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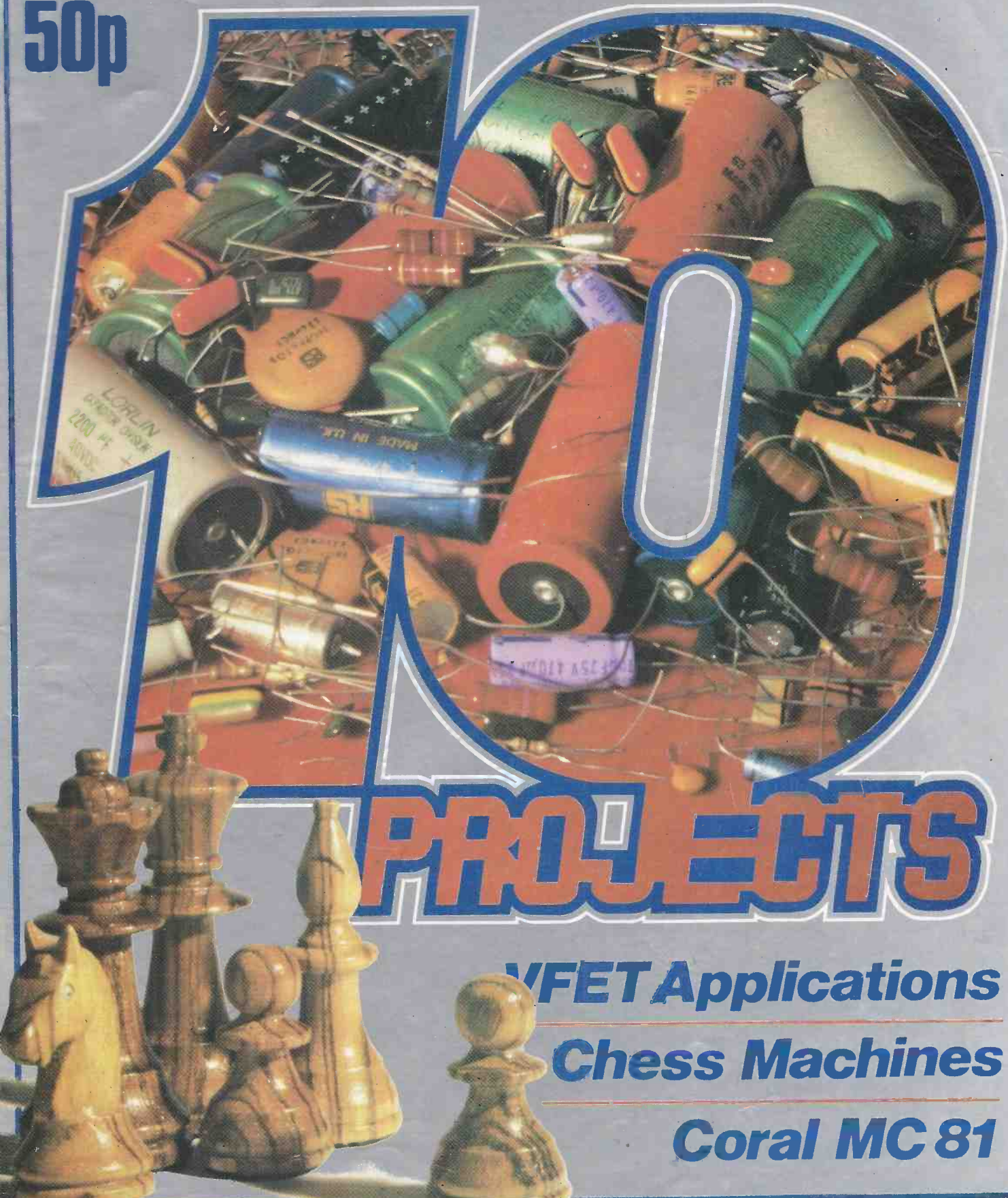
INTERNATIONAL

DECEMBER 1979

50p



10 PROJECTS

VFET Applications

Chess Machines

Coral MC 81

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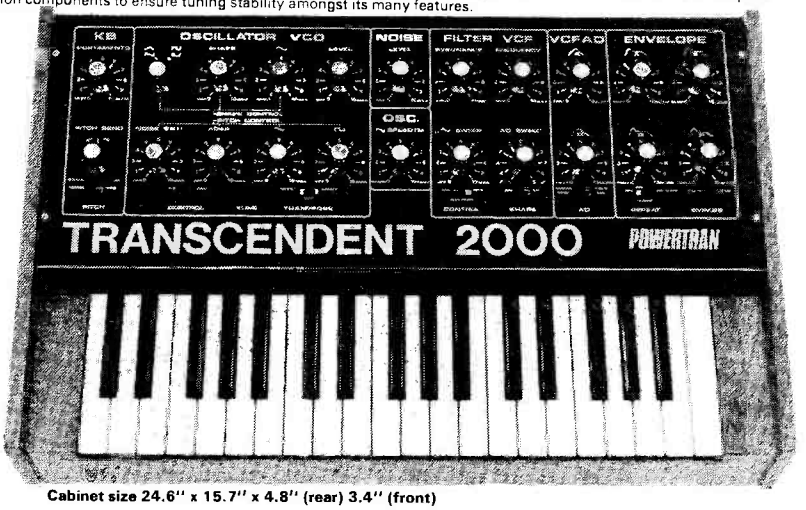
TRANSCENDENT 2000
SINGLE BOARD SYNTHESIZER

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

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

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



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

COMPLETE KIT ONLY £172.00 + VAT!

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

AS FEATURED IN AUGUST-NOVEMBER '79

Another superb design by synthesizer expert Tim Orr!

NEW! TRANSCENDENT DPX

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

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

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

COMPLETE KIT ONLY £365.00 + VAT!

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

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

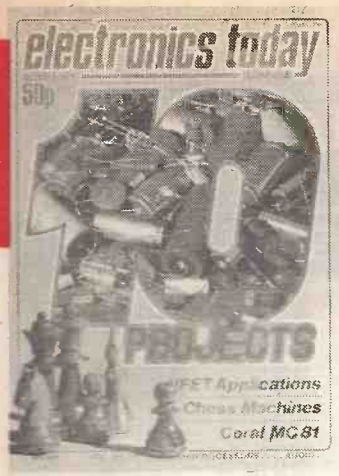
Although the DPX is an advanced design using a very large amount of circuitry, much of it very sophisticated, the kit is mechanically extremely simple with excellent access to all the circuit boards which interconnect with multiway connectors, just four of which are removed to separate the keyboard circuitry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

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

POWERTRAN

ORDERING INFORMATION AND MORE KITS ON PAGE 8

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



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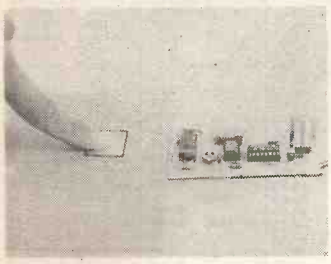

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FEATURES

PROJECTS

INFORMATION

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TRANSISTORS

Type	Price
AC107	£0.25
AC113	£0.23
AC115	£0.23
AC117	£0.35
AC117K	£0.39
AC121	£0.23
AC122	£0.16
AC125	£0.21
AC126	£0.21
AC127	£0.21
AC128	£0.18
AC128K	£0.30
AC132	£0.23
AC134	£0.23
AC137	£0.23
AC141	£0.25
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AC142	£0.42
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AC151	£0.23
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AC156	£0.23
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AC168	£0.29
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AC176	£0.21
AC178	£0.29
AC179	£0.29
AC180	£0.23
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AC181	£0.23
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AC187	£0.21
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AC188	£0.21
AC188K	£0.32
ACY17	£0.40
ACY18	£0.40
ACY19	£0.40
ACY20	£0.40
ACY21	£0.40
ACY22	£0.40
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ACY29	£0.58
ACY30	£0.40
ACY31	£0.40
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AD140	£0.99
AD142	£0.98
AD143	£0.86
AD149	£0.69
AD161	£0.40
AD162	£0.40
AD161/2	£0.81
AF124	£0.35
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TIP3CC	£0.51
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TIP32B	£0.48
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TIP41C	£0.55
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TIP42C	£0.55
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TIP3055	£0.53
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TIS90	£0.21
UT46	£0.23
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ZTX302	£0.10
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ZTX304	£0.23
ZTX330	£0.17
ZTX500	£0.15
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ZTX502	£0.18
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ZTX504	£0.29
ZTX531	£0.29
ZTX550	£0.18
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2N918	£0.35
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2N2160	£0.00
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2N3391A	£0.25
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2N3395	£0.25
2N3402	£0.24
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Type	Price
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2N5135	£0.12
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2N5138	£0.12
2N5172	£0.16
2N5194	£0.64
2N5245	£0.46
2N5294	£0.39
2N5296	£0.41
2N5296	£0.41
2N5457	£0.37
2N5458	£0.37
2N5459	£0.40
2N5551	£0.41
2N6027	£0.39
2N6121	£0.81
2N6122	£0.81
2S301	£0.58
2S302	£0.49
2S302A	£0.49
2S303	£0.64
2S303	£0.82
2S305	£0.92
2S306	£0.92
2S307	£0.92
2S321	£0.66
2S322	£0.49
2S322A	£0.49
2S323	£0.66
2S324	£0.82
2S325	£0.00
2S326	£0.82
2S327	£0.82
40311	£0.42
40313	£1.09
40316	£1.09
40317	£0.48
40326	£0.46
40327	£0.52
40346	£0.52
40347	£0.75
40348	£0.92
40360	£0.41
40362	£0.44
40406	£0.52
40407	£0.40
40408	£0.60
40409	£0.86
40410	£0.86
40411	£0.00
40430	£1.09
40476	£1.84
40494	£081
40495	£0.92
40512	£1.55
40594	£1.04
40636	£1.27

74 SERIES TTL ICs

Type	Price
7400	£0.10
7401	£0.13
7402	£0.13
7403	£0.13
7404	£0.13
7405	£0.13
7406	£0.25
7407	£0.25
7408	£0.15
7409	£0.15
7410	£0.13
7411	£0.20
7412	£0.17
7413	£0.28
7414	£0.58
7416	£0.26
7417	£0.26
7420	£0.13
7421	£0.23
7422	£0.18
7423	£0.24
7425	£0.22
7426	£0.26

Type	Price
7427	£0.28
7428	£0.30
7430	£0.15
7432	£0.25
7433	£0.35
7437	£0.24
7438	£0.24
7440	£0.14
7441	£0.58
7442	£0.46
7443	£0.81
7444	£0.81
7445	£0.75
7446	£0.69
7447	£0.55
7448	£0.64
7450	£0.13
7451	£0.13
7453	£0.13
7454	£0.13
7460	£0.13
7470	£0.29
7472	£0.23

Type	Price
7473	£0.29
7474	£0.29
7475	£0.33
7476	£0.29
7480	£0.51
7481	£0.98
7482	£0.78
7483	£0.87
7484	£1.01
7485	£0.78
7486	£0.25
7489	£1.96
7490	£0.37
7491	£0.74
7492	£0.40
7493	£0.35
7494	£0.86
7495	£0.58
7496	£0.58
74100	£0.98
74104	£0.45
74105	£0.44
74107	£0.28

Type	Price
74110	£0.41
74111	£0.57
74118	£0.92
74119	£1.36
74121	£0.28
74122	£0.45
74123	£0.46
74136	£0.60
71411	£0.63
74145	£0.63
74150	£0.78
74151	£0.55
74153	£0.55
74154	£0.94
74155	£0.58
74156	£0.58
74157	£0.58
74160	£0.67
74161	£0.71
74162	£0.71
74163	£0.71
74164	£0.78
74165	£0.78

Type	Price
74166	£0.90
74174	£0.75
74175	£0.71
74176	£0.67
74177	£0.67
74180	£1.73
74181	£0.67
74182	£0.81
74184	£0.81
74190	£0.78
74191	£0.71
74192	£0.69
74193	£0.67
74194	£0.71
74195	£0.09
74196	£1.21
74197	£1.21
74198	£2.13
74199	£2.13

CMOS ICs

Type	Price
CD4000	£0.16
CD4001	£0.18
CD4002	£0.18
CD4006	£1.06
CD4007	£0.20
CD4008	£1.06
CD4009	£0.52
CD4010	£0.55
CD4011	£0.23
CD4012	£0.22
CD4013	£0.48

Type	Price
CD4015	£0.94
CD4016	£0.49
CD4017	£0.94
CD4018	£0.98
CD4019	£0.48
CD4020	£1.04
CD4021	£0.94
CD4022	£0.94
CD4023	£0.22
CD4024	£0.75
CD4025	£0.22

Type	Price
CD4026	£1.38
CD4027	£0.58
CD4028	£0.76
CD4029	£0.98
CD4030	£0.55
CD4031	£2.30
CD4035	£1.38
CD4037	£1.00
CD4040	£1.01
CD4041	£0.87
CD4042	£0.83

Type	Price
CD4043	£1.01
CD4044	£0.94
CD4045	£1.01
CD4046	£1.50
CD4047	£1.00
CD4049	£0.55
CD4050	£0.55
CD4054	£1.27
CD4055	£1.15
CD4056	£1.55
CD4069	£0.20

Type	Price
CD4070	£0.20
CD4071	£0.20
CD4072	£0.20
CD4081	£0.20
CD4082	£0.25
CD4510	£1.27
CD4511	£1.44
CD4516	£1.15
CD4518	£1.15

LINEAR ICs

Type	Price
CA3011	£1.12
CA3014	£1.55
CA3018	£0.75
CA3020	£1.96
CA3028	£0.92
CA3035	£1.01
CA3036	£1.15
CA3042	£1.73
CA3043	£2.13
CA3046	£0.81
CA3052	£1.84
CA3054	£1.27
CA3075	£1.73
CA3081	£1.73
CA3089	£2.30
CA3090	£4.14
CA3123	£2.19
CA3130	£1.07
CA3140	£0.81

Type	Price
LM301	£0.33
LM304	£1.84
LM308	£1.15
LM309	£1.73
LM320-5V	£1.73
LM320-12V	£1.73
LM320-15V	£1.73
LM320-24V	£1.73
LM380	£0.96
LM381	£1.67
LM3900	£0.67
MC1303L	£0.98
MC1304	£2.19
MC1310	£1.09

Type	Price
MC1312	£2.19
MC1350	£1.38
MC1352	£1.01
MC1469	£3.30
MC1496	£1.04
NE536	£3.06
NE550	£1.08
NE555	£0.28
NE556	£0.69
NE565	£1.38
NE566	£1.73
NE567	£1.96
UA702C	£0.53
72702	£0.53
UA703	£0.29
UA709	£0.29
72709	£0.53
709P	£0.29
UA710C	£0.46

Type	Price
72710	£0.35
UA711C	£0.37
72711	£0.37
UA723C	£0.52
72723	£0.52
UA741C	£0.28
72741	£0.28
7417	£0.23
UA747C	£0.69
72747	£0.09
UA748	£0.40
72748	£0.40
748P	£0.40
SN76013N	£2.01
SN76023	£2.01
SN76110	£1.73
SN76115	£2.19
SN76660	£0.86

Type	Price
SL414A	£2.24
TAA550B	£0.40
TAA621A	£2.30
TAA621B	£2.88
TAA661	£1.73
TAD100	£1.50
TBA540	£2.42
TBA810S	£0.86
TBA810	£1.13
TBA920	£0.81
TBA9200	£2.88
TCA270S	£2.30
TBA800	£0.92

DIODES

Type	Price
AA110	£0.09
AA120	£0.09
AA129	£0.09
AAY30	£0.10
AAZ13	£0.17
BA100	£0.12
BA102	£0.37
BA148	£0.17
BA154	£0.14
BA155	£0.16
BA173	£0.17
BB104	£0.46

Type	Price
BAX13	£0.08
BAX16	£0.09
BY100	£0.25
BY101	£0.25
BY105	£
BY114	£0.25
BY124	£0.25
BY126	£0.17
BY127	£0.18
BY128	£0.18
BY130	£0.20
BY133	£0.24

Type	Price
BY164	£0.59
BY176	£0.86
BY206	£0.35
BYZ10	£0.52
BYZ11	£0.52
BYZ12	£0.46
BYZ13	£
BYZ16	£0.47
BYZ17	£0.41
BYZ18	£0.41
BYZ19	£0.41
OA5	£0.69

Type	Price
OA10	£0.40
OA47	£0.09
OA70	£0.09
OA79	£0.12
OA81	£
OA85	£0.12
OA90	£0.12
OA91	£0.12
OA95	£0.12
OA182	£0.15
OA200	£0.09
OA202	£0.09

Type	Price
SD10	£0.07
SD19	£0.07
IN34	£0.08
IN34A	£0.08
IN914	£0.07
IN916	£0.07
IN4148	£0.07
IS44	£0.06
IS920	£0.07

TRIACS

2 amp	T05 Case No.	Price
100	TR12a/100	£0.36
200	TR12a/200	£0.59
400	TR12a/400	£0.82

6 amp Volts		Price
100	TR16a/100	£0.59
200	TR16a/200	£0.70
400	TR16a/400	£0.89

10 amp Volts		Price
100	TR110a/100	£0.89
200	TR110a/200	£1.06
400	TR110a/400	£1.29

10 amp Volts		Price
400	TR110a 400p	£1.29

Diacs

BR100	£0.23	D32 £0.23

BRIDGE RECTIFIERS

SILICON 1 amp

Type	No.	Price
50v RMS	BR1 50	£0.23
100v RMS	BR1 100	£0.25
200v RMS	BR1 400	£0.29
400v RMS	BR1 400	£0.41

SILICON 10 amp

Type	No.	Price
50v RMS	BR10 50	£1.73
200v RMS	BR10 200	£1.96

SILICON 2 amp

Type	No.	Price
50v RMS	BR2 50	£0.52
100v RMS	BR2 100	£0.55
200v RMS	BR2 200	£0.60
400v RMS	BR2 400	£0.67
1000v RMS	BR2 1000	£0.78

SILICON 25 amp

Type	No.	Price
50v RMS	BR25 50	£2.19
200v RMS	BR200	£2.53

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BP49	Popular Electronic Projects	£1.45
BP50	IC LM3900 Projects	£1.35
BP55	Radio Stations Guide	£1.45
BP160	Coil Design & Construction Manual	£0.75
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240	Semiconductor Handbook Part 1	£5.25
241	Semiconductor Handbook Part 2	£4.28
242	Electronics Pocket Book	£3.90
244	Beginners Guide to Integrated Circuits	£2.75
209	BI-PAK TTL Data Book	50p
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SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0.16
DPDT standard slide	1974	£0.17
Toggle switch SPST 1½ amp 250V ac	1975	£0.38
Toggle switch DPDT 1 amp 250V ac	1976	£0.48
Rotary on-off mains switch	1977	£0.58
Push switch — Push to make	1978	£0.16
Push switch — Push to break	1979	£0.21

ROCKER SWITCH	Colour	No.	Price
A range of rocker	RED	1980	£0.35
switches SPST — moulded	BLACK	1981	£0.35
in high insulation	WHITE	1982	£0.35
material available in a	BLUE	1983	£0.35
choice of colours ideal	YELLOW	1984	£0.35
for small apparatus	LUMINOUS	1985	£0.35

Description	No.	Price
Miniature SPST toggle 2 amp 250V ac	1958	£0.81
Miniature SPST toggle 2 amp 250V ac	1959	£0.86
Miniature DPDT toggle 2 amp 250V ac	1960	£0.91
Miniature DPDT toggle centre off 2 amp 250V ac	1961	£1.07
Push-button SPST 2 amp 250V ac	1962	£1.04
Push-button SPST 2 amp 250V ac	1963	£1.09
Push-button DPDT 2 amp 250V ac	1964	£1.34

MIDGET WAFER SWITCHES
Single bank wafer type — suitable for switching at 250V ac 100mA or 150V dc in non-reactive loads make-before-break contacts. These switches have a spindle 0.25 in dia and 30 indexing.

