TRANSCENDENT POLYSYNTH

By brilliant design work and the use of high technology components the Polysynth brings to the reach of the home constructor a machine whose versatility and range of sounds is matched only by ready built equipment costing thousands of pounds. Designed by synthesizer expert Tim Orr and being featured in this issue of Electronics Today International, this latest addition to the famous Transcendent family is a 4 octave (transposable over 7½ octaves) polyphonic synthesizer with internally up to 4 voices making it possible to play simultaneously up to 4 notes. Whereas conventional synthesizers handle only one at a time.

The basic instrument is supplied with 1 voice and up to 3 more may be plugged in. A further 4 voices may be added by connecting to an expander unit, the metalwork and woodwork of which is designed for side by side matching with the main instrument. Each voice is a complete synthesizer in itself with 2 VCOs, 2 ADSRs, a VCA and a VCF (requiring only control voltages and a power supply, the voice boards are also suitable for modular systems). One of these voices is automatically allocated to a key as it is operated. There are separate tuning controls for each VCO of each voice. All other controls are common to all the voices for ease of control and to ensure consistency between the voices.

Although using very advanced electronics the kit is mechanically very simple with minimal wiring, most of which is with ribbon cable connectors. All controls are PCB mounted and the voice boards fit with PCB mounted plugs and sockets. The kit includes fully finished metalwork, solid teak cabinet, professional quality components (resistors 2% metal oxide or metal film of 0.5% and 0.1%), nuts, bolts, etc.

EXPANDABLE POLYPHONIC SYNTHESIZER

COMPLETE KIT

ONLY

£320 + VAT

(Single Voice)
Plug in extra Voices – Kit price £52 + VAT (£46 + VAT if ordered with kit)

Cabinet size 31.1" x 19.6" x 7.6" rear 3.4" front

Kit also available as separate packs

ADSR IC CEM 3310	£4.00
VCO IC CEM 3340	£6.00
0.1% 25 ppm M.F Res	£0.50
0.5% 25 ppm M.F. Res	£0.25
30 ppm multilayer ceramic cap	£0.50

ICs and details of all packs in our

FREE CATALOGUE

Pack		Price
POLY 1	Pair of PCB s for multiplex cct K B contacts	£9.50
POLY 2	IC s, IC sockets Rs, Cs for multiplex cct	£8.20
POLY 3	Superior quality keyboard	£32.25
POLY 4	Contacts & bus bars	£12.00
POLY 5	Double sided plated through PCB for digital control & pitch gate generator cct	£17.25
POLY 6	Rs, Cs, heat sink for fitting to Pack 5	£10.50
POLY 7	IC's IC sockets, diodes for fitting to Pack 5	£31.30
POLY 8	Double sided mother board (for plug in voices)	£18.90
POLY 9	Rs, Cs, connectors for mother board	£14.10
POLY 10	IC's IC sockets, Trs, heat sinks for mother board	£13.10
POLY 11	PCB for master controls (left of section marked VOICES)	£18.80
POLY 12	ICs, IC sockets, diodes Trs, Rs, Cs for master control PCB	£9.30
POLY 13	Pots, Switches for master control board	£11.80

Pack		Price
POLY 14	PCB for VOICE section	£6.80
POLY 15	Pots, Switches, diodes, Cs for VOICE PCB	£4.80
POLY 16	PCB for plug in voices	£8.20
POLY 17	Rs, Cs, presets, connectors for one voice	£16.30
POLY 18	ICs, IC skts, diodes for one voice	£27.50
POLY 19	Transformer 0 120 240 17 0 17 0 7 7	£6.30
POLY 20	Pitch bend control	£3.90
POLY 21	Misc parts eg jack sockets, knobs mains switch etc	£13.00
POLY 22	Ribbon cable, ribbon cable connectors, mains cable	£8.45
POLY 23	Fully finished metalwork and fixing parts	£25.60
POLY 24	Solid teak cabinet	£25.80
Total cost for individually purchased packs for single voice instrument		£355.15
Complete kit for 4 voice expander including connectors		**£295.00**

All prices VAT exclusive.

POWERTRAN

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

POWERTRAN ELECTRONICS
PORTWAY INDUSTRIAL ESTATE
ANDOVER, HANTS SP10 3NM
ANDOVER (STD 0264) 64455

PRICE STABILITY: Order with confidence. Irrespective of any price changes we will honour all prices in this advertisement until May 31st 1981, if this month's advertisement is mentioned with your order. Errors and VAT rate changes excluded.

EXPORT ORDERS: No VAT. Postage charged at actual cost plus £1 handling and postal documentation.

U.K. ORDERS: Subject to 15% surcharge for VAT.* No charge is made for carriage.* or at current rate if changed.

SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50 (VAT inclusive) per kit.

SALES COUNTER: If you prefer to collect kit from the factory, call at Sales Counter. Open 9 a.m.–12 noon, 1–4.30 p.m. Monday–Thursday.

MANY MORE KITS ON PAGE 8

personal computer.

Now available for the ZX80... New 16K-BYTE RAM pack

Massive add-on memory. Only £49.95.
The new 16K-BYTE RAM pack is a complete module designed to provide you – and your Sinclair ZX80 – with massive add-on memory. You can use it for those really long and complex programs – or as a personal database. (Yet it can cost as little as half the price of competitive add-on memory for other computers.)

For example, you could write an interactive or 'conversational' program to show people what your ZX80 can do. With 16K-BYTES of RAM, they could be talking to your computer for hours!

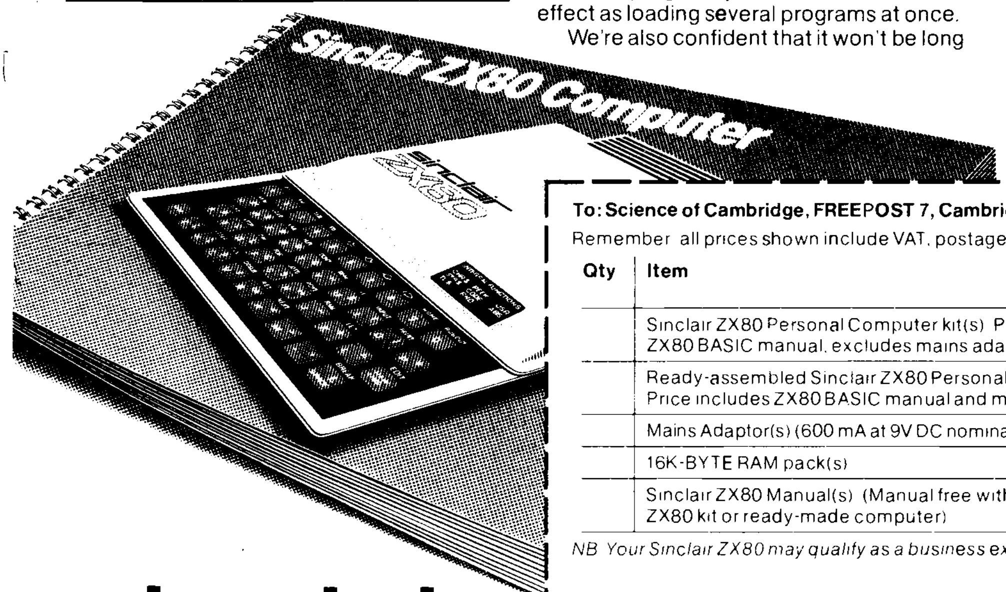
Or you can store a mass of data – perhaps in a fairly simple program – such as a name and address list, or a telephone directory.

And by linking a number of separate programs together into one giant, but modular, program, you can achieve the same effect as loading several programs at once.

We're also confident that it won't be long before you can buy cassette-based software using the full 16K-BYTE RAM. So keep an eye on the personal computer magazines – and brush up your chess perhaps!

The RAM pack simply plugs into the existing expansion port on the rear of the ZX80. No wires, no soldering. It's a matter of seconds and you don't need another power supply. You can only add one RAM pack to your ZX80 – but with 16K-BYTES who could want more!

How to order
Demand for the ZX80 exceeds all other personal computers put together! So use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.



To: Science of Cambridge, FREEPOST 7, Cambridge CB2 1YY.
Remember all prices shown include VAT, postage and packing. No hidden extras. Please send me:

Qty	Item	Code	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	02	79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor.	01	99.95	
	Mains Adaptor(s) (600 mA at 9V DC nominal unregulated).	03	8.95	
	16K-BYTE RAM pack(s).	18	49.95	
	Sinclair ZX80 Manual(s). (Manual free with every ZX80 kit or ready-made computer.)	06	5.00	

NB. Your Sinclair ZX80 may qualify as a business expense. **TOTAL: £**

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £ ______
Please print
Name: Mr/Mrs/Miss ______
Address ______

FREEPOST – no stamp needed. ETI04

sinclair ZX80

Science of Cambridge Ltd.
6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: 0223 311488.

WATFORD ELECTRONICS

33/35 CARDIFF ROAD, WATFORD, HERTS, ENGLAND
MAIL ORDER, CALLERS WELCOME
Tel. Watford (0923) 40588/9

ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.Os OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS' OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRY WELCOME. P&P ADD 50p TO ALL ORDERS UNDER £10. OVERSEAS ORDERS POSTAGE AT COST. AIR/SURFACE. ACCESS ORDERS WELCOME.

VAT Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 15% to all prices.

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

ELECTROLYTIC CAPACITORS: (Values are in µF) **500V:** 10 **52p;** 47 **78p; 250V:** 100 **85p; 63V:** 0.47, 1.0, 1.5, 2.2, 3.3 **8p;** 4.7 **9p;** 6.8 10 **10p;** 15, 22, **12p;** 33 **15p;** 47 **12p;** 100, **19p;** 1000 **70p. 50V:** 47 **12p;** 68 **20p;** 220 **24p;** 470 **32p;** 2200 **90p 40V:** 4.7, 15, 22 **9p;** 3300, **90p;** 4700, **120p; 25V:** 1.5, 6.8, 10 22 **8p;** 33 **9p;** 47 **8p;** 100 **11p;** 150 **12p;** 220, **15p;** 330 **22p;** 470 **25p;** 680, 1000, **34p;** 2200, **50p;** 3300 **76p;** 4700 **92p; 16V:** 40, 47, 100 **9p;** 125, **12p;** 220 **13p;** 470, **20p;** 680 **34p;** 1000 **27p;** 1500, **31p;** 2200 **36p;** 3300 **74p;** 4700 **79p.**
TAG-END TYPE: 450V: 100µF **65p; 70V:** 4700, **245p; 64V:** 3300 **198p;** 2200 **139p; 50V:** 3300 **154p;** 2200 **110p; 40V:** 4700 **160p; 25V:** 10,000 **320p;** 15 000 **345p.**

POLYESTER CAPACITORS: Axial Lead Type
400V: 1nF 1n5, 2n2, 3n3 4n7, 6n8 **11p;** 10n 15n, 18n 22n **12p;** 33n 47n, 68n **16p;** 100n, 150n **20p;** 220n **30p;** 330n **42p;** 470n **52p;** 680n **60p;** 1µF **68p;** 2µ2 **82p;** 4µ7 **85p.**
160V: 10nF, 12n, 39n, 100n **11p;** 150n, 220n **17p;** 330n, 470n **30p;** 680n **38p;** 1µF **42p;** 1µ5 **45p;** 2µ2 **48p;** 4µ7 **58p.**
1000V: 1nF **17p;** 10nF **30p;** 15n **40p;** 22n **36p;** 33n **42p;** 47n, 100n **42p;** 470n **99p.**

POLYESTER RADIAL LEAD CAPACITORS: 250V:
10n 15n, 22n, 27n **6p;** 33n, 47n, 68n, 100n **7p;** 150n, 220n **10p;** 330n 470n **13p;** 680n **19p;** 1µ **23p;** 1µ5 **40p;** 2µ2 **46p.**

TANTALUM BEAD CAPACITORS
35V: 0 1µF, 0-22, 0-33 **15p;** 0-47, 0-68 1-0, 1 5 **16p;** 2 2, 3-3 **18p;** 4-7 6 8 **22p;** 10 **28p; 16V:** 2 2, 3 3 **16p;** 4 7 6 8 10 **18p;** 15, **36p;** 22 **30p;** 33, 47 **40p**, 100 **75p; 10V:** 15, 22, **26p;** 33 47 **35p;** 100 **55p; 6V:** 100 **42p.**

MYLAR FILM CAPACITORS
100V: 1nF, 2, 4, 4nF, 10 **6p;** 15nF, 22n, 30n 40n 47n **7p;** 56n 100n 200n **9p;**
50V: 470nf **12p.**

CERAMIC CAPACITORS 50V

Range: 0-5pF to 10,000pF	**4p**
0-015µF 0-022µF 0-033µF	**5p**
0 047µF **5p**, 0 1µF 0 2µF	**7p**

SILVER MICA (Values in pF) 2 3-3, 4-7, 6-8 8-2, 10, 12, 15, 18, 22, 27, 33, 39, 47 50, 56, 68, 75, 82, 85, 100, 120, 150 180pF **15p** each
200, 220, 250, 270 300, 330 360, 390, 470, 600, 800 820 **21p** each
1000 1200, 1800, 2200 **30p** each
3300 4700pF **60p** each

POLYSTYRENE CAPACITORS:
10pF to 1nF **8p;** 1.5nF to 12nF **10p**

MINIATURE TYPE TRIMMERS
2-6pF, 2-10pF **22p;** 2-25pF, 5-56pF **30p;** 10-88pF **35p**

COMPRESSION TRIMMERS
3-40pF, 10-80pF **20p;** 20-250pF **28p**, 100-580pF **39p;** 400-1250pF **48p**

POTENTIOMETERS: Rotary.sCarbon Track 0 25W Log & Lin
470Ω, 680Ω, 1KΩ & 2KΩ (Linear only)

Single Gang	**29p**
5KΩ-2MΩ Single Gang Log & Lin	**29p**
5KN-2MΩ Single Gang D. P Switch	**78p**
5KΩ-2MΩ Double Gang Log & Lin	**89p**
Wire Wound Single Turn 1 Watt 20Ω 20KΩ	**115p**

SLIDER POTENTIOMETERS
0-25W log and linear values 60mm

5KΩ-500KΩ single gang	**70p**
10KΩ-500KΩ dual gang	**110p**
Self Stick Graduated Bezels	**36p**

PRESET POTENTIOMETERS

0 1W 50Ω—5MΩ Miniature Vertical & Horizontal	**7p**
0-25W 100Ω—3-3MΩ horiz larger	**10p**
0-25W 200Ω—4-7MΩ Vert	**10p**
Cermet, Precision, multiturn, 0 75W ¾in 100Ω-100KΩ	**89p**

RESISTORS — Erie make 5% Carbon Miniature High Stability, Low noise

	RANGE	VAL	1-99	100+
¼W	2 2Ω-4.7M	E24	**2p**	**1p**
½W	2 2Ω-4 7M	E12	**2p**	**1p**
1W	2.2Ω-10M	E12	**5p**	**4p**
2% Metal Film 10Ω-1MΩ			**6p**	**4p**
1%0 5W 51Ω-1M		E24	**8p**	**6p**

100+ price applies to Resistors of each type not mixed values

COMPUTER ICs

2114-450n	185
2114-300n	245
2532-32K	£14
2708	350
2716-5V	450
4116	250
4315 Cmos	995
5532-250n	TBA
6502	675
6520	325
6522	570
6530	1350
6532	795
6545	1450
6551	785
6592	2572
6800	520
6805	670
6809	1550
6810	280
6821	315
6840	750
6850	315
6852	390
8080A	450
8085A	1100
81LS95	125
81LS96	125
81LS97	125
8212	210
8214	425
8251	475
8253	999
8T26A	190
8T28A	195
8T95N	160
8T97N	150
AY-3-1015	420p
AY-5-1013	365
AY-5-2376	750
MC1488	90
MC1489	90
MC14411	950
MC14412	1250
RO-3-2513U	600
SFF96364E	950
SFC71301	820
TMS2716-3V	1050
TMS4027	325
TMS6011	365
Z80CPU 2 5	650
Z80ACPU 4M	795
Z80P10	440
Z80AP10	575
Z80CTC	440
Z80ACTC	575
Z80SIO	TBA
Z80SIO	TBA
Z80Dart	TBA
Z80Adart	TBA

JACKSONS VARIABLE CAPACITORS

DILICON		0 2 365pF with slow	
100/300pF	**195p**	motion Drive	**450p**
500pF	**250p**	0 0 208/176	**395p**
6 1 Ball Drive		with slow	
4511/DAF	**160p**	motion drive	**450p**
Dial Drive 4103		C804-5pF 10 15	
6 1/36 1	**775p**	25 50pF	**280p**
Drum 54mm	**55p**	100, 150pF	**350p**
0-1-365pF	**325p**	L 3x310pF	**725p**
00 2 365pF	**395p**	00-3x25pF	**550p**

RF CHOKES
1µH 4 7 10 22 33 47 100 200 470 750, 1mH, 2.5 5 10 **35p each**
22mH 33 **45p;** 43, 100 120 **75p each**

VEROBOARD 0 1in

	Clad	Plain
2½ x 3¾"	**66p**	**47p**
2½ x 5"	**75p**	—
3¾ x 3¾"	**75p**	—
3¾ x 5"	**86p**	**72p**
3¾ x 17"	**296p**	**210p**
4¾ x 17"	**390p**	—

VQ Board **150p**
DIP Board **330p**
Vero Strip **144p**

Pkt of 100 pins **50p**
Spot face cutter **107p**
Pin insertion tool **147p**

PROTO — OECs
Veroblack **375p**
S-Dec **350p**
Eurobreadboard **520p**
Bimboard 1 **785p**
Superstrip SS2 **998p**

VERO WIRING

PEN + Spool	285
Spare Spool	65
Combs	6

DALO ETCH RESIST PEN
+ Spare tip **90**

FERRIC CHLORIDE
1 lb bag Anhydrous **195p** + 40p P&P

ULTRASONIC TRANSDUCER
40KHz **395p pr**

COPPER CLAD BOARDS

Fibre Glass	Single-sided	Double-sided	SRBP 9 5"x8 5"
6" x 6"	**90p**	**110p**	**95p**
6" x 12"	**150p**	**195p**	

DIL PLUGS
14 pin **44p;** 16 pin **49p**
24 pin **88p;** 40 pin **295p**

Ribbon Cable
10 way & 20 way available

Soldercon pins 100 **60p;** 500 **275p.**

DIL SOCKETS (TEXAS) Low Wire

	Prof.	Wrap
8pin	**10p**	**25p**
14pin	**10p**	**35p**
16pin	**10p**	**46p**
18pin	**16p**	**52p**
20pin	**22p**	**65p**
22pin	**25p**	**70p**
24pin	**30p**	**78p**
28pin	**35p**	**85p**
36pin	—	**105p**
40pin	**40p**	**109p**

EDGE CONNECTORS: (Double type)

	.1	.156
2x10 way	—	**85p**
2x15 way	—	**99p**
2x18 way	**115p**	**120p**
2x22 way	**130p**	**135p**
2x25 way	**149p**	**160p**
2x30 way	**170p**	—
2x36 way	**194p**	—
2x40 way	**210p**	—
2x43 way	**232p**	—

DIODES

AA119	15
BA100	15
BY100	24
BY126	12
BY127	12
CR033	250
OA9	40
OA47	12
OA70	12
OA79	15
OA85	15
OA90	8
OA91	8
OA95	8
OA200	8
OA202	8
1N914	4
1N916	5
1N4001/2	5
1N4003	6
1N4004/5	6
1N4006/7	7
1N4148	4
1N5401	15
1N5404	16
1N5406	17
IN5408	19
1S44	9
1S921	9
6A 100V	40
6A/400V	50
6A/800V	65

NOISE
Z5J **180**

VARICAPS

BA102	50
BB105B	40
BB106	40
MVAM2	165
MVAM115	158

TRIACS

3A200V	54
3A400V	56
8A100V	60
8A400V	69
8A800V	115
12A100V	78
12A400V	82
12A800V	135
16A100V	103
16A400V	105
16A800V	220
25A500V	220
25A800V	295
T2800D	120

BRIDGE RECTIFIERS (plastic case) p

1A/50V	20
1A/100V	22
1A/400V	29
1A/600V	34
2A/50V	35
2A/200V	40
2A/400V	46
2A/600V	65
6A/100V	83
6A/400V	95
6A/600V	125
10A/200V	215
10A/600V	350
25A 200V	240
25A/600V	395
BY164	56
VM18 DIL	50

ZENERS
Range 2V7 to 39V 400mW **8p each**
Range 3V3 to 33V 1 3W **15p each**

Thyristors

5A 40V	32
5A400V	40
5A600V	48
8A300V	60
8A600V	90
12A100V	78
12A400V	95
12A800V	188
BT106	150
BT116	180
C106D	38
TIC44	24
TIC45	29
TIC47	35
2N5062	32
2N5064	38
2N4444	130

DIAC
ST2 **25**

75 SERIES

75108	350
75150	140
75154	150
75450	95
75451	70
75454	225
75491	89
75492	95

LINEAR ICs

702	75
709 14 pin	40
709C 8 pin	35
710	67
733	75
741 8 pin	17
747C 14 pin	78
748C 8 pin	36
753 8 pin	185
810	159
9400CJ	350
AY-1-0212	595
AY-1-1313A	660
AY-1-1320	225
AY-1-5050	99
AY-1-5051	160
AY-3-1015	550
AY-3-1270	840
AY-3-8500	390
AY-3-8910	850
AY-3-8912	950
AY-5-1224A	235
AY-5-1230	450
AY-5-1317A	630
AS-5-3500	350
AY-5-4007D	450
AY-5-8100	775
CA3011	110
CA3012	175
CA3014	157
CA3018	68
CA3019	70
CA3020	166
CA3023	191
CA3028A	80
CA3035	235
CA3036	115
CA3043	275
CA3045	365
CA3046	70

TRANSISTORS

	p
AC125	35
AC126	25
AC127	25
AC128	25
AC141	30
AC142	30
AC176	28
AC187	28
AC188	30
ACY17	70
ACY18	70
ACY19	75
ACY20	75
ACY21	75
ACY22	60
ACY28	75
ACY39	85
ACY41	85
AD142	120
AD149	79
AD161	42
AD162	42
AF118	95
AF124	70
AF126	65
AF139	40
AF178	75
AF186	70
AF239	78
ASZ21	125
BC107	10
BC107B	12
BC108	10
BC108B	12
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC114	22
BC115	22
BC117	24
BC118	23
BC119	38
BC137	40
BC139	40
BC140	30
BC142	30
BC143	30
BC147	9
BC147B	10
bc148	9
BC148B	10
BC149	9
BC149C	10
BC153	27
BC154	27
BC157	10
BC158	10
BC159	11
BC160	45
BC167A	10
BC168C	10
BC169C	10
BC170	15
BC171	11
BC172	11
BC177	20
BC178	20
BC179	20
BC182	10
BC183	10
BC184	10

BC182L	10
BC183L	10
BC184L	10
BC181	20
BC186	30
BC187	26
BC212	10
BC212L	10
BC213	10
BC213L	10
BC214	10
BC214L	10
BC237	14
BC238	14
BC307B	14
BC308	16
BC327	15
BC328	15
BC337	15
BC338	15
BC441	34
BC461	34
BC477	40
BC516	40
BC517	40
BC547	14
BC548	14
BC549C	14
BC556	15
BC557	15
BC558	15
BC559	15
BCY30	68
BCY34	85
BCY35	50
BCY39	85
BCY40	85
BCY42	14
BCY43	35
BCY45	50
BCY58	35
BCY59	35
BCY70	16
BCY71	18
BCY72	20
BCY78	24
BD112	125
BD124	115
BD131	48
BD132	48
BD133	60
BD135	45
BD136	40
BD137	40
BD138	40
BD139	40
BD140	40
BD144	198
BD145	175
BD158	55
BD205	110
BD206	110
BD222	85
BD245	45
BD378	70
BD434	55
BD517	75
BD695A	85
BD696A	85
BDY56	180
BDY60	160
BDY61	160
BF115	35

BF154	25
BF158	25
BF167	29
BF173	27
BF177	25
BF178	30
BF179	35
BF180	38
BF182	38
BF184	38
BF185	38
BF194	12
BF195	12
BF196	12
BF197	12
BF198	16
BF199	18
BF200	30
BF224A	25
BF244B	29
BF245	30
BF256A	35
BF256B	45
BF257	32
BF258	32
BF259	35
BF274	42
BF336	40
BF337	40
BF451	35
BF594	30
BF595	30
BFR39	23
BFR40	23
BFR41	23
BFR79	23
BFR80	25
BFR81	25
BFR98	105
BFX29	28
BFX81	45
BFX84	26
BFX85	28
BFX86	28
BFX87	28
BFX88	28
BFY18	50
BFY50	23
BFY51	23
BFY52	23
BFY53	32
BFY55	32
BFY56	32
BFY64	35
BFY71	20
BFY81	120
BRY39	40
BSX20	20
BSX26	34
BSX29	34
BSX78	45
BSY26	30
BSY95A	25
BU105	170
BU205	190
BU206	200
BU208	200
E421	250
MD8001	250
MJ490	90
MJ491	175
MJ2955	90
MJE170	150
MJE180	150

MJE340	54
MJE370	100
MJE371	100
MJ490	90
MJE520	65
MJE521	95
MJE2955	99
MJE3055	70
MPF102	66
MPF103	36
MPF104	36
MPF105	36
MPF106	40
MPSA05	22
MPSA06	25
MPSA12	32
MPSA55	30
MPSA56	30
MPSU02	58
MPSU05	55
MPSU06	55
MPSU52	65
MPSU55	60
MPSU56	60
MPU131	52
OC26	170
OC28	130
OC35	125
OC36	120
OC41	120
OC42	120
OC44	120
OC45	40
OC70	40
OC71	40
OC72	40
OC74	50
OC75	50
OC76	50
OC77	50
OC81	50
OC82	50
OC83	40
OC84	40
OC140	110
OC170	85
OC171	85
OC200	85
TIP29	34
TIP29A	36
TIP29B	56
TIP29C	60
TIP30	47
TIP30A	48
TIP30B	50
TIP30C	58
TIP31A	45
TIP31B	48
TIP31C	55
TIP32A	48
TIP32C	60
TIP33A	65
TIP33C	78
TIP34A	74
TIP34C	88
TIP35A	160
TIP35C	185
TIP36A	170
TIP36C	199
TIP41A	55
TIP41b	60
TIP42A	60
TIP42B	75

TIP120	90
TIP121	99
TIP122	99
TIP141	120
TIP142	120
TIP147	120
TIP2955	60
TIP3055	60
TIS43	32
TIS44	45
TIS45	45
TIS46	45
TIS59	50
TIS74	50
TIS90	30
TIS91	32
UC734	65
ZTX107	11
ZTX108	11
ZTX109	12
ZTX212	28
ZTX300	13
ZTX301	16
ZTX302	16
ZTX303	25
ZTX304	17
ZTX314	25
ZTX326	30
ZTX341	30
ZTX500	14
ZTX501	15
ZTX502	15
ZTX503	18
ZTX504	25
ZTX1	25
ZTX550	25
2N697	23
2N698	40
2N699	48
2N706A	19
2N708	19
2N918	35
2N1131	24
2N1132	24
2N1302	45
2N1303	60
2N1304	65
2N1305	60
2N1306	65
2N1307	65
2N1308	68
2N1613	30
2N1670	150
2N1671B	160
2N2160	295
2N2217	45
2N2218A	45
2N2219A	28
2N2220A	26
2N2221A	26
2N2222A	25
2N2297	45
2N2303	45
2N2368	25
2N2369A	18
2N2476	50
2N2483	27
2N2484	27
2N2492	50
2N2497	63
2N2646	45
2N2784	55
2N2904	28

2N2905A	26
2N2906	26
2N2907	26
2N2907A	26
2N2926G	10
2N3011	28
2N3020	45
2N3053	26
2N3054	58
2N3055	48
2N3108	45
2N3252	46
2N3302	30
2N3441	140
2N3442	140
2N3663	15
2N3702	10
2N3703	10
2N3704	10
2N3705	10
2N3706	10
2N3707	10
2N3708	10
2N3709	10
2N3710	10
2N3711	10
2N3713	140
2N3771	179
2N3772	195
2N3773	270
2N3819	22
2N3820	45
2N3822	65
2N3823	65
2N3824	65
2N3866	90
2N3879	150
2N3903	18
2N3904	18
2N3905	15
2N3906	17
2N4037	46
2N4041	40
2N4058	10
2N4061	10
2N4062	10
2N4064	115
2N4220	78
2N4234	48
2N4236	48
2N4264	24
2N4286	15
2N4289	18
2N4314	68
2N4400	18
2N4427	80
2N4859	78
2N4871	55
2N4898	135
2N4901	175
2N4921	55
2N4922	60
2N5102	145
2N5135	20
2N5136	20
2N5138	18
2N5172	18
2N5179	45
2N5180	45
2N5191	75
2N5305	24
2N5308	24
2N5457	36
2N5458	36

2N5459	36
2N5485	36
2N5777	45
2N5879	190
2N6027	32
2N6388	150
2SD234	75
3N128	112
3N140	112
40311	60
40313	130
40315	60
40316	95
40317	60
40320	80
40323	60
40324	100
40326	60
40327	70
40347	90
40348	120
40360	40
40361	50
40362	50
40408	70
40411	285
40467A	130
40468	85
40594	105
40595	110
40603	110
40636	175
40673	95

SPECIAL OFFER

2114-450n **185p**
2114-300n **245p**
2708 **350p**
2716-5V **450p**
4116 **250p**
IM6402 (UART) **380p**
MM1702AQ **295p**

Access

Telephone orders by Access now accepted (£10 min.)

CA3048	214
CA3059	195
CA3075	213
CA3080E	65
CA3081	190
CA3085	95
CA3089E	215
CA3090AQ	375
CA3123E	150
CA3130	90
CA3140	48
CA3160	95
ICL7106	795
ICL7107	975
ICL8038CC	340
ICL8211A	150
ICM7204	550
ICM7205A	1150
ICM7207	475
ICM7215	1050
ICM7216AJ	1950
ICM7216B	1950
ICM7216C	1950
ICM7217A	790
ICM7224	785
ICM7555	89
LD130	452
LF351	49
LF356	90
LM10	395
LM301AP	26
LM308T	95
LM311	70
LM318N	200
LM324A	50
LM339	68
LM348	90
LM349	115
LM379	415
LM380	80
LM381N	145
LM382	125
LM384	140
LM386	99
LM387	120
LM389	99
LM733	99
LM1458	45
LM2917	195
LM3900	60
LM3909N	70
LM3911	125
LM3914	240
LM3915	240
LM3916	255
LM13600	135
M252AA	625
M253AA	1150
MC663	50
MC1204	250
MC1301	79
MC1303	68
MC1304P	260
MC1310P	150
MC1458	45
MC1488	90
MC1489	90

MC1494	694
MC1495	350
MC1496L	92
MC1596	225
MC1710	79
MC3302	150
MC3340P	120
MC3360P	120
MC3401	52
MC3403	135
MC3405	150
MFC6040	97
MK5039B	635
MM5303	635
MM5307	1275
MM57160	520
MSM5526	820
NE515	275
NE529	225
NE543K	210
NE544	185
NE555	22
NE556	55
NE560	325
NE561	398
NE562B	410
NE564	435
NE565A	120
NE566	180
NE567V	170
NE570	450
NE571	420
RC4136D	110
S566B	275
SAB3209	425
SAB3210	275
SAS560	150
SAS570	150
SG3402	295
SL414A	275
SN76003N	240
SN76013	170
SN76013ND	130
SN76018	148
SN76023	170
SN76023ND	170
SN76033N	195
SN76115N	215
SN76131	125
SN76227N	95
SN76477	175
SN76660	120
SP8629	299
TAA621AX1	250
TAA661A	155
TAA700	250
TAD100	159
TBA120S	70
TBA540Q	220
TBA550Q	330
TBA641-A12	
BX or BX11	250
TBA651	190
TBA800	90
TBA810	95
TBA820	70
TBA920Q	260

TBA990Q	270
TCA270Q	250
TCA965	120
TDA1004	290
TDA1008	310
TDA1022	575
TDA1024	105
TDA1490	290
TDA2020	320
TDA2030	320
TL061CP	46
TL062CP	90
TL064CN	159
TL071CP	45
TL072CP	90
TL074CN	140
TL081CP	42
TL082CP	70
TL083CP	95
TL084CN	120
UAA170	170
UAA180	170
XR2206	350
XR2211	575
XR2266	750
ZN414	95
ZN423	195
ZN424E	130
ZN425E	415
ZN1034E	200
ZN1040E	685

TTL 74 (TEXAS)

7400	11
7401	11
7402	11
7403	14
7404	14
7405	18
7406	36
7407	36
7408	17
7409	20
7410	17
7411	25
7412	20
7413	32
7414	38
7416	30
7417	30
7420	19
7421	38
7422	25
7423	28
7425	28
7426	43
7427	32
7428	35
7430	19
7432	27
7433	36
7437	35
7438	32
7440	20
7441	68
7442	58
7443	120
7444	116
7445	105
7446	132
7447	72
7448	75
7450	20
7451	20
7453	20
7454	20
7460	20
7470	40
7472	30
7473	35
7474	34
7475	56
7476	40
7480	52
7481	120
7482	75
7483	90
7484	99
7485	105
7486	33
7489	205
7490	42
7491	84
7492	50
7493	57
7494	85
7495	70
7496	80
7497	176
74100	130
74104	62
74105	62
74107	34
74109	60
74110	54
74111	68
74112	170
74116	198
74118	85
74119	120
74120	75
74121	35
74122	50
74123	65
74125	50
74126	45
74128	65
74132	55
74136	65
74141	75
74142	185
74143	250
74144	250
74145	90
74147	150
74148	125
74150	130
74151	70
74153	70
74154	120
74155	75
74156	75
74157	70
74159	165
74160	99
74161	99
74162	99
74163	99
74164	120
74165	120
74166	130
74167	205
74170	205
74172	375
74173	110
74174	100
74175	82
74176	80
74177	85
74178	110
74179	155
74180	90
74181	280
74182	88
74184	130
74185	130
74188	310
74190	130
74191	120
74192	120
74193	120
74194	102
74195	75
74196	99
74197	88
74198	160
74199	160
74221	150
74246	150
74247	151
74248	189
74249	189
74251	110
74265	66
74273	267
74278	249
74279	99
74283	149
74284	350
74285	350
74290	107
74293	135
74297	236
74298	185
74365	95
74366	95
74367	95
74368	95
74390	185
74393	185
74490	185

74L

74L00	68
74L30	60
74L47	380
74L75	145
74L85	349
74L121	165
74L123	325

74S

74S00	60
S04	73
S132	138
S138	240
S158	240
S188	210
S189	158
S194	360
S195	795
S241	540
S262	850
S287	325
S288	210
S470	325
S472	1150
S475	825

74LS

LS00	13
LS01	13
LS02	15
LS03	15
LS04	16
LS05	23
LS08	22
LS09	23
LS10	20
LS11	32
LS12	32
LS13	40
LS14	80
LS15	40
LS20	21
LS21	32
LS22	35
LS26	44
LS27	35
LS28	35
LS30	20
LS32	25
LS33	35
LS37	30
LS38	35
LS40	28
LS42	66
LS47	85
LS48	105
LS49	106
LS51	25
LS54	30
LS55	30
LS63	160
LS73	45
LS74	35
LS75	45
LS76	45
LS78	50
LS83	105
LS85	80
LS86	38
LS90	50
LS91	125
LS92	75
LS93	80
LS95	115
LS96	120
LS107	45
LS109	75
LS112	40
LS113	75
LS114	40
LS122	70
LS123	75
LS124	180
LS125	45
LS126	45
LS132	80
LS133	35
LS136	55
LS138	70
LS139	70
LS145	120
LS147	210
LS148	170
LS151	90
LS153	85
LS155	96
LS156	65
LS157	70
LS158	70
LS160	90
LS161	96
LS162	110
LS163	95
LS164	115
LS165	155
LS166	175
LS168	210
LS169	210
LS170	288
LS173	105
LS174	147
LS175	110
LS181	295
LS183	298
LS189	128
LS190	95
LS191	95
LS192	95
LS193	95
LS194	125
LS195	130
LS196	120
LS197	85
LS200	345
LS202	345
LS221	120
LS240	165
LS241	165
LS242	165
LS243	165
LS244	195

DIGEST

OOPS

Digital Test Meter

Some constructors of the DTM (September '80) have reported problems with the DVM module blowing. This can be prevented by putting a 10M resistor in series with the IN HI pin of the module.

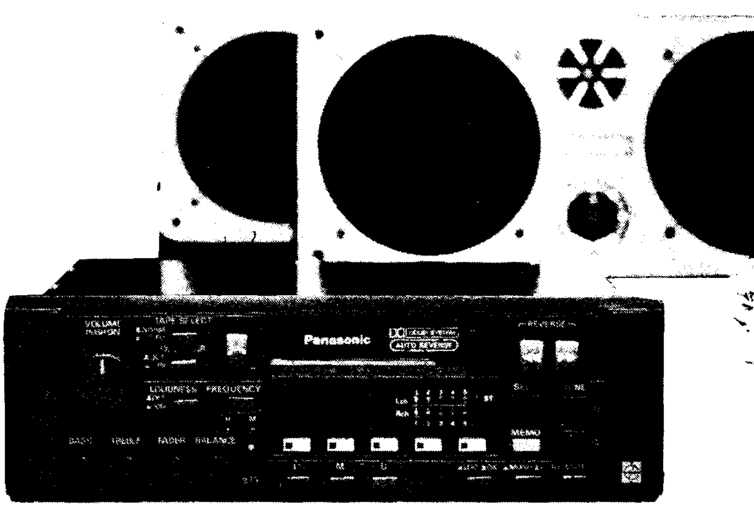
On page 83 the overlay for the resistance measurement board (bottom overlay) shows the common of R43, R44, R45 and C15 connected to IC7 pin 4. In fact IC7 pin 4 should go only to the −6 V takeoff point and C7 −ve. Cut the PCB track just above R45 (page 80 Fig.1 shows the correct wiring).

Vocoder

Two of the ICs in the Vocoder (September '80) are listed incorrectly. In the circuit diagram and Parts List for the internal excitation board, IC5 is a 4030 and IC6 is a 4006.

Breadboard 80

In our report on Breadboard 80 (in the February News Digest), our reporter, no doubt overcome by the occasion, said that our celebrity guest was Brian Rix. In fact Mr Rix, a radio amateur, was at the show as a guest of Practical Wireless, to whom we offer our apologies.



Panasonic Car-Fi

Panasonic has introduced what it believes to be the first full hi-fi stereo car radio/cassette that will fit into a standard DIN size dashboard aperture. The CQ 973 combines microprocessor electronics with full hi-fi specifications and according to Panasonic it is the most advanced in-car system available.

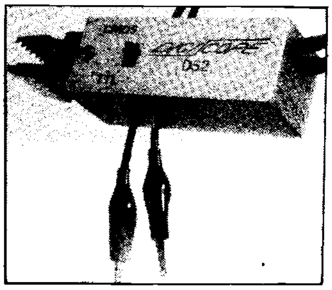
For those of you who can afford the £395.95 price tag, the CQ 973 offers digital frequency readout, three waveband stereo radio, (LW/MW/FM), electronic preset tuning, auto-seek tuning, an auto-reverse cassette player with a Dolby Noise Reduction system, and an output of 100 W. The radio functions are all push-button controlled, with a total of 15 preset stations (five on each band); as an additional safety feature the driver can also keep his hands on the steering wheel and tune the radio by footswitch. The bright green digital frequency readout also functions as a clock, and at night all the major controls are illuminated.

The unit is fitted with normal/metal tape selection and both the fast forward and rewind buttons can be locked in. Separate bass, treble and loudness controls are provided. For further information on the CQ 973 and the rest of Panasonic's in-car entertainment range, contact any of Panasonic's authorised dealers.

Take It Anywhere

New from JVC is the CX 610GB, a 6" VHF/UHF portable colour TV/monitor. This compact unit can be taken anywhere; it is capable of PAL and SECAM TV reception so you can receive programmes in any country that has one of the following TV systems — PAL B, G, or I system and SECAM B, G, D, K, or KI system (both CCIR continental and OIRT standards). The CX 610GB's colour system automatically switches to the broadcast system being used and the corresponding sound IF frequency can then be selected. The set has a newly developed JVC precision in-line picture tube, giving excellent colour pictures, and its highly sensitive swivel antenna ensures good quality reception wherever you are. The flexibility of this unit is further enhanced by a four-way power supply — from the household mains, ordinary batteries, its own rechargeable battery pack or from a 12 V DC car or boat battery.

The CX 610GB can also function as an on-location video monitor when used in conjunction with a colour video camera and portable video recorder. You can even record off-the-air television broadcasts out-of-doors by connecting the CX 610GB to a portable video recorder. The recommended retail price is £259 (including VAT), and further information is available from JVC (UK) Ltd, Eldonwell Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2 7AF.

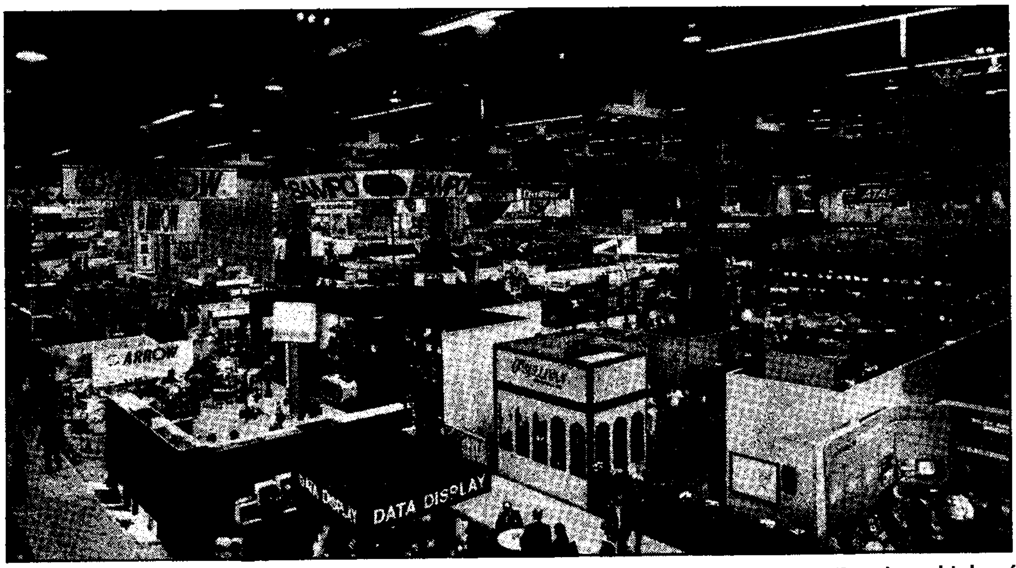


Logic Monitor

If you're in the business of developing or trouble-shooting digital circuits then you'll be interested in the Digiscope DS2 Logic Monitor. The device simply clips over any 14 or 16 pin DIL logic IC during operation, and indicates the state of each pin, either 0 or 1. Each pin has its state shown simultaneously on a 16-LED display, enabling circuit action and faults to be traced with ease. The DS2 is powered from either the circuit supply or an external source and draws negligible current from the IC under test, so circuit operation is unaffected. The input threshold is adjustable to suit either TTL or CMOS ICs. The monitor can also be used to check free packages; power is applied to the supply pins and since the DS2 pulls all the inputs high, operation can be checked by grounding the appropriate inputs and observing the effect. The DS2 is housed in a tough aluminium case and is suitable for use in industrial environments; the case is only 1" wide so several ICs may be checked side-by-side simultaneously. There is a range of accessories available including plugs and an extension lead for remote monitoring. The Digiscope DS2 costs £27.40 and further information is available from the manufacturers, J.E. Sinclare & Co., 82 Plumstead Common Road, London SE18 3RE.

Micro Talk

General Instrument Microelectronics have announced the introduction of a new speech synthesis chip, the SP0256. It's a 28 lead LSI device, designed to generate up to 256 discrete sequences of human speech or other complex sounds stored in its built-in 16K ROM. External expansion can increase the SP0256's repertoire to almost 3825 sequences. Commonly used sounds can be stored once and called from memory when necessary, reducing data storage requirements. Applications envisaged include warning systems, radar, test gear and security systems.



Vegas

The Winter Consumer Electronic Show keeps breaking its own records, and this year's event will be no exception. The Show organisers said that more than 850 exhibitors are showing off their new products at the Las Vegas Convention Centre, up from 757 at last year's Winter Show.

By the end of the year, it seems improbable that anyone will not have heard of the Video Disc. The long wait for the disc to become a functioning reality is over, and by next Winter's CES, close to 25 manufacturers will have a system on the market. The most carefully orchestrated and the most expensive promotion, advertising, and distribution programmes ever seen for an electronic product will forcefeed the video disc message to the American consumers in 1981.

Much of the attention is still focused on the competition between the Philips-made optical laser disc format and the RCA-patented CED Disc system. Matshushita's VHD system, which will be a later entry into the field, can be expected to buck the other two, benefitting from the publicity about discs created by the optical — CED dogfight.

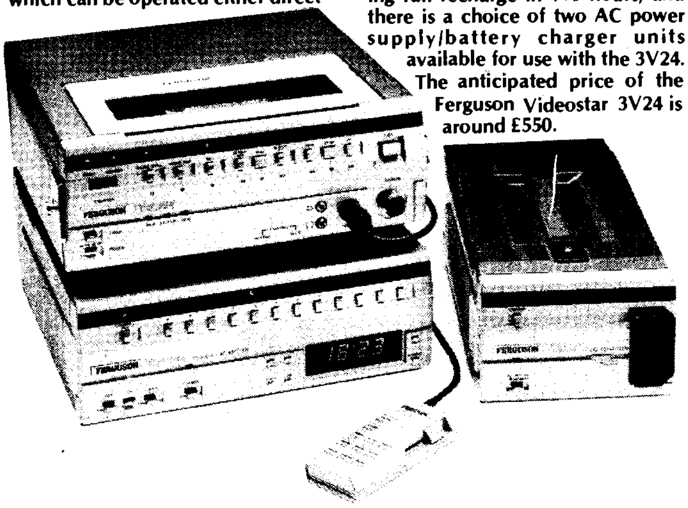
Another Atari first is their new remote control console which combines sleek, futuristic styling and advanced technology and simply makes the game more enjoyable. Two quick-action remote controllers allow the players to move around the room freely without clumsy controller wires interfering with game action. Now the players can select, play and reset games on this new system without ever having to get up. Fingertip touch controls and LED signals are built into the hand-held remote controllers for game select and game reset options and the combination joystick and pedal controllers respond quickly and easily to the players' touch. Activision also showed some new cartridges they have lined up which are compatible with the Atari system. One is Centrecourt Tennis, which offers everything from lightning-quick serves to breathtaking back-hand cross-court returns. Charging players can rush the net or lay back and play the baseline. Laserblast casts you as the commander of a fleet of spacecraft; you come upon some very unfriendly alien types — just get them before they get you but remember the bad guys don't miss very often.

Finally, Studer/Revox enter the cassette equipment market with their model No. B710, utilising the same professionalism inherent in the company's other audio products. It is aimed to achieve the same high level of acceptance and respect by consumers that has been accorded to previous Studer/Revox audio equipment. Two peak reading LED bar displays are used for level indication and feature a resolution of 1 dB from −10 to +6 dB, with 2 dB intervals between −20 and −10 dB. A 0 dB indication represents "Dolby level". Stylistically, the B710 matches the other components in the Revox line.

Gerald Chevin

Versatile Video

Supplies of the new Ferguson Videostar VHS Portable video cassette recorder, model 3V24, are soon to become available. The 3V24 is expected to be the most lightweight recorder on the market, weighing in at 5.2 kg. The 3V24 has a microprocessor-assisted, fully electronic logic control cassette deck which can be operated either directly or by the full remote control unit supplied. The recorder incorporates a new Edit Start Control system for minimising picture break-up between recordings, as well as a picture scan facility which operates at 10 times normal speed, both forward and reverse. Other facilities include still frame, single frame advance and variable slow motion. A new quick-change power pack is supplied giving full recharge in 1½ hours, and there is a choice of two AC power supply/battery charger units available for use with the 3V24. The anticipated price of the Ferguson Videostar 3V24 is around £550.



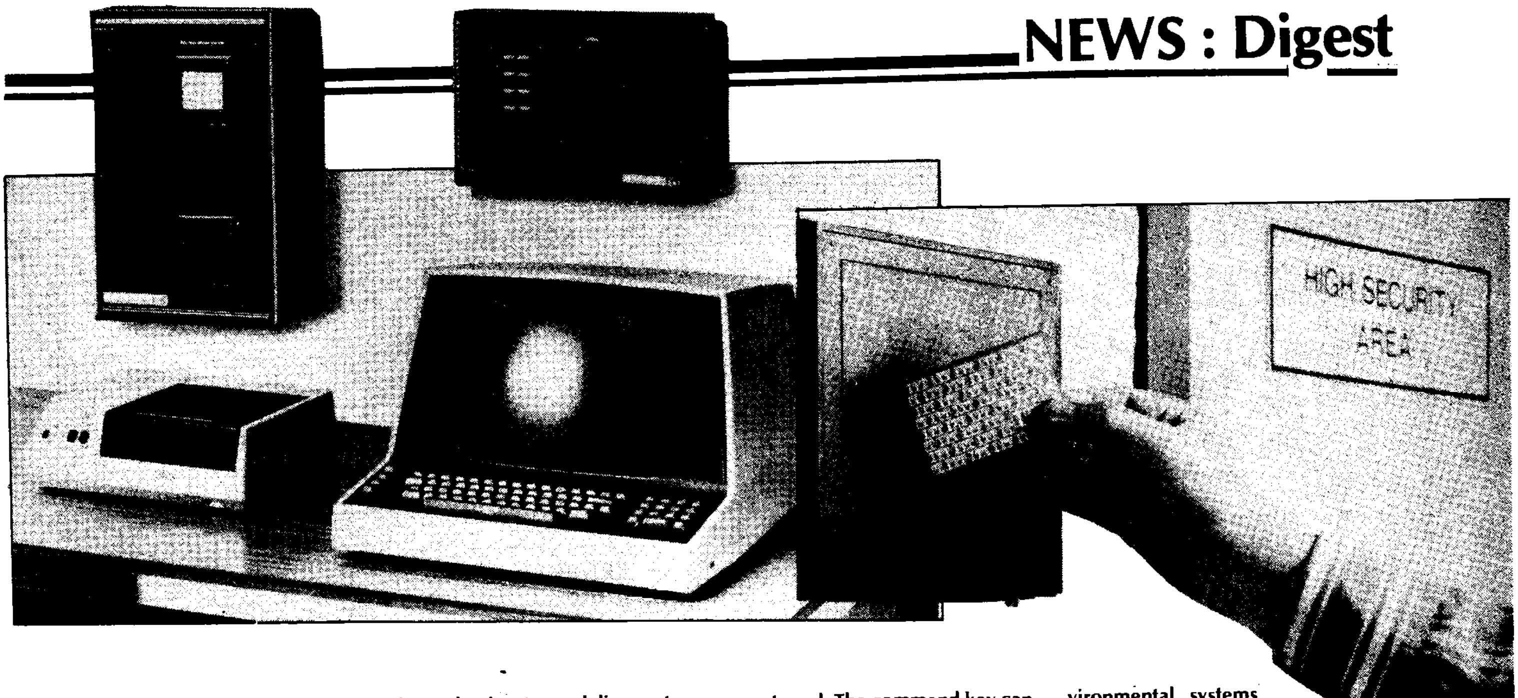
Telly Type

Delpa Systems have just announced their new Video telex which is capable of overcoming many of the inherent problems of ordinary telex machines. The Video telex uses a VDU and so the typing of messages takes half the normal time. The machine offers full correction and editing facilities, including the correction of spelling mistakes and the deletion of lines or paragraphs. It also provides full tabulation which means more attractive layouts, particularly useful in reports and orders. On existing machines where punch tapes are used, error correcting is extremely awkward and any incoming calls will interrupt the process, but the Video telex does not punch the message until it is 100% correct. The machine can either be used in the telex room or by other staff throughout the office building. Each station costs around £900 and further details can be obtained from Delpa Systems (UK) Ltd, Data Transfer Division, 56 Chiswick High Road, London W4 1SZ.

IMPORTANT NOTICE

Readers have recently confused Electronics Today Limited as being associated with the ownership of our magazine, Electronics Today International. Our magazine is owned by Modmags Limited, part of the Argus Press Holdings Limited Group of Companies.

Electronics Today Limited has advertised in our magazine, as "Metac", but so as to prevent any further confusion we wish to make it clear that Electronics Today Limited is not owned or managed by any member of the Argus Press Holdings Limited Group of Companies.



Hidden Security

A new system from STC Electronic Security Systems (STC-ESS) protects itself while it is protecting the customer. The ITT Access Control System, now marketed by STC has no visible mechanism to vandalise or attack at the point of entry. It operates by proximity. A hidden sensor reads a credit-card-size command key and transmits signals to a unit which controls and records access. Conventional keys, key holes or card slots are not used. The command key can even be used while it is still inside a wallet, pocket or bag or is being used as a lapel badge.

The system is modularly expandable and can be integrated into existing or planned security and environmental systems requiring control of multiple access locations. More information on Access Control Systems and other STC security products is available by contacting STC-ESS, 313 Ballards Lane, London N12.

Wire Cutting

If you've ever had an electrical fault in your Rolls, you're only too well aware of the jungle of wires that lurk beneath your bonnet, the colour coding cleverly hidden under years of crud. Ripault of Enfield in collaboration with Liverpool University's Dept. of Electrical Engineering and Electronics have addressed themselves to the sticky problem of cutting down the wiring harness to something a little more manageable.

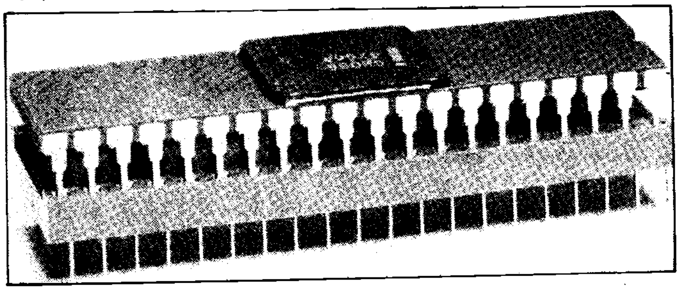
The prototype has already been installed in a Maxi. It uses 10 m of twin core cable instead of 100 m of 130 separate leads used in the conventional Leyland harness. The wire links a number of electronic control boxes, one core carrying power and the other digital control signals for the black boxes. Not only does this method cut down enormously the amount and complexity of the vehicle's wiring, but it also eliminates the use of high current electromechanical relays which are subject to contact wear.

The system is designed to meet a BL specification. Amongst the requirements are that the system should operate under the hostile environment of the engine compartment. That means surviving a temperature range of -40°C to +120°C.

Benefits of the new system include low power consumption, quick and convenient fault diagnosis and easier servicing. A security system could also be built-in.

IC Survival

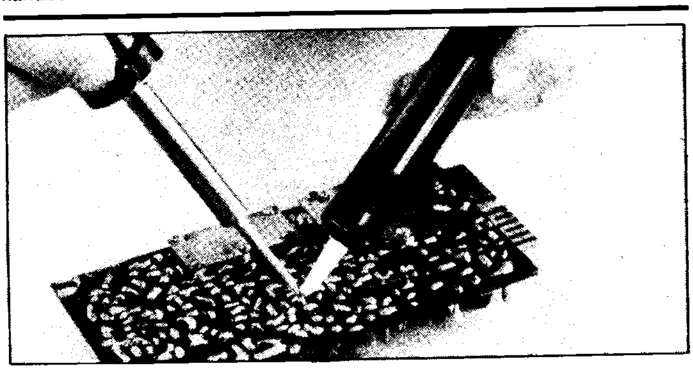
Winslow Component Systems has introduced a new range of IC sockets designed to be virtually indestructable. The heart of the socket is a new contact featuring an inverted leaf design. This double-sided inverted leaf allows for a certain degree of careless handling when inserting an IC, which also facilitates the use of automatic insertion equipment. It is available in two versions — the W3200 series, which has tin plated contacts, for the lower cost consumer type applications and the W3300, aimed at the industrial and professional market incorporating tin and gold plated contacts which are totally insulated from surface tracks on double sided PCBs. The W3300 is also 100% anti-wicking. Both versions come in the complete range of contact configurations from 8-40 pins, they are only 0.15" high and are moulded in UL approved glass reinforced polyester.



Teach Yourself Video

Have you invested in a video recorder, but haven't yet discovered its full potential? If the sole function of your recorder is to commit 'Crossroads' to tape, a new publication from 'those awfully nice Sony people' might widen your horizons. Their 48 page full colour handbook 'How To Video' is on sale at their 134 Regent Street showroom in London for 60p (also by post for 90p).

Video recorders are very complex electronic devices, but are nevertheless simple to operate. 'How To Video' uses simple, non-technical language and ample illustrations to explain what your recorder is capable of, how to make home movies, the use of sound and lighting and even the creation of professional style, special effects and titling.



Suck It And See

New from OK Machine & Tool (UK) Ltd is the DSP-1 desolder pump. OK claim that it features industrial performance at an economy price. For about £6.00 you can arm your toolkit with this all-metal device, with an easy-to-replace Teflon tip — self-cleaning on each stroke.

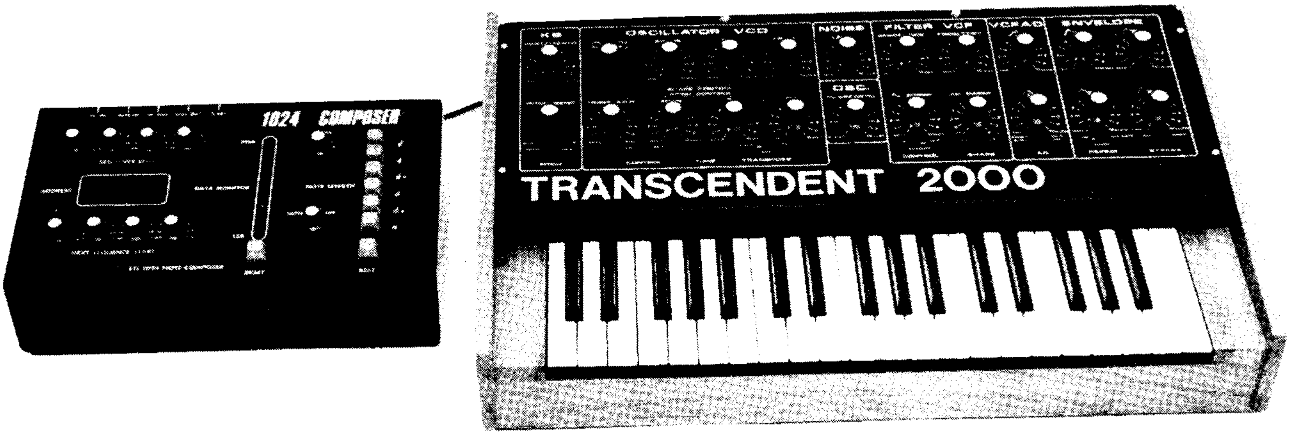
The DSP-1 desolder pump is supplied by OK Machine & Tool (UK) Ltd, Dutton Lane, Eastleigh, Hants SO5 4AA.

April Fair

Keep April 14th to 16th of 1981 free in your diary for the gathering of the clans in the Polytechnic of North London Theatre when the Association of London Computer Clubs hold their second London Computer Fair. For only 75p you can spend a day in North London in the company of everyone who is anyone in personal computing. In addition to retail stands you can visit seminars, workshops and club stands. There's even a bring and buy sale. If you're within reach of a tube station, you're half way there. The venue, the Polytechnic of North London, is opposite Holloway Road tube station.

NEXT MONTH

electronics today INTERNATIONAL



1024 COMPOSER

This machine will plug into the back of your synthesiser and allow sequences of up to 1024 notes to be played automatically. This Powertran design provides complete control of the starting and finishing points of the sequence, so several shorter tunes may be stored in the memory simultaneously. Both pitch and note length are fully programmable and rests may also be entered.

IR REMOTE CONTROL

As promised last month, we present a five-channel infra-red remote control system which will interface with last month's Noiseless Power Switch. The unit has three latching channels (ie push-on, push-off), two non-latching channels, and a range of up to 30 feet. Full constructional details of both the transmitter and receiver will be given.

SOLDERING IRON

A DIY design for a thermostatically-controlled soldering iron that is a must for any serious constructor. If you've ever cursed your unwieldy welding device, you'll be glad to know that with our tiny version your fingers are only 1½" from the bit for precision control. The iron runs from a switched-mode power supply at only 3 V, so it's completely safe for soldering CMOS — with a continuous temperature range up to 500°C, built-in light, interchangeable tips and a price one-fifth of a commercial equivalent, you can't afford *not* to build one.

TOUCH DIMMER

This project makes light work of lamp dimming. Based on the S566B IC, it provides touch control of brightness and a memory that turns the light on at a pre-determined level. The big difference with this design is that it can be used with the IR remote control and still retain all the normal functions. The remote control unit can operate two of these dimmers.

POWER SWITCH

For those of you who don't need the low noise and high current capability of the Noiseless Power Switch, we're publishing a cheap power switch that will handle a current of 5 A and interface with the IR remote control. Up to three of these switches can be controlled by the IR transmitter.

SONIC HOLOGRAPHY

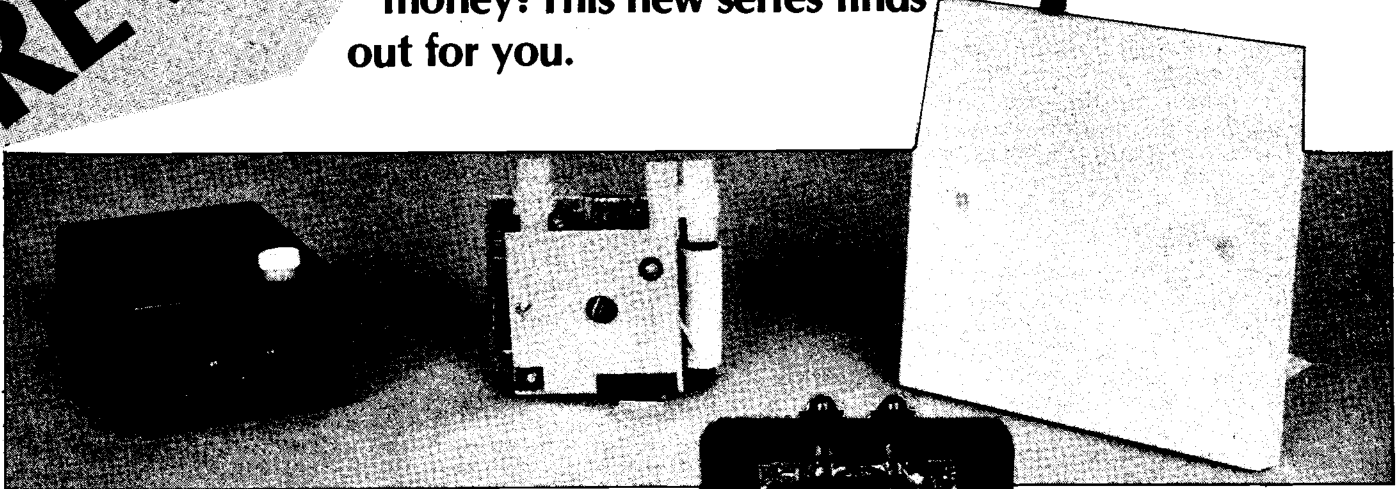
Surround-sound in your living room! No, your eyes don't deceive you — the speakers are in front of you. No, your ears don't deceive you — sounds to the left of you, to the right, behind and above you. Find out more in next month's ETI.

