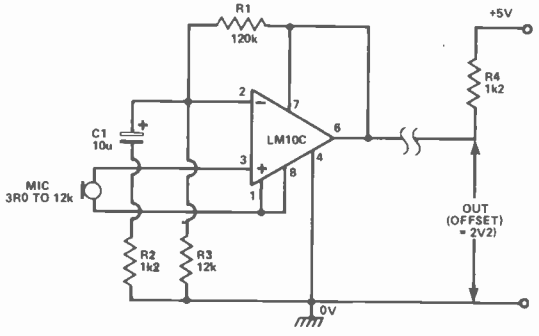


Fig 19(above): remote 40dB voltage amplifier.

Figures 18 to 21 show examples of remote linear amplifiers or 2-wire analogue transmitters. The Fig 18 and 19 circuits are suitable for use with low- to medium impedance input devices, such as moving coil or magnetic microphones, etc., and the Fig 20 circuit is suitable for use with high impedance devices such as crystal microphones or vibration sensors, etc. The Fig 21 circuit is suitable for use with resistive sensors.

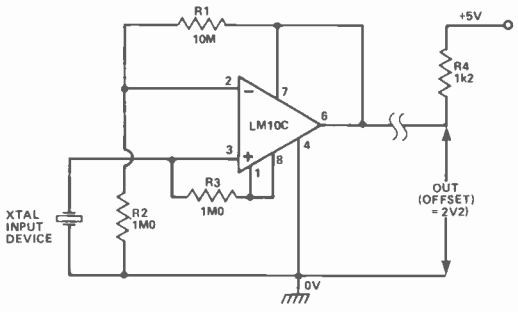


Fig 20 (above): 20dB voltage amp for use with high impedance input device.

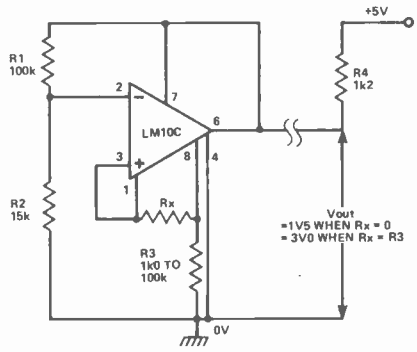


Fig 21 (above): a two-wire transmitter for use with a variable resistance sensor.

Figures 22 to 26 show the circuits of 2-level 2-wire 'fault-indicator' transmitters with either resistor, LED, or transistor outputs at their 'receiver' ends. Figures 25 to 30 show 2-wire 'fault indicator' transmitters with either flashing LED or monotone audio outputs. ▶

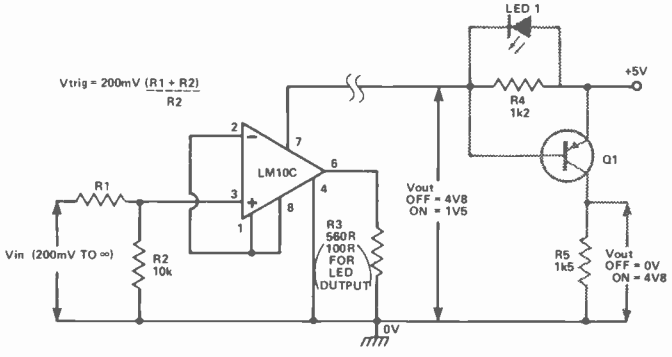


Fig 22 (above): two wire precision over-voltage transmitter with LED or resistor/transistor output.

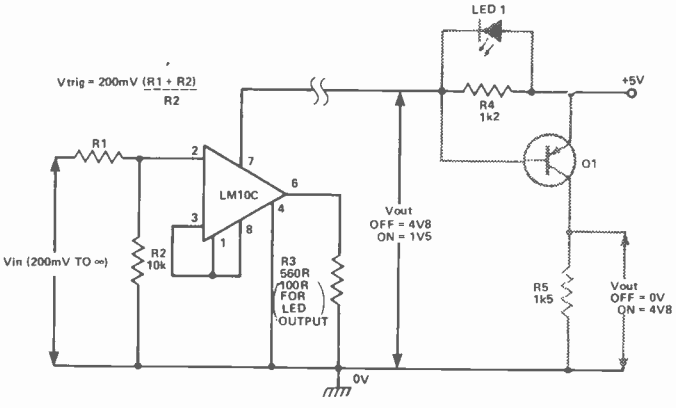
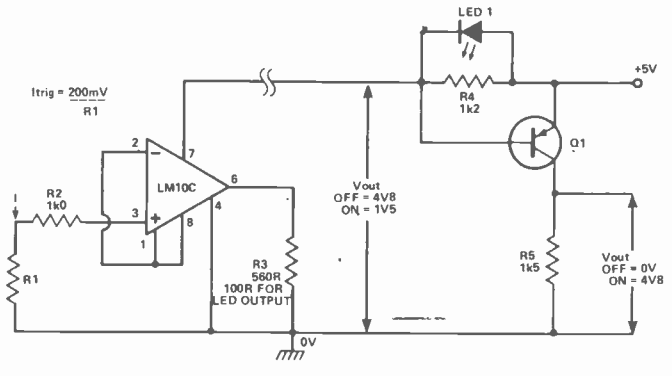


Fig 23 (above): under voltage version of Figure 22 circuit.
Fig 24 (below): over current version of basic circuit.



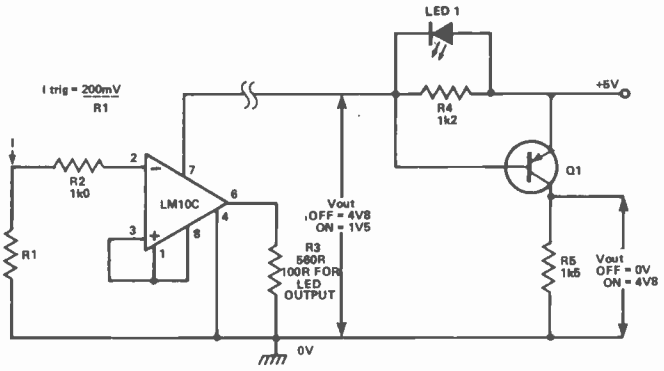


Fig 25 (above): two wire under current transmitter with LED, resistor or transistor output.

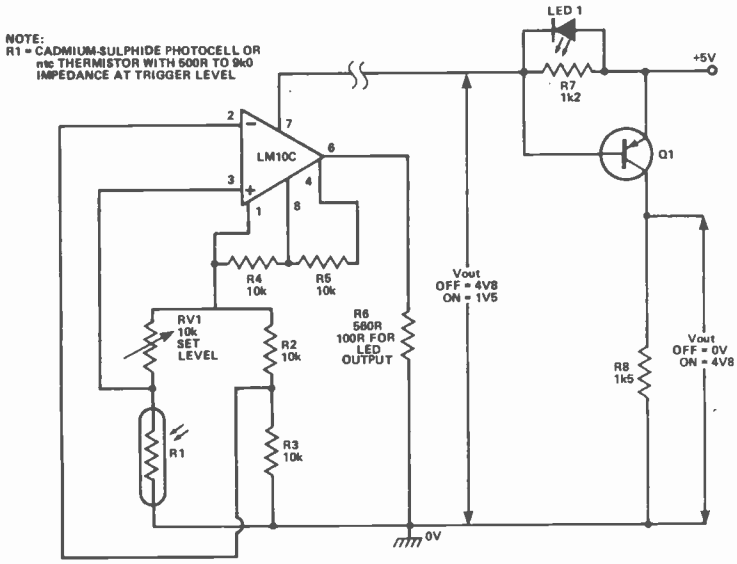


Fig 26 (above): two wire precision 'dark' or 'under-temp' transmitter with same basic outputs as previously. Transposing R1 and RV1 makes the circuit act as a 'light' or 'over-temp' alarm.

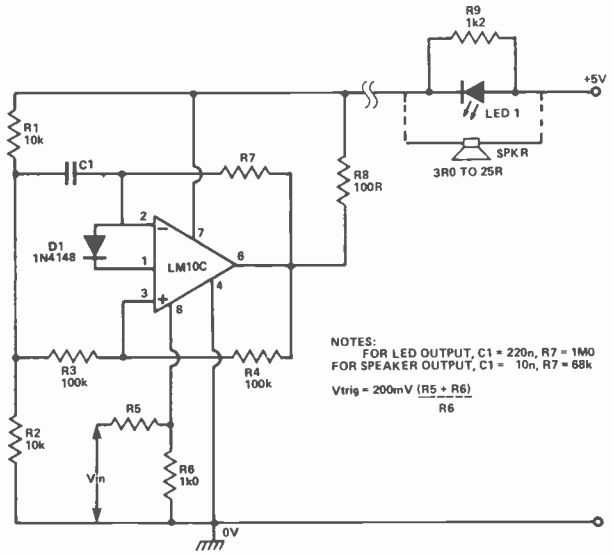


Fig 27 (above): two wire precision under-voltage transmitter with flashing LED or monotone audio output (400 HZ).

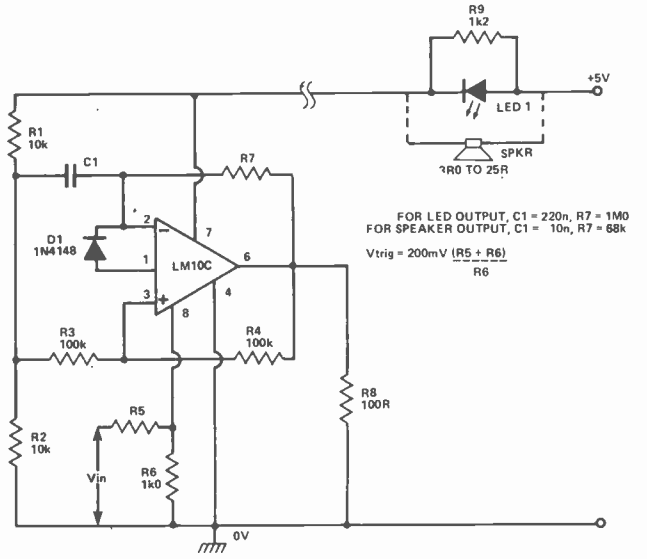


Fig 28 (above): over-voltage transmitter — output options on Fig 27.

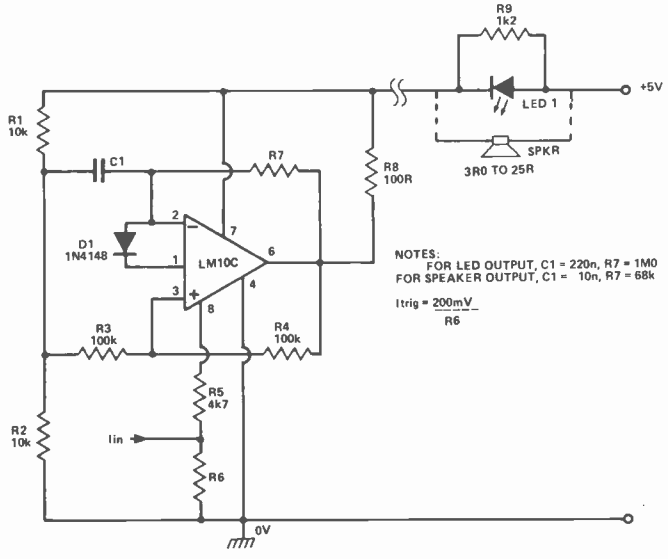
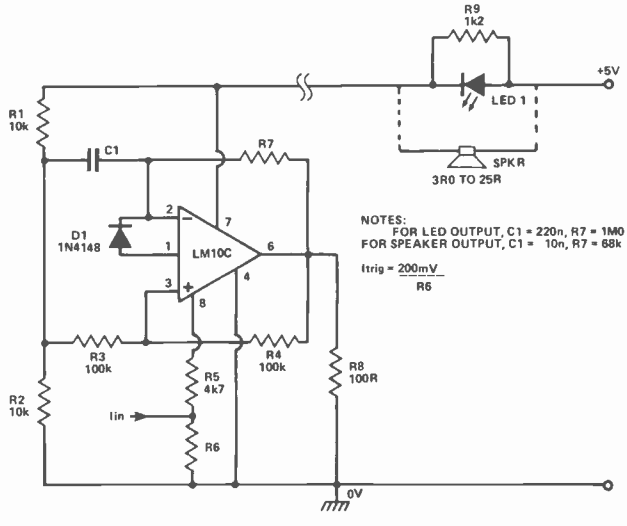


Fig 29 (above): under-current transmitter — output options as Fig 27.

Fig 30 (below): over-current transmitter — output options as Fig 27.



FEATURE: The LM10 - Applications

Meter Amplifier Circuits

To conclude this look at applications of the LM10, Figures 31 to 33 show a variety of ways of using the device as a moving-coil meter amplifier.

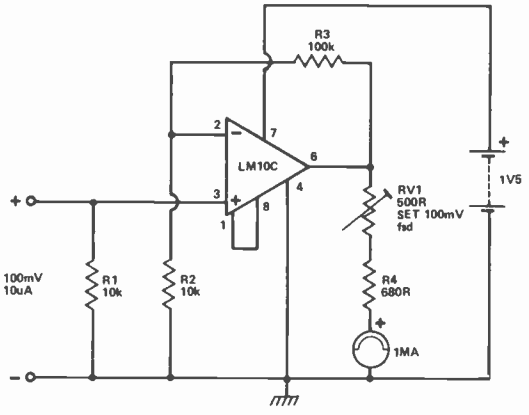


Fig 31: the op-amp is used as a simple non-inverting amplifier, and increases the meter sensitivity by a factor of about 100. This circuit has no 'set null' facility, and can give no indication of reverse-connected signals. The modified circuit of Fig 32 (below) does not suffer from this defect.

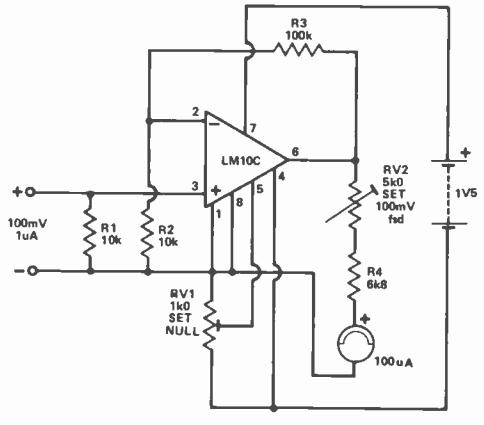
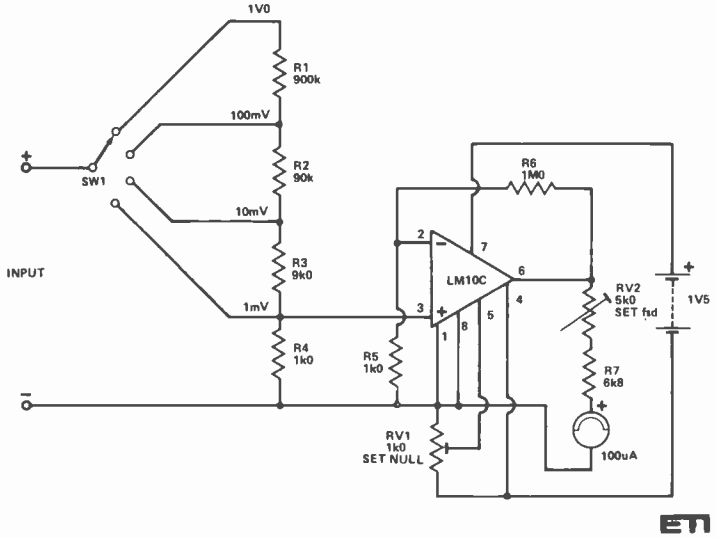


Fig 33 (below) how the basic Fig 32 circuit can be adapted for use as a four-range DC millivoltmeter. Note that these meter circuits are powered from a 1V5 cell! Not bad for an op-amp.