Description		No.	Price
1 pole	12 way	1965	£0.55
2 pole	6 way	1966	£0.55
3 pole	4 way	1967	£0.55
4 pole	3 way	1968	£0.55

MICRO SWITCHES	No.	Price
Plastic button gives simple 1 pole change over action Rating 10 amp 250V ac	1970	£0.29

OPTOELECTRONICS

NEW INCREASED RANGE — ALL 1ST QUALITY
LEDS (diffused)

O/no.	Type	Size	Colour	Price
1501	ARL209 (TIL209)	.3mm (.125)	RED	£0.12
1502	MIL3232 (TIL211)	.3mm (.125)	GREEN	£0.22
1503	MIL3331 (OP212A)	.3mm (.125)	YELLOW	£0.22
1504	ARL4850 (FLV117)	.5mm (.2)	RED	£0.12
1505	MIL5251 (TIL222)	.5mm (.2)	GREEN	£0.22
1506	MIL5351 (MV5353)	.5mm (.2)	YELLOW	£0.22
1509	FLV111	.5mm (.2)	CLEAR (ill. Red)	£0.13

SUPER 'HI-BRITE' TYPE

1521	MIL32	.3mm (.125)	RED	£0.12
1522	MIL52	.5mm (.2)	RED	£0.12
1514	ORP12 Light dependent resistor			£0.63
1520	OCP71 Photo transistor			£0.40

LED CLIPS

150B/125	pack of 5	125 clips	£0.17
150B/2	pack of 5	2 clips	£0.21

DISPLAYS:

DL703 7 segment D.P. left (.30" height)	Common Anode	
RED Single Digit	o/no. 1523	£0.85
DL707 7 segment D.P. left (.30" height)	Common Anode	
RED Single Digit	o/no. 1512	£0.92
DL527 7 segment D.P. left (.50" height)	Common Anode	
RED Two-Digit Reflector	o/no. 1524	£2.08
DL727 7 segment D.P. right (.510" height)	Common Anode	
RED Two Digit Light Pipe	o/no. 1512	£2.07
DL747 7 segment D.P. left (630" height)	Common Anode	
RED Single Digit Light Pipe	o/no. 1511	£1.73

OPTO-ISOLATORS
Isolation Breakdown — Voltage 1500 — continuous fwd current 100mA
CIL74 Single-Channel 6 pin DIP standard type — optically coupled pair with infra-red LED Emitter and NPN Silicon Photo Transistor
o/no. 1497 **£0.61**
CILD74 Multi-Channel 8 pin DIP Two Isolated Channels
o/no. 1498 **£1.22**
CILQ74 Multi-Channel 16 pin DIP Four Isolated Channels
o/no.1499 **£2.69**

MEL 11 (TIL81) NPN LIGHT DETECTOR
Silicon Photo Darlington Amplifier — VCBO 30v VECO 10v Ic 100mA Ptot 300mW IL Min 0.5 Typ 2mA ID 100mA nA o/no. 1496 **£0.29**

NUTS AND BOLTS

BA BOLTS — packs of BA threaded cadmium plated screws slotted cheese head. Supplied in multiples of 50

Type	No.	Price	Type	No.	Price
1in 0BA	839	£1.38	½in 4BA	846	£0.37
½in 0BA	840	£0.86	¼in 4BA	847	£0.29
1in 2BA	842	£0.75	1in 6BA	848	£0.46
½in 2BA	843	£0.52	½in 6BA	849	£0.24
¼in 2BA	844	£0.60	¼in 6BA	850	£0.29
1in 4BA	845	£0.51			

BA NUTS — packs of cadmium plated full nuts in multiples of 50

Type	No.	Price	Type	No.	Price
0BA	855	£0.83	4BA	857	£0.35
2BA	856	£0.55	6BA	858	£0.28

BA WASHERS — flat cadmium plated plain stamped washers supplied in multiples of 50

Type	No.	Price	Type	No.	Price
0BA	859	£0.16	4BA	861	£0.14
2BA	860	£0.14	6BA	862	£0.14

SOLDER TAGS — Hot tinned supplied in multiples of 50

Type	No.	Price	Type	No.	Price
0BA	851	£0.46	4BA	853	£0.25
2BA	852	£0.32	6BA	854	£0.25

AUDIO LEADS

No.	Type	Price
107	FM indoor Ribbon Aerial	£0.69
113	3.5mm Jack plug to 3.5mm Jack plug. Length 1.5m	£0.86
114	5 pin DIN plug to 3.5mm Jack connected to pins 3 & 5. Length 1.5m	£0.98
115	5 pin DIN plug to 3.5mm Jack connected to pins 1 & 4. Length 1.5m	£0.98
116	Car aerial extension Screened insulated lead. Fitted plug and socket	£1.44
117	AC mains connecting lead for cassette recorders and radios. 2 metres	£0.78
118	5 pin DIN phono plug to stereo headphone Jack socket	£1.21
119	2+2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones Length 0.2m	£1.04
120	Car stereo connector. Variable geometry plug to fit most car cassettes, 8-track cartridge and combination units. Supplied with inlined fuse power lead and instructions	£0.69
123	6.6m Coiled Guitar Lead Mono Jack plug to Mono Jack plug Black	£1.72
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0.85
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0.85
126	5 pin DIN plug to Tinned open end. Length 1.5m	£0.85
127	5 pin DIN plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1.49
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0.92
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1.21
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0.78
131	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 Length 1.5m	£0.95
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1.13
133	5 pin DIN plug to 2 Phono plugs. Connected pins 3 & 5. Length 1.5m	£0.86

AUDIO LEADS

134	5 pin DIN plug to 2 Phono sockets. Connected pins 3 & 5. Length 23cm	£0.78
135	5 pin DIN socket to 2 Phono plugs. Connected pins 3 & 5. Length 23cm	£0.78
136	Coiled stereo headphone extension lead Black, length 6m	£2.01
178	AC mains lead for calculators, etc	£0.52

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V-0-6V 100mA	£1.04
2022	9V-0-9V 100mA	£1.04
2023	12V-0-12V 100mA	£1.29

MINIATURE MAINS Primary 240V with two independent secondary windings

No.	Type	Price
2024	MT280-0-6V 0-6V RMS	£1.84
2025	MT150-0-12V 0-12V RMS	£1.84

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V-0-6V 1 amp	£2.88	P.&P. 45p
2027	9V-0-9V 1 amp	£2.30	P.&P. 45p
2028	12V-0-12V 1 amp	£2.99	P.&P. 55p
2029	15V-0-15V 1 amp	£3.16	P.&P. 66p
2030	30V-0-30V 1 amp	£3.97	P.&P. 86p

STANDARD MAINS Primary 240V
Multi-tapped secondary mains transformers available in ½ amp, 1 amp and 2 amp current rating. Secondary taps are 0-19-25-33-40-50V
Voltages available by use of taps. 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25-0-25V

No.	Rating	Price	
2031	½ amp	£3.91	P.&P. 86p
2032	1 amp	£5.06	P.&P. 86p
2033	2 amp	£6.27	P.&P. £1
2035	240V Primary 0-55V @ 2A Secondary	£7.30	P.&P. £1

SPECIAL OFFER
2042 240V Primary 0-20V @ 2A Secondary. By removing 5 turns for each volt from the secondary winding any voltage up to 20V @ 2A is easily obtainable. Ideal for the experimenter.
£1.50 P.&P. 86p

CASES AND BOXES

INSTRUMENT CASES. In two sections, vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
155	8in	5½in	2in	£1.73
156	11in	6in	3in	£2.92
157	6in	4¾in	1¾in	£1.79
158	9in	5¼in	2½in	£2.43

ALUMINIUM BOXES. Made from bright alu. folded construction each box complete with half-inch-deep lid and screws

No.	Length	Width	Height	Price
159	5¼in	2¼in	1½in	£0.85
160	4in	4in	1½c0	£0.85
161	4in	2¼in	1½in	£0.85
162	5¼in	4in	1½in	£0.97
163	4in	2½in	2in	£0.87
164	3in	2in	1in	£0.60
165	7in	5in	2½in	£1.43
166	8in	6in	3in	£1.82
167	6in	4in	2in	£1.18

SLOPE front aluminium boxes with black vinyl base and sides & aluminium back, top & front — strong construction easily accessable

169	2⅛in	5⅜in	2¾in	12in	3½in	8in	£5.45
168	1⅝in	7¼in	4in	16in	4½in	11in	£8.31

VERO plastic-case box. These boxes consist of top and bottom sections which include fixing points for horizontal mounting PC boards/chassis plates, the two sections are held together by four screws which enter through the base and are concealed by plastic feet.

No.	Length	Width	Height	Price
170	140mm	40mm	205mm	£4.35
171	140mm	75mm	205mm	£4.85
172	140mm	110mm	205mm	£6.30

FUSE HOLDERS AND FUSES

Description	No.	Price
20mm x 5mm chassis mounting	506	£0.18
1¼in x ¼in chassis mounting	507	£0.14
1¼in car inline type	508	£0.18
Panel mounting 20mm	509	£0.23
Panel mounting 1¼in	510	£0.37

QUICK BLOW 20mm

Type	No.		Type	No.		Type	No.	
150mA	611	7p	1A	615	6p	3A	619	6p
250mA	612	6p	1.5A	616	7p	4A	620	10p
550mA	613	6p	2A	617	6p	5A	621	6p
800mA	614	8p	2.5A	618	7p			

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2.5A	628
250mA	623	2A	626	3.15A	629
500mA	624	1.6A	627	5A	630

All 8p each

QUICK-BLOW 1¼in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 8p each

Type	No.	Type	No.	Type	No.
1A	635	2.5A	638	4A	641
2A	637	3A	639	5A	642

All 6p each

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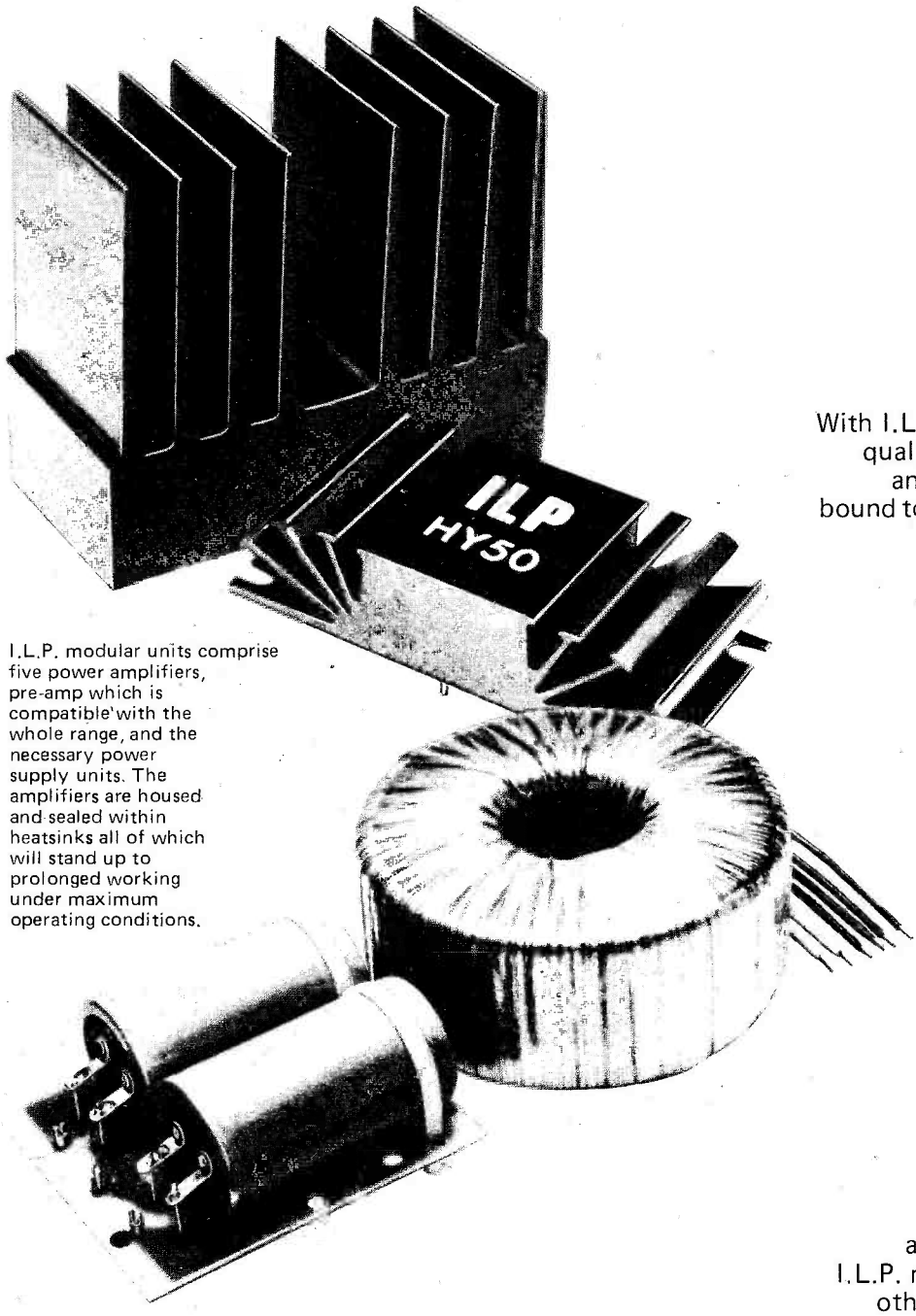
ILP'S NEW GENERATION OF HIGH



I.L.P. modular units comprise five power amplifiers, pre-amp which is compatible with the whole range, and the necessary power supply units. The amplifiers are housed and sealed within heatsinks all of which will stand up to prolonged working under maximum operating conditions.

With I.L.P. performance standards and quality already so well established, any advances in I.L.P. design are bound to be of outstanding importance — and this is exactly what we have achieved in our new generation of modular units. I.L.P. professional design principles remain — the completely adequate heatsinks, protected sealed circuitry, rugged construction and excellent performance. These have stood the test of time far longer than normally expected from ordinary commercial modules. So we have concentrated on improvements whereby our products will meet even more stringent demands such, for example, as those revealed by vastly improved pick-ups, tuners, loudspeakers, etc., all of which can prove merciless to an indifferent amplifier system. I.L.P. modules are for laboratory and other specialised applications too.

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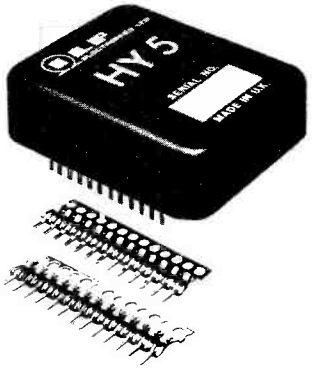
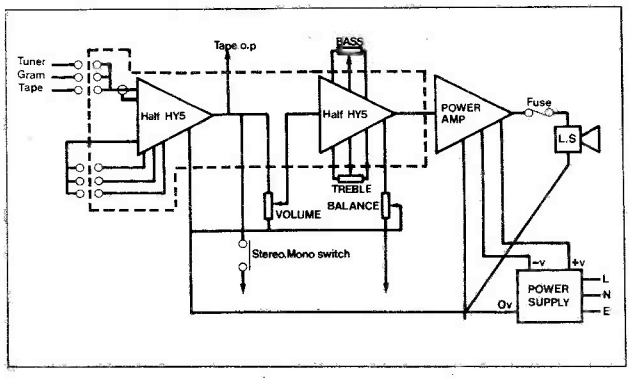
and staying there

PERFORMANCE MODULAR UNITS

HY5 PRE-AMPLIFIER

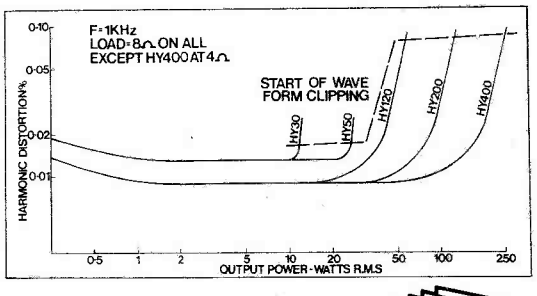




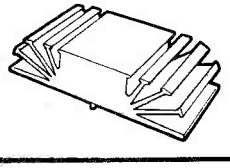
The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm. and provides multi-function equalisation for Magnetic/Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion at 1KHz—0.01%. Special strips are provided for connecting external pots and switching systems as required. Two HY5's connect easily in stereo. With easy to follow instructions.

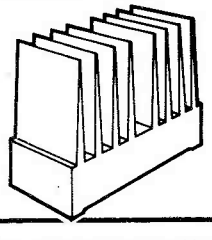
£4.64 + 74p VAT

THE POWER AMPLIFIERS



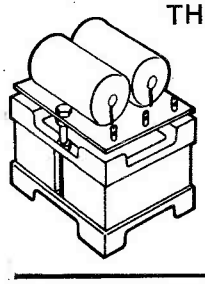
Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105x50x25	155	**£6.34** + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0- +25	105x50x25	155	**£7.24** + £1.09
HY120	60 W into 8 Ω	0.01%	100dB	-35 -0- +35	114x50x85	575	**£15.20** + £2.28
HY200	120 W into 8 Ω	0.01%	100dB	-45 -0- +45	114x50x85	575	**£18.44** + £2.77
HY400	240 W into 4 Ω	0.01%	100dB	-45 -0- +45	114x100x85	1.15Kg	**£27.68** + £4.15





Load impedance — all models 4 - 16 Ω
Input sensitivity — all models 500 mV
Input impedance—all models 100 KΩ
Frequency response — all models 10Hz - 45KHz - 3dB

THE POWER SUPPLY UNITS



I.L.P. Power Supply Units are designed specifically for use with our power amplifers and are in two basic forms — one with circuit panel mounted on conventionally styled transformer the other with toroidal transformer half weight and height of conventional laminated types.