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

LOOK OUT FOR THE MAY ISSUE ON SALE APRIL 3rd

KIT REVIEW

There are many adverts about for build-it-yourself electronic kits — everything from door chimes to hi-fi. But do they represent value for money? This new series finds out for you.



This is the first in a new series of articles, designed to look in detail at some of the DIY kits available on the market, particularly those which yield a useful item for the home or car when completed.

We will be paying close attention to ease of construction — which includes a consideration of the clarity of the instruction leaflets provided. Anyone reading this who produces a kit which they feel might be suitable, is asked to ring the editor at our office number and we'll take if from there.

Taking A Dim View!

For our first month we're having a look at TK Electronic's remote controlled light dimmer, which sells for around £20. The kit comprises two separate units, a touch operated light switch and an IR (infra-red) control box. The dimmer can be constructed initially with straightforward touch operation, and the IR option added later.

The dimmer itself uses the 566 IC, which allows for a neat little circuit with 'memory' capability. Turn on the light by touching the plate and it will assume the level of brightness you last set it at. Holding a finger on the plate will cause the level to cycle between maximum and minimum brightness.

To add the IR facility an external photodiode is fitted to the mounting plate (see photo). This then produces full operation from the hand-held unit. The latter is little more than a multivibrator and two IR LEDs. A neat little black plastic box is provided, predrilled, for mounting the controls.

Constructive Thinking

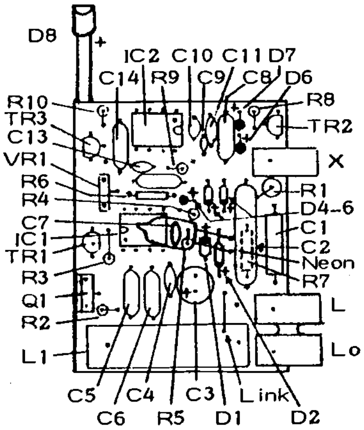
The instructions provided with the kit are well explained, but could be better presented. A separate sheet is included with details of different types of electronic components and some helpful hints on soldering.

These serve as a general construction guide, the detailed building notes for a specific project being pretty sparse. This, together with the very high component density found on the PCB, makes me think that an absolute beginner would find the dimmer a difficult task. As this is a mains circuit, best make a start in electronics elsewhere.

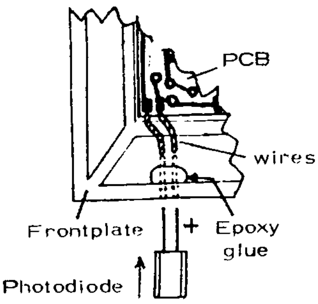
Having said that, anyone who has built a few magazine projects would find the kit *relatively* simple to put together, although care will still be needed in soldering up the PCB, however experienced you may be!

Assembly of the hand controller is very simple indeed, as there are only some eight components involved! The push button is PCB mounted, as are the LEDs. One point about the controller that I did not like was the fact that the LED leads are used to secure the PCB into the box. This means that every time the push button is operated, the leads are stressed unnecessarily. Also the box is a fraction too narrow to admit a PP3 with a battery clip fitted. Thus, it has to be laid along the case which means in turn that it is effectively jammed against the PCB — again putting stress upon the LED leads!

P.C.B. LAYOUT



How to connect photodiode D8 to P.C.B.



Above left: the assembled transmitter. Note the shaky PCB fittings. Above and right: examples from the well-explained notes. Diagrams are basic, but well thought out. Instructions are generally adequate for the constructor with a little experience.

Built And Working

Assembly took about two hours, including the time required to sort out the components initially. No "sillies" manifested themselves from the instructions and the kit was complete as supplied.

Once built the unit functioned first time and the notes provided on installation and use were clear and concise. Take some care with the choice of wiring box you use for mounting the kit, though, as it is fairly deep and will protrude some 35 mm behind the front plate when fitted.

In use the dimmer functioned perfectly at all times, with the photodiode having a good wide acceptance angle. Range is about 30 ft — more than most living rooms I would have thought.

Conclusions

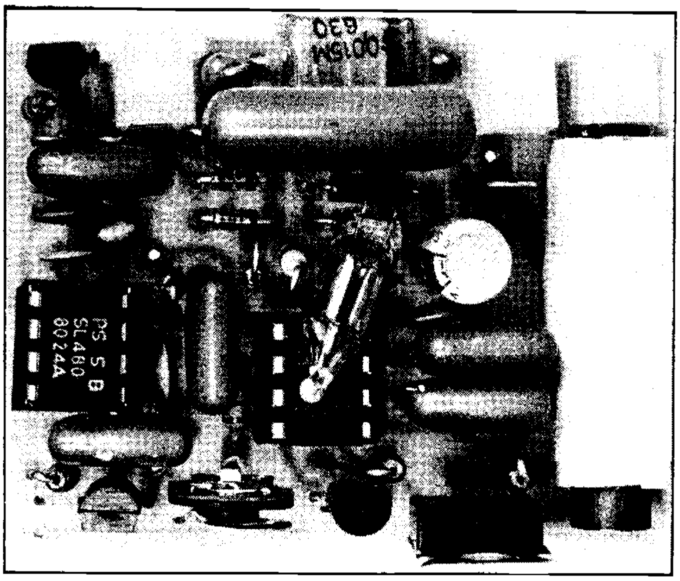
Overall a good design. The circuit is neat and well thought out and the PCB design quite a feat of miniaturisation! However, this does tend to mean that the kit is best suited to someone with some previous constructional experience.

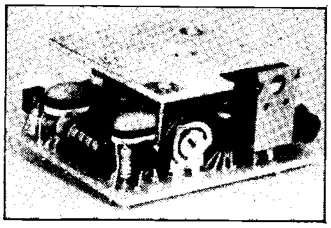
The unit represents reasonable value for money and can be confidently recommended.

RON HARRIS

BUYLINES

TDR300K Touch Dimmer Kit £14.30 + VAT (+ 40p P&P per order), MK6 Infra-red Transmitter £4.20 + VAT. TK Electronics, 11 Boston Road, London W7 3SJ. Tel: 01-579 9794.





Above: the main PCB assembled — note the bulb fitting. This is to ensure that it lines up with the hole in the touch plate, shown fitted (right photo). The board is somewhat crowded in places and care needs to be exercised when soldering.

ETI

B

New from Casio, world leaders in creative technology combined with high quality and reliability

JOIN THE KEYBOARD REVOLUTION!

For everyone music has its own meaning. It is to capture the true values of music that Casio have spent years of research and development efforts. They bring to life beautiful sound experiences never before available. A new generation of tone-true electronic sounds of vivid realism — the composition of a fresh musical system.
By closely analyzing the natural sound variations in the waves and pitches of different instruments, Casio have been able to trace the characteristics peculiar to each traditional instrument. Pitch, timbre and harmonics have been measured, digitalised and stored in electronic chip memory for faithful and exciting reproduction of the clarity and beauty of the originals

CASIOTONE 401

RRP £345

ONLY £295*

Full polyphonic 8-note playing of **14 instruments and sounds** over 4 octaves.
Rhythm accompaniment. 16 different rhythms with full-in **auto-rhythm.**
Casio Auto Chord. Allows one finger accompaniment. Just press a key with a single finger and play major, minor and seventh chords, with bass accompaniment, automatically. Combines with auto-rhythm for professional sounds.
Vibrato, Delayed vibrato, sustain and hold are incorporated in the at-a-glance, simple to use operational panel. Pitch control makes group tuning easy. Compact 4⅝ × 31⅜ × 12⅞ inches with integral amplifier and speaker. The light weight (28.2lb) allows playing anywhere there is an A C socket. **Stand £39.**

CASIOTONE 301

The same size and basic specification as the 401 above, the 301 does not have Casio Auto Chord or built-in sustain and hold facilities. There are 8 rhythm voices with a variation on each. Weight 27lbs.

£245*

CASIOTONE MT-30

RRP £115

ONLY £95*

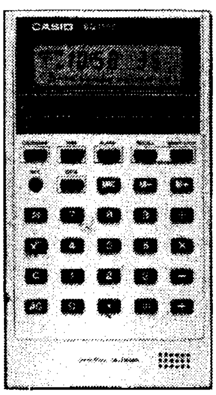
Full polyphonic playing of **22 instruments and sounds** over 3 octaves. 4-position **sound memory** lets you switch between pre-selected sounds without pause. Built-in **vibrato and sustain functions** greatly enhance the overall musical effect. **Compact** 2⅜ × 22¾ × 6½ inches, with built-in amplifier and loudspeaker. Battery/mains power source and light weight (6lb) allows playing anywhere.

CASIOTONE 201 and M-10

Please telephone for availability.
201. Mains version of the MT-3D. 29 instruments over 4 octaves **£245***

M-10. 4 instruments over 2½ octaves. Battery/mains. **£69***

CASIO BQ-1100 BIOLATOR/ WATCH



Clock, calendar, 2 alarms, countdown alarm stopwatch, time memory, three date memories, biorhythm and date calculations, calculator
Clock. Hours, minutes, seconds, am/pm. Day/date.
Universal calendar. Pre-programmed 1901 to 2099 Day, date, month and year display
Alarm. Two separate alarms. 24-hour system.
Countdown alarm. 1/10 second to 24 hours, or
Stopwatch 1/10 second to 24 hours. Net times, or
Time memory. Dual time facility. 24-hour system.
Calculator. 8 digits. Full memory. Sq roots, %. Date calculations Any monthly calendar from 1901 to 2099 can be displayed and utilised
Biorhythm calculations. Forecast your physical, emotional and intellectual performance potential. Chart your peak, ebb and critical days and reschedule to avoid mistakes. Two silver oxide batteries last approx 1 year.
Dims: ¼ x 2.7/16 x 4⅜ inches. Leatherette wallet.

ALL THIS FOR ONLY £14.95*

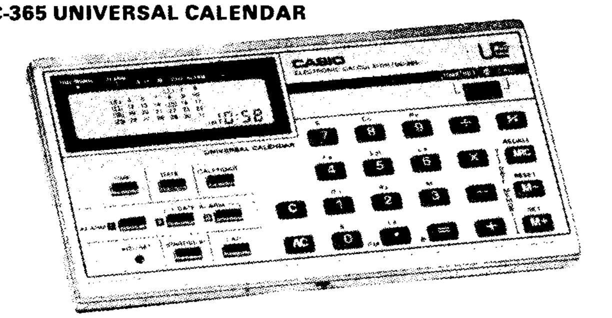
MG-880 SPACE GAME/CALCULATOR

Our best selling calculator. Thousands sold! An action packed speed game that will give you hours of skilful entertainment and chair-gripping excitement. Also an 11-note melody calculator with full memory, %.

KEEP A DATE WITH CASIO

You always wanted a musical calculator with date memories and date/time alarms — HERE IT IS!

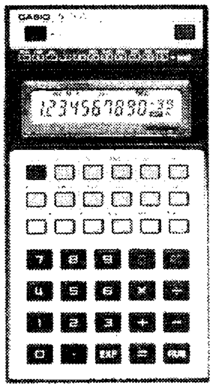
UC-365 UNIVERSAL CALENDAR



Clock, universal calendar, date memories, daily alarm, 2 daily or date/time alarms, hourly chimes, stopwatch, countdown alarm, time memory, calculator.
Clock display: Hours, minutes, seconds, am/pm, or hours, minutes, full calendar.
Calendar: Pre-programmed from 1901 to 2099. Full month display.
Date memories: Any day or days pre-settable within 12-month period. (Birthdays, etc.)
Alarms: Alarm 1 — Daily alarm Alarm 2 & 3 — Daily alarms or time alarms on pre-set dates. (Pre-programmed melodies or electronic buzzer.)
Stopwatch: 1/10 second to 24 hours; net, lap and first and second place. Or
Countdown alarm: 1/10 second steps, settable in minutes up to 24 hours. Or
Time memory: 24 hour system. The time of any other zone can be stored.
Calculator: Optional musical keys, full memory and percentage.
Two silver oxide batteries last approx. 1 year. RRP £22.95
¼ × 4½ × 2½ inches. Leatherette wallet with window **£19.95***

UC-360. Card sized version of above. 7/32 × 3⅜ × 2⅛ inches **£19.95***
UC-3000. Office desk version. Angled display. 1¾ × 4 × 6¼ inches **£27.95***

CASIO'S AMAZING NEW FX-3500P

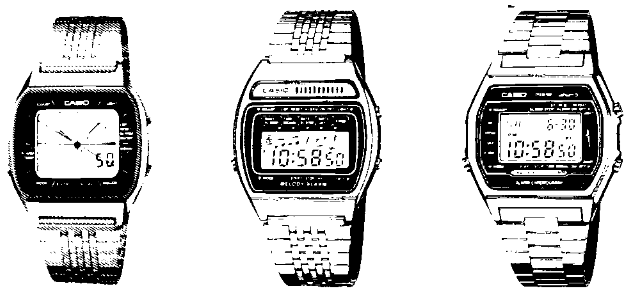


Programmable. Non-volatile memories and stores. Statistical regression and integrals.
38 functional (non-volatile) steps. 2 programme storage capability. Unconditional and conditional jumps. 7 (non-volatile) memories, one independent, 6 constant memories. 18 pairs of parentheses, nestable in 6 levels.
61 built-in functions, including Integrals (Simpson's rule). Linear regression, logarithmic regression, exponential regression and power regression
Hyperbolics, sexagesimal and co-ordinates conversions. 10 digit mantissa or 10+2 exponent. Two silver oxide batteries give approximately 1,000 hours continuous use with power-saving automatic cut-off, with data and memory protection.
Dims: 9/32 x 2⅞ x 5¼ inches. Supplied with leatherette wallet.

ALL THIS FOR ONLY £22.95*

FX-180P. Hand held version without hyperbolics. 2 x AA batteries: ¾ × 3 × 5⅞ **£19.95***
FX-2700P. As FX3500P but 8+2; without integrals, regression, 1 programme **£19.95***
FX-8100. Scientific with clock, calendar, alarm, chimes, stopwatch, etc **£24.95***

CASIO'S BEST SELLING WATCHES



AA81 M1200 W150B

LCS ANALOGUE/DIGITAL ALARM CHRONOGRAPH with countdown alarm.
AA-81 chrome, s/s bracelet **£29.95. AA-81G.** Gold plated **£49.95. AA-82.** All s/s **£39.95.**
12 MELODY ALARM CHRONOGRAPHS with countdown alarm. **M-12** resin case/strap **£24.95. M1200** all stainless steel **£29.95.**
100 METRE WATER RESISTANT Alarm chronographs with countdown alarm. **W100.** Resin case/strap **£19.95. W150C** Stainless steel case/resin strap **£25.95. W150B** Stainless steel case/bracelet **£32.50.**

Send 20p (postage) for our illustrated catalogue of Casio and Seiko.

***PRICES** We will beat any lower advertised price by 5% providing we still make a profit! Just send details and your remittance for the lower amount. **Prices include VAT and P&P.**

Price includes VAT, P&P. Send your company order, cheque, P.O. or phone your ACCESS or BARCLAYCARD number to:

TEMPUS

Dept. ETI, FREEPOST, 164-167 East Road, Cambridge CB1 1DB. Tel: 0223 312866

VISUAL COMPLEX SOUND ANALYSER

This unusual unit continuously analyses the amplitude/frequency content of complex audio signals and presents the results on a multi- colour 60-LED display. Design by Ray Marston. Development by Steve Ramsahadeo.

This very unusual project makes an excellent multi-colour visual display accessory for use with any audio-output system. The unit continuously analyses the complex sound content of the audio signal and presents the results of the analysis, in three colours, on six 10-LED bar displays arranged as a diamond with a diagonal. Naturally, in the presence of music, etc., the displays bounce and sway in sympathy with the analysed contents of the audio signal and present an attractive moving display.

The Visual Complex Sound Analyser display unit is mains powered and receives its audio input signal from the output (speaker) of the system under test. The audio signal is actually analysed in the form of three overlapping audio bands, having nominal 3 dB points of 20 Hz — 120 Hz (red display), 250 Hz — 2 kHz (yellow display), and 2 kHz — 7 kHz (green display). The upper three 10-LED bars each move in 3 dB steps and display the instantaneous signal amplitudes of the three audio bands. The lower three 10-LED bars move in linear steps and display the instantaneous dominant frequencies of the three bands.

The Display

This is a project where the skilled constructor might like to experiment with alternative display-pattern layouts. Our development prototype unit was originally built up on Veroboard and had a display in which the six 10-LED bars were arranged as three parallel 20-LED lines, each representing a specific colour-coded frequency band, with the upper half of the display showing amplitude and the lower half showing instantaneous dominant frequencies. On this unit, the central 'reference' bar (four LEDs) of the display represents zero amplitude/frequency, so that each of the three display lines appears to expand and contract from its central point.

On the final PCB version of the unit we've changed the display to the form shown in the photographs. Here, the display is again in the form of three 20-LED lines, each representing a specific colour-coded frequency band, with the upper half of the display showing amplitudes and the lower half showing dominant frequencies, but in this case the two outer lines of the display are angled to form a diamond shape. The major difference of this display is that the individual 10-LED bars are so arranged that the entire display appears to rotate left or right in sympathy with the music, rather than simply expand or contract. Thus, on the low-frequency (red) band the two 10-LED bars expand downwards with increasing amplitude/frequency, whereas on the high-frequency (green) band the two 10-LED bars expand upwards under the same condition; the central (yellow) band expands in a downwards direction. If you've got any better ideas, feel free to do your own thing.

Construction

The entire circuit, with the exception of mains transformer T1 and pot RV1, is built up on a single large (12 x 8 inches) PCB. On our prototype we've coated the entire top surface of the PCB with navy-blue flock paper, to enhance the visual appeal of the unit: if you wish to do the same, proceed as follows.

(1). The PCB uses a fairly large number of bridging links on the top side of the PCB, as well as several long links on the underside; these underside links are facilitated by Veropins (marked on the overlay as A, B, C, etc) pushed through the board from the top side. The underside links are completed by joining A to A, B to B, etc. To start the construction, drill all holes to accommodate the wire links and the Veropins, then insert the links and pins from the component (upper) side of the PCB and solder into place.

(2). Now coat the entire upper surface of the PCB and the lower side of the flock paper with cow gum, allow ten minutes to set and then press the paper evenly into place and trim the outer edges.

(3). Next, drill all remaining holes in the PCB and then proceed with the construction in the normal way, taking extra care to observe the polarities of all semiconductor devices (particularly IC17 and IC18) and electrolytic capacitors. Take special care to check the functioning/polarity of all LEDs before soldering them into place and note that the LEDs *must* be of the colours →

shown in the circuit diagram. Don't forget to connect the (several) links on the underside of the PCB.

When the construction is complete, double-check all wiring, connect the unit to RV1 and T1 and then switch on. Initially, only the central 4-LED 'bar' should illuminate. Now connect the unit to an audio (music) source and check that the unit is functioning by adjusting RV1 to give a display that behaves in the manner already described.

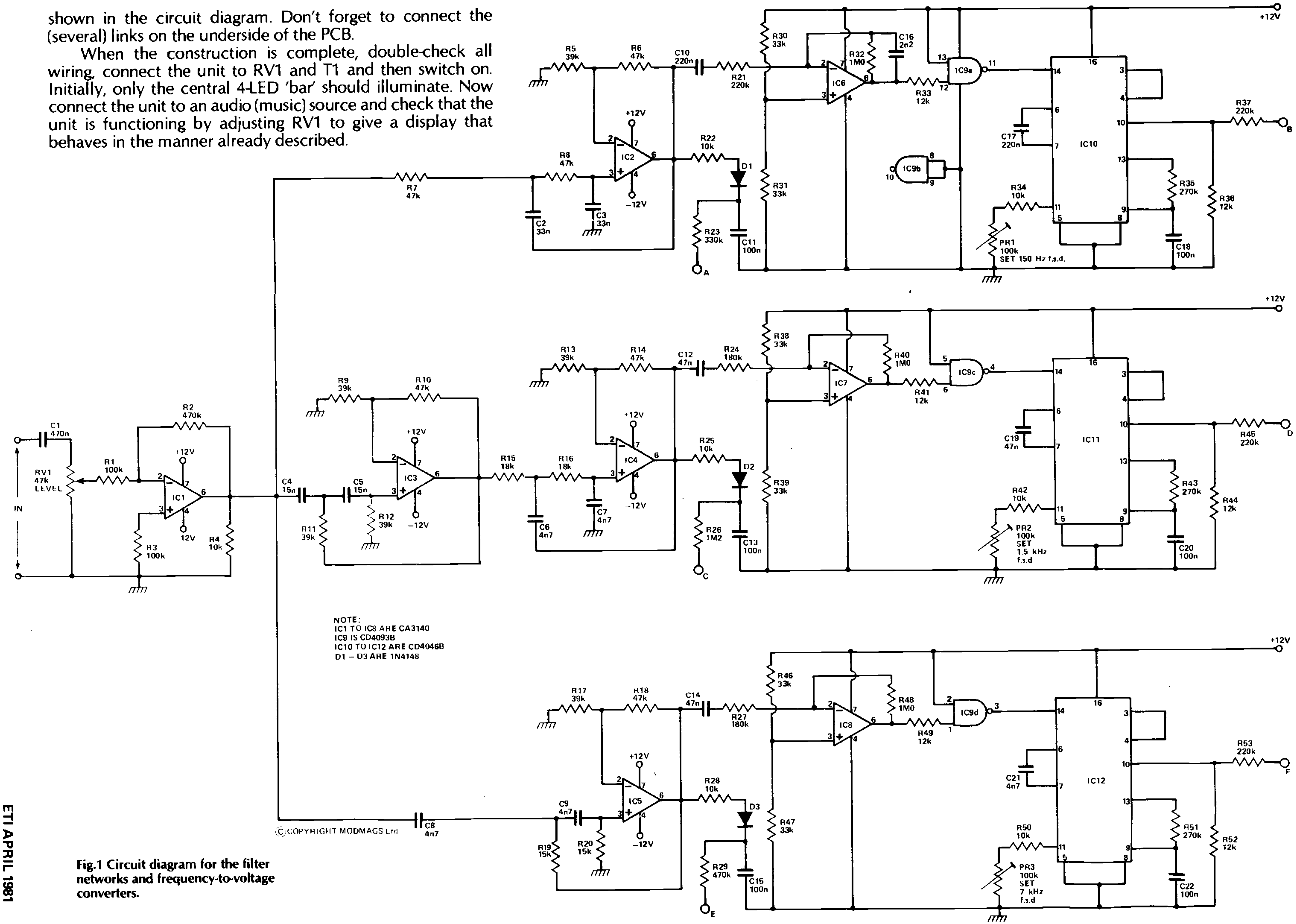


Fig.1 Circuit diagram for the filter networks and frequency-to-voltage converters.

HOW IT WORKS

The audio input signal is fed, after a simple 'level control' (RV1-IC1), to a multiple filter network, which divides the complex input signal into three distinct (but overlapping) bands. The lowest band has an upper 3 dB cut-off frequency of 120 Hz and operates in the low-pass mode (IC2). The middle band operates in the band-pass mode (using high-pass filter IC3 and low-pass filter IC4) and has lower and upper cut-off points of 250 Hz and 2 kHz respectively. The upper band operates in the high-pass mode (IC5) and has a lower cut-off point of 2 kHz.

The output of each filter is peak-detected and filtered by a rapid-charge slow-discharge network (R22-D1-C11-R23-R56, etc) and passes to the input of a 10-LED 'amplitude indication' display. These displays are based on LM3915 dot/bar drivers and give a log display in 10 3 dB steps: they are set, via pins 6-7, to read full scale at 1.2 V. The outputs of the rectifier networks are fed to the inputs of the LM3915 drivers via fixed potential divider networks (R23-R56, R26-R60, and R29-R64), the values of which have been calculated to compensate for differences in the gains of the three sets of filters.

Note that in the LM3915 circuits the ICs are powered from a 12 V supply, but the LED chains are driven from a 24 V supply. The ICs are wired to operate in the 'dot' mode (via pins 9 and 11), but the 10 LEDs in each chain are wired in series; consequently, the LEDs produce a 'bar' display with the LEDs that are on passing a common current. Thus, the LED current consumption is constant, irrespective of whether one or 10 LEDs are turned on.

The low-frequency level indicator (IC13) uses red LEDs, the mid-band indicator (IC15) uses yellow LEDs and the upper indicator (IC17) uses green LEDs. To give an equal brightness to all three colours, the LED drive current of each LM3915 is weighted by the resistor connected to pins 6-7. The red LEDs pass approximately 8 mA, the yellow pass 18 mA and the green pass 25 mA.

The output of each of the three audio filters is also fed to a frequency-to-voltage converter network, and the instantaneous frequency is subsequently displayed on another line of 10 LEDs by LM3914 linear drivers. These drivers are again operated in the dot mode with a bar display and are current-weighted.

Each frequency-to-voltage converter operates as follows. The output of each audio filter is amplified (by IC6, etc) and converted to a square wave by one of the IC9 Schmitt gates. The resulting square wave signal is fed to the input of a phase-locked loop (PLL) circuit (IC10, etc) and compared with an externally set reference frequency (set by C17-R34-PR2, etc). The PLL incorporates a phase comparator and a voltage-controlled oscillator (VCO). The output of the comparator is coupled to the input of the VCO via a simple filter network (R35-C18) and the VCO input voltage is made available, via an internal buffer, at pin 10. As the PLL tries to track the rapidly-shifting input signal, it generates a signal at pin 10 that is proportional to the instantaneous frequency of the input signal (0 V at zero frequency, 12 V at the reference frequency, etc). The output signal of each PLL circuit is fed to the input of its respective LM3914 display driver via a simple potential divider network (R37-R57, etc).

The total of six 10-LED displays are arranged in three pairs, each of a different colour and each displaying the instantaneous amplitude (upper LEDs) and frequency (lower LEDs) of a specified audio band. A bar of four red LEDs is mounted horizontally across the centre of the display, to enable the amplitude and frequency areas of each band to be readily distinguished.

The complete unit uses +24 V, +12 V and −12 V supply rails, each regulated by an IC.

The unit incorporates only three preset controls (PR1, PR2, PR3), which are used to set the full-scale reading of each frequency display (150 Hz, 1.5 kHz and 7 kHz). Figure 5 shows a simple circuit which can be used to generate suitable reference signals when initially calibrating the unit. The circuit is a basic astable, with its frequency determined by the C1-R2-R3-R4 values; the circuit can be easily built on a spare piece of Veroboard.

Fig.2 Block diagram of the complete circuit.

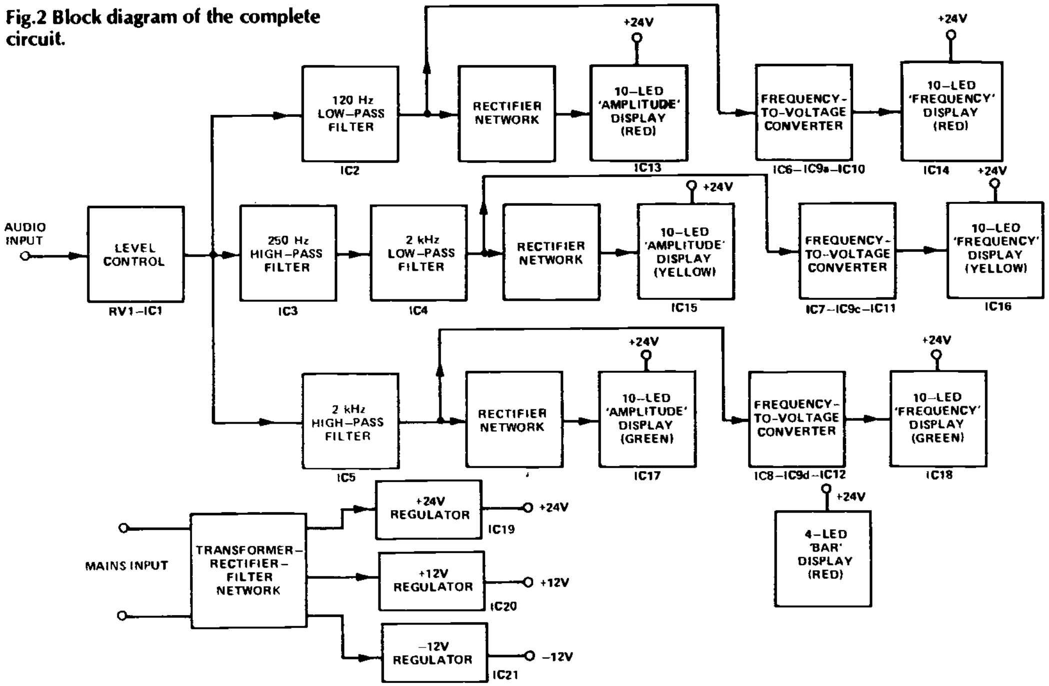
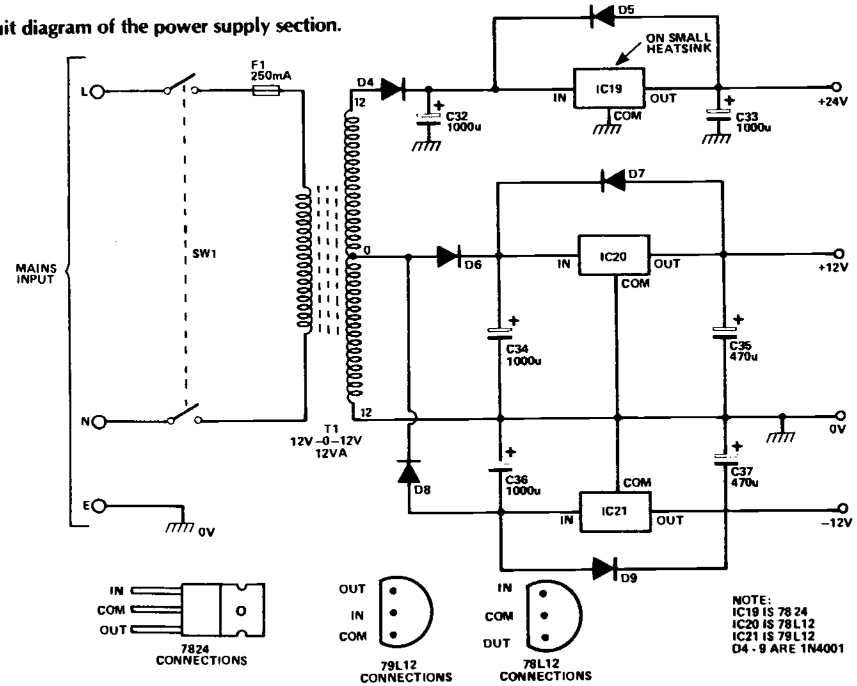


Fig.3 Circuit diagram of the power supply section.



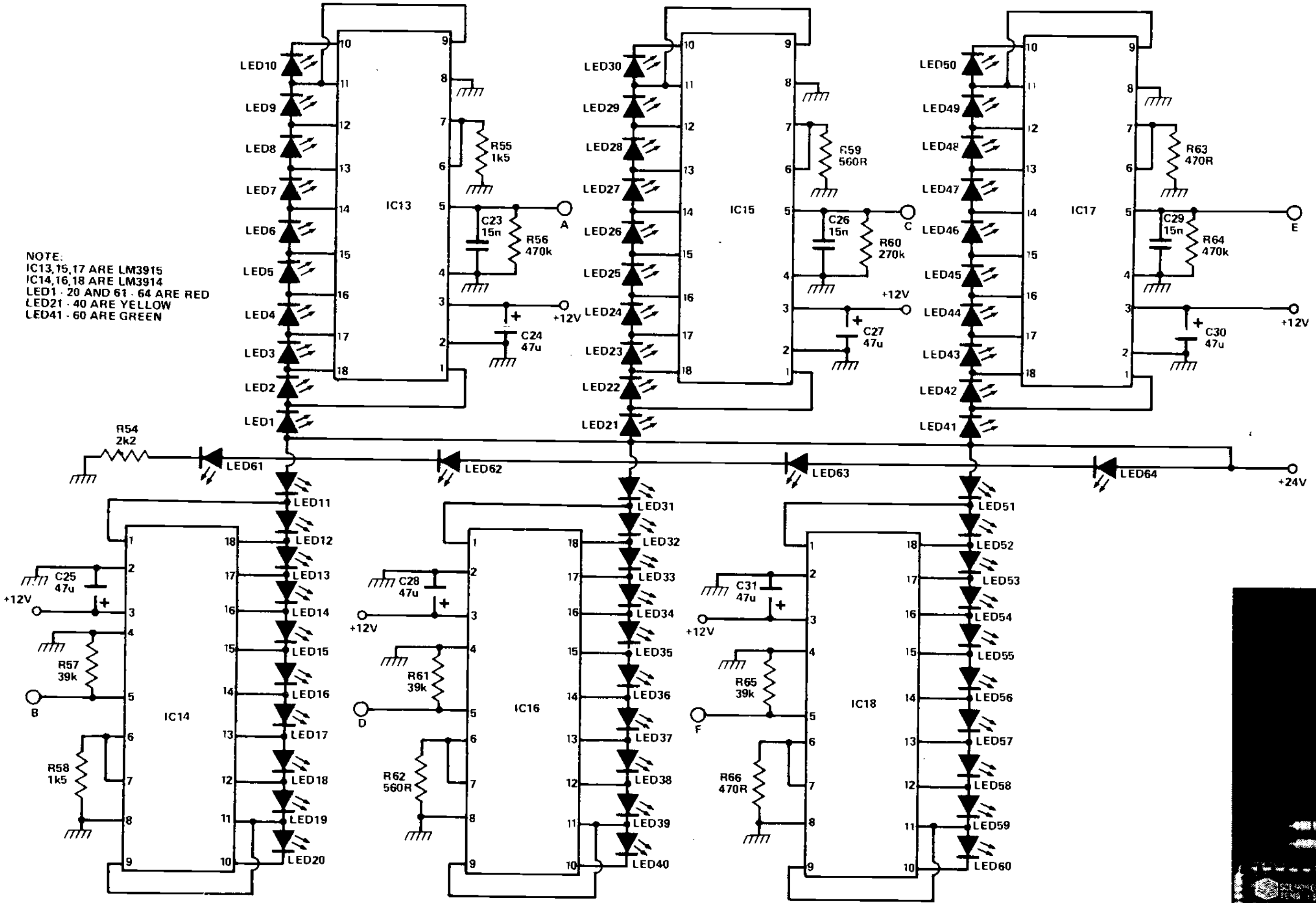
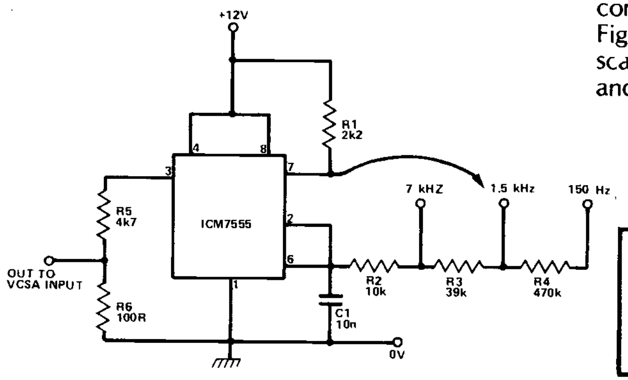
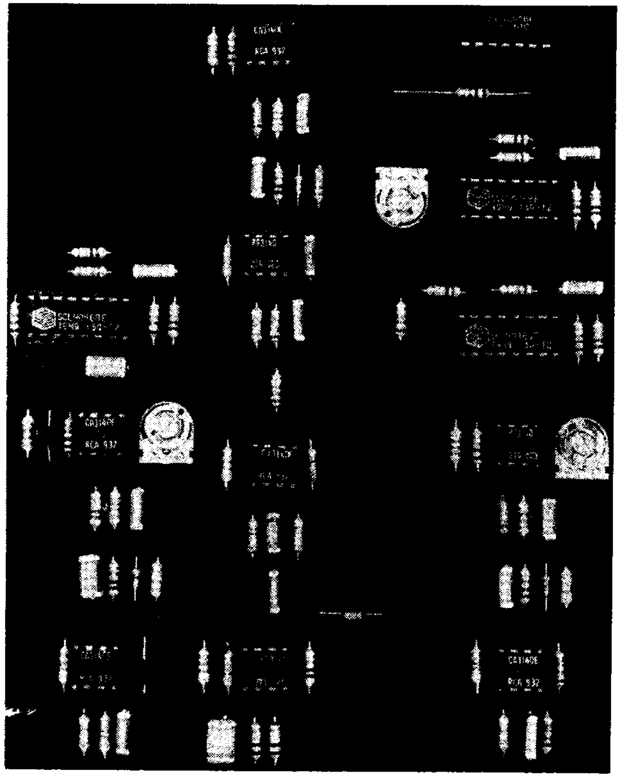


Fig.4 Circuit diagram of the display circuitry. The three sections at the top display the amplitude, and those below display the dominant frequency, in each of the three bands.



Close-up of the filter circuitry (below).



Finally, to correctly calibrate the frequency response of the completed unit, build the simple calibration oscillator (see Fig. 5) on a piece of Veroboard and then use it to set up the full-scale frequency levels of the three frequency bars with PR1, PR2 and PR3.

Fig.5 (left) This simple circuit will generate the three frequencies required to calibrate the frequency display.

BUYLINES

All components used in the V.C.S.A. are easily available. In case of difficulty the LM3914 and LM3915 can be purchased from advertisers in this issue. Should you decide to enhance the appearance of your PCB with flock paper then Paperchase Products Ltd., 213 Tottenham Court Road, London W1P 9AF offer a selection of colours.

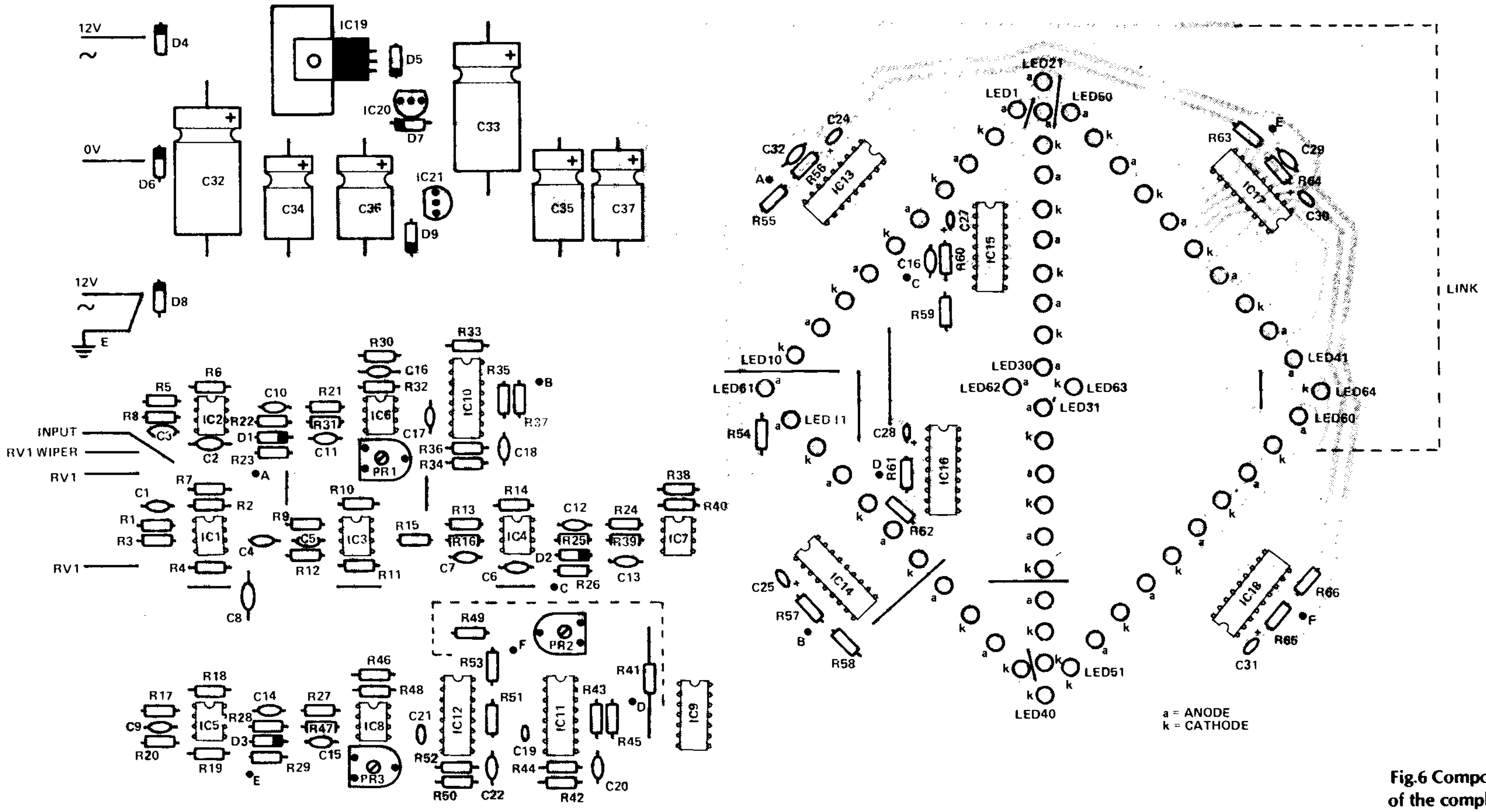
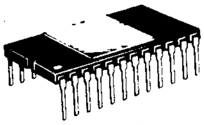


Fig.6 Component overlay of the complete VCSA.

PARTS LIST

Resistors (All ¼W 10%)		R63, 66	470R	C35, 37	470u 16 V electrolytic
R1, 3	100k			Semiconductors	
R2, 29, 56, 64	470k	Potentiometers		IC1-8	CA3140
R4, 22, 25, 28, 34, 42, 50	10k	RV1	47k linear	IC9	4093B
R5, 9, 11, 12, 13, 17, 57,		PR1, 2, 3	100k minature horizontal preset	IC10, 11, 12	4046B
61, 65	39k			IC13, 15, 17	LM3915
R6, 7, 8, 10, 14, 18	47k	Capacitors		IC14, 16, 18	LM3914
R15, 16	18k	C1	470n polycarbonate	IC19	7824
R19, 20	15k	C2	33n ceramic	IC20	78L12
R21, 37, 45, 53	220k	C3	33n polycarbonate	IC21	79L12
R23	330k	C4, 5, 23, 26, 29	15n polycarbonate	D1-3	1N4148
R24, 27	180k	C6, 7, 8, 9, 21	4n7 polycarbonate	D4-9	1N4001
R26	1M2	C10, 17	220n polycarbonate	LED1-20, 61-64	0.125" Red
R30, 31, 38, 39, 46, 47	33k	C11, 13, 15, 18, 20, 22	100n polycarbonate	LED21-40	0.125" Yellow
R32, 40, 48	1M0	C12, 14	47n polycarbonate	LED41-60	0.125" Green
R33, 36, 41, 44, 49, 52	12k	C16	2n2 ceramic		
R35, 43, 51, 60	270k	C19	47n ceramic	Miscellaneous	
R54	2k2	C24, 25, 27, 28, 30, 31	47u 16 V tantalum	T1	12-0-12, 12 VA
R55, 58	1k5	C32, 33	1000u 63 V electrolytic	SW1	DPDT miniature toggle
R59, 62	560R	C34, 36	1000u 25 V electrolytic	F1	250 mA fuse and holder

MICROS



Micros, memory and support

MC1489	85	74S287	2.50
MC1488	85	74S268	2.50
MC14411	11.95	74S471	4.95
MC14412	11.95	74S472	11.95
1702	6.95	74S474	11.95
2101	2.99	8T26	1.80
2102	99	8T28	1.80
2111	2.32	8T95	1.80
2112	2.32	8T97	1.80
2114	3.45	8T98	1.80
2114L	3.75	SC/MP2	9.95
2142	10.40	8080	5.49
2376	11.50	8085	11.95
2513	6.50	8086	89.00
2516(5v)	13.95	8154	11.50
2532	29.00	8155	12.50
2708	6.50	81LS95	1.30
4027	2.95	81LS96	1.30
4116	4.95	81LS97	1.30
4118	14.95	81LS98	1.30
5204	7.95	8212	2.45
57109	12.43	8216	2.50
57161	9.95	8224	2.50
6011	4.95	8228	4.20
6402	4.95	8251	4.95
6502	7.95	8253	10.95
6520	4.50	8255	4.95
6522	7.95	8257	10.95
6532	8.50	8259	11.95
6545	17.50	8678	12.95
6576	14.95	8602	2.20
6800	7.95	96364	10.95
6802	12.49	Z80-2mHz	7.50
6809	19.95	Z80-PIO	6.95
6810	3.95	Z80-CTC	6.95
6821	4.50	Z80-4mHz	8.95
6845	19.50	Z80-PIO	7.50
6850	3.95	Z80-CTC	7.50
6852	5.95	Z8000	120.00
74S00	59	ADC0817	14.47
74S04	65	DG300	3.80
74S201	3.95	F8	9.95
74S188	2.50	F8SMI	9.95
74S262	9.95		

SOFTWARE

CP/M® DISK WITH MANUAL / MAN

Available on 8" IBM format & 5¼ for TUSCAN & TRITON

TCL SOFTWARE

TCL Disc Basic	£55/£9
TCL Pascal	£120/£9

MICROSOFT

Basic-80	£155/£15
Basic Compiler	£195/£15
Fortran-80	£205/£15
Cobol-80	£325/£15
Edit 80	£45/£10
Macro 80	£75/£10

MICROPRO

Word Star	£255/£15
Word-Star/Mail-Merge	£315/£15
Data Star	£195/£25
Word-Master	£75/£15

DIGITAL RESEARCH

CP/M 1-4	£75/£18
CP/M 2-2	£95/£18
MAC	£55/£10
SID	£45/£10

OTHERS

KISS	£190/£15
SUPER SORT I	£125/£15
C BASIC 2	£75/£10
Z80 Dev Pack	£50/£12
ZSID	£60/£7
POSTMASTER	£85/£10

MEDIA

5¼ S/Sided D/D	£3.50
" per 10	£29.50
8" S/Sided D/D	£4.50
" per 10	£35.00
C12 Data Cassettes	50p

MAIL ORDER

TEL & MAIL ORDERS ACCEPTED

BARCLAYCARD VISA — Access

74LS00

LS00	13
LS01	13
LS02	15
LS03	15
LS04	20
LS05	23
LS08	23
LS09	23
LS10	20
LS11	32
LS12	32
LS13	40
LS14	75
LS15	40
LS20	24
LS21	32
LS22	40
LS26	48
LS27	45
LS28	48
LS30	24
LS32	30
LS33	39
LS37	39
LS38	39
LS40	28
LS42	80
LS47	85
LS48	120
LS49	120
LS51	25
LS54	30
LS55	70
LS63	180
LS73	40
LS74	40
LS75	48
LS76	45
LS78	45
LS83	105
LS85	105
LS86	45
LS90	50
LS91	125
LS93	75
LS95	115
LS96	180
LS107	45
LS109	75
LS112	80
LS113	85
LS114	49
LS122	70
LS123	95
LS124	180
LS125	80
LS126	80
LS132	95
LS133	30
LS136	55
LS138	70
LS139	80
LS145	120
LS148	175
LS151	95
LS153	85
LS155	95
LS156	95
LS157	75
LS158	85
LS160	120
LS161	98
LS162	110
LS163	100
LS164	115
LS165	165
LS166	175
LS168	210
LS169	210
LS170	288
LS173	105
LS174	147
LS175	110
LS181	295
LS190	120
LS191	120
LS192	125
LS193	125
LS194	125
LS195	125
LS196	120
LS202	345
LS221	120
LS240	225
LS241	225
LS242	232
LS243	232
LS244	225
LS245	360
LS247	135
LS248	135
LS249	135
LS251	130
LS253	130
LS257	115
LS258	120
LS259	180
LS261	450
LS266	75
LS273	180
LS275	320
LS279	88
LS280	250
LS283	180
LS290	130
LS293	130
LS295	215
LS298	215
LS299	420
LS324	200
LS325	320
LS326	330
LS327	315
LS352	185
LS353	185
LS355	85
LS366	85
LS367	85
LS368	85
LS373	180
LS374	180
LS375	150
LS377	190
LS378	185
LS379	215
LS386	85
LS390	140
LS393	140
LS395	210
LS396	190
LS398	275
LS399	230
LS445	140
LS447	195
LS490	150
LS668	105
LS669	105
LS670	270

CMOS

4000	18
4001	18
4002	24
4006	92
4007	22
4008	82
4009	40
4010	48
4011	24
4012	24
4013	45
4014	85
4015	85
4016	42
4017	82
4018	28
4019	48
4020	90
4021	105
4022	95
4023	25
4024	75
4025	25
4026	180
4027	48
4028	82
4029	105
4030	80
4033	175
4034	210
4035	125
4040	105
4041	80
4042	80
4043	95
4044	95
4046	130
4047	98
4049	45
4050	48
4051	80
4052	80
4053	80
4054	130
4055	135
4068	28
4069	28
4070	30
4071	25
4072	25
4073	25
4075	25
4075	99
4078	30
4081	28
4093	89
4502	125
4507	80
4508	325
4510	99
4511	150
4512	65
4514	195
4515	299
4516	120
4518	105
4519	70
4520	115
4521	250
4522	150
4526	150
4527	180
4528	120

REGS

T03	+ ve
7805	145
7812	145
7815	145
7818	145
− ve	
7905	220
7912	220
T0220	plast
7805	80
7812	80
7815	80
7818	80
7824	80
7905	85
7912	85
7915	85
7918	85

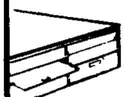
74XX
74CXX
LINEARS
Many other types in stock. Tel for details

WE HAVE MOVED

TO OUR NEW CENTRAL LONDON SHOWROOM

59/61 THEOBALDS RD, WC1 TUBE HOLBORN.

FLOPPY DISK DRIVES

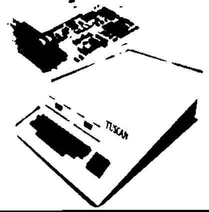


We sell all you need cased or uncased. Cables & connectors. Brand new fully guaranteed.

	Price
Single 5¼ Drive	£195
Single 8" SA800	£395
Dual 5¼ PSU	£59
Dual 8" PSU	£76
Dual Cabinet & PSU 1x8"	£565
Dual 8" Drive Unit	£945
Dual 5¼ Drive Unit	£440

TUSCAN S100

A Z80 based S100 Computer

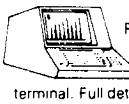


Single board will hold up to 8K RAM, 8K ROM, Video interface Z80 processor – I/O and cassette interface. 5 spare S100 expansion sockets for memory/disc expansion. System monitor, resident BASIC or CP/M system option. All components available separately or ready-built

NEW LOW PRICES

TUSCAN MAIN BOARD KIT ONLY £235 + VAT SAE FOR DETAILS

VIDEO TERMINAL

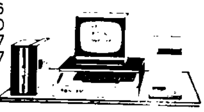


24x80 display Pentland Video Terminal full features professional terminal. Full details on request Price £595

TRITON

SINGLE BOARD PERSONAL COMPUTER

8080 BASED SINGLE BOARD system with EUROCARD EXPANSION



Complete Kit incl. PSU/Case/Keybd	£286
Expansion Motherboard Kit	£ 50
8K (2114) RAM Card Kit	£ 97
8K (2708) ROM Card Kit	£ 97

Expandable up to CP/M Disc System SAE for details

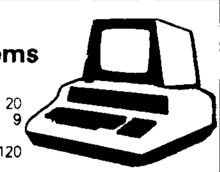
S100 CARDS

NEW LOW PRICES

16K STATIC	KIT	ASSM
with no RAM(2114)	£ 62	£ 82
" 8K RAM "	£109	£130
" 16K RAM "	£157	£178
8K static (16x2114 chips)		£ 48
64K DYNAMIC (4116)		
with 16K RAM	£149	£165
with 32K RAM	£189	£205
with 48K RAM	£229	£245
with 64K RAM	£269	£285
16K upgrade 8x4116		£ 40
16/32K EPROM CARD		
Without EPROMs		
2708/2516	£63	£ 89
FDC DOUBLE DENSITY		
Double Density for 5¼ or 8" Drives	£ –	£195

TCL PASCAL

FOR PET & CP/M systems



Put Pascal on your PET now	
Pascal conversion ROM	£ 20
Pascal manual	£ 9
Complete package including compiler	£120

VAT

ALL OUR PRICES EXCLUDE VAT & P/P

CENTRONICS 737 PRINTER LETTER QUALITY FOR £425

Uses any paper roll, fanfold, single sheets, 96 character ASCII, 7 x 7 dot matrix, 50 CPS, RS232 or parallel I/O

OK TOOLS

Full range of wire wrapping accessories & boards & dip jumpers etc. Visit our showroom or send for our catalogue.

VERO

S100 prototyping boards and full range of accessories.

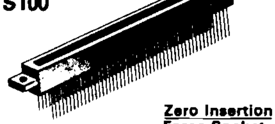
BOOKS

Complete range of microcomputer books and magazines on sale in our showroom.

CATALOGUE AVAILABLE

Catalogue available. Send 50p & S.A.E. (A4 size).

Edge £4.00 Connectors S100



DIP Switches

4 way	£1.20
7 way	£1.75
8 way	£1.80

DIP Plugs

14 DIL	£ .65
24 DIL	£2.20
40 DIL	£3.60

DIL SOCKETS (TEXAS)

	Low Prof	Wire Wrap
8pin	10p	26p
14pin	12p	35p
16pin	13p	42p
18pin	16p	60p
20pin	22p	90p
22pin	25p	–
24pin	30p	85p
28pin	35p	90p
40pin	40p	1.10p

Zero Insertion Force Sockets

16 way	£4 95
24 way	£6.00
40 way	£9 50

D-Types

25W Male	£2.80
25W Female	£3.80
25W Cover	£1.80

Edge Connectors

	1	156
2x 6 way	–	1 75
2x12 way	–	3.00
2x10 way	–	2 00
2x15 way	–	3 20
2x18 way	–	3.50
2x22 way	3.20	3.65
2x25 way	3.60	–
2x30 way	4.15	–
2x36 way	4.75	3.90
2x40 way	5.00	–
2x43 way	5.50	4.60

Insulation/Piercing Ribbon/Cables

I/O HEADER		PLUG	
10 way	£2.20	10 way	£1.60
20 way	£3.40	20 way	£2 30
26 way	£4.00	26 way	£2.70
34 way	£4.80	34 way	£3 30
40 way	£5.40	40 way	£3.75
50 way	£6.00	50 way	£4.60
60 way	£6 50	60 way	£6 00

Insulation Piercing Edge Connectors

20 way	£3.60	40 way	£5.30
26 way	£4.00	50 way	£6.00
34 way	£4.60		

Insulation Piercing DIP Plugs

14 way DIP Plug	£1.30
16 way DIP Plug	£1.50
24 way DIP Plug	£2 80

Ribbon Cable

PRICE/M

Grey		Coloured	
10	.65	10	.90
14	.90	14	1.20
16	1.20	16	1 40
20	1.40	20	1.60
26	1 60	26	2.40
34	2.40	34	2.80
40	2 80	40	3.30
50	3.30	50	4.00
60	4.00	60	5.50

CRYSTALS FOR MICROS

32.768KHz	3.00	4 00MHz	2.70	10.00MHz	2.70
100KHz	3.00	4.43MHz	1.00	10 7MHz	2.70
200KHz	3.70	5.0MHz	2.70	16.00MHz	2.90
1 0MHz	3.60	6.0MHz	2.70	18.00MHz	2.90
1 008MHz	3.50	6 144MHz	2.70	18.432	2.90
1.8432MHz	3.00	7.0MHz	2.70	36MHz	2.90
2 00MHz	1.50	7.168MHz	2.50	48.0MHz	2.70
2.45760MHz	3.05	8.00MHz	2.70	100MHz	2.90
3.276MHz	2.70				

TRANSAM

59/61 THEOBALDS RD
LONDON WC1
TEL: 405 5240/2113
TELEX 444198.

TRANSAM

electronics today international
BOOK SERVICE

How to order; Make cheques payable to ETI Book Service Payment in sterling only please. Orders should be sent to: ETI Book Service, Modmags Sales Office, 145 Charing Cross Road London WC2 All prices include P&P Prices may be subject to change without notice.

BEGINNERS

Beginners Guide to Electronics Squires **£4.25**
Beginners Guide to Transistors Reddihough **£4.25**
Beginners Guide to Integrated Circuits Sinclair **£4.25**
Understanding Electronic Circuits Sinclair **£5.10**
Understanding Electronic Components Sinclair **£5.10**
Beginners Guide to Radio King **£4.25**
Beginners Guide to Audio Sinclair **£4.25**
Understanding Electronics, Warring **£4.90**

COOKBOOKS

TV Typewriters Cookbook £7.75
CMOS Cookbook £8.20
Active Filters £11.30
IC Timer Cookbook £7.65
IC Op-Amp Cookbook £10.00
Video Cookbook £6.50
TTL Cookbook £7.55
The Basic Cook £4.00
IC Converter Cookbook £9.50
Master IC Cookbook Hallmark **£7.45**

APPLICATIONS

Fire and Theft Security Systems B. Weis **£2.15**
How To Build Electronic Kits Chapel **£3.25**
110 Electronic Alarm Projects R.M. Marston **£4.95**
110 Semiconductor Projects for the Home Constructor R. M. Marston **£4.95**
110 Integrated Circuit Projects for the Home Constructor R. M. Marston **£4.95**
110 Thyristor Projectors Using SCRs R. M Marston **£4.95**
110 Wave Form Generator Projects R. M. Marston **£4.95**

COMPUTING & MICROPROCESSORS

What is a Mircroprocessor? 2 cassette tapes plus a 72 page book **£10.00**
Beginners Guide to Computers and Microprocessors with Projects C. Adams **£6.05**
BASIC Computer Games Ahl **£6.05**
BASIC for Home Computers A self-teaching guide B. Albrecht **£6.60**
Illustrating BASIC D. Alcock **£4.25**
Troubleshooting to Microprocessors and Digital Logic Goodman **£5.90**
Z-80 Microcomputer Handbook W. Barden **£7.75**
How to Program Microcomputers W. Barden **£7.25**
Introduction to Microcomputers and Microprocessors A. Barna **£9.50**
Microprocessors in Instruments and Control R. J. Bibbero **£13.10**
Basic BASIC J. S. Coan **£7.40**
Advanced BASIC J. S. Coan **£6.40**
Getting Acquainted with Microprocessors L. Frenzel **£7.25**
Beginners Guide to Microprocessors C. M. Gilmore **£4.90**
1001 Things to do with Your Personal Computer Sawusch **£6.00**
Beginning BASIC R. E. Gosling **£4.75**
Microprocessor Programming for Computer Hobbyists N. Graham **£7.15**
Miniprocessors from Calculators to Computers Heiserman **£5.35**
Microcomputers, Microprocessors, Hardware, Software and Applications J. L. Hilburn **£17.40**
BASIC Programming J. G. Kemeny **£8.20**
Microprocessor Systems Design E. Klingman **£17.65**
Intro to Microprocessors Leventhal **£11.00**
Microprocessor — Technology, Architecture & Applications D. R. McGlynn **£11.30**
Interactive Computing with BASIC Monro **£4.35**
BASIC with Style P. Nagin **£4.50**
Software Design for Microcomputers Ogdin **£8.85**
Microcomputer Design Ogdin **£7.45**
Microcomputer Base Design Peatman **£6.10**
Hands on BASIC with a PET Peckham **£10.50**
Complete Microcomputer Systems Handbook £8.75
6800 Software Gourmet Guide and Cookbook Scelbi **£9.20**
8080 Software Gourmet Guide and Cookbook £9.20
The 8080A Bugbook: Microcomputer Interfacing & Programming P. H. Rony **£8.35**
8080/8085 Software Design Titus **£7.60**
57 Pratical Programs & Games in BASIC Tracton **£6.65**
How to Design, Build and Program Your own Working Computer System £7.10
Your Own Computer Waite **£2.25**
Microprocessor/Microprogramming Handbook Ward **£6.20**

LOGIC

Logic Design Projects Using Standard ICs J. Wakerly **£7.25**
Pratical Digital Design Using ICs J. Greenfield **£16.00**
Designing With TTL Integrated Circuits Texas Instruments **£9.60**
How To Use IC Circuit Logic Elements J. Streater **£4.85**
110 COSMOS Digital IC Projects for the Home Constructor R. M. Marston **£4.95**
Understanding CMOS Integrated Circuits R. Melen **£4.60**
MOS Digital ICs G. Flynn **£5.25**

TEST INSTRUMENTS

The Oscilloscope In Use Sinclair **£4.00**
Working with the Oscilloscope A. Saunders **£4.60**
Servicing with the Oscilloscope A. King **£7.50**
Radio Television and Audio Test Instruments King **£8.30**

OP-AMPS

Applications of Operational Amplifiers Graeme (Burr Brown) **£8.45**
110 Operational Amplifier Projects for the Home Constructor R. M. Marston **£4.95**
Designing With Operational Amplifiers Burr Brown **£19.65**
Operational Amplifiers Design and Applications G. Tobery (Burr Brown) **£7.80**

COMMUNICATIONS

Communication Systems Intro To Signals & Noise B. Carlson **£7.65**
Digital Signal Processing Theory & Applications L. R. Rabiner **£24.40**
Electronic Communication Systems G. Kennedy **£8.75**
Frequency Synthesis. Theory & Design Mannassewitsch **£25.00**
Principles of Communication Systems H. Taub **£8.40**

THEORY

Introduction to Digital Filtering Bogner **£10.60**
Transistor Circuit Design Texas Instruments **£10.00**
Foundations of Wireless Electronics M. G. Scroggie **£6.10**
Electronic Circuit Design Handbook 4th Edition **£16.75**
Master Guide to Electronic Circuits Adams **£9.25**

REFERENCE

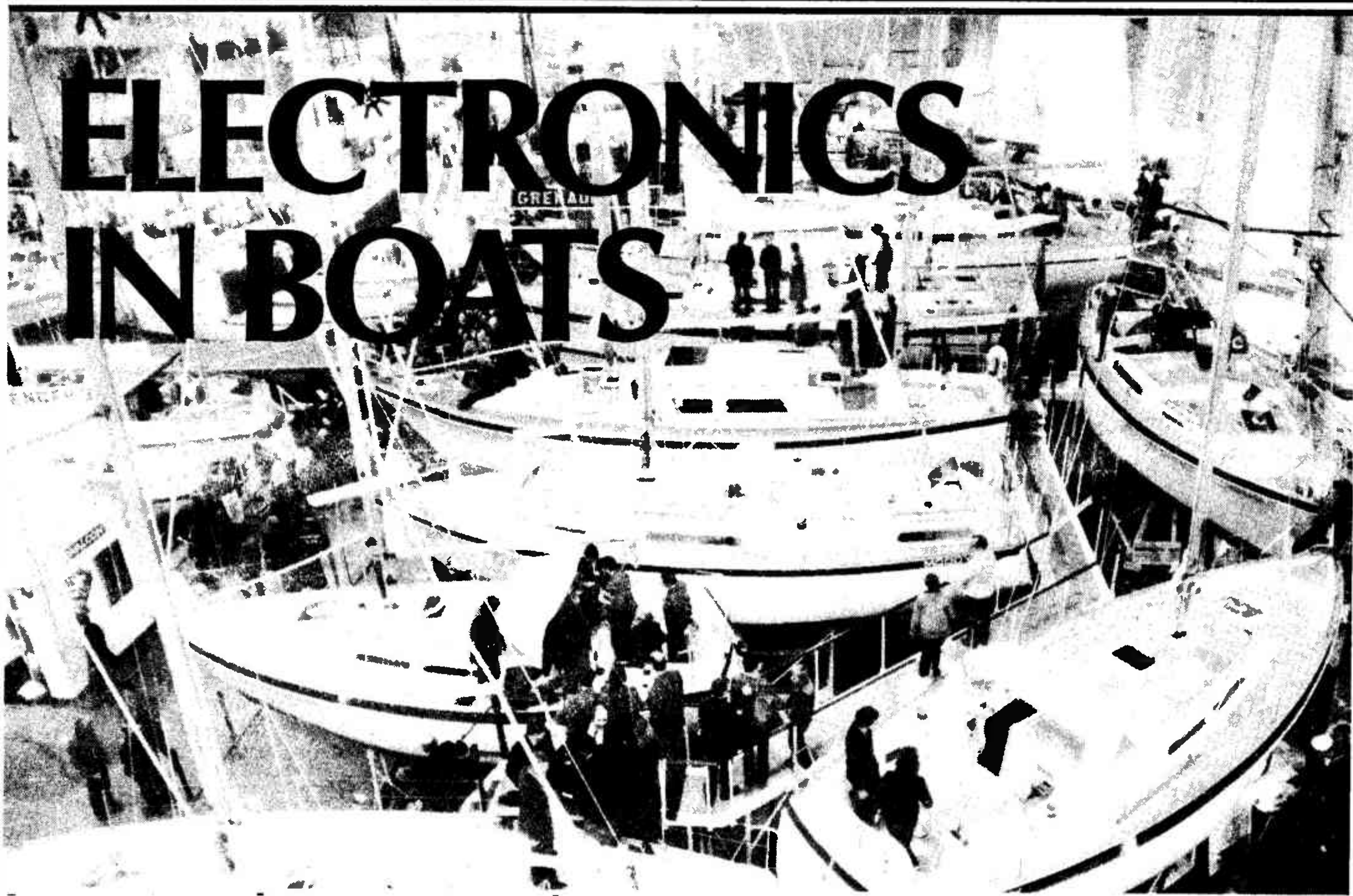
Electronic Engineers Reference Book (Ed. 4) L. W. Turner **£38.00**
Electronic Components M. A. Colwell **£3.40**
Electronic Diagrams M. A. Colwell **£3.40**
International Transistor Selctor T. D. Towers New update **£10.70**
International FET Selector T. D. Towers New update **£4.60**
International Op-Amp Linear IC Selector Towers **£8.00**
International Microprocessor Selector (NEW) Towers **£16.00**
Radio, TV and Audio Technical Reference Amos **£37.00**

MISCELLANEOUS

Electronic Fault Diagnosis Sinclair **£4.00**
Integrated Electronics J. Milman **£8.20**
Practical Solid State DC Supplies T. D. Towers **£6.50**
Practical Triac/SCR Projects for the Experimenter R. Fox **£2.35**
Printed Circuit Assembly Hughes & Colwell **£3.40**

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

ELECTRONICS IN BOATS



January saw the return to Earl's Court of the International Boat Show. Tina Boylan, (ETI's very own Tiller Girl) and Peter Green went along to see what part electronics plays in boating.