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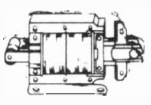

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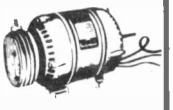

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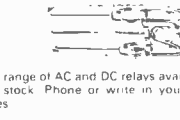

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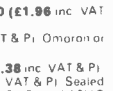

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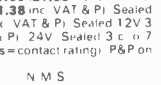

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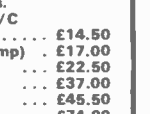
Other types available — phone for details N M S

Diamond H heavy duty AC relay 230 240V AC two c o contacts 25 amps res at 250V AC **£2.50** P&P 50p (**£3.45** inc VAT + P&P) Special base **50p.**

GEARED MOTORS

100 R.P.M. 115 lbs. ins.!!



115 lb ins 110 volt 50Hz 2 8 amp single phase split capacitor motor Immense power Continuously rated Totally enclosed Fan cooled In line gearbox Length 250mm Dia 135mm Spindle Dia 15 5mm Length 115mm ex equipment tested **£12.00** Post £1 50 (**£15.53** inc VAT & P) Suitable transformer 230 240 volt **£8.00** Post 75p (**£10.06** inc VAT & P) R&T

GEARED MOTORS

28 r.p.m., 20lb. inch 115V AC Reversible motor

71 r.p.m. 10 lb. inch 115V AC Reversible motor

Both types similar to above drawing Price either type **£4.75** + 75p P&P (**£6.33** inc VAT + P&P)

Supplied with transformer for 240V AC operation **£7.25** + P&P £1 (**£9.49** inc VAT + P&P) N M S

FRACMO MOTOR

56rpm 50lbs inch 240V AC reversible 0 7 amp sharplength 35mm dia 16mm weight 6 kilos 600 grams Price **£15.00** P&P £1 50 (**£18.98**). N M S

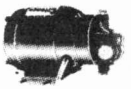
PARVALUX MOTOR TYPE S.D.2

12V DC shunt 1 30th ph motor Continuously rated 4 000 rpm **Price £10.00** P&P 75p (**£12.36** inc VAT & P) N M S

PARVALUX 230/250V AC MOTOR

Type SD18 240V AC reversible **30 rpm 50lbs** inch Price **£15.00** P&P £1 50 (**£18.98** inc VAT) N M S

CITENCO



FHP motor type C 7333/15 220 240V AC 19 rpm reversible motor torque 14 5 kg Gear ratio 144 1 Brand new incl capacitor our price **£14.25** + £1 25 P&P (**£17.83** inc VAT & P) N M S

CROUZET — 230/240V AC **2 rpm** synchronous geared motor **£2.90** P&P 30p (Total **£3.68** inc VAT) N M S

HAYDON — 230 240V AC **1 rpm** synchronous geared motor **£2.90** P&P 30p (Total **£3.68** inc VAT) N M S

REVERSIBLE MOTOR 230V AC

General Electric 230V AC 1 600 r p m 0 25 amp Complete with anti-vibration mounting bracket and capacitor O/A size 110mm x 90mm Spindle 5 16 dia 20mm long Ex-equipment tested **£3.00.** Post 50p (**£4.03** inc VAT & P)

12V DC GEARED MOTOR

Precision built miniature motor 6 12V DC operation Incredibly powerful for size

Approx speed at 6V 60 rpm 40 ma

Approx speed at 9V 80 rpm 50 ma

Approx speed at 12V 120 rpm 60 ma

Size 27mm dia 38mm length weight 55 gram Drive spindle 5 mm x 2 mm dia

Price: £2.50 post paid (**£2.88** inc VAT)

FRACMO MOTOR

1400 rpm HP 1-30 continuously rated 115V AC fitted with anti vibration cradle mounting Supplied complete with transformer for 230-240V AC op **£10.00** P&P £1 00 (Total **£12.65** inc VAT)

N M S — New Manufacturers Surplus

R & T — Reconditioned and Tested

REDUCTION DRIVE GEARBOX

Ratio 72 1 Input spindle ¼ x ½in Output spindle ⅜ x 3in long Overall size approx 120 x 98 x 68mm All metal construction Ex-equip tested. Price: **£2.00** + 50p P&P (**£2.88** inc. VAT & P)

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AC Amp, Type 62T2 0-1A 0-5A 0-20A **AC Volt.** 0-15V 0-300V **DC Amp.** Type 65C5 0-2A 0-10A 0-20A 0-50A **DC Volt.** 0 15V 0-30V All types **£3.50** ea + P&P 50p (**£4.60** inc VAT) 0-50A DC, 0-100A DC Price **£5.00** + 50p P&P (**£5.94** inc VAT)

'VENNER TYPE' ERD TIME SWITCH

200 250V AC 30 amp 2 on 2 off every 24 hrs at any manually pre-set time 36-hour spring reserve and day omitting device Built to highest Electricity Board specification Price **£9.00** P&P 75p (**£10.35**). R & T

SANGAMO WESTON TIME SWITCH

Type S251 200 250V AC 2 on 2 off every 24 hours 20 amps contacts with override switch diameter 4 x 3 price **£8.00** P&P 50p (**£9.20** inc VAT & P) Also available with solar dial R & T

AEG TIMESWITCH

200 250V AC 1 on 1 off every 24 hours 80 amp contact (ideal storage heaters) Spring reserve **£10.00** P&P 50p (Total **£12.08** inc VAT) N M S

AC MAINS TIMER UNIT

Based on an electric clock with 25 amp single pole switch which can be preset for any period up to 12 hrs ahead to switch on for any length of time from 10 mins to 6 hrs then switch off An additional 60 min audible timer is also incorporated Ideal for Tape Recorders Lights Electric Blankets etc Attractive satin copper finish Size 135 mm x 130 mm x 60 mm Price **£2.25.** Post 40p (Total inc VAT & Post **£3.05**). N M S

POWER RHEOSTATS

New ceramic construction vitreous enamel embedded winding heavy duty brush assembly continuously rated

25 WATT 10 25 100 150 250 500 1k 1 5k ohm **£2.40** Post 20p (**£2.99** inc VAT & P) **50 WATT** 250 ohm **£2.90** Post 25p (**£3.62** inc VAT & P) **100 WATT** 1 5 10 25 50 100 250 500 1k 1 5k 2 5k 5k ohm **£5.90** Post 35p (**£7.19** inc VAT & P)

Black Silver Skirted Knob calibrated in Nos 1-9 1½ in dia brass bush Ideal for above Rheostats **24p ea.**

SPECIAL OFFER BERCO type L RHEOSTAT

85 ohm 300 watt 1 86 amp **£7.50** P&P 50p (Total **£9.20** inc VAT) N M S

FRACMO MOTOR

1400 rpm HP 1 30 continuously rated 115V AC fitted with anti vibration cradle mounting Supplied complete with transformer for 230 240V AC op **£10.00** P&P £1 00 (Total **£12.65** inc VAT) N M S

N M S — New Manufacturers Surplus

R & T — Reconditioned and Tested

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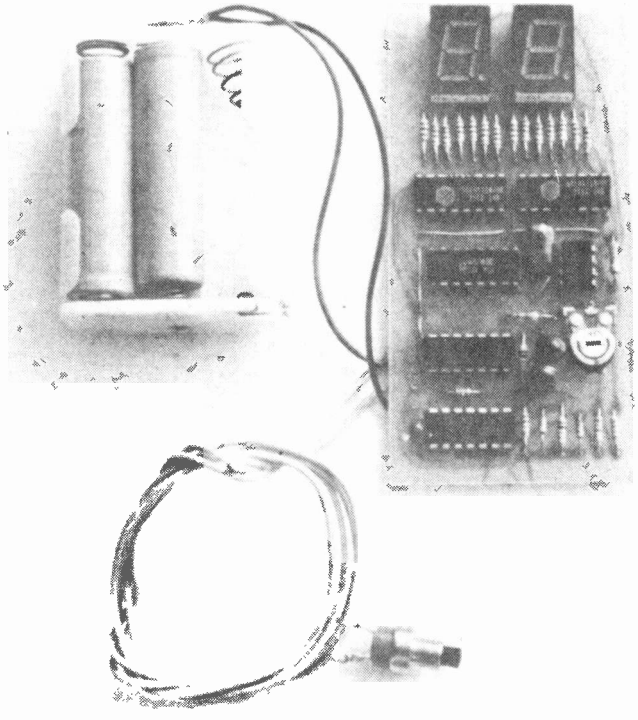
REACTION TIMER

Check your reflexes with this ingenious project

WHILE WE HAVE published reaction timers before, the feature which makes this unit unique is that it gives a random time interval between tests. This prevents anticipation causing a shorter than actual reaction time. As the prototype was built on veroboard and used 9 TTL packages plus two of the nice (and expensive) HP displays (which have the decoder on board), we decided that at least one PCB was required.

On looking at the logic involved, we saw it could be simplified without any change in operation and with the use of CMOS the power supply is less critical than with TTL.



Operation

If the unit has not been used for more than 30 seconds the display will be blank. Pressing the button and releasing it will initiate operation. When the display comes on again it will start counting from zero until the button is pressed. It should be held depressed while the time (in hundredths of seconds) is read. Releasing the button blanks the display for a random time before it comes on again, counting from zero for a second test. If the button is not pressed the display will blank after about 30 seconds to conserve power — no on/off switch is required.

Construction

We will describe only the electrical side of the project, leaving the housing details to individual tastes.

Assemble the PCB with the aid of the overlay in Fig. 1. Start assembly with the resistors, diodes and the four links. The 555 should now be fitted and soldered, followed by the other ICs. These are all CMOS and their pins should not be handled more than is necessary. As an added precaution, solder the power rails first (pins 7 and 14 on ICs 8 and 16) using an earthed soldering iron. The rest of the components can now be assembled. ▶

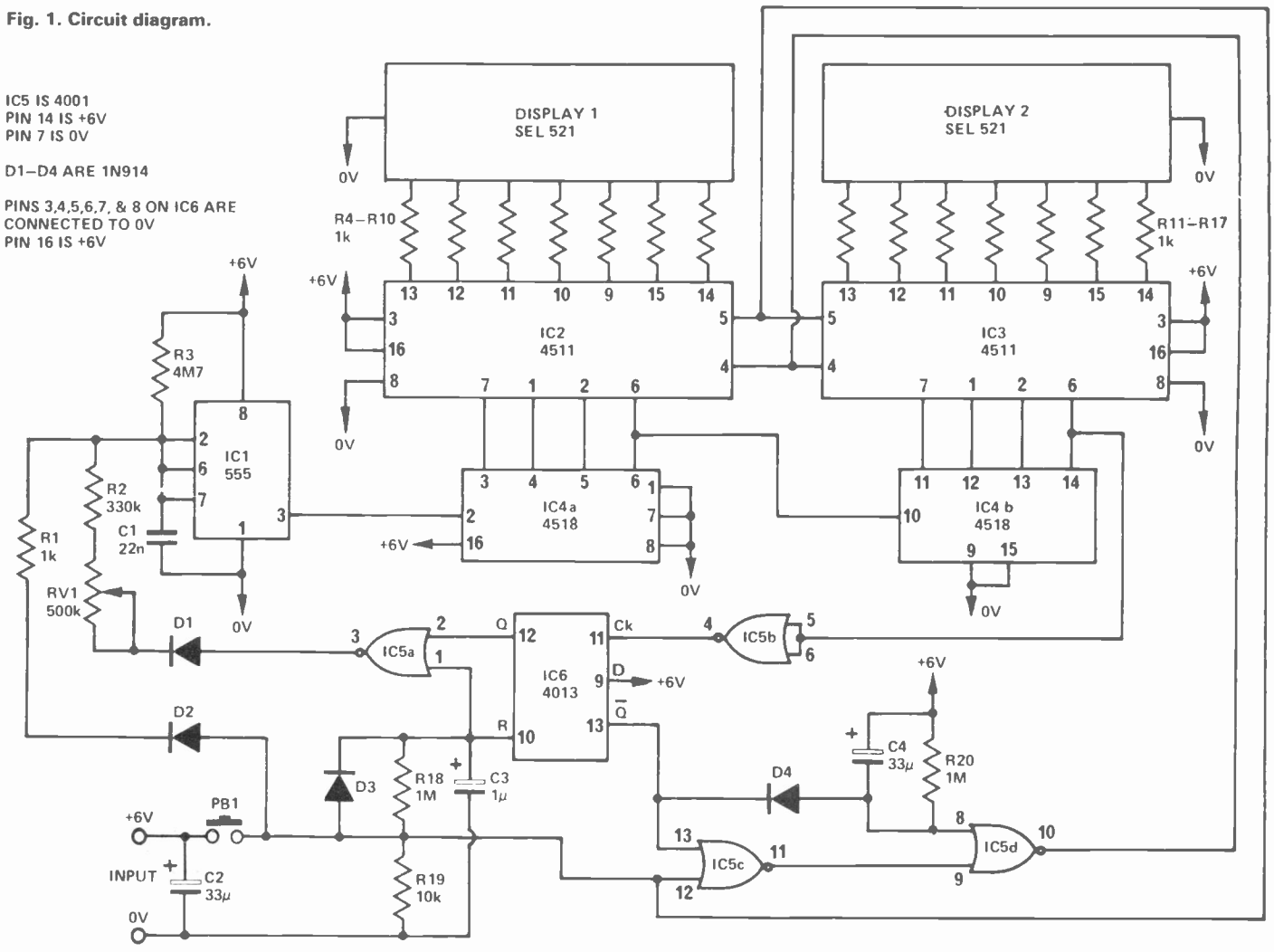
SPECIFICATION

Reaction time	**0 to 0.99 seconds**
Delay between tests	**½ to 10 seconds (random)**
Power reuiqrements	**4 to 12 volts DC**
	@ 50 mA (display on)
	@ 1.9 mA (display off)

BUYLINES

Suitable displays for this project can be obtained from any of the large semiconductor suppliers advertising in this magazine. People like Technomatic, Marshalls, Maplin, etc. Most will stock all components needed.

Fig. 1. Circuit diagram.



HOW IT WORKS

The unit is basically an oscillator, IC1, clocking two decade counters (i.e. ÷ 100), with their outputs being decoded by IC2 and IC3 and displayed on the LED displays. Control of the oscillator and displays is done by IC5 and IC6.

When the push-button is activated, IC6 is reset so that pin 13 is "0" and pin 12 is "1". Also, a "1" is applied to the latches in the decoders (IC2, 3) so that the number presented to the decoders at that instant is stored. It also applies a "1" to pin 12 of IC5c, forcing its output low. As there is a "0" on pin 13 of IC6, the diode D3 brings the voltage on pin 8 of IC5d low. Two "lows" on these gates (NOR) make the output go high. As the output of this gate controls blanking ("0" = dark), the display will be on.

The push-button also (yes, it does a *lot*) causes the 555 oscillator to run at about 50 kHz. The oscillator clocks the counter ICs — they are completely cycled 500 times per second.

When the button is released, the oscillator frequency drops to about 10 Hz. The display blanks as IC5c now has both zeros on its input, a "1" on its output and hence a "0" in the output of IC5d. The latches in the decoder ICs also open, although counting cannot be seen as the display is blanked.

After about ½ sec the voltage on the reset input of IC13 (pin 10) falls below the threshold level, allowing it to be toggled by the clock input (pin 11). As when the push-button was released, the counters (IC4) could have started at any count, the time until the voltage on pin 14 of IC4 goes low is random. The delay on the reset line going low is to prevent IC6 from being toggled too soon.

When IC6 is toggled (after ½ sec to 10 sec), pin 13 goes high and pin 12 low. IC5a now has two lows on its input, giving a "1" on its output. This raises the oscillator frequency to 100 Hz. The "1" now on pin 13 of IC5c gives a "0" on pin 9 of IC5d and a "1" on pin 10. This brings the display back on. As IC6 can only be toggled on the overflow of IC4, the display comes on at the zero count.

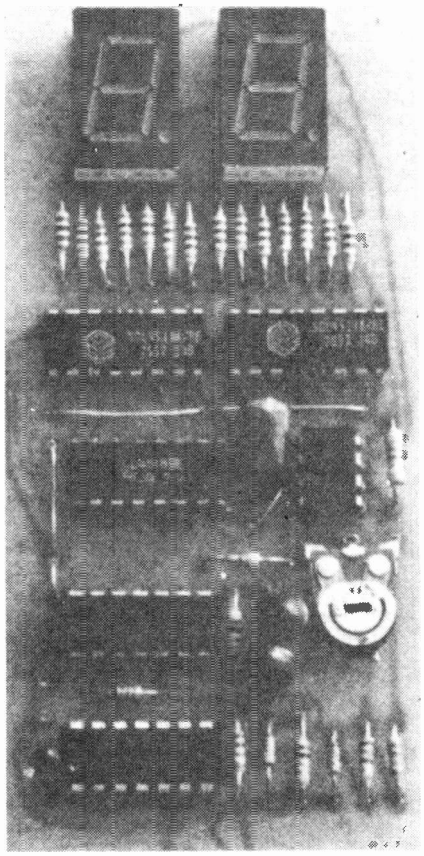
The display continues counting up at 100 Hz until the button is pressed, freezing the display to indicate reaction time. The whole thing is then repeated.

If the button is not pressed for more than 30 sec the voltage on pin 8 of IC5d will go above the high threshold, forcing the output low and thus blanking the display.