PSU 30 ± 15V at 10ma to drive up to five HY5 pre-amps **£4.50** + 68p VAT
PSU 36 for 1 or 2 HY30's **£8.10** + £1.22 VAT
PSU 50 for 1 or 2 HY50's **£8.10** + £1.22 VAT
PSU 70 with toroidal transformer for 1 or 2 HY120's **£13.61** + £2.04 VAT
PSU 90 with toroidal transformer for 1 HY200 **£13.61** + £2.04 VAT
PSU180 with toroidal transformer for 1 HY400 or 2 x HY200 Ma **£23.02** + £3.45 VAT

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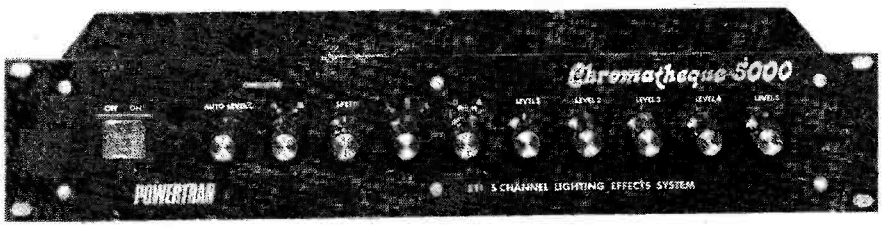
CHROMATHEQUE 5000



Panel size 19.0" x 3.5". Depth 7.3"

POWERTRAN

5 CHANNEL LIGHTING EFFECTS SYSTEM

COMPLETE KIT

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£49.50 + VAT!

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

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

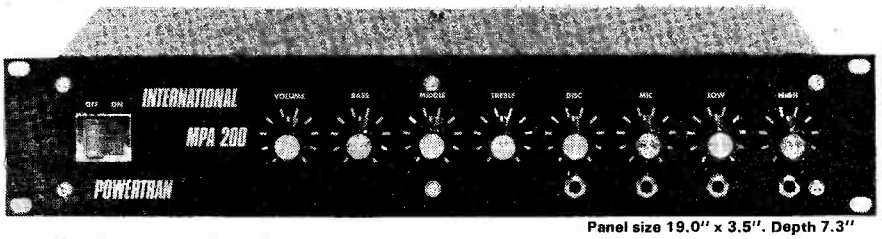
MPA 200 100 WATT (rms into 8Ω) MIXER/AMPLIFIER

COMPLETE KIT

ONLY

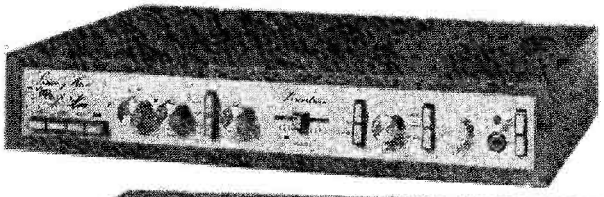
£49.90 + VAT!

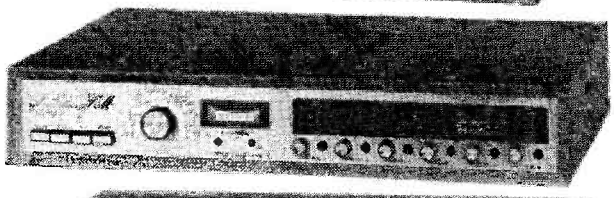
MATCHES THE CHROMATHEQUE 5000 PERFECTLY!

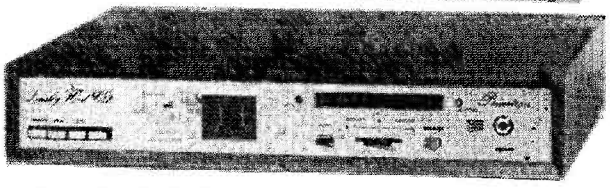


Panel size 19.0" x 3.5". Depth 7.3"

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







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

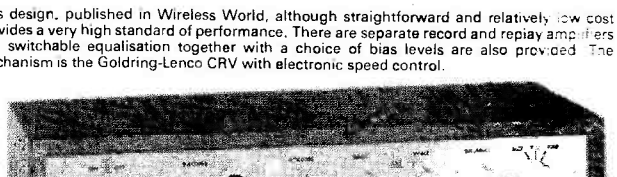
This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in H-Fi News and Record Review and features include rumble filter,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

WIRELESS WORLD FM TUNER £70.20 + VAT

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

LINSLEY-HOOD CASSETTE DECK £79.60+VAT

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



T20+20 20W STEREO AMPLIFIER £33.10+VAT

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

MATCHING TUNERS — SEE OUR FREE CATALOGUE!

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

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

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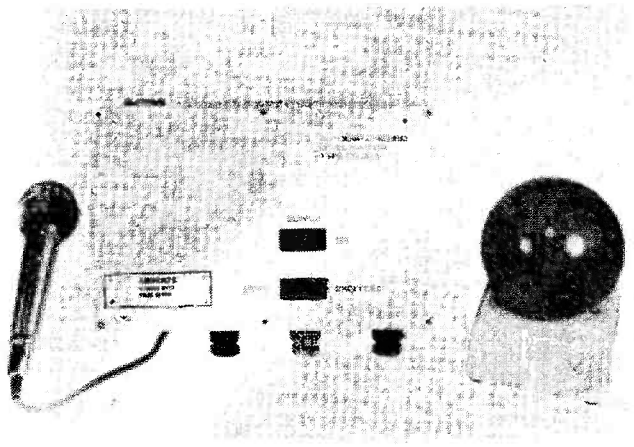


Silence Is Golden

It's also ball-shaped. (I'm not going to be rude, honest). The Golden Ball is a new, automatic sound level controller for discos and dance halls. Made by Ardente of Windsor, well-known for their work in noise control, this unit is designed to help club owners avoid complaints, keep neighbours happy and reduce health risks to audiences.

A sensitive directional mike detects harmful noise levels, a golden, ball-shaped light switches on when the sound is too loud and a control box shuts off amplifier power if the warning is ignored.

The mechanically accepted figure at which sound becomes a danger to health is 90dB, so the system automatically cuts out noise in excess of this figure. Below that, users can set their own particular comfortable maximum noise level.

So what happens when the maximum is exceeded? Well, the ball lights up to warn everyone that the limit has been reached. Five seconds then elapses in which the sound level can be reduced voluntarily. If this isn't done, there's an embarrassing five seconds of silence until the system resets itself.

Full details of the Golden Ball are available from the Anti-Noise Pollution Division, Ardent Ltd, Thames Avenue, Windsor, Berkshire.

Air-Porters

If you've had to lug cases miles around an airport, from terminal to bus station or car park, you're well aware of the need for transport within an airport complex. Gatwick are going in for a luxury system — unmanned vehicles.

However, these won't be the sort of unmanned buses that sit stationary by the kerbside defying all timetables and raising the blood pressure. Built by Westinghouse (couldn't a British firm do it?) the system will comprise two fully automatic buses, each operating on its own track connecting the main terminal to the new satellite building.

Each bus will carry 80 passengers, mainly standing, although some seats will be provided for the elderly, infirm or panic-stricken. Doors will open and shut automatically and pre-recorded message will advise passengers to mind the doors and hold tight. No passenger should have to wait more than 90 seconds for a lift.

Although it's an American system, 45% of the work will be done by UK industry. Work has already begun on the new satellite project, which is due for completion in 1982.

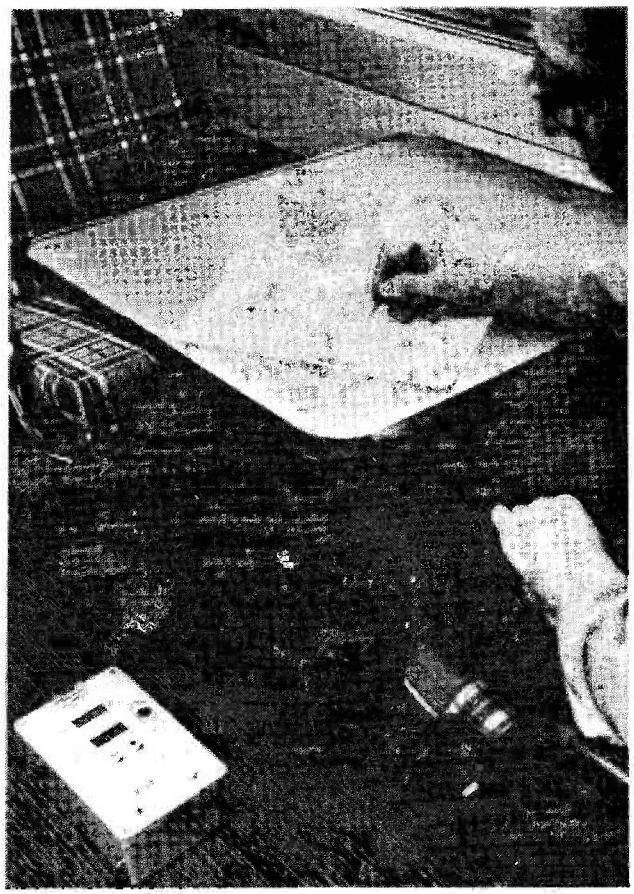
Sitting Comfy?

How do you rate the ride comfort of your daily commuter train? Perhaps the number of coffee spills per mile or the number of times you're woken from pleasant slumbers.

Well, the ride comfort on the new Advanced Passenger Train should be improved, thanks to the Jacobmeter. This interesting little instrument (named after the BR engineer who developed the concept) measures vertical and horizontal accelerations separately and displays calculated root mean square values according to criteria in ride comfort curves derived from the ISO and motion sickness data. The integration period can be set to either 10 or 60 seconds.

The Jacobmeter is currently being used in commissioning trials on the prototype Advanced Passenger Train. It may later be used as a tool for general use throughout British Rail. So, fellow commuters, it looks like chuff-chuff comfort may be a bit better by the time we take out a mortgage on our next season ticket.

The Jacobmeter is made to a BR design by Kemo Ltd, 9-12 Goodwood Parade, Elmers End, Beckenham, Kent BR3 3QZ.



SOS (Save Our Servos)

Radio-control fans — remember that sinking feeling in your stomach as you watched your R/C model fall out of the sky, unable to do anything about it. Bet it was a shock, especially if your model was a yacht.

Chromatronics have just announced the introduction of an electronic fail-safe for radio modellers to minimise the danger of a model going out of control in the event of interference or loss of signal. Interference from what? Who said Citizen's Band (or is it Banned)?

The system will cope with co-channel interference from another R/C transmitter or CB (I promise I won't mention it again), total or partial transmitter or receiver failure and the model moving out of range. If your model tips the scales at 5kg or more, a fail-safe device is obligatory under CAA regulations.

Unlike earlier simple devices, the PP1M-4CH works by two level threshold detection on all four receiver outputs. So, all primary control functions can be protected from severe glitches from whatever source. The unit is used to set up to four control servos in preset safe positions during a catastrophe. So, if the world should end, your Sopwith or Starfighter will still be zooming around the blue yonder until it runs out of four star, thanks to Chromatronics.

The unit works with any three wire positive pulse servo and has individual preset controls for each servo and variable fault detection thresholds. Cut-in time is only 0.1 seconds. The PP1M-4CH is connected between the receiver and servos and works with either AM or FM systems on the 27MHz UHF band or any other operational frequencies. It is small (62×42×23mm) and lightweight, packed in a robust plastic capsule. It comes with four input leads and four output leads already fitted, but you have to fit the appropriate plugs and sockets for your equipment.

For only £14.95 (including VAT), this electronic fail-safe device sounds like remarkably good value, considering the cost of replacing a crashed model. The PP1M-4CH is available from Chromatronics, Coachworks House, River Way, Harlow, Essex.

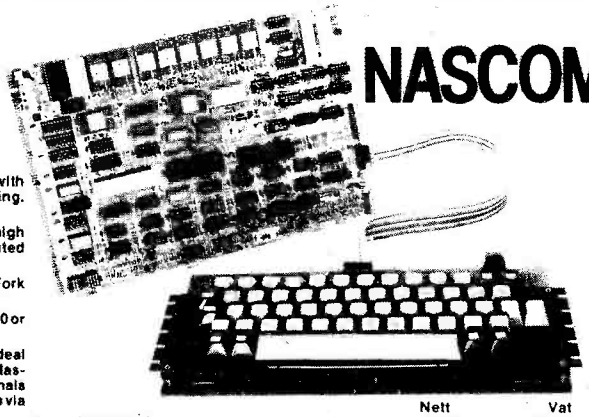
New Neosid

Neosid, a name well known in professional and consumer electronics, has recently established a new outlet for the amateur constructor and small user.

The new Small Order Catalogue covers a broad cross section of the company's products — ferrite beads, screw cores, rods, E, I and U cores and coil assemblies, plastic formers and trimming tools.

Send a stamped, addressed envelope for the Small Orders Catalogue to Neosid Small Orders, PO Box 86, Welwyn Garden City, Herts AL7 1AS.

Just a little bit more... NASCOM-2



Compare its features:

- Z-80A 4MHZ. CPU: The most powerful 8-bit processor on the market.
- 8K Basic: resident on board, MICROSOFT Basic, the industry standard, with extensions for on-screen editing, graphics, machine code interfacing. Optimised for speed (see benchmarks below).
- Full 57 Key Licon solid state keyboard: switch mechanisms are contactless, high reliability professional units for long trouble free life. Keyboard is mounted separately to avoid straining main P.C.B.
- Total of 20K on-board memory: 2K monitor (Nas-Sys 1), 1K Video RAM, 1K Work space RAM, 8K Microsoft Basic, 8K user RAM.
- Kansas City cassette interface: for reliable storage of programs and data at 300 or 1200 baud, with full checksum error detection.
- Nas-sys monitor: A powerful 2K machine code monitor provides an ideal environment for learning about and developing machine code programs. Nas-sys uses a blinking non destructive cursor, with 22 commands. ASCII terminals are fully supported via the serial interface; users can add their own I/O drivers via the system I/O vector table to support other devices.

Nas-sys commands are:

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

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

Screen display of 16 lines x 48 characters: Stable, clear display to British television standards. Full 128 ASCII character set; option for further 128 graphics characters.

- Fully buffered NASBUS compatible: Well defined bus structure with a range of expansion cards; including (shortly) a floppy disc system with CP/m — the industry standard operating system.

	Nett	Vat	Total
Nascom-2	295.00	44.25	339.25
Power supply	24.50	3.68	28.18
10 C15 cassettes	4.44	0.66	5.10
Z-80 Programming manual (Mostek)			4.50
Z-80 Microcomputer handbook			6.95
Practical microcomputer programming the Z-80			20.00
Sargon-8K Z-80 Chess program (book)			9.50

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	APPLE II		RM. 380Z	PET
BM 1	1.5	1.1	1.4	1.7
BM 2	3.2	5.4	6.5	9.9
BM 3	7.3	11.1	13.2	18.4
BM 4	7.2	11.6	13.9	20.4
BM 5	8.9	12.6	15.0	21.7
BM 6	18.6	19.3	22.3	32.5
BM 7	28.2	27.6	31.6	50.9
BM 8		5.2	6.2	12.3

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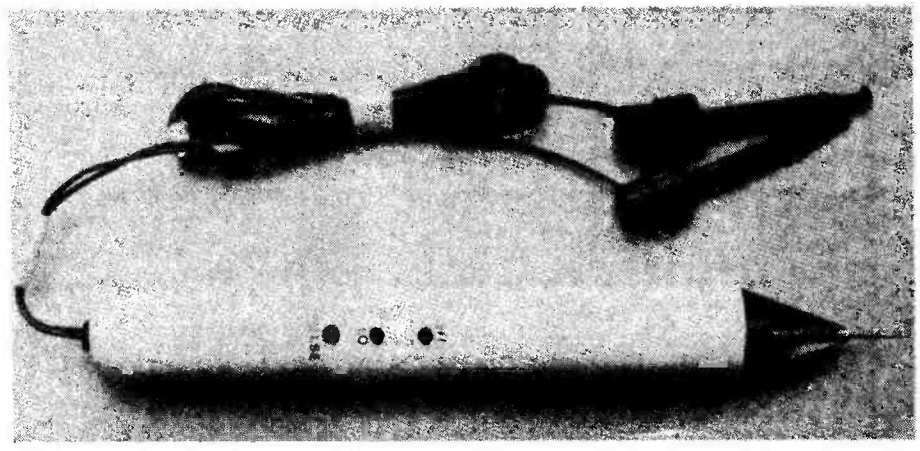
Interest in digital electronics has grown rapidly in the past few years with the advent of microprocessors and large scale integration. The most essential test instrument for experimenting with digital circuitry is a logic probe.

In its most basic form this should provide an indication of the logic level at any point in a circuit without overloading the section being tested. Other desirable features are the ability to follow high frequency pulse trains (preferably over 1 MHz) and to detect isolated, narrow pulses less than 1 uS in width. Finally, the instrument should be compatible with both TTL and CMOS ICs and be able to operate from a wide range of supply voltages (say five to 15 volts).

Commercial logic probes that satisfy all these requirements are available, but they invariably cost over £30. The probe design described here offers comparable performance for less than £4. combined with an excuse to enjoy a good cigar – a cigar tube is used for the case!

Indication is by means of three LEDs. Two red LEDs indicate either a HIGH or a LOW condition on the point under test, a green LED is used to indicate that a pulse train is occurring.

The circuit uses a single CMOS IC and a handful of resistors and capacitors. The components are mounted on a small board and housed in a tubular case such as an aluminium cigar tube or a length of plastic conduit. The power is supplied from the actual circuit under test and the performance characteristics of the prototype are described in the specification listed here.



The logic probe in a cigar tube, showing the Hi, Lo and Pulse indication LEDs.

Construction

A printed circuit board is recommended for this project to provide consistent performance characteristics.

Before attempting to mount the components on the printed circuit board check to see that it fits easily into the case. The board must be a loose enough fit to allow it to be moved up and down within the case over a range of at least 5 mm. (Refer to the diagram).

Mount the wire links, the resistors and the capacitors on the board, keeping all components as close to the board as possible. Note that C3 is mounted on the underside of the board. Next, install the three LEDs. The height of the LEDs above the board must be such that the assembly will slide into the case with the board pushed down against the bottom of the case (see diagram). For a 20 mm diameter case this height should be about 12 mm. If the LEDs are not high enough, then it will not be possible to push the assembled board up into a position where the LEDs project through the holes in the case.