The 27th London International Boat Show brought a brief glimpse of the sunny Caribbean to a frost-bitten and land-locked crowd this January at Earl's Court. It was filled to the gunwales with land-lubbers and sea-goers alike, for the show is not merely aimed at the enthusiast or those of us with money to burn. There are plenty of attractions; gadgets to puzzle over and pleasure craft of every conceivable shape and size fill the huge halls as far as the eye (no offence, Nelson) can see. The whole experience is geared towards sun-baked fantasies and the epitome of luxury.

As you leave the lower halls, however, you find stands with some of the more down-to-earth(?) elements of boating on offer. Waterproof gear, life jackets and a million different types of rope. Proving that there's a lot more to boats than basking in the sun!

Messing About In Boats

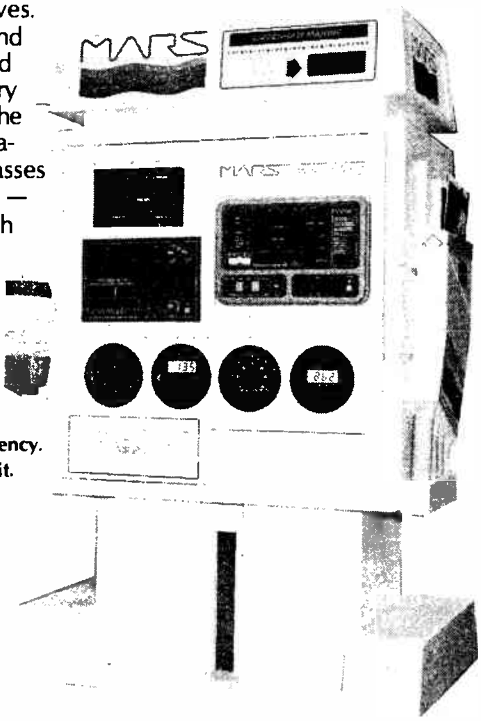
Practically a whole floor was given to what interests ETI most — electronic devices. Electronics now plays an extremely important part in sailing the seven seas; the aid it gives to navigation and safety is immeasurable. For although men have successfully managed to sail over quite long distances for thousands of years with little more than the stars to guide them, electronics enables them to navigate far more accurately and has saved hundreds of lives.

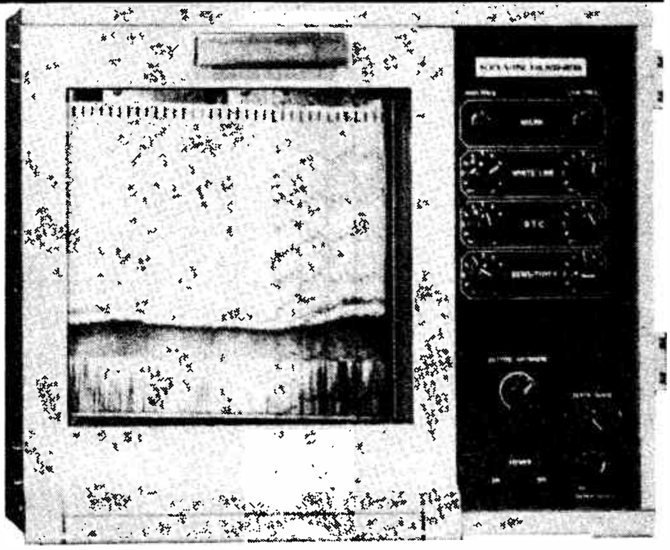
Direction finding and measurement of speed are the most rudimentary necessities for sailing. The earliest form of navigation used charts, compasses and the first instrument — the log (literally!), which was a log tied to a rope knotted at equal intervals and dropped over the stern of the boat, the rope being paid

Far left: A small radio direction finder with digital readout of the selected frequency.

Left: A satellite navigation unit.

Right: A demonstration console for various navigational aids.





Above: A depth sounder with pen recorder.
Bottom: Another satellite navigation console.

out for a known length of time and the knots counted. Calculations would then be made using these three ingredients. The result was always an approximation, as time keeping was not very accurate. In order to solve this problem, during the 17th century the British Admiralty offered a prize of ten thousand pounds for the development of an accurate chronometer. This huge sum was clearly an indication of the importance of such a device. In 1762 horologist John Harrison collected the prize for his design which kept an accuracy of better than two minutes over a six week period — a considerable achievement for the time(groan)!

Today electronic time keeping and calculation are accepted as being both accurate and simple. But electronics in navigation has come a long way from this simple level. Any mechanical instrument can be used in conjunction with electronics and in the case of navigation it is used in three main ways.

Which Way Now?

The first simple method is mainly an offshore aid and is called Radio Direction Finding (RDF). To use this system you must know your approximate position and from your (still indispensable) charts, you then choose three or more transmitting aircraft or marine radio beacons which are in the vicinity of your approximate position. The simplest RDF receivers are operated by manually turning a loop of ferrite antenna until the chosen beacon is heard at minimum strength. Beacon direction is then read off a calibrated scale. A separate sensing antenna must be incorporated to tell whether the beacon is in front of the boat or behind it. Some of the hand-held RDFs, of which there were many at the show, have a built-in compass. Using this it is possible to obtain a fix quickly and the skipper is able to use this on deck, therefore avoiding interference from rigging etc. Headphones are provided on many models for aural identification of very weak signals. When you have read off the bearing of each beacon you plot them on the chart and where the lines cross — X marks the spot, your position has been found! The bearings taken from these fixed stations give a resultant bearing which is usually accurate to within 2°.

The second method of navigation is an essential for any water-going vessel and is the aforementioned log, only somewhat changed in design! The log indicates speed and nautical mileage using a sensor. The simplest form of this is a small impellor monitoring water flow which is mounted through the hull, or over the stern of small boats. As it rotates it pulses a reed or similar switch to provide a suitable signal for subsequent analogue or digital processing and display. This type of sensor is unfortunately liable to clogging by seaweed or flotsam or may be inaccurate due to protrusions from the hull of the boat.

A way round this is to use one of two other electronic systems which have no moving parts. The first of these transmits ultrasonic pulses through the hull into the water and then listens for reflections caused by bubbles or other moving particles under the boat. The frequency of the received signal will differ from the transmitted one because of the Doppler shift and this is proportional to the speed of the water flow. The instrument displays the frequency difference as units of speed. Incorporated circuitry compensates for variations in the speed of sound in water at different temperatures and salinities.

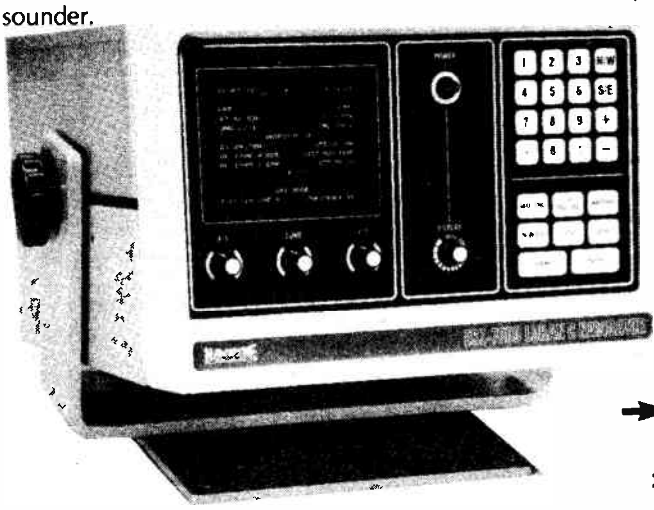
The second and more common device is a hull-mounted electromagnet which creates a magnetic field at right-angles to the motion of the boat, with the lines of flux passing vertically through the hull. Since seawater is conductive, a voltage is induced in the water proportional to the velocity at which the water cuts through the field. There are two small metal studs which protrude through the hull and pick up the voltage — and that's all there is to it! With the log to calculate speed and mileage and bearings taken from a compass, this method can be used for dead reckoning navigation out at sea.

Seeing Stars

Satellite navigation is the last and most accurate means of position finding at present. This method is used mostly in large boats and ships as it can be rather expensive to install. As each satellite orbits the earth it transmits a signal on 150 and 400 MHz every two minutes. These signals give its exact orbital parameters, which are frequently updated with information based on observations made by land-based dedicated tracking stations. The satellites can provide information 19 or 20 times in every 24 hours, and, although their passes are not evenly spaced the worst delays are not normally longer than 2½ to 3 hours. Using the most sophisticated type of on-board dual frequency receivers, a positional accuracy of a few metres can be achieved anywhere in the world. Current satellite navigation receivers often incorporate extra features which are capable of predicting the next satellite pass, and have the ability to perform dead reckoning navigation *between* passes as well as ringing an alarm when the predicted destination is reached.

Sounds Fishy

So now your direction is pretty clear, but there is more information which must be found because you *really* need to know what's around you as well, and particularly what's under you. The open sea is not a swimming pool with a constant depth everywhere, and rivers are not like canals; they have sandbanks and shallows. So next on the list of electronic aids is a depth sounder.



→

These work by transmitting an impulse and measuring how long it takes to return. Ultrasonic energy is used for this; all types of depth sounder use this principle and only vary in the type of display, output power and frequency.

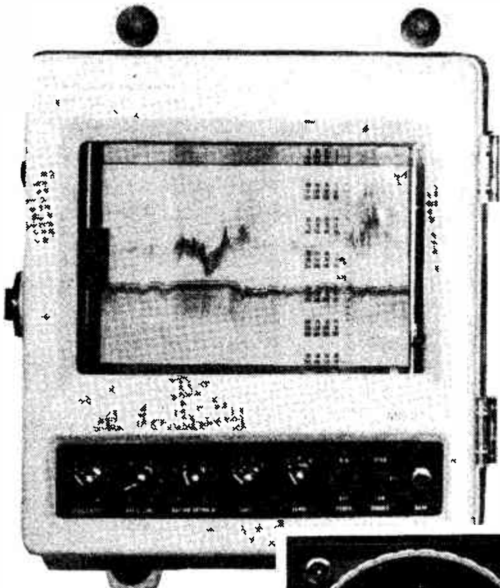
The display is usually an LED type, and when the acoustic pulse is sent out an LED flashes at the zero mark. When the echo returns another LED flashes on the dial at an angle proportional to the time since the transmit pulse was sent, thus indicating the depth of water below the hull. Apart from indicating the distance of the sea bed, the depth sounder will also pick up the position of shoals of fish, making it a useful aid for fishermen. Many depth sounders incorporate a pen recorder which enables them to return to a particularly good area where shoals have been found before. The depth sounder also makes landing less hazardous in bad weather conditions.

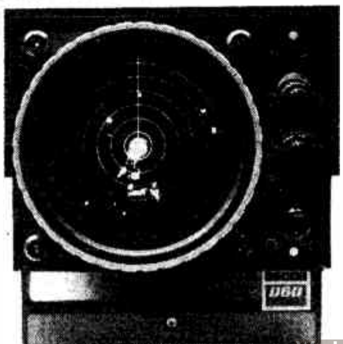
So now you know exactly where you're going. Great. But with the waterways of the world crowded with many different types of vessel, it's rather important that you know where *they're* going to, otherwise — oops! A collision, and that happens all too frequently!

On The Rebound

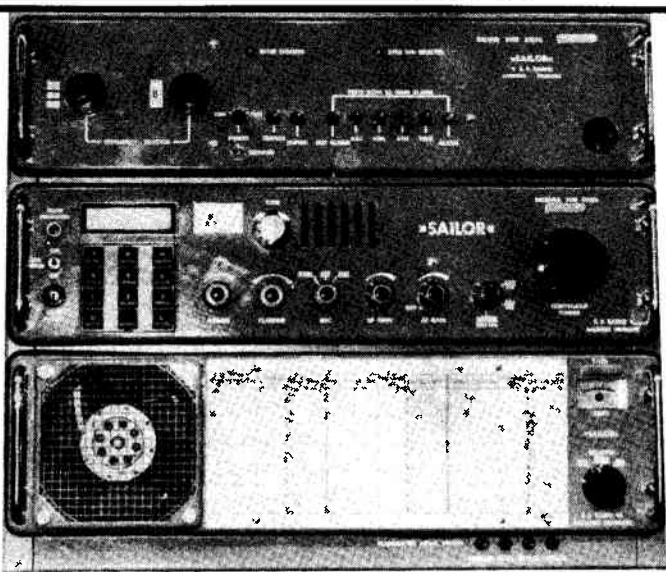
As far as hitting other vessels at sea goes, radar is the most effective safeguard available, even for the smallest craft. Radar not only enables you to see other vessels, but can also be used as a navigational aid because coastlines are also visible on it. Most radar sets consist of two main units — a console containing the display circuitry and controls, and a transceiver/scanner unit containing the RF electronics and the rotary antenna. Efficient radar does depend largely upon the height of elevation of the antenna since radar waves are transmitted on a line-of-sight principle. In bad weather this can mean that high waves will deflect the radar signal from a small boat making readings inaccurate. A small boat can also be easily mistaken for a wave by a radar operator on a large vessel, and this point brings us neatly to an associated safety device which is used with radar.

A small boat, particularly if it is built of fibreglass or wood, does not reflect radar waves as well as a large vessel or one made of steel or aluminium, which leaves it little hope of being spotted on radar. Luckily there is a device which greatly improves the visibility of a small boat and can be easily fitted.





Above: another depth recorder.
Right: small radar screen.



Above and left: Two reasons for choosing a small VHF radio telephone. These HF units are fairly bulky and would only suit large craft travelling far out to sea.

The metal radar reflector is masthead mounted and its shape and material make it an effective reflector of radar beams, giving a clear indication of the presence of a small boat on a radar monitor. These do have to be carefully fitted or they can be practically useless.

Steering A Straight Course

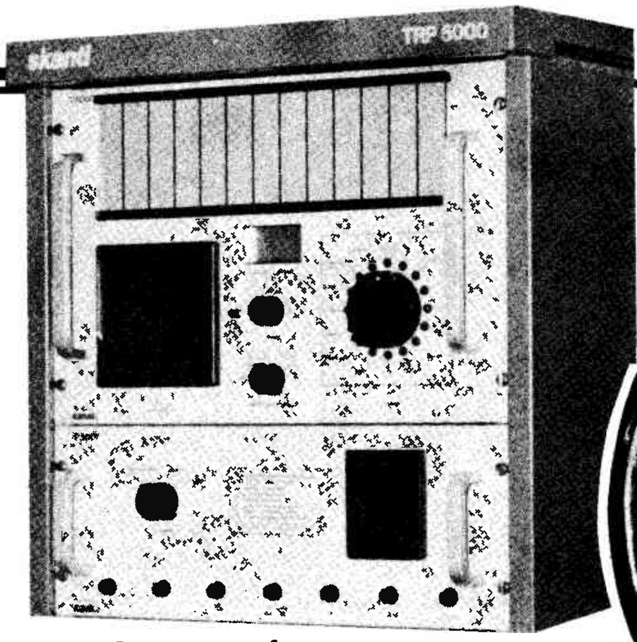
Electronics can also be used for steering your course once it is chosen. An 'autopilot' can be used for either power boats or sailing boats. Basically an autopilot is a straightforward servomechanism; the actual heading is compared to the desired course and the error signal is used to drive a servomotor, thus correcting the rudder. A disadvantage with this system is that the swell of waves can affect the autopilot and cause it to continually try to correct the movements of the rudder, however insignificant they may be, so many autopilots have a built-in override mechanism which can be adjusted to compensate for varying sea conditions.

On a sailing boat, steering is far more dependent on wind direction, so an autopilot of the type used in power boats would be next to useless; it would keep a heading regardless of wind change leaving the sails set wrongly, which, at best, would cause the boat to lose speed and at worst could put it into a dangerous situation. So most sailboat autopilots keep the boat on the right heading relative to the wind; these units offer a choice of compass or wind vane to generate the control signal.

Come In Number 44

Even boats equipped with all of the safety features so far mentioned can find themselves running into trouble and in need of communication with rescue services. Or maybe you want to contact someone you wish to speak to (you're half-way across the North Sea when you realise that it's Aunt Maud's birthday and you forgot to send a card . . .).

British Telecom International, the new telecommunications branch of the Post Office, now operates 12 coastal radio stations in Britain; 11 of these are for medium/short range use, one is for long range. In addition, there is a continually growing network of remotely controlled VHF stations. The coastal stations will deal with any type of message, from ship-to-shore social calls to distress signals — the latter naturally receiving priority at all times — and also broadcast routine weather reports, gale warnings and details of navigational hazards.



The Art of RT

The VHF radio telephone solves many of the problems that prevent small boat owners from fitting HF equipment and as such is an invaluable aid to safety for pleasure boats. HF radios are generally large and draw a lot of power, sometimes necessitating extra batteries. They are more complex, more prone to interference, more expensive and more difficult to install (aerials are generally loaded whips which require a ground plane). A typical VHF unit, though, is only slightly bigger than a car radio/cassette player and is just as easy to install. Mounting brackets for vertical or horizontal fitting are usually provided, and some types have a mounting flange that allows flush installation in a bulkhead, car dashboard style. After that you simply fit a mast-top aerial, plug into the boat's 12 V supply and you're ready to go.

Models generally offer similar facilities and these are limited to the essentials — on/off switch, volume, squelch and channel selector switch. The VHF frequencies allocated are from 156 MHz to 162 MHz and generally the transceivers will have a selection of a dozen channels in this range. Some models use a frequency synthesiser, so you can only transmit on the frequencies pre-selected by the manufacturer. Others have individual crystals fitted for each channel, and by changing crystals you can pick any set of frequencies that are convenient. *All* radio telephones should be capable of transmitting on channel 16 — this is the VHF international distress frequency.

Output power ranges from about 10 W to 25 W and often a control is provided to reduce the power output when speaking to a station at close quarters. This may either be in the form of a high/low switch or a continuously variable pot, and prevents unnecessary interference to more distant users.

Simply Simplex

Although there are some duplex channels in the VHF band (ie you may transmit and receive simultaneously, as with a telephone), only simplex transceivers were in evidence at the Show. These require the use of a press-to-talk button on the microphone, a feature well-known to those "good buddies" who have the *other* sort of radio fitted in their cars!

The qualification "in-shore and coastal" is due to the one disadvantage of VHF compared to HF: lack of range. VHF frequencies are not subject to 'skip' via the ionosphere and while this provides immunity from unwanted signals, it does mean that only line-of-sight communication is possible. Even with a mast-top aerial, range is limited to about 20 nautical miles.

A few VHF radio telephones have an optional version which allows completely portable use: the set has a battery pack (rechargeable from the ship's 12 V supply), a telephone handset and a small helical aerial. In an emergency the set can be removed from its installation and used as a walkie-talkie; an obvious advantage if your cockpit is on fire, you've lost your mast and the main aerial with it, or you're sitting in a small rubber dinghy about 20 fathoms above the remains of your yacht! However, in this mode your range will be reduced still further, especially at sea level.

Left: This VHF radio telephone features more facilities than the basic models but is still quite compact.

Hand-Held Help

For absolute assurance that an accident at sea will not be compounded by your inability to summon help, a portable distress radio telephone is essential. These units are complete, self-contained HF radio telephones, pre-tuned to one frequency only, the international maritime distress frequency (2182 kHz). Unlike the VHF band, this frequency is not subject to line-of-sight restrictions and is insensitive to aerial height. Typical 'worst-case' transmitting ranges exceed 40 miles; under favourable conditions this can be greatly extended.

A typical distress radio telephone is shock-resistant, waterproof and self-buoyant (radio overboard?!). The controls are kept to an absolute minimum and are designed to be easy to operate even with numbed fingers. Instructions are clearly and concisely printed on the case for the benefit of untrained people. To use the unit, the earth-wire with its lead sinker is thrown into the sea, the telescopic aerial extended fully, and the alarm button pressed for abut 20-30 S. This causes a two-tone signal to be transmitted which overrides all other traffic on the 2182 kHz frequency and automatically activates the watch-keeping receivers used by coastguards, rescue services, merchant ships and trawlers. Once you've attracted everyone's attention you can make speech contact with your rescuers.

These units may also be used for 'urgency' calls (without using the alarm button), for direct contact with coastguards and commercial ships in order to obtain medical, meteorological or navigational advice, or to report any less serious damage to your vessel such as engine failure.

It should be pointed out that, especially in the case of VHF sets, there is little point in fitting a radio telephone unless *everyone* who is aboard the boat has been told where the set is and how to use it. Help is going to be a long time coming if the only man who can use the radio is the one who has just suffered a heart attack, or food poisoning, or been washed irretrievably overboard. For similar reasons, try to get a VHF set with duplex operation. Then anyone unfamiliar with radio procedure is unable to cause, at least, confusion and at worst, fatal delay, by forgetting to press the push-to-talk button.

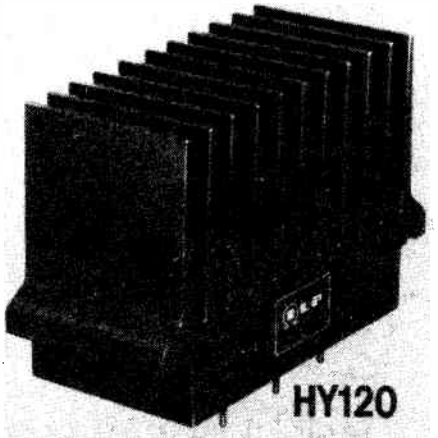
Be Prepared

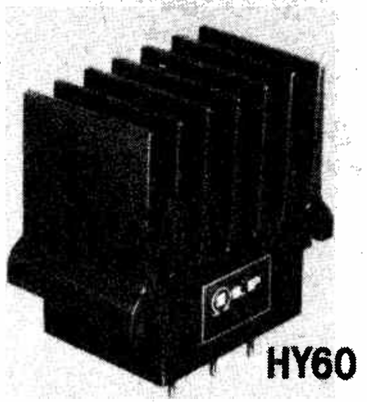
So that more or less sums up the wide range of electronic gadgets you will need for your boat, whatever size it may be. Of course, there are still many developments being made in nautical electronics because, unfortunately accidents *do* still happen. One thing visiting the Boat Show can teach you is how important having the right equipment is, and, if you visit next year's Show you too may become hooked on boats for life! **ETI**

SIMPLY AHEAD and staying there

The range grows bigger...better...

New Profile Amplifiers - Two New Series





MOSFET

CHOOSE AN I.L.P MOSFET POWER AMP when it is advantageous to have a faster slew rate, lower distortion at higher frequencies, enhanced thermal stability, the ability to work with complex loads without difficulty and complete absence of cross-over distortion. I.L.P's exclusive encapsulation technique within fully adequate heatsinks has been taken a stage further with specially developed computer-verified 'New Profile' extrusions. These ensure optimum operating efficiency from our new MOSFETS, and are easier to mount. Connection is via five pins on the underside. **I.L.P MOSFETS ARE IDENTICAL IN PERFORMANCE TO THE COSTLIEST AMPLIFIERS IN THIS EXCITING NEW CATEGORY BUT ARE ONLY A FRACTION OF PRICES CHARGED ELSEWHERE.**

Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
MOS120	60W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£25.88 + £3.88
MOS200	120W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£33.46 + £5.02

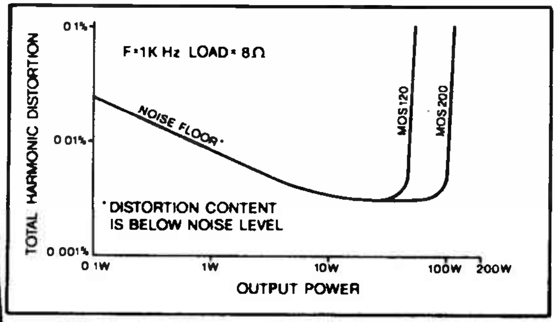
BIPOLAR

(Standard O-P Transistors)

CHOOSE AN I.L.P BIPOLAR POWER AMP where power and price are first consideration while maintaining optimum performance with hi-fi quality and wide choice of models. From domestic hi-fi to disco and P.A., for instrument amplification, there is an I.L.P Bipolar to fill the bill, and as with our new Mosfets, we have encapsulated Bipolars within our New Profile extrusions with their computer-verified thermal efficiency and improved mounting shoulders. Connections are simple, via five pins on the underside and with our newest pre-amps and power supply units, it becomes easier than ever to have a system layout housed the way you want it.

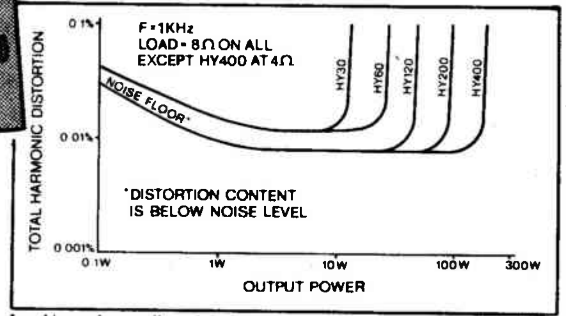
Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
HY30	15W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£7.29 + £1.09
HY60	30W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£8.33 + £1.25
HY120	60W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£17.48 + £2.62
HY200	120W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£21.21 + £3.18
HY400	240W into 4Ω	0.01%	15V/μs	5μs	100dB	£31.83 + £4.77

ILP POWER AMPS ARE ENCAPSULATED FOR THERMAL STABILITY AND LONGER LIFE



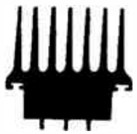
Load impedance both models 4Ω - ∞ Input sensitivity both models 500mV

Input impedance both models 100KΩ Frequency response both models 15Hz-100KHz – 3dB



Load impedance all models 4Ω - ∞ Input sensitivity all models 500mV

Input impedance all models 100KΩ Frequency response all models 15Hz-50KHz – 3dB



THE NEW PROFILE EXTRUSIONS

The introduction of standard heatsink extrusion for all I.L.P. power amplifiers achieves many advantages:— Research shows they provide optimum thermal dissipation and stability. Slotted shoulders allow easy mounting; standardisation enables us to keep our prices competitive. Surfaces are matt black, anodised for higher thermal conductivity. Extrusions vary in size according to module number.

Rapid Electronics

Pack No.		
A10	10 PP3 battery leads	50p
A72	10 3.5mm jack plugs	80p
A73	10 3.5mm jack sockets	80p
A74A	5 Standard jack plugs	80p
A75A	5 Std. jack sockets	90p
A84A	5 5 pin 180 DIN plugs	70p
A85A	5 5 pin 180 DIN sockets	55p
C21	5 Min. slide switches	75p
C28	5 Push to make switches	70p
C29	5 Push to break switches	90p
C50	20 8 pin DIL sockets	170p
C51	20 14 pin DIL sockets	200p
C52	20 16 pin DIL sockets	220p
E10	Resistor kit. 650 resistors ¼W 10 ea value 4.7 to 1M	480p
–	Single potentiometers 5K-1M log in lin	35p
–	Slide potentiometers. 60mm travel. 5K-500K log or lin	65p
E26	10 100K min. presets	70p
E31	10 1u 63V electrolytics	50p
E33	10 4u7 63V radial elec.	50p
E34	10 10u 25V radial elec.	50p
E37	10 100u 25V radial elec.	75p
E44	10 1u 35V bead tants.	100p
E50	10 0.01 C280 polyester	50p
E54	10 0.01 C280 polyester	50p
E10	10 BC107 transistors	90p
F11	10 BC108 transistors	90p
F12	10 BC109 transistors	90p
F17	10 BC214L transistors	90p
F27A	5 2N3819 transistors	100p
F311	1 BD131 transistor	45p
F312	1 BD132 transistor	45p

Pack No.		
F331	1 BD139 transistor	45p
F421	1 MJ2955 transistor	110p
F43	5 78L05 regulators	180p
F46A	1 7805 regulator	70p
F47A	1 7812 regulator	70p
F49A	1 7905 regulator	75p
F53	1 LM317T variable reg.	200p
F54	LM323K 3A 5V reg.	500p
H11	20 1N4002 diodes	75p
H30	2 W005 bridge rectifiers	45p
H60	100 1N4148 diodes	180p
H73	2 C106D thyristors	90p
J5	10 0.2in red LEDs	100p
J25	10 0.2in green LEDs	150p
J45	10 0.2in yellow LEDs	150p
J70	20 0.2in LED clips	60p
J7	10 0.125in red LEDs	100p
J27	10 0.125in green LEDs	150p
J47	10 0.125in yellow LEDs	150p
J72	20 0.125in LED clips	60p
J75	1 FND500 CC display	100p
K5	5 741 op amps.	90p
K20	5 CA3140 op amps.	225p
K30	5 LM301A op amps.	140p
K40	1 LM324 op amps.	50p
K50	1 LM380 2W amp.	70p
K75	1 LM3914 LED bar graph	320p
K85	5 NE555 timers	110p
K90	1 NE556 timer	50p
K100	5 TL081 op amps.	175p
L8	5 4011 CMOS	130p
L9	1 4013 CMOS	40p
L11	1 4017 CMOS	75p
L22	1 4049 CMOS	45p

All prices include VAT. Please add 50p postage and packing. Send s.a.e. for our complete catalogue.

Rapid Electronics Limited
Hillcroft House, Station Road, Eynsford, Kent

LANGSTONE ELECTRONICS

38 OUTRAM ROAD, SOUTHSEA, HANTS. PO5 1QZ

TRANSISTORS

ACY18/19	29p
BC107/8/9	12p
BC177/8/9	16p
BC182/3/4	9p
BC212/3/4	11p
BCW91/2	30p
BCY70/1/2	17p
BD135/6	40p
BDY56	200p
BF257/8	29p
BFY50/1/2	23p
BU126	150p
BU208	200p
BUX48	500p
ME0404	13p
ME1001	10p
MEF3819	23p
MEU11/12	30p
MEU21/2	38p
2N404A	25p
2N914	17p
2N2218/9	23p
2N2221/2	23p
2N2369A	17p
2N2484	30p
2N2646	45p
2N2904/5	24p
2N2906/7	24p
2N3055	48p
2N3702/3	11p
2N3704/11	10p
2N3819	23p
2N4058-62	11p
2N5308	29p

DIODES

AA143/4	10p
OA91/5	10p
1N914	4p
1N4001/2	5p
1N4003/5	6p
1N4006/7	7p
1N4148	4p
1N5401/2	14p
1N5404/5	19p
1N5406/7	19p
Diac	25p

ZENERS

0.5W	8p
1.3W	12p

THYRISTORS

0.8A/100V	37p
1.6A/400V	39p
4A/400V	47p
10A/400V	140p
25A/400V	620p

TRIACS

1.6A/400V	47p
6A/400V	70p
10A/400V	115p
25A/700V	500p
40A/700V	600p

74 TTL

7400	12p
7401/2	14p
7404/5	16p
7406/7	28p
7413	26p
7447	79p
7450/4	16p
7473/4	23p
8481/3	89p
7485	110p
7489	190p
7491	65p
7493	38p
74121	33p
74123	62p
74145	79p
74155/6	69p
74164/5	106p
74182	99p
74192/3	95p

LINEARS

355/6/7	80p
358	60p
301A	39p
324	65p
741	25p
1458	45p
309K	120p
7805/12	85p
7905/12	92p
555	25p

CMOS

4000/1/2	18p
4008	79p
4011/2	18p
4016	39p
4017/8	79p
4023/5	18p
4040	90p
4046	120p
4049/50	49p
4093	79p
4402/12	38p
4502	99p
4510	110p
4514	240p
4516/8	99p
4528/31	99p
4581	185p
4582	125p
4584	69p
4585	99p

CONSUMER

SAJ180	196p
SAK115	123p
TAA930	180p
TBA800	196p
TCA910	95p
ESM1601	165p
TDA1067	190p
TDE2608	290p
ULN2136	120p
ULN2244	250p

MPUs

6800	440p
6802	680p
6809	1790p
6821	230p
6840	680p
6850	230p
6852	270p
6862	820p
6875	480p
6880	130p
6882	270p
6888	95p
6889	130p
9364	1150p

MEMORIES

6810	170p
2114	340p
4116	370p
2708	510p
2716	840p

PLUS:
Resistors
Capacitors
Veroboards
Veroboxes
Connectors
Knobs
Potentiometers
Solder Eqpt.
Wire & Cable

NOTE: ALL OUR PRICES INCLUDE VAT

PLEASE RUSH ME YOUR CATALOGUE — FREE!

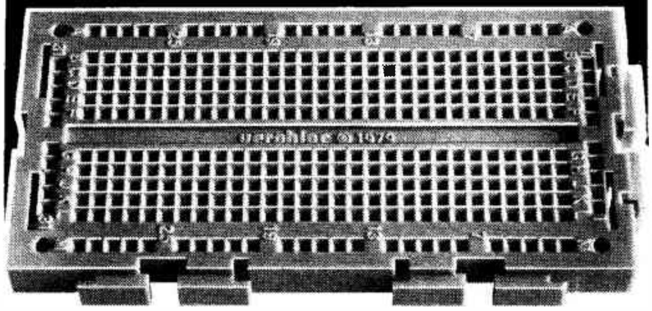
Name: ....

Address: ....

....

....

THE NEW AND UNIQUE VEROBLOC



ADDS TO YOUR CAPABILITY

Already used in industry, this solderless breadboard is now available to the hobbyist. Unique because of its universal interlocking facility meaning you no longer need lots of different boards.

Send now for the unique Verobloc.
Order code 200-21092G. £4.16p inclusive.

AND VERO HAVE ADDED TO THEIR TRADITIONAL RANGE OF HIGH QUALITY BOARDS, ALSO EX-STOCK.

No.	Order Code	Description	Size (mm)	Price
1)	10-2845B	Microboard	160 x 100	5.66
2)	10-2846H	Microboard	160 x 233.4	12.41
3)	200-21084E	V-Q Board	147.83 x 73.66	1.65
4)	09-2196L	Veroboard	160 x 100	1.63

Carriage & VAT included.

Vero Electronics Limited, Retail Dept., Industrial Estate, Chandler's Ford, Hampshire SO5 3ZR. Tel (04215) 62829

State quantity and order codes required ....

Name ....

Address ....

....

ETI4

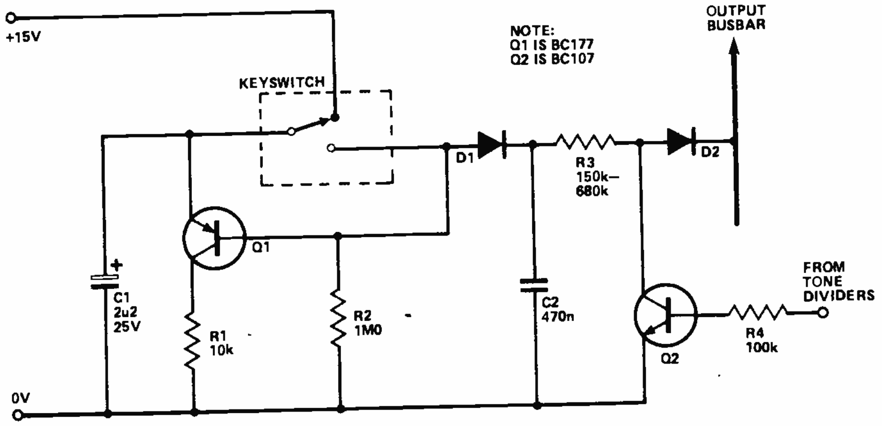
I enclose Cheque/PO for £ .... or debit my Barclay Card/

Access No ....

Exp. date ....

vero

TECH TIPS



Touch-Sensitive Piano Keying

J. Cozens, York

The circuit is operated by a single-pole change-over key switch. When the key is in the fully released position C1 is held charged from the 15 V rail. Q1 is turned on by the bias current supplied by R2. When the key is depressed C1 is disconnected from the 15 V rail and starts to discharge through Q1 and R1. When the key is fully depressed Q1 is turned off and the remaining voltage on C1 then charges up C2 via D1. Both capacitors then discharge via R3. The envelope produced by this decaying voltage is chopped by Q2, driven directly from the tone dividers. Upon the release of the key, C1 is disconnected from the chopper circuit and C2 discharges rapidly via R3, simulating the action of the dampers. D1 is included to prevent C2 discharging through R2 when the key is released and D2 prevents interaction with other keying circuits.

As the voltage remaining on C1 at the completion of a keystroke depends on the key velocity, a degree of touch-sensitivity is obtained with this circuit.

Tuning Fork Mods.

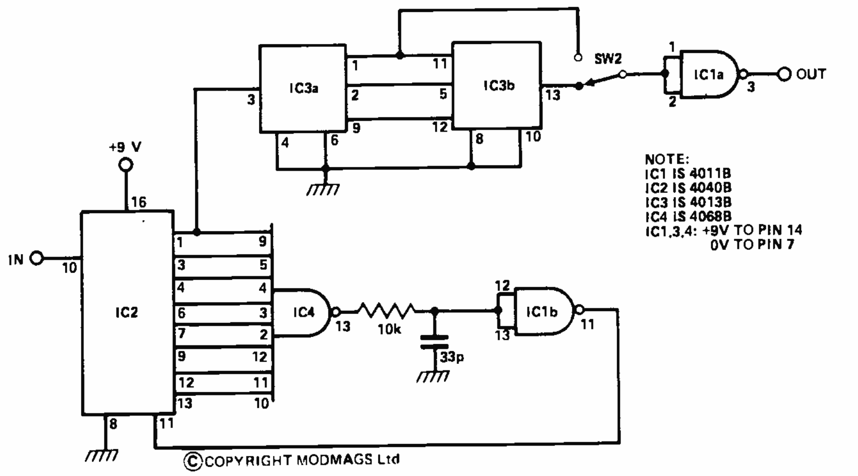
M.L. Duncan, Greenford.

With a few slight modifications to the ETI Tuning Fork it is possible to use the very cheap and plentiful TV colour crystal tuned to 4.43361875 MHz.

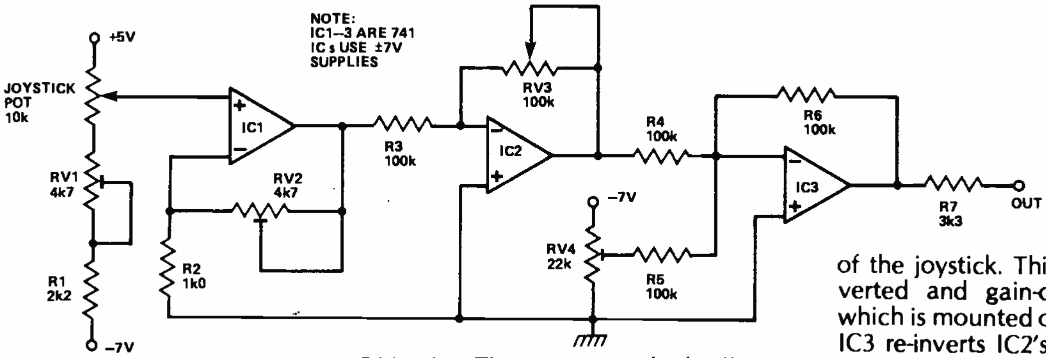
The oscillator circuit output is divided by 2519 giving a frequency of 1760 accurate to one part in 250,000. The division is done by a 4040 in place of the 4020 and the switching giving an alternate 'A' at 445 Hz is eliminated.

A 4013 dual flip-flop is added before the output buffer to give further division by two and four. These outputs are switched before the buffer to give a choice of 'A's at 880 and 440 Hz respectively. The extra cost of the 4013 is offset by eliminating one of the 4011s.

The diagram shows the altered parts of the circuit. The oscillator is retained, using the changed crystal, as is the output circuit from R4 onwards.



Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items.
ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International, 145 Charing Cross Road, London WC2H 0EE.



Joystick Control

M. Swale, Cardiff

Having recently built the ETI 4600 synthesiser, I found, to my dismay, that most joystick pots only vary by about 30° at maximum deflection. Consequently, the original circuit for the joystick control, which assumes complete rotation of the joystick pot, will not give the required 5 V swing. The circuit attached will convert a small DC voltage change provided by the joystick into 0-5 V at the output.

Circuit function and setting up is as follows:- RV1 is adjusted so that there is 0 V at the joystick pot wiper. (Note that RV1 and R1 may need to be on the + 5 V side of the joystick pot, depending on the actual pots used in the joystick).

RV2 is then adjusted to give ±2V5 swing at IC1 output with full deflection of the joystick. This voltage is then inverted and gain-controlled by RV3, which is mounted on the joystick plate. IC3 re-inverts IC2's output and RV4 is adjusted to add 2V5 to the output of IC3. The output then becomes a 0-5 V swing, with 2V5 at the centre point.

This control voltage swing is ideal for use in the 4600 synthesiser since 2V5 into the keyboard modulation input gives no variation in pitch, ie the keyboard pitch can be shifted up and down by an amount dependent on RV3. The power for the circuit can be taken directly from the 4600 PSU.

Improved Speaker Overload Indicator

J. Harrold, Bristol

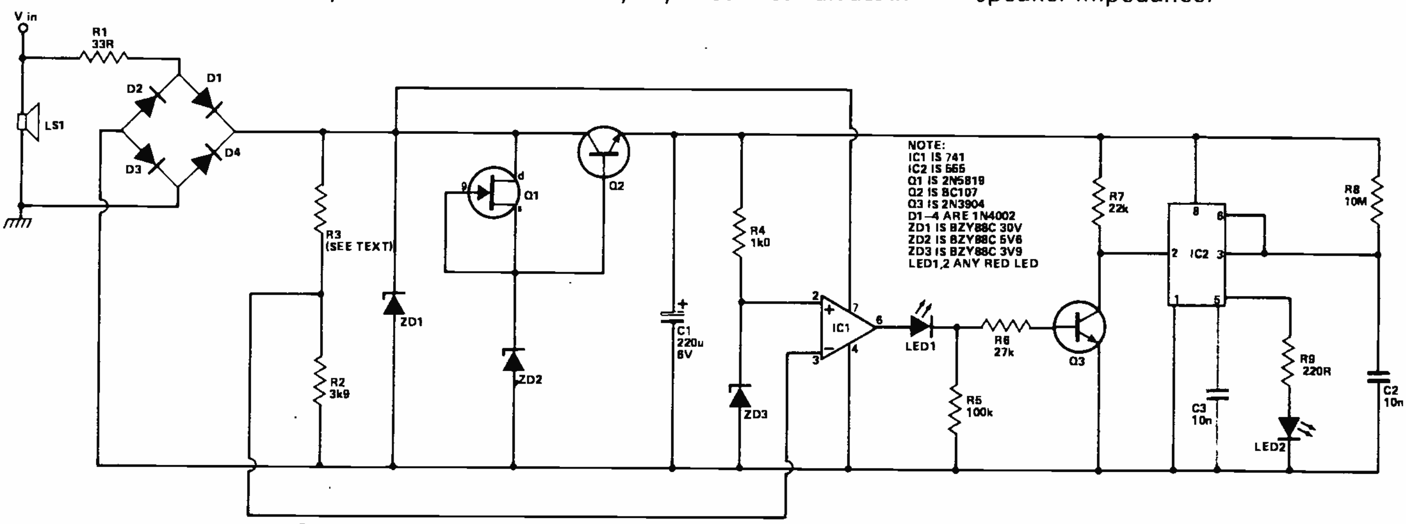
This circuit is based on a design by J. P. Macaulay, which appeared in Electronics Digest Vol. 1. This one offers an improvement in performance, which is low cost and does not introduce an external DC power supply.

Peaks in music can be very short and may be too fast (or dim) to be seen clearly on a LED if held for their duration only. This circuit uses a monostable to hold a LED on for a set time after triggering by a peak in music.

The voltage at the speaker output terminals is rectified and then passed to potential divider R2, R3. ZD1 provides 'last ditch' protection for Q1 and IC1 (this method is not suitable if indication of overloads of greater than 50 W is required). Q1 is used as a voltage variable resistor and with ZD2, series pass transistor Q2 and C1, provides a regulated supply. This supply improves the stability of the 3V9 reference potential at the inverting input of IC1 and also provides a stable supply for IC2 and its timing components R8, C2. C1 cannot be placed between 0 V and the collector of Q2 as this would have an adverse filtering effect on high frequency signals. When the voltage across R2 is less than 3V9, the output from comparator IC1 is low (≃1V5) and this voltage is dropped across forward biased red LED 1 (or alternatively any three silicon diodes in series). Q3 is off and the trigger (pin 2) of IC2 is high. When the voltage across R2 exceeds 3V9, IC1 output goes high and Q3 is turned on, lowering the voltage at IC2 pin 2, triggering the monostable and lighting LED 2 for a period dependent on R8, C2 (about 100 mS with given values). C2 must be a low leakage type (not ceramic). Decoupling of the control voltage (pin 5) by C3 was not necessary in the prototype. R1 protects the amplifier from possible bridge failure. Q1 may be replaced by a fixed resistor appropriate to the input voltage with slight degradation of performance. The value of R3 is given by:

$$R3 = (\sqrt{2PR} - 3.9)\ \text{kilohms},$$

where P is the power output and R is the speaker impedance.



'Zener-less' Battery Eliminator

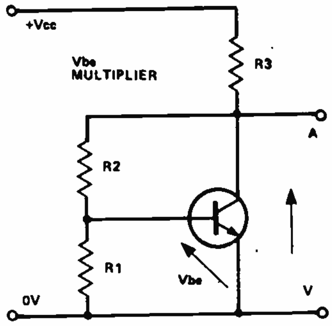
P.J. Hunt, Wimborne

Designed as a variable-voltage battery eliminator, this circuit provides a stabilised output without Zener diodes as the reference source. Instead, a V_{be}-multiplier is employed, so that the output voltage may be continuously varied by PR1 over the range 6-10 V.

The V_{be}-multiplier is shown schematically in the inset. Provided that V_{cc} is high enough, the potential across R1 will be about 600 mV for a silicon transistor. The current through R1 can thus be adjusted so that the base current of the transistor may be ignored for practical purposes. In this case, the current through R1 will equal the current through R2. The potential at point A is thus given by:

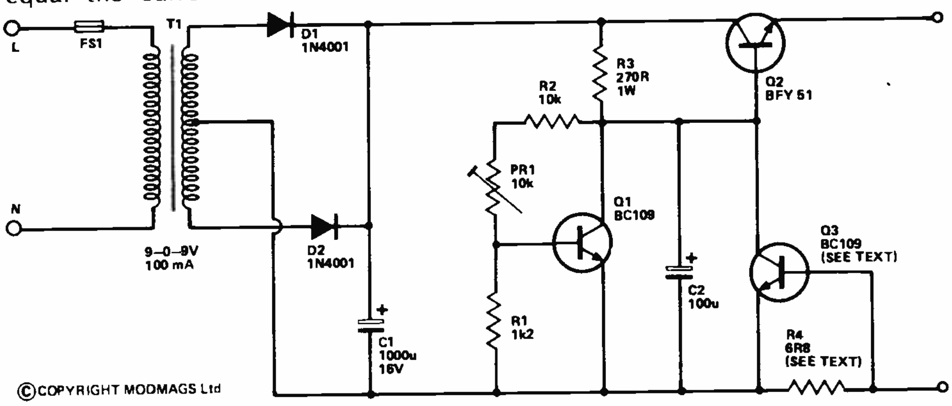
$$V = V_{be} \times \frac{(R1 + R2)}{R1}$$

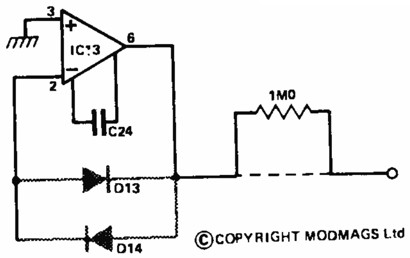
— hence the name V_{be}-multiplier.



R3 limits the current through the parallel combination of the transistor and R1/R2. Suppose as an example that V_{cc} tries to rise. The potential divider formed by the three resistors will try to raise the voltage across R1. This will tend to increase the collector current and thus increase the potential drop across R3, leading to a stabilising effect at point A. This is a case of voltage-derived series feedback.

In the practical circuit, R3 also provides base current for the series transistor Q2. Q3 and R4 form a current limiter. If the output current exceeds approximately 100 mA, Q3 starts to turn on, reducing the output voltage. If desired, Q3 and R4 may be omitted, in which case R3 may be de-rated to ½ W. The whole unit fits easily inside a PP9 battery case.



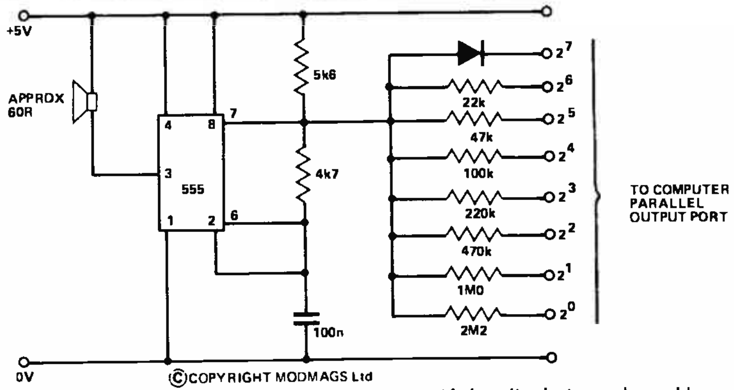


Transcendent Pulse Wave Improvement

J.F. Jordan, Cambridge

The pulse wave on the original Transcendent 2000 suffers from a slow falling edge, making LFO modulation of pulse width less effective for chorus sounds and removing the characteristic hollow tone of the square wave.

This problem can be solved by removing D13 and D14 and inserting a 1M0 resistor across a break in the track from the output of IC13 to SW4. The comparator then operates in open loop mode giving much improved waveform edges.



Cheap Micro Music Box

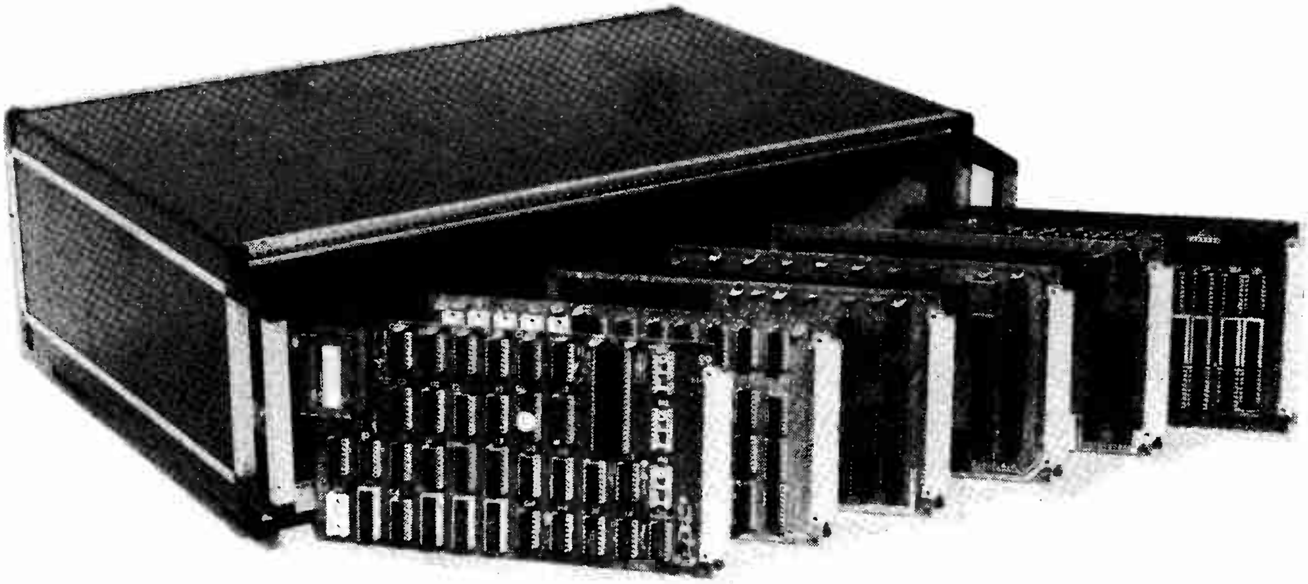
T.M. Tobin, Birmingham

This circuit may be connected to the output port of any micro to generate musical notes over a range of about 1½ octaves. On/off control is provided by the most significant bit and the resistors provide seven bit resolution. Alternative on/off control methods can be used to give eight bit resolution, eg by using the handshake lines, if available.

If the diode is replaced by a resistor, say 10k, it will be found that below a certain output value the voltage at pin 7 is insufficient to charge the capacitor. Thus the sound can be switched off.

The resolution is sufficient to enable values to be found corresponding to tones and semitones throughout the frequency range. Current consumption depends largely on the loudspeaker impedance and is generally low enough for power to be taken directly from the computer. Most constructors will have all the parts required which in any case will cost less than £1.

microtan 65



The **Microtan** system is rapidly becoming accepted as the ultimate approach to personal computing. Start with **Microtan 65**, a 6502 based single board computer, and expand to a powerful system in simple and in-expensive stages. The **Microtan** system is a concept and not an afterthought, this means expansion is easy and very efficient! Unlike many other systems, you'll find it difficult to outgrow **Microtan**, and you won't be wasting your money on a product that will only last you a few months! When you are ready to expand, **Tanex** is waiting. The features offered by **Tanex** are tremendous, and you can start into them for just £49.45! Cassette interface, 16 I/O lines, two 16 bit counter timers, data bus buffering, memory mapping and a further 1K of RAM are standard. From thereon expansion is simple, just plug in extra integrated circuits to get yourself 8K of RAM, a further 16 I/O lines and two more counter timers a serial I/O line with RS232/20mA loop and full modem control, **XBUG** – a firmware package containing cassette file handling routines, plus a line-by-line assembler (translator) and dis-assembler, PLUS 10K EXTENDED MICROSOFT BASIC, a suped-up version of the Basic as used by major manufacturers such as Apple, Tandy and Nascom, NO OTHER LOW COST MICROCOMPUTER OFFERS YOU THIS SUPERB PACKAGE. O.K. so you want more memory, try **Tanram** for size! Upto 40K bytes on one board starting for as little as £50.60. RAM freaks will be pleased to hear that our system mother board offers page memory logic which will support 277K Bytes, satisfied? To house these beautiful modules you can choose between our mini-rack (as used on **Micron**), which accepts **Microtan** and **Tanex**, or our system rack pictured above. The system rack will support 12 modules. What are these extra modules? Well for starters there's a couple of I/O modules, parallel and serial offering upto 128 I/O lines organised as 16 8 bit ports and 8 serial I/O ports respectively. Shortly we'll be introducing high definition (256x256) colour graphics, A to D and D to A modules, IEEE 488 Bus interface, a PROM programmer, disc controller and **TANDOS** – a 6502 CPM system. So there's plenty to keep you busy. Send for more details, and find out how you can get started for just £79.35!

ALL PRICES QUOTED INCLUDE V.A.T.

AIM 65, KIM 1, SIM 1 USERS– READ ON!

We have produced a T.V. interface module which simply connects to the expansion socket of your computer and produces a display of 16 rows by 40 characters! Of even more interest will be our Buffer module, which allows you to expand into our system rack, giving you access to the full range of Microtan modules.

Please underline the information required.

AIM T.V. INTERFACE. MICROTAN SYSTEM.

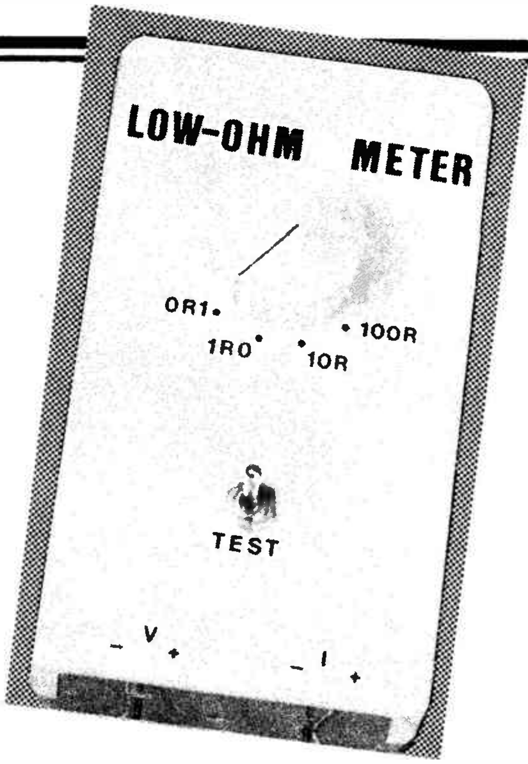
NAME: ______________________

ADDRESS: ______________________

____

PLEASE ENCLOSE 12p STAMP. THANK YOU.

LOW-OHM METER

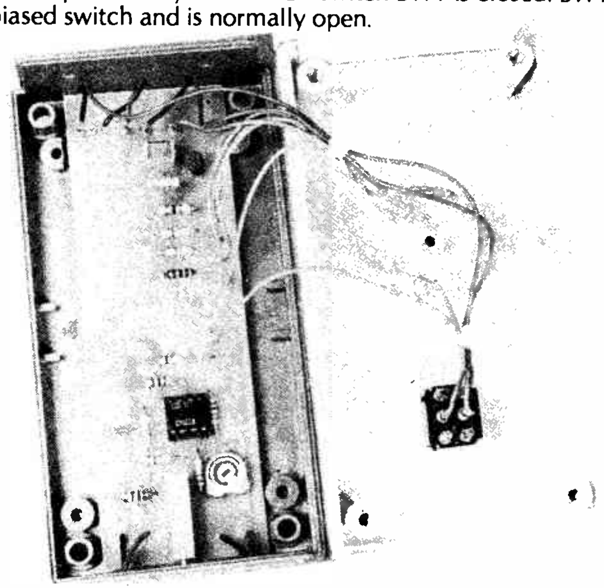


Measure resistances from a hundred ohms down to a few milliohms with this accurate four-range meter. It can be built as a self-contained unit or as an adaptor for use with an existing multimeter. Design and development by Ray Marston.

Ever wanted to measure the resistance of a transformer winding or a suspect solder joint, but found that your trusty multimeter wasn't sensitive enough to do the job? If so, our Low-Ohm Meter will solve your problems. It accurately measures resistances from a hundred ohms down to a few milliohms, in four decade ranges, using a precision four-terminal measuring technique that eliminates the effect of connecting leads, etc, from the readings.

Our Low-Ohm Meter contains two fully independent (and independently powered) circuits, these being a multi-range constant-current generator and a DC millivoltmeter with a full-scale sensitivity of 10 mV. The generator is used to apply a fixed test current to the resistor that is being measured, and the voltmeter is used to measure the resultant voltage that is developed directly across the resistor, indicating the true value of the resistor and ignoring the effects of the test leads. This four terminal measurement technique is widely used in precision calibration laboratories.

The Low-Ohm Meter indicates 100 milliohms (0R1) on its most sensitive range, using a test current of 100 mA. Supply battery B1 must be capable of supplying this current without excessive voltage drop; a PP9 type is recommended. The unit consumes power only when TEST switch SW1 is closed. SW1 is a biased switch and is normally open.



Construction

The Low-Ohm Meter can be built as either a self-contained unit, with built-in supply batteries and moving coil meter, or as an adaptor unit for use with an existing multimeter. In this latter instance, use a meter set to its 1 V DC range.

Start the construction by assembling the components on the PCB, as shown on the overlay. If your meter or multimeter has a sensitivity of 100 uA (10k/V) or better, give R9 a value of 10k. If the sensitivity is 1 mA (1k0/V) or better, reduce the R9 value to twice the ohms-per-volt value of the meter.