PARTS LIST

RESISTORS	all ¼W 5%
R1, 4-17	1k
R2	330k
R3	4M7
R18, 20	1M
R19	10k
POTENTIOMETERS	
RV1	500k trimmer
CAPACITORS	
C1	22n polyester
C2, 4	33u 16V tantalum
C3	1u 16V tantalum
SEMICONDUCTORS	
IC1	555
IC2, 3	4511
IC4	4513
IC5	4001
IC6	4013
D1-3	1N914
DISP1, 2	SEL 521 or similar "jumbo" LED

MISCELLANEOUS
PCB, box to suit, push to make pushbutton
6V battery and holder



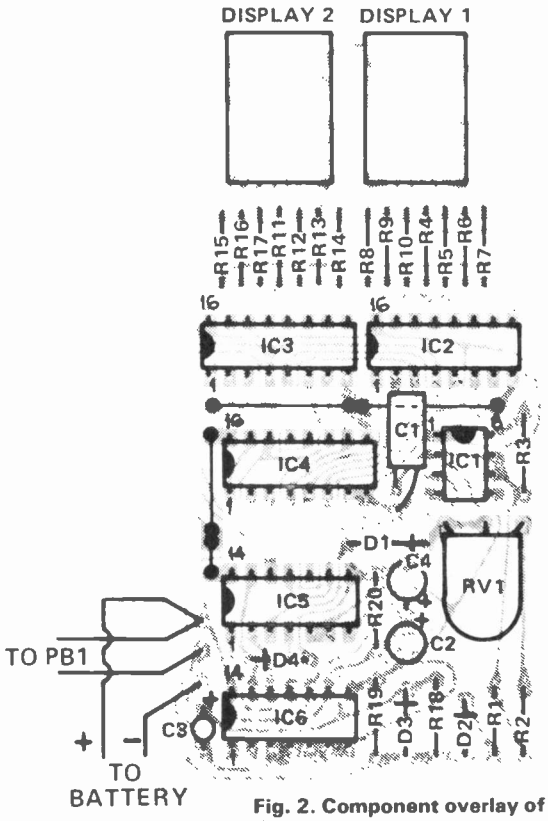


Fig. 2. Component overlay of the reaction timer.

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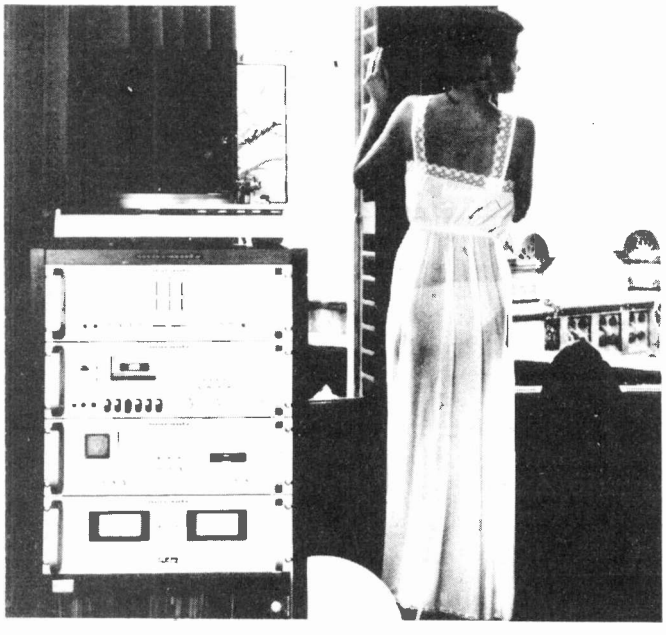
audiophile.....

Competition results, a new amplifier manufacturer and a totally new concept in loudspeaker design. Ron Harris considers . . .

MANY THANKS to all the readers who entered the Audiophile competition a while back.

Entries ranged from outright unprintable (but mostly hilaraious) to outright obscure. All but displayed a wit of which Oscar Wilde would have been proud. In consequence I chose four runners-up all of whom will be receiving copies of Top Projects No 7 as some consolation.

The winning entries are given below, Mr Percival's triumphant ditty first:—



"Oh maid so beautious and so fair,
What vanity makes you look out there?
The whistle was not from a handsome blade,
But from your hi-fi, wrongly played!"
F. PERCIVAL
SALE
CHESHIRE

"I know it's wrong to doubt, but does my husband's fidelity match up to Marantz?"
S. IBBS
WOLVERHAMPTON
W. MIDLANDS

"It's transparently obvious that this unit has class — you don't need statistics to see there's no distortion."
P. HORSFALL
SALE
CHESHIRE

"Now, if I can just find a SPEAKER salesman . . ."
P. PARSONS
BATH
AVON

"Complete home entertainment for the discerning amateur."
S. GILLBARD
DYLOE
CORNWALL

Well done one and all

Now all I want is someone to offer ME a chance to enter a competition, with dinner at San Martinos with Felicity Kendal as the prize.

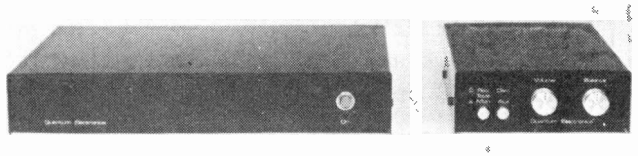
●

Quantum Jump

Formation of new audio companies is always good to see. Quantum Electronics is a new name in the DIY amplifier market, being an off-shoot in both personnel and (developed) product from another VERY well known module manufacturer.

Quantum sell kits in the main, but will supply ready built units upon request. In kit form the amps arrive as tested PCBs metwork and output transistors. Couldn't be easier really. The pre-amp is of the 'Naim' species lacking tone controls and other frills.

Assembly of any of the range seems to consist of bolting in all the bits and wiring up inputs and outputs to the PCBs.



There are four amplifier variations and two pre-amps (moving coil and 'normal'). Prices range from £67.81 for the (mono) 45W P1 up to a mere £99 for the stereo 110W P4. RMS of course.

Tests will be under way soon, and Audiophile readers will hear the results very shortly I hope. Meanwhile if you're interested Quantum are existing at Stamford House, 1A Stamford Street, Leicester — from which the eagle-eyed will be able to infer which module company Quantum is sired by!

●

Speaker Speaker

The following is from a letter I received from a reader named Mr H. Lipschutz. It outlines a brand new form of loudspeaker design he has pioneered (no pun — honest) and makes very interesting reading indeed.

Anyone — manufacturers for example — wishing to contact Mr Lipschutz can do so c/o Audiophile.

Description

The low frequency output of a speaker does not depend on size of box but on size of cone area. This can be quadrupled for a given size of box by mounting drivers in the four usually unused side walls. The combined increase in efficiency due to this, and the direct coupling of low-cost power-ICs to each driver from a common electronic cross-over/12db per octave attenuator (to attenuate excess output at higher frequency), is traded off against loss due to operating woofer below resonance frequency, while medium/high frequency driver(s) are operated above resonance frequency. Thus neither is influenced by resonance effects. Cost of multiple drivers and ICs is saved on box and usual cross-over.

Result is: Small box, but output equal to unit several times its size.

There is no getting away from the fact that loudspeaker development, in terms of distortion, efficiency, and size, is well behind the rest of the hi-fi chain, even if the better speakers sound quite 'nice.' It is debatable which of the parameters needs improving most, but I decided that to reduce size without impairment of the other parameters would be a good start, especially as most buyers of hi-fi speakers would prefer the convenience of small size when given the choice, provided everything else was equal or even better than other speakers.

I therefore decided to develop such a speaker. As the problem of size is normally associated with the woofer and its box, my approach was concentrated upon that area.

To avoid cancellation of the pressure waves front and rear, bass drivers have to be enclosed in a box, the size of which is normally governed by

a) the requirements of resonance of the system as a whole, and

b) the cone area, which ideally should increase in line with the increase in wavelength towards the lower bass.

As below 125 Hz sound directivity is minimal, it did not matter which way the driver(s) faced; it was therefore possible to increase cone area at least fourfold without increase of box size merely by utilizing four sides of the box. The result — a considerable improvement in efficiency. The enclosure comes into its own mainly when used as a resonator, when it is intended to use resonance in order to boost output at a particular frequency, usually the lowest for which the system was designed.

This, however, required large size, which was therefore decided by the laws of physics. While it is convenient to use resonance of the systems for this particular purpose, it is not necessarily the only, or best way.

It has been stated in a number of textbooks and magazines that it is for all practical purposes impossible to force a great deal of electrical power into a speaker from an amplifier at frequencies below their main resonance, and that vastly greater distortion is produced below this resonant frequency, as well as speakers becoming very inefficient at generating sound output, so that normal designs suffer a great drop in output just where a peak is required, and distort badly as well.

This, however, is not the result of physical laws per se, but due to the limitations of the particular design. Clearly the normal bookshelf air suspension design with its 'enormous' 8-inch driver, and design resonance at approx. 75 Hz would attain maximum cone excursion at this very same frequency, caused and helped by resonance of the system. In order to move correspondingly further in and out, which it cannot do without hitting its end-stops, quite apart from the fact that in its work to compress and rarefy the enclosed air it now does not get any help from the effects of resonance.

If, however, it is designed to attain its maximum excursion at 32 Hz, regardless of whether it is helped to do so by resonance effects or not, then this is a different matter, although its movement at resonance, now being far too much, would have to be controlled. This can be done most conveniently by making the box so small that system resonance falls *above* the cross-over point, i.e. above, say, 125 Hz.

Accordingly a speaker with these features was built, with quadrupled cone area, utilizing four sides of the box, active cross-over before the amplifier, in order to avoid power loss in the usual passive cross-over; and the gain in acoustical efficiency traded off against the absence of the usual gain from resonance, with the cross-over frequency at 125 Hz, and a roll-off of 12 dB per octave towards the high end in order to compensate for the increase in output due to the large cone area compared to the smaller wavelength towards 125 Hz.

The result was a speaker of similar efficiency to a transmission line speaker of 10 times its volume with the additional advantage of quadrupled voice-coils (connected in series/parallel) affording four times the heat dissipation capabilities of comparable normal designs, and therefore increased output reserve.

Furthermore, since the 'box' only consisted of not much more than a frame for the four drivers, it was extremely cheap and simple, and quite stiff as well.

Ideally each driver should be driven by its own amplifier.

In listening tests, compared to highly recommended professional monitor speakers, every listener so far has preferred the sound of the prototype, thus proving that the size reduction did not result in loss in any other parameter.

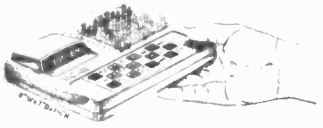
This principle has meanwhile been further developed, and patents are pending for new types of drivers, which permit an increased efficiency estimated to be more than tenfold over conventional systems, thus making possible the design of a speaker which combines small size, extended bass and very high efficiency — design parameters which until now have been considered to be mutually contradictory.

It is intended to follow this development with the construction of an advanced speaker, in which distortion and linearity is improved likewise by a factor of ten at least, thus bringing it more in line with the quality of the other links of the audio chain.

Provis. Patent applied. H. Lipschutz

ETI

BORIS DIPLOMAT



Travelling Chess Companion
£94.50 inc. VAT cwo

BORIS DIPLOMAT is the world's most portable personal chess companion. His compact size and battery operation make him perfect to slip into a briefcase.

The **BORIS DIPLOMAT** is the only full featured chess computer with complete Rank Display and Position Verification. He'll play at a level to teach a child, or let him loose, and he'll keep the attention of the Master.

BORIS DIPLOMAT is the perfect teacher and opponent. As a teacher, he'll guide you through your first game by suggesting the best moves. An exclusive Position Programmer allows you to set up problems, or remove pieces for handicapping.

BORIS is unlike any other game you've played. With his seemingly-human brain he can play for or against you. He knows all classic chess moves including castling and en passant, and features a built-in chess board.

Operates up to eight hours on 6AA alkaline batteries (not included). Operates on AC adaptor, included. Size: 8" x 7" x 1½" (20.3 cm x 17.78 cm x 3.81 cm).

DELUXE BORIS at **£175.**

KRAMER & CO.
Dept. ETI, 9 October Place, Holders Hill Road, London NW4 1EJ. Tel. 01-203 2473. Telex: 888941. ATTN. KRAMER K7.

Mail order only. Send SAE for data sheet. Callers by appointment. Barclay & Access by arrangement.

CALCULATORS

CASIO SCIENTIFICS

FX80	£15.95
FX48	£13.95
FX58	£22.95
FX2500	£18.95
FX3100	£22.95
FX8000	£27.95

LCD PROGRAMMABLES

FX501P 128 steps. 11 memories	£45.95
FX502P 256 steps, 22 memories	£62.95
FA1 ADAPTOR for prog. and data storage on cassette recorder	£19.95
TEXAS T158	£146.95
TEXAS T159	£58.95
PC100C Printer for above	£122.95

CANON CALCULATORS

LC8M LCD Pocket	£13.95
L813 Small Desk	£25.00
P21 Print Out	£69.95
P21D Print and Display	£79.95
L1217 12-digit full feature desk	£74.95
P1014D Full feature desk print and display	£102.95

DECIMO

BOSS Print out	£69.95
BIG BOSS Print and Display	£79.95
POCKET MEMO	£48.95

All prices inc. VAT AT 15% and postage and packing.

CALCULATOR SALES AND SERVICE
ARROW WORKS, ARROW ROAD
REDDITCH, WORCS. B98 8NN
TEL. REDDITCH (0527) 43169

Car Audio

Manual MW/LW

Full medium and long wave tuning. Complete with speaker and mountings. Suitable for positive or negative chassis. Latest model.

£10.25 + £1.00 Post

Push-Button MW/LW

One LW, four MW buttons plus manual tuning. Complete with speaker and mountings. Latest model, negative chassis only.

£15.95 + £1.00 Post

Stereo FM/ Cassette + MW

Standard cassettes and FM in stereo plus medium wave. Tone and balance controls. Fast forward facility on tape. Adjustable shafts. Suitable for 4 or 8 ohm speakers (not supplied). This model is discounted elsewhere at £50 up.

£40.95 + £1.00 Post

Stereo Speaker Set

Suitable for above stereo unit. Good quality in surface mounted casing, 5W nominal, 8W peak.

£4.00 (pair) + 70p Post

Telescopic Car Antenna

Multi-section standard type, suitable for angled mounting with locking key.

£1.60 + 30p Post

Metal Detectors

Treasure Tracer Mk III

The original Treasure Tracer. Sales exceed 7,000. 5-transistor circuit with Varicap tuning. Sensitive, stable BFO design. Built-in speaker and earphone. Fitted with Faraday shield. Kit supplied with pre-built search head.

Kit. £18.60 + £1.00 Post
Built £23.95 + £1.00 Post

★ Induction Balance Model

Built with sensitivity up to 10in on single coin; fitted with speaker and meter; PP3 battery; 7in dia. search head. Telescopic stem. Excellent pin-pointing, positive reaction to non-ferrous, negative reaction to iron. This model's normal price is £39.95!

£24.50 + £1.00 Post

All goods guaranteed one year. 10-day money-back offer. Goods ex-stock at time of going to press. Callers by appointment only please. Send s.a.e. for illustrated leaflet.

Minikits Electronics Ltd.
6E Cleveland Road
S. Woodford
London E18 2AN

CALCULATORS

SCIENTIFIC

★ SPECIAL OFFER
TEXAS T159 together with PC100B
(Complete as manufacturer's specifications)
£285.00

TEXAS / HP Accessories available

★TEXAS T159 (New Card prog 960 prog steps of 100 mem)	£156.50
★TEXAS T158 (New Key prog 480 steps or 60 mem)	£60.00
★TEXAS PC100B (New updated Printing Unit for T158 / T159)	£140.00
★TEXAS T157 (Key Prog 8 mem. 150 Keystrokes / 50 Prog Steps)	£25.00
TEXAS T133 (New — same spec. as T130, but 3 mem)	£13.95
★TEXAS T145 (New updated version of the Texas T140)	£19.95
★TEXAS 42MBA (10 Dig Fin / Stat Prog 12 mem 32 keystrokes)	£42.95
★TEXAS TI PROGRAMMER (Hexadecimal Oct)	£46.50
★TEXAS T151 / iii (New 8 Dig + Exp 10 mem 32 Prog Steps, Stat / Sci)	£26.30
TEXAS T150 LCD (Sci / Stat. 2 Con Mems)	£23.00
TEXAS T125 LCD (Sci / Stats)	£18.50

Make more of your
Texas T158 / 59 Calculator
MATH / UTILITIES MODULE
If you write your own programs this library is for you! Most programs in this library are designed to be used either on their own or as subroutines of your programs.
Applications range from utility programs such as printer formatting and large-scale plotting to advanced mathematical routines.
Module includes:
Prompter. Alpha Messages.
Printer Formatting. Superplotter.
Sorting. Data Arrays.
Data Packing. Prime Factors.
Hyperbolic Functions.
Gamma / Factorial.
Random Numbers.
Normal Distribution.
Interpolation. Roots of a Function.
Minimax. Romberg Integration.
Differential Equations.
Discrete Fourier Series.
Calculator Status.
Variable Arithmetic
Module Check.