Next, add the power leads (without clips or E-Z hooks at this stage) and the 10 cm wire to the probe tip. Last of all solder IC1 into position, observing all the usual precautions – shorted pins, heat sink, earthed soldering iron, pins 8 and 16 soldered first.

Drill the 3 mm holes for the LEDs at 10 mm intervals, starting 75 mm from the front of the case. The hole for the supply leads is drilled in the back of the case and fitted with a small rubber grommet (or plastic LED housing) to prevent the case rubbing through the insulation on the leads.

Before mounting the assembled board in the case check the circuit for dry joints, solder bridges, incorrectly mounted components, etc. Then test the device as follows. Connect to a five volt supply and observe the three LEDs. None should light with the probe tip isolated. If the LOW LED (LED 2) comes on or flashes, then R2 is too small and must be replaced by a slightly larger resistor (say 820k). Touching the probe tip with the fingers may cause LED 2 to light, but this should go off when the tip is isolated. Touching the probe tip to either supply rail should▶

HOW IT WORKS

Three of the six inverter/buffers in IC1 are used in the high/low detection circuit. IC1c is connected to the probe tip via R9. When the input goes HIGH (logic 1), IC1c output goes low and illuminates LED 2 through R5. Similarly when the input goes LOW (logic 0), the series pair IC1e and f illuminate LED 1 through R4. The resistor network R1, R2 and R3 ensure that the outputs of both IC1c and IC1f remain high when the input is 'floating'. C1 is connected across R2 as a 'speed-up capacitor' to maintain a sharp pulse shape into IC1e and so improve the ability to follow high frequency pulse trains (over 1MHz).

The two inverters IC1a and b form a monostable circuit that stretches short pulses (less than 500 nsec) out to 15 msec (0.7RC) using C3 and R8. The input of the monostable comes from the output of IC1c and is isolated from the DC level of this output by C2. The combination of R7 and D1 normally holds IC1b through C2, the output goes high, forcing IC1a to go low and illuminate LED 3. Diode D1 ensures that the input to IC1b is kept low (0V7 above zero) so long as the output of IC1a remains low. This prevents subsequent pulses from retriggering IC1b until the monostable itself retriggers via discharge of C3 to earth through R8, and allows IC1a output to go high, switching off LED 3.

Capacitors C4 and C5 (optional) confer immunity to spikes or pulses in the supply lines, which are taken from the circuit being tested.

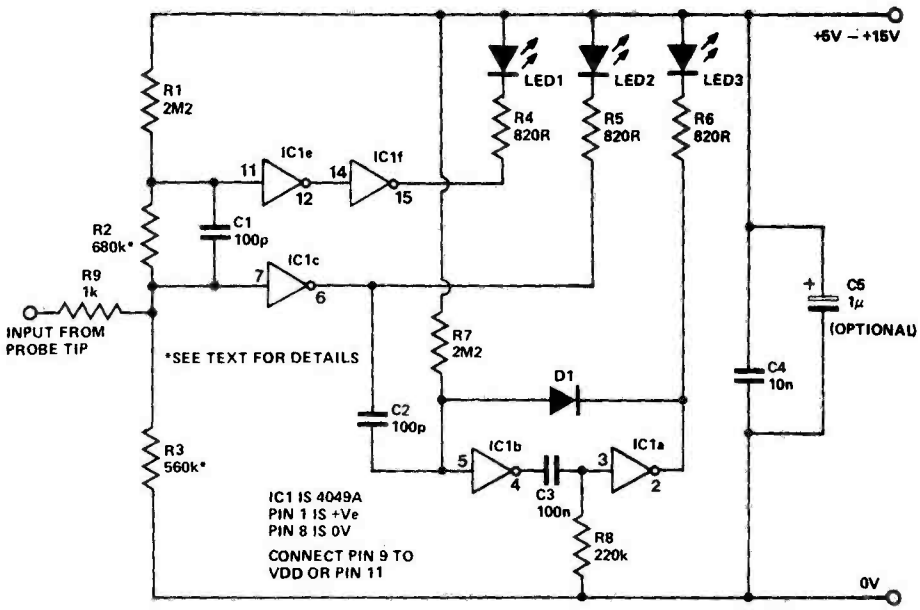
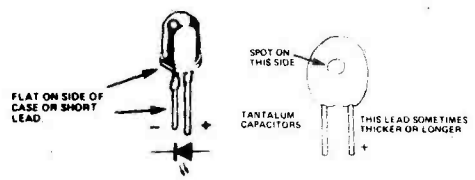


Fig.1. Circuit diagram. Note the polarity of LEDs 1, 2 and 3.



NOTE
C5 IF USED IS MOUNTED ACROSS C4 (OBSERVE POLARITY)

CONNECT RESPECTIVE LETTERS TOGETHER
A TO A B TO B etc.

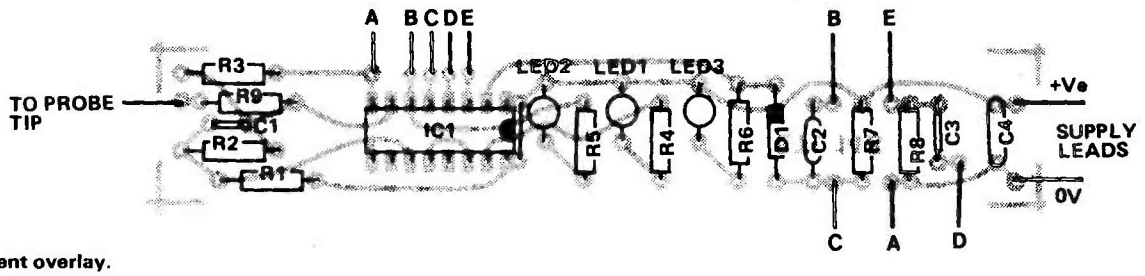


Fig.2. Component overlay.

PARTS LIST

Resistors all ¼W, 5%

R1,7	2M2
R2	680k*
R3	560k*
R4,5,6	820R
R8	220k
R9	1k

Capacitors

C1,2	100p Ceramic
C3	100n Polyester
C4	10n Polyester
C5	1u (Optional)

Semiconductors

IC1	4049A
LED 1,2	3mm red
LED 3	3mm green
D1	1N4148 (or equivalent)

Miscellaneous

PCB; red and black leads with alligator clips or E-Z hooks; cigar case (or equivalent) – minimum dimensions 20mm ID, 140mm long; probe tip housing.

* Resistors R2 and R3 may have to be altered slightly (in the range 470k to 820k) to suit the transfer characteristics of IC1 – see text.

BUYLINES

Once again, components should be readily available from most suppliers. Make sure the components you buy will fit into the container you choose. If you're not a cigar smoker, plastic piping from your local hardware store will do just as well.

The long thin PCB should look like this when it's finished.

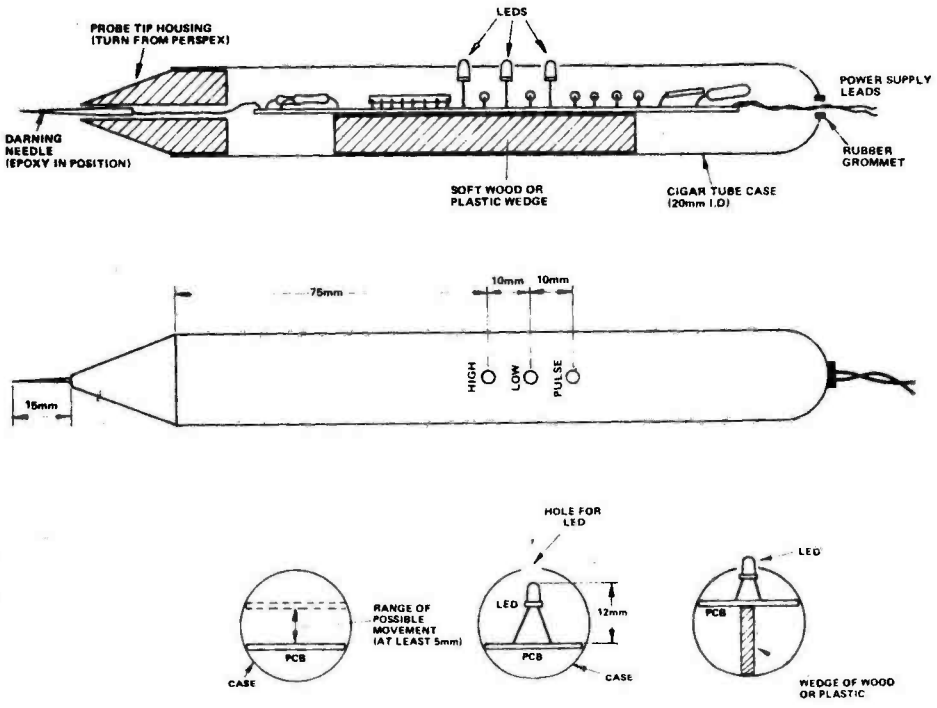
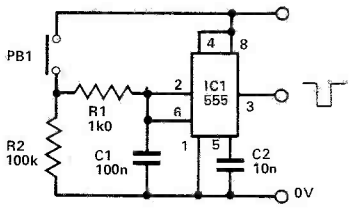


Fig.3. The PCB slides into the cigar tube and rests on a piece of wood or plastic.

light the appropriate LED, with the PULSE LED flashing when the tip first touches the positive rail. If the LOW LED does not light when the probe is connected to 0V, then R2 is too large. Change R2 to 560k and repeat the sequence above.

Now try a 15 volt supply. Again, all LEDs should be extinguished when the probe tip is isolated. The HIGH LED (LED 1) may glow very faintly. If this glow is too strong, reduce the value of R3 to say 470k. However, if R3 has to be altered it will be necessary to recheck the circuit at 5V to see that the low voltage performance is still satisfactory. At 15 volts repeat the process of touching the probe tip to the two supply rails. The results should be the same as in the case of the 5 volt supply, but the LEDs will be considerably brighter. ETI

TECH TIPS



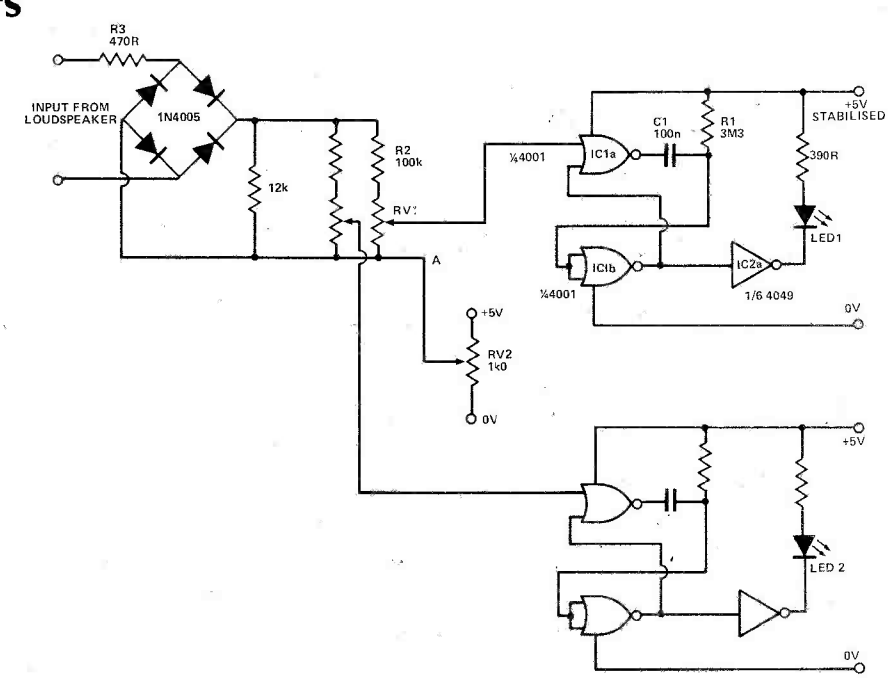
555 Micro Input Reset

P. Davidson

When dealing with a microprocessor system, there are several features which place requirements on the duration of their input leg reset. These signals are usually negative (in the author's experience) and so, with the use of a 555, these requirements can be filled reliably (as opposed to the normal flip-flop debounce circuit). The circuit saves on logic used to invert the normal 555 monostable action.

LED Audio Power Indicators

M. P. Downes



The circuit diagram shows the input circuitry from the loudspeaker terminals. For simplicity only two of the monostable and LED driver cuits are shown. Six of these circuits can be constructred using three 4001s and one 4049 CMOS ICs. The circuit is based on the fact that CMOS has an input threshold of approximately half the supply voltage (actually 0.45 — 0.55 supply volts). IC1a and IC1b are dual input NOR gates connected in a monostable configuration with timing components R1 and C1. When the input to IC1a exceeds the threshold voltage, the monostable's output goes high for a period determined by R1 and C1 (with values shown approximately 200 mS). This output is inverted and buffered to drive a LED for this period. The input to trigger the monostable comes from the speaker terminals where it is full wave rectified and appears across RV1. R3 is a safety resistor in case of bridge failure. IN4005 diodes have the desired voltage and frequency characteristics for the bridge. R2 is to limit the current flowing into IC1a's internal protection diodes under large signal conditions and the value of RV1 depends on the desired input triggering voltage.

The lowest input voltage that can trigger the monostable is limited by the voltage drop across the bridge (0V8) and the threshold voltage of IC1a (approximately 2V5). The threshold limit is largely overcome by using RV2 to bias point A to just below the threshold voltage. In practice, the circuit operates on an input frequency of from less than 5 Hz to more than 50 kHz sinewave and at an input voltage of from approximately 1V4 RMS (0.25 W into 8R) to more than 90 V RMS (1 kW into 8R). A single positive or negative 4 uS wide pulse will also operate the circuit.

The +5 V supply must be stabilised to ensure stable threshold levels and the usual decoupling of ICs and supply is advisable. If two units are required for stereo use, two completely separate +5 V power supplies are essential to prevent partial shorting out of the input bridge, due to a possible common loudspeaker terminal in the amplifier. Greater input sensitivity can be achieved by using 0A91 diodes in the input bridge, but with slight loss in high frequency response and a lower maximum input voltage. If there is a variation in the threshold voltage of individual ICs then the lower threshold ICs should be used in the most sensitive positions of the circuit, i.e. 0.25W.

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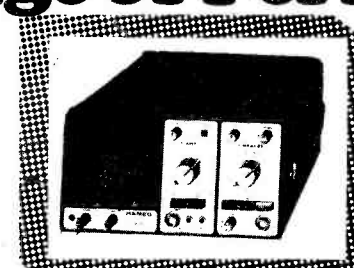

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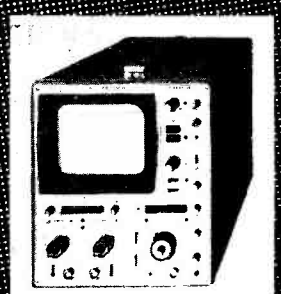

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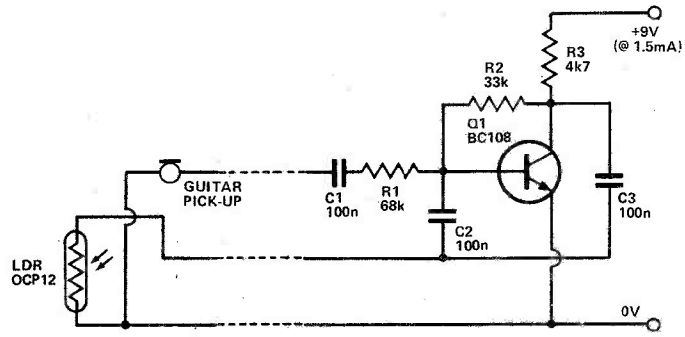
Autowah Without Tears

S. N. Goodwin

The main disadvantage of a simple wah-wah circuit is that it requires a manual trigger for the effect, usually provided by a foot-pedal, which needs solid (and often expensive) mechanical construction and also prevents the guitarist from moving freely about the stage. After a couple of hand-made pedal systems collapsed in use, the standard wah-wah circuit was modified as follows: A light dependent resistor was mounted on the soundboard of the guitar about 2 cms from the highest string, pointing out about 1 cm from the front of the instrument. The shadow of the player's hand moving across the guitar triggers the effect — the more light shining on the LDR, the higher the frequency-range boosted by the circuit.



It is tolerant of quite a wide range of light levels and if the range is found to be incorrect this can be rectified in two ways. Lenses or filters can be put across the LDR, or resistors can be connected in series/parallel with it. Fluorescent lights could give problems with mains hum, but, under normal incandescent lighting, none were experienced. The wire to the LDR should ideally be screened, but over short distances this is not vital. Avoid bending its leads close to the body, as they can be snapped off very easily.

A Simple Sequencer

P. Hill

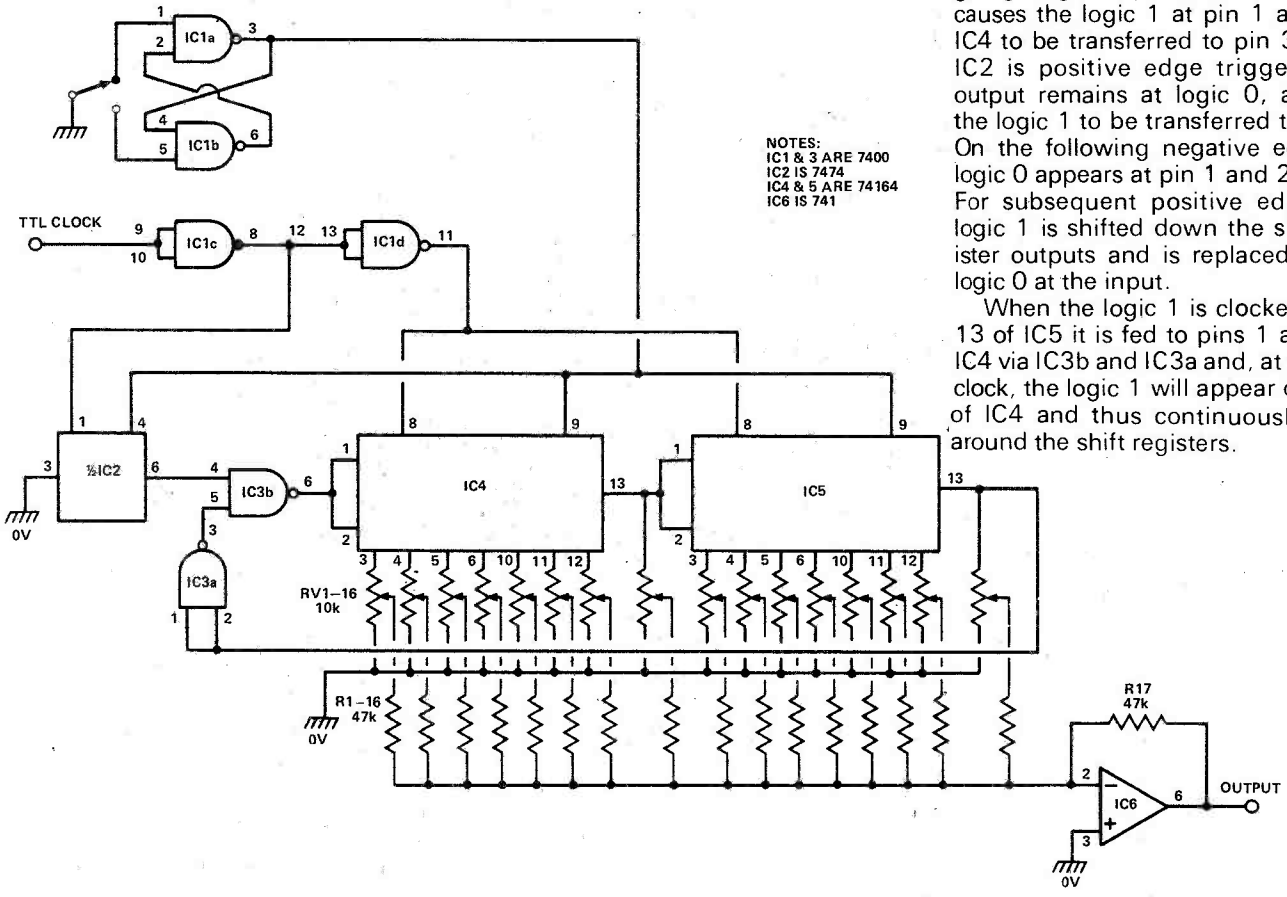
A simple sequencer can be constructed using shift registers.