When assembling the components, note that PR2 is a multi-turn 3/4 inch cermet trimmer and that its adjuster spindle overhangs the edge of the PCB; we'll refer to this end of the PCB as the 'front'. Solder four flexible leads to the indicated points at the front of the PCB. Solder Veropins to the other terminal points. Now test-fit the PCB in your chosen case. Drill a small hole in the front of the case, in line with PR2, to accept PR2's spindle and facilitate external 'set zero' adjustments. Drill two additional holes in the case front, to allow passage of the two pairs of 'I' and 'V' leads. You might consider taking the 'I' leads to a pair of quick-connection terminals (push-button loudspeaker type), for easy insertion of the resistor under test. Now drill the top of the case to accept SW1 and SW2 and fit these components into place. Finally, fix the PCB into the case and complete the interwiring to the switches.

Test And Use

When construction is complete, connect the two 9 V batteries to the unit, noting that B1 must be capable of supplying 100 mA, and connect the 'M' terminals to a 1 V DC meter or multimeter. Now short the two 'V' terminals together, close the test switch, and adjust PR2 to obtain a zero reading on the meter.

Next, turn SW1 to the 100R range and connect a 100R resistor (5% or better) accross the 'I' terminals. Now connect the 'V' terminals across the test resistor (on the resistor side of the 'I' leads), with like polarities to like (+ to +, etc), close the test switch, and adjust PR1 to obtain a full scale reading on the meter. The unit is now calibrated and ready for use.

The PCB is mounted so that the cermet preset can be adjusted through a hole in the case.

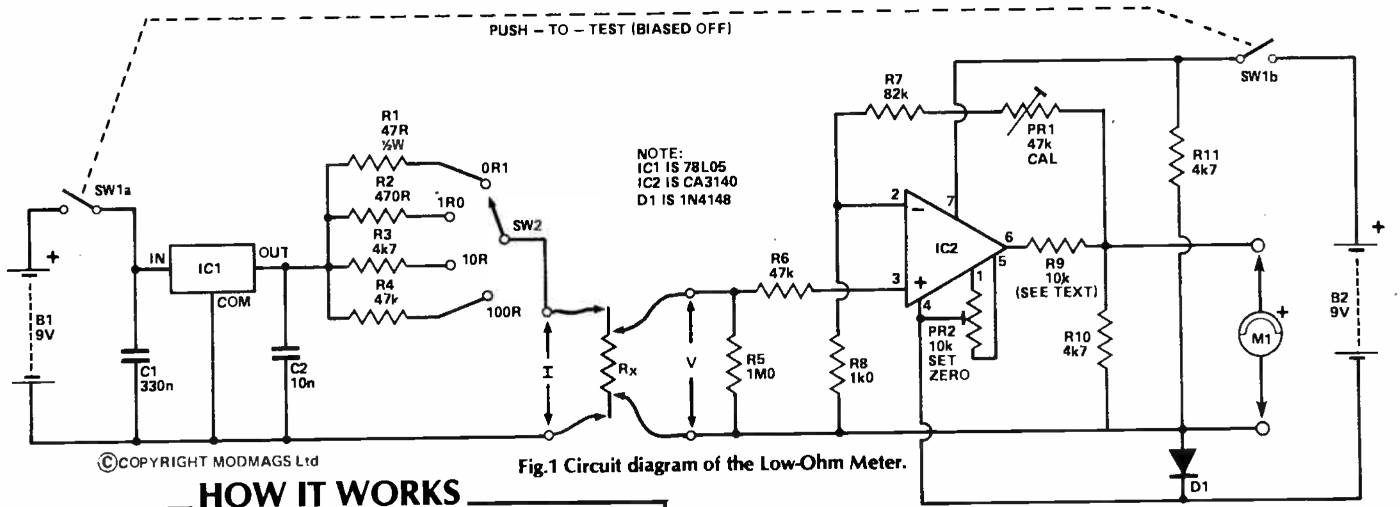


Fig.1 Circuit diagram of the Low-Ohm Meter.

HOW IT WORKS

The constant generator circuit is very simple. IC1 is a 5 V regulator and the output test current (I) is determined by resistor R1 to R4. On each range, the value of the test resistor (Rx) is very low relative to the current-limiting resistor, and the full scale test voltage (10 mV) is very small relative to the 5 volts of the regulator. Consequently, on each range, the test current is virtually independent of the effects of lead resistances, etc: on the most sensitive (100 milliohms) range (I = 100 mA), one ohm of lead resistance will introduce a maximum full-scale error of 2%. A similar lead resistance will introduce an error of only .002% on the 100R (I = 100 uA) range. In practice, therefore, the reading errors are primarily determined by the accuracies of R1 to R4.

The DC millivoltmeter (designed around IC2) is a fairly conventional design. It is based on a CA3140 op-amp, which can respond to DC inputs down to zero volts. To enable the output to go slightly negative (for zero-setting purposes), a −600 mV supply rail is generated by R11 and D1. Resistor R9 is used to limit the maximum voltage to the meter to about 2 V, to eliminate the possibility of meter damage if the unit is incorrectly ranged. The sensitivity of the meter is variable over a limited range by PR1, for calibration purposes (to compensate for test-current errors).

PARTS LIST

Resistors (¼W 5%, unless otherwise stated)	
R1	47R ½W
R2	470R
R3, 10, 11	4k7
R4,6	47k
R5	1M0
R7	82k
R8	1k0
R9	10k
Potentiometers	
PR1	47k miniature horizontal preset
PR2	10k ¾ inch cermet multiturn preset
Capacitors	
C1	330n polycarbonate
C2	10n polycarbonate
Semiconductors	
IC1	78L05
IC2	CA3140
D1	1N4148
Miscellaneous	
SW1	Miniature 2-pole biased toggle (normally off)
SW2	1-pole 4-way rotary switch
M1	Moving coil meter, 1 V FSD, sensitivity 100 uA or better.
Case, quick-connection terminals.	

BUYLINES

Absolutely no problems here: all components are readily available

When using the unit, note that the 'I' terminals supply a test current to the resistor being measured, and that the 'V' terminals indicate the voltage developed directly across the resistor. The 'V' terminals must therefore always be connected to the resistor 'inside' the 'I' leads, as indicated by the circuit diagram. When using the meter on its most sensitive (0R1) range, the 'I' leads should be kept as short as possible: on this range, 1R0 of lead resistance will introduce a maximum reading error of 2% on a 100 milliohm test resistance.

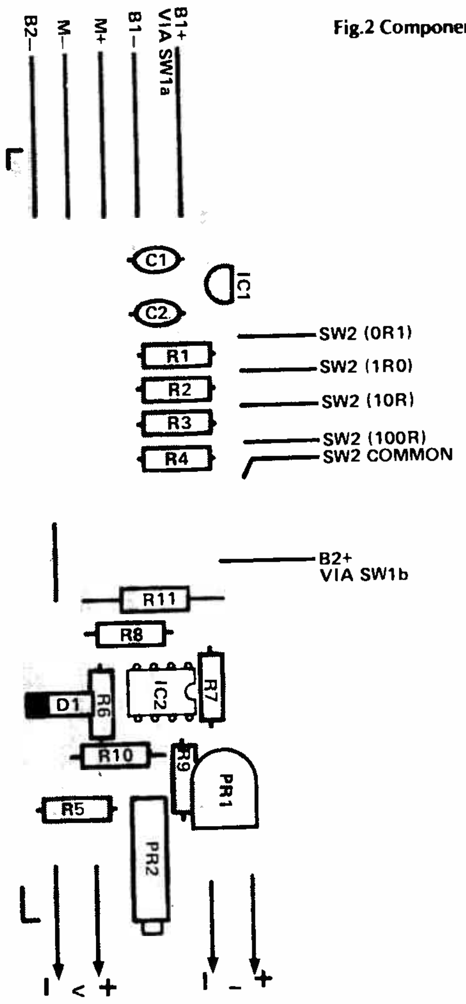
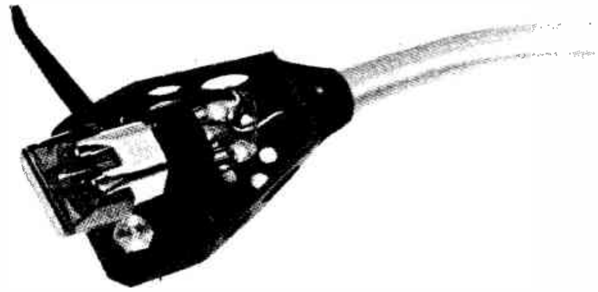


Fig.2 Component overlay.

World Radio History

PICKUP PRINCIPLES



There have been many features on hi-fi in ETI. We have pondered preamplifiers. We have looked at loudspeakers. We have tested turntables. And now — Ron Harris gives you the needle!

The pickup cartridge is the smallest and most oft overlooked component in the hi-fi chain. Much debate has taken place of late as to the what, which and how of turntables and amplifiers. Speakers have also had their day in the centre of the stage, but cartridges — apart from the resurgence of the moving coil a few years back — have simply and quietly gone from strength to strength. Companies such as Goldring, Shure, Ortofon and Empire have continued to add more art to the science of music reproduction without always receiving due attention or accolade.

There have been many variations on the pickup theme. Such divergences as the electret/capacitive cartridge and the almost universal (cheap and cheerful!) piezo-electric are still for sale in most emporiums, but are of little importance to the main hi-fi market. Two main systems dominate; moving magnet and moving coil.

Both are based upon Faraday's laws of electromagnetic induction, which can be briefly, if a little impolitely, summed up as stating that if you move a magnet around anywhere near a coil of wire, you will cause a voltage to appear across that coil. The voltage will bear a direct relationship to the movement.

Elements Of Generation

Before moving on to a consideration of the important parameters and how they affect performance, let's take a look at how each of the systems work:-

1/ Moving Magnet And Induced Magnet

Figure 1 shows a very generalised view of a moving magnet cartridge. Figure 1a shows the relationship of magnet to record groove and the position of the pole pieces. Axis A allows the two drawings to be related.

As the stylus follows the groove wall the magnet transcribes a similar path, parallel to PR and at varying distance from PL. A voltage is thus generated in the coil which is directly related to the groove information.

All cartridges must be well shielded from external fields generated by such as mains transformers, as the flux changes are minute and such a field can induce an output comparable to the wanted signal. (Hence that all-too-familiar mains hum.)

The most oft employed variation upon this theme replaces the moving magnets with a single high permeability armature (usually iron). The magnets are fixed within the body, with a resulting drop in mass attached to stylus. A voltage is induced into the coils by the movement of the iron armature within the magnetic field. For this reason the technique is called 'induced magnet' or 'moving iron' and excellent examples are marketed by Ortofon and Empire amongst others.

Output levels are generally around 2-3 mV.

2/ Moving Coil

It may come as a surprise to some of the newer converts to the black arts of hi-fi to know that moving coil cartridges have a longer history than the ubiquitous moving magnet. Originally

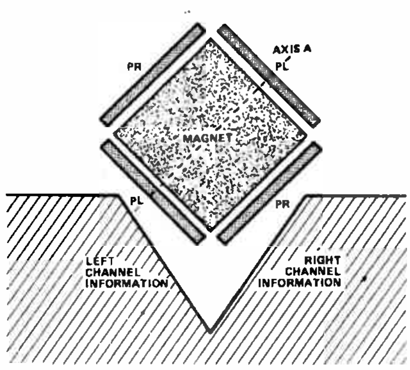


Fig. 1a The mechanical relationship between the pole pieces (which are fixed to the cartridge body), the magnet (which is attached to the stylus), and the record groove wall.

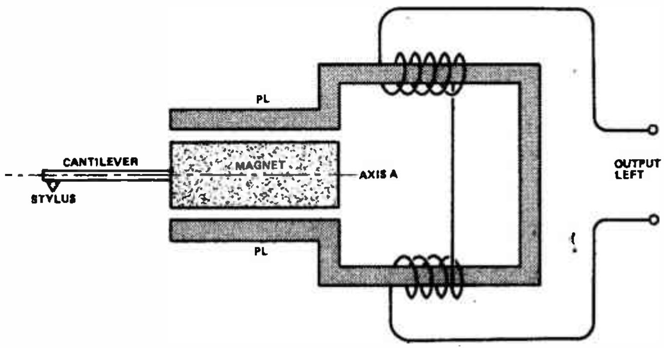


Fig. 1b Axis A can be referred to Fig. 1a to show the positioning of the generator within a moving magnet cartridge.

Strange looking things, but every home should have one. This particular point is a close-up Van der Hul stylus as employed in the Goldring G900IGC.

developed by Ortofon, their tracking-ability weaknesses and requirement for a step-up device led to their practical extinction a few years ago. However, the birth of the 'esoteric' hi-fi market and the subsequent interest of the Japanese audiophiles, has led to their virtues being prized over their vices once more.

The principle is extremely simple, and is illustrated in very general terms in Fig.2. The magnets are held in a fixed position within the cartridge body and the coils are mechanically linked to the stylus assembly. As the stylus follows the groove modulations the coils move relative to the magnets, thus generating the required signal voltages.

Output is generally lower, of the order of 0.2 mV and an extra amplification stage (step-up device) is required. However, a new generation of cartridges has arisen which utilise a far greater number of windings on the coils and more powerful magnets to generate a higher voltage level, comparable to moving magnet designs. The need for a step-up device is thus eliminated.

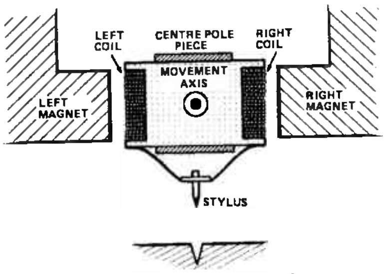


Fig. 2 Moving coil cartridge basics. As the stylus moves the coils, a current is generated within them by the magnetic field from the fixed magnets.

Two By Two

Considering the cartridge to be composed of two separate systems allows the different parameters of each to be evaluated correctly. The two systems are (i) dynamic components:- i.e. stylus, cantilever, pivot and moving generator (ii) static components:- i.e. body, fixed generator elements, electrical connections. If we define the task of the pickup as that of translating the mechanical movements produced at the stylus, by the LP, into an electrical signal for transmission to an amplifier, then we can consider the design requirements for each stage of that translation in turn.

Before proceeding, it should be noted that the pickup cartridge is an integral part of the record playing system as a whole. Many of the design parameters for the cartridge are correctly chosen to optimise the complete system under dynamic condition. In this article we cannot fully explore these interactions, but merely highlight them where they impinge upon the cartridge design directly.

Putting On The Stylus

In order to correctly interpret the record groove, a stylus must remain in contact with the groove wall, and be able to follow each and every modulation. The earliest stylus shape employed was a spherical one, simply because it was easiest to make and required least alignment. This suffered from the disadvantage of an inability to follow the highest frequencies recorded on a disc, because it will get "squeezed out" of the groove once the modulations become shorter than the length of the stylus, measured along the groove.

Elliptical stylii were introduced to overcome this by reducing that length and yet maintaining as large an area of contact with the groove wall as possible. Tracking weights had to be lower to prevent record wear increasing significantly, but the modulation tracing (tracking) deficiency of the spherical tip was overcome. Many companies have since attempted to refine this stylus configuration, with varying degrees of success. Only the Shure hyper-elliptical appears to offer any real advantage over the basic design, having an increased tracking ability and better high frequency definition.

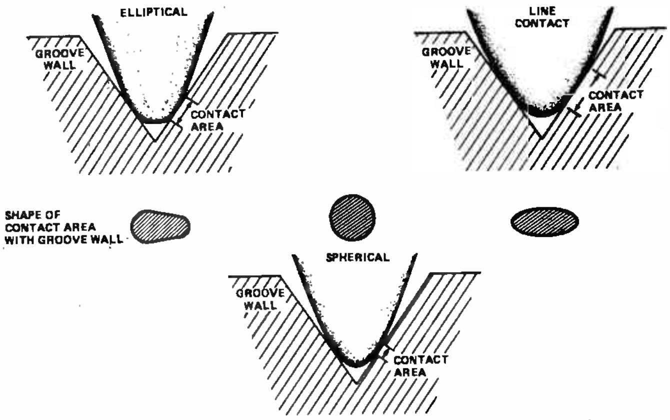


Fig. 3 The three most common stylus profiles and their relative parameters. Note that whilst the elliptical offers a greater tracking ability, its area of contact will generate increased record wear.

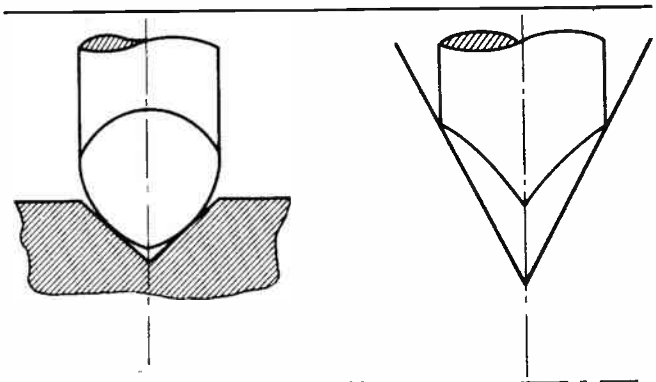
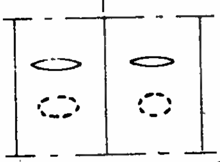


Fig. 4 Could this be the answer? Goldring's new Van der Hul point has great advantages over conventional tips, as its shape more closely mimics the cutting head and thus allows better tracking. The area of contact is also larger than for an elliptical (see small drawing).



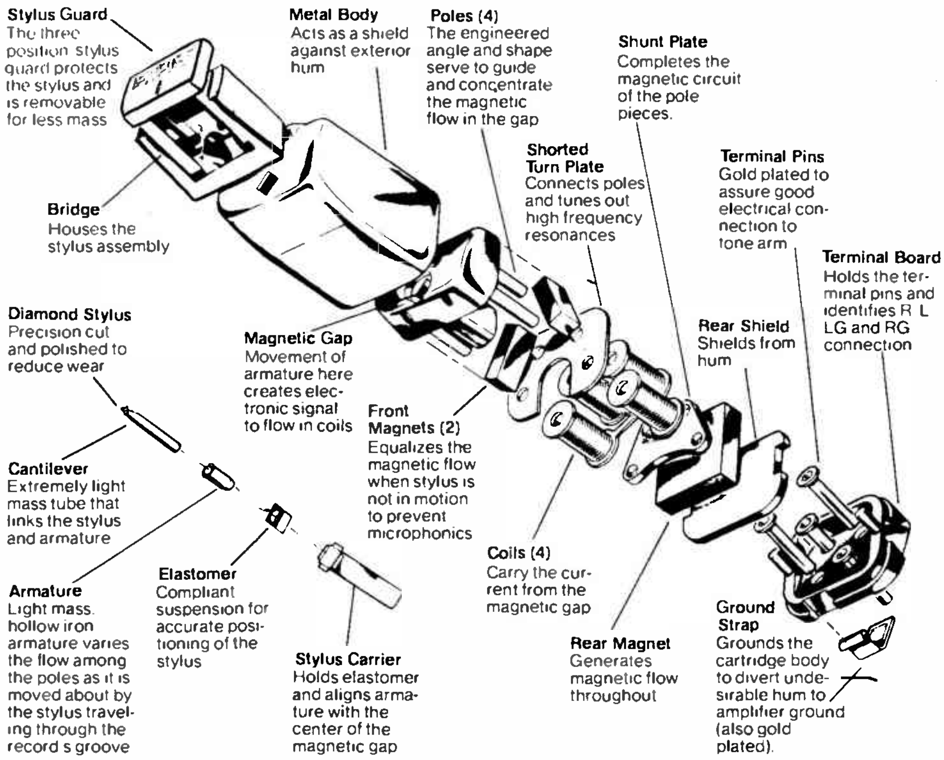
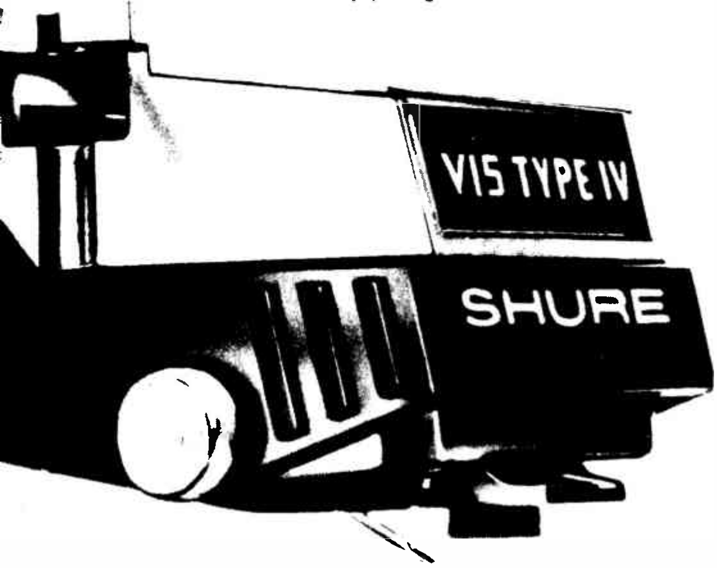


Fig. 5 This exploded view of an Empire induced magnet design gives an indication of the lengths that top manufacturers will go to in order to beat reasonances and colourations.

A still later development has been the line-contact stylus, (Shibata) which has attempted to get closer to the shape of the cutter head used in the initial production of the disc — this would obviously allow it to follow the groove more closely than anything else. Contact area would also be increased, with a resultant reduction in record wear. This type has reached its zenith with the introduction of the Goldring G900IGC cartridge and its Van der Hul stylus. It dramatically improved the performance of the G900 series and would seem, at the moment, to be closer to The Answer than anything else.



This V15IV attempts to optimise its own working conditions by using a damped, static-conducting 'rider' brush, operating ahead of the stylus. Warp effects are drastically reduced.

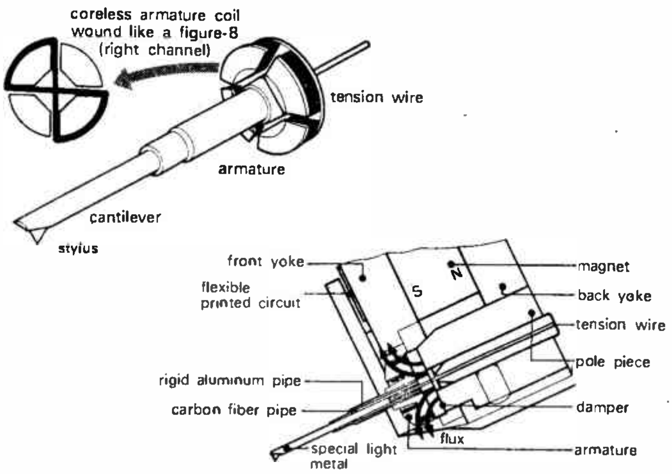


Fig. 6. A cross-section of a Sony moving coil pickup, showing how the coils are miniaturised to decrease the mass of the moving element, thus improving transient behaviour.

Cantilever Leavings

The stylus is joined to the generating element, be it coils or magnetic material, by the cantilever. It should be so attached that it tracks the disc at 20° to the vertical, (vertical tracking angle), since this is the cutting head angle and any deviation from this will be yet another source of distortion. (20° is, in fact, not yet a totally standard figure, but is the most used and best compromise figure we have).

If the cantilever were a totally rigid coupling then the pickup would be just as totally unable to produce a signal from the record, since the stylus would be prevented from moving with the groove. If it were too compliant, then the slightest warp or variation in surface would destroy the unit, with the arm mass inertia bending the cantilever out of shape.

Compliance is thus an important compromise parameter. The higher the compliance the lower must be the arm mass for the correct operation. This is because, like any mechanical system, the two working together will possess a resonant frequency — i.e. they will move easier at one frequency than any other, producing a non-linear response. Since the usable audio band extends approximately from 20 Hz-20 kHz and disc warps generally produce a signal somewhere around 6 Hz the ideal compromise is to place the system resonance between the two.

Combinations of compliance and arm mass are chosen to achieve this aim. Low mass pickup arms score a few points here as mass is easily added to these to 'tune' the resonance to an ideal frequency. If an arm is too heavy for a particular cartridge then there is little that can help — short of a hacksaw! For that reason alone, I tend to favour the SME Series III for all but a couple of cartridges — and those are low compliance, low output, moving coil designs, for which there exist specially designed carriers.

Compliance is normally measured in Compliance Units or CU where 1 CU = 1×10^{-6} cm/dyne.

Damping For All

All cartridge cantilevers are 'damped' to some extent, to control the resonances of the system. Some companies eg Ortofon (in the MC30) employ a complex mechanical linkage to overcome both the low frequency resonance and that at around 18 kHz — way at the other end of the spectrum — excited by the interaction between the record itself and the stylus. It is this resonace, and how successfully it is controlled which, more than any other single factor, determines how well a cartridge will audition.

A large number of factors are involved here; the mass of the stylus tip itself, the length of cantilever, compliance, damping of the pivot and the mass seen by the stylus reflected back from the arm through the cantilever, ie the effective mass of the system. It is an unfortunate fact that the better solutions to the problem are all expensive, which is why cartridges continue to cost a comparable amount of money, per ounce, to precious metals.

Generators

In the case of moving magnet designs the requirement for the fixed coils is fairly straightforward. The vast majority of amplifiers carry a 47k input, which is designed to accept these units. This makes electrical matching a fairly simple affair. The greatest source of contention will be the level of capacitance that the cartridge will be subjected to as a load. Too high a value will act as an HF filter and 'dull' the cartridge sound significantly. Too little will subjectively boost the treble, giving increased noise and a harsh brittle sound. Manufacturers always specify a capacitance value at which their unit performs best and this should be rigidly adhered to. Add about 150pF, for arm leads, to the input value of the amplifier and adjust by adding capacitors if necessary — ±15% will generally be close enough.

Some units, such as Grado are uncritical to a great extent, whilst others, eg Goldring, will have their subjective performance jeopardised if the value is not adjusted properly.

Moving coils present a more involved problem. The output here is too low to be connected directly to a conventional pickup, and so too is the impedance, so the step-up device must act as a buffer stage as well as providing the gain needed to allow normal usage. Impedance levels are of the order of 10-40R and as the device is essentially a current generator, noise will be a problem if matching is not precise. Again the easiest way around this is to stick with the manufacturer's recommendations as to which unit performs best with his cartridge.

High-Outputs

The latest generation of moving coil cartridges employ a generator technique which obtains outputs of around 2 mV, allowing their direct connection to a standard input. The coils in these models are generally wound with many more turns of wire to produce a higher voltage from the same magnetic field strength. The impedance is also 'padded' by this technique to improve matching. However, the resultant unit 'gain' has led some companies into problems with hum induction and electrical matching difficulties, despite their precautions.

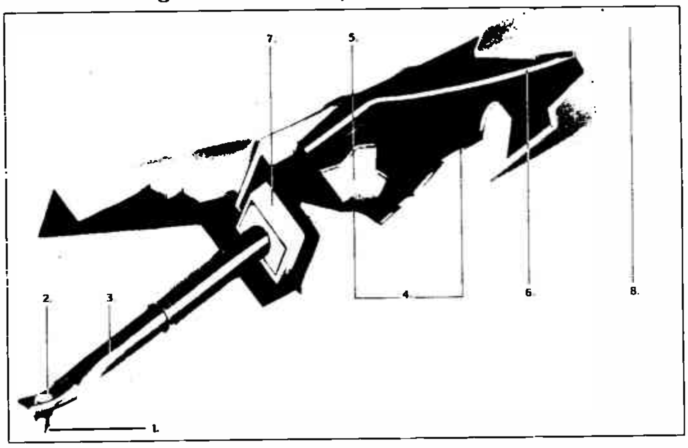


Fig. 7. So you thought cantilevers were simple? Take a look as this Shure version:- 1. Full diamond stone, meticulously shaped and polished, then assembled into an accurately machined mounting. Hyperelliptical in the V15 Type IV; hyperbolic in the M24H; biradial (elliptical) in the V15 Type III, and spherical in the V15 IV-G. 2. Doubly secure mounting — aligned, the diamond is first fitted into its socket, then high-temperature cemented to ensure permanent geometric orientation. 3. Ultra-thin-wall stylus shank — telescoped structure in V15 Type IV for low mass. Beryllium interior control lever in V15 Type III, M24H, M95 Series, M75 Type 2, and M91 Series for rigidity where needed to prevent tracking errors. 4. Viscoelastic suspension block — the efficient "heart" of the bearing which defines the pivot point of the stylus. In the V15 Type IV and M24H, a two-function bearing system separately optimized for high frequencies and for low frequencies. 5. High-energy magnet with electro-machined aperture for exact positioning of stylus shank. Pivot location ensures minimal contribution to effective mass of moving system. 6. Precisely adjusted, resonance-free support wire. 7. Pivot control — correct location and function of bearing and support wire ensured. 8. Stylus assembly carrier — placement of stylus assembly relative to pickup coils within cartridge body is optimised. Not so straightforward really, is it?

Ultimo produce perhaps the best known examples of high-output moving coils and they are also renowned for requiring very high capacitive loading, well in excess of the levels normally found in amplifier circuits. *Correctly* loaded, though they possess a very high sound quality and avoid the need (and expense) of a step-up device altogether.

Conclusions

Summarising briefly then, a cartridge has to extract the mechanical information from the record groove without passing on any appreciable vibration to the pickup arm if possible, and translate this into as faithful an electrical signal as possible; it must not be affected by warps or distortions in the vinyl surface; it must be impervious to electrical fields produced by motors, transformers etc and, ideally should be totally insensitive as to which pickup arm it is used in.

Any cartridge which met those requirements could be safely described as perfect, and whilst we are unlikely ever to have such a unit offered for sale, some of the approximations we do have are really incredible engineering achievements when you consider the difficulties involved, — whether you happen to like the sound of them, or not! **ETI**

CHROMASONIC electronics

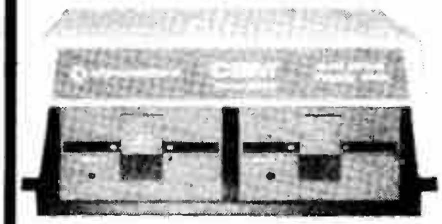
48 JUNCTION ROAD, ARCHWAY, LONDON N19 5RD — 100 yards from Archway Station & 9 Bus Routes
TELEPHONE: 01-263 9493/01-263 9495

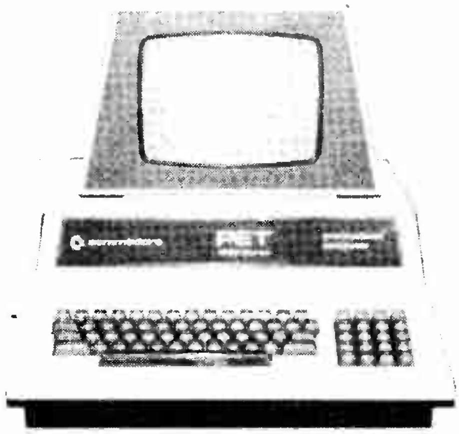
YOUR SOUNDEST CONNECTION IN THE WORLD OF COMPONENTS AND COMPUTERS

PETS & SYSTEMS

8N 8K RAM — £399
16N 16K RAM — £499
32N 32K RAM £599
CASSETTE DECK — £55

343K Twin Floppy Disk
£695



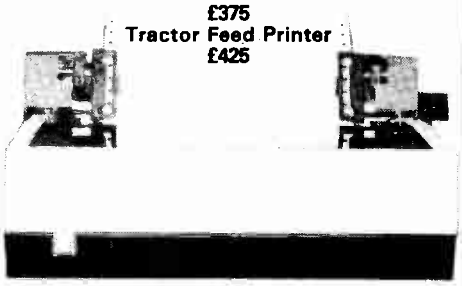


COMPLETE 32K SYSTEM £1789

NEW 32K with 80 col Screen £825
Twin Disk Drive 950K £896

All with new keyboard and green screen

FRICTION FEED PRINTER
£375
Tractor Feed Printer
£425

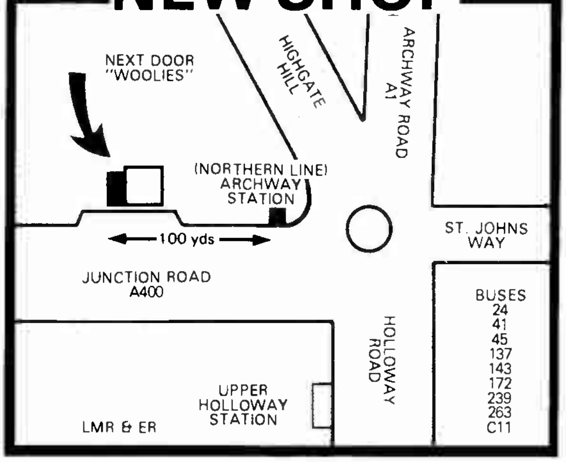


MEMORY EXPANSION KIT

Suitable for UK101, Superboard expansion using 2114's each board has 16K ram capacity kit contains:

- ★ On board power supply
- ★ 4K Eprom expansion
- ★ Fully buffered for easy expansion via 40 pin socket
- ★ 8K kit **£79.95**
- ★ 16K kit **£106.95**
- ★ Printed Circuit Board **£29.95**
- ★ 40 pin-40 pin header plug **£8.50**

NEW SHOP



VIDEO GENIE

VIDEO GENIE based on TRS80

Utilises Z80, 12k level II Basic, Integral Cassette Deck, UHF O/P 16k RAM, all TRS80 features

£289

CASES

Available for UK101, Superboard, Nascom.
Appx. DIM 17" x 15"
435 x 384 mm

PRICE £24.50
Post & Packing £1.50

UK101 P.P.I

Built & tested. Interfaces TX80 Printer direct. Can be programmed to operate relays, motors, various other peripherals "CENTRONICS COMPATABLE"
Plugs into IC socket. LED binary display fully documented.

£29.95

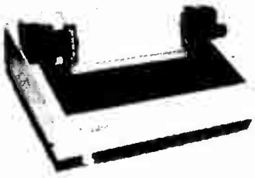
U K 1 0 1

£179 IN KIT FORM
£229 READY BUILT & TESTED
£255 COMPLETE IN CASE

4K Expansion (8x2114) NOW ONLY £14.00
No extras required

- ★ Free sampler tape
- ★ Full Qwerty keyboard
- ★ 8K basic
- ★ Ram expandable to 8K on board (4K inc)
- ★ Kansas City tape interface
- ★ NEW MONITOR ALLOWS FULL EDITING & CURSOR CONTROL **£22.00**

PRINTERS



¯PSON MX80 £359
EPSON TX80 £295

Dot-matrix printer with Pet graphics interface: Centronics parallel and serial: Pet and Apple compatible.

BARCLAYCARD VISA

Please add VAT 15% to all prices Postage on computers printers and cassette decks charged at cost all other items P&P 30p Place your order using your Access or Barclaycard (Min tel order £5) Trade and export enquiries welcome, credit facilities arranged

CHROMASONIC electronics

NEW SHOP & SHOWROOM NOW OPEN

Telephone: 01-263 9493/01-263 9495

UK101 SOUND

Sound Generator and combined parallel in out port kit, containing P.C.B., AY-3-8910, 6820 PIA. Fully documented and demo tape. **£29.95.**
AY-3-8910 £8.50.

UK101 SOFTWARE

	£
Space Invaders	6.50
Real Time Clock	3.00
Chequers	3.00
Othello	4.00
Game Pack I	5.00
Game Pack II	5.00
Game Pack III	5.00
Screen Monitor	4.00
Assembler Editor	14.90
10xC12 Blank Tapes	4.00

Z80 2.5Meg	7.95
Z80A 4Meg	9.95
6502	6.95
6800	6.50
8080	4.75
9900	25.95

SUPPORT CHIPS

Z80 CTC	5.95
Z80A CTC	6.95
Z80 P10	5.95
Z80A P10	6.95
6520	3.95
6522	6.85
6532	8.50
6821	4.25
6850	3.60
6852	4.35
8212	1.95
8216	1.95
9224	2.75
8228	
8251	4.95
8253	9.75
8255	4.50
TMS9901	13.16
TMS9902	11.18
TMS9904 (74LS362)	8.40

I.C. SOCKETS

	D.I.L.	W/W
8 pin	.09	.25
14 pin	.11	.35
16 pin	.12	.42
18 pin	.16	.50
20 pin	.20	.62
22 pin	.22	.65
24 pin	.24	.70
28 pin	.30	.80
36 pin	—	.99
40 pin	.40	1.10

MEMORY

D.RAMS	£ p
4027	2.75
4050 (350NS)	2.35
4060 (300NS)	2.39
4116	3.95
S.RAMS	
2102A	1.30
2102A2	1.69
2112A	2.75
2114/4045	2.75
4035	1.07
4044-5257	6.93
6810	3.50
BULK PURCHASE	
8x2114	14.00
8x4116	18.00
16x2114	26.00

EPROMs

2708	4.25
2716 (5v)	6.95
2532	29.95

ROM

2513 (UC)	5.95

BUFFERS

81LS95	1.25
81LS96	1.25
81LS97	1.25
81LS98	1.25
SN74365	.52
SN74366	.52
SN74367	.52
SN74368	.52
8T26	1.50
8T28	1.50
8T95	1.50
8T96	1.50
8T97	1.50
8T98	1.50

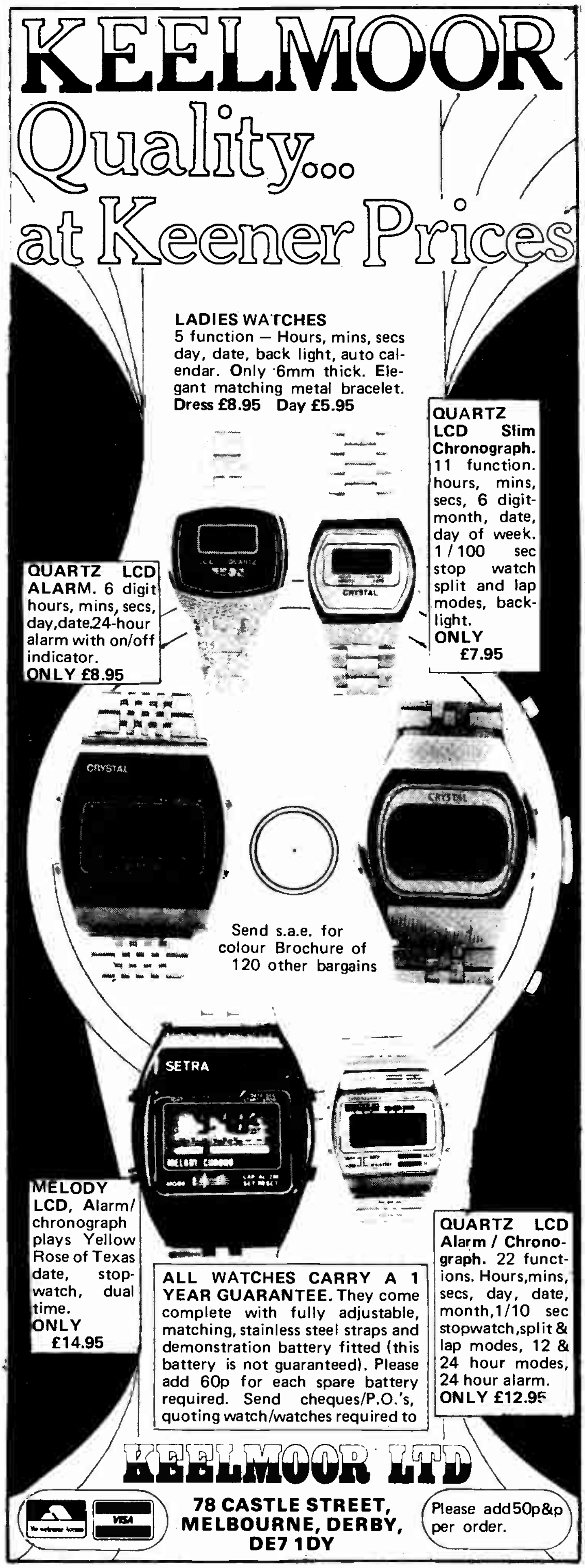
BAUD RATE GENS

MC14411	8.75
MM5307	8.75

UARTS

AY-5-1013	3.95
AY-3-1015	4.75
MM5303	4.75
TMS6011	3.55

SEND S.A.E. FOR COMPLETE PRICE LIST OR PHONE 01-263 9493



MUSICAL BOX

Built in an evening, this project can provide hours of fun for kids of all ages, and illustrates charge pump principles. Guaranteed to break the ice at parties (the box has sharp corners). Design and development by Ray Marston.

This neat little novelty project contains a variable-frequency master tone generator and a variable-rate gate oscillator, both activated by a single built-in mercury tilt switch. The output of the tone generator is fed directly to a miniature acoustic transducer (sound generator); the frequency of this generator slowly rises when the tilt switch is open or slowly falls when it is closed. The gate oscillator is used to pulse the master tone generator on and off. Its operating rate is proportional to the switching rate of the tilt switch; the rate decays slowly towards zero when the tilt switch takes up a stable state.

Thus, if the unit is gently tilted downwards, a rising tone is generated; tilt the unit upwards, and a falling tone is produced. Give the unit a gentle shake and the tone will be pulsed on and off at a slow rate. Shake the unit vigorously and the pulse rate will rise to a high value. In all cases, the tone can be increased or decreased by suitably tilting the unit. A whole range of sounds can be produced by shaking and/or tilting the unit.

The unit is housed in a pocket-sized 'flip-top' black case. The unit's on/off switch is mounted directly on the PCB, access to the switch being gained by flipping open the case top. The unit is powered by a single PP3 battery.

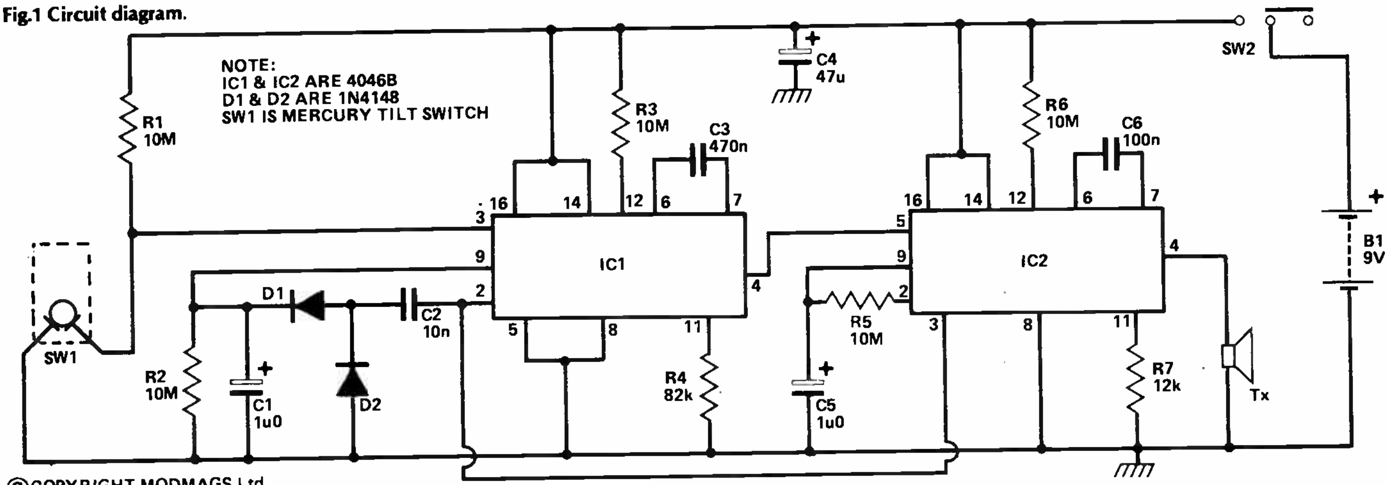
Construction

This is a very easy project to build, since all of the circuit's components (including the battery and the acoustic transducer) are mounted directly on a single PCB. The PCB is designed to fit into the Verobox mentioned in the list of components.

When building the unit, note that the two CMOS ICs should be mounted in suitable sockets. Other points to note are that two bridging links are used on the board and that the mercury tilt switch is fixed by soldering it to Veropins (see photograph). On/off switch SW2 is a sub-miniature PCB-mounting type, soldered directly to the board. Don't solder the transducer leads yet.

When construction is complete, fix the acoustic transducer (Tx) to the underside of the PCB (below the large unetched copper area) with double-sided sticky pads. Now pass the transducer leads through the hole near the centre of the board and solder them in place. Fix the PP3 battery in place on the PCB, again using sticky pads. Now fix the completed PCB into the specified case, after first drilling a large hole in the case below the position of the acoustic transducer. Finally, switch the unit on, snap the lid shut, give it a shake, and sit back and enjoy the sounds.

Fig.1 Circuit diagram.



HOW IT WORKS

The circuit contains two wide-range voltage-controlled oscillators (VCOs), each built around a 4046B IC, together with a mercury tilt switch and some switch-conditioning circuitry. The two oscillators are basically similar, their frequencies being determined by the input voltage on pin 9 (of the 4046B ICs) and by the values of the capacitors/resistors connected to pins 6, 7, 11 and 12.

The 4046B ICs contain a variety of elements in addition to the VCOs. In our circuit, the most important of these is an EX-OR gate which, in our application, is wired as a simple pulse inverter with its input at pin 3 and its output at pin 2. We use these inverters as part of the switch-conditioning circuitry.

The mercury tilt switch is wired to the input of the built-in inverter (pin 3) of IC1: the output of this inverter (pin 2) is connected to the input of the inverter of IC2. If the tilt switch is opened, these two inverters cause the pin 2 voltage of IC2 to switch to a high value, so C5 starts to charge up via R5, thereby causing the VCO in IC2 to generate a rising tone signal in the acoustic transducer. When the tilt switch closes, pin 2 of IC2 switches low, causing C5 to discharge via R5 and so generating a falling tone.

The inverted switch output of IC1 (pin 2) is also fed to a charge pump circuit (designed around C2-D1-D2-C1-R2), which causes a small amount of charge to be fed to C1 each time that the tilt switch activates. This charge leaks away slowly via R2, so that the mean voltage of C1 is proportional to the rate at which the tilt switch is operated or shaken. The C1 voltage is used to control the VCO frequency of IC1, and the output (pin 4) of this IC is used to gate the VCO of IC2 on and off via pin 5.

Thus, the operating frequency of IC2 is controlled by tilting the mercury tilt switch and the pulse rate is controlled by shaking the switch.

PARTS LIST

Resistors (all ¼ W 5%)

R1,2,3,5,6	10M
R4	82k
R7	12k

Capacitors

C1,5	1u0, 16 V electrolytic (PCB-mounting)
C2	10n polyester
C3	470n polyester
C4	47u, 16 V electrolytic (PCB-mounting)
C6	100n polyester

Semiconductors

IC1,2	4046B
D1,2	1N4148

Miscellaneous

SW1	mercury tilt switch
SW2	sub-miniature PCB-mounting slide switch
Tx	PB-2720 transducer

Verocase, order no. 202-21317

BUYLINES

The only unusual components here are the mercury tilt switch and the acoustic transducer. The transducer is available from Ambit International.

The tilt switch used in our prototype is available, to order, from Watford Electronics.

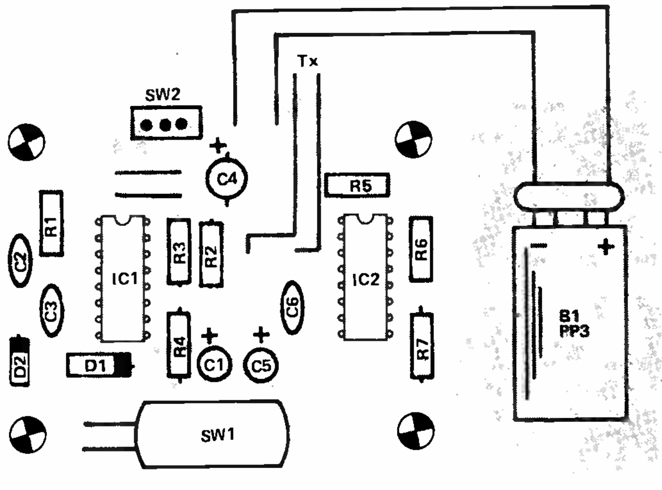
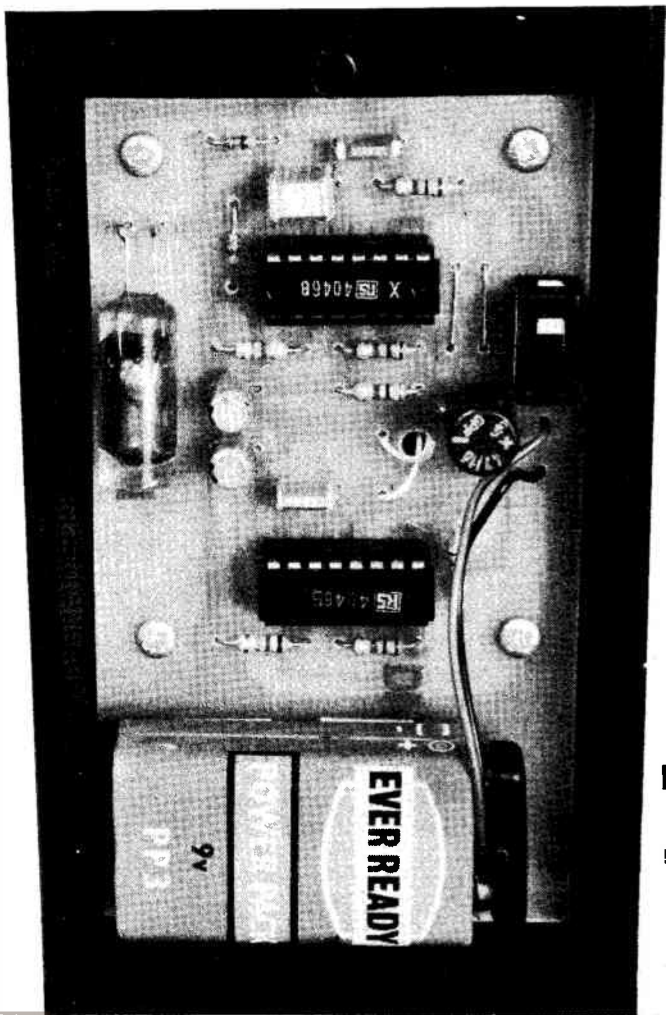


Fig.2 Component overlay for the Musical Box.



Unique in concept - the home computer that grows as you do!

-The Acorn Atom

NEW! Colour Encoder for full colour graphics **£21.50**

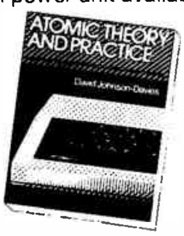
£120 plus VAT and p&p. An outstanding personal computer kit

Also available ready-built **£150** plus VAT and p&p

The ATOM – a definitive personal computer. Simple-to-build, simple-to-operate. But a really powerful full-facility computer. And designed on an expandable basis. You can buy a superb expanded package now – tailored to your needs. Or, you can buy just the standard Atom kit, and, as you grow in confidence and knowledge, add more chips. No need to replace your equipment. No need to worry that your investment will be overtaken by new technology. As you need more power, more facilities, you can add them!

*The picture shown demonstrates mixed graphics and characters in three shades of grey provided by the Standard Atom.

The standard ATOM kit includes:
● Full sized QWERTY keyboard ● Rugged polystyrene case ● Fibreglass PCB ● 2K RAM ● 8K ROM ● 23 integrated circuits ● Full assembly instructions including tests for fault-finding. (Once built, connect it to any domestic TV and power source) ● Power requirement: 8V at 800 M A. ATOM power unit available. See coupon. PLUS FREE MANUAL written in two sections – teach yourself BASIC and machine code for those with no knowledge of computers, and a reference section giving a complete description of the ATOM's facilities. All sections are fully illustrated with example programs.



The ATOM concept
Adding chips into sockets on the PCB allows you to progress in affordable steps to large-scale expansion. You can see from the specifications that the RAM can be increased to 12K allowing high resolution (256 x 192) graphics. Two further ROM chips, e.g. maths functions, can be added directly to the board giving a 16K capacity. In addition to 5 I/O lines partly used by the cassette interface, an optional VIA device can provide varied I/O and timer functions and via a buffer device allow direct printer drive. An optional module provides red, green and blue signals for colour. An in-board connector strip takes the ATOM communications loop interface. Any number of ATOMs may be linked to each other – or to a master system with mass storage/hard copy facility. Interface with other ACORN cards is simplicity itself. Any one ACORN card may be fitted internally.

So you can see there are a vast number of modular options and additions available, expanding with your ability and your budget.

The ATOM hardware includes:
● Memory from 2K to 12K RAM on board (up to 35K in case) ● 8K to 16K ROM (two 4K additions) ● 6502 processor ● Video Display allows high resolution (256 x 192) graphics and red, green and blue output ● Cassette Interface – CUTS 300 baud ● Loudspeaker allows tone generation of any frequency ● Channel 36 UHF Modulator Output ● Bus output includes internal connections for Acorn Eurocard.

The ATOM software includes:
● 32-bit arithmetic (±2,000,000,000) ● High speed execution ● 43 standard/extended BASIC commands ● Variable length strings (up to 256 characters) ● String manipulation functions ● 27 32-bit integer variables ● 27 additional arrays ● random number function ● PUT and GET byte ● WAIT command for timing ● DO-UNTIL construction ● Logical operators (AND, OR, EX-OR) ● LINK to machine-code routines ● PLOT DRAW and MOVE.

ACORN COMPUTER 4a Market Hill, CAMBRIDGE CB2 3NJ

Your ACORN ATOM may qualify as a business expense. To order complete the coupon below and post to Acorn Computer for delivery within 28 days. Return as received within 14 days for full money refund if not completely satisfied. **All components are guaranteed with full service/repair facility available.**

Quantity	Item	Item price inc. VAT+p&p	TOTALS
	ATOM KIT – 8K ROM + 2K RAM (MIN)	@ £140.00	
	ATOM ASSEMBLED – 8K ROM + 2K RAM (MIN)	@ £174.50	
	ATOM KIT – 12K ROM + 12K RAM (MAX)	@ £255.00	
	ATOM ASSEMBLED – 12K ROM + 12K RAM (MAX)	@ £289.50	
	1K RAM SETS	@ £11.22	
	4K FLOATING POINT ROM (inc. in 12K Version)	@ £23.30	
	PRINTER DRIVE 6522 VIA	@ £10.35	
	(inc. in 12K version) LS244 Buffer	@ £3.17	
	COLOUR ENCODER	@ £21.50	
	MAINS POWER SUPPLY (1.3 amps)	@ £10.20	
		TOTAL	

To: Acorn Computer Ltd., 4a Market Hill, CAMBRIDGE CB2 3NJ

I enclose cheque/postal order for £

Please debit my Access/Barclaycard No.

Signature

Name (Please print)

Address

Telephone No.

Registered No: 1403810. VAT No: 215 400 220

ETI 4/81

MICROBASICS

Having dealt with the hardware, Microbasics now takes a look at its use. Programmers aren't born, they're.... programmed? A.P. Stephenson explains how.

Programming entails far more than the mechanical mastery of the BASIC language. However cunning you are with the IF/THENs, however nifty with the FOR loops, however subtle with ON GOTOs and however flashy your attack on the keyboard, you can remain in a time-wasting rut unless all this brilliance is tempered with self-discipline.

The media in general and the American TV slush programs in particular would have us believe that programmers have an IQ of three figures and walk about with glazed eyes and swollen brains. This is absolute codswallop. The primary attribute required of a programmer is patience. The secondary attribute is a strong sense of method.

A programmer must also have compassion. Consideration for the poor wretch who must use the program afterwards is not always taken as seriously as it should be. Rather paradoxically, this compassion should also be directed inward. A month or so can elapse between the start and finishing date of even moderately sized programs, at the end of which the details of the structure seem to be indelibly printed in the mind... a dangerous and often entirely false assumption. A year after writing it, scrutiny of the listing may fail not only in recalling to mind how the thing works but in many cases may not even be recognised as one's own work! Superficially, this would appear to be unimportant. It worked when I wrote it so why the hell does it matter if I can't understand it now? This is a comforting philosophy if the program was perfect, complete, covered all possible variations and was immune to constructive criticism. The probability of this is about as remote as finding a farmer who confesses to making a profit. In truth, any program will eventually reveal annoying deficiencies or omissions with the result that modifications are reluctantly forced upon the original masterpiece. It is at this time that the programmer may wish a little more care had been taken in the original version. A few more REMarks, perhaps, or a few less purposeless GOTOs all over the place... in short, a little more compassion.

A programmer must also be willing to learn from others. To put it more bluntly, you must not be afraid to cheat a little by indulging in controlled plagiarism. Programs in magazines should be studied for novel twists, clever little short cuts or elegant new solutions to old problems. Most 'inventions' are ninety-nine percent other peoples' ideas, plus perhaps a few additions or rearrangements. The same applies to programs.

For example, the well known trick used in the PRESS ANY KEY TO CONTINUE situation:

```
200 GET K$ : IF K$ = "" THEN 200
```

must have been invented by somebody and yet we all use it at times. But this is obvious you might say. So is the safety pin *now*, but the 'inventor' is alleged to have made a fortune. There is of course a respectable middle of the road approach between blatent stealing of an entire program (perhaps with a few pathetic attempts at disguise by changing the names of a few variables) and complete avoidance of all previous ideas.

A programmer should be familiar with the programming language. This should be self-evident but surprisingly is not always the case. It is easy to become hooked on a small subset of the language and neglect some of the keywords because they are difficult to understand. The string handling keywords LEFT$, RIGHT$, MID$ AND STR$ are particularly neglected in BASIC and even subscripted variables are sometimes shunned. Before embarking on any ambitious project, any weaknesses in this area should be patched up by re-reading the manual and practising at the keyboard. Learning to program is like learning to play the piano. You practice difficult exercises even if they sound boring.

Last but certainly not least, a programmer must be dedicated. Once a program has been started, whatever difficulties arise, it must be finished. Shelving a program because it becomes difficult is disgraceful, pretending it was due to the usual 'lack of time' is worse. Unfortunately, it takes some time before you acquire an instinct for assessing the 'complexity potential' of a given programming project. However dedicated, it is no good carrying on if the project turns out to be beyond your capabilities. There is a balanced midway approach between dedication and pigheadedness which can only come with experience.

Before Sitting At The Keyboard

Serious works on programming have traditionally sneered at the thought of 'writing' a program at the keyboard. The correct approach, we are told, is to first draw the flowchart and then the coding on paper... only then should we sit at the keyboard. Whilst agreeing with the general principle, it is a little hard to stick rigidly to such idealistic advice. In the days when the main (or usually the only) peripheral was the printer and the keyboard was operated under time-sharing disciplines it was too expensive on paper and computer time to monopolise the keyboard for trial-and-error programming techniques. In the modern era of the personal computer the situation is easier and the advice can be taken less literally. However, it is advisable to scribble out a rough flowchart outlining the strategy to be employed before the bout of keyboard bashing.

Regarding flowcharts in general, there appears to be a growing doubt as to their usefulness in some quarters. It has even been suggested that most programmers write the program *first* and the flowchart *afterwards* just to please the academic Establishment. In other words the flowchart is used to explain how the program *was* designed rather than as a prelude to the actual design. The structure of a flowchart is beginning to show basic changes. A new idea entirely is superseding the old scheme. Thus, the flow in the new flowchart is from left to right with progressively more detailed levels of 'explanation' beneath. If you are experienced, the first left — right level is sufficient without assistance from lower levels. An idea of the difference between the old and the new can be gained by examining Fig.1 and Fig.2.

Deeper levels of even greater detail can be shown if desired. This leads on to the idea of structured programming which is a set of rules and regulations which advanced programmers are now expected to use when they are part of a team. Anyone interested should buy a book on the subject if they want to get with it!

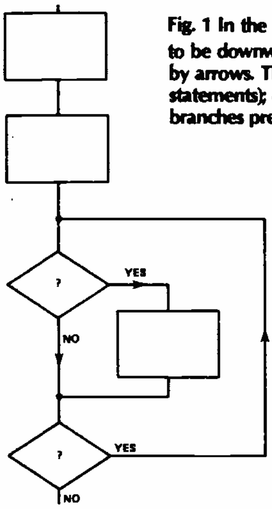


Fig. 1 In the traditional flowchart, data flow is assumed to be downwards or the right unless otherwise indicated by arrows. The diamonds are decision elements (IF/THEN statements); complex programs with many decision branches present a rather confusing appearance.

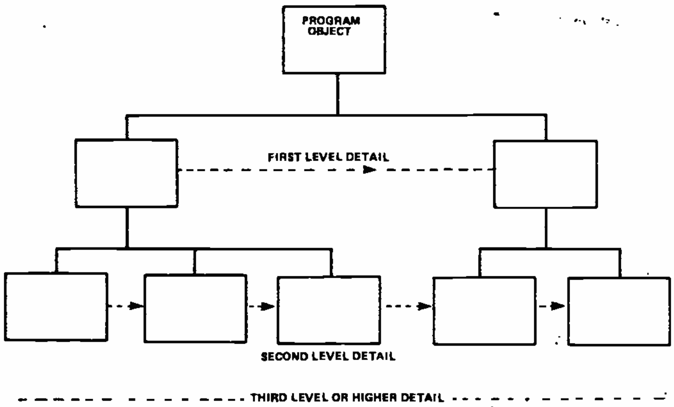


Fig. 2 In the modern flowchart, flow is only from left to right (the arrows shown are normally omitted). The different levels of detail simply 'explain' how the level above is programmed. If you are clever, the crude first level is sufficient to understand the program structure; the second level merely explains more fully how the first level works.

Back to earth again. Get hold of a folder, preferably a loose leaf ring binder, and collect vital pieces of information such as POKE numbers and codes, hex to decimal conversion tables, an abridged BASIC keyword list, the memory map (and in particular, the screen memory map), cuttings from magazine articles etc. etc. But watch the Parkinson syndrome. The binder can get fatter and fatter and particular information more and more difficult to locate as the collection grows. Be ruthless and periodically spit out the muck which, in this sense, means anything you now KNOW.

One final piece of advice... have some scrap paper and a pencil by the side of you. Once you get locked-on to a computer keyboard, it becomes an effort of will to get up and search for a pencil. Consequently you will try to memorise GOTO line numbers and almost certainly forget them once the listing scrolls back.

Starting At The Keyboard

Rule 1. Always have a blank (or rubbish) tape in the cassette, fully rewound, and another by the side. As soon as a reasonable segment of the program has been entered and roughly proved, get it onto tape and rewind it again. Then place the other tape in the cassette and continue with another segment and then tape it. The reason for this advice is based on the following possible hazards:

a. another member of the household or workshop, unacquainted with the volatile properties of RAM may suddenly decide to unplug the PET in order to use the iron!

b. the current segment you are working on has been the subject of an improvement... but a bug shows up and you get lost. Frantic efforts to remember the pre-modified version to get back to safety often fail miserably.

Under these conditions the advantage of a "fall-back" tape is obvious. By continually swopping the tapes as the program progresses, each one being a proven update of the last, much frustration can be avoided without the expensive assistance of the psychiatrist.