★TEXAS T158 with Maths / Utilities	£90.00
★TEXAS T159 with Maths / Utilities	£188.50
★TEXAS T158 with Applied Statistics	£80.00
★TEXAS T159 with PC100C & Applied Statistics	£305.00

AUTUMN SALE
★TEXAS T159 Calculator (complete as manufacturer's spec., master module, charger, etc.), *PLUS* statistics module and extra set of 40 Blank Prog Cards with wallet, etc.
ONLY **£180**

★CBM 9190R (as 4190R but with 9 memories)	£27.50
★CBM Pro 100 (72 Step Prog)	£29.50
★HP33E (8 mem Pro Sci / Sta)	£49.00
★HP32E (Advanced Sci with Statistics)	£37.00
★HP31E (New Sci replaces HP21)	£25.00
★HP67A C Prog 224 Steps 26 Mem)	£190.00
★HP97A (Fully prog with Printer)	£399.00
CASIO AQ2000 (updated AQ10D0 Cal. 3-Way Stopwatch / Alarm plus Date Calendar)	£22.00
CASIO FX3100 (LCD Sci Std / DP / Rec.)	£22.50
CASIO FX8000 (as above + Stop Watch / Alarm)	£27.73
★CASIO FX202P (127 Step Sci Progs Con Mem)	£44.50
CASIO FX501P (Sci. LDC Prog. 128 Steps. 11 Mem)	£46.00
CASIO FX501P (Sci LCD Prog 256 Steps. 22 Mem)	£64.00
CASIO Prog Adapter — permits Progrs to be recorded on to standard cassette recorders for reply on Casio FX501P / EX502P at laster stage	£20.00

COMMODORE PET COMPUTER
with 8K bytes RAM 2001-8 **£550**
PET. 2001 / 4 **£499**
Pet 2001 / 16N **£675.00**
Fully guaranteed Warranty by CBM

NOW IT'S YOU AGAINST 'COMPUTERS'
BORRIS the most advanced chess computer yet. Borris is ideal for the learning and improving your chess game from beginner to master. Borris can play against himself, has Alpha-Numeric prompting to help improve play and by simple switching you have facility to follow Borris's thinking while he analyses position before making a move. Walnut case, wooden chessmen, board mains adaptor, etc **£135.00**
CHESS CHALLENGER "10" (10 Levels of beginner to master) **£118.00**
CHESS CHALLENGER "7" 7 levels of game) **£76.50**
"VOICE" CHESS CHALLENGER **£200.00**

★ FREE — Mains / Charger Included **★**
GOODS FULLY GUARANTEED. PRICES EXCLUDE VAT (ADD 15%) *BUT INC.* P&P CHEQUE WITH ORDER
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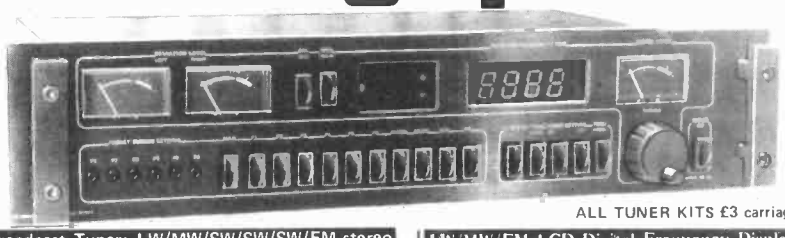
MOUNTAINDENE
22 Cowper St., London, EC2

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 + £4.95 VAT**
Complete with digital frequency readout/clock-timer hardware	**£99.00 + £14.85 VAT**
Complete with MA1023 clock/timer module with dial scale	**£66.00 + £9.90 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 + £2.93 VAT, built and tested module £27.00 + £4.05VAT

Ambit stocks and distributes a wide range of frequency counter LSI for all types of DFM- part two of the catalogue contains details of the MSM5523/4/5/6 range, and the versatile MSL2318 divide by ten or hundred prescalar IC. The DFM1 combined counter for AM,FM SW and direct/clock/stopwatch/timers - details available, but SAE please !

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+£5.55vat

VHF MONITOR RX WITH PLESSEY IC

4/9 channel version of the PW design but using standard (fundx9) 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 .

MICROMARKET OSTS overflow:

6800P	650p	8212	230p	2102	170p
6820P	600p	8216	195p	2112	340p
6850P	275p	8224	350p	2513	754p
6810	400p	8228	478p	4027	578p
6852	365p	8251	625p	2114	1000p
8080	630p	8255	540p	+15% VAT	

RADIO and AUDIO MODULES : Consistently the most advanced

FOR FM

EF5801-3-4 series: 6 stage varicap tuning, all with oscillator output		
5801	Dual gate MOSFET RF stages, bipolar mixer	£17.45 + 2.61VAT.
5803	Dual gate RF/mixer stages, amplified LO out	£19.75 + 2.96VAT
5804	'Hyperfi' series, with internal PIN diode agc, and ultra wide range tuning system	£24.95 + 3.74VAT
EF5402	4 stage varicap tuner with TDA1062 and LO output. Uses FET/IC input. PIN agc	£10.75 + 1.61VAT

FOR 30-200MHz

The EF series are available on special order to cover bands (usually approx 20% of the centre frequency) in the range described. Details in our price list.

FOR FM IFs at 10.7MHz

7030	single 6 pole linear phase filter IF with HA1137	£10.95 + 1.64VAT
7130	two 6 pole linear phase filter IF with CA3189E	£16.25 + 2.44VAT
7230	Hyperfi IF, switched bandwidth, AGC IF preamp, linear phase ceramic filters with diode switched narrow filter	£24.95 +3.74VAT

DECODERS for MPX (STEREO)

Various types, guaranteed the world's biggest and best ranges

LARSHOLT FM TUNERSETS

7252	MOSFET front end combined with CA3089 IF	£26.50 +3.97VAT
7252	JFET front end, combined with IF and decoder	£26.50 +3.97VAT

FM/AM tuning synthesiser, see details elsewhere in th is advertisement

COMPONENTS FOR RADIO/COMMUNICATIONS/AUDIO/TV etc.

As usual, Ambit brings you the latest and best, a small selection of which is shown in this advertisement. The Ambit catalogues contain information on most of the devices mentioned here - and an order for the new part three will ensure you stay up with latest developments. Data photocopying service described in pricelist info.

RADIO ICs for FM		vat
CA3089E	1.94	29
CA3189E	2.45	37
HA1137W	2.20	33
HA11225	2.20	33
SN76660N	0.75	11
RADIO ICs for AM/FM		
TDA1090	3.35	50
TDA1083	1.95	29
TDA1220	1.40	21
IF AMPLIFIERS		
KB4406	0.50	07
MC1350	1.20	18
see comms ics also		
COMMUNICATIONS		
KB4412	2.55	38
KB4413	2.75	41
SD6000	3.75	56

SL1600 series		
SL1610	1.60	24
SL1611	1.60	24
SL1612	1.60	24
SL1613	1.89	28
SL1620	2.17	33
SL1621	2.17	33
SL1623	2.44	37
SL 624	3.28	49
SL1625	2.17	33
SL1626	2.44	37
SL1630	1.62	24
SL1640	1.89	28
SL1641	1.89	28
SL6640	2.75	41
SL6690	3.20	48
MC3357	3.12	47
MC1496	1.25	19
NE544	1.70	25

Audio preamps		vat
LM381N	1.81	27
LM382N	1.65	25
KB4436	2.53	38
KB4438	2.22	33
TDA1028	3.50	53
TDA1029	3.50	53
TDA1074	3.75	56
Audio power		
TBA820M	0.75	11
TBA810AS	1.09	16
LM380N	1.00	15
ULN2283	1.00	15
TDA2002	1.95	29
HA1370	2.99	45
TDA2020	2.99	45

FETs, MOSFETs, bipolars. and various others: see PL

2SJ133/2SJ48 £10.00 + £1.50 pr. various high voltage drivers etc. from correctly matched Hitachi series transistors. (All 120v types)

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	
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
7423	27	
7425	27	
7426		27
7427	27	29
7428	35	32
7430	17	24
7432	25	24
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
7451	17	24
7453	17	
7454	17	24
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	
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	
741XX series		
74107	32	38
74109	63	38
74110	54	54
74111	68	
74112		38
74113		38
74114		38
74116	198	
74118	83	
74120	115	
74121	25	
74122	46	
74123	46	
74124		137
74125	38	44
74126	57	44
74128	74	
74132	73	78
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		78
74162		130
74163	92	78
74164	104	130
74165	105	
74167	20	
74169		200
74170	230	200
74172	625	
74174	87	120
74175	87	110
74176	75	
74177	78	
74181	165	350
74183		210
74184	135	
74185	134	
74188	275	
74190		92
74192	105	180
74193	105	180
74194	105	
74196	99	110
74197		110
74198	150	
74199	160	
74247		90
74253		105
74257	108	
74260	153	
74273	124	
74283	120	
74293	95	
74365	49	
74366	49	
74367	43	
74368	49	
74373	77	
74374	77	
74377	124	
74379	130	
74393	140	

VOLTAGE REGS:

7800 series 1Amp pos	95p
7900 series 1Amp neg	100p
78M series ½Amp pos	90p
78LCP 100mA	35p
78MGT2C variable	175p
79MGT2C variable	175p
723CN variable IC	65p
NE550	73p
L200 variable V and I	195p

MAINS EMI FILTERS

(BS etc approved types)

1 Amp in IEC chassis connector	4.83
6 Amp in IEC	5.83
5 Amp wirein	3.87
(Toroid cores in Cat no. 2)	

MISC. Counter/timer, scalar devices.....

NE555 30p NE556 78p NE558 180p

LM3909 72p

95H90DC divide by 10/11 to 320MHz 780p

11C90DC divide by 10/11 to 650MHz 1400p

8629 divide by 100 to 175MHz min 420p

MSL2318 divide by 10/100 to 175MHz min 420p

ICM7216BIPI : 8 decade 10MHz DFM counter and full function timer, with direct drive for an LED display (mpx). Uses 10MHz xtal 1982p

ICM7217AIBI ; 4 decade programmable counter with direct LED drive 950p

ICM7207 clock pulse generator 495p

ICM7208 : 7 decade counter display 1495p

ICM7106CP : LCD DVM (3½ digit) 955p

ICM7106CPK : evaluation kit for 7106 24.80

ICM7107CP : LED DVM (3½ digit) 955p

ICM7107CPK : LED DVM kit for 7107 20.65

OKI MSM5523/4 : LED/Fluorescent display driver IC for time/timer/stopwatch/ AM/FM received frequency display and direct counter (use MSL2318 prescalar) inc Crystal 1400p

MSM5525 : AM/FM frequency only counter, for fluorescent displays (6LT06) inc xtal 1100p

MSM5526 : as MSM5525 but for LCD 1100p

4 digit LCD for ICM7106 or MSM5526 1100p

10 LED (2½x5mm) bar graph driver PCB for LOG or LIN (specify). Kit ex leds 300p

IMPORTANT: ALL PRICES SHOWN EXCLUDE VAT - WHICH MUST BE ADDED AT 15% OVERALL. PLEASE NOTE THE REDUCED CMOS/LPSN TTL RANGES DUE TO CURRENT SUPPLY SHORTAGE

CD4000

4000	17	4522	149
4001	17	4528	102
4002	17	4529	141
4006	109	4532	125
4007	18	4538	150
4008	80	4539	110
4009	58	4543	174
4010	58	4549	399
4011	17	4554	153
4012	17	4558	117
4013	55	4560	218
4014	95	4562	530
4016	52	4566	159
4017	80	4568	281
4018	80	4569	303
4019	60	4572	25
4020	93	4584	63
4021	82	4585	100
4022	90		
4023	17		
4024	76		
4025	17		
4026	180		
4027	55		
4028	72		
4029	100		
4030	58		
4035	120		
4040	83		
4042	85		
4043	85		
4044	80		
4046	130		
4048	60		
4049	55		
4050	55		
4051	65		
4052	65		
4053	65		
4055	135		
4059	563		
4060	115		
4063	109		
4066	53		
4068	25		
4069	20		
4070	20		
4071	20		
4072	20		
4073	20		
4075	20		
4076	90		

MORE FROM THE GENERAL AMBIT CATALOGUE RANGES:

Varicap tuning diodes for AM/FM/TV :

1-9 v AM tuning (Cr 15:1) from TOKO–

KV1211 double matched	175p	26p vat
KV1210 triple matched	245p	37p vat
KV1215 triple snap-apart	245p	37p vat
MVAM115 single 15v	105p	16p vat
MVAM125 single 25v	105p	16p vat
MVAM2 double 25v	148p	22p vat
BB204/104 double FM	40p	6p vat
BA102 single AFC etc	30p	4p vat
BA121/ITT210 single afc	30p	4p vat
BB105B single UHF	40p	6p vat

PIN DIODES, BANDSWITCH types

BA479 PIN attenuator	35p	5p vat
TDA1061 Pi-form atten.	95p	14p vat
BA182 Bandswitch	21p	3p vat

All RF semiconductors stocked in depth. Please ask for quantity pricing details.

LINEARS

CA3130E	84
CA3130T	90
CA3140E	
CA3140T	72
LM301AH	67
LM301AN	30
LM339N	66
LM348N	186
LM3900N	60
709HC	64
709PC	36
710HC	65
710PC	59
723CN	65
741CH	66
741CN	27
747CN	70
748CN	36
NE531N	105

7 SEG DISPLAYS

HP5082 series.....		
Red	7650	233p
	7653	233p
Yell	7660	233p
	7663	233p
Grn	7670	233p
	7673	233p
Fairchild FND		
500/507		150p

MPU controllable digital freq. synthesiser PCB. Preliminary: Serial data controlled, with the standard swallow count system for maximum speed of operation. Multiple time constant filters, suitable for AM/FM and other communications/generator applications. Not for beginners. Full preliminary data package £1 + SAE. No phone enquiries answered on this system for the time being. Watch this space..... Projected cost of the controller PCB less than £30: comprises the two modulus counter, prog.div., phase detector, multiple TC loop filter/integrators.

TOP GRADE LEDs by AEG: PRICES ARE EXC. VAT (add 15%)

SIZE	Red	Green	Yello	Orang	Quantity discounts for LEDs:
5mm	14p	16p	15p	20p	10 per type - less 10%
3mm	13p	15p	18p	19p	100 per type - less 30%
2½x5	17p	20p	20p	24p	100 mix in 10s - less 25%

FUTABA FLUORESCENT VACUUM DISPLAYS for CLOCKs etc

5LT02	clock display (static drive) with AM/PM flags £9 + 1.35
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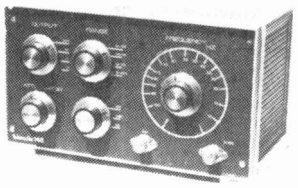

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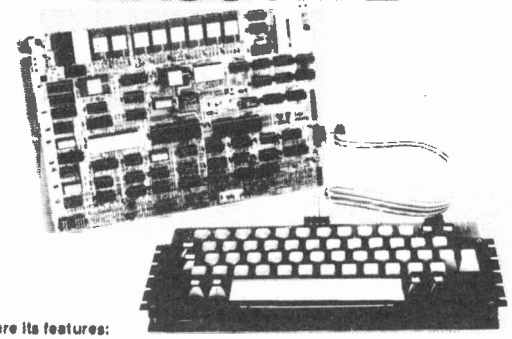

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- Kansas City cassette interface: for reliable storage of programs and data at 300 or 1200 baud, with full checksum error detection.
- Nas-sys monitor: A powerful 2K machine code monitor provides an ideal environment for learning about and developing machine code programs. Nas-sys uses a blinking non destructive cursor, with 22 commands. ASCII terminals are fully supported via the serial interface; users can add their own I/O drivers via the system I/O vector table to support other devices.

Nas-sys commands are:

A—Hex arithmetic	N—return to normal
B—set breakpoint	O—Output to P.I.O.
C—Copy	Q—Query input port
E—Execute	R—Read tape
G—Generate	S—Single step
H—Operate as half duplex, terminal.	T—Tabulate memory
I—Intelligent copy	U—activate user I/O drivers
J—Execute at FFA	V—Verify tape
K—set keyboard options	W—Write tape
L—load from tape	X—set external device
M—Memory modify	Z—execute at FFD

- On board P.I.O. — An uncommited P.I.O. (MK 3881) giving 16 programmable I/O lines with handshake.
- On board RS-232-Will interface directly into any standard teletype — allowing use of BASIC or Nas-sys from the teletype.
- Full on-screen editing: a complete screen editor with cursor movement (UP, DOWN, LEFT, RIGHT), insert and delete, backspace etc.

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BM 8		5.2	6.2	12.3

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ETI

DESIGNER'S NOTEBOOK

Another look at the notebook of ETI's chief design engineer, project editor Ray Marston.

THERE ARE MANY occasions when the electronics design engineer needs one or two basic gates in a circuit and is faced with the possibility of having to wastefully commit an entire IC to this simple function. Alternatively, it may be the case that the inputs to a gate come from such widely separated points of a circuit that the use of an IC in a particular application will result in an excessively complicted PCB layout. In both of these instances, a simple diode gate may offer an ideal solution to the problem.

Figure 1 shows the practical circuit of a 3-input diode OR gate. The circuit is simple, reasonably fast, very cost-effective, and can readily be expanded to accept any number of inputs by merely adding one more diode to the circuit for each new input.

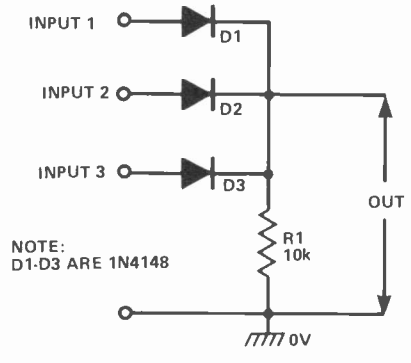

Fig. 1. The diode OR gate is simple but efficient. It can be expanded to accept any number of inputs by adding extra diodes.