A logic 1 is shifted down the shift registers (IC4, 5) outputs, otherwise at logic 0, at each clock pulse. This places a voltage across the variable resisters RV1 — 16 in turn. A preset DC voltage is thus available at the output, after being buffered by R1 - 16 and IC6 for each clock pulse. A sequence of control voltages can be set up and used to drive a voltage controlled oxillator.

The sequencer is reset by S1. The switch is debounced by IC1a and IC1b. Resetting zeros all shift register outputs and results in a logic 1 appears at the input of IC4.

When a clock is applied a positive going edge at pin 8 of IC4 and 5 corresponds to a negative-going edge at pin 1 of IC2, due to inverters IC1c and IC1d. The first positive going edge at pin 8 of IC4 and 5 causes the logic 1 at pin 1 and 2 of IC4 to be transferred to pin 3. Since IC2 is positive edge triggered it's output remains at logic 0, allowing the logic 1 to be transferred to pin 3. On the following negative edge the logic 0 appears at pin 1 and 2 of IC4. For subsequent positive edges the logic 1 is shifted down the shift register outputs and is replaced by the logic 0 at the input.

When the logic 1 is clocked to pin 13 of IC5 it is fed to pins 1 and 2 of IC4 via IC3b and IC3a and, at the next clock, the logic 1 will appear on pin 3 of IC4 and thus continuously cycle around the shift registers.



TTLs by TEXAS

7400	11p	74251	140p	4018	89p
74S00	60p	74259	250p	4019	45p
7401	12p	74278	290p	4020	100p
7402	12p	74279	110p	4021	110p
7403	14p	74283	160p	4022	100p
7404	14p	74290	150p	4023	22p
74S04	90p	74293	150p	4024	50p
7405	18p	74298	200p	4025	20p
7406	32p	74365	100p	4026	130p
7407	32p	74366	100p	4027	50p
7408	17p	74367	100p	4028	84p
7409	19p	74368	100p	4029	100p
7410	15p	74390	200p	4030	55p
7411	24p	74393	200p	4031	200p
7412	20p	74490	225p	4033	180p
7413	30p	**74LS SERIES**		4034	200p
7414	50p	74LS00	14p	4035	110p
74C14	90p	74LS02	16p	4036	295p
7416	27p	74LS03	18p	4037	115p
7417	27p	74LS04	16p	4038	120p
7420	17p	74LS05	25p	4039	295p
7421	40p	74LS08	22p	4040	100p
7422	22p	74LS10	20p	4041	80p
7423	34p	74LS11	40p	4042	80p
7425	30p	74LS13	40p	4043	90p
7426	40p	74LS14	72p	4044	90p
7427	34p	74LS15	45p	4046	110p
7428	367430	74LS20	20p	4047	100p
17p		74LS21	40p	4048	55p
7432	30p	74LS27	38p	4049	40p
7433	40p	74LS30	20p	4050	49p
7437	35p	74LS32	27p	4051	80p
7438	35p	74LS42	70p	4052	80p
7440	17p	74LS47	90p	4053	80p
7441	70p	74LS51	24p	4054	150p
7442A	60p	74LS55	30p	4055	125p
7443	112p	74LS73	50p	4056	135p
7444	112p	74LS74	36p	4059	600p
7445	100p	74LS75	40p	4060	115p
7446A	93p	74LS76	46p	4063	120p
7447A	50p	74LS83	110p	4066	55p
7448	80p	74LS85	100p	4067	450p
7450	17p	74LS86	40p	4068	22p
7451	17p	74LS90	40p	4069	20p
7453	17p	74LS92	70p	4070	30p
7454	17p	74LS93	60p	4071	22p
7460	17p	74LS96	110p	4072	22p
7470	36p	74LS107	45p	4073	22p
7472	30p	74LS109	80p	4075	22p
7473	34p	74LS112	100p	4076	107p
7474	30p	74LS113	90p	4081	22p
7475	30p	74LS114	45p	4082	22p
7476	35p	74LS122	80p	4086	72p
7480	50p	74LS123	70p	4089	138p
7481	100p	74LS124	180p	4093	80p
7482	84p	74LS125	60p	4094	250p
7483A	90p	74LS126	60p	4095	95p
7484	100p	74LS132	95p	4096	95p
7485	110p	74LS133	30p	4097	340p
7486	34p	74LS136	55p	4098	107p
7489	175p	74LS138	75p	4099	200p
7490A	30p	74LS139	75p	40100	220p
7491	80p	74LS145	120p	40101	132p
7492A	46p	74LS147	220p	40102	180p
7493A	30p	74LS148	175p	40103	180p
7494	84p	74LS151	100p	40104	99p
7496A	70p	74LS153	60p	40105	99p
7498	65p	74LS154	200p	40106	60p
7497	180p	74LS155	90p	40107	60p
74100	130p	74LS156	90p	40108	470p
74104	65p	74LS157	60p	40109	100p
74105	65p	74LS158	90p	40110	300p
74107	34p	74LS160	130p	40114	250p
74109	55p	74LS161	100p	4411	1100p
74110	55p	74LS162	140p	4502	120p
74111	70p	74LS163	100p	4503	70p
74116	200p	74LS164	120p	4507	55p
74118	130p	74LS165	160p	4508	290p
74119	210p	74LS166	180p	4510	99p
74120	110p	74LS173	110p	4511	150p
74121	28p	74LS174	110p	4512	80p
74122	48p	74LS175	110p	4514	265p
74123	48p	74LS181	320p	4515	300p
74125	55p	74LS190	100p	4516	110p
74126	60p	74LS191	100p	4518	100p
74128	75p	74LS192	100p	4520	100p
74132	75p	74LS193	100p	4526	108p
74135	50p	74LS195	140p	4527	150p
74136	75p	74LS196	120p	4528	100p
74137	50p	74LS197	120p	4538	120p
74141	50p	74LS221	140p	4543	180p
74142	200p	74LS240	175p	4553	450p
74145	90p	74LS241	175p	4556	72p
74147	190p	74LS242	170p	4560	250p
74148	150p	74LS243	170p	4569	250p
74150	100p	74LS244	195p	4572	40p
74151A	70p	74LS245	250p	4583	90p
74153	70p	74LS247	140p	4584	90p
74154	100p	74LS248	140p	4724	250p
74155	90p	74LS249	140p	40014	90p
74156	90p	74LS251	140p	40085	200p
74157	70p	74LS253	140p	40097	90p
74159	190p	74LS257	120p	14411	1100p
74160	100p	74LS258	160p	14412	1100p
74161	100p	74LS259	160p	14433	1100p
74162	100p	74LS266	100p	14500	700p
74163	100p	74LS273	175p	14599	290p
74164	120p	74LS279	90p	CD22100	350p
74165	130p	74LS298	249p	CD22101	700p
74166	120p	74LS324	200p	CD22102	700p
74167	200p	74LS348	200p	**INTERFACE**	
74170	240p	74LS365	100p	**ICs**	
74172	450p	74LS367	100p	DM8123	175p
74173	120p	74LS368	100p	MC1488	100p
74174	90p	74LS373	180p	MC1489	100p
74175	85p	74LS374	195p	25S10	350p
74176	90p	74LS378	200p	75107	160p
74177	90p	74LS390	160p	75150	175p
74178	160p	74LS393	160p	75154	175p
74180	93p	74LS445	140p	75182	230p
74181	160p	74LS668	100p	75322	300p
74182	90p	74LS669	100p	75324	375p
74184A	150p	74LS670	400p	75325	375p
74185	150p	**4000 SERIES**		75361	300p
74186	500p	4000	15p	75363	400p
74188	325p	4001	17p	75365	350p
74190	90p	4002	17p	75451	72p
74191	90p	4006	95p	75491/2	96p
74192	90p	4007	18p	8T26	250p
74193	90p	4008	80p	8T28	300p
74194	90p	4009	40p	8T95	200p
74195	95p	4010	50p	8T97	200p
74196	95p	4011	17p	81LS95	140p
74197	80p	4012	18p	81LS96	140p
74198	150p	4013	50p	81LS97	140p
74199	150p	4014	84p	81LS98	140p
74200	£10	4015	84p	9601	110p
74221	160p	4016	45p	9602	220p
		4017	80p	9603	160p

93 SERIES

9301	160p
9302	175p
9308	316p
9310	275p
9311	275p
9312	180p
9314	165p
9316	225p
9321	225p
9322	150p
9334	360p
9368	200p
9370	200p
9374	200p

LINEAR I.Cs

AY1-0212	600p
AY1-1313	668p
AY1-1320	320p
AY1-5050	170p
AY3-1270	840p
AY5-1224A	240p
AY5-1315	600p
AY5-1317A	775p
CA3019	80p
CA3046	70p
CA3048	225p
CA3080E	72p
CA3086	48p
CA3089E	225p
CA3090AQ	375p
CA3130E	100p
CA3140E	50p
CA3160E	100p
CA3161E	140p
CA3162E	450p
CA3189E	400p
DAC1408-8	200p
FX209	750p
ICL7106	850p
ICL8038	340p
LF356P	95p
LF398P	75p
LM10C	425p
LM301A	30p
LM311	120p
LM318	200p
LM319	225p
LM324	50p
LM339	75p
LM348	95p
LM377	175p
LM380	75p
LM381AN	160p
LM709	36p
LM710	50p
LM725	350p
LM733	100p
LM741	18p
LM747	70p
LM748	35p
LM2917	250p
LM3900	70p
LM3909	70p
LM3911	130p
LM3914	250p
LM4136	120p
MC1310P	150p
MC1458	48p
MC1495L	350p
MC1496	100p
MC3340P	120p
MC3360P	120p
MK50398	750p
MM57160	620p

VOLTAGE REGULATORS
Fixed Plastic TO-220

1A	+ve		-ve	
5V	7805	60p	7905	70p
12V	7812	60p	7912	70p
15V	7815	60p	7915	70p
18V	7818	60p	7918	70p
24V	7824	60p	7924	70p

100mA	TO-92			
5V	78L05	30p	79L05	70p
12V	78L12	30p	79L12	70p
15V	78L15	30p	79L15	70p

OTHER REGULATORS	
LM309K	135p
LM317T	200p
LM323K	550p
LM723	37p
TBA625B	120p
78HGKC	725p
78H05KC	625p
78MGT2C	135p
78P05	900p

OPTO-ELECTRONICS

2N5777	45p	ORP60	90p
OCP71	130p	ORP61	90p
ORP12	90p	TIL78	70p
OPTO-ISOLATORS			
ILD74	130p	TIL111	90p
MCT26	100p	TIL112	90p
MCS2400	190p	TIL116	90p
LEDS			
0.125"		0.2"	
TIL32	75p	TIL220 Red	16p
TIL209 Red	13p	TIL222 Gr	18p
TIL211 Gr	20p	TIL228 Red	22p
TIL212 Ye	25p	MV5491 TS	120p
TIL216 Red	18p	Clips	3p
DISPLAYS			
3015F	200p	NSB5881	570p
DL704	140p	TIL311	600p
DL707 Red	140p	TIL312/3	110p
707 Gr	140p	TIL321/2	130p
DL747 Red	225p	TIL330	140p
747 Gr	225p	7750/60	200p
FND357	120p	**DRIVERS**	
FND500	120p	9638	200p
FND507	120p	9370	200p
MAN3640	175p	UDN611B	320p
MAN6640	200p	UDN6184	320p

VERDOBOARDS 0.1 0.15 (copper clad)

2.5×3.75"	48p	43p
2.5×5"	57p	51p
3.75×3.75"	57p	—
3.75×5"	64p	64p
3.75×17"	222p	194p
4.75×17.9"	290p	—
Pkt of 100 pins	50p	
Spot face cutter	86p	
Pin insertion tool	118p	
Vero Wiring Pen + 2 wire spools + combs	370p	
Combs	7p	

NE531	150p
NE555	22p
NE556	70p
NE561B	425p
NE562B	425p
NE565	130p
NE566	155p
NE567	175p
NE571	425p
RC4151	400p
SAD1024A	1250p
SFF96364	£11
SN76003N	175p
SN76013N	140p
SN76013ND	120p
SN76023N	140p
SN76023ND	120p
SN76477	250p
SP8515	750p
TAA621	275p
TBA641B11	225p
TBA651	200p
TBA800	90p
TBA810	100p
TBA820	90p
TCA940	175p
TDA1004	300p
TDA1008	320p
TDA1010	225p
TDA1022	600p
TDA1024	120p
TDA1034B	250p
TDA1170	250p
TDA2002V	325p
TDA2020	320p
TL071	50p
TL072	95p
TL074	150p
TL081	45p
TL082	95p
TL084	130p
TL170	50p
UAA170	200p
UAA180	200p
UDN6118	320p
UDN6184	320p
ULN2003	100p
XR2206	400p
XR2207	400p
XR2211	600p
XR2216	575p
XR2240	400p
ZN414	90p
ZN419C	POA
ZN424E	135p
ZN425E	400p
ZN1034E	200p
95H90	800p
11C90	1400p

TRANSISTORS

AC126	25p	BF259	36p	TIP29C	55p
AC127/8	20p	BFR39	25p	TIP30A	48p
ACY17	25p	BFR40	25p	TIP30C	60p
AC187/8	25p	BFR41	25p	TIP31A	58p
AF116	50p	BFR79	25p	TIP31C	62p
AD149	70p	BFR80	25p	TIP32A	68p
AD161/2	45p	BFR81	25p	TIP32C	82p
AU107	200p	BFX29	30p	TIP33A	90p
BC107/8	11p	BFX30	34p	TIP33C	114p
BC109	11p	BFX84/5	40p	TIP34A	115p
BC117	20p	BFX86/7	30p	TIP34C	160p
BC147/8	9p	BFX88	30p	TIP35A	225p
BC149	10p	BFY50	30p	TIP35C	290p
BC157/8	10p	BFY51/2	30p	TIP36A	270p
BC159	11p	BFY56	33p	TIP36C	340p
BC169C	12p	BFY90	90p	TIP41A	65p
BC172	12p	BRY39	45p	TIP41C	78p
BC177/8	17p	BSX19/20	20p	TIP42A	70p
BC179	18p	BU104	225p	TIP42C	82p
BC182/3	10p	BU105	190p	TIP54	160p
BC184	11p	BU108	250p	TIP120	120p
BC187	30p	BU109	225p	TIP122	130p
BC212/3	11p	BU205	200p	TIP142	160p
BC214	12p	BU208	200p	TIP147	160p
BC237	15p	BU406	145p	TIP2955	78p
BC327	16p	E300	50p	TIP4055	70p
BC337	16p	E308	50p	TIS43	34p
BC338	16p	E310	50p	TIS93	30p
BC461	38p	MJ2501	225p	ZTX108	12p
BC477/8	30p	MJ2955	90p	ZTX300	13p
BC516/7	50p	MJ3001	225p	ZTX500	15p
BC547B	16p	MJE340	50p	ZTX502	18p
BC548C	9p	MJE2955	160p	ZTX504	30p
BC549C	18p	MJE3055	70p	2N696	35p
BC557B	16p	MPF102	45p	2N697	25p
BC559C	18p	MPF103/4	40p	2N698	45p
BCY70	18p	MPF105/6	40p	2N706A	20p
BCY71/2	22p	MPS6531	50p	2N708A	20p
BD131/2	50p	MPS6534	50p	2N918	45p
BD135/6	54p	MPSA06	30p	2N930	18p
BD139	56p	MPSA12	50p	2N1131/2	20p
BD140	60p	MPSA13	50p	2N1613	25p
BD189	60p	MPSA20	50p	2N1711	25p
BD232	95p	MPSA43	50p	2N2102	70p
BD233	75p	MPSA56	32p	2N2160	350p
BD235	85p	MPSA70	50p	2N2219A	30p
BD241	70p	MPSU06	63p	2N2222A	30p
BD242	70p	MPSU07	90p	2N2369A	16p
BDX53B	150p	MPSU45	90p	2N2484	30p
BDY56	200p	MPSU65	78p	2N2646	45p
BF200	32p	OC28	130p	2N2904/5	25p
BF244B	35p	OC35	130p	2N2906A	24p
BF256B	70p	R2008B	200p	2N2907A	30p
BF257/8	32p	R2010B	200p	2N2926	9p
TIP29A	40p	2N3053	27p		