Rule 2. Risking the charge of advertising, PET owners should save up and get the PROGRAMMER'S TOOLKIT. This is without doubt the most useful aid to programming the PET you are ever likely to meet. Once you have used it, it appears to be indispensable. No more ragged line number sequences. No more endless searches to discover which variables have been used and which haven't. The ability to append subroutines to programs on tape is a joy to behold and operate. All this at seemingly lightening speed and idiot-proof in operation. (This should bring me a crate of whisky at Christmas).

One word of advice regarding the RENUMBERING facility. Avoid renumbering too many times during program development. This is not due to any technical reason but to the erasure of previously memorised GOTO line numbers. The TOOLKIT changes all the GOTO and THENs accordingly but it doesn't change your memory with it! As far as possible, renumber *after* the last bug has been hurled out of the system.

Developing The Program

There are no rules... just keep pegging away until you have 'finished'. To finish a program is perhaps the most elusive of all the arts. The elusive nature is seldom due to unexpected difficulties in the actual programming. It is a self-inflicted elusiveness resulting from, on the one hand a growing confidence, and on the other a dissatisfaction with the original terms of reference. The original moderate aim gathers momentum and the 'end' is pushed further and further away, the number of lines grow and grow, the number of variables increase, the facilities offered are increased until the bomb bursts with a polite but spine chilling message... "OUT OF MEMORY ERROR IN LINE 2.597E25".

The moral from all this can be summed up in one sentence: Decide the aim, stick to it, write it, debug it, test it, save it and switch off.

Testing The Program

After the crude bugs have been cleared and the programmer is satisfied with it, the real testing should now begin. It is necessary to enlist the aid of an independent guinea pig with no prior knowledge of computer keyboards. The luckless individual should be persuaded (or forced) to sit down and operate the program. Signs of consternation should be noted and the offending message from the screen should be earmarked for amendment. It is an astounding law of nature that if the message... "PRESS ANY KEY TO CONTINUE" meets the eye of certain guinea pigs, their diabolical little finger will jab at the STOP or the SHIFT LOCK keys; this in spite of there being about seventy other keys to assault. If you subsequently change this to PRESS SPACE BAR, the very size of the thing seems to make it transparent to the gaze and the eyes will be seen to oscillate wildly as they search for a key marked "SPACE BAR". The air usually becomes charged with emotion, sarcasm is freely interchanged between programmer and guinea pig, at times even escalating to full scale military activity. It is all very disappointing and sad for anyone trying to become a programmer. But don't let that discourage you. **ETI**

NOISE GENERATOR

Despite what the average audiophile will tell you, noise can be useful. This noise generator with sample and hold facility is the basic building block for Project 80 sound effects. Design and development by Charles Blakey.

Noise sources are essential for the synthesis of many sounds. These range from musical instruments, such as pipe organ and percussive devices, to natural sounds like wind, rain and surf, and to man-made sounds such as steam engines, explosions and gunfire. The 80-12 module provides white noise, which has the characteristic hissing sound, pink noise, which is deeper in intensity, and a low frequency noise (sometimes referred to as red noise). The low frequency noise may also be used as a random modulating source.

A sample and hold circuit, also incorporated, allows external sound sources to be sampled and converted into control voltages for, say operating a VCO. The sample and hold unit, therefore, provides a means by which the synthesiser can play itself.

Noisy Networks

In this design white noise is produced by reverse biasing an NPN transistor, since this method produces a wide bandwidth. The main problem with this technique is the low amplitude of the noise and often the need to try several transistors to attain the desired amplitude. This has been largely overcome by using a two stage amplifier, IC1a and IC1b, which allows the overall gain to be varied between about 100 to 5700 times. As an additional safeguard the transistor is mounted in a socket to facilitate trying other devices, should the amplitude prove insufficient. White noise is defined as having equal energy per cycle and pink noise equal energy per octave. To derive the latter requires the white noise to be filtered at — 3 dB/octave and, since filters usually have slopes of 6 dB/octave, a 3 dB type has to be approximated. Note that other variations in noise colouration may be obtained by filtering the white or pink noise with Project 80 filters 80-6 or 80-7. The low frequency noise is obtained by low pass filtering the pink noise using a 6 dB/octave filter with a cut-off frequency of about 16 Hz (constructed around IC1d). The white and pink noise outputs will be in the range 5-10 V p-p while the low frequency noise is 10 V p-p.

The sample and hold circuit uses the principle of gating a FET, Q2, on and off and storing the sampled voltage on C16, which is buffered by voltage follower IC5b. FET gating is achieved using a CA3140E, configured as a comparator such that a positive clock pulse will cause it to go high (about 13 V) and allow the signal through to be stored on C16. When the clock pulse is near zero, IC4 will swing to about -14 V and gate the FET off. If the signal being sampled is varying rapidly in amplitude, it is essential that the clock pulse be short otherwise the output will not be in discrete steps but will follow the variations in signal amplitude while the clock pulse is high.

The internal clock in the 80-12 uses a CMOS 555 timer whose sampling rate may be varied from about 1 cycle per 4.5 S to 25 Hz. The pulse width is adjustable and the output from the clock, buffered by IC3, is available for use as, say, a synchronising trigger on an ADSR. Provision is made for using an external clock and the pulse output from the 80-2 VCO or 80-3 VCLFO is suitable.

Achieving the desired results depends on the clock rate and the amplitude of the signal being sampled. The latter may be attenuated by RV2. Additionally, when using a VCO as the clock, the pulse width is another variable for special effects.

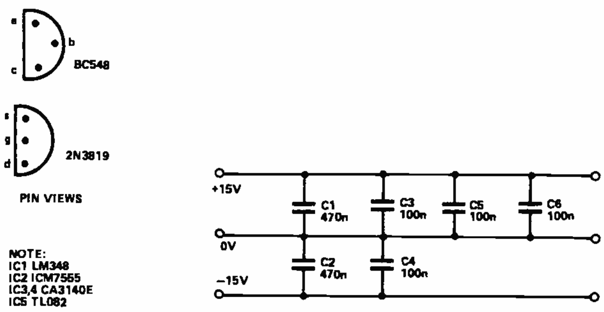
PROJECT 80 NEWSFLASH: Due to considerations of space and time, the final Project 80 module, a combined effects unit (containing an external Input Interface and Dual Ring Modulator), the system keyboard and the keyboard controller will now be available in a booklet at the end of February. To get your copy send a cheque or postal order for £2.95 (including postage and packing) to: ETI/Project 80, 145 Charing Cross Road, London WC2H 0EE.

Construction And Setting Up

Setting up the noise generator is simply achieved by adjusting PR1 to obtain the desired amplitude. This may be done in three ways: (a) using a DMM on the white noise output and adjusting PR1 until a reading of about 1V8 to 3V2 is obtained on the AC range; (b) using an oscilloscope and observing the white noise output while adjusting PR1 to obtain a peak to peak output of 5-10 V; or (c) connecting the output of the low frequency noise at R16 to a DC voltmeter and adjusting PR1 until occasional readings of about - 7 V are obtained when observed over a period of a few minutes. With most analogue meters the above readings will be approximately halved. With some transistors it may be possible to obtain the correct amplitude of the white and pink noise by increasing the gain with PR1, but the amplitude of the low frequency noise will be too high. In the latter circumstances the best approach is to try another NPN transistor rather than alter the value of R14.

Only one adjustment is required in the sample and hold section, namely, to adjust PR2 to obtain a short pulse output from the internal clock based on IC2. This adjustment should be made in the following sequence:-

a) Connect the low frequency noise output to the signal input of the sample and hold with RV2 fully clockwise. ➔



b) Connect the output of the sample and hold to a VCO with the coarse frequency control set to mid position and one of the waveforms connected to an amplifier.
c) Set RV1 (clock rate) to about 75% rotation which should give a sampling rate of about 2-3 Hz.
d) Turn PR2 fully anti-clockwise and switch power on.
e) After a few seconds delay slowly turn PR2 clockwise until the VCO output starts changing frequency in a step-wise manner.
f) Finally check that the VCO continues to change step-wise over the full range of the internal clock (RV1) and if necessary turn PR2 further clockwise until this is achieved.

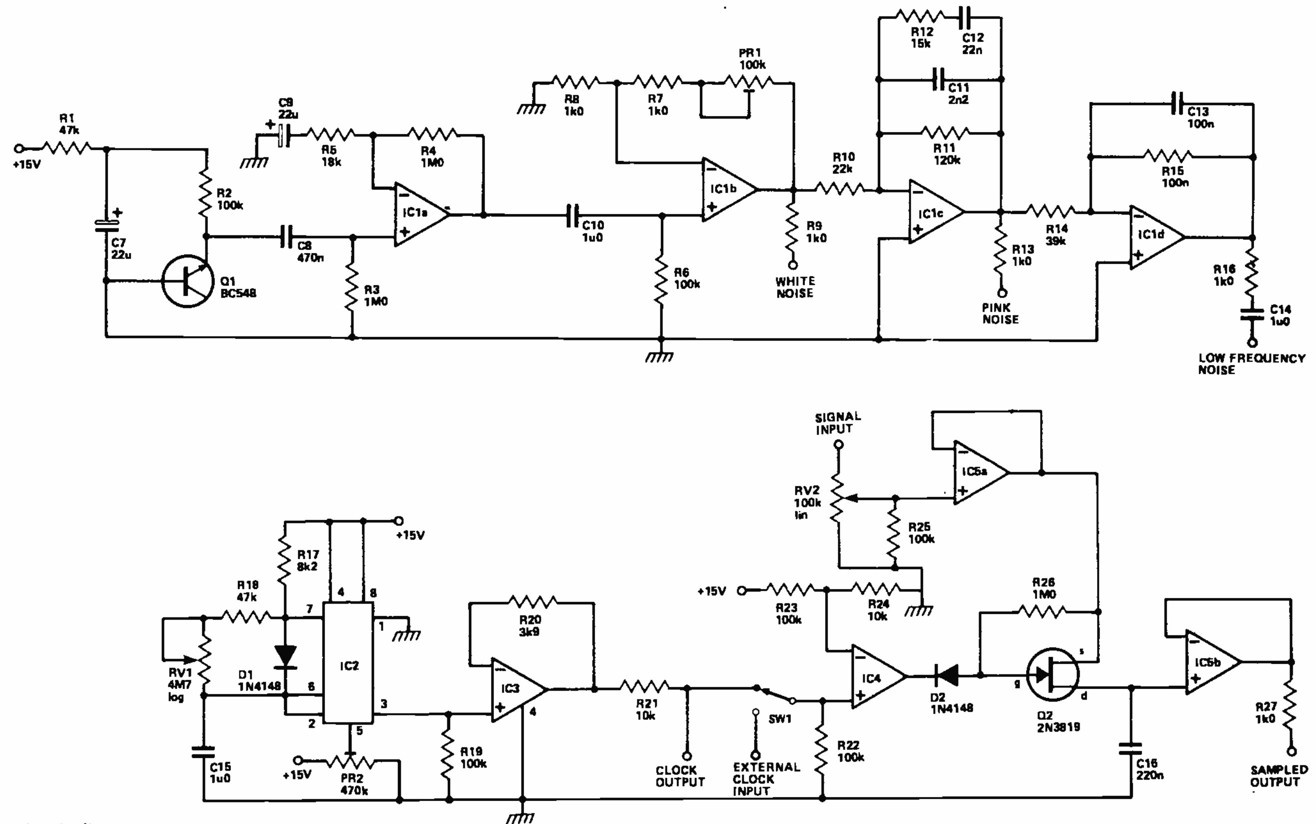


Fig.1 Circuit diagram.

HOW IT WORKS

Reverse biasing the NPN transistor, Q1, will generate noise at its base-emitter junction. The few millivolts of noise at the output of Q1 has to be amplified to the levels required for the synthesiser and this is achieved with two AC coupled non-inverting amplifiers configured around IC1a and IC1b. The gain of IC1a is fixed at about 56 while the gain of the IC1b amplifier may be adjusted from 2 to 102 by means of PR1. The overall gain of the amplifier section may, therefore, be varied from 113 to 5760 times. The amplified white noise is available via R9.

To obtain pink noise it is necessary to filter the white noise by -3 dB/octave and a close approximation over the audio range is obtained with the active filter built around IC1c. R11 and C11 form a first order low pass filter with a cut off frequency of 663 Hz, while R12 and C12 are an augmenting integrator which has an output proportional to the input signal added to an output proportional to the time integral of the input signal. The frequency response of the latter is relatively flat above about 1 kHz and below this frequency the incoming signal is attenuated at a rate of 6 dB/octave. The combination of R11/C11 with R12/C12 achieves the -3 dB/octave response and the pink noise output is available at R13. The low frequency noise is obtained by using a first order low pass filter with a cut off frequency of about 16 Hz and this is obtained with IC1d, R15 and C13 with the output being available via R16 and C14.

In the sample and hold network a signal is applied to the source of FET, Q2, via IC5a configured as a voltage follower and whose signal input may be attenuated by RV2. When Q2's gate is positive, the signal passes through and the voltage present at the signal input will change the voltage on C16 accordingly. If Q2 is gated off the last voltage on C16 is held, since leakage is kept low by buffering it with a voltage follower based on IC5b. By sampling the input for only very short durations, the voltage on C16, available at R27, will be a series of discrete steps which may in turn be used to control voltage controlled modules. The negative to positive voltage transition for gating Q2 on for sampling is obtained with IC4 configured as a comparator. With a near zero voltage at the non-inverting input of IC4 its output will be close to the negative rail voltage of -15 V and Q2 will be off. When a positive pulse is applied to the non-inverting input then IC4 goes positive (about + 13 V) and turns on Q2 so that a sample of the signal voltage can be taken and stored on C16. The internal clock used to turn Q2 on and off via IC4 is based on CMOS 555 timer, IC2. The pin configuration and operational features are the same as a bipolar 555 but the CMOS version has advantages in terms of power consumption and absence of crowbarring the power supply during the output transition. A conventional astable configuration is used and, while D1 allows a wide range of duty cycle, the main adjustment for the latter is the application of a positive voltage to its control voltage input, pin 5, via PR2. The output of the timer is buffered by IC3 so that it may be used for external synchronisation purposes. The output also goes via an SPDT switch, SW1, to comparator IC4. The switch allows external clock sources to be used.

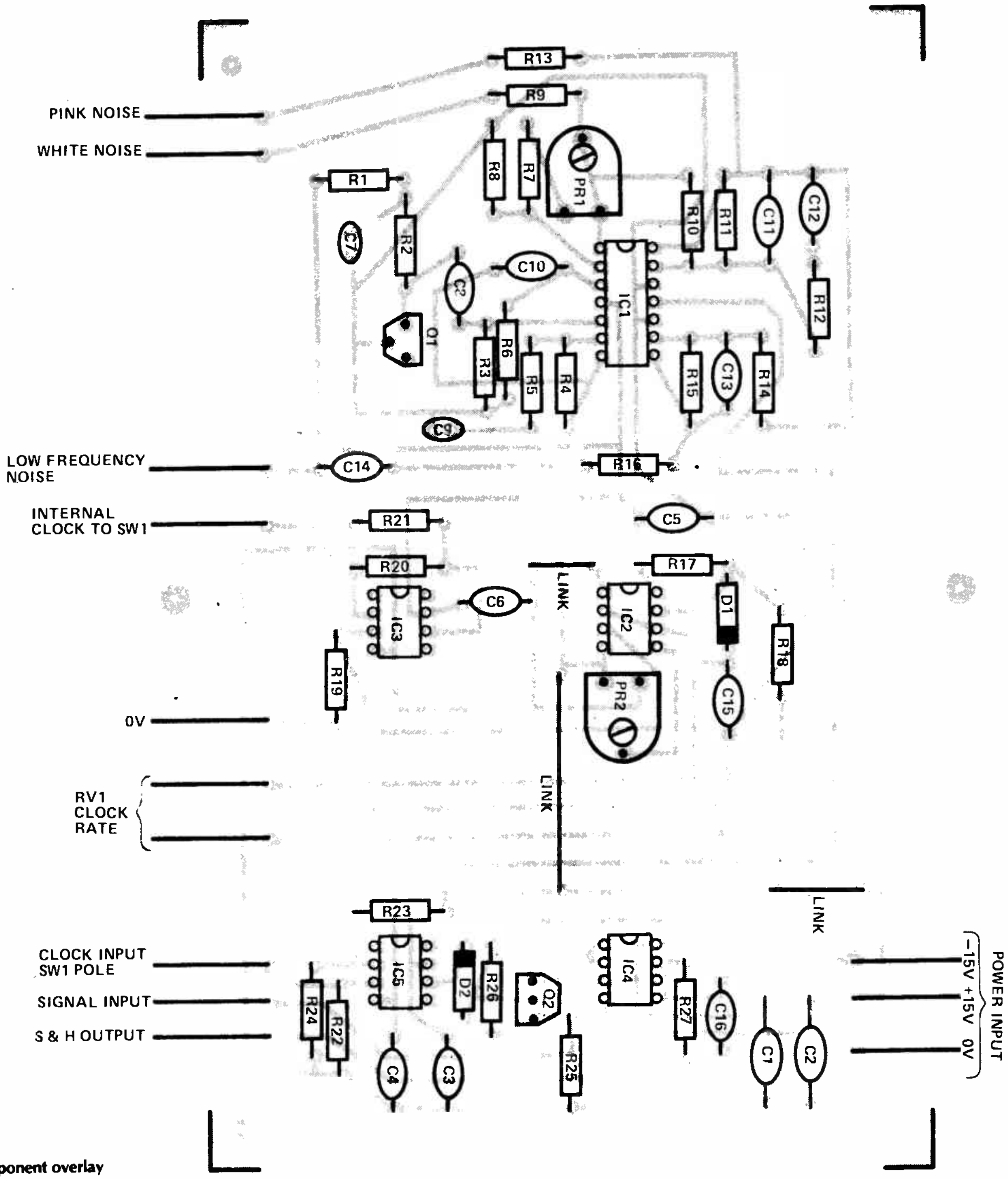
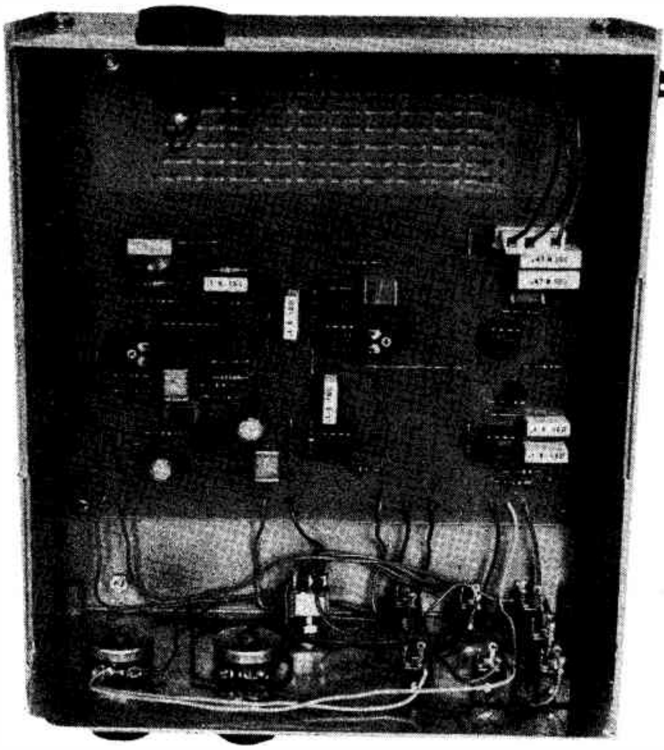
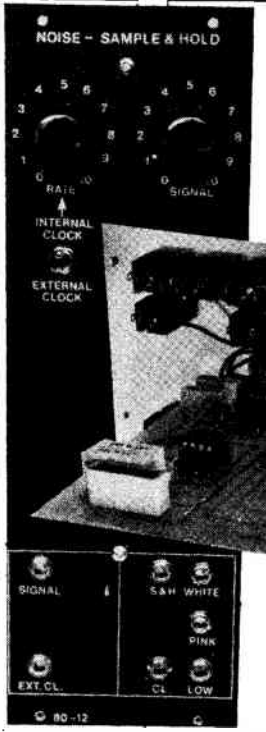


Fig.2 Component overlay

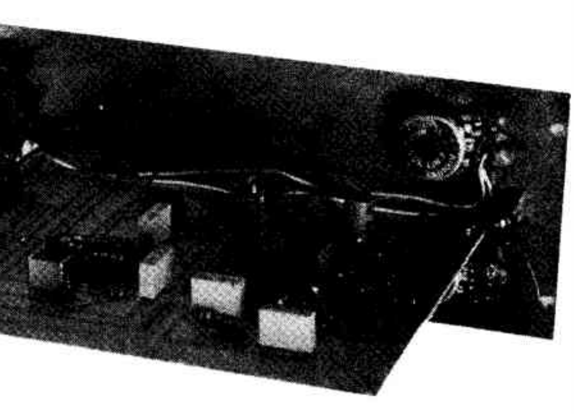
PARTS LIST

Resistors ¼ W 5% carbon		**Capacitors**		PR1	100k carbon
R1,18	47k	C1,2	470n polyester	PR2	470k carbon
R2,6,15,19,22,23,25	100k	C3,4,5,6,13	100n polyester	**Semiconductors**	
R3,4,26	1M0	C7,9	22u 25V PCB electolytic	IC1	LM348N
R5	18k	C8	470n MKH polyester	IC2	ICM7555 IPA
R7,8,9,13,16,27	1k0	C10,14,15	1u0 MKH polyester	IC3,4	CA3140E
R10	22k	C11	2n2 polystyrene	IC5	TL082 CP
R11	120k	C12	22n polycarbonate	D1, 2	1N4148
R12	15k	C16	220n MKH polyester	Q1	BC548
R14	39k			Q2	2N3819
R17	8k2	**Potentiometers/Trimmers**		**Miscellaneous**	
R20	3k9	RV1	4M7 linear	SW1	5PDT miniature toggle
R21,24	10k	RV2	100k linear	Transistor holder	





Each Project 80 module can be housed in a West Hyde Developments' Teko Alba A23G case (far left) or on a front panel only (left).



All the modules can be mounted on front panels (above) and cased together in one cabinet.

BUYLINES

The 80-12 Noise Generator — Sample & Hold module is available as a kit with PCB and all listed components for £13.17, inclusive of postage and VAT, from Digisound Limited, 13 The Brooklands, Wrea Green, Preston, Lancs. PR4 2NQ.

ETI

COMPUTER WAREHOUSE

NOW OPEN MONDAY-SATURDAY 9.30-5.30

In stock now test equipment, microprocessors, teletypes, transformers, power supplies, scopes, sig. gen's, motors, peripheral equipment, I.C.'s, tools, components, variacs, keyboards, transistors, microswitches, V.D.U's sub-assemblies + thousands of other stock lines. Just a mere fraction of our vast range, is displayed below. 100's of bargains for callers.

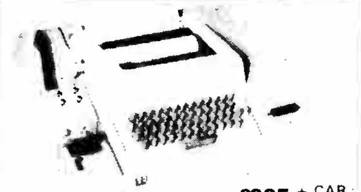
RAM AND EPROM NEW LOW VAT INCLUSIVE PRICES

2716	5v Rail	£9-50
2716	3 Rail	£8-50
2708	450 NS	£4-50
2708	Ex Equip	£2-25

4116	200 NS 16KX1 DYN.	8 for £19-95
2114L-3	300 NS 1KX4 ST.	8 for £22-50
2102L-3	650 NS 1KX1 ST.	8 for £ 5-50
TMS4030JL	300 NS 4KX1 DYN	8 for £ 9-95

All devices full spec. and guaranteed. Bulk enquiries welcome.

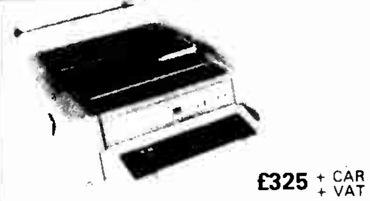
TELETYPE ASR33 I/O TERMINALS



£235 + CAR + VAT

Fully fledged industry standard ASR33 data terminal. Many features including: ASCII keyboard and printer for data I/O, auto data detect circuitry, RS232 serial interface, 110 baud, 8 bit paper tape punch and reader for off line data preparation and ridiculously cheap and reliable data storage. Supplied in good condition and in working order. Options: Floor stand £12.50 + VAT Sound proof enclosure £25.00 + VAT

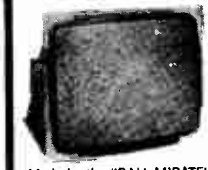
ICL TERMIPRINTER 300 BAUD TERMINALS



£325 + CAR + VAT

Made under licence from the world famous GE Co. The ICL Termiprinter is a small attractive unit with so many features it is impossible to list them in the space available! Brief spec. as follows; RS232 serial interface, switchable baud rates 110, 150, 300, (30 cps), upper and lower case correspondence type face, standard paper, almost silent running, form feed, electronic tab settings, suited for word processor applications plus many more features. Supplied in good condition and in working order. Limited quantity.

SCOOP PURCHASE 12" VIDEO MONITORS



CONNECT DIRECT TO YOUR MICRO

Made by the "BALL MIRATEL" CORPORATION USA the CD12 is a self contained, mains powered chassis professional monitor. All controls are inbuilt on a single PCB with exception of the brightness control which can be brought out for external use. Many features such as composite video, quoted bandwidth of 19 Mhz, superb linearity and definition make this a must for any MICRO/CCTV application.
Brand new and boxed only + carriage £7.50 + VAT. **£97.50 + VAT**
Input harness, brightness pot and connector £2.50 + VAT. Dimensions 9"H × 11"D × 11½"W

HURRY WHILE STOCKS LAST

EX STOCK SOFTY

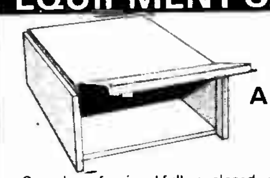
EPROM BLOWER

Software development system invaluable tool for designers, hobbyists, etc. Enables open heart surgery on 2716, 2708 etc. Blows, copies, reads EPROMS or emulates EPROM/ROM/RAM in situ whilst displaying contents on domestic TV receiver. Many other features. **£115 + carr. + VAT.** Optional 2716, 2716 Function Card **£40 + VAT.** PSU **£20 + £1.50 carr. + VAT.**
Write or phone for more details.

3K × 8 STATIC RAM CARDS

BRAND NEW PCB organised as a 3K × 8 page memory with 24 socketed 2102-L 650ns Rams, 4 Eprom Sockets and 16 TTL Chips for decoding. All IC's guaranteed.
Complete with circuit only **£24.50** + £1.75 P.P.
Dimensions 264 × 195mm.
0.1" connector

EQUIPMENT CASES



GIVE YOUR M.P.U. A HOME ONLY £9.95 + 1.85 pp

Superb professional fully enclosed, made for the G.P.O. to the highest standard, offered at a fraction of their original cost they feature aluminium sides, hinged removable front panel, which can be secured by 2 screws to prevent prying fingers. All are finished in two tone G.P.O. grey and although believed brand new may have minor scuff marks/scratches due to bad storage. Dimensions 16"D × 6½"H × 14¾"W

NATIONAL MA1012 LED CLOCK MODULE

★ **12 HOUR**
★ **ALARM**
★ **50/60 HZ**

The same module as used in most ALARM/CLOCK radios today, the only difference is our price! All electronics are mounted on a PCB measuring only 3" × 1½" and by addition of a few switches and 5/16 volts AC you have a multi function alarm clock at a fraction of cost. Other features include snooze timer, am pm, alarm set, power fail indicator, flashing seconds cursor, modulated alarm output etc. Supplied brand new with full data only **£5.25**
Suitable transformer £1.75.

SEMICONDUCTOR 'GRAB BAGS'

Amazing value mixed semiconductors, include transistors, digital, linear I.C.'s, triacs, diodes, bridge recs. etc. etc. All devices guaranteed brand new, full spec. with manufacturers markings, fully guaranteed.
50 + BAG £2.95 100 + BAGS £5.15

MUFFIN FANS

Keep your equipment Cool and Reliable with our tested ex-equipment "Muffin Fans" almost silent running and easily mounted. Available in two voltages. **110 V.A.C. £5.05 + pp 90p OR 240v A.C. £6.15 + pp 90p DIMENSIONS 4½" × 4½" × 1½".**

ELECTRONIC COMPONENTS & EQUIPMENT 66% DISCOUNT

Due to our massive bulk purchasing programme which enables us to bring you the best possible bargains, we have thousands of I.C.'s, Transistors, Relays, Cap's., P.C.B.'s, Sub-assemblies, Switches, etc. etc. surplus to our requirements. Because we don't have sufficient stocks of any one item to include in our ads., we are packing all these items into the **"BARGAIN PARCEL OF A LIFETIME"** Thousands of components at giveaway prices! Guaranteed to be worth at least *3 times* what you pay plus we always include something from our ads. for unbeatable value!! Sold by weight

2.5kls £ 4.75 + pp £1.25 5kls £ 6.75 + pp £1.80
10kls £11.75 + pp £2.25 20kls £19.99 + pp £4.75

OP PRESS – STOP PRESS – STOP PRESS – ST

STEP INTO THE 80's EX STOCK

WITH TOMORROW'S WORLD TECHNOLOGY TODAY

The "TANTEL" Post Office approved

PRESTEL – VIEWDATA ADAPTOR

At last this amazing piece of micro technology is available at a price you can afford. Just connect to the aerial socket of any colour or black and white domestic TV receiver and to your Post Office installed jack socket and you are into the exciting world of **PRESTEL**. Via simple push button use you are able to view a staggering 170,000 pages of up to the minute information on many services and utilities, order goods from companies, even play games!! All this and more without ever leaving your armchair!

ONLY £170 + £1.75 carr + VAT **Send £197.50p**

Note: When ordering please give the address and telephone number where the Tantel adaptor is to be used, we will arrange all details with the Post Office for installation of the jack socket (normally within 7 days).

WE'VE BOUGHT ANOTHER SHIPMENT! SAVE OVER £1300!! DZM 180 CPS HIGH SPEED MATRIX PRINTERS

NOW ONLY £499 + Carr + VAT

This must be one of our greatest bulk deals, this fabulous printer is listed at over £1800 and judging by the construction we are not surprised. Made under license from the LOGABAX Co. the DMZ180 is an exceptionally sturdy high speed 180 cps matrix printer, capable of printing up to 132 characters per line on standard "Fan Fold" sprocket fed paper. A precision 7 × 7 matrix head using ruby bearings, gives a clear concise type font. Many other features include internal buffer for high throughput, standard ink ribbon, software controllable form and tab functions, standard "CENTRONICS" ASCII parallel interface etc. etc.
Optional extras **Floor Stand £30.00 + VAT, Paper Stand £18.00 + VAT**

DIABLO S30 2.5MB HARD DISK DRIVES

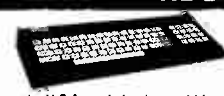
Limited quantity of these ultra high speed access hard disk drives type Diablo 30. They accept interchangeable 200 TPI disk packs and require only a + and −15v DC supply. Fully DEC RK05 compatible, supplied second hand and in excellent condition.
Only £425 + carr + VAT
Dimensions H × 17½"W × 22½"D

"THE MULTIVOLT PSU"

The PSU to end *all* your MPU/LAB requirements made by "Weir" Electronics at over £200.00. The supply features full regulation, current limit, and overvoltage protection on all 7 outputs, just look at the spec.
+5v @ 12 amps, +5v @ 4.5 amps, +5v @ 4 amps, +30v @ 2 amps, +12v @ 2.5 amps, −12v @ 2.5 amps and −9v @ 1 amp.
A superb unit supplied in two grades, complete with data.

Brand New, Fully Tested	£59.99
Used and Untested	£39.99
Carriage and Insurance	£7.50

RCA FULLY CASED ASCII CODED KEYBOARDS



Straight from the U.S.A. made by the world famous R.C.A. Co., the VP600 Series of cased freestanding keyboards meet all requirements of the most exacting user, right down to the price! Utilising the latest in switch technology. Guaranteed in excess of 5 million operations. The keyboard has a host of other features including full **ASCII** 128 character set, user definable keys, upper/lower case, rollover protection, single 5V rail, keyboard impervious to liquids and dust, TTL or CMOS outputs, even an on-board tone generator for keypress feedback, and a 1 year full R.C.A. backed guarantee.

VP601 7 bit fully coded output with delayed strobe, etc.	£43.95
VP611 Same as VP601 with numeric pad.	£54.95
VP606 Serial, RS232, 20MA and TTL output, with 6 selectable Baud Rates.	£60.95
VP616 Same as VP606, with numeric pad,	£72.50
Post, Packing and Insurance.	£1.95

ORDER NOW OR SEND FOR DETAILS.

5v D.C. POWER SUPPLIES

Following the recent "SELL OUT" demand for our 5v 3 amp P.S.U. we have managed to secure a large quantity of ex-computer systems P.S.U.'s with the following spec.; 240 or 110v A.C. input. Outputs of 5v @ 3-4 amps, 7.2v @ 3 amps and 6.5v @ 1 amp. The 5v and 7.2v outputs are fully regulated and adjustable with variable current limiting on the 5v supply. Unit is self contained on a P.C.B. measuring only 12" × 5" × 3". The 7.2v output is ideal for feeding "on board" regulators or a further 3 amp LM323K regulator to give an effective 5v @ 7 amp supply.
Supplied complete with circuit at only **£10.95 + £1.75pp.**
Believed working but untested, unguaranteed.

DISPLAY ELECTRONICS

Dept. E.T.I. 64-66 Melfort Rd., Thornton Heath, Croydon, Surrey. Tel: 01-689 7702 or 01-689 6800

MAIL ORDER INFORMATION

Unless otherwise stated all prices inclusive of V.A.T. Cash with order. Minimum order value £2.00. Prices and Postage quoted for UK only. Where post and packing not indicated please add 50p per order. Bona Fida account orders minimum £10.00. Export and trade enquiries welcome. Orders despatched same day where possible. Access and Barclaycard Visa welcome.

DESIGNER'S NOTEBOOK

Certain elementary safety precautions must be taken when handling CMOS ICs or designing CMOS circuits. Ray Marston explains all in this month's 'Notebook'.

Early CMOS ICs earned a reputation for being easily damaged by static electricity, either when being handled or when being soldered into circuit boards, etc. Subsequently, manufacturers tried to overcome this 'fragility' problem by providing the ICs with extensive built-in input and output protection on each gate in each package. These protection networks do a fairly satisfactory job, but provide the design engineer with a few extra problems when designing CMOS circuits. This month's Notebook takes an in-depth look at the subject.

CMOS Protection Networks

CMOS ICs are, by definition, Metal-Oxide Semiconductor devices, in which the input signal is applied to the near-infinite impedance (about 10^{12} ohms) of the metal-oxide gate. Typically, the gate oxide has a breakdown voltage of about 80 V: if a gate oxide break-down does occur, the resultant damage to the device is catastrophic and irreversible. To protect the CMOS against excessive input voltages (particularly arising from static energy), all modern CMOS ICs are provided with extensive built-in protection on all inputs and outputs.

Figure 1 shows the standard protection network that is used on the vast majority of B-series CMOS devices. Here, all diodes marked as 'D1' are used to prevent the input or output from swinging more than 600 mV below the V_{SS} (0 V) rail, and all diodes marked as 'D2' are used to prevent the input or output from swinging more than 600 mV above the V_{DD} (supply positive) rail. D3 is intended to prevent the V_{DD} terminal from swinging negative to the V_{SS} pin (electrostatically) when the device is being handled.

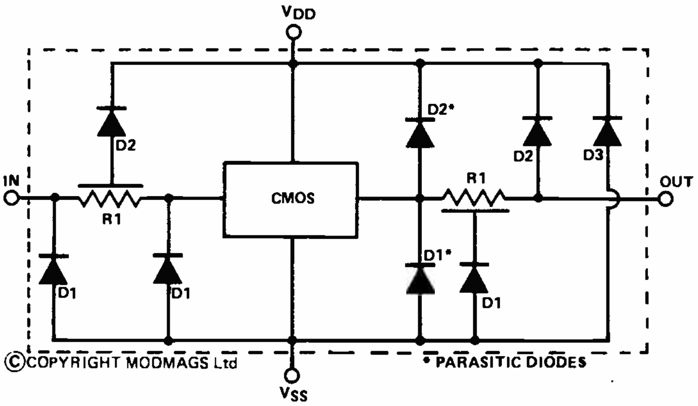


Fig. 1 These are the standard electrostatic-discharge protection networks used on most B-series CMOS ICs. The two diodes associated with the resistors are distributed across the entire resistance, as shown.

There are a couple of minor exceptions to the standard version of the protection network. One of these is the type used on the 4049B and 4050B series of hex buffer/converters which, as shown in Fig. 2, have their inputs free to swing well above the V_{DD} rail. These particular ICs are specifically intended for use in logic-level conversion applications, in which (for example) the input may come from a 12 V CMOS network but the output and the IC supply rail are matched to a 5 V TTL network.

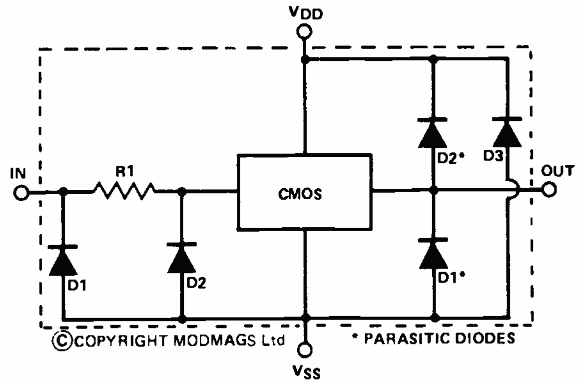


Fig. 2 This protection network is used on the 4049B and 4050B hex buffers. Note that the input is free to swing above the positive supply (V_{DD}) rail.

Another exception is the 4066B type of transmission gate or bilateral switch, and its equivalents. These devices comprise a bilateral electronic switch and a switch-control network. In these circuits, all switch-control networks have the type of input protection shown in Fig. 1, but the switches themselves have the simple protection network shown in Fig. 3.

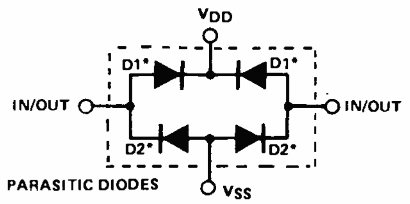


Fig. 3 The 4066B quad bilateral switch has standard B-series protection on its gate control input terminals, but has this simplified form of protection on its 'switch' elements.

Note in Figs. 1-3 that all diodes marked with asterisks are 'parasitic' devices, which just happen to occur fortuitously as an inherent part of the CMOS manufacturing process, while all other diodes are specifically designed into the circuits. Also note that the networks are intended only to give protection against 'normal' electrostatic discharge voltages. When the networks are subjected to ordinary DC signals, the diodes are liable to burn out if their forward currents exceed 10 mA or so, thereby causing possible catastrophic damage to the IC substrate.

Major CMOS manufacturers such as RCA reckon that an electrostatically charged human body can be approximated by the circuit of Fig. 4, in which the 'body' has an effective capacitance of 100pF and a source resistance of 560R. The manufacturers have carried out extensive tests with this model by charging the 'body' to various voltages and then discharging it (via the 560R series resistor) into different terminal combinations (input, output, V_{SS}, V_{DD}) of CMOS devices to establish worst-case capability figures for the three types of electrostatic-discharge protection networks. It should be noted in these tests that the 560R series resistor acts as a current-limiting voltage dropper, so the voltage actually reaching the CMOS device is far lower than the initial electrostatic voltage.

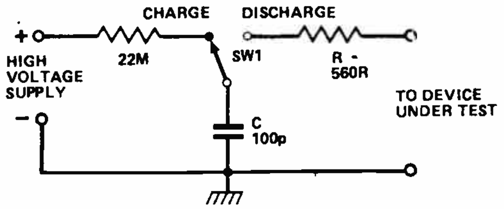


Fig. 4 Manufacturers use this equivalent-body discharge network when evaluating the capabilities of their CMOS protection networks.

The results of the manufacturer's protection capability tests are shown in Fig. 5. As you can see, the standard protection network can withstand a 4 kV electrostatic discharge. A quick calculation shows, however, that this represents a peak protection-diode current of several amps, yet we've already seen that these diodes can withstand DC currents of only 10 mA or so. Puzzled?

PROTECTION NETWORK	WORST – CASE CAPABILITY
STANDARD B–SERIES	4 kV
4049B AND 4050B	1 kV TO 2 kV
4066B BILATERAL SWITCH	< 800 V

Fig. 5 These are the worst-case capabilities of the three different CMOS protection networks, when tested with the network of Fig. 4.

Up The Junction

Just about the only way of destroying a diode is to literally vaporise its junction, and this can only be done by applying an adequate amount of power for sufficient time for the melting process to take place. Since a junction must inevitably be formed on a substrate, which has a finite mass, all junctions inevitably have a certain amount of thermal inertia and are, in fact, destroyed by energy overloads (power-time product), rather than by simple power overloads.

Consequently, it is quite normal to find that a diode rated at 1 A (for example) can, in fact, withstand brief current surges up to several hundred amps. Similarly, CMOS protection diodes, which have very low DC current ratings (10 mA), can withstand very high levels of surge current (several amps), provided that the surge current duration is very brief. Figure 6 shows the typical surge current capabilities of these protection diodes. Remembering that the 100p — 560R 'human body' equivalent circuit has a time constant of a mere 56 nS, it no longer comes as a surprise to note that these diodes can withstand several amps of peak current from a 4 kV discharge!

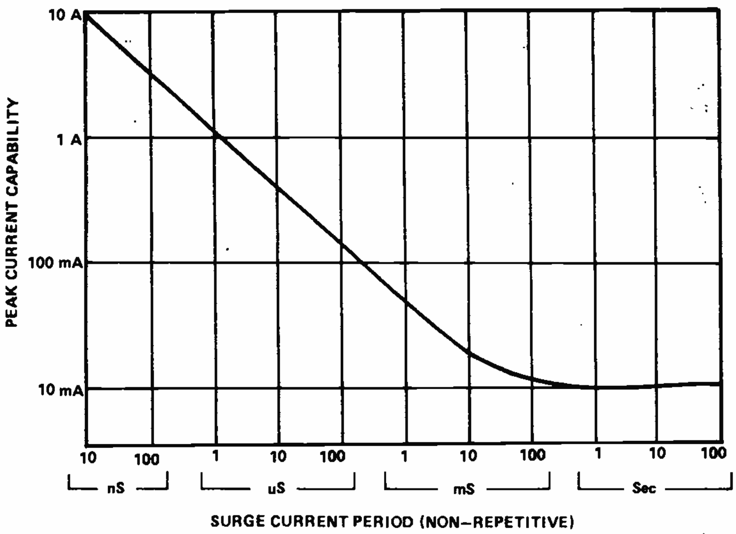


Fig. 6 Typical surge-current capabilities of CMOS protection diodes.

CMOS Circuit Design

By now you will have gathered that you can effectively destroy a CMOS device by simply blowing one or more of its 'protection' diodes with a DC current as low as 10 mA. Consequently, when designing CMOS circuits, precautions must be taken to ensure that excessive diode current cannot flow in the CMOS chips.

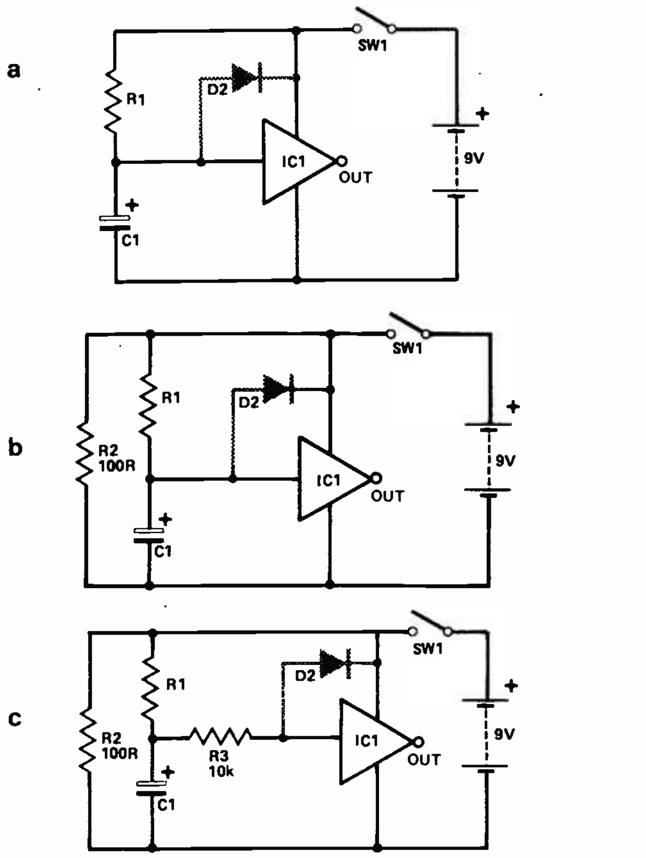


Fig. 7 Circuits (a) and (c) are safe, but circuit (b) will almost certainly cause a front-end 'blow'. See text for explanation.

CMOS ICs can be 'blown' by excessive signals applied to either the input or the output terminals. If several CMOS stages are cascaded, empirical experience shows that a front-end blow will usually destroy only a single device (because low energy levels are normally involved), but a rear-end (output) 'blow' will often have a ripple effect (because high energy levels are involved) and cause the destruction of all ICs in the chain.

The most common cause of front-end 'blow', and its cure, are illustrated in Fig. 7. Here, a capacitor is connected directly between the IC gate and the 0 V line: when SW1 is closed, the capacitor charges up via R1 and eventually attains the full positive supply potential. When SW1 is opened (to switch the circuit off), C1 tries to discharge via D2, the 'upper' input protection diode of the gate.

In the Fig. 7a circuit, the only discharge path for C1 is via D2 and the IC's supply terminals; consequently the discharge currents will be quite low and the IC will probably suffer no damage. In Fig. 7b, on the other hand, a 100R resistor is connected across the supply terminals, so C1 will try to discharge to ground via D2 and R2, and the resulting 90 mA peak current will almost certainly result in the destruction of the chip. In practice, R2 may well take the form of various resistors and semiconductor devices distributed throughout the total circuit.

Figure 7c shows the cure for the Fig. 7b design problem, a 10k resistor wired in series with the gate to limit the C1 discharge currents to a safe value. Whenever you design CMOS circuits and have to connect a capacitor between a gate and the 0 V rail, always make sure that the capacitor discharge current is limited to a safe value, either by a series gate resistor or by some other factor.

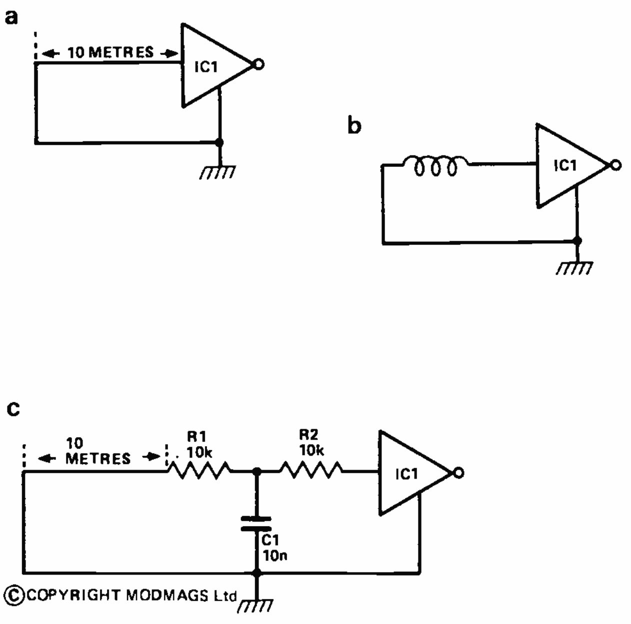


Fig. 8 Long input cables, as in (a), can be equivalent to an inductor (b), and present another front-end blowing hazard. The cure is simple (c).

Figure 8 illustrates another possible cause of front-end 'blowing', and its cure. In Fig. 8a, it seems that the IC's input is safely grounded by the 10 m of input cable (in practice, this cable may go to a low impedance sensor, etc), but in actual fact (Fig. 8b) this cable will inevitably be inductive and can easily pick up unwanted radiation and possibly feed destructive signals to the IC input. Figure 8c shows that the circuit can be rendered safe with a simple filter (R1-C1) and a series gate resistor (R2).

Back-end Blowing

The most common cause of back-end blowing is unexpected back-EMFs (from inductive loads) reaching the CMOS output by breaking through from power-driving circuitry.

Inductive loads, such as relays, can generate surprisingly large back EMFs as their fields collapse at switch-off, as can be proved by connecting a relay in the 'buzzer' mode shown in Fig. 9. Typically, a 12 V relay will generate a back-EMF of about 300 V! If you ever use CMOS to switch a relay or other highly inductive load using a transistor driver, always protect the transistor with a pair of 1N4001 diodes connected as shown in Fig. 10a. If you want to be really safe, you can use another pair of similarly-connected diodes to directly protect the output of the CMOS stage, as shown in Fig. 10b.

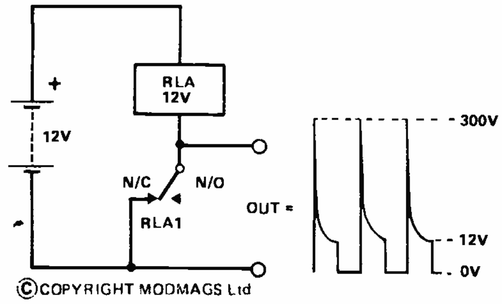


Fig. 9 This 'buzzer' circuit can be used to check the magnitude of the back-EMF from a relay. 300 V is typical!

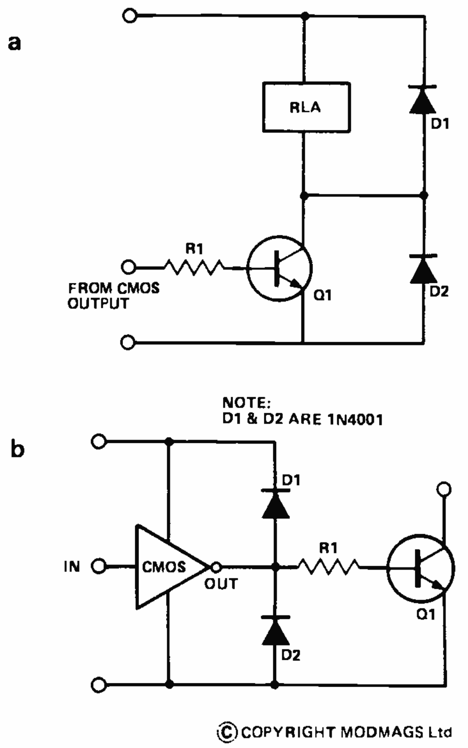


Fig. 10 (a) A transistor relay-driver can be protected with a pair of diodes. (b) The output of a CMOS stage can be given added protection with a similar arrangement.

ETI

DORAM

DORAM ELECTRONICS LTD

Fitzroy House, Market Place,
Swaffham, Norfolk, PE37 7QH.

TEL: (0760) 21627 TELEX: 817912
VAT Reg: 324 5604 75

PROJECT PACKS

Projects for beginners

LCD Converter (80117) Simple to construct display for FM and AM Bands	£41.20
Pools predictor (79053) An analogue computer that may win you a fortune	£8.15
Talk Funny (80052) A ring modulator circuit that produces very strange results when fed with a human voice	£9.60
Pest Pester (80130) An electronic insect repellant	£2.35
Steam train sound effects (80019) Simulates the sound of steam and whistle	£6.50
Electronic Nuisance (80016) Makes an annoying noise, but only in the dark!	£3.85
Cackling Eggtimer (9985) An eggtimer with a difference, it clucks like a hen	£7.20

New projects

200w Disco Power Amplifier (81082)	£20.85
Swinging Poster (81073) Animated poster	£15.20
Minimixer (81068) High quality 5 channel stereo mixer	£37.50
Process Timer (81101) Photographic darkroom timer	£18.20
High Com (81117-1) Telefunken noise reduction system	£49.55

Audio projects

Top-preamp (80031) Mini, all IC preamplifier for use with most power amplifiers	£34.40
Topamp (80031) Hybrid audio power amplifier uses Philips modules for high fidelity performance. Two power levels:	
OM931 (output 30 watt)	£18.50
OM961 (output 60 watt)	£33.40
Parametric Equalizer (9897) A modular system of construction to suit your equalisation requirements. Filter section (9897-1)	£6.45
Tone section (9897-2)	£5.20
Elektornado (9897) A single board design that can be used as either a single 100 Watt amplifier or two 50 Watt amplifiers	£19.50
UAA180 LED meter (9817) A two channel voltage display unit	£13.00
Peak Programme Meter (9860) To be used with UAA180 LED meter to give PPM display	£3.70
Audio Analyser (9932) An analyser that can pinpoint the deficiencies in an audio chain	£14.80
Stereo dynamic Preamp (80532) A low noise high quality disc preamplifier	£5.20
STAMP (80543) Super tiny amplifier up to 1 Watt output	£3.75
Melody Maker (80502) An electronic musical box that can play up to 27 tunes	£23.50

Car projects

Car Battery Charger (79517) Reliable and safe charger for all types of lead-acid batteries	£21.70
Transistor Ignition (80082) The most significant advantages of other systems combined in one	£20.45
Dipstick Probe (80102) Direct warning of high oil temperature. State long or short dipstick required	£11.25
Intelligent Wiper Delay (80086) Can be set to produce delayed wipes at any predetermined interval	£15.85
Battery Protection (80109) Automatically switches off the headlamps of a parked car	£5.15
Battery Voltage Indicator (80101) LEDs indicate the condition of your battery	£6.85
Active Car Aerial (80081) Improves the sensitivity of AM and FM radio reception in your car	£13.85

Music projects

Chorosynth (80060) A cheap mini synthesizer. Send for details	£57.90
Elektor Vocoder (80060) The first Vocoder designed to be built in kit form. 10 Channel modular construction	£162.50
Analogue Reverberation Unit (9973) Uses a SAD 1024 which can produce a delay up to 100mS	£27.70
Guitar Preamp (77020) With three tone controls	£6.50

Projects for the home

Touch Dimmer (78065) Room lighting controlled by a single touch	£6.80
Programmable Slide Fader (81002) Mixes audio signals on tape with operation of two slide projectors	£46.50
Fridge Alarm (81024) Audible warning if fridge door is left open	£5.55
Loudspeaking telephone amplifier (9987) Amplifies without direct connection	£11.50
Proximity Detector (9974) Detects by electric field change movement in a room	£9.80

Our Project Packs include the electronic components, the PCB, sockets and solder together with assembly instructions. Cases, knobs etc can be supplied as extra items if required. This is only part of our wide range of projects. See our catalogue for details of other projects that we can supply. You can also ring our number between 12.30 and 1.30 p.m. any weekday for a recorded announcement of any new items we have available.

HOW TO ORDER
Send a cheque or postal order to DORAM ELECTRONICS LTD or write or ring with your Access account number. All our prices include VAT. Overseas customers deduct 15%. Please add 40p to your order for postage and packing. An answering service is available to take your orders outside our normal office hours. Mail Order service only.

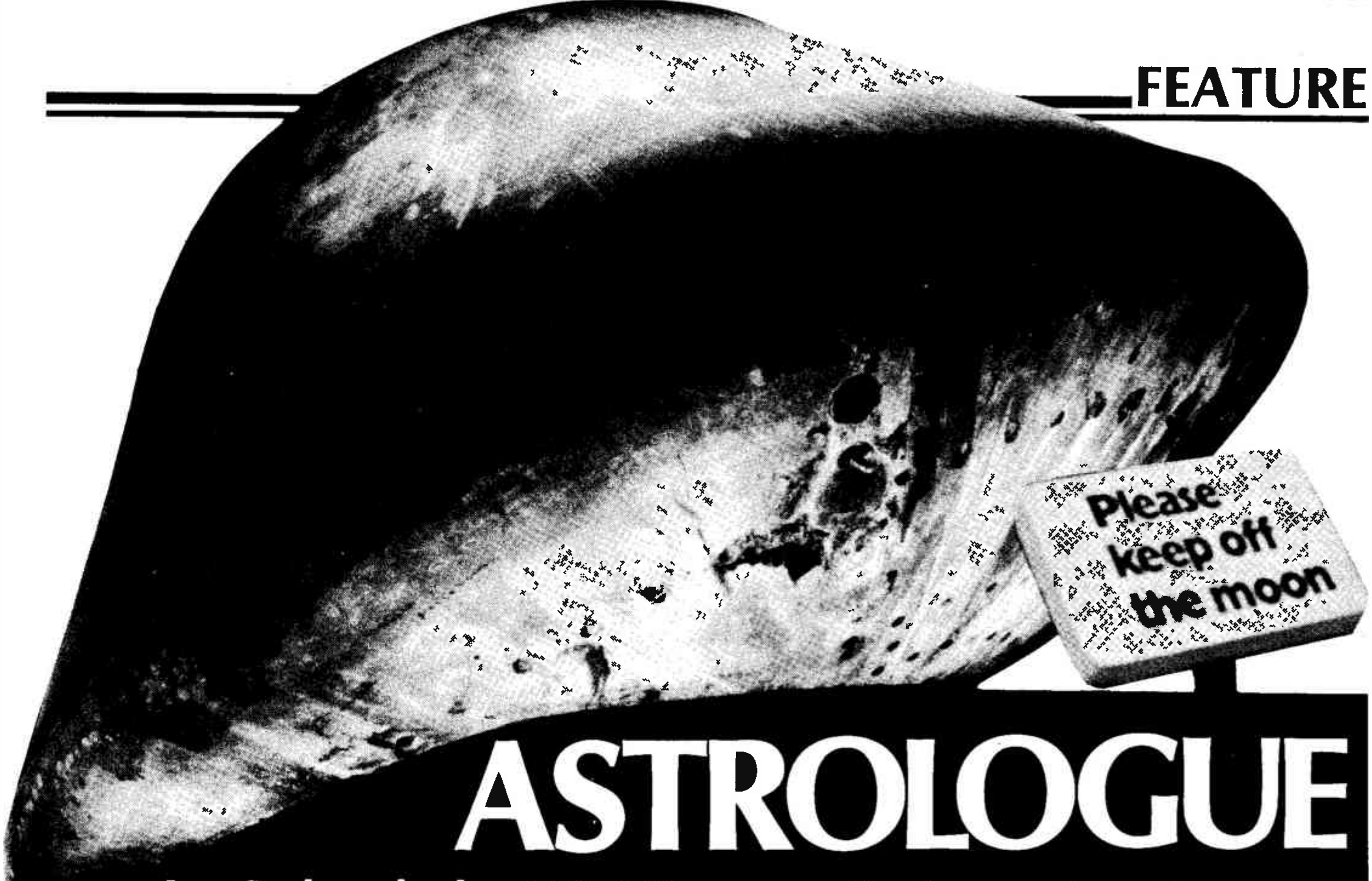
Buy it with Access

a de boer company

NAME ____________________

ADDRESS ____________________

____



ASTROLOGUE

Ian Graham looks at NASA's aeronautical research and answers a common Astrologue inquiry.

Say NASA and most people think of rockets and moonshots. One side of NASA's activities that doesn't hit the headlines is its aeronautical research. The work falls into four categories:

Proof of concept — flying hardware to prove a theory eg the X-series of research aircraft.

Extension of the art — building upon the contemporary state of the art.

Future needs — meeting broad and far-reaching research goals.

Problem solving — trouble-shooting design problems.

The research reaches into almost every aspect of aviation — fluid physics, propulsion, materials, structures, electronics and human factors, all of which came together to support the development of safer, environmentally compatible (quieter and pollution-free), fuel-efficient aircraft.

Flying Circus

Testing out the drawing board ideas has brought some weird machinery into existence. The Bell Tilt Rotor Research Aircraft can, as the name implies, tilt its engines vertically and take off like a helicopter. Once off the ground, the rotors tilt forward into the horizontal attitude and, together with the fixed wing, generate lift in the normal way. This programme is aimed at developing more advanced vertical and short take-off and landing aircraft for use in difficult airport areas where long runways and shallow glide paths are impossible. They could also be a regular feature of future 'bus-stop' airports close to city centres.

Pivoting Wings

We naturally expect aircraft to be symmetrical vehicles. The port wing is always swept back at the same angle as the starboard wing. An aircraft with one wing swept forward and one swept back wouldn't fly. Wrong! Several decades ago, NASA's Robert T. Jones tested the idea in a wind tunnel and it worked. Scepticism and insufficiently advanced technology meant that the aircraft has not been built until now. It even has advantages over conventional first generation supersonic transports, producing a substantially quieter sonic boom. At low speed, the wing is kept at right angles to the fuselage. At high speed, the whole wing pivots up to 60° to reduce drag. In this configuration, the aircraft looks rather like a pair of flying scissors.

HiMAT

Inevitably, NASA is involved in a great deal of military aircraft research. The next generation of fighters must combine very high speeds and manoeuvrability, but remain within the g-forces that a pilot can withstand. To this end NASA has flight tested a scaled down remotely piloted airframe called HiMAT (Highly Manoeuvrable Aircraft Technology). The futuristic airframe is dropped from a modified B-52. The HiMAT pilot stays on the ground and flies the aircraft from the Dryden Flight Research Centre in front of typical flighter cockpit displays. If ground control is lost, an airborne pilot can take over. If both fail, HiMAT automatically flies in circles until control is regained (or it's fuel runs out). I hope to look at HiMAT in detail in a future Astrologue.

Windy Caverns

The traditional image of aero research at this level is of a cavernous wind tunnel containing a full-size mock-up of the aircraft. This certainly still goes on, but much more advanced techniques can provide a means of 'flying' the aircraft before it is built. Computer dynamic analysis is still used to predict the behaviour of the new design in flight. A tethered scale model can be 'flown' in a wind tunnel to study the aircraft's behaviour at the limits of its performance. All the data from these studies can be used to program a simulator computer to give crewmen experience in handling the aircraft in potentially dangerous situations before they get off the ground in the real thing. →

Computer analysis, model testing and simulator flights all contribute to the designers' and pilots' understanding of the behaviour of the aircraft in the air. The fourth stage is the acid test — a NASA research pilot must actually strap the strange new machine to his seat and probe the limits of the flight envelope for himself.

Where Can I Get.......

The most common inquiry I receive in the Astrologue mail is, 'Where can I get slides, posters, photos, etc of astronauts, spacecraft, rockets, the planets.....?' I can answer you all by saying Space Frontiers. They will gladly supply sets of slides, postcards, charts, posters, mission badges, T-shirts, video tapes, movies, sound cassettes and replica plaques.

The slide sets cover Mercury, Gemini, Apollo, Skylab, Apollo-Soyuz, Space Shuttle, Mariner, Viking, Pioneers 10 and 11, Voyagers 1 and 2, stars and planets, rockets, storms and weather, space centres, 21st century space colonies and UFOs. They come in everything from five-slide sets at £1.75 to mammoth 80-slide sets at £16. A general set called 'Image of Space' (15 slides), showing an Apollo launch, the Earth from space, Earth-rise over the Moon, Buzz Aldrin on the Moon, UV activity in the Sun, a Skylab spacewalker, etc is available for £5 all inclusive. Quality and presentation are first class.