The diode OR gate can be converted to a NOR type by either feeding its output through an NPN transistor inverting stage, as shown in Fig 2a, or by feeding it's output through any type of IC inverting stage that happens to be 'spare' in the circuit that you are playing with, as shown in Fig 2b.

Figure 3 shows the connections for making a 3-input diode AND gate. The circuit can again be expanded to accept virtually any number of inputs by simply adding an appropriate number of diodes. ▶

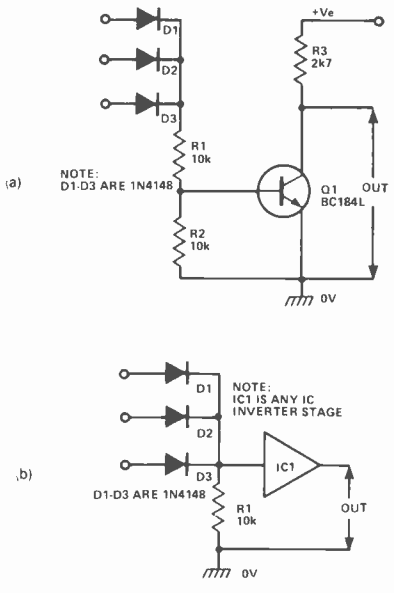

Fig. 2. The diode OR gate can be converted to a NOR type by feeding its output through a transistor (a) or IC (b) inverting stage.

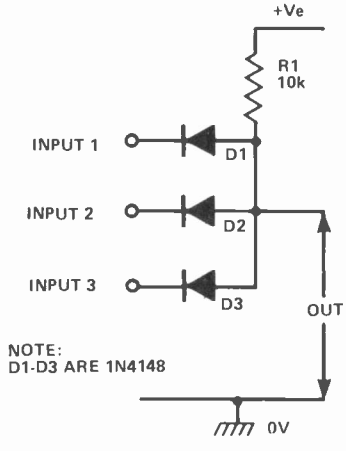

Fig. 3. The circuit of a 3-input AND gate. The number of inputs can be increased by adding extra diodes.

The AND gate can be converted to a NAND type by feeding it's output through a PNP transistor or an IC inverting stage, as shown in Figures 4a and 4b respectively.

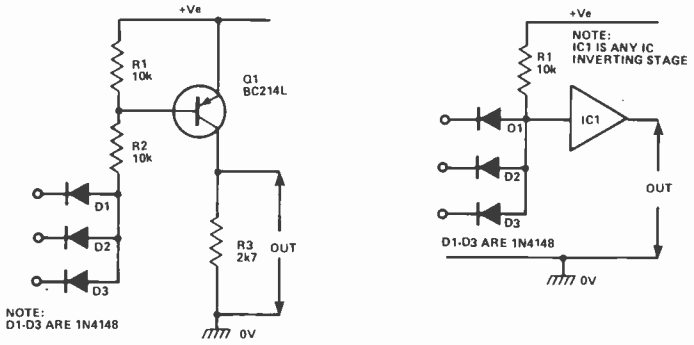

Fig. 4. The diode AND gate can be converted to a NAND type by feeding its output through a transistor (a) or IC (b) inverting stage.

Linear Operation Of Diode Gates

Diode AND and OR gates can give very useful performances when one or more of their inputs are operated in the linear mode. Figures 5 and 6 show two useful ways of using the 2-input diode OR gate in linear applications.

In the case of the Figure 5 circuit, in which analogue voltages are applied to both of the input terminals, the output of the circuit is (ignoring a diode volt drop of about 600 mV) equal to the greater of the two input voltages.

Figure 6 shows what happens when a pulse signal is fed to one input of the OR gate and an analogue voltage is fed to the other. The output signal comprises a pulse with a peak amplitude equal to that of the input pulse, and with a 'zero' value equal to the analogue input voltage.

Figures 7 and 8 show similar circuits based on the 2-input diode AND gate. In the Fig 7 circuit, where analogue voltages are fed to both inputs, the output is (ignoring a diode volt drop 'gain' of about 600 mV) equal to the lesser of the two inputs.

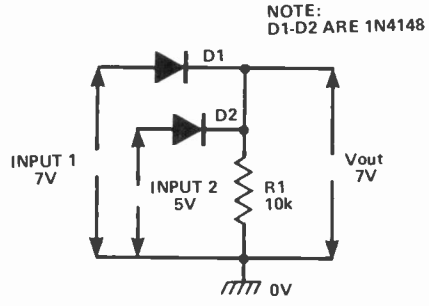

Fig. 5. When a diode OR gate is used in the linear mode, Vout equals the greater of the inputs.

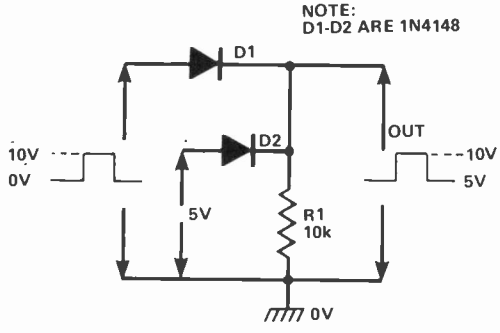

Fig. 6. The effect of feeding a pulse to one input and a DC voltage to the other input of a 2-input diode OR gate.

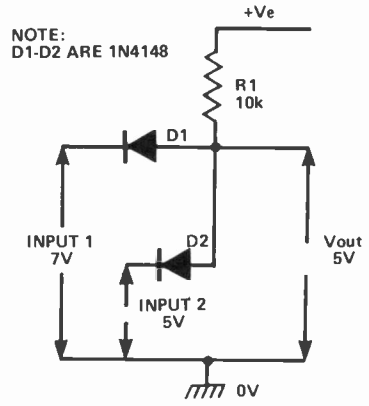

Fig. 7. When a diode AND gate is used in the linear mode, Vout equals the lesser of the inputs.

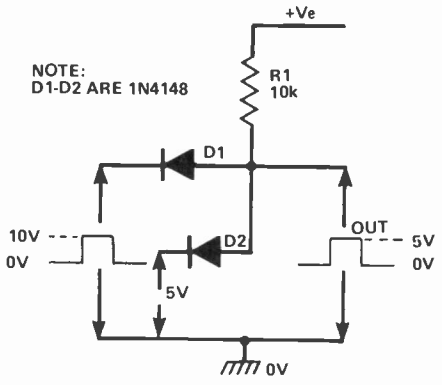

Fig. 8. The effect of feeding a pulse to one input and a DC voltage to the other input of a 2-input diode AND gate.

In the case of the Fig 8 circuit, where a pulse is fed to one input and an analogue voltage to the other, the output pulse has a peak amplitude equal to that of the analogue input voltage.

Diode Volt Drops

We've mentioned above that the output of the 'analogue' diode gate may be 'within a diode volt drop' of the input signal. The magnitude of this 'volt drop' depends on the type of diode that is in use, on the magnitude of the diode forward current, and on the temperature of the diode junction. All silicon diodes have a negative temperature coefficient of about —2mV/°C.

Figures 9 and 10 show typical volt-drop curves for the popular 1N4148 and 1N4001 silicon diodes at 25°C. The graph of Fig. 9 spans the current range 0.1 to 1 mA, and the graph of Fig. 10 spans the range 1 mA to 50 mA.

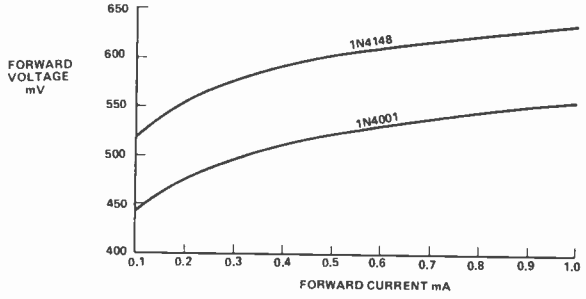

Fig. 9. Volt-drop curves for 1N4001 and 1N4148 diodes over the 0.1mA to 1mA current range.

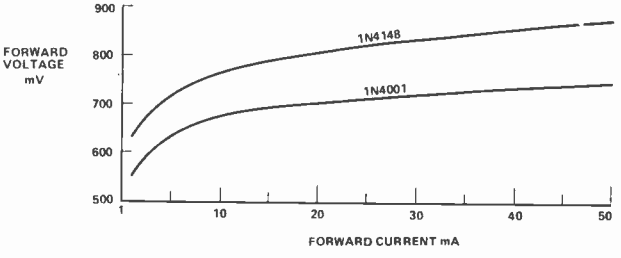

Fig. 10. Volt-drop curves for 1N4001 and 1N4148 diodes over the 1mA to 50mA current range.

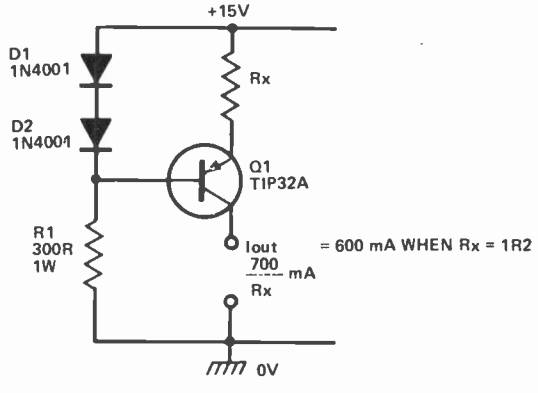

Fig. 11. A simple but useful constant-current generator.

Note that the 1N4148 volt drop typically ranges from 519 mV at 0.1 mA to 874 mV at 50 mA, compared to the 1N4001's range of 441 mV at 0.1 mA to 744 mV at 50 mA.

A point of particular note about the 1N4001 curve is that it's volt drop of 714 mV at 25 mA increases by only a fraction over 4% (to 744 mV) when the current is doubled, to 50 mA. In other words, the diode has a voltage-to-current coefficient of about .04%/% in this current range. The diode can thus be used as a reasonably stable voltage reference at these current levels, but has a negative temperature coefficient of about —0.3%/°C.

A Constant Current Generator

Figure 11 shows how the above mentioned 'voltage reference' characteristics of the 1N4001 can be put to good use in a simple constant-current generator circuit that can be used for re-charging Ni-Cad cells or for linearly charging large capacitors, etc. Here, two 1N4001's are wired in series and operated at a current level of roughly 50 mA. Consequently, the voltage across R_x is equal to the volt drop of the two diodes minus the base-emitter volt of Q1 (about 700 mV), which gives an R_x voltage of about 700 mV. The emitter (and hence collector) current of Q1 is thus approximately $700/R_x$ mA.

To give an idea of the magnitudes of things, an Rx value of 1R2 gives an output current of about 600 mA, 3R9 gives about 200 mA, and 6R8 gives about 100 mA. All in all, a simple but very useful circuit.

Diode Protection Circuits

To wrap up this edition of 'Notebook', let's take a quick look at some diode 'protection' circuits. By 'protection' we mean circuits that are designed to insure devices against irreversible damage, and also circuits that are designed to prevent simple malfunctioning. Figures 12 to 15 show four circuits in this latter category.

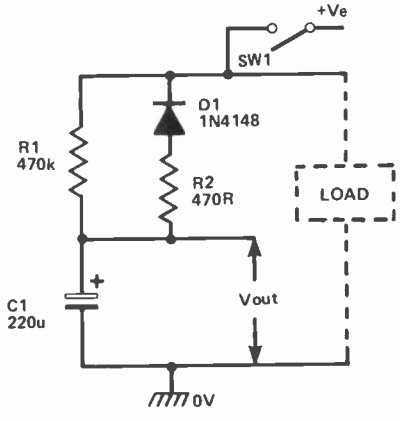

Fig. 12. An example of the use of a diode to rapidly discharge a timing capacitor when the power supply connection is broken.

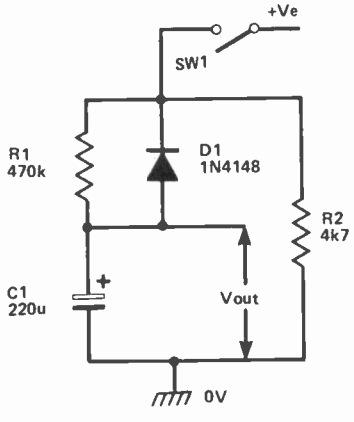

Fig. 13. A modification in the use of a capacitor discharge diode.

In the case of Fig 12, we have a basic time constant circuit in which a rising voltage with a time constant of about 100 seconds is developed across C1 each time ▶

SW1 is closed. This voltage may be used to activate some additional circuitry. The problem is that once C1 has charged up, it has no means of rapidly discharging again (resetting) once SW1 is opened. If there is a load in parallel with the C-R network, as shown dotted in the diagram, C1 will of course discharge via R1 and the load, but then has a very long (greater than 100 seconds) time constant.

An easy way round this problem is to connect a discharge diode in parallel with R1, as shown in Figs 12 and 13. If there is a low-impedance load in parallel with the C-R betwork, a current-limiting resistor must be wired in series with the discharge diode, as shown in Fig 12. If there is no load in parallel with the C-R network, then an artifical load must be provided to complete the discharge path, as shown in Fig 13.

Figures 14 and 15 show two basic variations of the above circuits, in which the C and R networks are configured to give a falling output voltage across R1. Circuit operation should be self-evident.

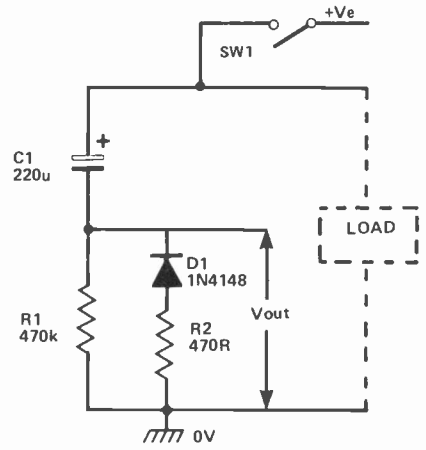

Fig. 14. A basic variant of the Fig. 12 circuit.

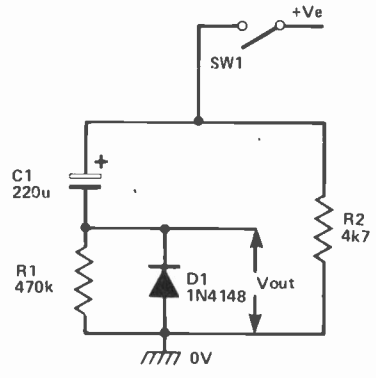

Fig. 15. A basic variant of the Fig. 13 circuit.

Finally, Figures 16 and 17 show ways of using diodes to protect two types of transistor circuit from destructive damage. Figure 16 shows how to protect a pulse-driven common-emitter amplifier that has a highly inductive collector load, such as a transformer or a relay coil. Very high back EMF's can be generated by inductive loads, and can easily be sufficient to destroy transistor junctions. In the diagram, D1 prevents the collector of Q1 from being driven above the positive supply rail value by these back EMF's and D2 prevents it from being driven below the zero-volts value.

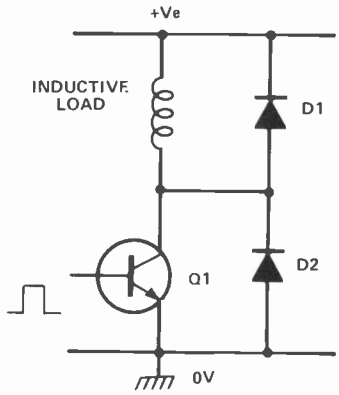

Fig. 16. An example of the use of diodes to protect a pulse-driven common emitter amplifier with an inductive collector load.

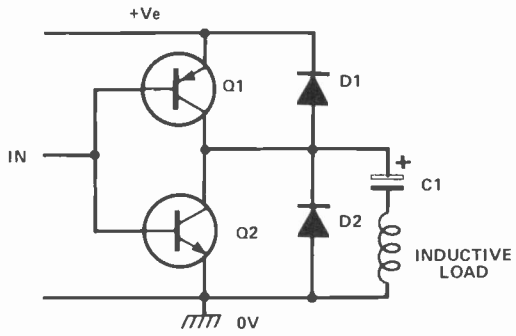

Fig. 17. An example of the use of diodes to protect the complementary emitter follower output stage of a power amplifier that is used to drive an inducting load.

Figure 17 shows how a similar type of protection can be given to the complementary emitter follower output stages of a power amplifier that is used to drive highly inductive loads. This circuit can give good protection to Hi-Fi amplifiers in which the speakers may be inadvertently plugged in at a moment when the amplifier is being hard driven. The protection diodes must have a current rating that is compatible with the inductive (speaker) load.

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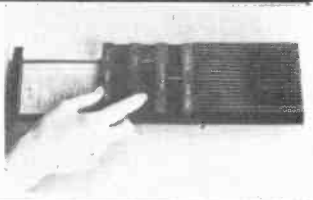

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using your own TV to display the board and pieces. Star Chess is a new absorbing game for two players, which will interest and excite all ages. The unit plugs into the aerial socket of your TV set and displays the board and pieces in full colour for black and white on your TV screen. Based on the moves of chess. It adds even more excitement and interest to the game. For those who have never played, Star Chess is a novel introduction to the classic game of chess. For the experienced chess player, there are whole new dimensions of unpredictability and chance added to the strategy of the game. Not only can pieces be taken in conventional chess type moves, but each piece can also exchange rocket fire with its opponents. The unit comes complete with a free 18V mains adaptor, full instructions and twelve months guarantee.