2N3054	65p	40361/2	45p	10A 400V	200p
2N3055	48p	40364	120p	25A 400V	400p
2N3442	140p	40408	70p		
2N3553	240p	40409	85p	**ZENERS**	
2N3565	30p	40410	85p	2.7V-33V	
2N3584	250p	40411	300p	400mW	9p
2N3643/4	48p	40594	97p	1W	15p
2N3702/3	12p	40595	105p		
2N3704/5	12p	40673	75p	**TRIACS PLASTIC**	
2N3706/7	14p	40841	90p	3A 400V	60p
2N3708/9	12p	40871/2	90p	3A 500V	65p
2N3773	300p			6A 400V	70p
2N3819	25p	**DIODES**		6A 500V	88p
2N3820	50p	BY127	12p	8A 400V	75p
2N3823	70p	BYX36-300	20p	8A 500V	95p
2N3866	50p	OA47	9p	12A 400V	85p
2N3902	700p	OA81	15p	12A 500V	105p
2N3903/4	18p	OA85	15p	16A 400V	110p
2N3905/6	20p	OA90	9p	16A 500V	130p
2N4037	65p	OA91	9p	T2800D	130p
2N4058/9	12p	OA95	9p		
2N4060	12p	OA200	9p		
2N4061/2	18p	OA202	10p		
2N4123/4	27p	1N914	4p		
2N4125/6	27p	1N916	7p		
2N4401/3	27p	1N4148	4p		
2N4427	90p	1N4001/2	5p		
2N4871	60p	1N4003/4	6p		
2N5087	27p	1N4005	6p		
2N5089	27p	1N4006/7	7p		
2N5172	27p	1N5401/3	14p		
2N5179	90p	1N5404/7	19p		
2N5191	83p	IS920	9p		
2N5194	90p				
2N5245	40p	**HEAT SINKS**			
2N5296	55p	For TO220 Voltage Regs. and Transistors	22p		
2N5401	50p	For TO5	12p		
2N5457/8	40p				
2N5459	40p	**BRIDGE RECTIFIERS**			
2N5460	60p	1A 50V	19p		
2N5485	44p	1A 100V	20p		
2N5875	250p	1A 400V	25p		
2N6027	48p	1A 600V	30p		
2N6107	65p	2A 50V	30p		
2N6247	190p	2A 100V	35p		
2N6254	130p	2A 400V	45p		
2N6290	65p	3A 200V	60p		
2N6292	65p	3A 600V	72p		
2SC1172	150p	4A 100V	95p		
3N128	120p	4A 400V	100p		
3N140	100p	6A 50V	80p		
3N141	110p	6A 100V	100p		
3N201	110p	6A 400V	120p		
3N204	100p				
40290	250p				
40360	40p				

THYRISTORS

1A 50V	40p
1A 400V	65p
3A 400V	90p
8A 600V	140p
12A 400V	160p
16A 100V	160p
16A 400V	180p
16A 600V	220p
BT106	110p
C106D	45p
MCR101	36p
2N3525	120p
2N4444	140p
2N5060	34p
2N5064	40p

LOUDSPEAKERS

Size		
2½"	64R	70p
2½"	8R	70p
2"	8R	80p
1½"	8R	80p

MEMORIES

2102-2L	120p
2107B	500p
2111-2	225p
2112-2	300p
2114	525p
2114-2L	600p
4027	375p
4044	900p
4116	900p
5101	510p
6810	350p
74S201	325p
82516	325p

ROM/PROMs

71301	700p
74S188	225p
74S287	350p
74S387	350p
74S470	650p
74S471	650p
74S571	1100p
82S137	750p
93427	400p
93436	650p
93446	650p
93448	1000p

CPUs

1600	£12
2650A	£20
8502	£10
6800	900p
6802	1250p
8080A	550p
1NS8060	£11
Z80	£11
Z80A	£12.50

EPROMS

1702A	500p
2516	£29
2708	800p
2716	£29

SUPPORT DEVICES

3245	400p
6532	1100p
6820	500p
6821	500p
6850	500p
8205	320p
8212	225p
8216	225p
8224	400p
8228	525p
8251	700p
8253	1200p
8255	550p
8257	1100p
8259	1400p
Z80P10	650p
Z80CTC	650p
MC14411	1100p
MC14412	1100p

UART

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

CHARACTER GENERATORS

3257ADC	990p
MCM6576	£10
RO-3-2513 U.C.	600p
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SN74S262AN	1350p

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AY-5-2376	£9

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(prim 220/240V)

6-0-6	100mA	88p
9-0-9	75mA	92p
12-0-12	100mA	95p
0-120	12500mA	280p
0-25V (5VA)		250p
9-0-9 1A		270p
12V 2A		350p
0-12-15 20-24-30 1A		340p
15-0-15 1A		265p

(Please add 50p p&p charge to all marked * above our normal p&p charge).

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¼W 10R-1M one value	7p/5pcs
½W 10R-10M one value	5p/3pcs

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Hor/Vert 100R-1M Carbon Track Pots 5K-1M Log or Lin	12p
Single	30p
Single with Switch	60p
Dual	72p

SLIDER POTS 60mm Track
LIN 5K, 10K, 50K, 100K — 60p
LOG 10K — 60p

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	10p	18 pin	22p	24 pin	30p
14 pin	11p	20 pin	25p	28 pin	38p
16 pin	12p	22 pin	28p	40 pin	48p

WIRE WRAP SOCKETS BY TEXAS

8 pin	30p	18 pin	70p	24 pin	90p
14 pin	40p	20 pin	75p	28 pin	110p
16 pin	55p	22 pin	80p	40 pin	140p

SUBMINIATURE SWITCHES

Toggle	
SPST	60p
SPDT	65p
DPDT	70p
DPDT (centre off)	85p
Push to make	15p
break	25p
Push latching SPCO	60p
SLIDE DPDT	18p
ROCKER SPST	28p

WAFER

1P/12W	45p
3P/4W	45p
4P/3W	45p
2P/6W	45p

CRYSTALS

100KHz	300p
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1.008MHz	370p
3.2768MHz	350p
3.579545MHz	200p
4MHz	350p
8.867237MHz	400p
10.7MHz	350p
18MHz	300p
26.690MHz	210p
27.145MHz	210p

COUNTERS

74C925	475p
74C928	600p
ICM7216B	£20
ICM7217A	850p
ZN1040E	700p

ANTEX SOLDERING IRONS

C-15W	400p
CX-17W	415p
CCN-15W	415p
X25	415p

SPARE BITS

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CCN	200p

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S-100 Busboard	£12

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

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MC4044	325p
10116	70p
10231	350p

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TTLs, CMOs, Linears, Memories, etc, by Mfrs stocked. Please send S.A.E. for details.

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EXP300 6" x 1.1" (Uto 6 x 14 pin ICs)	£5.75
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PB103	24 x 14 DIL ICs	£34.45
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(The above boards are suitable for all DIL ICs.)

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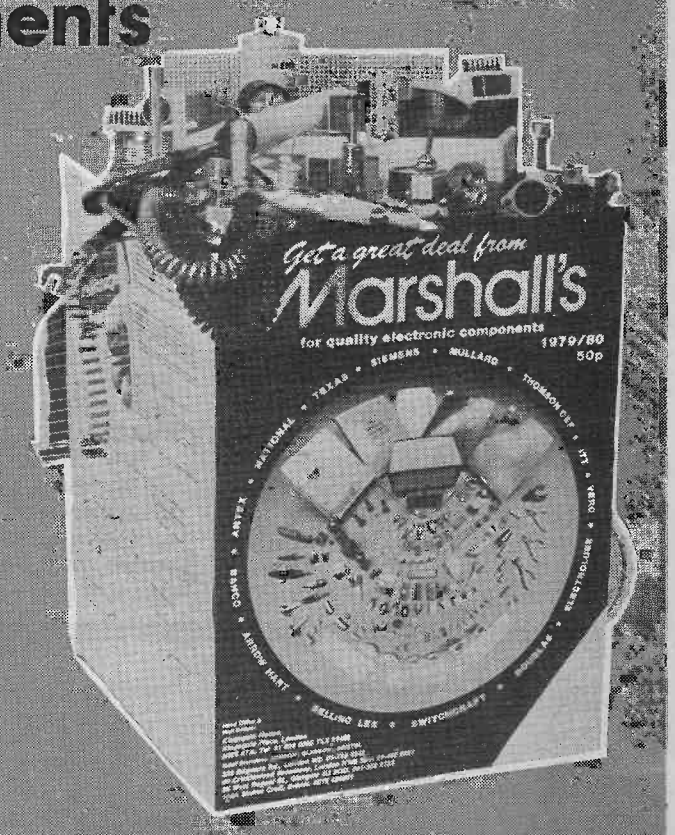

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AMPHENOL CONNECTORS [PL259] PLUGS 47p. Sockets 42p. Elbows 90p. Reducers 13p. **DUMMY LOADS** [PL259] 52ohms 1 watt with indicator bulb 97p.

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SWITCHES. Sub. Min. Toggles. SPST 8×5×7mm. 52p. DPDT (8×7×7) 62p. DPDT Centre off (12×11×9mm) 77p.

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RIBBON CABLE 8-way single core miniature 22p per metre.

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PROJECT BOXES. Sturdy ABS black plastic boxes with brass inserts and lid. 75×56×35mm 54p 95×7×35mm 65p 115×9×37mm 75p.

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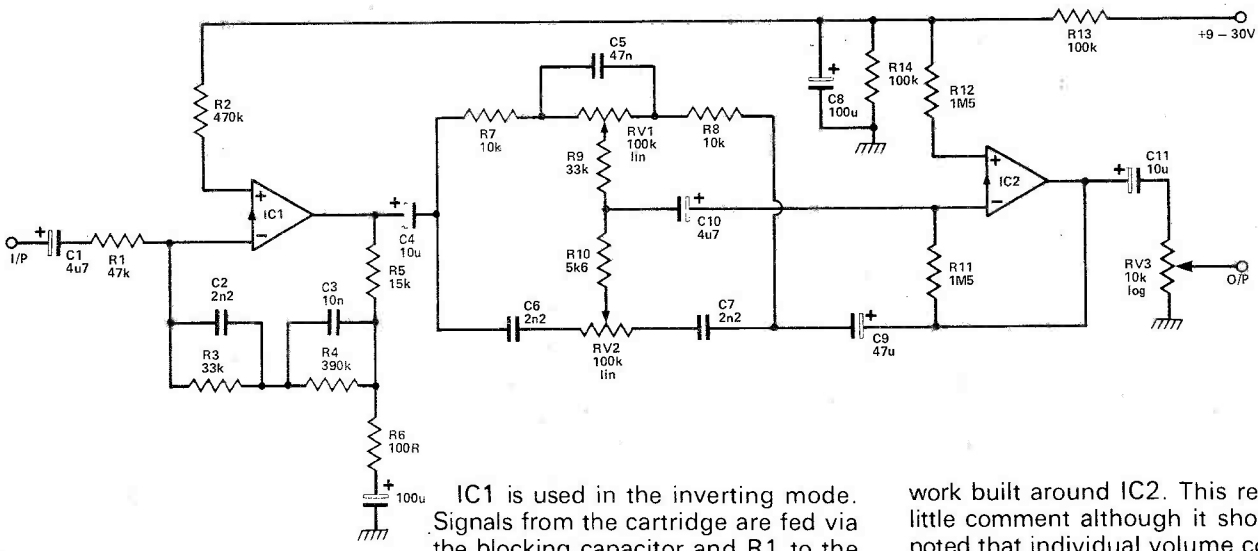


One Chip Preamplifier

J. P. Macaulay

The circuit shown utilises the four Norton op amps contained within an LM3900 to produce a high quality stereo preamp, catering for magnetic cartridges.

IC1 is used in the inverting mode. Signals from the cartridge are fed via the blocking capacitor and R1 to the inverting input. R1 defines the input impedance and provides the right damping for the cartridge.

R5 and R6 define the midband gain of the stage whilst the network R3, R4, C2 and C3 provide the required RIAA equalisation. From here the equalised signal is fed to a standard Baxendall tone control network built around IC2. This required little comment although it should be noted that individual volume controls are employed four each channel. This not only reduces crosstalk between channels but also works out cheaper in that only two single gang potentiometers are used.

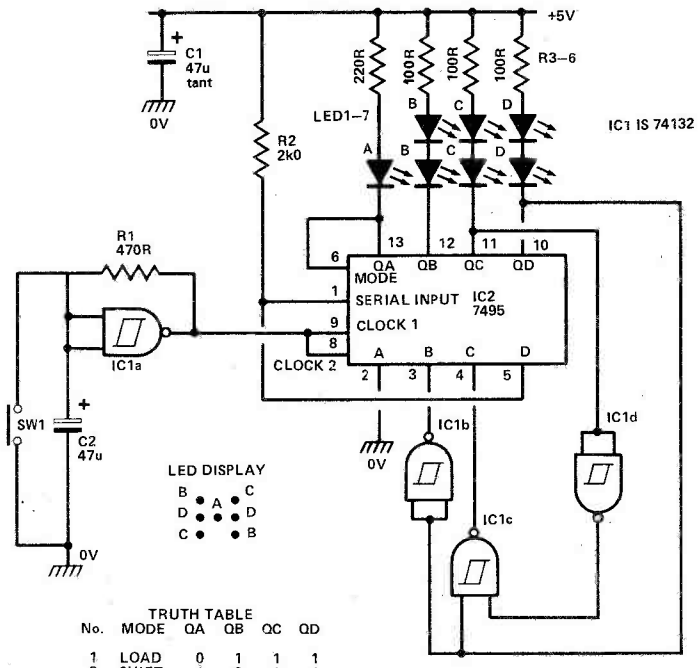
Performance is good with overall distortion below 0.1% and a S/N ratio of —67db unweighted, ref 500 mV out.

2 Chip Electronic Dice

P. Adams

This electronic dice produces a true dice display using only two IC's — a 74132 and a 7495. The 7495 is a 4-bit parallel-access shift register. It can either operate as a shift-register or be parallel (broadside) loaded at inputs A-D. Control over these two functions is by a mode control unput. When the mode is high data is loaded into Qa — Qd from inputs A - D on the next negative-going clock edge. When the mode is low data is shifted on Qa — Qd on the next negative-going clock edge.

By connecting the mode control to Qa so that the register alternates between load and shift and making the input word a function of the existing output word, with some simple logic, the register can be made to execute a count that will drive LEDs in a dice display. Note LEDs are lit when outputs are low. IC1a is connected as a conventional Schmitt oscillator providing clock pulses to the register. SW1 stops the oscillator and halts the count. On switch-on the register may start on an invalid count, but in a couple of clock cycles it will produce a valid count and then remain in that sequence.

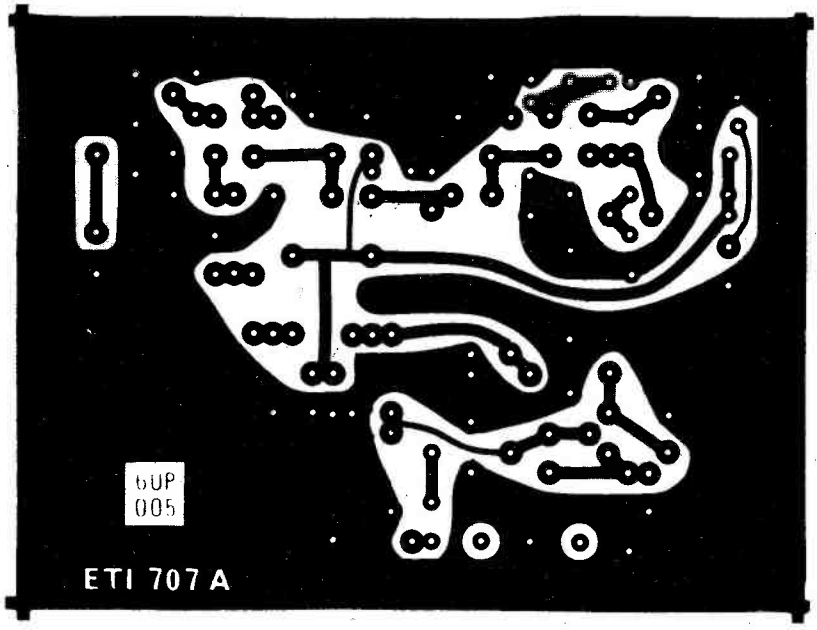


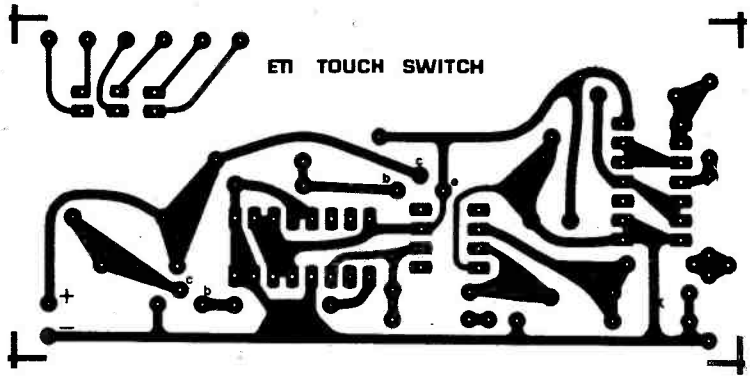
TRUTH TABLE

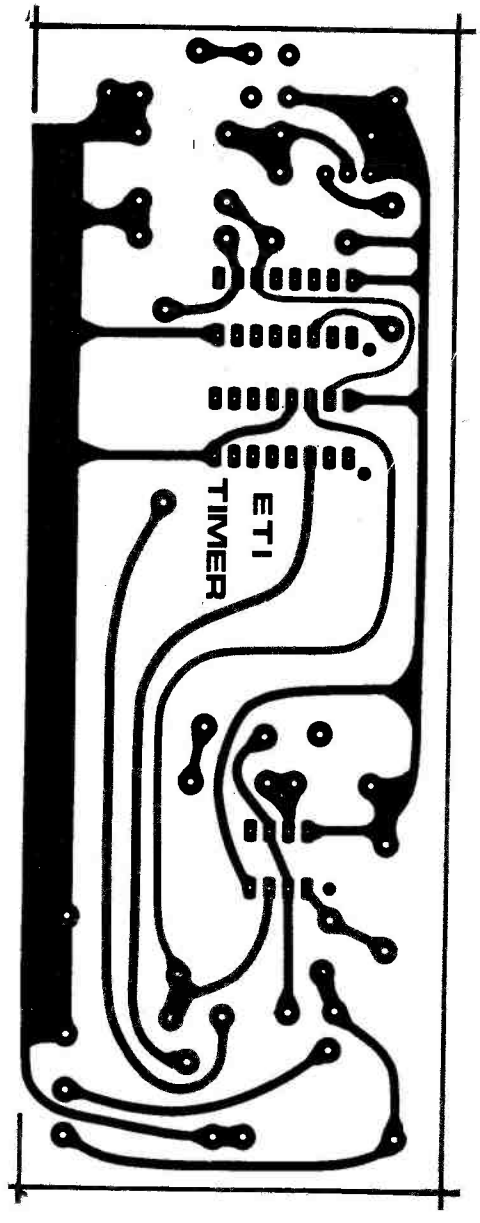
No.	MODE	QA	QB	QC	QD
1	LOAD	0	1	1	1
2	SHIFT	1	0	1	1
3	LOAD	0	0	1	1
4	SHIFT	1	0	0	1
5	LOAD	0	0	0	1
6	SHIFT	1	0	0	0
1	LOAD	0	1	1	1
ETC					