Science Museum

If you're in London, you can come by a set of Space Frontiers postcards at the Science Museum (nearest tube — South Kensington). 'Men in Space', a six-card set, and 'Man On The Moon', a 12-card set from the Hansen Planetarium in Salt Lake City, are available from the Museum shop.

While you're there it's worth popping into the ground floor 'Exploration' display. The theme is 'the extension of mankind's faculties by artificial means.' This special area is regularly brought up to date. In addition to the third floor space exploration and rocketry display, 'Exploration' features the Apollo 10 Command Module (not a replica — it's the real thing) and a full-size copy of the Apollo 11 Lunar Module.

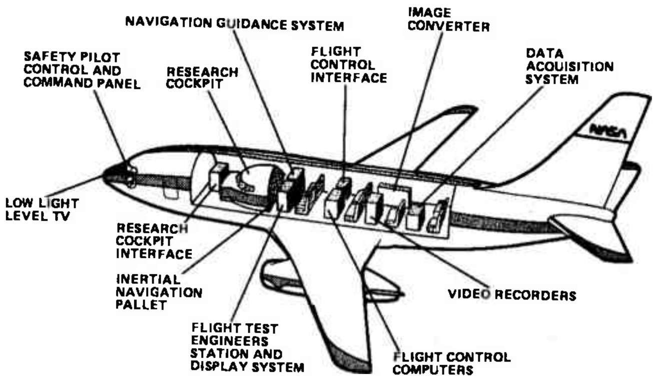


Fig.1 This modified Boeing 737 was used to study flying and take-off/landing routines in bad weather and the use of 'smart' avionics to assist in air traffic control. The Terminal-Configured Vehicle (TCV) can be flown from the research cockpit with the conventional cockpit crew providing a safety back-up. The aim of the programme is to reduce hold-ups at airports due to bad weather, reduce the separation of aircraft on take-off and landing and save fuel by using the most fuel-efficient landing programs. The end result — airlines and airports can substantially cut their losses.

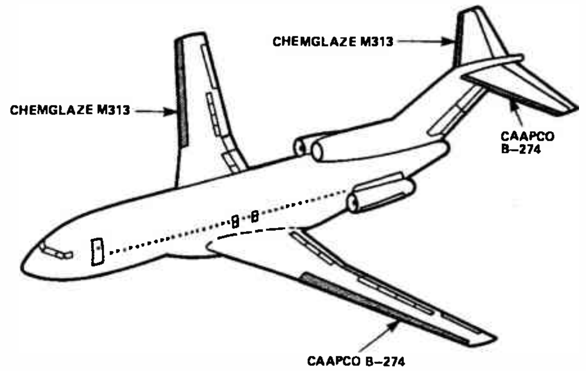


Fig.2 An Air Micronesia Boeing 727 was used to experiment with plastic coatings to reduce skin friction drag on wing and tail surfaces in a tropical environment. Two types of coatings — Chemglaze M313 and CAAPCO B-274 — are being investigated. The location and extent of the coatings on the 727 are shown above. Potential fuel savings from small drag reductions are substantial.

SHORTS

The Arianespace consortium has signed a $150 million contract with the Columbian government to launch two telecommunications sateliites, Satcol 1 and 2, into geostationary orbit in 1984.

The Mark II version of the Skyflash medium range, air-to-air missile has fallen prey to the latest defence cuts. The Mk. II version would have incorporated an improved homing head and electronic counter measures. The Mk I will have to be improved if it is to be a worthwhile weapon in service until the late 1980s.

BUYLINES

All manner of spaceflight memorabilia are available from Space Frontiers Ltd, 30 Fifth Avenue, Havant, Hampshire PO9 2PL. Tel:0705 475313. Send for details, price lists, etc.

Ed White floats in space, the solar wind experiment rises on the moon and supermen exercise in Skylab. Space Frontiers will supply these and many, many more in full colour.

Our lead photograph is the Apollo 10 Command Module, now on display in the Exploration section of the Science Museum, South Kensington.

ETI

The watches everyone wants at prices everyone can afford.

SENSATIONAL SEIKO OFFER

Three genuine Seiko quartz masterpieces – the world's most wanted watches – at the sort of incredible prices only Mitrad's purchasing power makes possible. (Check at any jewellers and see how much you save).

SEIKO QUARTZ DIGITAL ALARM CHRONOGRAPH/TIMER

Seiko prestige and precision in an elegant gentleman's watch. Exceptionally clear and uncluttered digital presentation give a continuous readout in hours, minutes, seconds, day and date, and with month, day and date calendar. Alarm, with AM/PM indication, sounds twice a second for 10 seconds, then four times a second for 10 seconds. Hourly time signals. 12 hour stopwatch records elapsed time and lap times to 1/100 second. Countdown timer sounds a continuous tone at the end of the selected time. Pushbuttom illumination. Water resistant. Hardlex glass. Stainless steel case with black panel. Adjustable stainless steel strap. In presentation box with operating instructions.

SPECIAL OFFER PRICE

ONLY £34.95

plus £1.25 p&p
Trade £26. Add 15% VAT + £1.50 p&p per order. *(Minimum order 5 watches, one style or mix of styles)*

SEIKO QUARTZ ANALOGUE WATCH

A beautiful, classically styled, ladies watch that combines elegance with the incredible accuracy of Seiko quartz technology. Gold plated case with stainless steel back. Gilt face with clear gold markings. Hardlex glass. Most attractive strap that has the appearance of the fashionable bangle strap, but is so flexible and adjustable that it will fit virtually any wrist – even a small child's. Gold safety chain. In presentation box with setting and care instructions.

SPECIAL OFFER PRICE

ONLY £49.95

plus £1.25 p&p
Trade £41. Add 15% VAT + £1.50 p&p per order. *(Minimum order 5 watches, one style or mix of styles)*

☎ Credit card holders may telephone (0536) 522024 24 hours a day stating card number for immediate attention.

NB. Please do not use the coupon for trade orders.

SEIKO QUARTZ MEMORY BANK CALENDAR WATCH

Inimitable Seiko styling in a gentleman's precision watch. Clear digital presentation provides continuous display of hours, minutes, seconds, month, day and date for optional 12/24 hour cycle. Optional monthly calendar display of month, year and dates for designated month (any month, January 1930 to December 2009). Sunday indication and Sunday dates flashing. Memory bank stores up to 11 dates, displays 'MEMO' and flashes on designated dates. Display flashes as battery life nears end. Pushbutton illumination. Water resistant. Hardlex glass. Stainless steel case with black panel. Adjustable stainless steel strap. In presentation box with operating instructions.

SPECIAL OFFER PRICE

ONLY £27.95

plus £1.25 p&p
Trade £20. Add 15% VAT + £1.50 p&p per order. *(Minimum order 5 watches, one style or mix of styles)*

MITRAD

MITRAD 68/70 High Street, Kettering, Northants, NN16 8SY. Telephone (0536) 522024

The premier mail order house specialising in quality products and superior after-sales care.

To Mitrad 68/70 High Street, Kettering, Northants.
Please send me
- [ ] Seiko Quartz Digital Alarm Chrono. at £36.20 (incl. p&p)
- [ ] Seiko Quartz Memory Bank Calendar Watch at £29.20 (incl. p&p)
- [ ] Seiko Quartz Analogue Watch at £51.20 (incl. p&p)

Total value of my order £ ______

I enclose cheque/PO made payable to Mitrad

Or debit my Access/Barclaycard No. ______

Signature ______

Name ______

Address ______

(BLOCK LETTERS PLEASE)

Allow up to 28 days for delivery. Full refund if not completely satisfied. Registered in England No. 2554356.

ETI 4/81

World Radio History

DRUM MACHINE

Drums, cymbals, snares and bongos. You can simulate these instruments with this 'double percussion' project. The instruments can be played either manually or automatically using a built-in sequencer. Design by Ray Marston. Project development by Steve Ramsahadeo.

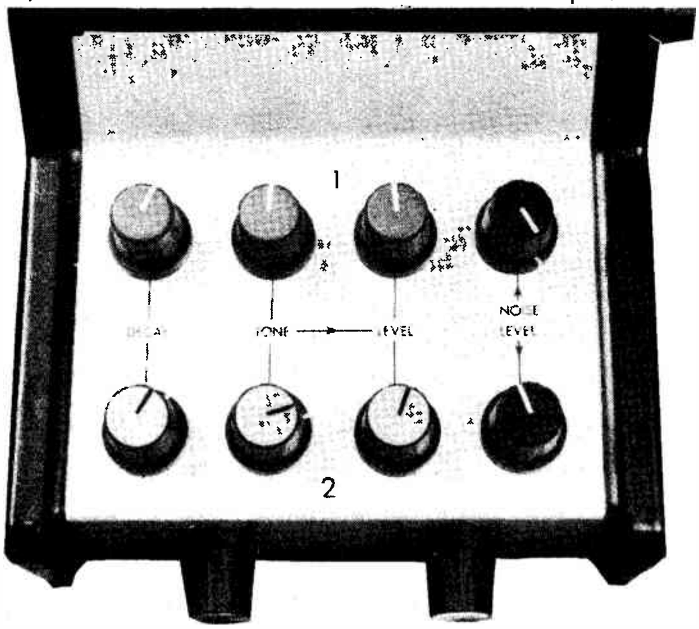
This attractive little musical instrument has two 'percussion simulator' channels. Channel 1 can be used to simulate the sounds of normal drums only: channel 2 can be used to simulate the sounds of all types of drums, including snares, plus metallic percussion sounds such as cymbals, etc. On each channel, the envelope decay times and the basic musical tones, etc., are fully variable using the manual controls, to enable a wide range of percussion sounds to be simulated. The outputs of the two channels are mixed internally and can be fed to an external power amplifier from a single output socket. The complete instrument is powered from a 12 V battery pack.

Play It, Sam

The instrument can either be played manually, automatically, or by a combination of the two methods. In the manual mode, each channel can be played using a small speaker, connected to the channel input: the speaker acts as a 'drum head' transducer and triggers a percussion sound when the cone is tapped with a finger or stick.

The instrument can be played automatically using the built-in eight-step double sequencer. Each channel of the sequencer is used to control one of the channels of the percussion instrument, and can be programmed with a DIL package of eight SPST switches to generate any one of a variety of rhythms. The sequencer can be used in the fully automatic mode, in which it continuously cycles through the eight-step sequence, or can be used in a triggered, or manual initiate, mode in which it runs through a single eight-step sequence each time that an external switch is momentarily closed. The manual initiate facility enables the internally-generated rhythm to be manually synchronised to an external beat (with a foot switch, etc), or to be introduced into the music only in those parts where it is required.

The manual and automatic playing methods operate in the OR mode. In other words, manually-initiated percussion sounds can be played at the same time as the automatically initiated sounds. A particularly attractive way of using the instrument is to play it mainly in the manual mode, but to occasionally bring in a few bars of automatic sequencing with a foot switch, using the manual initiate facility. The unit thus acts as a highly versatile musical instrument.

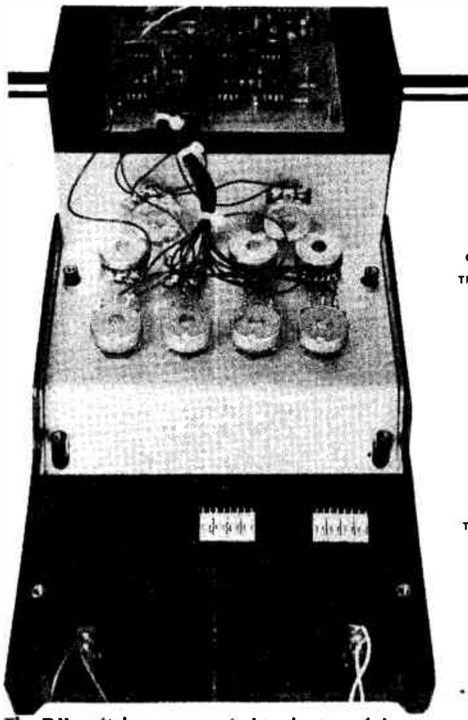


Construction

The circuitry is built up on two PCBs, a single large board being used to hold all of the components (except the pots and switches) of the main double percussion instrument, and a smaller board being used for the components of the sequencer circuit. The unit uses a good deal of interwiring between the PCB and the total of eleven control pots, etc., so some care is required in the construction.

Start the construction by building up the main PCB, taking the usual care over the component polarities. Use Veropins to facilitate the connections from the PCB to the ten control pots.

When construction of the main PCB is complete, give it a functional check by temporarily connecting the ten pots to the unit, wire a couple of small speakers (impedance not important) to the two input terminals, connect the unit to a 12 V supply and take the output to an external power amplifier. Check that plain drum sounds can be manually generated on channel 1, and all types of percussion sounds from channel 2. Note on channel 2 that Q5 is used as a white noise source (for generating cymbal



The DIL switches are epoxied to the top of the case as shown here. The sequencer board can then be secured by plugging the DIL sockets onto the exposed pins.

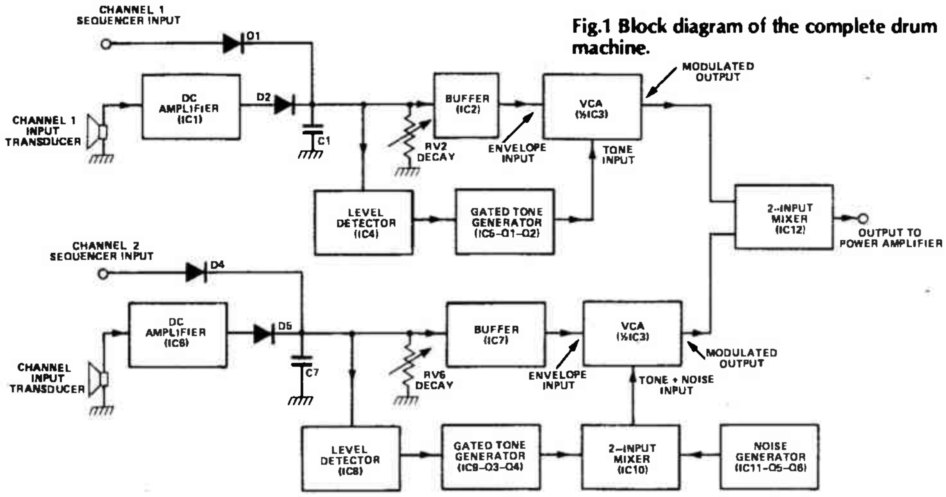


Fig.1 Block diagram of the complete drum machine.

BUYLINES

No unusual components are used in this project, your local emporium should meet your requirements. However, if you experience difficulty in obtaining the NE570, Watford Electronics are stockists of this device.

Collet knobs are available from Electrovalue Ltd. and the case from West Hyde Developments, order as BOC668.

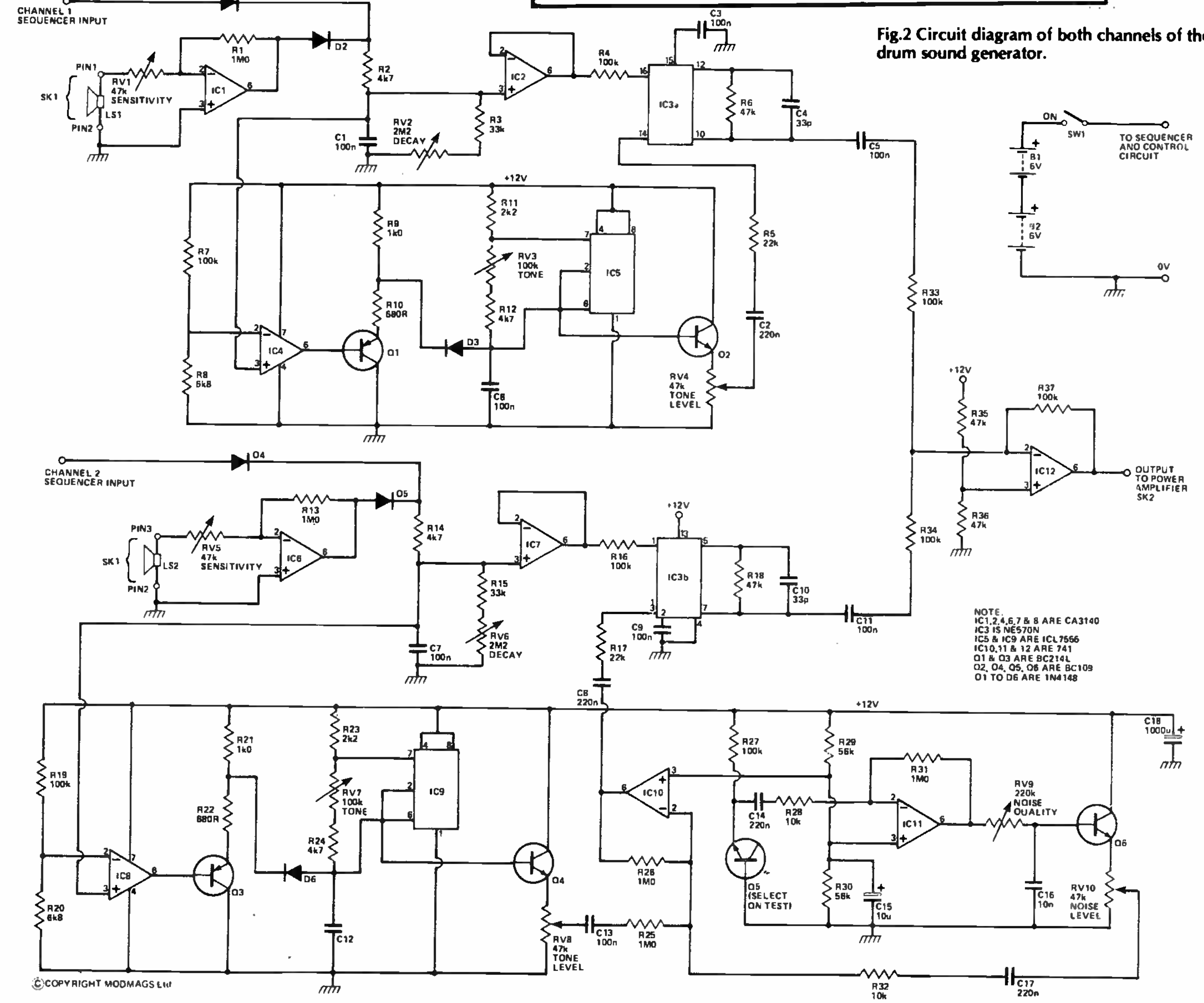


Fig.2 Circuit diagram of both channels of the drum sound generator.

HOW IT WORKS

The basic instrument contains two essentially similar channels (see block diagram), each comprising a voltage-controlled amplifier (VCA), a gated tone generator and an envelope generator. The envelope generator produces the characteristic fast-attack/slow-decay modulation waveform of a percussion instrument and can be activated by either an external transducer (a speaker) or the pulse input of an automatic sequencer unit.

The outputs of the two channels are added in a two-input mixer and are made available at a phono socket, where they can be fed to a power amplifier. The channel 1 circuitry produces modulated tone signals only, and can be used to generate a range of simple drum sounds. The channel 2 circuitry incorporates a noise generator and a two-input mixer as well as a tone-generator, and can be used to reproduce all of the sounds of channel 1 plus snare drums, cymbals, etc.

The two channels of the instrument are basically similar, so let's start off with a detailed description of channel 1. When used in the manual mode the instrument is played using an external transducer such as a speaker (LS1), which is connected to the input of high-gain DC amplifier IC1. Each time that the transducer is tapped, the output of IC1 jumps abruptly positive and rapidly charges C1 via D2-R2: C1 then discharges exponentially via R3-RV2, to produce the characteristic fast-attack/slow decay modulation waveform of a percussion instrument. The waveform is then fed to one half of dual VCA IC3 via unity-gain buffer IC2, where it is used to control the gain of the VCA.

Note that the C1 modulation generator can be activated by either the transducer or by a pulse signal fed to C1 via D1-R1 from the independent sequencer circuit (auto mode). The C1 voltage is monitored by comparator IC4, which gates on astable IC5 whenever the C1 voltage exceeds a few hundred millivolts. The astable generates a symmetrical ramp waveform, which is buffered by Q1 and fed to the 'tone' input of VCA via level control RV4. The tone of the astable can be varied over the range 83 Hz to 1.4 kHz with RV3.

Thus, each time the channel is activated (by the transducer or by a sequencer) a modulation waveform is fed to one input of the VCA and a tone signal is fed to the other, to produce a modulated tone signal at output pin 10 of IC3. The signal is fed to one input of two-input mixer IC12. A wide variety of drum sounds can be simulated by suitable adjustment of RV2, RV3 and RV4.

Channel 2 is similar to channel 1, except that the output of the tone generator (from RV8) is fed to the VCA via a two-input mixer designed around IC10. The other input to this mixer is derived from a noise generator designed around Q5-IC11 and Q6. Here, the reverse-biased base-emitter junction of Q5 is used as a noise source and the noise signal is then amplified by IC11, filtered by RV9-C16 and made available via level control RV10.

The instrument is powered from a 12 V supply, derived from eight 1V5 cells. This supply is also used to power the Auto-Manual Eight-Step Sequencer unit.

The sequencer unit has two output channels, each of which produces a single or repeating sequence of up to eight 5 mS output pulses: the sequencing period can be varied over a wide range by a clock (or 'tempo') generator, and individual pulses can be programmed in or out on each channel with a dual-in-line package of eight SPST switches. The unit is designed to automatically sequence the double percussion instrument.

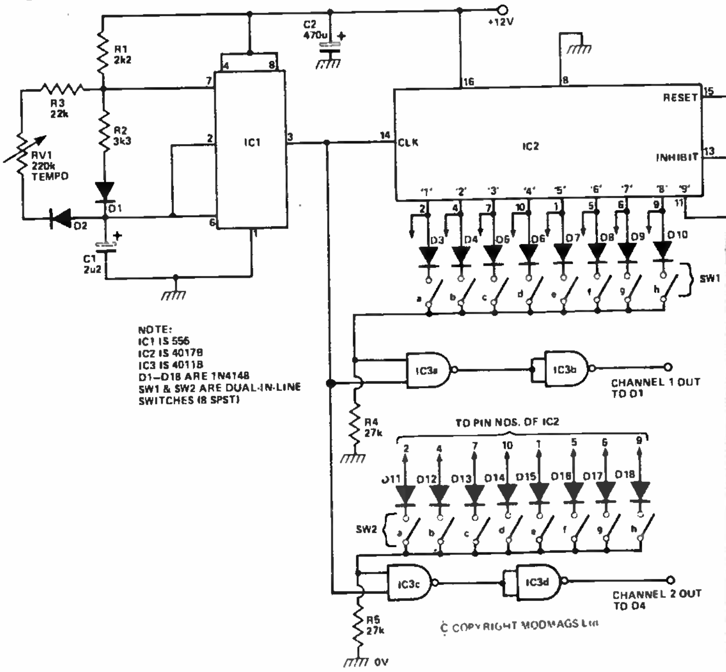
The unit comprises a clock generator (IC1), a 4017 counter (IC2) and two sets of switch-programmable clock/decoder coincidence detectors (IC1 and D3 to D18). The clock generator is designed around a 555 astable and generates a series of 5mS pulses, with the inter-pulse period variable over a wide range by RV1. The pulses are used to clock IC2.

IC2 is a 4017 counter with ten decoded outputs. These outputs sequentially go high on the arrival of each new clock pulse, with only one output being high at any moment in time. On each channel the decoded 4017 outputs that are required are fed to one side of a two-input AND gate (IC3a-IC3b or IC3c-IC3d) via a bank of diodes and switches, while the 5mS clock pulse is fed to the other side of the AND gate. The programmed sequence of 5 mS pulses are thus generated at the output of each AND gate.

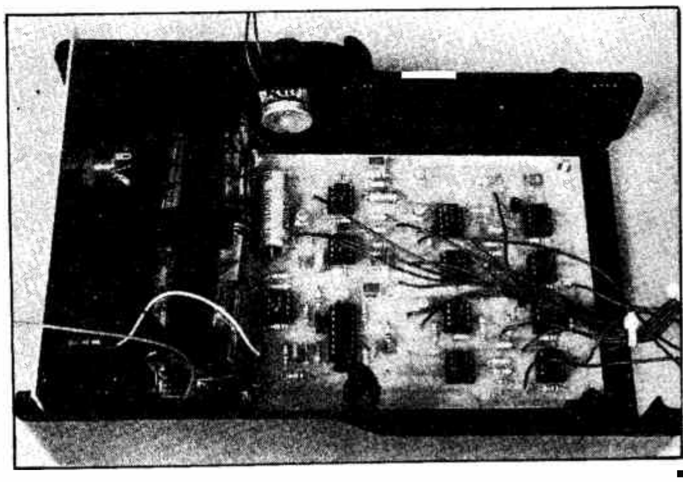
When the unit is operated in the manual mode, the 4017 sequences automatically for the first eight clock pulses and then stops as its '9' output goes high and activates the inhibit pin: the single automatic sequence can be re-initiated by momentarily closing PB1 and thus resetting the 4017, so that the '1' output goes high on the arrival of the next clock pulse. The manual facility enables the sequencer to be manually synchronised to an external beat.

When the unit is operated in the auto mode the reset and inhibit pins of IC2 are shorted together by SW3. This configuration effectively causes the 4017 to see a double clock pulse as the '9' output goes momentarily high, thereby causing the '0' output to go high as the IC resets but then causing the '1' output to go high almost immediately. The net effect of all this is that the sequence repeats continuously when SW3 is set to the auto mode.

Fig.3 Circuit diagram of the eight-step sequencer unit.



Below: the sound generator board and batteries are mounted in the lower half of the case. RV1 (tempo control) can be seen mounted on the side — all other pots are situated on the front panel.



sounds, etc), and may have to be selected on test to produce an adequate noise level.

Proceed next with the construction of the sequencer circuit on the smaller PCB. Note that the two sets of DIL switches MUST be mounted in sockets, and that capacitor C2 is mounted on the *underside* of the PCB.

You can now proceed with the assembly of the two boards and all other components in the specified case. Note the following points. The large PCB is secured to the base of the case with stand-off pillars: leave sufficient space at the rear of the case to accommodate the battery pack (eight 1V5 cells). The ten percussion-control pots are mounted on the front section of the top half of the case.

The sequencer board is secured to the rear half of the top section of the case by the board's DIL switches, which are epoxied to the case. Proceed as follows.

First, hold the board in position below the case top and very carefully mark out the precise outlines of the two switches. Now cut two holes in the case top, to allow the switches to pass through the case. Next, remove the switches from their PCB sockets, push them into the holes so that the top faces are flush with the case top and then fix the two switches into place with epoxy or super-glue. When the glue has set, fit the PCB to the switches (and thus the case) by carefully inserting the DIL switches in the sockets. Tempo control RV1 is mounted on the right hand side of the lower half of the case.

Finally, to complete the construction, fit all the remaining switches and sockets into place and complete the interwiring. We recommend that you use jack sockets to connect the two 'drum head' speakers to the unit, configured so that the input pins short out if the speakers are removed.

When using the completed unit, note that, if the 'drum head' speakers are not used, they must be replaced by short circuits, to eliminate the possibility of circuit instability.

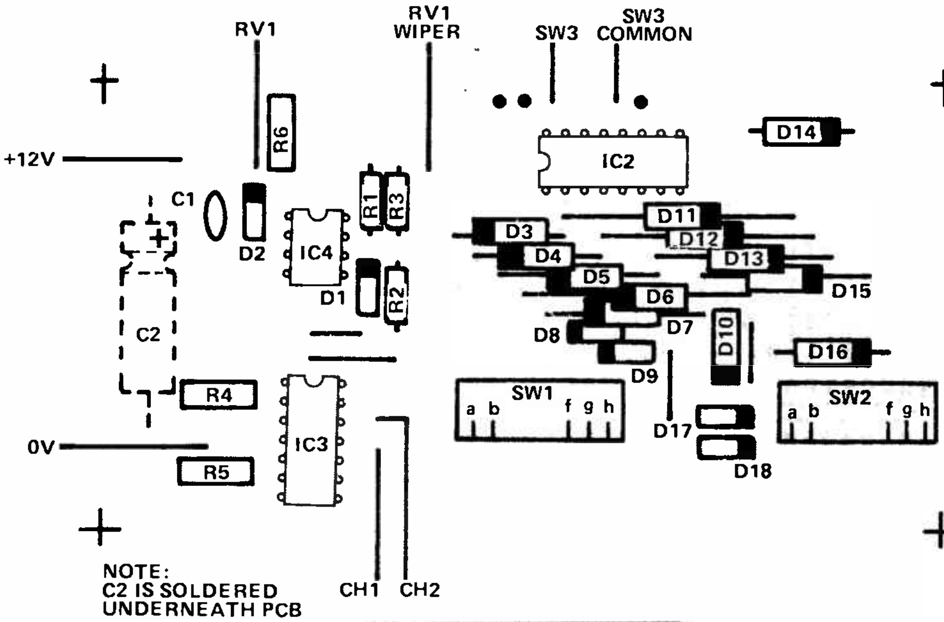
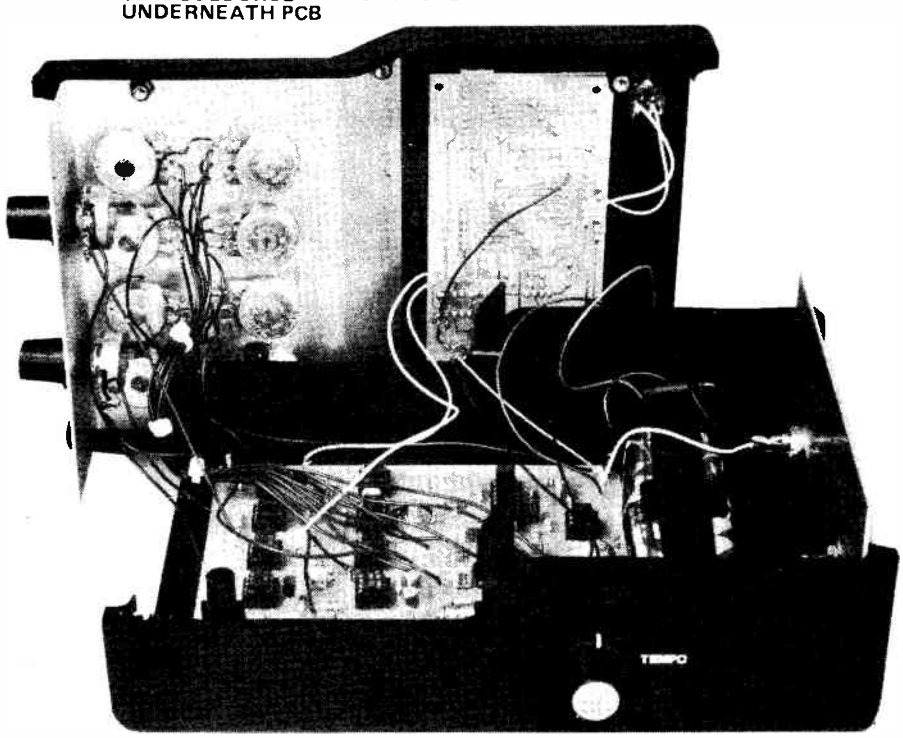
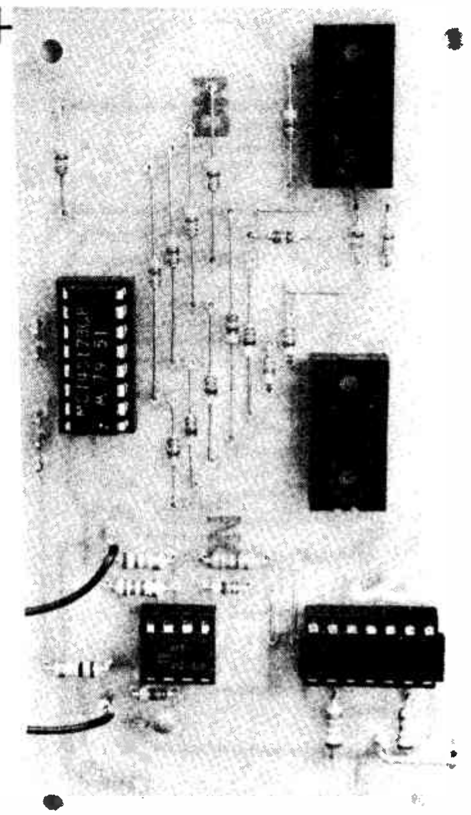


Fig.4 Component overlay for the sequencer board. Note that C2 is soldered underneath the PCB, and an insulated link should be soldered between IC2 pin 8 and the 0 V rail.





Below left: with the case open you can see how the boards and controls are interwired. The sequencer board (below) is secured to the top of the case by pressing the empty sockets onto the pins of the DIL switches.

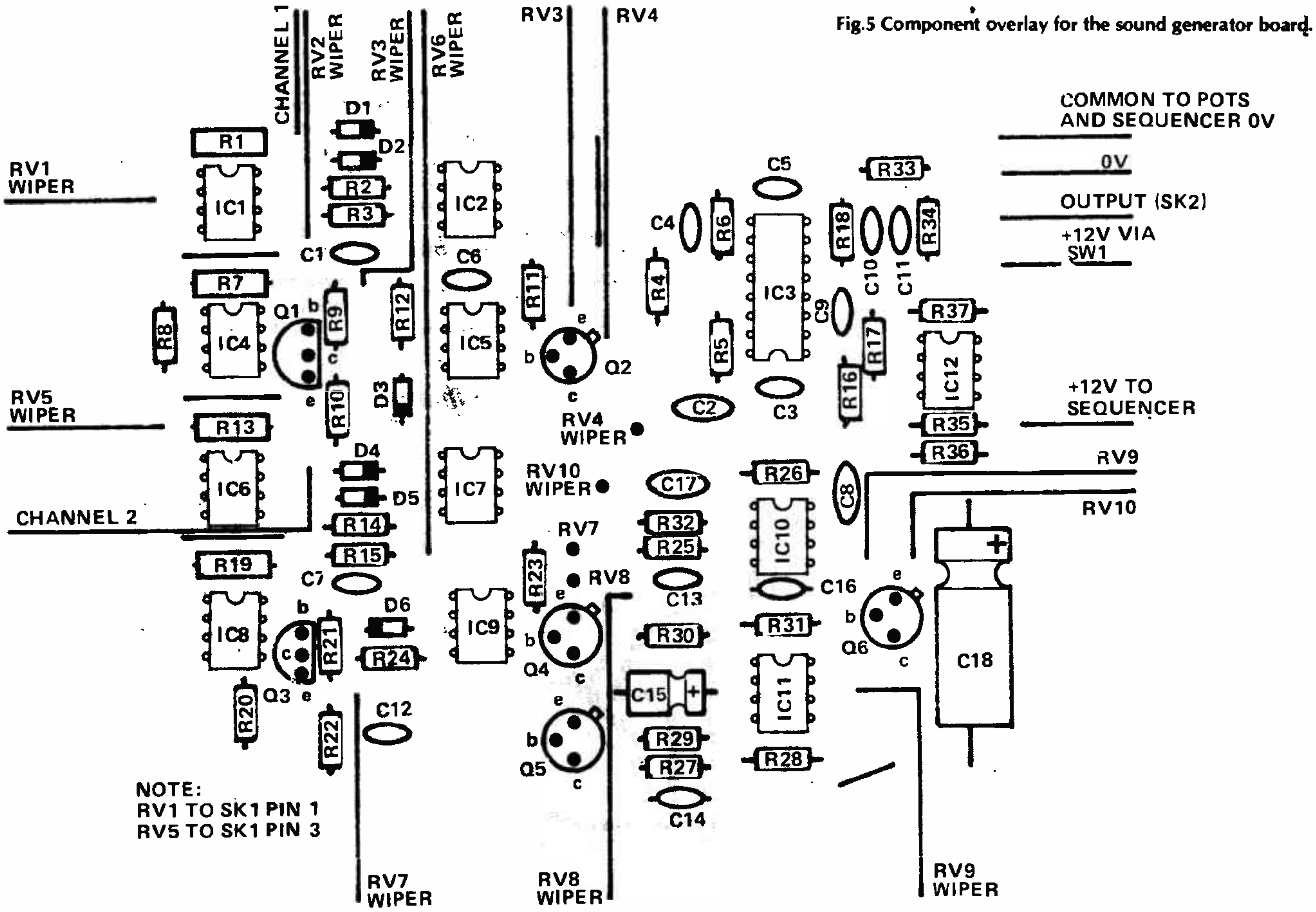


Fig.5 Component overlay for the sound generator board.

PARTS LIST

CONTROL CIRCUIT

Resistors (all ¼W, 5%)

R1,13,25,26,31	1M0
R2,12,14,24	4k7
R3,15	33k
R4,7,16,19,27,33,34,37	100k
R5,17	22k
R6,18,35,36	47k
R8,20	6k8
R9,21	1k0
R10,22	680R
R11,23	2k2
R28,32	10k
R29,30	56k

Potentiometers

RV1,4,5,8,10	47k linear
RV2,6	2M2 linear
RV3,7	100k linear
RV9	220k linear

Capacitors

C1,3,5,6,7,9,11,12,13	100n ceramic
C2,8,14,17	220n polycarbonate
C4,10	33p ceramic
C15	10u 25 V axial electrolytic
C16	10n ceramic
C18	1000u 16 V axial electrolytic

Semiconductors

IC1,2,4,6,7,8	CA3140
IC3	NE570N
IC5,9	7555
IC10,11,12	741
Q1,3	BC214L
Q2,4,5,6	BC109

Miscellaneous

SW1	SPST miniature toggle
SK1	3 pin DIN socket and plug
SK2	phono socket
LS1,2	50 mm loudspeaker

10 off collet knobs, caps and nut covers
Case (see Buylines)
2 off HP7- four section battery holders
8 off HP7 batteries

SEQUENCER

Resistors (all ¼W, 5%)

R1	2k2
R2	3k3
R3	22k
R4,5	27k
R6	100k

Potentiometers

RV1	220k linear

Capacitors

C1	2u2 35 V tantalum
C2	470u 25 V axial electrolytic

Semiconductors

IC1	555
IC2	4017B
IC3	4011B
D1-D18	1N4148

Miscellaneous

SW1,2	8-SPST dual-in-line lateral switches
SW3	SPST miniature toggle
PB1	momentary push button

1 off collet knob, cap and nut cover

ETI

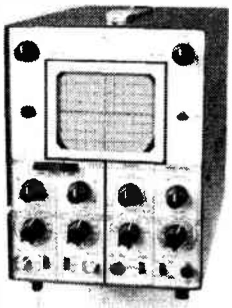
SAFGAN DT-400 SERIES

DUAL TRACE OSCILLOSCOPES

NEW BRITISH PRODUCTS
FROM £169+VAT

ALL MODELS

- DUAL TRACE
- 5mv/div
- 4'' CRT


DT-400 SERIES

MODELS

DT-410 10MHz £169+VAT
DT-412 12MHz £175+VAT
DT-415 15MHz £188+VAT

SPECIFICATION FOR ALL MODELS

★ CH1, CH2; 5mv div – 20V/div in 12 cal steps.
★ Bandwidth: 10MHz (DT-410), 12MHz (DT-412), 15MHz (DT-415).
★ Time Base; 0.5µs div – 200ms/div in 18 cal steps.
x 5 expansion to 100ns/div.
x 5 multiplier to 1s/div.
★ XY facility: matched x = CH1, Y=CH2.
★ Trigger: Level Control, ± slope selection.
★ Bright Line Auto, Normal, TV Triggering.
★ CH1, CH2 0.5div; 100mv External Source.
★ Z modulation.
★ CAL o/p for probe compensation.
★ Graticule blue ruled 8x10div (6.4x8 cm²).
★ Size: H 215mm, W 165mm, D 280mm, Weight 4.5kg.

PROBE (X1 – REF – X10) £11.50+VAT

ORDERS TO SAFGAN ELECTRONICS LTD.
56 BISHOPS WOOD, ST. JOHN'S, WOKING
SURREY GU21 3QB. Tel: Woking
69560 or Woking 66836

GOODS + p&p £3.50 or parcel service £6.50 + 15%
LONDON STOCKIST: AUDIO ELECTRONICS. TEL: 01-724 3564
DT400s are designed and manufactured by SAFGAN in England

Lowest Prices Yet!

Memory Chips

Guaranteed quality – Any faulty chips should be returned to us within 12 months of purchase with proof of purchase for replacement by return of post.

4116 and 2114 chips at the same price

4116 dynamic memory chips guaranteed to 200 nanoseconds full cycle time. Suitable for Apple, TRS 80, Nascom, Exidy Sorceror, Sharp MZ 80K etc (8 chips give 16k bytes of memory).

2114 static memory chips guaranteed to 300 nanoseconds full cycle time. Low power, suitable for Superboard Compukit, Atom, ZX 80 etc. (2 chips give 1K byte of memory).

Prices

No. of Chips	Unit Price	Total Price Nett	Vat	Total
2	1.80	3.60	.54	4.14
8	1.70	13.60	2.04	15.64
24	1.60	38.40	5.76	44.16
100	1.40	140.00	21.00	161.00
500	1.30	650.00	97.50	747.50
1000	1.25	1250.00	187.50	1437.50

Official orders welcome. Post and Packing free.
24 Hr Telephone Credit Card Orders 051-236 0707

Mail orders to:
MICRODIGITAL LIMITED
FREEPOST (No stamp required)
LIVERPOOL L2 2AB

Retail Premises at:
25 BRUNSWICK STREET,
LIVERPOOL L2 0PJ
Tel. 051-227 2535/6/7

MICRODIGITAL

A NEW ADVENTURE IN COOKING!
COMPONENTS AND CHIPS FROM DISPLAY ELECTRONICS

Fast Service — Low Prices — Great Menu

COMPUTER GRADE HIGH RIPPLE CAPS

MF	Volts	Dim mm	Price	pp
1500*	100	80 × 35	70p	
2200	40	50 × 25	150p	
3300	25	50 × 25	150p	
3300*	63	115 × 35	80p	
3300*	150	100 × 65	120p	
4700	75	115 × 35	190p	
11000	25	68 × 50	180p	
15000	16	80 × 35	180p	
15000	40	115 × 35	190p	
22000	16	80 × 50	220p	
22000	25	115 × 35	250p	
28000	25	105 × 70	270p	80p
34000	50	145 × 75	350p	80p
64000	40	115 × 75	590p	80p
68000	16	115 × 60	575p	80p
138 000	10	145 × 75	600p	60p
160 000	30	220 × 75	750p	120p

ALL TYPES HAVE SCREW TERMINALS.
*EX-EQUIPMENT TESTED

P.C.B. EDGE CONNECTORS

Pitch	Ways	*	Price
0.1"	17	AC	60p
0.1"	36	BD	190p
0.1"	45	BC	245p
0.1"	54	AC	110p
0.1"	85	AC	200p
0.1"	85	BC	400p
0.15"	12	AC	75p
0.15"	25	BC	120p
0.15"	56	BC	325p
0.156"	12	PET	150p
0.156"	28	BC	190p
0.156"	36	BC	200p

*A SINGLE SIDED B DOUBLE SIDED
C SOLD TAG D WIRE WRAP
ALL GOLD PLATED EASILY CUT TO SIZE

VOLTAGE REGULATORS

Type	V	A	Case	Price
LM309K	+5	1.2	TO3	110p
LM323K	+5	3.0	TO3	599p
7805	+5	1.0	TO220	50p
7815	+5	1.2	TO3	110p
LM723	VAR	–	DIL	35p

TTL ICs

Type	N	LS	S
7400	10p	15p	25p
7401	12p	–	–
7402	12p	15p	14p
7403	14p	–	16p
7404	14p	15p	–
7405	18p	–	–
7406	32p	–	–
7407	32p	–	–
7408	17p	22p	–
7409	22p	–	–
7410	15p	19p	–
7411	–	38p	–
7413	30p	–	–
7414	50p	–	–
7416	27p	–	–
7417	28p	–	–
7420	17p	19p	18p
7423	30p	–	–
7427	34p	–	–
7428	35p	–	–
7430	17p	20p	–
7432	28p	30p	–
7437	35p	–	–
7438	30p	35p	–
7439	30p	–	–
7440	17p	19p	–
7441	65p	–	–
7442	55p	–	–
7445	120p	–	–
7447	45p	–	–
7450	17p	–	–
7451	–	22p	–
7454	17p	23p	–
7470	33p	–	–
7472	28p	–	–
7473	34p	–	–
7474	28p	32p	38p
7475	28p	–	–
7476	35p	–	–
7485	90p	–	–
7486	34p	35p	–
7489	200p	–	–
7490	28p	–	–
7492	50p	–	–
7493	28p	–	–
7495	65p	–	–
7496	60p	–	–
7497	175p	–	–
74100	130p	–	–
74104	45p	–	–
74107	32p	–	–
74109	50p	–	–
74111	50p	–	–
74112	–	–	90p
74114	–	–	45p
74116	195p	–	–
74118	75p	–	–
74121	28p	–	–
74122	41p	–	–
74123	45p	60p	–
74125	53p	–	–
74128	72p	–	–
74132	68p	–	–
74133	–	25p	–
74147	180p	–	–
74148	103p	–	–
74150	98p	–	–
74151	80p	100p	–
74153	65p	–	–
74154	98p	–	–
74155	60p	–	–
74157	60p	65p	–
74161	90p	–	–
74163	80p	–	–
74164	120p	110p	–
74166	120p	–	–
74170	235p	–	–
74172	445p	–	–
74173	110p	–	–
74174	85p	–	–
74175	80p	100p	–
74180	92p	–	–
74181	150p	–	–
74182	–	90p	–
74190	85p	–	–
74191	85p	–	–
74193	85p	95p	–
74194	85p	–	–
74197	75p	–	–
74198	140p	–	–
74241	150p	–	–
74266	–	95p	–
74273	265p	–	–
74279	80p	–	–
74283	155p	–	–
74284	400p	–	–
74285	400p	–	–
74298	180p	–	–
74366	95p	–	–
74387	90p	–	–
74390	–	140p	–
74393	195p	–	–

XTALS

Frequency	Case	Price
19.20 KHz	HC6U	300p
38.40 KHz	HC6U	400p
100.00 KHz	HC6U	300p
110.00 KHz	B7G	400p
1.00 MHz	HC6U	320p
2.00 MHz	HC6U	280p
4.00 MHz	HC18	280p
5.00 MHz	HC18	280p
6.00 MHz	HC18	280p
8.00 MHz	HC18	280p
10.00 MHz	HC18	280p
10.25 MHz	HC18	280p
11.20 MHz	HC18	280p
20.00 MHz	HC18	280p
DIL XTAL OSC 9.600 MHz		450p

5000 XTALS EX – STOCK
PHONE YOUR FREQUENCY

LINEAR

CA3011	60p
CA3028B	100p
CA3046	85p
GE424	110p
LM301	30p
LM324N	40p
LM3900	60p
MC1408L8	400p
MC1458R	45p
NE555	25p
NE556	60p
NE567	165p
TBA673	225p
TL082	85p
741	15p

BRIDGE RECTIFIERS

A	V	Price
1.5	50	30p
1.5	200	50p
2.5	75	40p
5	100	60p
10	100	150p
12	400	190p

'D' RANGE CONNECTORS

Ways	Plug	Sock
9	103p	126p
15	117p	201p
25	172p	258p
37	235p	414p
50	290p	546p

25 WAY RIGHT ANGLE P C B
PLUG 255p, SOCK 295p

RAMS

1103		50p
2101-4		410p
*2114L-3	300NS	350p
4006-4		95p
4027	375NS	350p
*4116	200NS	200p
5101L	450NS	495p
TMS3114 SH REG		140p
*4116 8 for		1995p
*2114 8 for		2250p

EPROMS

1702	375p
2708	495p
2716 5v	950p
2716 3 rail	850p

I.C. SOCKETS

Pins	Prices		
8	10p	28	30p
14	14p	40	44p
16	16p	Wire Wrap	
18	18p	14	30p
20	20p	16	38p
24	25p	24	40p

MPU DEVICES

4004	250p
8085A	999p
8155C	895p
8251	350p
8253	695p
8255	995p
8259A	475p
8755A	2400p
2652	2200p
6850P	375p
6011	400p
AY-5-1013	400p

TRANSISTORS

2N697	22p	AD162	40p	BC251A	15p
2N689	35p	BC108	10p	BC252	16p
2N706A	25p	BC109	10p	BC327	13p
2N1136A	25p	BC147	7p	BC337	13p
2N2646	45p	BC148	7p	BC338	14p
2N2904	23p	BC149	7p	BC348	15p
2N2906	23p	BC157	8p	BC547	12p
2N2926	7p	BC159	10p	BC548	8p
2N3053	25p	BC167	10p	BC549	9p
2N3055H	60p	BC170	10p	BCY33A	120p
2N3440	60p	BC170A	11p	BD242C	80p
2N3442	120p	BC170C	12p	BF258	35p
2N3702	8p	BC171	10p	BFT60	28p
2N3703	8p	BC171A	11p	BFW22	20p
2N3704	8p	BC172A	10p	BFY50	28p
2N3771	150p	BC172B	10p	MJ1000	95p
2N3906	15p	BC172C	10p	MJ4030	225p
2N4304	20p	BC172	10p	MPU131	25p
2N4351	50p	BC173C	10p	TIP29	40p
2N4352	50p	BC174B	10p	TIP29A	30p
2N5447	10p	BC182L	10p	TIP30A	42p
2N5449	12p	BC207B	15p	TIP31	28p
2N5943	55p	BC212L	8p	ZTX108	8p
2N6385	125p	BC213A	8p	ZTX314	20p
ACY19	75p	BC250A	12p		
AD161	40p	BC251	14p		

SPECIAL OFFERS

4116	2200 NS RAMS 8 for £19.95
2114L-3	300 NS RAMS 8 for £22.50
2102L-3	650 NS RAMS 8 for £5.50
40305L	300 NS RAMS 8 for £9.95

BULK ENQUIRIES MOST WELCOME

Electronic Components and Equipment purchased for cash

Buy it with Access — BARCLAYCARD VISA

DISPLAY ELECTRONICS 64-66 Melfort Road Thornton Heath, Croydon, Surrey CR4 7RN
Telephone Orders: 01-689 7702/01-689 6800

Please add 50p Post and Packing

All Prices Include VAT

Bona Fide Account Orders Minimum £10.00 | Warehouse Open 10-5.30 Mon-Sat | 1,000's of Other Items

TEKTRONIX STORAGE OSCILLOSCOPE. Type 434. as new. 12 months' warranty **£1,950.**
TEKTRONIX OSCILLOSCOPE. Type 647, with 10A2 and 3B11. **£500**
TEKTRONIX STORAGE OSCILLOSCOPE. Type 564 with 3A6 and 3B4 **£350.**
TELEQUIPMENT STORAGE OSCILLOSCOPE. Type DM53A **£285.**
TELEQUIPMENT OSCILLOSCOPE. Type D32. Portable, mains/battery. **£275.**
HAMEG OSCILLOSCOPE. Type 512 DB, 50MHZ **£350.**
TELEQUIPMENT OSCILLOSCOPE. Type S54A SB 10MHZ. **£190.**
SE LABS OSCILLOSCOPE. Type SM111 DB 20MHZ. **£325.**
ADVANCE OSCILLOSCOPE. Type OS1000 DB 15MHZ **£250.**
TEKTRONIX OSCILLOSCOPE 547 with 1A1 plug-in Dual TB 50MHZ. **£375.**
TEKTRONIX OSCILLOSCOPE. Type 561A with 3A1 and 2B67 10MHZ. **£300.**
TEKTRONIX OSCILLOSCOPE. Type 533A with CA. DB 24MHZ **£140.**
HEWLETT PACKARD AC CONVERTOR. Type 3461A **£120.**
MARCONI FM SIG. GEN. Type TF1066B/6S **£295.**
G. & E. BRADLEY LTD. R.F. MILLIVOLTMETER. Type 112 **£75**
ADVANCE A.C. VOLTMETER. Type VM77E **£60**
MARCONI WAVE ANALYSER. TF2330 Good condition. **£150**
AVO R.F. SIG. GEN. Model HF135. **£75**
MARCONI WIDE RANGE R.C. OSCILLATOR. TF1370. **£95.**
MARCONI AM/FM SIG. GEN. Type TF1066/1. **£225.**
MARCONI SENSITIVE VALVE VOLTMETER. TF2600. **£50.**
MARCONI SIG. GEN. MK2. TF995A/3/S (CT402) **£275.**
TEKTRONIX type 1L30 SPECTRUM ANALYSER PLUG-IN. (works, slight corrosion) **£325**
AIRMEC SIGNAL GENERATOR. Type 204 AM/FM 320MHZ **£150**
WAYNE KERR UNIVERSAL BRIDGE. Type B221 **£50**
ADVANCE R.F.Signal Generator E2 100KHZ-100MHZ **£40**
ADVANCE VHF MILLIVOLTMETER VM79 (No probe) **£50**
ADVANCE SIGNAL GENERATOR type B4B7 30KHZ-30MHZ **£25**
COSSOR NOISE LEVEL METER CT454 (Ex-Ministry) **£18**
S.T.C. ATTENUATOR 0-100DB 600ohm **£9**
S.T.C. ATTENUATOR 0-100DB 75 ohm **£5**
AVO VALVE CHARACTERISTIC METER £20
E.H.T. UNIT 230V 50cs 25VA 7 5V **£22.50**
BRANDENBURG HIGH VOLTAGE GENERATORS 10KV **£60**
BRANDENBURG HIGH VOLTAGE GENERATORS 30KV **£60**
VARIACS Ex-equipment. Good condition 8 amp **£25**
VARIACS Ex-equipment. Good condition 20 amp **£35**
CRC GENERATOR T8FG8860. Sine/square/Triangle Very good **£60**
B&K AUTOMATIC VIBRATION EXCITER CONTROL. Type 1018 **£50**
B&K AUTOMATIC VIBRATION EXCITER CONTROL. Type 1019 **£50**
MARCONI UNIVERSAL BRIDGE. Type TF868B **£100**
SOLARTRON TRUE RMS VOLTMETER. Type VM1484 **£75**
TAYLOR VALVE TESTER. Type 45D **£65**
ADVANCE LF OSCILLATOR. Type H1E **£45**
ADVANCE SIGNAL GENERATOR S62B 150KHZ-220MHZ **£60**
MARCONI UNIVERSAL BRIDGE. Type TF868A **£50**
TAYLOR METER MODEL 128. £15
R&S SELEKTOMAT USWY BN 15221/2 **£100**
B&K LEVEL RECORDER. Type 2304 **£50**
RACAL HF SELECTIVE ANALYSER. Type 9056. **£375**
SCHLUMBERGER AUTO COUNTER. Type FB2602. **£150**
MARCONI F.E.T. MULTIMETER. Type TF2650 (new) **£95**
LEVELL MULTIMETER. Type TM11 **£50**
ICE MULTIMETER SUPERTESTER 680R £15
MARCONI SIGNAL GENERATOR. Type TF144H **£225**
MARCONI SIGNAL GENERATOR. Type TF801D/1/S **£195**
MARCONI UNIVERSAL BRIDGE. Type TF1313 **£250**
RACAL SIGNAL GENERATOR. Type 365A, 1 to 320MHZ AM/FM **£175**
R&S Z-g DIAGRAPH BN3562 300-2400MHZ £85
R&S POLYSKOP 1 SWOB BN 4244/2/50 £350
WAYNE KERR COMPONENT BRIDGE. CT375 (B521) **£75**

R&S UNBALANCED STANDARD ATTENUATOR 500HM. BN18942/50 **£45**
STODDART AIRCRAFT Radio Interference and Field Intensity Meter, type NM-52A 375-1000MHZ (2 pieces) **£325**
MARCONI SIGNAL GENERATOR. Type TF801B **£85**
R&S DIRECT CAPACITANCE METER £50
B&K HETERODYNE VOLTMETER (RECEIVER) Type 2005 **£250**
MARCONI VARIABLE ATTENUATOR. TF1073A/2S **£40**
MARCONI DOUBLE PULSE GENERATOR. Type TF1400/S **£50**
RADIOMETER (COPENHAGEN) WAVE ANALYSER. Type FRA 2CT3a **£80**
SOLARTRON DIGITAL VOLTMETER. Type LM1867 **£75**
HEWLETT PACKARD DIGITAL RECORDER. Type 5050B **£50**
HATFIELD PSOPHOMETER. Type DRG 657167A **£50**
ADVANCE DUAL STABILISED D.C. SUPPLY PP3. 0-30V 1A **£25**
PICTURE MONITOR MODEL PM-52T (5in screen) As new **£65**
HEWLETT PACKARD POWER SUPPLY 6214A. 0-12V; 0-1.2A, new. boxed. **£85.**
H.P. DC POWER SUPPLY 6209B 0-320V, 0-0.1A, new boxed. **£140**
T.O.A. ELECTRONICS LTD Electronic Polyrecorder EPR-2T. Mains **£120**
THE JAMES KING COMPANY FS-1100T FREQUENCY STANDARD £50
MARCONI CARRIER DEVIATION METER. Type TF891D **£50**
SOLARTRON PULSE GENERATOR. Type GO1101.2 **£40**
MI SANDERS LEVELLING AMPLIFIER. Type 6587 **£175**
SCOPEX OSCILLOSCOPE. Type 4D10 DB 10MHZ **£170**
ADVANCE OSCILLOSCOPE. Type OS240 DB 10MHZ **£175**
COSSOR OSCILLOSCOPE. Type CDU150 DB 35MHZ **£225**
TELEQUIPMENT OSCILLOSCOPE. Type D61 DB 10MHZ **£195**
HEWLETT PACKARD OSCILLOSCOPE. Type 120B X-Y **From £85**
FLUKE DIFFERENTIAL AC/DC VOLTMETER. Model 832A **£60**
ADVANCE AUDIO SIGNAL GENERATOR. Type H1. Sine/Square **£25**
R & S TUNABLE INDICATING AMP. BN 12121/2 45-600MHZ **£100**
MUIRHEAD WAVE ANALYSER 30-31HZ **£50**
HEWLETT PACKARD DIGITAL VOLTMETER. Type 3460B **£75**
WAYNE KERR THERMOMETER. Type LT100 with probe. **£50**
HATFIELD RADIO FREQUENCY BRIDGE. Type LE300A/1. **£50**
SOLARTRON OSCILLOSCOPE. Type CD1400. DB 15MHZ. **From £75**
HAMEG OSCILLOSCOPE. Type HM412. **£250**
KNIGHT RF SIG. GEN. KG686 with Sweep Marker Gen. KG687. **The Pair £100.**
H.P. MEMORY DISPLAY 5480B with 5486A Control TB and 5488A Y System. **£275**
H.P. MEMORY DISPLAY 5480A with 5486A Control TB and 5485A two channel input. **£225.**
R&S UHF TEST RECEIVER 0.9-2.7GHZ BN1524 **£150**
EDDYSTONE RECEIVER. Type 990S 250-850MHZ. **£450**
R&S UHF TEST RECEIVER. BN1523 280-940 MHZ. **£120**
KEITHLEY REGULATED HIGH VOLTAGE SUPPLY. Type 241 **£250**
HEWLETT PACKARD D.C. CURRENT SOURCE. Type 6181B **£175**
MARCONI XY MEMORY Type TK2214. **£140**
R&S UHF SIGNAL GENERATOR. BN41022 300-1000MHZ **£80**
GPO DATEL TESTER NO IC. £100
LEVELL BROADBAND VOLTMETER. Type TM6B. **£40.**
DAWE AF ANALYSER. Type 1461A. **£30**
R&S UHF/VHF FREQUENCY METER. BN442 30-3000MHZ **£60**
R&S UHF MILLIVOLTMETER. BN1091. **£70**
GERROLD SWEEP FREQUENCY GENERATOR. Model 602 **£40**
TELONIC SWEEP GENERATOR. Type SD-3 450-900 MHZ. **£75.**
H.P. VHF SIGNAL GENERATOR. Type 608D. Case damaged hence **£50**
MARCONI VALVE VOLTMETER. Type TF1300. **£15**
SOLARTRON DIGITAL VOLTMETER. Type LM1420.2. **£30**
VIDEO CIRCUITS LTD TUBE TESTER. Type V33. **£30**
LABGEAR COLOURMATCH 625 PATTERN GENERATOR. Type CM6004-PG. **£30**
B & K BEAT FREQUENCY OSCILLATOR. Type 1014 **£175**
ADVANCE OSCILLOSCOPE. Type OS1000A. DB 20MHZ **£300**
PLEASE CHECK AVAILABILITY BEFORE ORDERING.

FERRET A.T.E.
£650
Phone for details

EDDYSTONE RECEIVERS
Model 770R-AM/FM
£95 each
Model 770R Mk II
£150 each

INFRA RED IMAGE CONVERTER Type 9606 (CV 144)
1¾in diameter. Requires single low current 3KV to 6KV supply individually boxed. With data.
£12.50 each
Infra Red Lamps also advertised

VARIAN RUBIDIUM STANDARD
Model R20
5mhz, 1mhz, 0.1mhz
£600

EX-MINISTRY SOLID STATE 400 HZ INVERTOR
28 VDC input, 115V output. Size 7 x 2½ x 15in approx. Connection details supplied.
£18 each. P&P £2

TRANSISTOR INVERTOR
115V AC 1.7 Amp Input. Switching is at 20Khz. Output windings from Pot Core. Can be rewound to suit own purpose or unit can be broken for host of components. Circuits supplied.
£1.25 each. P&P £2.

CONVERT THIS UNIT TO A
SUPER BATTERY CHARGER
Attractive green ministry quality case with removable top and bottom plates — heavy duty power switches, high powered resistors to control current, good quality centre mounted amp meter, strip of wing nut terminals on front panel which can be used for connecting leads. All this for **£3.50**. P&P £2. Four units £12. Carriage £5.

SOME TEKTRONIX 500 RANGE OSCILLOSCOPES
with Single Trace Plug-ins. Working.
From £100. Phone for details

DIODES
All new full spec. devices IN3063 BAX 13, 1S44, 1N414B; 1N3470; 1N4151.
100 off **£1.50,** 1,000 off **£10**

STEPPING MOTORS
6/12 position with additional where the rotor is coils. Device can be used as a tacho. Diagram supplied. Will actually work on 5 volts. 12/24 recommended.
£1.50 each P&P 75p
or 5 for **£5** P&P £1.50.

STEPPING MOTORS
200 Steps. 20 oz/in. torque, 12/24 volt input 4-wire.
£12 each. P&P £1.50

KEYBOARD PAD
Size 3x2½x2" high with 12 Alma Reed Switches. Blue keys marked in green 0-9 and a star with one blank.
£4 each, P&P £1, or 5 for **£15** P&P £2.

MINIATURE KEYBOARD
Push contacts, marked 0-9 and A-F and 3 optional function keys. **£1.75 each.**

CRYSTALS **50p each.**
Flat metal case — 19 2KHZ: 844.8KHZ; B7G — 10MHZ.