CHESS CHALLENGER 7 – £85.65 + VAT.
PLAY CHESS AGAINST THE COMPUTER.

The stylish, compact, portable console can be set to play at seven different levels of ability from beginner to expert including "Mate in two" and "Chess by mail". The computer will only make responses which obey international chess rules. Castling, on passant, and promoting a pawn are all included as part of the computer's programme. It is possible to enter any given problem from magazines or newspapers or alternatively establish your own board position and watch the computer react. The positions of all pieces can be verified by using the computor memory recall button.
Price includes unit with wood grained housing, and Staunton design chess pieces. Computer plays black or white and against itself and comes complete with a mains adaptor and 12 months guarantee.

ELECTRONIC CHESS BOARD TUTOR £17.17 + VAT

A special bulk purchase of these amazing chess teaching machines enables us to offer them at only £19.75 less than half recommended retail price. The electronic chess tutor is a simple battery operated machine that can actually teach anyone to play chess and improve their game right up to championship level. This machine is not only for total beginners but also for established players wanting to play better chess. Unit contains the electronic chessboard with 32 chess pieces, a 64 page explanatory booklet and a set of 32 progressive programme cards including 6 beginners cards, 16 check mate positions, 9 miniature games, 5 openings, 3 end games, 28 chess problems and 2 master games.

OTHER CHESS COMPUTERS IN OUR RANGE INCLUDE:

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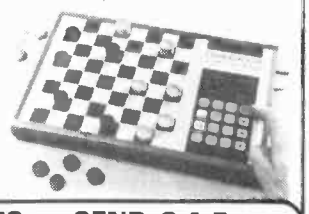
CHECKER CHALLENGER 2 LEVELS £43.98 + VAT.
4 LEVELS £80.09 + VAT.

The draughts computer enables you to sharpen your skills, improve your game, and play whenever you want. The computer incorporates a sophisticated, reliable, decision making microprocessor as its brain. Its high level of thinking ability enables it to respond with its best counter moves like a skilled human opponent. You can select offence or defence and change playing difficulty levels at any time. Positions can be verified by computer memory recall. Machine does not permit illegal moves and can solve set problems. Computer comes complete with instructions, mains adaptor and twelve months guarantee.

PLAY DRAUGHTS/CHECKERS AGAINST THE COMPUTER



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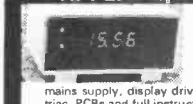

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Ready-built **£19.00**

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LEDs		Square LED
0.1" red	9p	Red. Size
0.2" Red	9p	5 x 2 5 x 9 mm
0.2" Green	12p	high
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"0.2" Red LEDs 25 at £1.25

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Moulded in high impact ABS. Supplied with lids and screws. Black or white.

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3A	49p	16A	90p
8A	62p	20A	165p
12A	70p	25A	190p
6A with trigger			80p
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Diac			18p

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Directly replace conventional light switch and control up to 300W of lighting. No mains rewiring. Insulated touchplates. Easy to follow instructions.

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Components are also included to enable the basic DV kit to be modified to a Digital Thermometer using a single diode as the sensor. Requires a 3mA 9V Supply (PP3 battery).

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TDA1024 Zero Voltage Switch	£1.20
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LM3914 Dot/bar Driver	£2.60
MM57160 (stac) Timer	£5.95
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S9263 Touchswitch	£4.85
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ALL COMPONENTS ARE BRAND NEW AND TO MANUFACTURERS SPECIFICATION. ADD VAT AT CURRENT RATE TO ABOVE PRICES PLUS 25p P&P. MAIL ORDER – CALLERS WELCOME BY APPOINTMENT.

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NEW STOCK ITEM — We are now stocking Expo mini hand held drills. These are a precision British made tool, ideal for P.C. board drilling, model makers etc. They operate on 12VDC. Drill only £7.35. Drill kit supplied in plastic hinged case, with drill and 21 accessories, drills, sanders, reamers, buffers etc, complete kit only £14.25.

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16 pin D.I.I. **SWITCHES** only 42p each.

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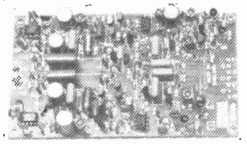
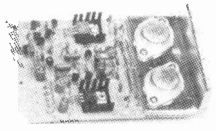


POWER AMPLIFIER



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Following this stage is the flat gain/balance stage to bring tape, tuner, etc. up to power amp signal levels. Signal to noise ratio 86dB, slew-rate 3V/uS. T.H.D. 20Hz—20kHz<.008% at any level.

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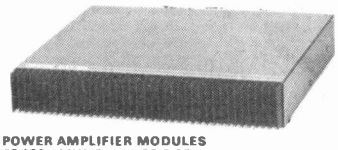
The kit includes all metalwork, heatsinks and hardware to house any two of our power amp modules plus a power supply It is contemporarily styled and its quality is consistent with that of our other products Comprehensive instructions and full back-up service enables a novice to build it with confidence in a few hours.



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These are available in two versions — one uses standard components, and the other (the S), uses MO resistors where necessary and tantalum capacitors.

CPR1	£31.65
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Pre-amp Kit	£38.07

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Obtain up to 340W using 2x170W amps and this module

BD1 . . . . £5.75

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HEWLETT PACKARD	
5263A Time interval plug-in	60
MARCONI	
TF2414A DC-40 MHz 7 digits	170
TF2422 Frequency divider to 300 MHz	30
RACAL	
9024 10 Hz 600 MHz 7 + 1 digits	325
9059 DC-560 MHz with battery pack	300
9835 DC-15 MHz 6 digits	145
9837 DC-80 MHz 6 digits	190

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HEWLETT PACKARD	
3300A 0·01 Hz-100 kHz sine square triangular	100
3301 Auxiliary plug in	

Logic Analysers

HEWLETT PACKARD	
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LAV3X Mains voltage recorder	45
GEC	
FB31A Surge monitor records mains spikes + filter	85
RUSTRAK	
288 + CT Clamp-on AC recording ammeter	95

Modulation Meters

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*409 3-1500 MHz AM/FM	325
MARCONI	
*TF2300A 1-1000 MHz AM/FM	520

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OS1000A DC-20 MHz dual trace	310
COSSOR	
110/111 DC-20 MHz dual trace	325
110/112 DC-1 MHz differential	275
HEWLETT PACKARD	
184A + 1801A + 1822A DC 50 MHz system, T B and amplifier included storage facility (storage de rated please ask for details)	650
1707B20 DC-75 MHz dual trace D T B	700
1710B DC-200 MHz dual trace	1250
TEKTRONIX	
5103N/D15 Storage system 800 div/ms DC-2 MHz	350
7A13 DC-100 MHz differential comparator	350
7B70 Dual time base with 7B71 delayed sweep (for 7000 series)	275
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585A/81 DC-80 MHz dual trace DTB	550
454 DC-150 MHz dual trace DTB	1350
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D53/CD/G DC-15 MHz Dual Trace with differential amplifier	225

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TEKTRONIX	
P6046 Differential probe DC 100 MHz	215

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STARTRONIC	
117 20 V 0 5 A Variable	25
SYSTRON DONNER	
LNG 16-10 16 V, 10 A variable	75

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PG23 10 V/50 Ω 1 Hz-10 MHz RT 5 ns	135
SYSTRON DONNER	
101 10 V/50 Ω 10 Hz-10 MHz RT 5 ns	95

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ME102C Wow and flutter meter	90

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A1000 Galvo 600 Hz 0 34 mA/cm	30
MICROMOVEMENTS	
M400 Galvo 300 Hz 50 µA cm	25
M1000 Galvo 600 Hz 0 34 mA cm	25
M1600 Galvo 1000 Hz 0 4 maA/cm	25
M8000 Galvo 5 kHz 15 5 mA cm	25
SIEMENS	
KOMP III 2 pen potentiometric roll chart	425

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410C 0 1 Hz-10 KHz	40
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8693, 100 3 7 8 3 GHz 5 mW sweeper plug in	525
* 608E 10-480 MHz AM	410
* 618C 3·8-7·6 GHz FM	1600
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TF2005A Two tone 20 Hz-20 KHz	200
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264 Millivoltmeter 3 mV-1 V ranges	45
AVO	
*8 Mk V AC/DC/OHMS	60
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BRADLEY	
CT471C AC/DC/Ω/current multimeter and RF	165
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Voltmeters – Digital

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8300A 119999 FSD DC only	150
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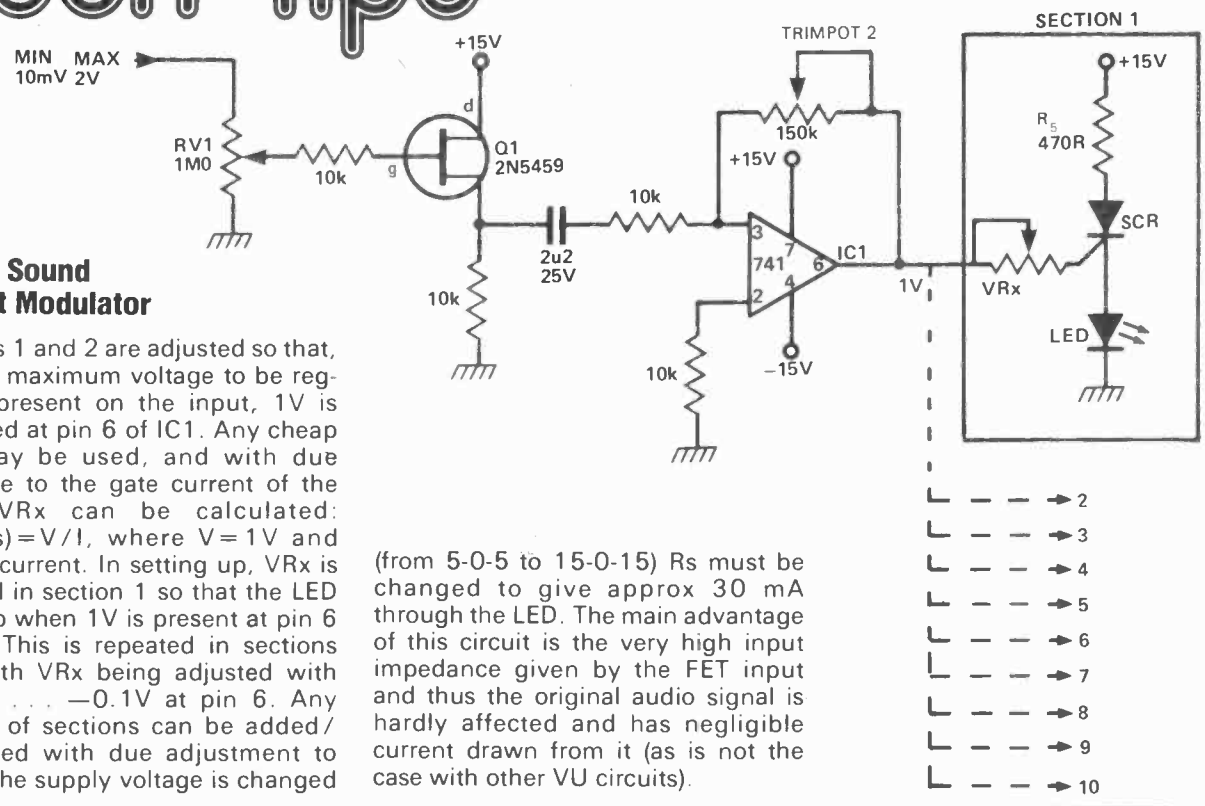


Trimpots 1 and 2 are adjusted so that, with the maximum voltage to be registered present on the input, 1V is registered at pin 6 of IC1. Any cheap SCR may be used, and with due reference to the gate current of the SCR, VRx can be calculated: R(ohms) = V/I, where V = 1V and I = gate current. In setting up, VRx is adjusted in section 1 so that the LED lights up when 1V is present at pin 6 of IC1. This is repeated in sections 2-10 with VRx being adjusted with 0.9:0.8 . . . —0.1V at pin 6. Any number of sections can be added/subtracted with due adjustment to VRx. If the supply voltage is changed (from 5-0-5 to 15-0-15) Rs must be changed to give approx 30 mA through the LED. The main advantage of this circuit is the very high input impedance given by the FET input and thus the original audio signal is hardly affected and has negligible current drawn from it (as is not the case with other VU circuits).

CMOS Mixer

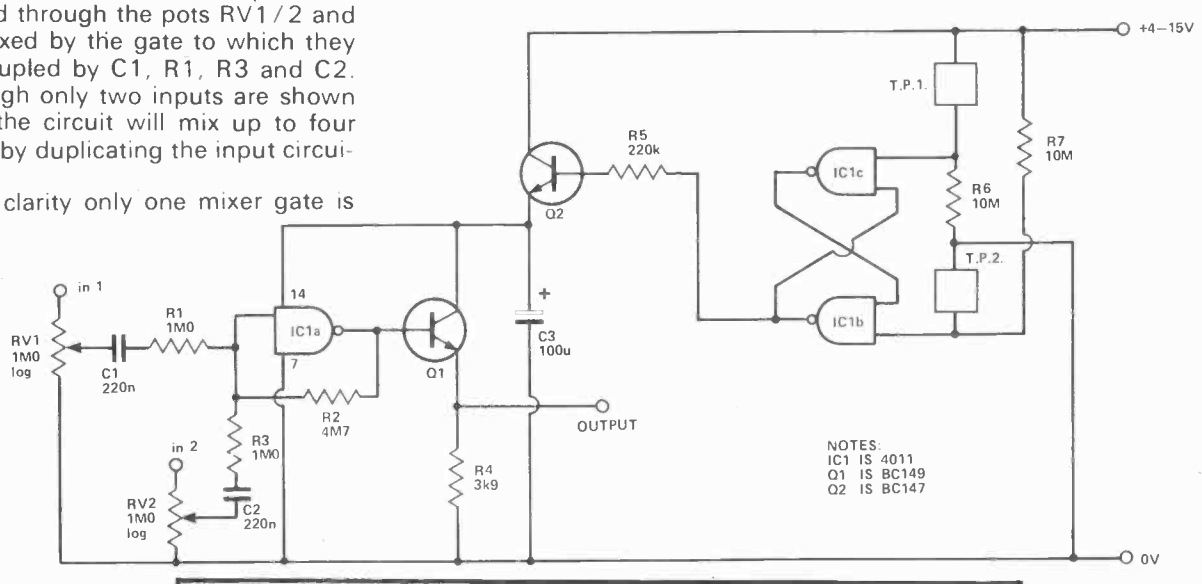
J. P. Macaulay

Although this circuit employs only one cheap CMOS IC and two transistors it is capable of high quality results. The IC, a 4011, contains four dual input NAND gates. Two of these are used with their inputs connected together to form inverters and biased into the linear mode by means of the feedback resistors, R2. Inputs are applied through the pots RV1/2 and are mixed by the gate to which they are coupled by C1, R1, R3 and C2. Although only two inputs are shown here, the circuit will mix up to four inputs by duplicating the input circuitry.

For clarity only one mixer gate is shown in the schematic. The other gate, along with all the components to the left of C3 are duplicated on the other channel. The other two gates are used in a touch operated on-off switch.

The plates, which may consist of a small piece of Veroboard with alternate strips linked together and connected to the input of the gate and line respectively, control the output polarity of the gates.

When the circuit is turned on, by placing a finger on the touch plate, the output of this gate goes high switching Q2 hard on and supplying the circuit with current. To switch off the other touch plate is touched with the finger. The output then goes low removing the operating current from the circuit. The transistor Q2 gives the circuit a low output impedance and the gain with the input pot at maximum is four.



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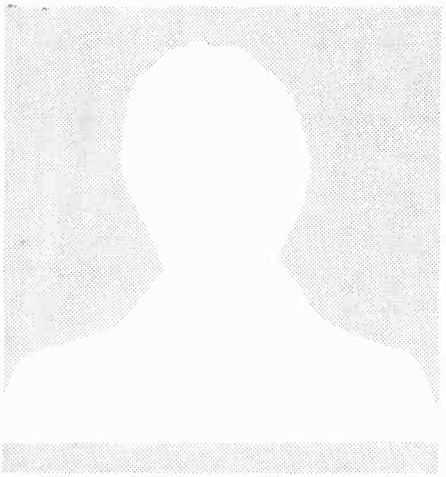
HELP!