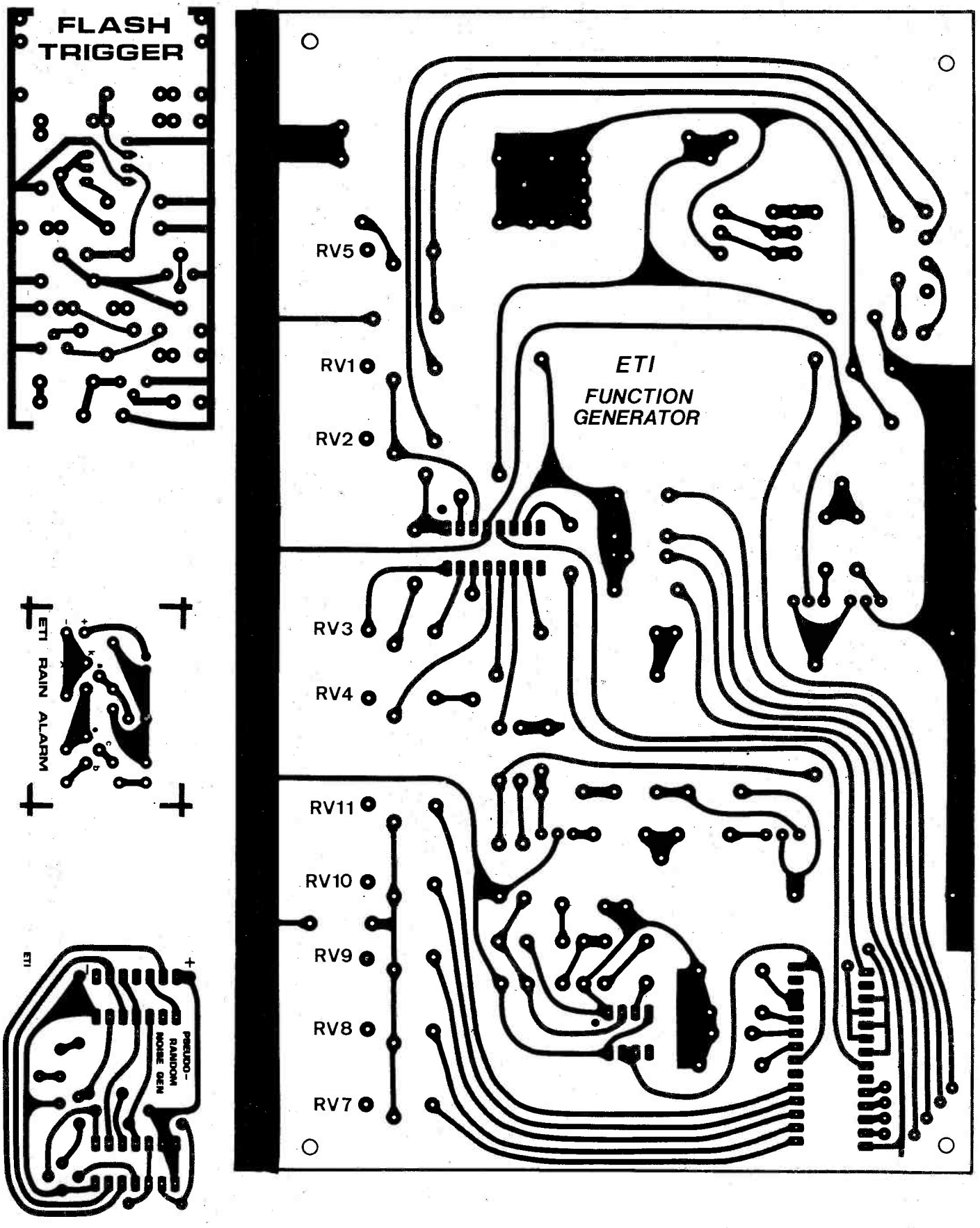
PCB FOIL PATTERNS

We didn't have room in this issue to pack in all the foil patterns. Never fear, if you're anxious to get started on your PCBs, send us a large sae and they'll be on their way to you. If you can bear to wait until next month's issue, we'll find a little space somewhere for them. Rest assured, they will all appear on Etiprints.





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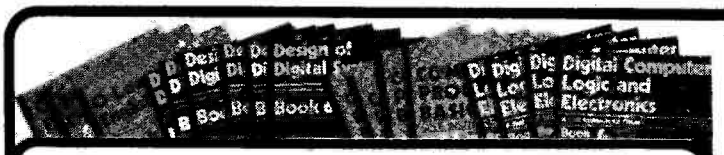

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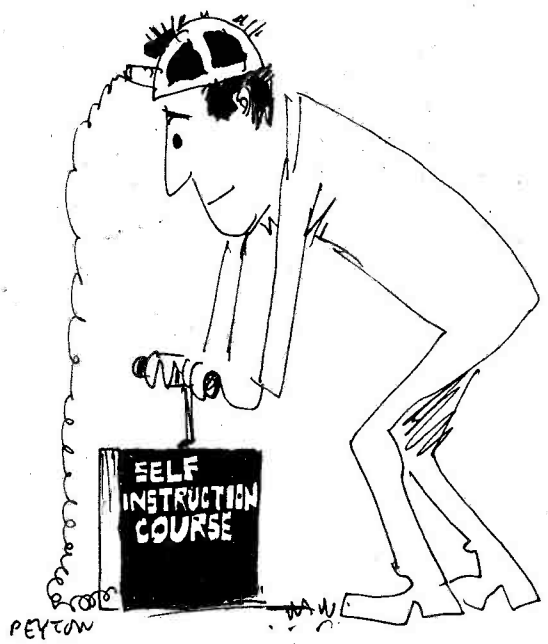

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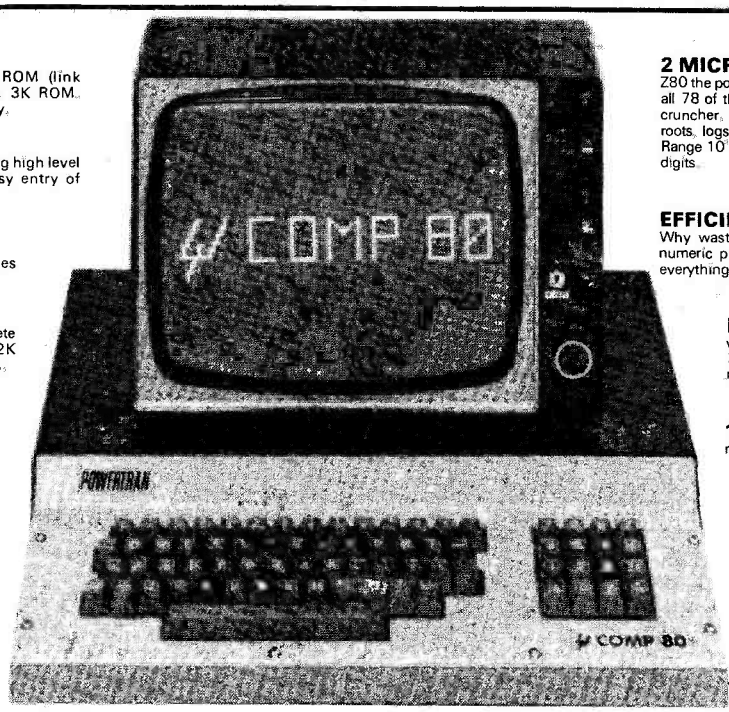

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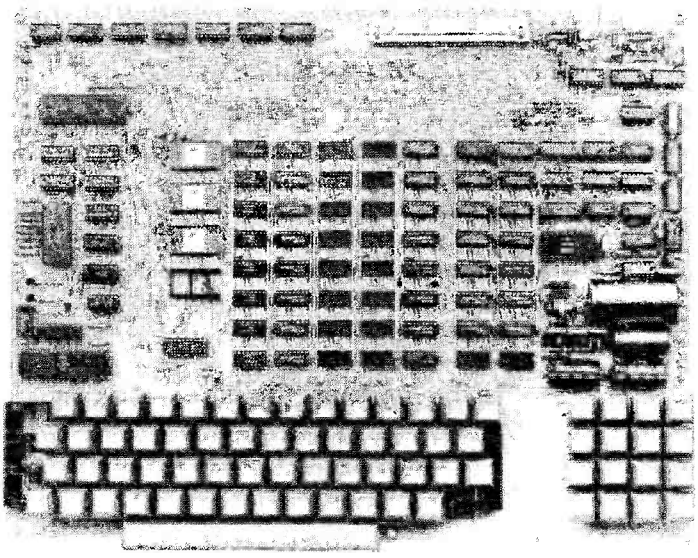

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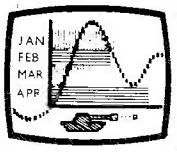

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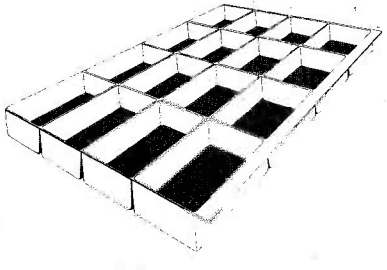

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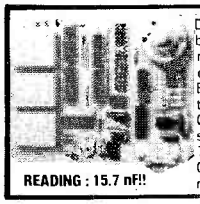

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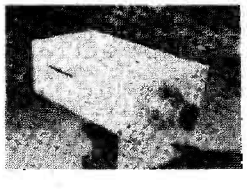

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ACY17	40	BC338	12	BFX86	28	TIP32C	75	2N2222A	20
ACY18	40	BC441	36	BFX87	28	TIP33C	105	2N2303	45
ACY19	40	BC461	36	BFX88	28	TIP34	85	2N2368	21
ACY20	40	BC477	25	BFY50	20	TIP34A	85	2N2369A	15
ACY21	40	BC517	38	BFY51	20	TIP34C	110	2N2483	28
ACY22	40	BC547	12	BFY52	20	TIP35A	185	2N2484	30
ACY28	40	BC548	12	BFY53	28	TIP35C	220	2N2646	48
ACY39	78	BC549C	13	BFY64	40	TIP36A	220	2N2784	55
ACY41	39	BC556	15	BFY71	20	TIP36C	255	2N2904	22
ACY44	38	BC557	15	BRY39	39	TIP41A	63	2N2905A	22
AD149	70	BC558	20	BSX20	18	TIP41B	73	2N2906	22
AD161	42	BC559	20	BSX26	75	TIP42A	64	2N2907	22
AD162	42	BCY30	57	BSY95A	18	TIP42B	82	2N2907A	22
AF114	50	BCY39	80	BU105	140	TIP147	199	2N2926G	10
AF115	50	BCY40	78	BU205	190	TIP2955	65	2N3011	24
AF116	50	BCY42	48	BU208	228	TIP3055	60	2N3053	20
AF117	50	BCY70	15	E5567	65	TIS44	45	2N3054	55
AF118	55	BCY71	20	MD8001	158	TIS45	45	2N3055	48
AF139	35	BCY72	20	MJ491	160	TIS46	45	2N3108	32
AF178	70	BCY78	25	MJ2955	105	TIS90	20	2N3442	140
AF186	50	BC124	115	MJE340	54	TIS91	24	2N3663	26
AF239	42	BD131	45	MJE370	58	ZTX107	12	2N3702	11
ASZ21	60	BD132	45	MJE371	60	ZTX108	12	2N3703	11
BC107	10	BD133	43	MJE520	65	ZTX109	14	2N3704	11
BC107B	10	BD135	38	MJE521	74	ZTX300	13	2N3705	11
BC108	10	BD136	40	MJE2955	99	ZTX301	16	2N3706	11
BC108B	10	BD137	40	MJE3055	70	ZTX302	20	2N3707	11
BC108C	12	BD138	50	MPF102	66	ZTX303	25	2N3708	11
BC109	10	BD139	40	MPF103	36	ZTX304	24	2N3709	11
BC109B	12	BD140	36	MPF104	36	ZTX314	24	2N3710	16
BC109C	12	BD144	198	MPF105	36	ZTX326	40	2N3711	12
BC114	20	BD145	198	MPF106	40	ZTX341	20	2N3771	275
BC115	20	BD205	110	MPSA05	25	ZTX500	15	2N3772	195
BC117	20	BD378	65	MPSA06	25	ZTX501	15	2N3773	288
BC119	28	BD434	42	MPSA12	42	ZTX502	19	2N3819	22
BC140	35	BD517	65	MPSA55	25	ZTX503	15	2N3820	45
BC142	30	BD696A	65	MPSA56	25	ZTX504	25	2N3823	95
BC143	30	BD696A	65	MPSU02	58	ZTX531	25	2N3866	90
BC147	8	BF115	34	MPSU05	50	ZTX550	25	2N3903	20
BC147B	10	BF154	25	MPSU06	56	40311	60	2N3904	18
BC148	8	BF158	29	MPSU52	65	40313	125	2N3905	18
BC148B	10	BF167	30	MPSU55	55	40315	55	2N3906	17
BC148C	10	BF173	25	MPSU56	60	40316	85	2N4037	52
BC149	8	BF177	24	OC26	170	40326	52	2N4058	17
BC149C	10	BF178	25	OC28	150	40327	62	2N4061	17
BC153	27	BF179	30	OC35	130	40347	80	2N4062	17
BC154	27	BF180	35	OC36	130	40348	105	2N5172	25
BC157	10	BF194	12	OC41	48	40360	43	2N5179	60
BC158	11	BF195	12	OC42	48	40361	45	2N5191	70
BC159	11	BF196	12	OC43	55	40362	48	2N5305	40
BC160	42	BF197	14	OC44	31	40408	70	2N5457	32
BC167A	11	BF198	18	OC45	28	40594	90	2N5458	32
BC168C	12	BF199	18	OC70	28	40595	98	2N5459	32
BC169C	14	BF200	32	OC71	28	40603	65	2N5485	35
BC170	18	BF224A	18	OC72	45	40673	68	2N5777	45
BC172	11	BF244B	30	OC74	55	2N697	25	2N6027	40
BC177	18	BF256	60	OC75	45	2N698	44	2N6109	50
BC178	17	BF256A	50	OC76	36	2N699	54	2SD234	50
BC179	18	BF256B	50	OC77	76	2N706A	19	3N128	112
BC182	9	BF257	30	OC81D	50	2N708	19	3N140	112
BC183	9	BF258	30	OC82D	50	2N918	40		
BC184	9	BF259	30	OC83	48	2N930	18	**Matched Pair 25p extra**	
BC182L	10	BF451	20	OC84	44	2N1131	22		
BC183L	10	BF3361	35	OC140	110	2N1132	22		
BC184L	10	BF594	40	OC170	85	2N1303	50		
BC187	28	BF595	38	OC171	75	2N1304	50		
BC212	9	BFR39	25	OC200	85	2N1305	28		
BC212L	10	BFR40	25	TIP29	43	2N1613	23		
BC213	9	BFR41	28	TIP29B	56	2N1670	150		

JACKSONS VARIABLE CAPACITORS

Dielectric		0·2 365pF with slow	
100 300pF	**140p**	motion Drive	**325p**
500pF	**165p**	00 208 176	**285p**
6 1 Ball Drive		with slow	
4511 DAF	**115p**	motion drive	**325p**
Dial Drive 4103		C804-5pF 10 15	
6 1 36 1	**650p**	25 50pF	**175p**
Drum 54mm	**30p**	100. 150pF	**235p**
0·1-365pF	**245p**	L 3x310pF	**495p**
00 3 365pF	**275p**	00 3x25pF	**430p**

RF CHOKES

1µH, 4.7, 10, 22, 33, 47, 100, 200, 470 ;750, 1mH, 2.5, 5, 10 **35p each**
43mH, 100 **60p each**

VEROBOARD

	0.1 (copper clad)	0.15 (plain)	0.15
2½ x 3¼"	**46p**	**39p**	**24p**
2½ x 5"	**55p**	**50p**	**31p**
3¼ x 3¾"	**55p**	**50p**	—
3¼ x 5"	**62p**	**67p**	**43p**
2½ x 17"	**169p**	**135p**	**92p**
3¾ x 17"	**218p**	**180p**	**120p**
4¾ x 17"	**280p**	—	**183p**
Pkt of 36 pins			**20p**
Spot face cutter			**99p**
Pin insertion tool			**120p**
DIP Board			**268p**
VQ Board			**90p**
Group Board			**60p**
S Board			**1285p**

VERO WIRING PEN

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

FERRIC CHLORIDE

1lb bag Anhydrous **95p** + 35p P&P

DALO ETCH RESIST PEN + spare tip **75p**

COPPER CLAD BOARDS

Fibre Glass	Single-sided	Double-sided	SRBP
6" x 6"	**75p**	**90p**	**80p**
6" x 12"	**130p**	**175p**	

SOLDERCON PINS 100 **50p**; 500 **200p**

HEADER PLUGS 14pin **35p**; 16pin **39p**

DIL SOCKETS (TEXAS) Low Wire

	prof.	Wrap
8pin	**10p**	**25p**
14pin	**12p**	**35p**
16pin	**13p**	**46p**
18pin	**16p**	**52p**
20pin	**22p**	**65p**
22pin	**25p**	**70p**
24pin	**36p**	**78p**
28pin	**39p**	**85p**
36pin	—	**105p**
40pin	**50p**	**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	**210**	—
2x43 way	**232p**	—

DIODES

	p
AA119	18
AAZ15	15
BY100	24
BY126	12
BY127	12
CRO33	157
OA9	75
OA47	12
OA70	12
OA79	15
OA81	15
OA85	14
OA90	7
OA91	7
OA95	8
OA200	9
OA202	8
IN914	4
IN916	5
IN4001/2	5
IN4003	6
IN4004/5	6
IN4006/7	7
IN4148	4
IN5404	17
IS44	20
3A/100V	15
3A/400V	20
3A/600V	27
3A/1000V	30

BRIDGE RECTIFIERS

(plastic case)	p
1A/50V	20
1A/100V	22
1A/200V	25
1A/400V	29
1A/600V	34
2A/50V	35
2A/100V	44
2A/200V	46
2A/400V	53
2A/600V	65
4A/100V	72
4A/200V	75
4A/400V	79
4A/600V	105
4A/800V	120
6A/100V	73
6A/200V	78
6A/400V	85
BY164	56
VM18 DIL	40

ZENERS

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

NOISE

Z5J 180

VARICAPS

MVAM115	140
BA102	25
BB104	40
BB105B	40
BB106	40

TRIACS

3A 200V	49
3A 400V	50
8A 100V	54
8A 400V	64
8A 800V	108
12A 100V	60
12A 400V	70
12A 800V	115
16A 100V	240
16A 400V	105
16A 500V	120
25A 500V	235
25A 800V	295
T28000	120