LOUDHAILERS. Transistorised hand-held, no leads. Standard internal batteries supplied. Howl Switch **£20 ea.** P&P £2
INFRA RED QUARTZ LAMPS. 230V 620 Watts Size 13½" × ⅛" dia **£1.50 ea.** 240V 1650 Watts Size 22¾" x ½" dia. **£3 ea.**
BRIDGE RECTIFIER. 2 Amp **50p ea.**
PHOTODIODE DETECTOR 4" fly leads. **25p ea.**
AMPHENOL. 17-way chassis mount edge connectors 0.1 spacing. **15p ea.**
I.E.C. Standard **MAINS LEAD.** Moulded (3 vertical flat pins centre offset) **60p ea.**
FANS. 115V 13 Watts Size 3¼ × 3¼ × 1½" BRAND NEW. **£4.50 ea.** Secondhand **£2.50 ea.**
DELAY LINE. 50 nanosecs. 3 connections — ground-in-out Size 2 × 7/16 ×5/16" New **25p ea.**
MOTOR 12V DC with pulley and integral semiconductor Speed Control New **£1 ea.**
LEDEX ROTARY SOLENOIDS. 115V DC. No switch assembly. **15p ea.**
DIAMOND H CONTROLS ROTARY SWITCH. Single pole 10-way. Printed Circuit Mount. New **10p ea.** 100 for **£7.50**

PULSE TRANSFORMER. Sub min. Size ½ × 5/16 × ¼". Secondary centre tapped. New **20p ea.**
REMO TV TYPE MULTIPLIER. Two high voltage outputs and focus, **£1 each.**
DON'T TAKE CHANCES. Use the proper EHT CABLE. **10p per metre or £7.50 per 100 metre/drum.** P&P £2.
PHOTOGRAPHIC LAMPS. Pearl 230V 500 watt. Screw cap **75p ea.** Box of 12 **£5.50.** P&P £1.50.
RAPID DISCHARGE capacitors 8mfd 4kV **£5 each.** P&P £2.
MYSTERY IC PACK. Some 40 pin — good mixture — all new devices. **25 ICs for £1.** P&P 50p
DECOUPLING CAPACITORS
0.05mfd 10V, 0.01mfd. 0.047mfd 250V; 33K, 330pf. All values 100 for **£1.50.**
E.H.T. Capacitor 500pf 8KV 20p each.
10-way MULTI COLOUR RIBBON CABLE. New 40p per metre. 10 metres for £3.
GEC UHF 4-button tuner **£1.50 each.**
CENTAUR 115V FANS 4½ × 4 × 1½" **£4.50 ea.**
EX-USED equipment, tested, **60p each.**
CONTACTORS. Heavy Duty 24V DC 5 make **£1 each.**
GEC UHF/VHF 6-button tuner **£2 each.**
931A PHOTO MULTIPLIER £2 each. P&P £1.
RANCO 250V 18A THERMOSTATS with Control knobs calibrated 50-200 degree C **£2.50 each.**
SOLID STATE UHF TUNERS. 30 acs **£1 each.**
BRAND REX blue wire wraps. 30 metres for **£1.** P&P 25p.
SLIDER CONTROL 500K Log. Single track. Complete with knob. Length 3½" **25p each.**
TRANSFORMERS
AUTO 240V input 115 V. 1 Amp output **£1.25 each.** P&P £1.25.
240V input. Soc. 6V. 1.86A. Size 2½ × 2 × 2". Good quality. **£1.50 ea.** P&P £1.
240V input Boc. 12V D.92A. Size 2½ × 2 × 2". Good quality, **£1.50 ea.** P&P £.
240V input 12V 100MA Size 60 × 40 × 42mm. **50p each.**
240V input. Soc. 12-0-12V 50MA Size 53 × 45 × 40mm. **£1 ea.**
115V input. Soc 5V 250MA Size 1 11/6 × 1.5 × 1¼". **2 for 50p.**
115V input. Sec 10-0-10V1A Size 2½ × 2 × 2". 2 for **£1.50.**
SEMICONDUCTORS
1N4005 — **5p;** 1N4002 — **3p.**
At 5p each:
BC147, BC148B, BC157, BC158, BC237, BF197, 0A90, 0A81, BA154, BA243.
At 25p each:
TIP31, TIP41A, 2N5£96, AF139, 2TX341
BY127 **10p.** BF181 **20p;** BD239 **49p;** BD241 **40p;** MA343AT **49p;** BD228 **50p;** BD233 & BD234 Comp Pair 25W — **80p per pr. at 50p each.**
REGULATOR TBA625 8to 20V in — 5V out 100MA TO5 Con. **50p each** BF256C **20p.**
TV AMPLIFIER TBA 120 **20p each.**

Integrated Circuits					
		74H74	12p	75325	£1
7453	5p	74H51	7p	SN15862	4p
7451	5p	74538	10p	MC4028	69p
7402	12p	74502	12p	7417	14p
7476	20p	74154	70p	7441	40p
7495	35p	74C02	16p	74C86	50p
74122	12p	74C04	16p	74C161	24p
74C00	17p	74C74	18p		

MOTOROLA DUAL in Line 6 pin Opto Coupler **30p each.** Gold plate tester version **50p each.**
EPROMS 2708 **£5.50 each.**
SMITHS encapsulated transistorised AUDIBLE WARNING DEVICES 4V 12V Can be driven from TTL **65p each.**
ELECTROSTATIC VOLTMETER. 7 5KV **£8 ea.** P&P £1.50. Other ranges available — please enquire.
TRIMMERS. Sub min 0.25 to 1.25 pf. 1 to 4 5 pf. 7 to 45 pf. **All at 6p each.**
HONEYWELL humidity controllers **50p each.**
THYRISTOR TIMER. Solid State 15 secs adjustable (reset) in plastic relay case. Standard 7-pin base Series delay **50p each.**
MINIATURE PC MOUNT SLIDE SWITCH. 2 pole 2 way **10p each.**
4 D1GIT 7 SEGMENT per digit plus a figure one to the left plus a centre minus sign to the left of the figure one with decimal places between digits Good brilliance at 1.5V. 15 connections **£2.50 each.** Some E H.T. Transformers and Capacigx available Please enquire
TELEPHONES 706 style black; grey or blue **£5.50 ea**; 746 style black or grey **£7.50.** Older style black **£2.50 each.** Discoloured grey 706 **£4 ea** P&P £1.50 per telephone.
DC SERVO MOTOR 110V 2.5Amp continuous. Double shaft. Brand new 4 wire 4 brush **£25 ea.** Plus carriage.
PC Mount POTS. Wire wound with knob 200 ohm & 10ohm. **10p ea.**
MIN. RELAY 24V. 2 pole c/o. Brand new. **75p each.**
TIME DELAY RELAY 0.1 to 10 secs. 115V AC. DPDT. **£5 each.**
CAPACITORS at 5p each. 0.1uf 400V Small rec block PC Mount German class; 3300pf. 220nf250V; 0.01mfd 160V
INSERT can be used as Microphone/Earpiece (Like used as insert in telephone but superior quality) Ex-Min Brand new wrapped **75p** each, or 10 for **£6.**
TORODIAL TRANSFORMERS. Input 0-120-240 Volts Output 0-12V, 0-12V 10VA per winding Encapsulated — identical to R.S. Components at £8.90. OUR SPECIAL PRICE **£5 ea.** P&P £1 50.
TANTALUM CAPACITORS —All at 10p each — 100 off **£7.50.** 22mfd 6V 39mfd 10V; 22mfd 35V, 1mfd 35V
MINIATURE SLIDE SWITCHES. Single pole 2 way **10p** each, 10 off **90p**
HEAVY DUTY RHEOSTAT. 7.5Ohm 5.5Amp. Diameter 5". Standard ¼" shaft **£2.50 each.** P&P £1.50.

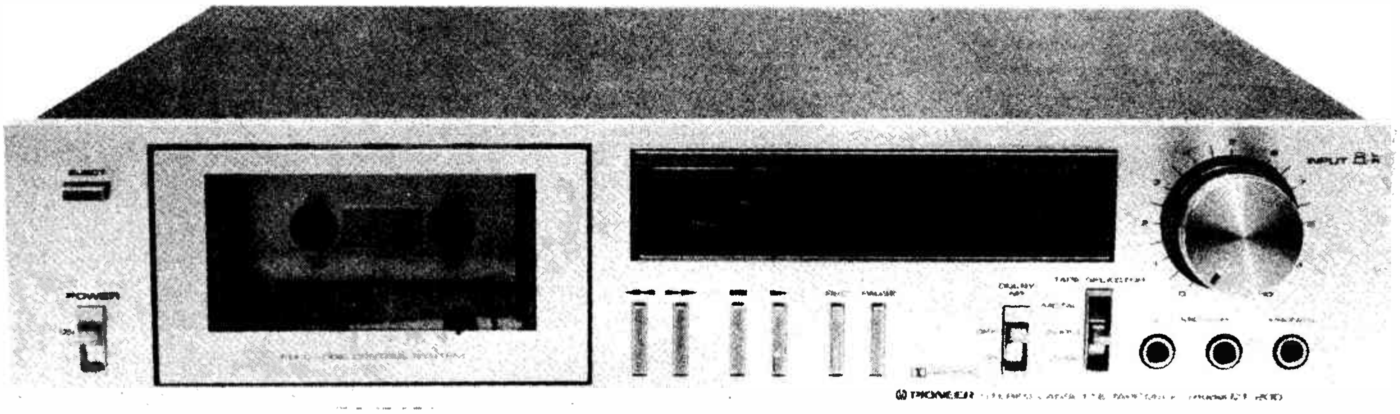
LARGE EX-MINISTRY SPEAKERS. OUTSIDE 15 ohm or 500 ohm Tested. £25 each or 5 for £100.

MINIMUM ORDER £3 VALUE OF GOODS. MINIMUM P&P £1.50 — where P&P not stated please use own discretion — excess refunded.
£5 CARRIAGE ON ALL UNITS. P&P or CARRIAGE and VAT at 15% on total MUST BE ADDED TO ALL ORDERS.
CALLERS VERY WELCOME STRICTLY BETWEEN 9am-1pm and 2-5pm Monday to Saturday inc.
BARCLAYCARD (VISA) and ACCESS taken. Official orders welcome.

CHILTMEAD LTD

NORWOOD ROAD, READING **TELEPHONE NO. READING 669656**
(2nd turning left past Reading Technical College in King's Road then first right — look on right for door with "Spoked Wheel")

AUDIOPHILE



Yes, you read it right. . . Audiophile is back! Ron Harris takes pen in hand again to review a couple of Pioneer tape decks, and enthuses over some old friends.

Right. Put down the trannie radios, pack away the pine needles — Audiophile has returned! That man at the back with the yellow handbag who whispered "Oh gawd, not again" can leave now of his own accord, or be carried out later when the boys get round to landscape his anatomy.

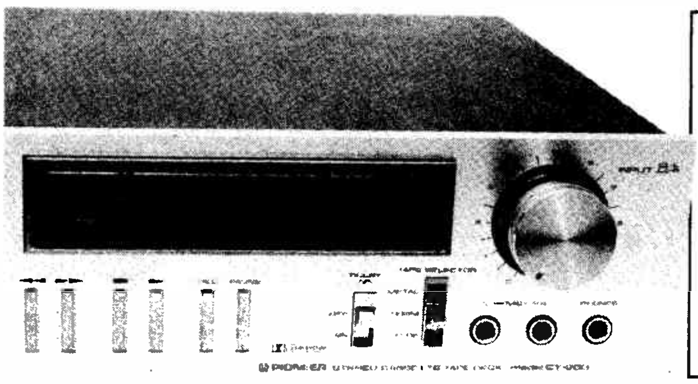
To all my regulars who sorely missed these pages and who wept and wailed their grief to the dawn — thank you. To any tasteless cloth-eared ingrate who thinks I should have stayed away — read on, read on, there is yet hope and charity for such as ye in the halls of the righteous! (ie here. . .).

For my return trick, I'm taking a look at two tape machines from Pioneer's cassette deck range, one from each end: the CTF-1250, which is their flagship design, and the CT-200, an interesting new release at the budget end of the price scale. Thus we shall be all things to all men. . . I think.

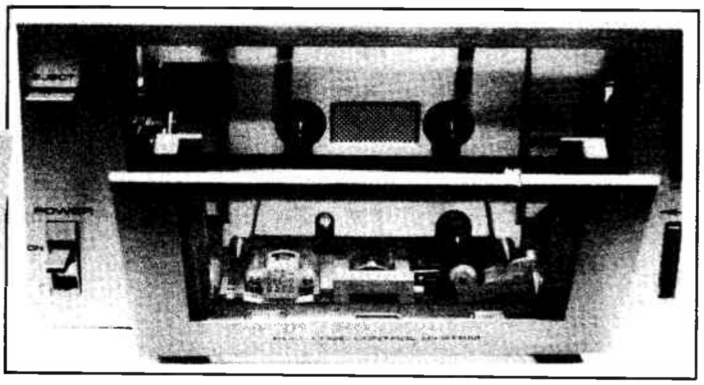
Tape For All Seasons

The new CT-200 is a basic, no-nonsense machine intended mainly for the first time hi-fi man who doesn't wish to have to upgrade again in a hurry. It is compact and sports little in the way of excess controls. Normal VU meters are fitted, with no peak indicators. Logic control is employed for the tape transport mechanism and, strangely, Pioneer have opted for captive phono leads on the input/output connectors. Surely a yard of screened lead and a phono plug can't cost less than a plain ordinary panel socket?

Apart from this the CT-200 is distinguished only by its normality! There are no frills and no gimmicks at all. The controls worked impeccably at all times and the meters were fast enough to give reliable results when recording.



As you can see from this detail of the control section of the CT-200, Pioneer have kept it simple. The meters are conventional VU, with no peak indicators, but this should not deter an intended purchase, as they are still pretty good at their jobs! Transport controls are solenoid operated, a plus point at the price.



Unusual is the way in which virtually a whole section of the front panel unhinges to accept a cassette. Can be a little un-nerving the first time, you think something somewhere has dropped off, if you'll pardon the expression!

The heads are easily accessed for cleaning.

The one minor annoyance was the switching 'thump' generated whenever the mains power was interrupted. A small thing, but one which Pioneer should attend to, ASAP.

Resulting Tests

The test bench brought forth no gremlins from the design and a scrutiny of the results will show that good figures were returned on all counts. The signal-to-noise and metal tape figures are particularly impressive for a machine in this price bracket.

Sensitivity was slightly below the spec., at about 80 mV, but this is still a very reasonable figure and one that, together with the input impedance of 90k, should ensure that the CT-200 will work happily with the majority of amplifiers.

Wow and flutter is very well controlled and proved unobtrusive in use. All in all the machine gave a surprisingly good account of itself under test and one which does it credit at the price.

Frequency response : (−20 dB)	LH tape :-	25 Hz — 14 kHz ±4 dB
	CrO_2 :-	25 Hz — 17 kHz ±3 dB
	Metal :-	25 Hz — 18 kHz ±2 dB
	FeCr :-	25 Hz — 18 kHz ±3 dB
Signal-to-noise Ratio :- (best result, Dolby on)		−65 dB
Wow and Flutter :	DIN :-	±0.15%
	WRMS :-	±0.05%
Harmonic Distortion :-		1.2% (0 dB)
Line Sensitivity :-		80 mV
Input Impedance :-		90k

Table 1 — Test Results CT-200

Auditioning

Having duly done my duty with the meters and measures, it was down to the nice part of the job — settling back in a chair and listening to the deck playing coherent music as opposed to all those monotonous tones. Again the CT-200 provided a surprise — put simply, it sounded better than I suppose I'd expected. The sound was clean and sharp, with little trace of the old 'cassette sound' that was so immediately recognisable a couple of years back. The machine was always detectable against a reference, as would be expected for a £100 deck, but was never anything less than satisfying to listen to.

Overall it represents very good value for money and can be thoroughly recommended. It just goes to show how far budget hi-fi — and tape in particular — has come of late.

Battleship Engineering

The CTF-1250 is a massive machine which is some 16½ x 7½ x 14½ inches in size, and 26 lb in weight. Once more into the truss dear friends, or block up the living room with tape deck . . .

For all that, the front panel is tightly packed with controls, buttons and things that glow in the night. There is even a control to turn down the brightness of the fluorescent display, lest its brilliance offend thee.

Basically the machine is possessed of full tape optimisation facilities, a digital tape counter, full logic controls which can be operated from the counter, and peak reading meters which can be set to one of *three* modes.

Rather than waste an issue describing it all in a thousand words, take a look at the photo and diagram, the caption to which should explain the myriad machinations of the machine.

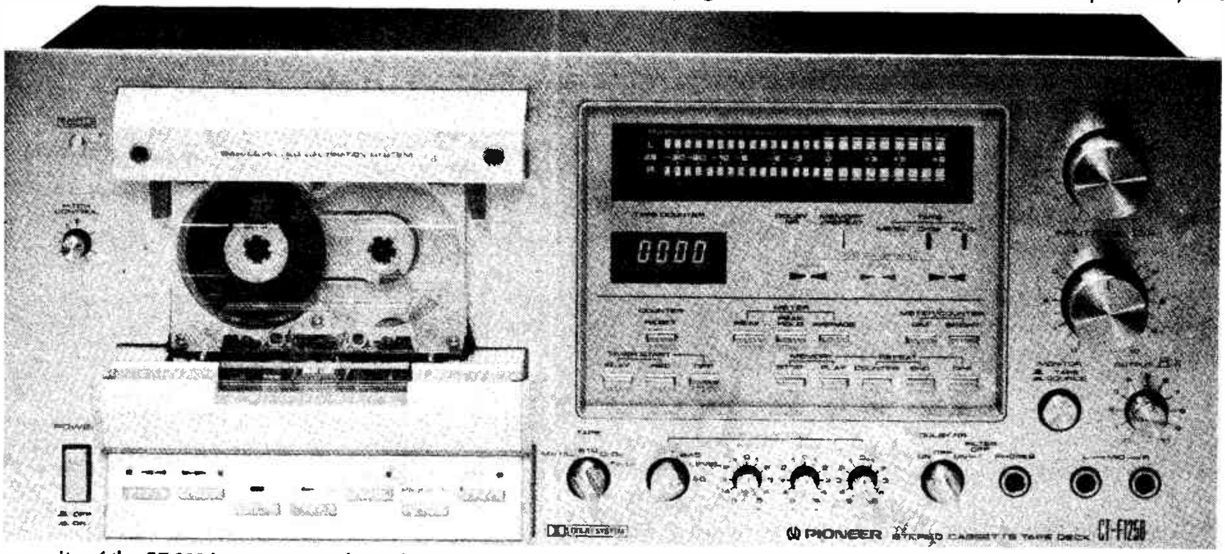
Results Of A Test

Table 2 gives a brief extract from the test results, in a form which can be compared to those for the CT-200. As you can see, there is not the difference you may expect, considering how many more bits of green paper are required to obtain the 1250. Those buttons cost money.

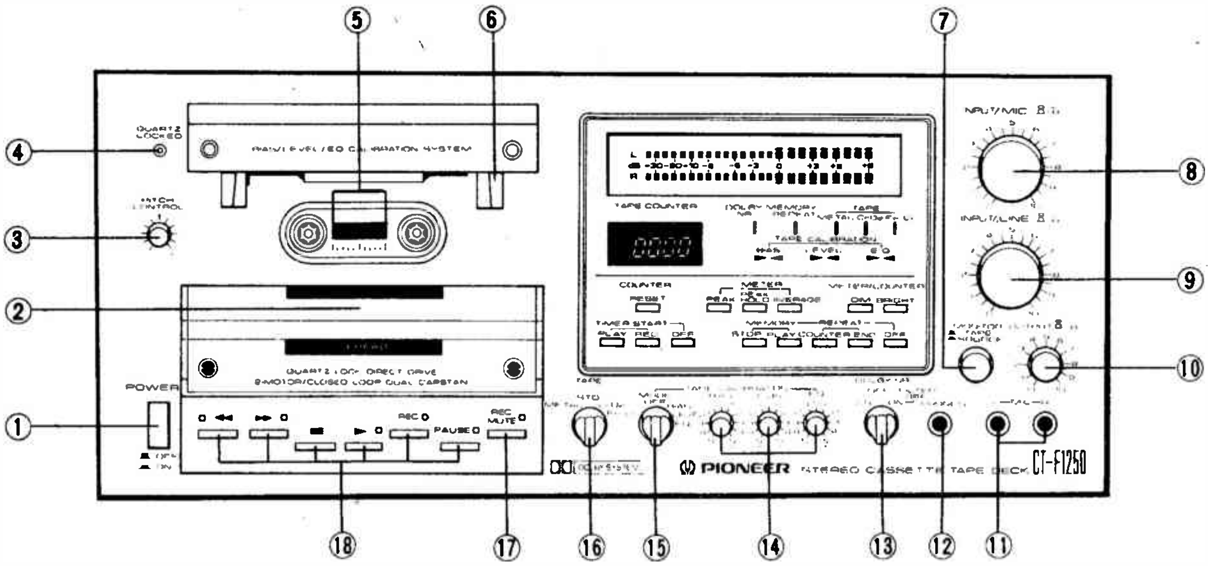
All results are given with the machine optimised for the tape in use. With the system employed here, such a set-up is easy and certainly yields improved results for relatively little effort. The figures are generally 'good' for a cassette deck but are nothing outstanding by any means. The CTF-1250 turned in solid, repeatable performance on all the important parameters.

Listening In

Under audition the 1250 proved a difficult machine to live with. No insult intended, it was just well-nigh impossible to stop playing with the controls and *listen* to it! In practice, once a par-



The exact opposite of the CT-200 in every way! This is the daunting 1250, Pioneer's tape flagship. Those impressive meters have three modes of operation, peak reading or hold and average.



Rather than attempt to describe the 1250, I've taken the visual approach and stolen this illustration from the Pioneer handbook!
1) *Mains Power:* **One fault here is that it is not 'de-thumped'. 2)** *Dust Cover:* **fits over the heads which would otherwise be very vulnerable. A nice touch this. 3)** *Pitch Control:* **yes, that's right the speed is quartz locked and can be varied if required. 4)** *PLL Indicator:* **activates when speed is correctly set. 5)** *Remaining Tape Markers:* **just the usual backlight to show how much tape is left. 6)** *Tape Guide:* **accurately machined guide paths to make sure you put the cassette in straight. 7)** *Monitor:* **standard stuff for a 3-head design, chooses tape or source. 8)** *Mic Level:* **ganged input control for the front panel jacks. 9)** *Line Input:* **ditto for the two inputs on the rear panel. Friction linking is a little** *too* **strong! 10)** *Output Level:* **click stopped at 0 dB. 11)** *Mic Inputs:* **¼" jack sockets. 12)** *Headphone Output:* **provides a healthy output to drive a pair of dynamic phones. 13)** *Dolby/Filter:* **allows use of the NR with/without MPX filtering. 14)** *Tape Calibration:* **just set the Mode switch to required parameter and adjust the appropriate control until the calibration lights indicate purity. Simple and efficient. 15)** *Mode Control:* **used with 14. 16)** *Tape Selector:* **standard choice of four tape types. 17)** *Record Mute:* **useful for killing ads. when taping from radio etc. 18)** *Solenoid Controls:* **all transport controls are logic locked and virtually idiot-proof.**

ticular brand of tape has been settled on, and the control settings noted, there is little reason to fiddle around at all.

The metering is superb and about the most useful I've encountered anywhere. The sound quality is, again, good, but not as good as can be obtained elsewhere for £450. Some sacrifice has to be made if you want to buy all those lovely facilities.

Best results — regardless of optimisation, strangely enough — were obtained with Maxell tapes and in particular the UDX-II. Sony Metal came a close second, which although providing a cleaner result, showed some signs of treble lift whatever I did to the optimiser.

Frequency response : (−20 dB)	LH :-	25 Hz — 15 kHz ±3 dB
	CrO_2 :-	25 Hz — 17 kHz ±3 dB
	Metal :-	25 Hz — 19 kHz ±3 dB
	FeCr :-	25 Hz — 16 kHz ±3 dB
Signal-to-noise Ratio :- (best result, Dolby on)		−66 dB
Wow and Flutter :	DIN :-	0.1%
	WRMS :-	0.03%
Harmonic Distortion :-		0.9% (0 dB)
Line Sensitivity :-		60 mV
Input Impedance :-		50k

Table 2 — Test Results CTF-1250

Sum Summary

Adding it all up, the CTF-1250 comes out as a very crafty compromise; one that will appeal to many. Its sound is not of the ultimate quality, but its facilities and versatility are second to none.

The CT-200 is a well-conceived and well-executed budget deck that offers excellent value for money and an outstanding sound quality for the class.

Audio Updates

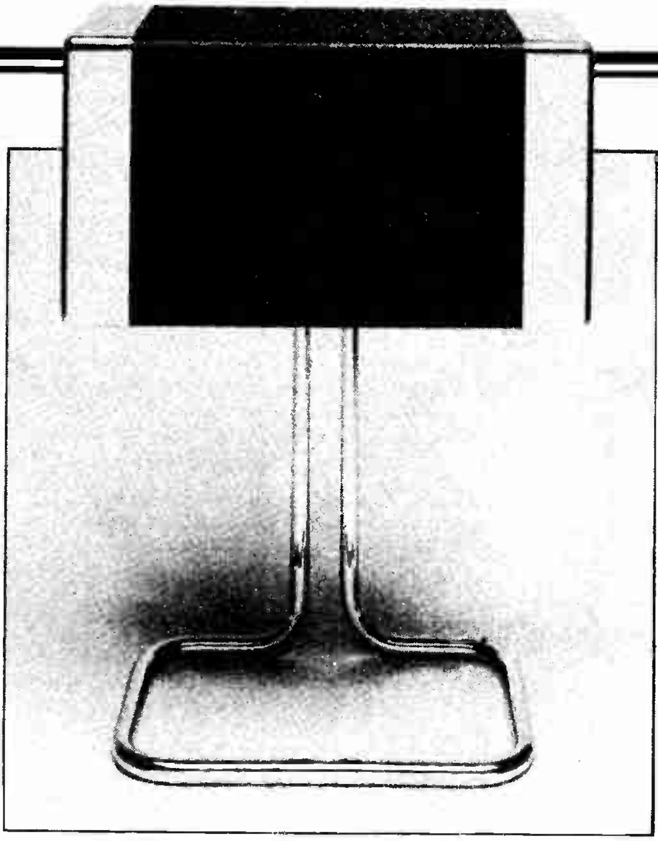
At present I'm working on a feature called 'Sonic Holography' for next month's ETI — and if you don't know what that is (S.H. not ETI!) then you're gonna have to buy our next issue, 'cos I ain't gonna tell you now — as part of which I've had the chance to renew my acquaintance with the Gale loudspeakers. I thought that since such opportunities occur but rarely, I'd drop the reader's letters and ramble on about them for a while instead.

Any Port In A Gale?

Few products, especially loudspeakers, can claim to have stood the ravages of time and changing tastes as successfully as the Gale GS401. It is now many years since Ian Gale first unleashed his chrome-end, unconventionally horizontal transducer upon the ears of the world and, if anything, its standing has risen with the passing of the summers.

Infinite baffle enclosure (330 x 605 x 270 mm)
Four unit design (2 x 200 mm; 1 x 100 mm; 1 x 19 mm dome)
Crossover frequency : 475 Hz and 5 kHz
Efficiency : 20 W produces 96 dB at 1 m
Power handling : 40 W — 200 W RMS per channel into 8R amplifiers recommended
Fuse-protected against overload

Table 3 — Specification of Gale GS401A



Above: the imposing Gale 401, in chrome livery. The stands are also available in a black finish and personally I prefer it that way!

It is basically a four unit, infinite baffle (sealed box) design of prodigious power handling and excellent imaging. Long before 'phase linearity' gathered unto itself the role of buzzword, the Gales were presenting an essentially phase stable performance, witnessed by the incredible square wave performance. This is one of the few loudspeakers through which such a signal may pass and emerge with some semblance of accuracy.

I had the Gales at home for a period of some weeks and grew to appreciate their virtues more with time. Comparing them to my usual reference — the KEF 105 II — they have a relatively similar approach to music. The 105 has a better defined bass register and a more transparent treble, but the Gales run them mighty close indeed — and at half the price!

Anyone who is about to spread over £400 on the counter for a pair of speakers would be well advised to hold onto the cash until he'd given the 401s a chance to show what they can do. They are more room dependent than most transducers in this league and less coloured than any when set up correctly. Still an outstanding design then, and a lasting credit to their designer.

Trailer

Next month it's back to pickups for a trio of moving coils from Mayware, Ultimo, and Ortofon. I'll also be putting down some words on a new Japanese speaker (shock horror . . .), the Mitshubishi DS-32B which has been specially designed for non-oriental ears.

ETI

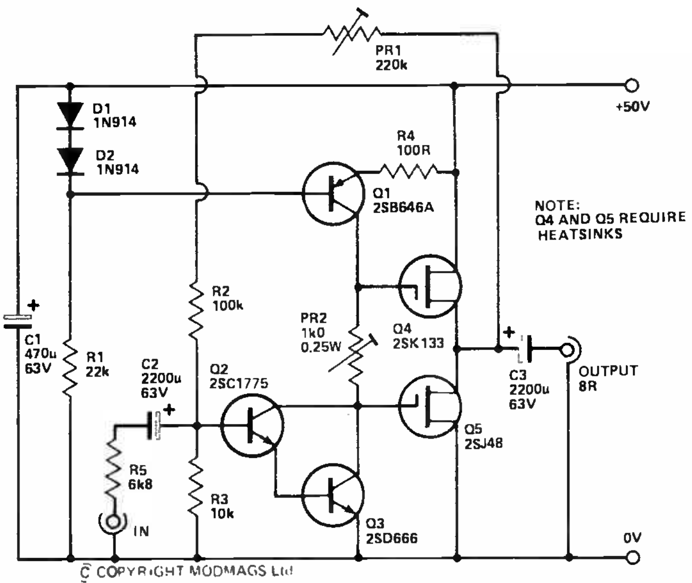
SPOT DESIGNS

20 W MOSFET Amplifier

Although power MOSFETS were originally only used in super-fi amplifiers, they have fallen in price to the point where they can be given serious consideration for use in any amplifier where an output power of between about 20 W and 100 W RMS is required. This simple design gives good quality results with the level of total harmonic distortion well below 1% at all audio frequencies provided the maximum output power is not exceeded. The maximum output power is a little over 20 W RMS if a 50 V supply is used and approximately 30 W RMS if a 60 V supply is employed with the unit (both are loaded voltages).

The circuit is basically quite conventional with Q2,3 being used as a Darlington pair, common emitter driver stage. The main collector load for this is formed by a constant current generator circuit using Q1 and its associated components. This gives a current of about 6-7 mA in the driver stage. Such a low current is acceptable due to the very high current gain of the complementary source follower MOSFET output devices. PR2 is used to set the appropriate quiescent output current through the output stage and the slightly negative temperature coefficient of the output devices makes any thermal stabilisation here totally unnecessary. R2,3 and PR1 are used to bias the amplifier. No phase or frequency compensation components are needed due to the excellent high frequency performance of the two output transistors.

Before initially connecting the supply to the circuit, set PR1 at about half maximum resistance. PR1 is then adjusted to give half the supply voltage at Q4 and Q5 source terminals and PR2 is advanced to give the circuit a quiescent current consumption of approximately 100 mA. The circuit has an input sensitivity of about 500 mV into 6k8



for full output. Current consumption is about 800 mA RMS at 20 W RMS output and almost 1 A with an output of 30 W RMS. The transistors are available from Ambit International.

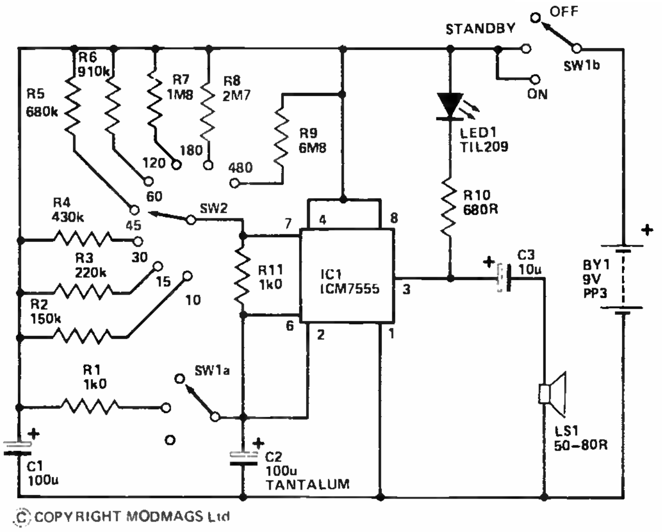
Call Charge Reminder

The idea of this simple circuit is to give the user some idea of the number of units that are being accumulated while a telephone call is in progress. It is not intended to give a readout of the number of units, but instead gives a warning (clicking) sound each time an extra unit is accumulated. This enables a very simple and inexpensive circuit to be used and is effective in that it prevents the user from losing track of time.

A CMOS version of the 555 timer device (the ICM7555) is used as the basis of the unit. Using the CMOS version has the advantage of giving a much lower current consumption (about 100 uA). Before starting to dial the required number the unit is switched to the standby mode using SW1. This connects power to the circuit, but the 555 astable is blocked from operating properly by R1 which holds timing capacitor C2 into a charged state.

When the call is answered, SW1 is switched to the on position and R1 is then disconnected so that the unit is able to function normally. However, the astable cycle does not start at the normal point with C2 charging from zero. Instead, C2 is rapidly discharged to one third of the supply voltage through R11 and IC1 and then starts to charge again. This is important, since the initial cycle of the circuit would otherwise be significantly elongated (an effect that occurs with virtually all astable circuits).

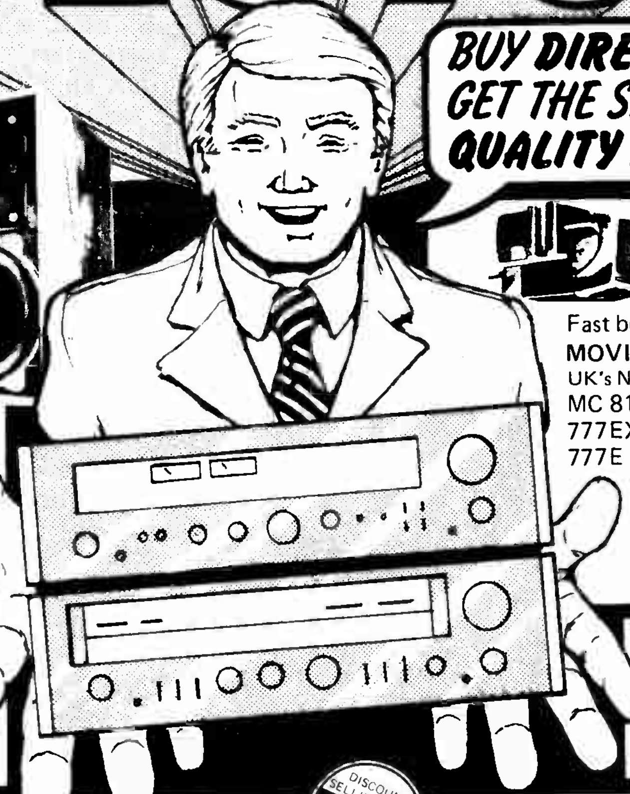
The operating frequency of the unit is controlled by SW2 and the series of timing resistors (R2-9). The telephone dialling instructions booklet should be consulted to ascertain the time per unit of the call you are about to make and SW2 is then set to the appropriate time. The output of IC1 is normally high, but at the end of each cycle it briefly



goes low, giving a clicking sound from LS1 and giving a brief flash from optional indicator LED 1. Each click, including the one that occurs as the unit is switched to the on position, indicates an extra unit has been accumulated.

VIDEOTONE

BUY DIRECT FROM US AND GET THE SAME HIGH QUALITY AT LOW PRICES!



CORAL CARTRIDGES

Fast becoming one of the top names

MOVING COIL UK's No. 1 Cartridge		MOVING MAGNET	
MC 81	£48.87	555SX	£7.28
777EX	£35.00	555E	£14.22
777E	£25.00	666E	£32.48

HEAD AMP		HEADSHELLS	
H300	£51.75	S100	£6.00
T100	£24.75	S101	£7.00
		S200	£4.00

DISCOUNT SELLING PRICE £50·00

LOUDSPEAKERS

The complete fully reviewed range of Videotone Speakers which dominate within their class. NOW AT LOWEST EVER PRICES.

D100	£38.00
Minimax 11	£44.00
GB3	£50.00
GB2	£60.00
GBS	£207.00
D 93	£40.00

TURNTABLES

Sansui SR222 Mk2	£69.00
Sansui P50S	£69.00

DISCOUNT SELLING PRICE £68·00

AMPS-TUNER-CASSETTE

30 watt amp MC input SA4 130	£75.00
Stereo Tuner ST 4120	£68.00
Cassette full features SC 4200	£95.00
50 watt amplifier WA7700	£77.00
20 watt amplifier LA2020	£58.00

This new range of Electronics from Videotone redefines the words quality and value for money to a new high.

DISCOUNT SELLING PRICE £75·00

MICROPHONES

MU 105-22	£29.30
MU 105-12	£22.25
MU 25 C	£17.39

HEADPHONES

Superbly made with top flight performance

£9.69

HP90	£12.65
HP80	£9.69

* A MESSAGE FROM VIDEOTONE *

Dear Customer

You will find that the products advertised on this page are the best possible value for money. They are only low in price because we have eliminated large amounts of selling costs that other brands have to suffer. These savings are passed directly onto you. We have full brochures on any specific item you may be interested in and a competent realistic staff of engineers at our London Showrooms to help you in your choice. Our consumer protection packages are comprehensive and we offer every form of financing you may require. We carry out our own servicing and are dedicated to giving **Value for Money.** We are confident our products are unbeatable. You may purchase with confidence because our Engineers have specially selected them from competitive sources throughout the world and we import them directly ourselves. **Remember, you have 21 days trial period on all products. That is the measure of our confidence.**

C. Hardcastle

Cliff Hardcastle, Managing Director.

Quality plus value ~ always

VIDEOTONE

ALL PRICES INCLUDE VAT

ALL PRODUCTS ON DISPLAY & CONTINUOUS DEMONSTRATIONS

98 CROFTON PARK ROAD LONDON SE4 TEL: 01-690 8511/2

SEND FOR OUR LATEST FREE BROCHURE AND DETAIL LIST OF LOCAL SALES OUTLETS IN THE U.K.

NAME ____________________

ADDRESS ____________________

____________________ ET

Get a great deal from

Marshall's

CRIMSON ELEKTRIK HI FI MODULES		
CE 608	Power Amp	£20.09
CE 1004	Power Amp	£23.43
CE 1008	" "	£26.30
CE 1704	" "	£33.48
CE 1708	" "	£33.48
CPS 1	Power Unit	£19.52
CPS 3	" "	£23.52
CPS 6	" "	£30.00
CPR1	Pre Amp	£32.17
CPR1S	" "	£42.52

SINCLAIR INSTRUMENTS

Digital Multimeter
PDM35 £ 34.50
" " DM235 £ 52.50
" " DM350 £ 72.50
" " DM450 £ 99.00

Digital Frequency Meter
PFM200 £ 49.80

Low Power Oscilloscope
SC110 £139.00

TF200 Frequency Meter
£145.00

TGF105 Pulse Generator
NEW £ 85.00

LCD Multimeter
TM351 £99.00

LCD Multimeter
TM352 £49.95

Prescaler
TP600 £37.50

ILP HI FI MODULES

Power Amplifiers
HY30 £ 7.29
HY60 £ 8.33
HY120 £17.48
HY200 £21.21
HY400 £31.83

Pre Amplifiers
HY6 £ 6.44
HY66 £12.19

Power Supplies
PSU30 £ 4.50
PSU36 £ 8.10
PSU60 £13.04
PSU70 £13.04
PSU180 £21.34

MULTIPLEX NICKEL CADMIUM CELLS

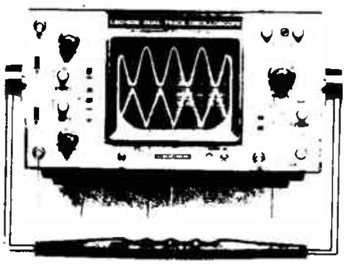
Type S101 (HP4) £0.98
Type SubC (HP11) £1.75
Type SubD (HP2) £1.95
Friwo Chargers for above
Penlight 4: accommodates 1—4 size HP7 £5.50
Combibox FW611: accommodates HP7, HP11 £13.25

NOTE ALL PRICES NET. EXCLUDING VAT. POSTAGE/PACKING

New

Presensitised PC Boards, Developer. U.V. units.
Toyo miniature Fans 230v AC £9.95
Mini Metal Detector/Voltage Tester for locating cable under plaster £9.95
Flow/Speed Sensors for monitoring fuel consumption electronically in vehicles

Just one of the exciting Leader range



£299 + VAT

LB0508A OSCILLOSCOPE With 20MHz DC bandwidth and 10 mv input sensitivity on a 5" screen this universal oscilloscope is suitable for a wide range of applications.

Send SAE for details of full range.

Marshall's 80/81 catalogue is now available by post, UK 75p post paid Europe 95p post paid: Rest of world £1.35 post paid.

A. Marshall (London) Ltd., Kingsgate House, Kingsgate Place, London NW6 4TA.
Industrial Sales: 01-328 1009
Mail Order: 01-624 8582 24hr service.

Also retail shops: 325 Edgware Road, London W2. 40 Cricklewood Broadway, London NW2. 85 West Regent St., Glasgow 108A Stokes Croft Bristol.

QUALITY DOES NOT HAVE TO COST VERY MUCH!

ALL PRICES INCLUDE VAT

BECKER *Hi-Fi Speakers*

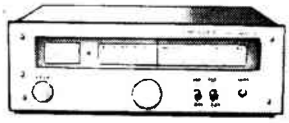
All models multi-speaker systems

With controls, attractive woodgrain finish. RMS ratings for 8 ohm.

12.60 12" 4 speaker system 60 watts 26½" × 14½ × 11" .... **£115.95** pair

15.90 15" 5 speaker system 90 watts 28" × 17½" × 11½" .... **£135.95** pair (UK c/p **£12.00** pair)

ON DEMONSTRATION TO CALLERS



SCOTT T516 STEREO FM/AM TUNER

HIGH QUALITY STEREO FM/AM TUNER BY SCOTT OF USA.

Overall size 5" x 14½" x 12". Brand new and fully guaranteed at a special low price.
(C/P £1.55)

£38.95

On demonstration for callers.

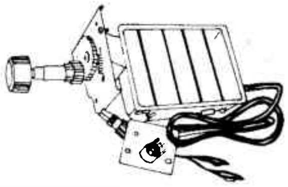
JVC BELT DRIVE TURNTABLE

JVC TURNTABLE WITH FREE AUDIO TECHNICA AT100 STEREO CARTRIDGE.

- ★ 'S' shaped tone arm
- ★ Belt drive
- ★ 12" Platter ★ Calibrated counter-balance weight
- ★ Anti-static device

Size 12¾" x 15¾"
(C/P £1.55)

£29.95



1000's SOLD

TV SOUND FROM YOUR HI-FI

High quality TV sound converter plugs into aerial socket of your FM tuner. 9 volt battery operated (battery not supplied). Nothing to look at ... but just listen!

- ★ **Fitted slow-motion drive**

(UK Post etc. 65p)

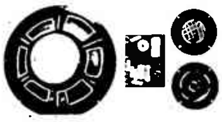
On Demonstration for callers.

£8.50

New model (appearance may differ from illustration)

SEAS SPEAKER KITS

8 ohm



Professional sound hi-fi speaker kits with high sensitivity (89-92dB). Extended frequency response ('223' 50-20kHz. '253' 35-25kHz). Designed and made in Scandinavia to the highest quality. All supplied with complete cabinet plans, tweeters/crossovers/leads etc. ★ On Demonstration to callers.

- ★ Hi-Fi 223. 30/45 watt 3 speaker 8" system .... **£43.50 pair**
- ★ Hi-Fi 253. 60/100 watt 3 speaker 8" system .... **£34.50 each**
- ★ Hi-Fi 403. 60/100 watt 3 speaker 10" system .... **£44.50 each**
- ★ Hi-Fi 603. 80/150 watt 3 speaker 12" system .... **£64.50 each**

(UK C/P £2.50)

COMPLETE RANGE OF SEAS CHASSIS SPEAKERS ETC ALWAYS IN STOCK ALSO STOCKISTS FOR AUDAX, GOODMANS, KEF, PEERLESS ETC.

PIEZO TWEETERS

New low prices

Clean sound, very low distortion tweeters. No crossover required. Suitable up to 100 watts — more in series.

1 Mid-range horn for disco/pa/groups .. £6.95
2 Tweeter horn for hi-fi/disco/pa £5.50
3 Popular hi-fi and disco £4.40
4 Flat type hi-fi £3.50

On Demonstration to callers.
C/P 50p (up to 4 items)

STEREO ACCESSORIES

- ★ GE1305 Hi-Fi Frequency Equaliser .. £62.95
- ★ APM 200 Peak programme meter (twin scale) £39.95
- ★ MS3219 Twin Scale audio output meter £12.95
- ★ MC350 Tape echo chamber £59.95

FREE CATALOGUE

Large range of speakers/stereophones/microphones/mixers/PA equipment etc — and much more!
Plus huge range of test equipment.
ALL PRICES INCLUDE VAT
SEND LARGE 20p SAE

PRICES CORRECT AT 1.2.81

AUDIO ELECTRONICS Cubegate Limited

301 EDGWARE ROAD, LONDON, W2 1BN, ENGLAND.
TELEPHONE 01-724 3564 OPEN 9-6 Mon-Sat

ORDER BY POST OR TELEPHONE WITH BARCLAYCARD/ACCESS OR CALL IN AND SEE FOR YOURSELF

THE LEPTONS

No, not more aliens for Captain Kirk to deal with, but a family of subatomic particles. Lepton means 'light particle', but some of them aren't, and they may not be made up of quarks either. Confused? So are the particle physicists. A.S. Lipson explains.

Once upon a time, physics was simple (well, nearly. . .). Subatomic physics especially, seemed to be fairly clear cut. Around the turn of the century, J. J. Thomson had discovered the electron, which carried a negative electrical charge. A few years later, Max Planck had stated the existence of the photon, or 'particle of light'. There was one other particle; the proton, which was positively charged, and had a mass about 1836 times that of the electron. The proton and electron were known to exist within atoms. That was the entire list of subatomic particles, and it looked as though everyone would live happily ever after.

Then things got complicated. In the 1930s and 40s, more particles started turning up, and they have continued to do so to the present day. First there were the neutron and mu-meson. Then there were the pi-mesons, or pions (three different ones!), the Kaons, the positron, the anti-proton, the anti-neutron, the anti-muon, a few different particles called Sigmas, and no less than four variations on a type of particle known as a neutrino (of which we will see more later). . . . The list seemed endless.

Eventually, the physicists managed to start simplifying the situation. It became apparent that many particles — the proton and neutron, for example, might be made up of various combinations of a few even more basic particles — called quarks. Instead of having all those different particles, maybe everything could be explained in terms of just three or four quarks. There was a particular group of particles, however — collectively known as 'leptons' — which did not seem to be made up of quarks. It's these particles which concern us in this article.

Light Matter

The word lepton comes from the Greek word 'lepto', meaning light, since the earliest leptons discovered were particles with relatively little mass. It is now known that not all leptons are light, after all, but the name has stuck.

The first lepton to be discovered was the electron, which has a negative electric charge of 1.6×10^{-19} coulombs, and a mass of 9.1×10^{-31} kg. (It will be convenient for the purposes of this article to refer to particles as having a mass of so many times the mass of the electron, so for the moment we can say simply that an electron has mass 1. Using this scale, a hydrogen atom has a mass of nearly 2000). The next particle to enter our story is the neutron. The neutron is not a lepton, but its relationship with the electron leads us to the next important point — the neutrino.

The neutron is a fairly massive particle; on the electron's scale it has a mass of 1839. It carries no net electrical charge — hence its name. One important feature of the neutron is that, like many particles, it is unstable. An isolated neutron will tend, after an average time of 15 minutes or so, to disintegrate, producing a proton (mass 1836) and an electron. You will notice that, since the neutron carries no charge, when it turns into a positively charged proton, it is necessary that an equal and opposite charge — the electron — is created at the same time, so that the total charge remains zero. All well and good, then; sometimes a neutron spontaneously changes into a proton and an electron.

Particle	Mass (x electron mass)	Charge (in coulombs)	Lifetime	Lepton
Proton	1836	1.6×10^{-19}	Stable	No
Neutron	1839	Zero	About 15 min	No
Electron	1	-1.6×10^{-19}	Stable	Yes
Electron-neutrino	Very small	Zero	Stable	Yes
Muon	207	-1.6×10^{-19}	2.2×10^{-6}S	Yes
Muon-neutrino	Very small	Zero	Stable	Yes
Tau	About 3500	-1.6×10^{-19}	Less than 3×10^{-12}S	Yes
Tau-neutrino	Very small	Zero	Stable	Yes

Table 1. Particles discussed in the article (antiparticles left out for simplicity).

Think Of A Particle. . .

Unfortunately, it isn't quite that simple. You see, when this reaction was first observed to happen, physicists weren't too happy with it. It seemed that certain physical laws which had always held before weren't holding any more. But then it was spotted that all the laws *would* be holding, if only there was another particle taking part in the reaction. This particle, although it had never been observed, was christened the 'neutrino', from Italian words meaning 'little neutral one' — since the neutrino, if it existed, would have little or no mass and be electrically neutral. The fact that the neutrino had never been detected was easily explained — all the methods used to detect subatomic particles depended on their having measurable masses and charges. The neutrino had neither. In fact, neutrinos react with other matter very rarely. If a beam of neutrinos was aimed at a concrete slab a light-year thick, by far the majority would get through easily!

You may think it a little bit far-fetched that scientists would actually *invent* a new particle — one that had never been found — just to explain why some physical laws didn't seem to work. Why not just change the laws? Well, all through the history of science, it has invariably turned out that the simplest explanation of a set of events is the correct one. In this case, it was simpler to keep the old, simple set of laws and invent a new particle, than it would have been to invent a whole new set of more complicated laws. This, at least, was how the physicists reasoned, and as it happened, they were right! In 1956, twenty-five years after its original invention, the neutrino was discovered! In fact, it was found that the particle produced when a neutron turned into a proton and an electron was not a neutrino, but its 'antiparticle', the antineutrino. This, however, was a small point, and the discovery of the actual existence of the neutrino is regarded as a major triumph for theoretical physics, which had predicted its existence all those years before.

So now our family of leptons contains two particles; the electron and the neutrino (and their antiparticles — the 'positron' and the 'antineutrino' respectively). This wasn't the case for long, though. In the late 1930s, another lepton was discovered in cosmic rays high up in the atmosphere. This particle was called the mu-meson, or muon for short. It was given the symbol μ , the Greek letter mu. There are only two real differences between the muon and the electron. Firstly, the muon has a much greater mass, about 207 times that of the electron; and secondly, the muon, like the neutron, is unstable, although on average it has a much shorter lifetime. Under normal conditions, a muon will disintegrate after only about one five hundred thousandth of a second, turning into an electron and producing two neutrinos. Apart from these two differences, however, the electron and muon are strikingly similar. For instance, both carry the same charge, -1.6×19^{-19} coulombs. The anti-muon carries a positive charge of the same magnitude, just as does the anti-electron, or positron. The similarity between the two particles has been puzzling physicists ever since the discovery of the muon. But there's one more thing puzzling them, too. . . .

Identical Twins?

It was found that many of the reactions involving electrons also involved neutrinos. Similarly, many reactions involving muons also involved neutrinos. The neutrinos that reacted along with electrons didn't seem to be the same as those which reacted along with muons. Apparently, there were two types of neutrinos. If you examined a neutrino from a reaction involving an electron, you would find that it could not be made to take part in a reaction involving a muon. Similarly, a neutrino from a muon reaction could not be made to react with an electron. Neutrinos, then, had to be divided into two groups; 'electron neutrinos' and 'muon neutrinos'. What is the difference between the two types of neutrino? The somewhat embarrassing answer (for a physicist) is that, even today, nobody really knows. They *are* different, but we don't know why. All we do know is that reactions involving electrons tend also to involve electron neutrinos, whereas reactions involving muons tend to involve muon neutrinos. When a reaction involves both electrons and muons, both types of neutrinos are involved. For instance, when a muon turns into an electron, a muon neutrino and an electron antineutrino are produced (see Fig.1b). The two types of neutrinos are like almost-identical twins — you can't tell the difference just by looking at them, but only by looking at the different ways they behave. And, of course, each of the two types of neutrino has its own anti-neutrino, as well.

Three's A Crowd. . . .

As if the situation wasn't already complicated enough, experiments conducted in the last five years or so indicate (wait for it) that there's yet another lepton. This one, called the tau particle (and given the symbol τ — the Greek letter tau) is, again, just like the electron and muon, but with a still greater mass (about 3500 times the mass of an electron — nearly as massive as a molecule of hydrogen! As far as subatomic particles go, this is well into the heavyweight league), and with a still shorter average lifetime before it distintegrates into other particles. As yet, experiments are not conclusive, but it seems that the tau particle also has its own pair of neutrinos — the tau neutrino and the tau antineutrino. Unsurprisingly, these neutrinos refuse to take part in electron or muon reactions, unless a tau particle is also involved.

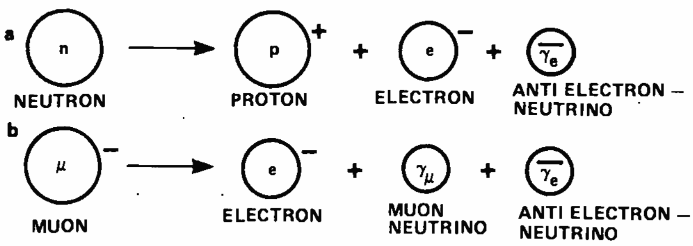


Fig. 1. (a) Neutron turning into proton and electron, giving off anti-neutrino. (b) Muon disintegrating to produce electron, muon-neutrino and anti electron-neutrino.

Any Answers?

So that is the situation at the moment. There are three known leptons which carry electric charge — the electron, the muon and the tau (each also having a positively charged antiparticle) and correspondingly, three sets of a pair of neutrinos — the electron-, muon- and tau-neutrinos, with their antiparticles. There are a lot of questions still to be answered. Are there any more leptons, like the electron, muon and tau, but with still greater masses, and shorter average lifetimes? If there are, do they also have their own neutrinos? And for that matter, what is it that makes, say, a muon neutrino different from a tau neutrino? There's one more major problem too. . . . . .

A Massive Question

It has been known for several decades now that neutrinos have very little, or perhaps no mass at all. In fact, there has been a tendency among physicists to believe that the latter is the case — that the neutrino has no mass, although this has never been proved. Very recent experiments, however, make it look as though perhaps the neutrinos do have masses after all. If this is so, then physicists may have to rethink a lot of theories. Do neutrinos have mass? We shall just have to wait and see and maybe everyone *will* live happily ever after. . . . . **ETI**

GUITAR NOTE EXPANDER

If you've ever built a conventional fuzz/sustain unit, you may have been disappointed by the harshness of the sound. If so, we present the answer to your problems — soft clipping. Design by Q.A. Rice. Development by Plamen Pazov.

A good number of fuzzbox circuits have appeared in the past which attempt to emulate the sound of an over-driven valve amp; the majority of these look great on a scope but still sound rough. The chief characteristic of valve amps is the way they overload; rounding off the peaks as opposed to transistor circuits which clip off the peaks, producing predominant odd harmonics. FET amps produce overload in a similar way to valve amps, and a cheaper and better (or worse) way to obtain this is to use CMOS gates in the linear mode. Figure 1 shows the overload for a triangular waveform. In the final circuit we have used a very versatile and much under-used CMOS IC, the CD4007 dual complementary pair and inverter. One complementary pair is wired as a second inverter — the two inverters are used as amplifiers and give a combined gain of 60 dB. One of the remaining CMOS FETs is used as a voltage-controlled resistor which can vary between from several megohms to a few hundred ohms. The output of the amplifier is passed to a detector which controls the resistance of the FET, and this is fed back to various parts of the circuit to give the expansion and compression effects. Figure 2 shows the input/output characteristics for the various functions. The compressor is effective over a 30 dB range.

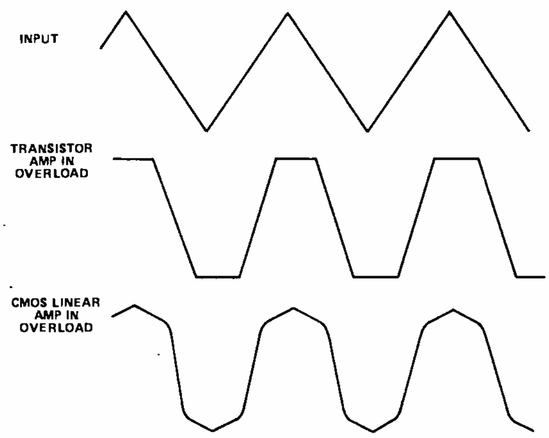


Fig.1 Clipping characteristics for two types of amplifier under overload conditions.

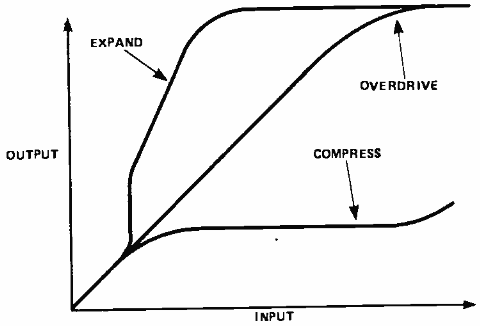


Fig.2 Input/output characteristics for various functions of the effects unit.

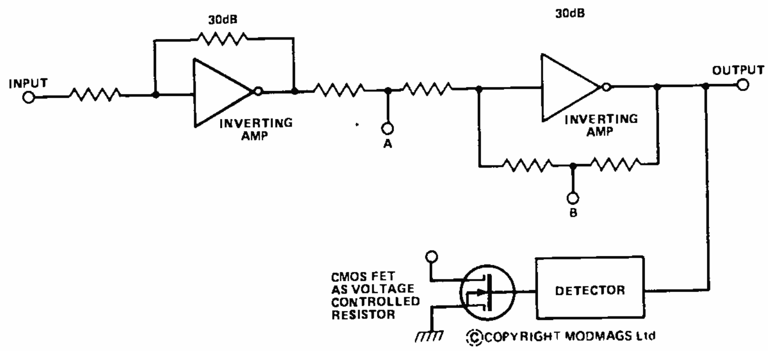
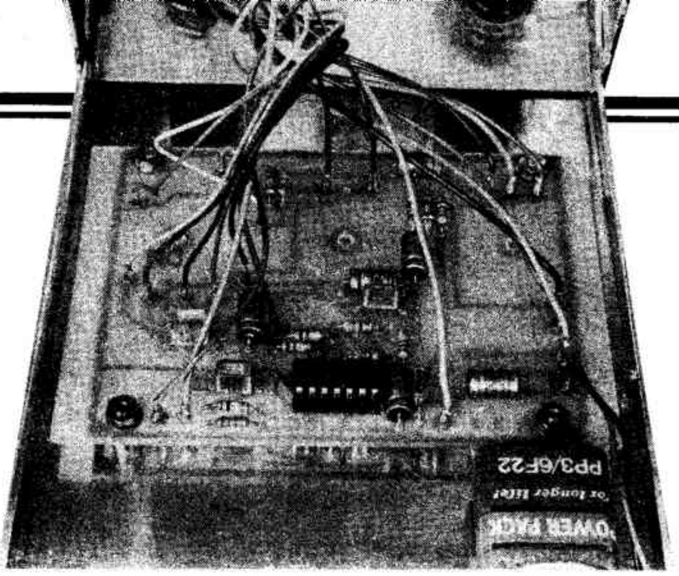


Fig.3 This diagram shows the basic principle of the unit.



The unit has six functions, as follows:

1. Overall overdrive
2. Overall compression, for sustaining
3. High frequency compression, for bass overdrive
4. Overall expansion, for sustained overdrive
5. Mid expansion, for mid to high accentuation
6. High frequency expansion, for high accentuation

The effect of all these functions is variable, with the exception of overdrive.

Construction

The PCB is designed to accept the control components (SW2 and pots) if PCB-mounting of these components is preferred, to give a very compact construction. For the prototype this was not necessary as we used a custom-built housing (see Buylines). The box comes unpunched so if you want to arrange the controls and sockets differently you can get a drill and do your own thing. If you use a different housing remember that a metal case should be used to maintain proper screening.

We used a volume control with a built-in on/off switch instead of the standard method of using the input jack, as the latter approach produces a 9 V peak back into the source circuit and can cause damage if this circuit is active.

If the guitar has a low sensitivity pickup, it may be necessary to increase the value of R2 accordingly. The unit only consumes 3 mA so the batteries should last quite a while.

HOW IT WORKS

CMOS inverters may be used in the same manner as op-amps in the inverting mode, with the added bonus that they are self-biasing. The input is fed into IC1a, configured as a high gain, high impedance amplifier to give a gain of around 30 dB. This is decoupled and passed through a resistor pair to a second amplifier stage, which has a resistor pair in its feedback (see Fig. 3). If point A is now taken to ground via a resistance, gain is reduced; if this is done to point B, gain is increased. The final output is passed through a detector to give a voltage proportional to the signal level; this voltage is used to control the CMOS FET. If the FET is taken to point A or point B, then the overall gain is proportional to the final output signal. Thus if the output reduces the signal, it is self compressing. If it increases it, the signal is expanded. By making these gain variations frequency-dependant, we can accentuate or subdue the high frequency as required, at various break points to give the effects required. The output signal has to be attenuated to return it to its original level.

PARTS LIST

Resistors (all ¼W, 5%)	
R1, 10	100k
R2	3M3
R3, 4, 7	4k7
R5, 6	150k
R8	1M0
R9	470k
Potentiometers	
RV1	10k logarithmic
RV2	100k logarithmic with integral switch
Capacitors	
C1	220n polyester
C2, 3, 4, 6, 10, 11	2u2 16 V axial electrolytic
C5	22n polyester
C7	3n3 ceramic or polycarbonate
C8	1n0 ceramic or polycarbonate
C9	10n polyester
Semiconductors	
IC1	CD4007
D1, 2	OA91
Miscellaneous	
SW1	DPDT latching footswitch
SW2	2-pole 6-way rotary switch
SK1, 2	mono jack sockets
~~Battery clip~~ (PP3), metal box (see Buylines).	