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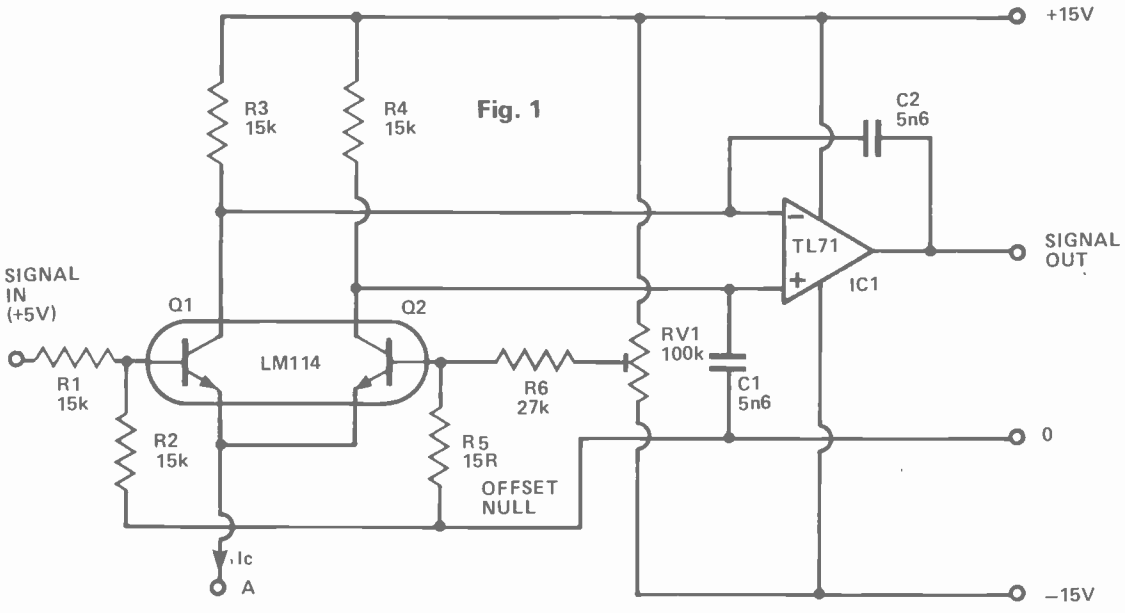

Fig. 1

Voltage Controlled Filter

T. W. Stride

The voltage controlled state variable filter has become almost standard in sound synthesizers, especially since the advent of the CA3080 transconductance amplifier. However, the CA3080 is a reasonably noisy device and this can be annoying when large passbands and/or high Q values are being used in the filter. This circuit is for a low noise, high performance transconductance multiplier, which though not cheap, will offer a truly Hi-Fi performance.

R1 and R2 attenuate the input signal to keep distortion low, and Q1, Q2 with R3, R4 form the transconductance multiplier. The differential output current is integrated by means of IC1, C1 and C2, a differential integrator. RV1 is provided to cancel out the offset of Q1, Q2; it is best adjusted by sweeping the filter and adjusting for minimum DC output shift.

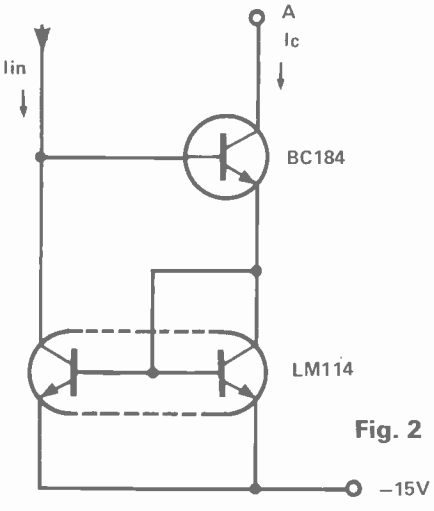

Fig. 2

As can be seen from Fig. 1, the gain of the integrator is controlled by a constant current IC. This current can be provided in two ways, either from a current mirror (Fig. 2) which then makes the circuit an almost exact replacement for the CA3080, or for original equipment designs, from a current source. If it is desired to use this circuit as a replacement for a CA3080 in, for example, the Transcendent 2000 synthesizer, the following modifications are necessary. The integrating capacitor on the output of the 3080 must be replaced with a 10 k resistor and the input attenuator on the above circuit is discarded. The control current that would flow into pin 5 of the 3080 is input to the current mirror and the output current is drawn from the transconductance multiplier (point A).

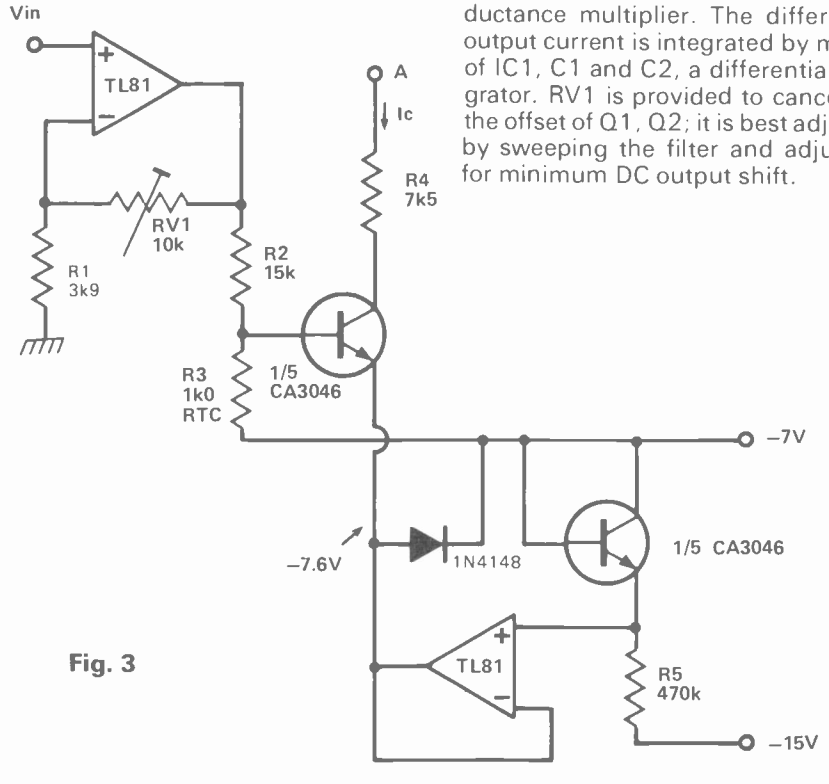

Fig. 3

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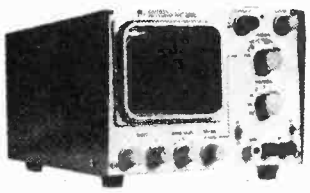

ELMAC 4" scope

SPECIFICATIONS
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 inhshunt 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.
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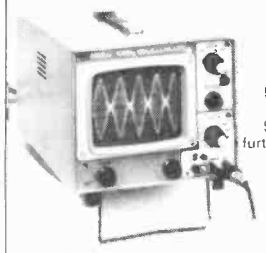

3106C
5" CRT
SAE for further details

As recommended by Practical Wireless
SPECIFICATION
Display: 8 × 10cm with 1cm graticule squares
Tube: 130BE/P31
EHT: 1.6kV
VERTICAL AMPLIFIER
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Bandwidth: DC to 6MHz —3dB. DC to 10MHz —6dB
Risetime: 55ns
Input Impedance: 1MΩ and 30pF
Input: ÷400V max
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SPC(I) SQR(X) TAB(I) TAN(X) USR(I)

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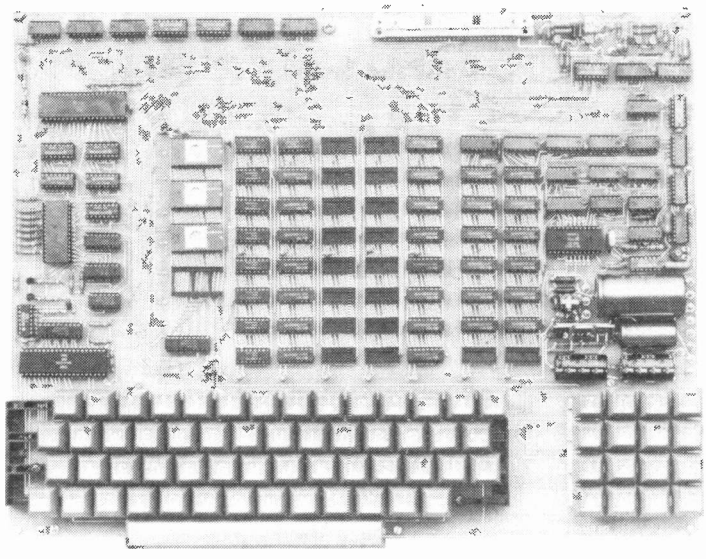

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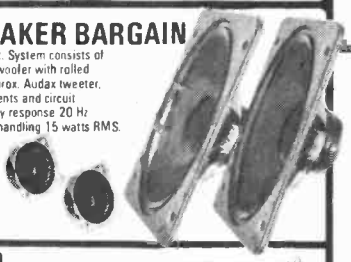
30 x 30 WATT AMPLIFIER KIT

with BSR P200 belt drive deck and Shure M75 cartridge.

£57.00
+ p&p £6.00

EMI SPEAKER BARGAIN



Stereo pair 350 kt. 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.

£15.25
Per stereo pair
£3.65 p&p

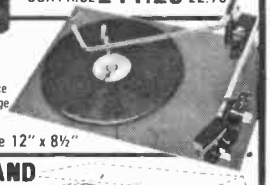
BSR P200

Belt drive chassis turntable unit semi-automatic, cueing device. **£25.50** p&p £2.60

A.D.C. QLM 30 Mk III Magnetic Cartridge to suit. **£7.95**

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

OUR PRICE **£11.25** p&p £2.75

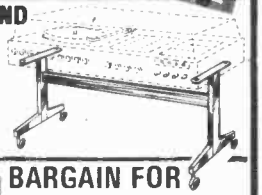


GARRARD DECK MODEL CC 10A

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

£8.15 p&p £2.05 Size 12" x 8½"

UNIT AUDIO STAND



Can be used with TV too! Finish in chrome with decorative wood spacer fitted with 4 Kenrick Mini Meteor castors.

£3.95 £1.50 p&p
24" x 12½" x 11½" approx.

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. **£35.75**

Micro Cassette Recorder

Pocket size—home or office use or when travelling. **£14.25**

Battery operated fluorescent camping lamp.

Runs off 8 U2 batteries. **£4.80**

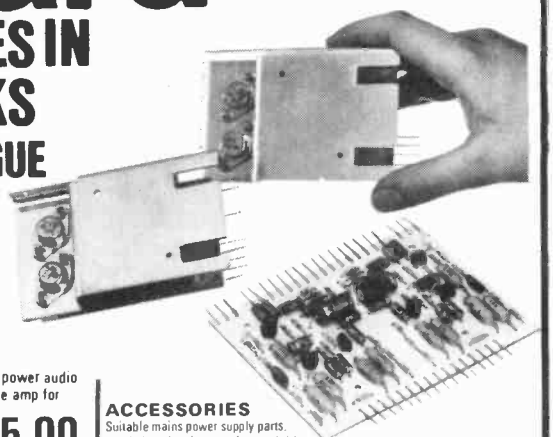
Mullard

AUDIO MODULES IN BARGAIN PACKS

CURRENT CATALOGUE PRICE £ AT OVER 25 PER PACK

SEE OUR PRICES

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



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 **£5.00**

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 **£7.65**

ACCESSORIES

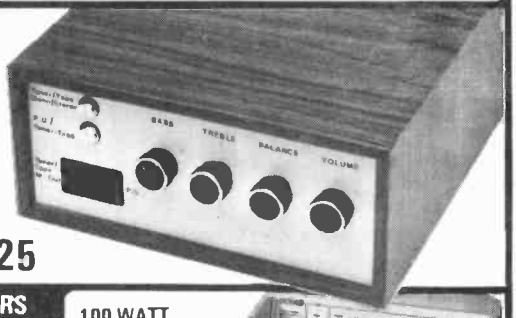
Suitable mains power supply parts, consisting of mains transformer, bridge rectifier, smoothing capacitor and set of rotary stereo controls for treble, bass, volume and balance **£3.00** plus £1.50 p&p

AVAILABLE ALSO TO PURCHASERS OF THE 10 + 10 AMPLIFIER KIT

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. **£4.05** per stereo pair plus £1.55 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 9¾" x 8¾" x 4" p&p £2.25 **£12.25**

BARGAINS FOR PERSONAL SHOPPERS

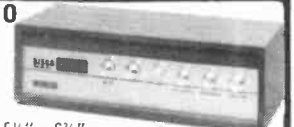
LCD Solar 5 function with backlite stainless steel finish case and strap	**£7.40**
LCD Solar Chrono 9 function with backlite stainless steel finish case and strap	**£9.55**
Chrono stop watch 9 function with back lite stainless steel finish case and strap.	**£8.95**
Solar Alarm LCD stainless steel case and strap.	**£21.95**
AM/FM DIGITAL CLOCK RADIO Accurate 4 Digit Electronic Clock with ½" LED display. Buzzer and snooze timer	**£12.20**
100 Watt Power Amp Module	**£14.25**
Mains power supply for above unit	**£3.60**
DECCA 20w Stereo speaker kit comprising 2 8" approx. bass units + 2 3½" approx. tweeter inc. crossovers	**£20.45**
'VIDEOMASTER' Super Score TV Game with pistol mains operation	**£15.95**
PORTABLE RADIO/CASSETTE RECORDER, AM/FM with clock. LW, MW, SW, VHF mains/battery operation	**£42.90**
ISP Radio Cassette recorder Mains/Battery AM/FM built in mic auto stop.	**£24.50**

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. L PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to b 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.

p&p £4.05 **£66.45**

50 WATT MONO DISCO AMP



£30.60
p&p £2.70

Size approx. 13⅜" 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.

FOR PERSONAL SHOPPERS ONLY

DUO II SPEAKERS

Attractive teak finish, modern design incorporating 2 speaker units - 8" approx. woofer and 2½" approx. tweeter. 45 to 1800 Hz. Impedance 8 ohms. Power 15 watts RMS. 18½" x 13½ x 7¼" approx. Per stereo pair **£16.50**

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"

RTVC

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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
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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

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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

4-1-79

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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		

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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

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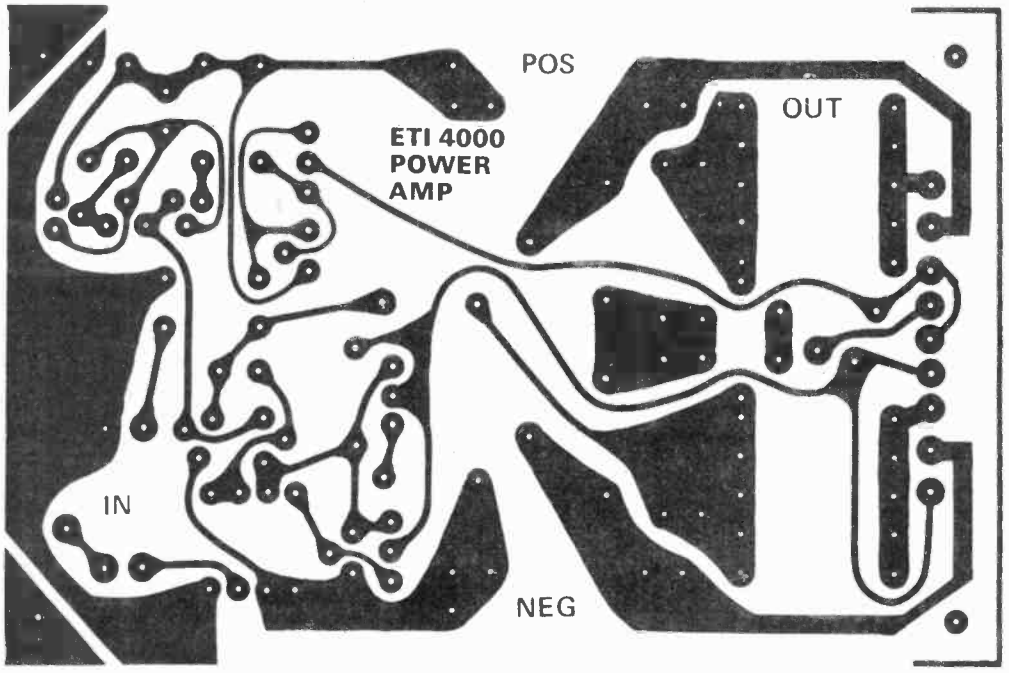
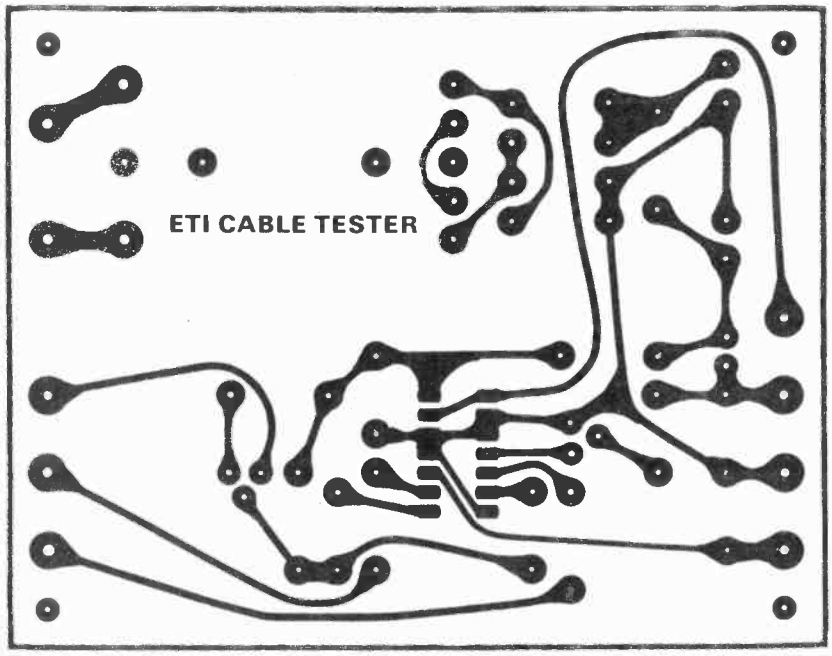
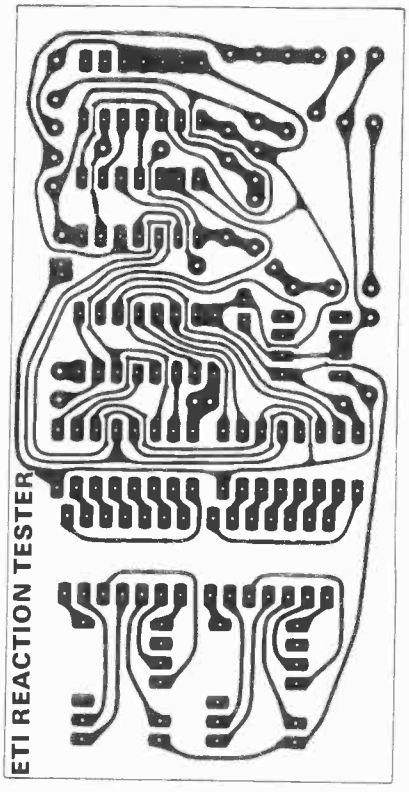
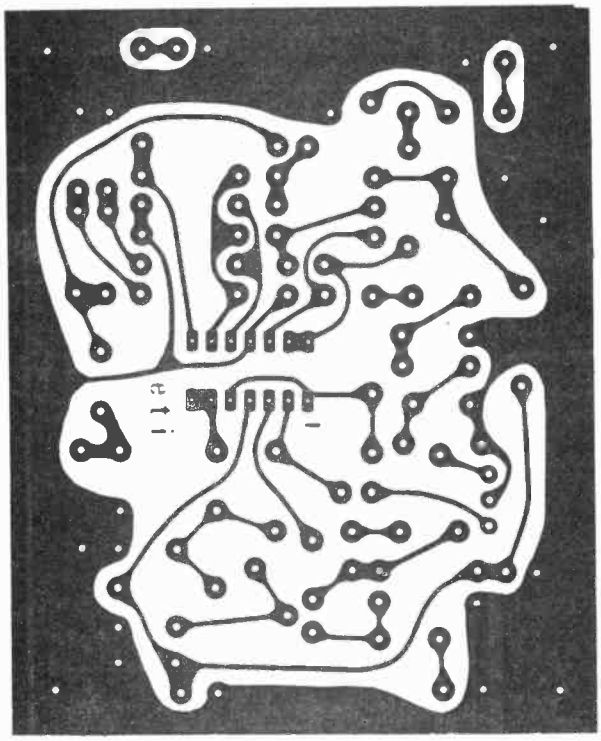
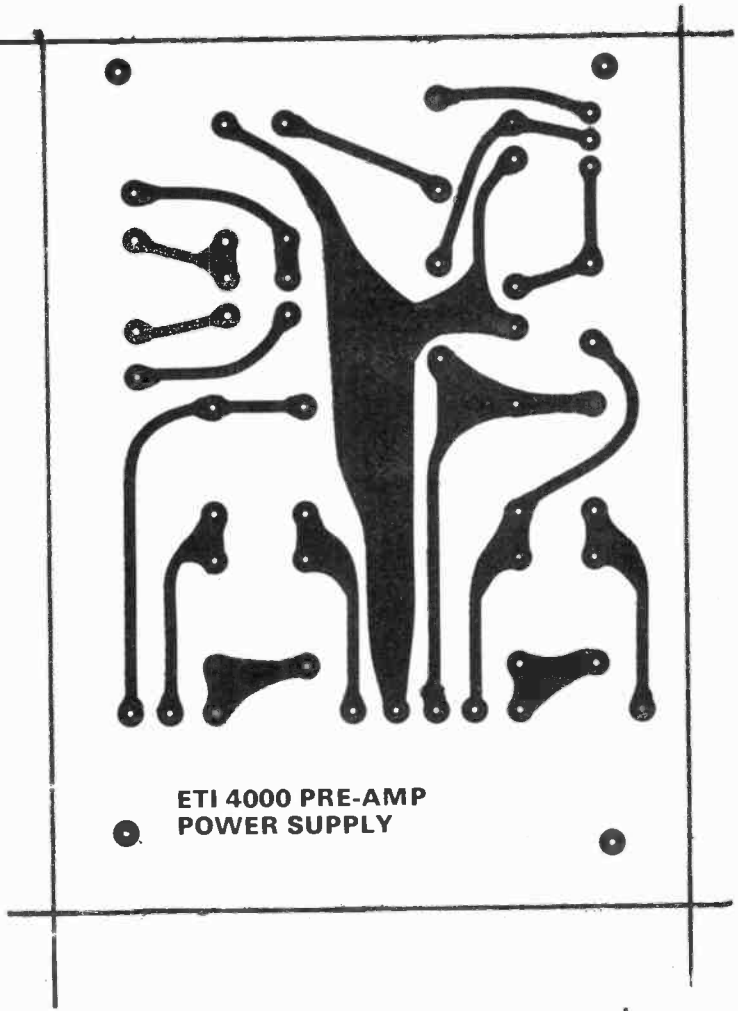




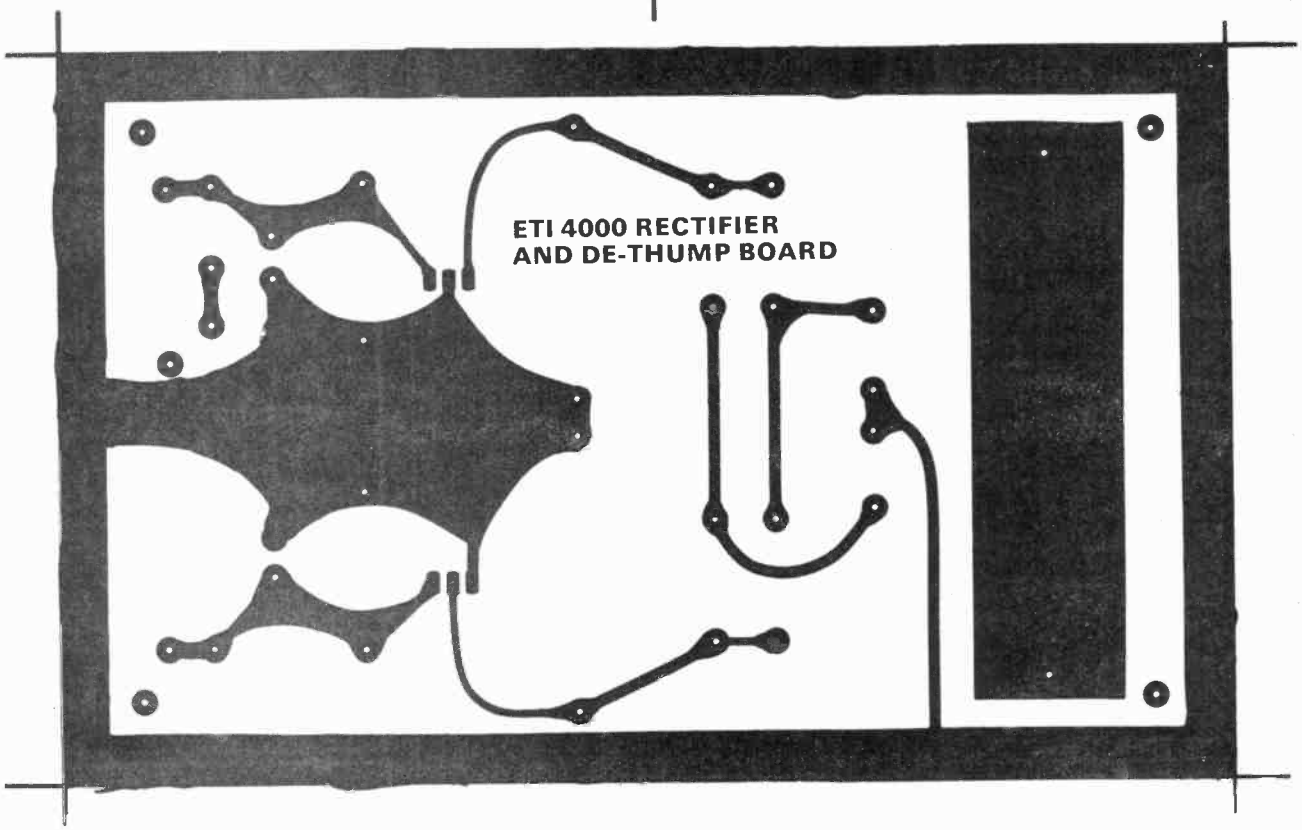




ETI SPEECH COMPRESSOR



ETI 4000 PRE-AMP
POWER SUPPLY



ETI 4000 RECTIFIER
AND DE-THUMP BOARD

THE ARAK VIII POLYPHONIC KEYBOARD CONTROLLER

The Arak VIII is so named because it can handle up to eight* note polyphony, and that means that if you have a large enough synthesizer you can play eight notes at once, and each one can be set to sound totally different.
The Arak VIII is a controller in every sense of the word. For instance it has built in vibrato so you don't waste those precious V.C.O.s. You can instantly get back to that fat monophonic sound by flicking the unison switch. Just touch the keys with infinite sustain selected and the Arak VIII brings in a big power chord while you get on with playing another instrument. Memorising a chord is no problem using the memory bank facility. You can even sequence between two chords set in the memory banks and interact with them from the keyboard. We designed the Arak VIII to interface with just about anything, apart from the gate and control voltage outputs, which incidentally, can be scaled between zero and two volts per octave, there is an I/O so you can interface it to a computer. This allows a computer to take data from the Arak VIII or feed data in and control the synth.
The case is hand-built out of black anodised aluminium and is finished off with solid mahogany end cheeks. Legends are silk screened on the front and back so you know precisely what to twiddle and what to plug into.

Arak VIII kit	**£248.39**
Arak VIII ready-built and tested	**£382.22**
PCB set	**£25.40**

Prices include VAT

*Four more store / portamento circuits are needed to give the necessary number of control voltages.

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CROWTHORNE, BERKS.

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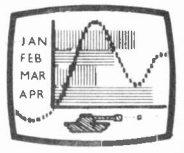

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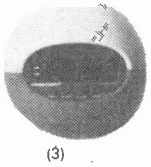

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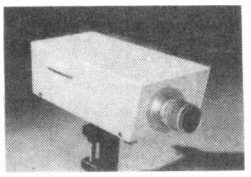

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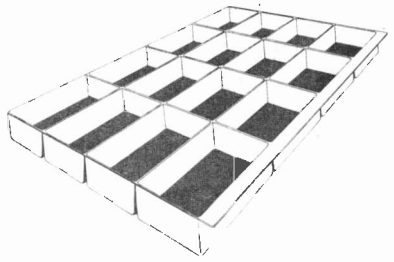

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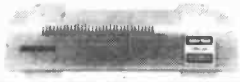

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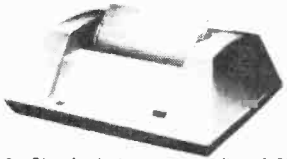

The DP 8000 prints the 96-character ASCII set in single or double width at 84 lines per minute. ● The unit operates bi-directionally to print a 9 x 7 matrix on multiple copy, pin-feed plain paper. ● This model accepts RS-232C or current loop serial data at baud rates switchable from 110 to 9600 and Parallel Bit data input at over 1000 characters per second. ● Standard storage capacity of 256 characters ● Other features include Out of Paper Detector, Top of Form Programming and Skip Over Perforation Control.

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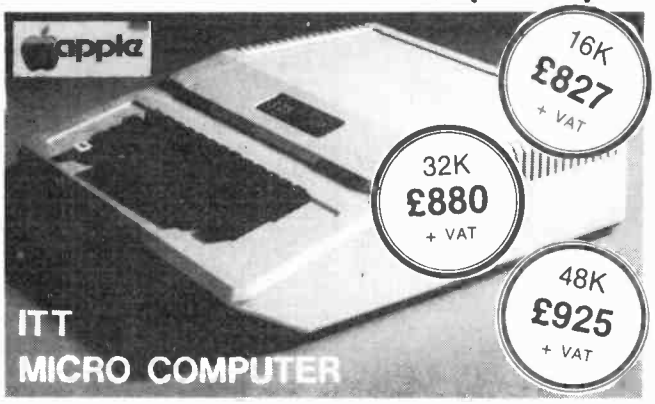

★ Full colour — UHF output ★ Audio cassette tape interface ★ Up to 48K RAM on board ★ BASIC in ROM (graphics commands include COLOUR = VLIN, HLIN, PLOT and SCRN) ★ Built in loudspeaker ★ Buckets of software available ★ Disk System (110K byte per drive — includes controller) only **£425** + VAT **EX-STOCK**

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video 100

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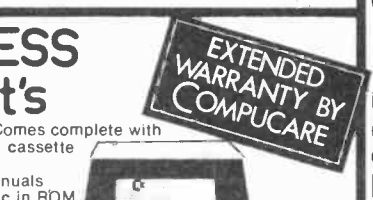

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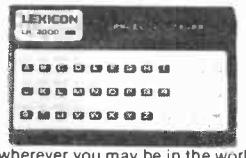

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COMMANDS
CONT LIST NEW NULL RUN

STATEMENTS
CLEAR DATA DEF DIM END FOR
GOTO GOSUB IF GOTO IF THEN INPUT LET
NEXT ON GOTO ON GOSUB POKE PRINT READ
REM RESTORE RETURN STOP

EXPRESSIONS

OPERATORS
+ - / ↑ NOT AND OR > < <> > = < = RANGE 10^{32} to 10^{+32}

VARIABLES
A B C ... Z and two letter variables
The above can all be subscripted when used in an array. Strang variables use above names plus $ e.g A$

*8K Microsoft Basic means conversion to and from Pet, Apple and Sorcerer easy. Many compatible programs already in print.

SPECIAL CHARACTERS
@ Erases line being typed, then provides carriage return, line feed.
← Erases last character typed.
CR Carriage Return — must be at the end of each line.
: Separates statements on a line.
CONTROL/C Execution or printing of a list is interrupted at the end of a line.
"BREAK IN LINE XXXX" is printed, indicating line number of next statement to be executed or printed.
CONTROL/O No outputs occur until return made to command mode. If an Input statement is encountered, either another CONTROL/O is typed, or an error occurs.
? Equivalent to PRINT

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including RF Modulator & Power supply.
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FUNCTIONS
ABS(X) ATN(X) COS(X) EXP(X)
LOG(X) PEEK(I) POS(I) RND(X)
SPC(I) SQR(X) TAB(I) TAN(X)
FRE(X) INT(X)
SGN(X) SIN(X)
USR(I)

STRING FUNCTIONS
ASC(X$) CHR$S(I) FRE(X$) LEFT$(X$,I)
RIGHT$(X$,I) STR$(X)
LEN(X$) MID$(X$,I,J)
VAL(X$)

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One lineprinter will be awarded to the winner of each category.
Send or bring along to the address shown below the following:
1) The program on cassette in the format used by the **COMPUKIT UK101**
2) Any documentation that you have for the program (source listing not necessary)
3) This coupon signed by you accepting the rules and conditions of the competition.

RULES:
1) Entries, including documentation, must be printed by computer or typed double spaced, with your name on every page.
2) Send or bring your entries to the address shown below.
3) Entries must be received by midnight on 29/2/80, any received after this time are void.
Winners will be notified by post before 31/3/80.
4) You warrant by your signature that all programs and documentation material included is entirely your own creation, and that no rights to it have been given or sold to any other party, and you agree to allow **COMPUKIT LTD.** to use, publish, distribute, modify, and edit it as it sees fit.
5) All entries become the property of **COMPUKIT LTD.** No entries will be returned nor any questions answered regarding individual entries.
6) Judging will be by a selected panel chosen by, and including representatives of COMPUKIT LTD. Judges may assign programs to any of the categories as they see fit. Decision of the judges is final.
7) Employees of **COMPUKIT LTD,** its dealers, distributors, advertising agencies and media are not eligible to enter.

Name _____

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I agree to abide by the above mentioned rules.

Signature _____

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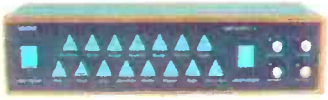

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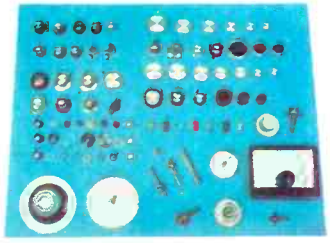

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