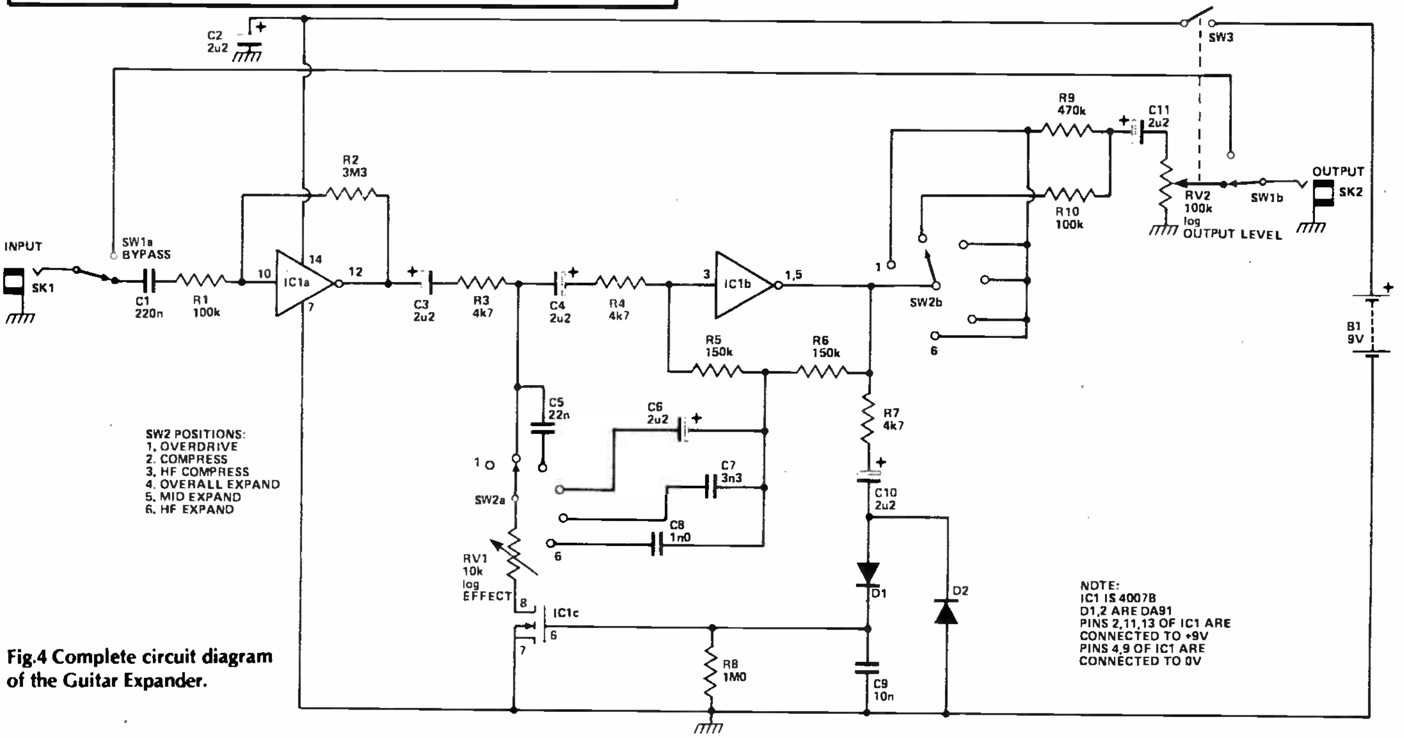
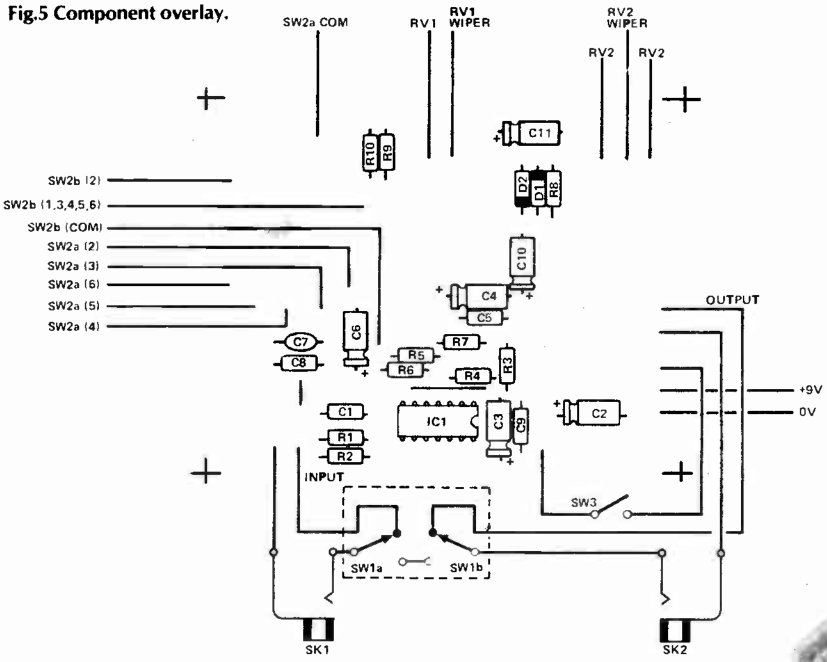
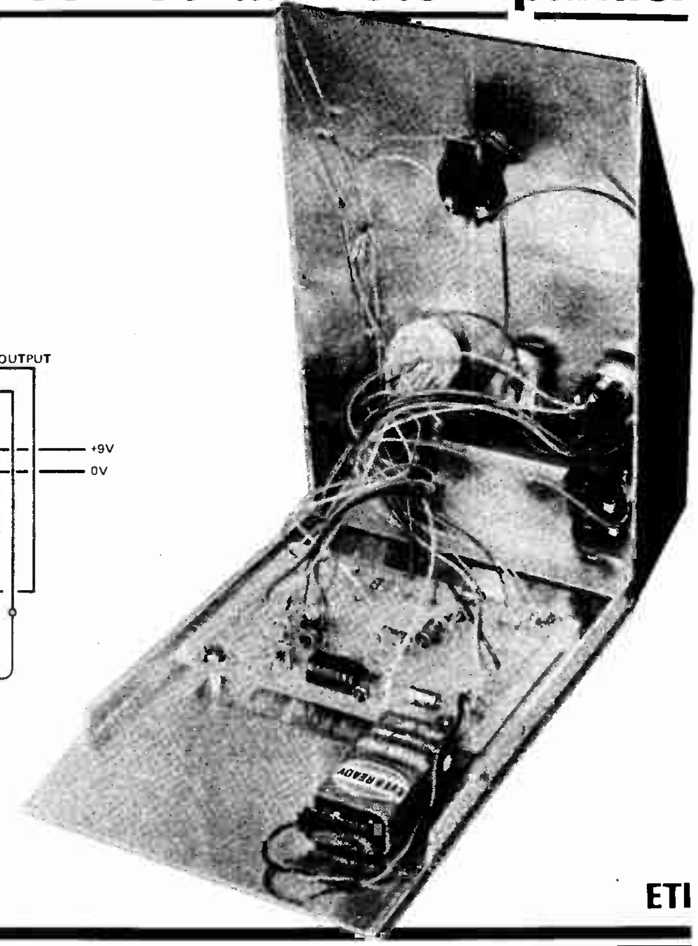


Fig.4 Complete circuit diagram of the Guitar Expander.

Fig.5 Component overlay.





BUYLINES

As mentioned in the text, we have arranged for the construction of a custom case for this project, or indeed any other of your musical projects. H.L. Smith & Co Ltd, 287 Edgware Road, London W2 1BE will supply the box, ref. ETI-1 for the modest sum of £2.00.

All the other components should be readily available from most of the distributors advertising in this issue.

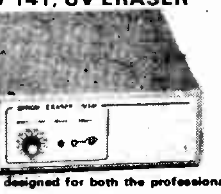
ETI

Greenbank

Greenbank Electronics
(Dept T4E) 92 New Chester Road, New Ferry
Wirral, Merseyside L62 5AG
(Tel: 051-645 3391)

TERMS, VAT. CWO. Cheques etc payable to Greenbank Electronics and crossed. Add VAT to all prices at 15% except where stated otherwise. Post etc: UK 40p (+6p VAT = 46p) per order. Export: NO VAT but add 40p (Eire), £1 (Europe) and £3.50 elsewhere. Access, Barclaycard, Visa, telephoned orders accepted. (Polys, universities, govt depts, etc can telephone their orders for immediate despatch on account.)

UV 141, UV ERASER



Two easy to use units designed for both the professional and amateur UV-prom user

Features

- Can erase up to 14 proms.
- Special short wave ultraviolet tube.
- Erase time variable between 5 and 50 minutes in 5 minute steps (preventing over exposure which may shorten prom life).
- Sliding tray carries proms on conductive foam.
- Safety interlock switch prevents the timing circuit from operating and switching on the tube with the tray open.
- "Mains On" and "Tube On" indicators.
- Smart textured case.
- Complete instructions supplied.

Supplied complete with mains plug and flex

Model UV 141. Price £77.70
Also available without timer as
Model UV 140: Price £61.20

TEX MICROSYSTEMS "EPROMPT" UV ERASER

A low cost alternative to the above erasers (UV 140/141) claimed by the manufacturer to erase up to 32 chips in 15-30 mins. This is the cheapest eraser we have seen. The unit has no timer, power switch or safety interlock switch. The user places up to 32 chips into loose conducting foam in the erasure tray (16 along the base, 8 on each side). The chips are held in place by the UV tube which sits in the tray. (Unlike the UV 140/141, no special precautions have been taken to prevent the seepage of UV light, but the manufacturers state that "Incident light from this device is quite safe at distances above 12 inches.")

(Dimensions — 325×64×38mm)

EPROMPT ERASER **Price £33**

EUROCARD COMPUTER BOARDS

"Custom 80" Modular Z80 Based System. Details in preparation, free on request.

"BIG BOARD" Z80 COMPUTER KIT

We hope this item will be in stock by the time this advert reaches you, but please check to see before sending any money! Features: 64K Dynamic RAM, Floppy Disk Controller, 80 x 24 Char. Video output **£395.** CP/M Disk Operating System to suit. **£99.**

MODULAR COMPUTER SYSTEM CARDS

A range of "International" (114 x 203mm) size cards which may be purchased individually as desired, or to build up a complete system. Further details available on request. All boards are epoxy glass with gold plated edge plug

VDU A, B, G (set of 3)	£27.20
SC/MP-P SC/MP CPU	£9.40
MPA 7 Buffered SC/MP CPU	£9.40
MZB-3 Z80-CPU	£9.40
MXA-1 2K of 2102	£9.40
MXA-3 8K of 2114	£9.40
MXD-2 16K of 4116	£9.40
PRM-2 4K of 5204	£9.40
PRM-8 8K of 2708	£9.40
RRM-14 8K of 2516 + 6K of 2114	TBA
SIO-2 RS-232 (two)	£9.40
TPA-2 Tape Interface	£8.90
IP-2 Input Port	£9.40
DCR 6 Keyboard Input	£8.90
OP-3 Output Port	£9.40
PP-2 PROM Programmer	£9.40
PSU-A4 Power Supply	£8.90
PSU B 5V Power Supply	£5.50
PSU C 25V Power Supply	£5.50
13-slot backboard, can be used with most of the above boards. 13" x 4⅜" ISBUS-1 1	£11.50

CMOS

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

4000	18p	4042	80p	4095	£1.97	4410	£8.55	4531	£1.45
4001	25p	4043	90p	4096	£1.97	4411	£10.72	4532	£1.30
4002	25p	4044	90p	4097	£5.98	4412VP	£14.93	4534	£5.60
4006	95p	4045	£2.63	4098	£1.92	4415V	£5.24	4536	£3.69
4007	18p	4046	£1.10	4099	£2.00	4422	£5.66	4537L	£26.10
4008	80p	4047	£1.71	40100	£1.92	4433	£12.30	4538	£1.20
4009	40p	4048	77p	40101	£1.69	4435V	£5.40	4539	97p
4010	50p	4049	45p	40102	£3.67	4450	£3.81	4541	£1.19
4011	25p	4050	49p	40103	£3.67	4451	£3.81	4543	£1.80
4012	18p	4051	80p	40104	£1.85	4461	£3.93	4549	£4.38
4013	50p	4052	80p	40105	£1.85	4462	£4.41	4552	£14.85
4014	84p	4053	80p	40106	92p	4490FP	£4.20	4553	£4.50
4015	84p	4054	£2.18	40107	£1.28	4490VP	£3.14	4554	£1.38
4016	45p	4055	£2.55	40108	£7.54	4500	£6.95	4555	78p
4017	80p	4056	£2.55	40109	£1.28	4501	29p	4556	72p
4018	89p	4059	£9.23	40110	£3.00	4502	£1.20	4557	£3.86
4019	45p	4060	£2.10	40114	£1.77	4503	70p	4558	£1.25
4020	99p	4062T	£10.00	40160	£1.54	4505	£5.71	4559	£4.38
4021	£1.10	4063	£1.90	40161	£1.54	4506	50p	4560	£2.50
4022	£1.00	4066	55p	40162	£1.54	4507	55p	4561	81p
4023	27p	4067	£7.21	40163	£1.54	4508	£2.90	4562	£5.60
4024	78p	4068	27p	40174	£1.54	4510	99p	4566	£1.59
4025	27p	4069	27p	40181	£5.03	4511	£1.50	4568	£2.38
4026	£3.25	4070	30p	40182	£1.90	4512	80p	4569	£2.50
4027	50p	4071	25p	40192	£2.41	4514	£2.65	4572	40p
4028	84p	4072	25p	40193	£2.41	4515	£3.00	4580	£4.77
4029	99p	4073	29p	40194	£3.27	4516	£1.10	4581	£2.62
4030	74p	4075	25p	40208	£7.54	4517	£4.46	4582	£1.14
4031	£4.31	4076	£1.07	40257	£2.31	4518	£1.00	4583	90p
4032	£1.31	4077	29p	4160	98p	4519	80p	4584	90p
4033	£2.63	4078	29p	4161	98p	4520	£1.00	4585	£1.27
4034	£2.00	4081	27p	4162	98p	4521	£2.50	4597	£2.44
4035	£1.10	4082	27p	4163	98p	4522	£1.11	4598	£2.98
4037	£1.99	4085	£1.35	4174	90p	4526	£1.08	4599	£6.95
4038	£1.20	4086	£1.35	4175	£1.15	4527	£1.50	4700	£1.75
4039	£2.78	4089	£2.91	4194	£1.16	4528	£1.20		
4040	£1.00	4093	80p	4408	£9.37	4529	£1.30		
4041	£1.59	4094	£2.50	4409	£9.37	4530	70p		

74C

74C00	20p	74C76	57p	74C163	£1.15	74C904	57p	74C926	£5.01
74C02	20p	74C83	£1.34	74C164	£1.00	74C905	£7.53	74C927	£5.01
74C04	20p	74C85	£1.34	74C165	£1.00	74C906	57p	74C928	£5.01
74C08	20p	74C86	67p	74C173	93p	74C907	57p	74C929	£17.00
74C10	20p	74C89	£4.62	74C174	93p	74C908	£1.00	74C930	£17.90
74C14	90p	74C90	80p	74C175	93p	74C909	£1.00	80C95	85p
74C20	20p	74C93	80p	74C192	£1.15	74C910	£7.45	80C96	92p
74C30	20p	74C95	£1.00	74C193	£1.15	74C911	£7.30	80C97	85p
74C32	20p	74C107	£1.27	74C195	£1.00	74C912	£7.30	80C98	92p
74C42	95p	74C150	£3.81	74C200	£7.46	74C914	£1.46	82C19	£6.28
74C48	£1.43	74C151	£2.95	74C221	£1.41	74C915	£1.15	88C29	£2.90
74C73	57p	74C154	£3.81	74C373	£1.79	74C918	£1.10	88C30	£2.90
74C74	50p	74C157	£2.20	74C374	£1.79	74C921	£17.07		
		74C160	£1.40	74C901	57p	74C922	£3.78		
		74C161	£1.15	74C902	79p	74C923	£3.86		
		74C162	£1.15	74C903	57p	74C925	£5.01		

74LS

74LS00	14p	74LS55	30p	74LS151	96p	74LS244	£1.70	74LS374	£1.95
74LS01	14p	74LS63	£1.50	74LS153	76p	74LS245	£3.50	74LS375	£1.60
74LS02	16p	74LS73	46p	74LS154	£1.70	74LS247	£1.90	74LS377	£2.12
74LS03	16p	74LS74	41p	74LS155	96p	74LS248	£1.90	74LS378	£1.84
74LS04	16p	74LS75	48p	74LS156	96p	74LS249	£1.90	74LS379	£2.15
74LS05	20p	74LS76	40p	74LS157	76p	74LS251	£1.34	74LS384	86p
74LS08	22p	74LS78	40p	74LS158	96p	74LS253	£1.42	74LS386	86p
74LS09	22p	74LS83	£1.15	74LS160	£1.28	74LS257	£1.10	74LS390	£2.30
74LS10	20p	74LS85	£1.18	74LS161	98p	74LS258	£1.46	74LS393	£2.30
74LS11	22p	74LS86	43p	74LS162	£1.38	74LS259	£1.60	74LS395	£2.18
74LS12	23p	74LS90	60p	74LS163	£1.18	74LS261	£4.50	74LS396	£2.15
74LS13	38p	74LS91	£1.04	74LS164	£1.14	74LS266	52p	74LS398	£2.76
74LS14	75p	74LS92	89p	74LS165	75p	74LS273	£2.44	74LS399	£2.30
74LS15	30p	74LS93	89p	74LS166	£2.26	74LS275	£2.50	74LS445	£1.50
74LS20	20p	74LS95	£1.16	74LS170	£2.88	74LS279	66p	74LS447	£1.44
74LS21	22p	74LS96	£1.16	74LS173	£1.05	74LS283	£1.92	74LS490	£1.80
74LS26	48p	74LS107	44p	74LS174	£1.06	74LS290	£1.28	74LS668	£1.82
74LS27	28p	74LS109	55p	74LS175	£1.10	74LS293	£1.28	74LS669	£1.82
74LS28	48p	74LS112	55p	74LS181	£3.98	74LS295	£1.85	74LS670	£2.48
74LS30	22p	74LS113	50p	74LS183	£2.98	74LS298	£1.68		
74LS32	27p	74LS114	50p	74LS190	£1.40	74LS324	£2.40		
74LS33	39p	74LS122	70p	74LS191	£1.40	74LS325	£2.90		
74LS37	39p	74LS123	70p	74LS192	£1.30	74LS326	£2.94		
74LS38	39p	74LS124	£1.80	74LS193	£1.30	74LS327	£2.86		
74LS40	28p	74LS125	60p	74LS194	£1.66	74LS347	£1.48		
74LS42	98p	74LS126	60p	74LS195	£1.36	74LS348	£1.86		
74LS47	90p	74LS132	95p	74LS196	£1.00	74LS352	£2.28		
74LS48	£1.20	74LS136	55p	74LS197	£1.40	74LS353	£2.28		
74LS49	£1.20	74LS138	85p	74LS221	96p	74LS365	65p		
74LS51	24p	74LS139	85p	74LS240	£2.36	74LS366	65p		
74LS54	28p	74LS145	£1.08	74LS241	£2.32	74LS367	65p		
		74LS147	£1.70	74LS242	£2.32	74LS368	66p		
		74LS148	£1.73	74LS243	£2.32	74LS373	£1.80		

QUARTZ

32.768KHz (Watch)	£3.23
60 KHz	£9.95
100.0 KHz	£3.62
200.0 KHz	£3.92
204.8 KHz	£3.92
262.144 KHz	£3.92
307.2 KHz	£3.92
312.5 KHz	£3.92
455.0 KHz	£4.95
1.000 MHz	£3.62
1.008 MHz	£3.92
1.280 MHz	£3.92
1.6 MHz	£4.25
1.8 MHz	£4.25
1.8432 MHz	£3.62
2.000 MHz	£3.62
2.097152 MHz	£3.23
2.4576 MHz	£3.62
2.500 MHz	£3.92
2.56250 MHz	£3.62
3.000 MHz	£3.62
3.2768 MHz	£3.23
3.579545 MHz	£1.95
3.93216 MHz	£3.92
4.000 MHz	£2.90
4.032 MHz	£3.23
4.096 MHz	£3.23
4.194304 MHz	£3.23
4.433619 MHz	£1.25
4.608 MHz	£3.23
4.800 MHz	£3.23
4.9152 MHz	£3.23
5.000 MHz	£3.23
5.0688 MHz	£3.23
5.120 MHz	£3.23
5.185 MHz	£3.23
6.000 MHz	£3.23
6.144 MHz	£3.23
6.400 MHz	£3.23
6.55360 MHz	£3.23
7.000 MHz	£3.23
7.168 MHz	£3.23
7.680 MHz	£3.23
7.86432 MHz	£3.23
8.000 MHz	£3.23
8.08333 MHz	£3.62
8.388608 MHz	£3.23
8.867237 MHz	£3.23
9.375 MHz	£3.92
9.800 MHz	£3.92
10.000 MHz	£3.23
10.245 MHz	£3.23
10.700 MHz	£3.23
10.92 MHz	£3.92
11.000 MHz	£3.92
12.000 MHz	£3.92
14.0 MHz	£3.92
14.31818 MHz	£3.23
16.000 MHz	£3.92
18.000 MHz	£3.23
18.432 MHz	£3.23
20.000 MHz	£3.62
20.1134 MHz	£3.23
24.0 MHz	£3.92
26.690 MHz	£2.10
27.0 MHz	£3.92
27.145 MHz	£2.10
27.648 MHz	£3.92
38.6666 MHz	£3.23
48.000 MHz	£3.23
100.000 MHz	£3.23
116.000 MHz	£3.23

VEROBOARD
0.1" Pitch with copper strips
2½"×1" (pack of 5) £1.01
2½"×3¾" 73p
2½"×5" 83p
2½"×17" £2.51
3¾"×3¾" 79p
3¾"×5" 95p
3¾"×17" £3.26
4.7"×17.9" £4.28
0.1" Plainboard (no strips)
3¾"×2½" 52p
3¾"×5" 79p
3¾"×17.0" £2.11
Terminal pins £1.50/500
V-Q DIP board £1.58
DIP breadboard £3.98
Spot face cutter £1.18
Pin insertion tool £1.82

SOLDERCON PINS
100 50p 1000 £3.95

DIL SOCKETS
8/14/16 pin 10p/12p/13p
18/20/22 pin 18p/20p/23p
24/28/40 pin 30p/40p/50p
24 pin Textool lever type zero insertion force £7.00

EDGE CONNECTORS
43 way, 0.1" pitch, wire wrap, polarizing slot pin 37
Single sided (1×42) £3.11
Double sided (2×42) £4.10

TIMER ICs
NE555/556 29p/49p

OP-AMPS (All Mini dips)
CA 3130E 84p
CA 3140E 35p
UA 741 (Texas) 22p

LED DISPLAYS
DL-704E 99p
DL 727E/728E £2.00
DL-747E/750E £1.80
FND 500/560 £1.20

LIQUID CRYSTAL DISPLAY
4×0.5" Digits 40 pin DIL £9.75

CLOCK CHIPS
AY-5-1224A £2.60
MK 50253 £5.50
MK 50366 £6.50

SIX DECADE COUNTERS
MK 50395/6/7 £9.90
MK 50398/9 £7.50

SWITCH MODE PSUs

AC 5221S 5V/10A	£69.90
AC 9221S 5V/5A, 12V/1A, −12V/1A, −5V/0.1A	£86.80
AC 5421S 5V/20A	£99.20
AC 9421S 5V/10A 12V/2A −12V/2A −5V/0.1A	£126.50

OPEN CARD SWITCH MODE PSU
FULLY ASSEMBLED P C B CARD 197 x 108 x 52mm Outputs +5V 6A −5V/0.5A, +12V/1A −12V 1A
Type AC9251 £79.80

FLOPPY DISK CONTROLLER BOARD

This is used in conjunction with 'Kemitron' Z80 boards to interface to twin single density S/S 8" floppy disks. It is not available as a bare board, but only built and tested. Regrettably Kemitron do not supply circuit diagram **£195.00**

To run CP/M on the system a serial interface (e.g. SIO board) to some sort of VDU or terminal is required, and 48K of RAM (e.g. three MXD-2 boards). The MZB-3 board has facilities for 'power on jump' and a 'boot prom' to load the CP/M operating system from the disk.

Boot PROM (2708) **£19.95**
CP/M (8" floppy disk) **£99.00**

8" FLOPPY DISK DRIVES
DRE Model 7100 **£350.00**

60 KEY ASCII KEYBOARD

High quality. Capacitive switches, metal mounting frame £49.70

T.V. MONITOR P.C.B. for OEM users

This is an assembled P.C.B. size 130 x 190mm, which you add to your own 12"/14" black and white C.R.T. (90 degree, 20mm dia neck), to obtain a T.V. monitor at modest cost. (Regrettably we cannot supply the C.R.T. at present.)

Preset controls, contrast, brightness, etc., are included, and the only inputs needed are 15 Volts ± 10% AC at 1.5 Amps and 1 Volt pk-pk composite video input.
Supplied with circuit diagram £33.50

KEYBOARD CASES

405 x 210mm. Panel size 330 x 188mm £10.14
510 x 340mm. Panel size 430 x 115mm £26.22

DOT MATRIX PRINTER

This is about the same price as for example the Nascom Imp, but has many features only previously found in models costing hundreds of pounds more:

Standard interfaces (not 'extras') RS-232, 20mA, IEE 488, Centronics I/O. 15 baud rates to 9600. 100 characters per second, 64, 72, 80, 96, 120 or 132 characters per line, rear, bottom or front paper loading, friction or tractor feed, can accept user defined characters, can also print graphics under program control, has 'self-test' facility. Supplied with mains cable and full operator's manual.

Base 2 Model 800 £325.00

QUME DAISYWHEEL PRINTER

High quality printer for use with word processing packages running under CP/M. 45 characters per second, RS 232 interface. (Check stock position before ordering.)

Qume Sprint 5 Model 45/RO **£1595.00**
Also available on lease.

QUME SUPPLIES AND ACCESSORIES

Forms Tractor	£110.00
Standard Printwheels	£6.60
Word Processing Printwheels	£6.80
Ribbons (in packs of 12)	
Medium Inked Fabric Black	£27.80
Multi Strike Black	£27.60
Single Strike Black	£40.56

EUROCARD 19" CARD FRAME

Kit of 2 end plates + angles, 2 front and 2 rear tie bars, 4 guide location strips £28.84

Accessories

Card guides (pack of 10)	£1.53
Eurocard Plug (64 way DIN 41612)	£2.22
Eurocard Socket (64 way DIN 41612)	£3.39
Connector mounting strips (pair)	£3.27
Case conversion kit	£19.80
(or fit into separate 3U 19" D-type case)	£32.58

MICROPROCESSORS

6502
6502 £6.95
6520/21 £4.95
6522 £6.95
6532 £8.25

Z80
Z80A-CPU £7.93
Z80A-PIO £5.75
Z80A-CTC £5.75

6800
6800 MPU £5.95
6802 MPU £0.95
6809 £19.95
6810 (128 × 8 RAM) £3.25
68A10 (128 × 8 RAM) £3.75
6820, 6821 PIA £3.50
6845 £22.30
6850 ACIA £4.85
MC6880 £2.84

SC/MP II RAM I/O
SC/MP II (4MHz) £10
INS 8154 RAM I/O £9.40
INS 8255 I/O £4.75

CMOS
COSMAC CDP 1802CE £8.50
COSMAC CDP 1802E £10.85
CDP 1864 £7.25

STATICS (Mostly 450nS)
2102—1K x 1 £1.20
2111—256 x 4 £2.25
2112—256 x 4 £2.25
2114/4045—1K x 4 £2.25
8 x 2114 £15.36
2114L—1K x 4 £1.99
4118—1K x 8 £8.95

DYNAMICS
4116 16K 200nS £1.99
8 x 4116 £15.36

1UV ERASABLES
5204 (512 x 8) £9.95
2708 1K x 8 £3.43
2716/2516 2K x 8 single 5v £4.98
2532 4K x 8 (5v) £14.95

5204/2708/2516 Programming Service £7.50/£7.50/£15.00 each prom. (Price does not include prom. We accept handwritten/typed source code — must be hexadecimal)

PROM WASHING SERVICE
50p each prom

UV PROM ERASER
UV140 £61.20
UV141 £77.70
EPROMPT £33.00

INTERFACE
81LS95/6/7/8 £1.40
1488 (RS232) 90p
75491 LED driver 50p
75492 92p
ZN425 £3.95
8T26/8T28 £2.84
IL74 48p
AY-3-8910 £8.50
FD 1771 £29.00

CRT Controller: Uarts
AY-5-1013 £4.00
AY-5-1013A £4.70
AY-3-1014A £5.00
AY-3-1015 £5.00
6402 £4.50
1402 £4.50

CHAR. GEN. KEYBOARD ENCODER
MK 2302 £15.29
RO-3-2513 (5v Uppercase) £4.75
DM 8678 CAB £14.27
AY-5-2376 £7.00

SOFTWARE
To suit Z80 Tiny Basic
Moonlander Game Cassette £1.00
Listing £1.00
Noughts and Crosses Cassette £1.00
Listing £1.00

FIRMWARE
ZMON for Z80 (1 x 2708) £14.95
2K Tiny BASIC for Z80 (2 x 2708) £19.95
4K NIBL for SC/MP (4 x 2708) £49.95
4K NIBL-MON for SC/MP (4 x 2708) £49.95
1K Various, for SC/MP (1 x 2708) £14.95
(Descriptive leaflet available on above. Ref SW4. 5)
1K Elektor Junior (1x2708) £19.95
1½K ELBUG (3×5204) £35.00
ETIBUG 1 (1×5204) £14.95
ETIBUG 2 (1×5204) £14.95
SCMP/KB (1×5204) £14.95

UHF MODULATORS
UM1111 E33 Vision modulator, T.V. game or cheap computer type £2.00
UM1231 E36 Wide bandwidth, computer VDU type, pos./neg. transfer characteristic £4.95
UM1233 E36 Wide bandwidth, computer VDU type £4.70
UM1286 E36 Combined wide bandwidth vision modulator with intercarrier sound, high performance £8.25

VOLTAGE REGULATORS
7805 75p
7905 £1.00
7812 97p
7912 £1.00
78H05 £5.81

VOLTAGE CONVERTER MODULES
Ideal for use in otherwise 5V only systems, to obtain +12V, −12V, or dual ± 12V power for ASCII keyboards, RS-232 interfaces, dynamic RAMs etc. All types need +5V input.
Size of each module (excluding pins) 34 x 28 x 10mm.
Type ADIP-12A10 +12V output (25-84mA) £4.95
Type ADIN-12A10 −12V output (25-84mA) £4.95
Type ADID-12A10 ± 12V dual output, 2 x (12-42mA) £5.25

READER'S DESIGNS

CARAVAN LIGHTS CHECKER

A project that will pay for itself in the first ticket from the police that you don't collect. Submitted by Graham Packer of Soutergate.

Many ETI readers, besides boring the pants off their neighbours with dreary electronics, are just as anti-social when it comes to cluttering up the highways with their sluggish caravans. Now that they (and their caravans) are in hibernation until summer, the time is at hand to reach for soldering iron and component catalogue and make amends.

Most caravans receive their power supply and lighting signals by way of a multiway plug and socket, terminating on a 'choc-block' terminal strip under the front seat/bed. This is where the 'guts' of the project goes. The cable is merely chopped and the large plastic box inserted. The display unit can be mounted anywhere that is visible from the driving mirror and double sided tape (the thick foamy kind) may be used to hold it on the wardrobe or side of the kitchen unit.

For once, no complicated electronics; just the most basic of electromagnetic devices, the relay, albeit in its more refined form of the reed insert. These reeds, originally developed for electronic telephone exchanges, need about 20 to 50 ampere turns to pull them in. The current drawn by a caravan sidelight, brakelight or indicator lamp can be found by calculation (or just asking people) and the correct number of turns wound around the reed.

Reed inserts may be obtained from a number of sources and be of dubious vintage. Therefore, it's best to wind on 40 or 50 turns of 22 swg insulated wire and check them out first with the test circuit shown.

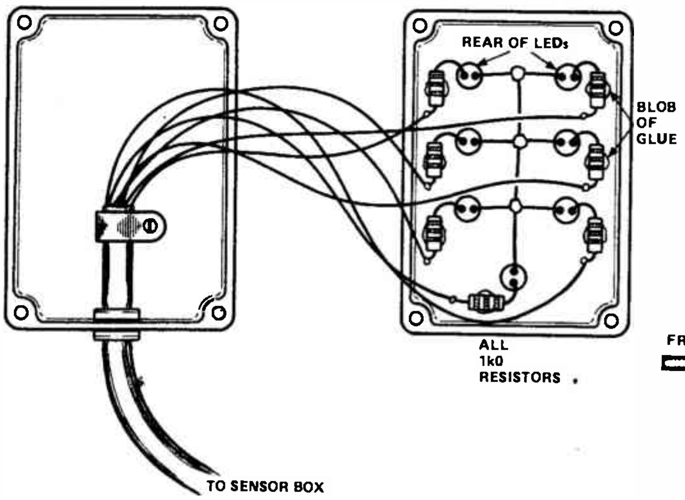
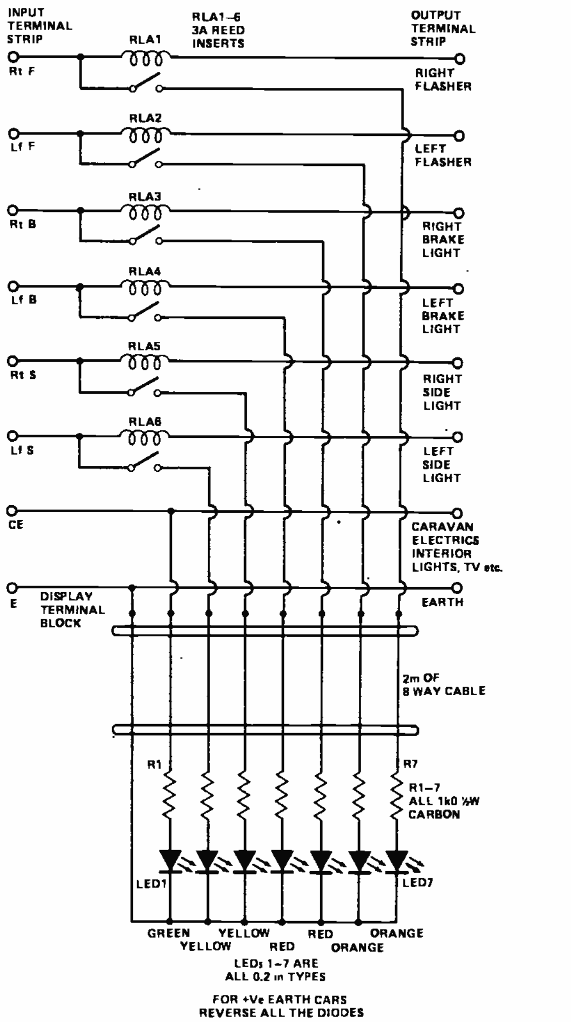


Fig. 1 Construction details of the display box.



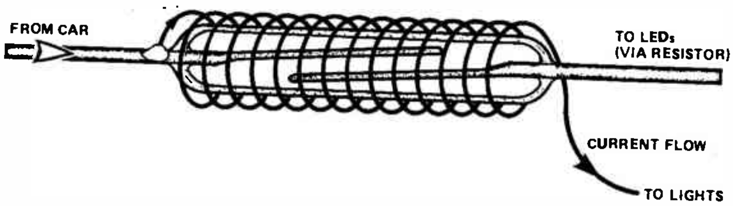


Fig. 2 Circuit diagram with relay assembly/wiring details.

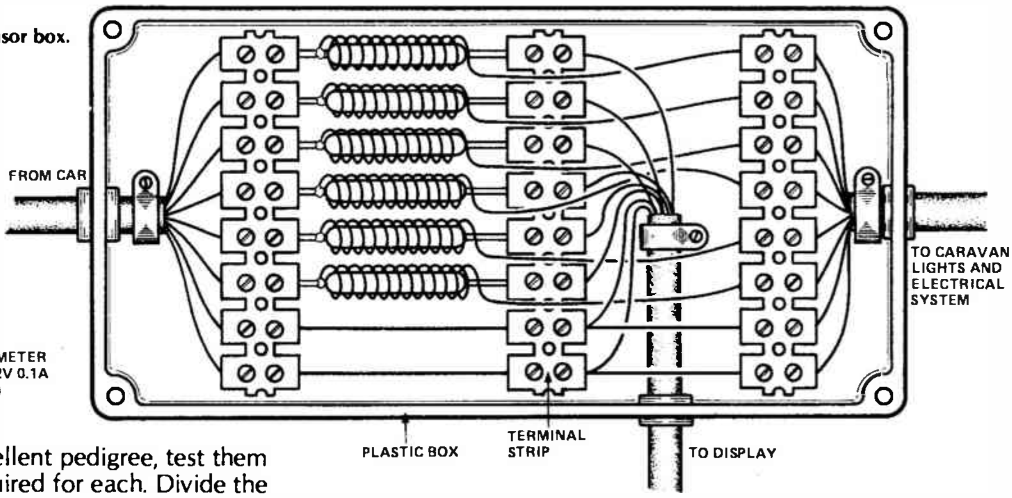


Fig. 3 Construction details of the sensor box.

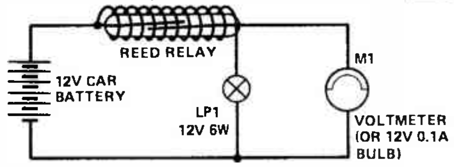


Fig. 4 This simple circuit can be used to check out reed relays.

If the reeds do not have an excellent pedigree, test them and decide how many turns are required for each. Divide the ampere turns by the current to be drawn and there's the number you need. Add 25% for luck. As a rule of thumb, 6 W sidelights need about 40 turns in two or three layers, or 20 turns if they are fore and aft. You could put separate current sensors in each line and make your caravan look like a mobile Blackpool Illuminations! Brake and indicator lights need only 12 turns.

Solder one end of a length of 20 swg insulated wire to one end of a reed and wind carefully along its entire length. Be careful not to break the glass as it will slice into your fingers with the greatest of ease. Hold the reed in your left hand with the loose end of wire pulled taut by your little finger and apply cyanoacrylate (Superglue). Two days later it should be possible to remove the completed current sensing relay from your hand!

Install the reeds between the two choc-blocks as shown in the diagram by holding the terminal blocks on a flat surface to ensure that no twisting action takes place when the assembly is finally installed in its box. Cyanoacrylate may now be used to mount the complete assembly in its box. Complete the wiring and install in your beloved behemoth.

The green 'power-on-to-the-caravan' light only consumes 15-20 mA and as long as the caravan is being pulled daily (as it would be on holiday) the overnight drain is negligible.

A complete kit of parts, including solder and superglue is available from Packer Communications, Bridge End Barn, Soutergate, Cumbria LA17 7TW for £12.75 including post and VAT.

ETI

ETIPRINTS

ETIPRINTS offer you the easy way to produce high quality printed circuit boards. Each ETIPRINTS sheet contains a set of etch resistant rub down transfers of the printed circuit board designs for several of our projects.

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

PARTS LIST

040A	ETI 80 VCO/VCLFO	Feb 80
040B	ETI 80 PSU Tuning Fork Hi-Lo Filter Coin Toss	Feb 80
041A	Audiophile Driver Amp VCA Signal Tracer Heater Controller Main Board Electromyogram	Mar 80
041B	ETI 80 VCM Heater Controller Sensor	Mar 80
046A	ETI 80 Dual VCA 100 W Power Amplifier	Aug 80
046B	Capacitance Meter US Alarm BGM 100 W Amplifier Logic Tester 100 W Power Amp	Aug 80
047A	Digital Test Meter	Sep 80
047B	Vocoder Internal Excitation Speed Control DTM Switching Board RIAA Preamp	Sep 80
047C	ETI 80 Envelope Shaper TV Sound Survival	Sep 80
048A	Sustain/Fuzz Box Flash Trigger FM Radio Control Receiver: (Top side) (Bottom side) FM Radio Control Transmitter	Oct 80
048B	Vocoder Slew Rate Control Vocoder Output Amp Vocoder Input Amp Vocoder PSU Vocoder LED PPM Display	Oct 80
048C	Cassette Interface ETI 80 Monitor Amp	Oct 80
049	AF Generator Multi-Option Board Space Invasion PSU	Nov 80

BUYLINES

Sheets for Sep 79, Dec 79, Jan 80 and April - July 80 are temporarily out of stock. Earlier ETIPRINT sheets are available.

Send a cheque for PO (payable to ETI) for £1.20 per sheet with details of the project for which you require an ETIPRINT, and the month and year of publication to:

ETIPRINTS,
ETI,
145 Charing Cross Road,
London WC2H 0EE.

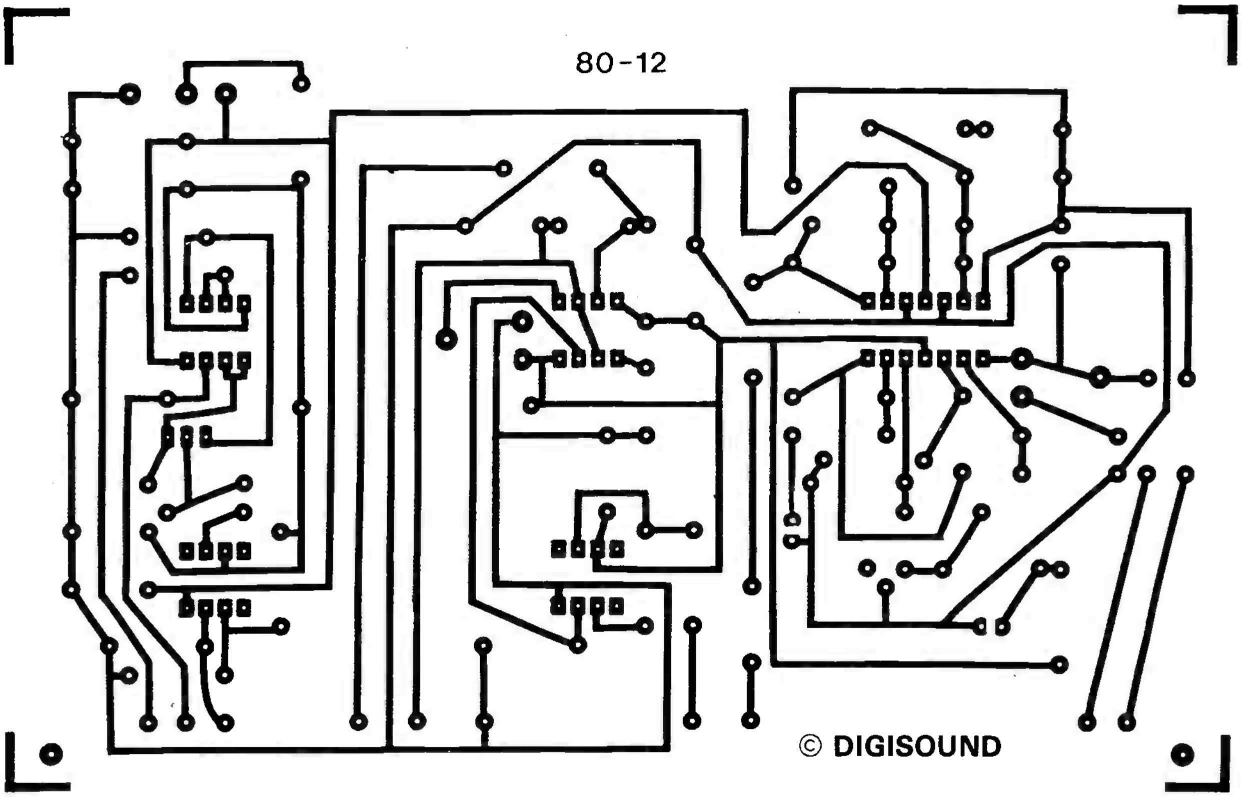
HOW IT WORKS

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

ETIPRINTS

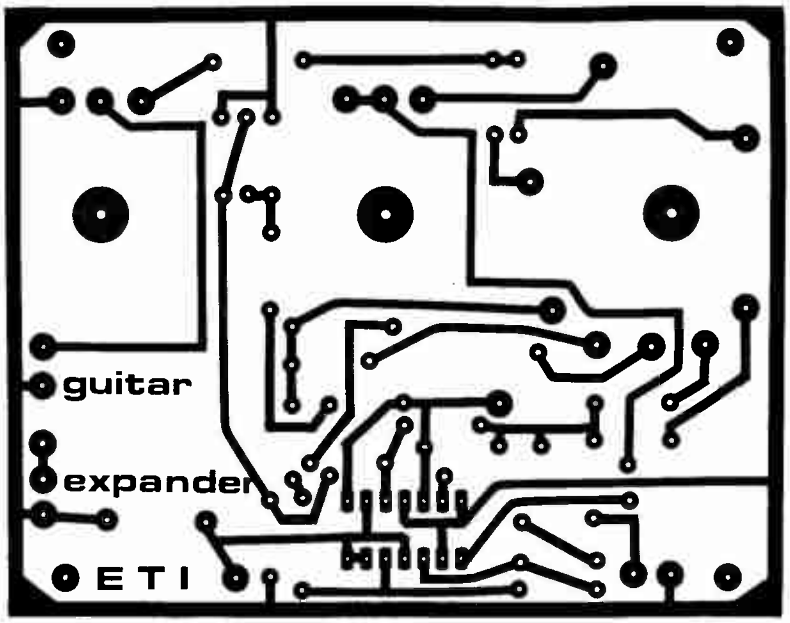
PCB FOIL PATTERNS

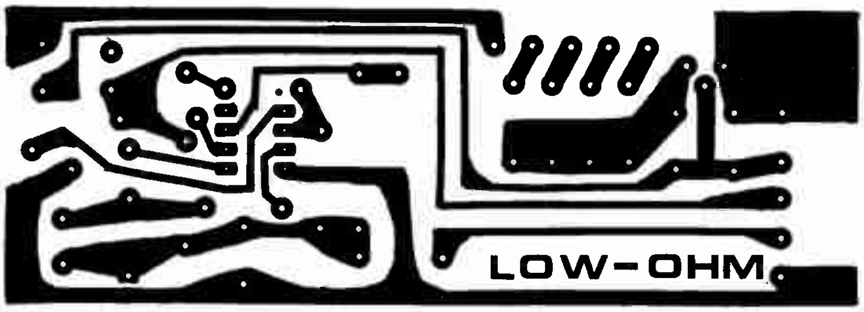
Please note that the foil pattern for the VCSA is too large to go into the magazine. A large SAE will secure a photocopy.

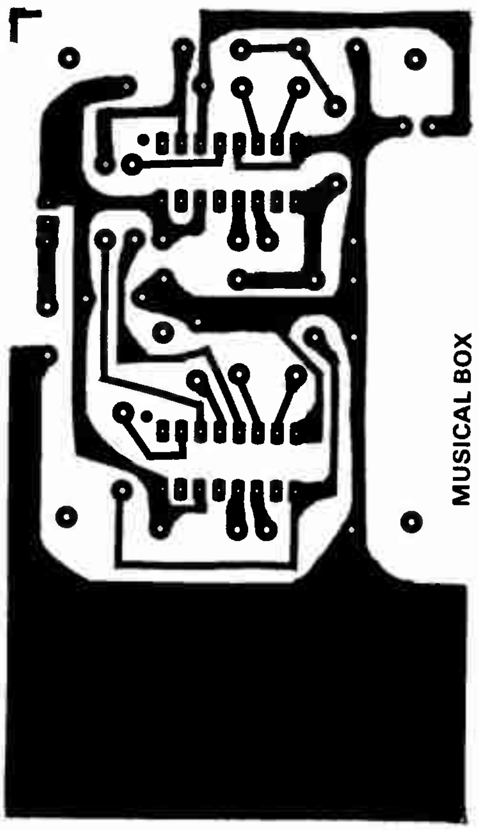


Above: Foil pattern for this month's Project 80 module. Note that Digisound hold the copyright on this board and firms may not reproduce the PCBs for sale.

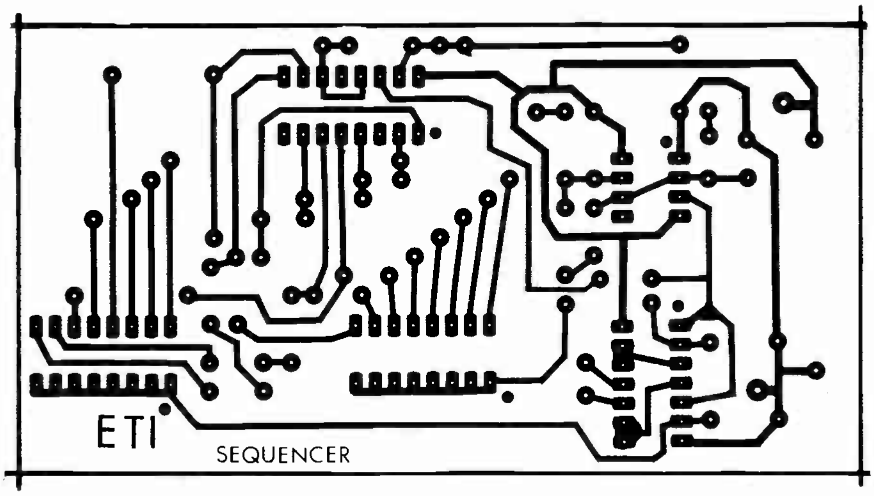
Right: Foil pattern for the guitar expander.



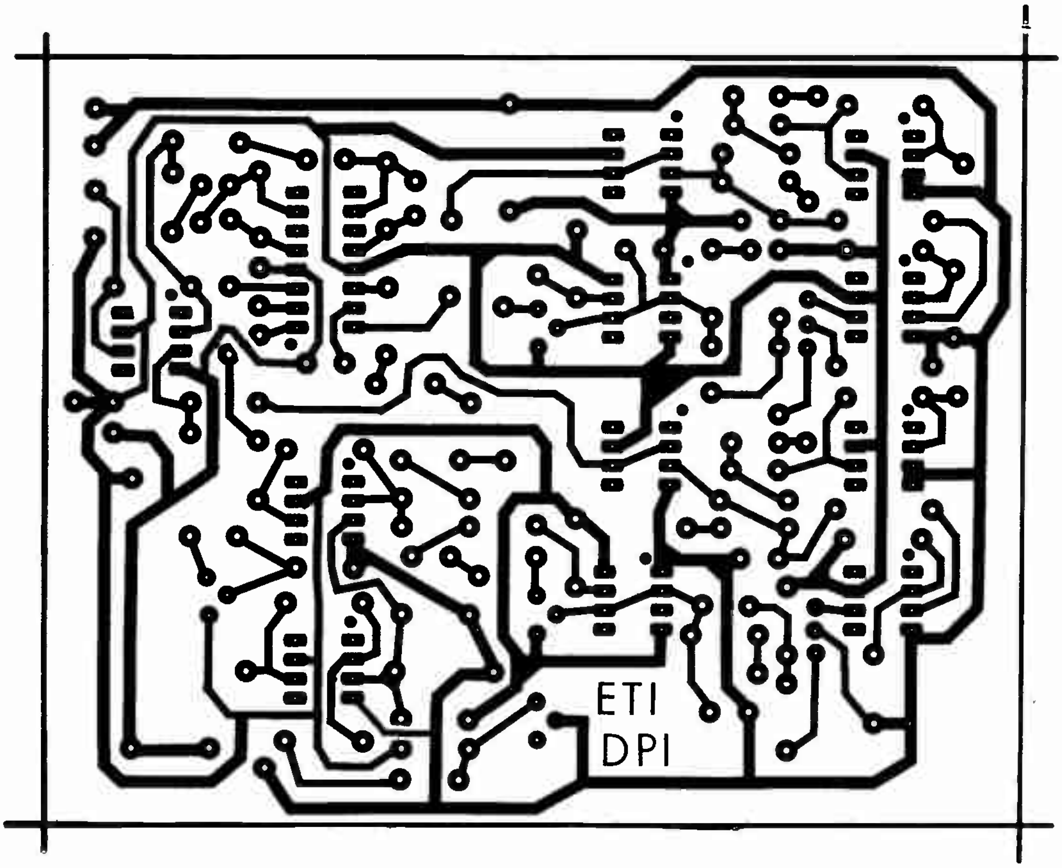




Above: The Low-ohm Meter foil pattern.
Right: Musical Box PCB — this has been designed to fit into the specified case.



Above and below: The two foil patterns for the ETI Drum Machine.



NEXT MONTH. NEXT MONTH. NEXT MONTH. NEXT MONTH. NEXT MONTH.

Hobby Electronics

Look for the April issue. You can't afford to miss it!

Anatomy Of The Space-Shuttle

A special HE report on the forthcoming NASA Space-Shuttle launch. We investigate what the technical problems have been, why it's overdue, and give you a timetable running up to the launch and beyond

Tremolo

Just the effect you want for your guitar to complement the Fuzzbox in the March issue,although it will work with any electronic musical instrument. Simple-to-build, even simpler-to-use yet it won't bum a hole in your pocket

Russian Roulette

A novelty game designed to eliminate the players — without any mess whatsoever

---- STOP PRESS ---- STOP PRESS---- STOP PRESS ---- STOP PRESS ----
- COMPETITION - STOP - NEXT MONTH'S ISSUE OF HOBBY ELECTRONICS
- STOP - PROMOTING THE UNITED NATION'S INTERNATIONAL YEAR OF
THE HANDICAPPED PERSON - STOP - QUERY - DO YOU THINK YOU CAN
DESIGN AN ELECTRONIC AID TO HELP A HANDICAPPED PERSON - STOP -
ANY ELECTRONIC AID - SOLID-STATE, COMPUTER PROGRAM, EVEN VALVE
- ANY ELECTRONIC AID - STOP - ANY HANDICAP - STOP - PRIZES TO
WIN - STOP
---- STOP PRESS ---- STOP PRESS---- STOP PRESS ---- STOP PRESS ----

High Fidelity Comes To HE

Announcing a special audio project for HE: a hi-fi, high-power amplifier system which you can tailor according to your budget by making use of our special-offer kits. We start with the pre-amplifier in the April issue. This pre-amp requires *no wiring* except for the leads to the power supply! You can use it with your own amplifier too

Windscreen Washer Alarm

For the motorist who's fed up with cleaning his windscreen by hand because his washer bottle has run dry. As soon as the fluid drops below a predetermined level a 're-fill me' alarm is displayed

Plus:

News, views and info on CB, circuits, recent developments in electronics — everything for the electronics enthusiast and hobbyist — things you can't afford to miss. Get It!

Items mentioned here are those planned, but unforeseen circumstances may affect the actual contents.

CLASSIFIEDS

RATES
1-3 insertions £7 per scc
4-11 insertions £6.50 per scc
12 insertions £6 per scc
24p per word (min. 15 words)
Box No. of application

All advertisements in this section must be pre-paid
Closing Date:- 1st Fri. month preceding publication

Advertisements are accepted subject to the terms and conditions printed on the advertisement rate card (available on request).

SEND TO:- ETI CLASSIFIED, 145, CHARING CROSS ROAD, LONDON WC2H 0EE. TEL: 01-437 1002

CIRCUIT DESIGN, Prototype construction, Analogue or Digital, Single Circuits or Complete Instruments/Systems. Write A. J. ATTWOOD, C.Eng., MIERE, Heathercote, Heatherton Park, Taunton, Somerset, TA4 1ET or Phone Bradford-on-Tone (082-346) 536.

PARAPHYSICS JOURNAL. Russian/Czech translations. Autogenics (self-training) improves vitality. Psychotronic Generators, UFOs, contacting extraterrestrials, Kirklianography, telekinesis, levitation, gravity lasers. S.A.E. 4x9": Paralab, Downton, Wilts.

ZX80 £75. Mk14 £37. ATCM £99. Occasionally available secondhand. Tel: Redditch Electronics (0527) 61240 evenings.

PANELS

Give your project the professional finish it deserves. Blend in with existing equipment with these tough 2mm thick anodised aluminium fascia panels, matt black or brushed silver finish. Stock sizes: 44 × 16 cm **£4.75**, 35 × 15 cm **£4.25**, 30 × 12 cm **£3.90**. Other sizes available in quantity to order. Prices incl. c.w.o.

PROJECT FINISHERS
P.O. Box 2, Buntingford, Herts.

CITIZEN BAND RADIO and accessories. — Phone 0527 43169 or s.a.e. with enquiries to P.O. Box 13, Redditch B98 8NS.

TRS-80 or ZX80. 4 games on cassette. TRS-80, £3.50; ZX80, £3. S.A.E. Details/list. — Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

TELEPHONE ANSWERING MACHINES, Super Phones, Radio Phones, etc. Ring C.W.A.S. 0274 682674.

BURGLAR ALARM Component Catalogue out now. Ring: C.W.A.S. 0274 682674.

ZX80, ATOM, Mk 14 wanted. Tel: Redditch Electronics (0527) 61240 evenings.

SUPERBOARD II

STILL the best value in Home Computers. Just compare the features:

- ★ 8K floating point BASIC in ROM
- ★ Full ASC11 keyboard
- ★ Standard cassette/TV interface
- ★ RS232 printer interface
- ★ 4K user RAM
- ★ Expandable to 32K & dual mini floppy.

AVAILABLE **NOW** from:
C.T.S.
31/33 Church Street
Littleborough
Lancs.

Please ring or write for latest prices
Tel: Littleborough (0706) 74342 any time

CENTURION ALARMS

BURGLAR ALARM EQUIPMENT AT UNBEATABLE VALUE JUST LOOK!

Order No
100 ALARM TRIGGER MODULE. 100% Solid State. Battery operation Pos. & Neg. Rings. N/C for 4-wire contacts. N/O for Mats, etc. One Amp Switching Capacity Only . . . **£9.95**
210 Quality White Flush fitting 4-wire **MAGNETIC REED CONTACT** + matching magnet . . . **£1.10**
220 Surface 4-wire **MAGNETIC REED CONTACT** . . . **£1.50**
240 PRESSURE MAT, Standard size 4-wire 30"x15" **£2.20**
250 PRESSURE MAT. Stair size 4-wire 23"x6½" **£1.73**
355 NEW PASSIVE MULTI-BEAM. Infra-red Detector, 8 metre range . . . **£55.00**
360 SIX INCH UNDER DOME BELL . . . **£9.95**
390 BEST QUALITY BELL HOUSING. PVC coated metal, not to be confused with the cheaper decoy covers. Fully signwritten with our Centurion Insignia . . . **£9.50**
400 DECOY P.V.C. BELL COVER . . . **£6.60**
NEW TWO-TONE U.S.A. POLICE SOUNDERS, complete with weatherproof horn . . . **£14.50**
SOUNDER PCB Module, only . . . **£4.95**
WEATHERPROOF Louspeaker, 8 ohm horn, only . . . **£9.55**
Note: All equipment operates on 12 Volts DC.
Terms: Add 15% VAT to Prices + 60p Postage & Packing.

No Minimum Order. Access telephone orders welcome on. 0484-35527 or send S.A.E. for Full List to:
CENTURION ALARMS & ELECTRONIC SALES, Dept. ETI, 265 Wakefield Road, Huddersfield, W. Yorks HD5 9BE.

MEMORY BARGAINS. Low-price guaranteed devices. Eprom Programming Service. S.A.E. information and discounts. — T.D.S., 57 Westmead, Woking, Surrey, GU21 3BS.

TELEPHONE ANSWERING MACHINES from £75; flipcaller £25, watches from £5.75; car radio, cassettes, boosters, speakers, walkie-talkies. S.A.E. for details. — H.P. Supplies, Dept. ETI, 162 London Road, Wembley, Middx.

Acorn Atom SOFTWARE

ON HIGH QUALITY C12 CASSETTE

Note: figures refer to TOTAL memory required

Atom Invaders! ★★

GRAPHICS MODE 4
12K

A fantastic machine code program utilising the high-resolution graphics capability of the Atom and sound output. All the usual features. £12.00

ATOM BREAKOUT Another highly entertaining machine code program with sound output. Requires 4K memory. £5.00

sinclair ZX80 SOFTWARE

.ZX80 PROGRAMMING COURSE

This consists of a book and a cassette of programs, which together cover those aspects of ZX80 programming likely to cause difficulty. Many useful programing examples are included, dealing with PEEK & POKE, arrays, USR etc.
Also includes sections on flowcharts, and the Z80 microprocessor. ONLY £8.95

NEW DIGITAL CLOCK (1K) for ZX80 only £4.50
CONTINUOUSLY CHANGING GRAPHICS – NO FLICKER!!

MANY MORE PROGRAMS AVAILABLE FOR ZX80 AND ATOM – SEND S.A.E. FOR DETAILS

BUG-BYTE DEPT. ETI
251 HENLEY ROAD, COVENTRY

Mail Order Protection Scheme

If you order goods from mail order advertisers in this magazine and pay by post in advance of delivery, this publication *Electronics Today International* will consider you for compensation if the advertiser should become insolvent or bankrupt, provided

1. You have not received the goods or had your money returned; and
2. You write to the publisher of this publication *Electronics Today International* explaining the position not earlier than 28 days from the day you sent your order and not later than 2 months from that day.

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the advertiser has been declared bankrupt or insolvent to a limit of £1800 per annum for any one advertiser so affected and up to £5400 p.a. in respect of all insolvent advertisers. Claims may be paid for higher amounts, or when the above procedures has not been complied with, at the discretion of this publication *Electronics Today International;* but we do not guarantee to do so in view of the need to set some limit to this commitment and to learn quickly of readers' difficulties.

This guarantee covers only advance payment sent in *direct* response to an advertisement in this magazine (not, for example, payments made in response to catalogues, etc., received as a result of answering such advertisements). Classified advertisements are excluded.

ADVERT INDEX

ELECTRIFY YOUR SALES! • CLASSIFIED ADVERTISEMENT

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15

Please place my advert in: Electronics Today International
(Delete as applicable) Hobby Electronics

Advertise nationally in Electronics Today International/Hobby Electronics. Simply print your advertisement in the coupon here (left), indicating which magazine you require. Or telephone for more information.

Name ....
Address ....
....
....
Tel. No. (Day) ....

Send, together with your cheque to:
Jenny Naraine, ETI/HE,
145 Charing Cross Rd., London WC2H 0EE.
Tel: 01-437 1002 Ext. 50.

World Radio History

Make it for a Song!

The New **Maplin in Matinée**

Amazing Value For Only **£299.95** + £99.50 for cabinet if required.

Easy to build. Latest technology — means less cost, less components and 80% less wiring. Comparable with organs selling for up to £1,000.00. Two 49-note manuals. 13-note pedalboard. All organ voices on drawbars. Preset voices: Banjo, Accordion, Harpsichord, Piano, Percussion. Piano sustain Sustain on both manuals, and pedalboard. Electronic rotor, fast and slow. Vibrato and Delayed vibrato. Reverb. Manual and Auto-Wah. Glide (Hawaiian Guitar Sound). Single finger chording plus memory. 30 Rhythms! 8-instrument voicing. Major, Minor and Seventh chords. Unique walking bass lines with each rhythm. Unique countermelody line with each rhythm. Truly amazing value for money. Full construction details in Electronics & Music Maker magazine.

The complete buyers' guide to electronic components. With over 300 pages, it's a comprehensive guide to electronic components with thousands of photographs and illustrations and page after page of invaluable data. Get a copy now — it's the one catalogue you can't afford to be without.

Post this coupon now for your copy of our 1981 catalogue price £1.
Please send me a copy of your 320 page catalogue. I enclose £1 (Plus 25p p&p). If I am not completely satisfied I may return the catalogue to you and have my money refunded. If you live outside the UK send £1.68 or 12 International Reply Coupons.
I enclose £1.25.

Name ____________________

Address ____________________

____

ETI481

MAPLIN

Maplin Electronic Supplies Ltd.
All mail to: P.O. Box 3, Rayleigh, Essex SS6 8LR
Telephone: Southend (0702) 554155. Sales (0702) 552911.
Shops:
159-161 King Street, Hammersmith, London W6. Telephone: (01) 748 0926.
284 London Road, Westcliff-on-Sea, Essex. Telephone: Southend (0702) 554000
Both shops closed Mondays.

Catalogue now on sale in all branches of WHSMITH Price £1.00