SCRs Thyristors

0.6A 200V	30
0.8A 100V	30
0.8A 200V	35
1A 100V	42
1A 600V	70
5A 100V	32
5A 400V	39
8A 300V	48
8A 500V	58
8A 600V	85
12A 300V	59
12A 500V	92
12A 800V	120
BT106	150
BT116	150
C106D	38
TIC44	22
TIC45	25
2N4444	140
2N5064	35

DIAC

ST2 20

LINEAR ICs

702	75
709 14 pin	38
709C 8 pin	35
710	67
723 14 pin	38
733	99
741 8 pin	18
741 TO5	35
747C 14 pin	70
748C 8 pin	36
753 8 pin	150
810	159
AY-1-0212	580
AY-1-1313A	660
AY-1-1320	315
AY-1-5050	190
AY-1-5051	145
AY-1-6721/6	195
AY-3-1270	840
AY-3-8500	390
AY-5-1224A	260
AY-5-1230	450
AY-5-1315	560
AY-5-1317A	630
AY-5-2376	980
AY-5-3500	510
AY-5-3507	415
AY-5-3600	1090
AY-5-4007D	650
AY-5-8100	735
CA3011	100
CA3012	150
CA3014	137
CA3018	68
CA3020	170
CA3023	170
CA3028A	80
CA3035	240
CA3036	110
CA3043	190
CA3045	140
CA3046	71
CA3048	210
CA3075	175
CA3080E	70
CA3081	190
CA3085	95
CA3089E	210
CA3090AQ	398
CA3123E	200
CA3130	90
CA3140	70
F944DC	60
ICL7106	795
ICL7107	975
ICL8038CC	335
ICM7205	1150
ICM7215	1050
ICM7216B	1950
ICM7216C	1950
ICM7217A	790
ICM7555	89
LD130	452
LF356	98
LM10	450
LM301AP	30
LM308T	110
LM311	98
LM318H	205
LM318S	195
LM324A	68
LM339	70
LM348	90
LM349	125
LM379	375
LM380	80
LM381N	145
LM382	125
LM389	93
LM1458	50
LM3900	60
LM3909N	70
LM3911	125
LM3914	220
LM13600	125
M252AA	750
M253AA	795
MC663	275
MC1204	000
MC1301	79
MC1303	88
MC1304P	260
MC1310P	175
MC1312PQ	195
MC1488	85
MC1489	90
MC14433L	1250
MC1495	350
MC1496L	92
MC1596	000
MC3302	000
MC3340P	120
MC3360P	120
MC3401	52
MC3403	135
MEM780	205
MFC6040	97
MK50253	650
MK50362	650
MK50398	675
MM5303	635
MM5307	1275
MM57160	620
NE515	80
NE518	210
NE543K	210
NE544	185
NE555	22
NE556DD	60
NE560	325
NE561	395
NE562B	410
NE564	425
NE565A	120
NE566	160
NE567V	170
NE570	375
NE571	420
RC4136D	120
SAD1024A	1350
SG3402	295
SN76003N	170
SN76013	140
SN76013ND	130
SN76018	148
SN76023	140
SN76023NO	130
SN76033N	175
SN76115N	215
SN76131	110
SN76227N	115
SN76477	225
SN76660	90
TAA550	50
TAA960	320
TAA621AX1	228
TAA661A	155
TAA700	353
TAD100	159
TBA120S	70
TBA540Q	220
TBA550Q	330
TBA641-A12	
BX or BX111	250
TBA651	180
TBA800	90
TBA810	95
TBA820	70
TBA920Q	260
TBA990Q	270
TCA270Q	220
TCA965	120
TDA1004	290
TDA1008	310
TDA1022	575
TDA1024	105
TDA2020	320
TL061CP	76
TL062CP	125
TL064CN	199
TL072CP	125
TL074CN	199
TL081CP	52
TL082CP	96
TL083CP	105
TL084CN	130
UAA170	198
UAA180	198
ZN414	90
ZN424E	130
ZN425E	415
ZN1034E	200
ZN1040E	685

TTL 74 (TEXAS)

7400	11	7491	50
7401	11	7492	30
7402	11	7493	26
7403	12	7494	48
7404	12	7496	45
7405	13	7497	15
7406	23	74100	85
7407	30	74104	62
7408	13	74105	62
7409	14	74107	20
7410	14	74110	54
7411	14	74111	60
7412	17	74116	150
7413	21	74118	70
7414	30	74119	110
7416	26	74120	79
7417	26	74121	25
7420	14	74122	31
7421	29	74123	35
7422	19	74125	33
7423	17	74126	31
7425	16	74128	60
7426	25	74132	42
7427	18	74136	60
7428	35	74141	42
7430	15	74142	169
7432	15	74143	250
7433	40	74144	250
7437	17	74145	52
7438	17	74147	110
7440	13	74148	80
7441	65	74150	50
7442	36	74151	50
7443	80	74154	60
7444	80	74155	45
7445	80	74156	45
7446	85	74157	36
7447	43	74159	160
7448	45	74160	55
7450	16	74161	55
7451	16	74162	55
7453	16	74163	55
7454	16	74164	60
7460	16	74165	60
7470	23	74166	75
7472	23	74167	150
7473	19	74170	95
7474	20	74172	350
7475	25	74173	65
7476	22	74174	50
7480	40	74175	55
7481	70	74176	50
7482	49	74177	45
7483	49	74178	60
7484	80	74179	000
7485	70	74180	50
7486	16	74181	118
7489	130	74182	35
7490	30	74184	135
		74185	80
		74188	275
		74190	45
		74191	45
		74192	45
		74193	45
		74194	40
		74195	40
		74196	45
		74197	45
		74198	80
		74199	000
		74220	120
		74221	132
		74246	204
		74247	204
		74248	240
		74249	204
		74251	125
		74265	63
		74273	320
		74278	220
		74279	119
		74283	173
		74284	385
		74285	395
		74290	125
		74293	150
		74298	185
		74365	128
		74366	118
		74367	115
		74368	124
		74390	184
		74393	184
		74490	198
		75150	120
		75450	84
		75451	70
		75452	70
		75454	225
		75491	89
		75492	94

74L

74L00	65
L30	70
L47	599
L75	298
L85	525
L121	150
L123	495

74S

74S00	60
S04	73
S132	350
S138	250
S158	524
S188	210
S189	158
S194	195
S195	795
S241	195
S262	895
S287	325
S288	210
S470	325
S472	1150
S475	825

74LS

00	11	107	44
01	11	109	55
02	13	112	55
03	13	113	50
04	14	114	50
05	23	122	70
08	22	123	70
09	22	124	180
10	20	125	60
11	22	126	60
12	23	132	95
13	38	136	55
14	75	138	85
15	30	139	85
20	20	145	108
21	22	147	170
22	20	148	173
26	48	151	96
27	28	153	76
28	48	155	96
30	22	156	96
32	27	157	76
33	39	158	95
37	39	160	128
38	39	161	98
40	28	162	138
42	98	163	102
47	63	164	114
48	120	165	75
49	120	166	226
51	24	170	288
54	28	173	105
55	30	174	106
63	150	175	110
73	46	181	398
74	41	183	398
76	40	190	140
78	40	191	140
83	115	193	130
85	118	194	166
86	43	195	136
90	38	196	100
91	104	197	140
92	89	221	96
93	89	240	236
95	116	241	232
96	116	242	232
107	44	243	232
109	55	244	155
112	55	245	270
		247	190
		248	190
		249	190
		251	134
		253	142
		257	110
		258	110
		259	160
		261	450
		266	52
		273	244
		275	250
		279	66
		283	192
		290	128

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NEW! Shows Date, Hours, Minutes, Seconds. 8 digit LED — larger digits for Hours and Minutes, also parallel BCD output, auto-reset after power failure, auto GMT/BST and leap year. 5x8x15cm, built-in antenna, TIME SIGNAL accuracy. **£48.80.**
60KHz MSF Receiver, serial data output. **£13.70.**
V.L.F.? EXPLORE 10-150KHz. Receiver **£10.70.**
MAKE UP YOUR OWN TUNES on a Programmable Chime — new carol each day? **£23.50** less speaker.
Each fun-to-build kit includes all parts, printed circuit, case, instructions, postage etc. money back assurance so SEND off NOW.

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ELECTRONIC TECHNICIANS Grades 3 and 4 required to assist in the construction, modification and maintenance of electronic equipment for use in teaching and research carried out in the Psychology Dept. of U.C.L. The work is varied and interesting and covers a wide range of analogue and digital techniques. ONC, C&G or equivalent required. The Grade 3 technician could have an electrical/mechanical background. Salary in range Grade 4: £3432-£3950; Grade 3: £3122-£3553, plus £524 London Weighting (under review). Application form from Personnel Officer (technical Staff CK3), University College London, Gower Street, London WC1E 6BT.

TOP QUALITY 1N4148 specification diodes: 150, 500, 1000 for £1, £3, £5. RESISTORS (5% C.F.) 20p per packet of 50. Following values only 270R, 1k, 3k9, 15k, 20k, 27k, 100k, 470k. Post free from D Johnston, 12 Balgillo Road, Dundee DD5 3LU.

URGENTLY WANTED. ETIs April, May, November 1972. Good price paid. T. Sheridan, 19 Maze Green, Bishop's Stortford, Herts. Tel: (0279) 54675 or 01-242 1055.

FLASHING RED L.E.D.s 89p. Small Reed Switches, 10p. Magnets 7p. Large 6V DC Electronic Buzzers 99p. Postage 18p. Grimsby Electronics, Lambert Road, Grimsby, Humberside (Retail Shop).

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Returned to Service Department within guarantee period.

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£5170 to £5620 in London
£4720 to £5170 elsewhere

Plus additional payments for shift or irregular hour working.

Applicants should have a Degree, HND or HNC in Electronic or Electrical Engineering or Applied Physics
OR
A City & Guilds Full Technological Certificate in Telecommunications (Course 271).

All our engineering staff receive comprehensive training, so experience is not essential.

Write for further information and application form to: **The Engineering Recruitment Officer, BBC, Broadcasting House, London W1A 1AA,** Quoting Ref: 79.E.4119/ET.

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CLASSIFIED ADVERTISEMENTS

CONTACT

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FOR RATES SEE PAGE 119

AD INDEX

PET COSTS LESS AT COMP and it's a pedigree

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8K — Comes complete with integral cassette deck

Full manuals supplied. Powerful 8K Microsoft Basic in ROM. Masses of software available — **£499** + VAT

16K — Same as above but with new improved keyboard and cassette supplied as extra. Machine code monitor on board so you can program in 6502 machine code — **£590** + VAT

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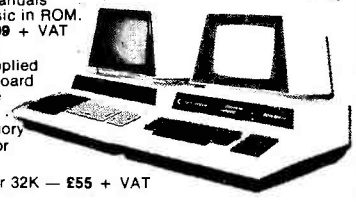

External Cassette deck for 8K, 16K or 32K — **£55** + VAT complete with cable and connector.

FULL RANGE OF PETSOFT SOFTWARE NOW AVAILABLE

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For personal or business use. The best value for money around.

★ 512 by 256 point screen resolution ★ 16K or 32K User RAM ★ Centronics Parallel Port ★ RS232C Serial Port ★ Composite IV peak to peak video output T.V. output supplied as extra. ★ 64 programmable graphics + 64 standard PET graphics ★ 79 key keyboard including 16 key numeric keypad. ★ Expansion bus for connection to S100 Expansion Box.

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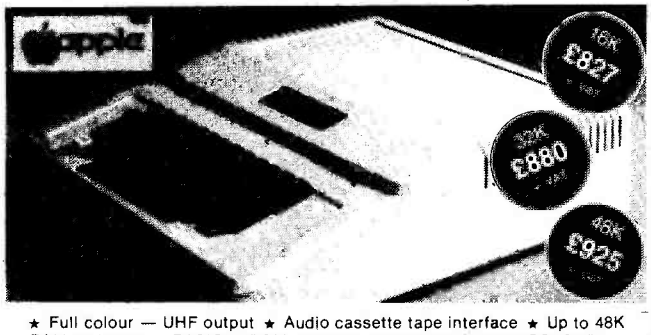
16K Sorcerer — £690.00 + VAT
32K Sorcerer — £790.00 + VAT
S100 Expansion Box — £210 + VAT

Word Processing Pac — £70 + VAT **Development Pac — £70** + VAT

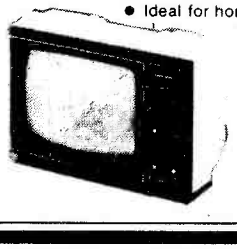
THE *NEW* ITT APPLE (2020)



★ Full colour — UHF output ★ Audio cassette tape interface ★ Up to 48K RAM on board ★ BASIC in ROM (graphics commands include COLOUR = VLIN, HLIN, PLOT and SCRN) ★ Built in loudspeaker ★ Buckets of software available ★ Disk System (110K byte per drive — includes controller) only **£425** + VAT **EX-STOCK**

video 100

12" BLACK & WHITE LOW COST VIDEO MONITOR



- Ideal for home, personal and business computer systems
- 12" diagonal video monitor
- Composite video input
  - Compatible with many computer systems
  - Solid-state circuitry for a stable & sharp picture
  - Video bandwidth - 12MHz + 3DB
  - Input impedance - 75 Ohms
  - Resolution - 650 lines Minimum In Central 80% of CRT; 550 Lines Minimum beyond central 80%.

Only **£79** + VAT

MODULATORS UHF Channel 36

Standard 6 meg band width **£2.25**

High Quality 8 meg band width £4.90 EX-STOCK

THE TRS80 (Special Scoop) Low Priced, Ready to Go!

£399 + VAT

EXTENDED WARRANTY BY COMPUCARE

PLUGS INTO YOUR OWN TV
Use your own cassette

LEVEL II BASIC WITH 16K USER RAM provides you with possibly the most powerful micro around. All our TRS80s are fully converted to English Television Standard and include a U.K. Power Supply, Cassette Leads, Sample Tape, Level I & Level II programming manuals, and special lead that enables you to connect direct into your own television.

Special features of Level II Basic enable you to:-
— Set or reset any point on the screen — Test for the presence of a point on the screen (these features enable easy animation) — Save or load data from cassette under program control — File handling capabilities on cassette using named files. — Graphics blocks as standard — design your own pictures and many many more features for only **£399** + VAT

FULL RANGE OF TRS80 SOFTWARE NOW AVAILABLE

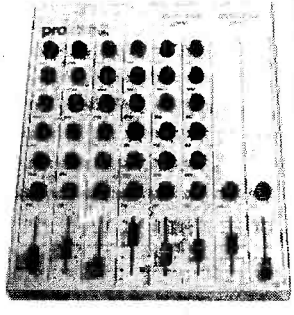
ANADEX DP8000

ONLY **£540** + VAT
PET Connector — £49

The DP 8000 prints the 96-character ASCII set in single or double width at 84 lines per minute. ● The unit operates bi-directionally to print a 9 x 7 matrix on multiple copy, pin-feed plain paper. ● This model accepts RS-232C or current loop serial data at baud rates switchable from 110 to 9600 and Parallel Bit data input at over 1000 characters per second. ● Standard storage capacity of 256 characters ● Other features include Out of Paper Detector, Top of Form Programming and Skip Over Perforation Control.

COMP PRO Mixer

Professional audio mixer that you can build yourself and save over £100.



6 into 2 with full equalization and echo, cve and pan controls.

All you need for your own recording studio is a stereo tape or cassette recorder.

This superb mixer kit has slider faders, level meters and additional auxilliary inputs.

Only **£99.90** plus VAT for **complete** kit Plus **FREE** power supply valued at £25.00

Ideal for

DISCOS STAGE MIXING HOME STUDIOS
AND MANY OTHER APPLICATIONS

SHORT C12 CASSETTES FOR COMPUTER PROGRAMMES 10 for £4.00

HIRE PURCHASE AVAILABLE THROUGH HODGE FINANCE.

SEND S.A.E. FOR APPLICATION FORM.

JUST COMPARE OUR CASH AND CARRY PRICES!

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OCTOBER 1979

EUROPES FASTEST SELLING ONE BOARD COMPUTER —
JUST CHECK THE SPEC'S.

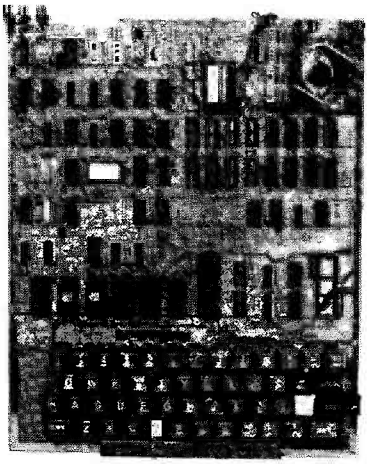
COMPUKIT UK101

SAMPLE TAPE
WITH EXTENDED
MACHINE CODE MONITOR
AND DISSASSEMBLER
INCLUDED FREE

LOW COST SUPERBOARD IN KIT FORM

The Compukit UK101 has everything a one board 'superboard' should have.

- ★ Uses ultra-powerful 6502 microprocessor.
- ★ 50Hz Frame refresh for steady clear picture (U.S.A. products with 60Hz frame refresh always results in jittery displays).
- ★ 48 chars by 16 lines — 1K memory mapped video system providing high speed access to screen display enabling animated games and graphs.
- ★ Extensive 256 character set which includes full upper and lower case alphanumerics. Greek symbols for mathematical constants and numerous graphic characters enabling you to form almost any shape you desire anywhere on the screen.
- ★ Video output and UHF Highgrade modulator (8Mz Bandwidth) which connects direct to the aerial socket of your T.V. Channel 36 UHF.
- ★ Fully stabilised 5V power supply including transformer on board.
- ★ Standard KANSAS city tape interface providing high reliability program storage — use on any standard domestic tape or cassette recorder.
- ★ 4K user RAM expandable to 8K on board £49 extra.
- ★ 40 line expansion interface socket on board for attachment of extender card containing 24K RAM and disk controller. (Ohio Scientific compatible).
- ★ 6502 machine code accessible through powerful 2K machine code monitor on board.
- ★ High quality thru plated P.C.B. with all I.C.'s mounted on sockets.
- ★ .Professional 52 Key keyboard in 3 colours — software polled meaning that all debouncing and key decoding done in software.



COMMANDS
CONT LIST NEW NULL RUN
STATEMENTS
CLEAR DATA DEF DIM END FOR
GOTO GOSUB IF..GOTO IF THEN INPUT LET
NEXT ON..GOTO ON..GOSUB POKE PRINT READ
REM RESTORE RETURN STOP

EXPRESSIONS
OPERATORS
+ - * / ↑ NOT.AND.OR. > < <> > = < = RANGE 10^{-32} to 10^{+32}

VARIABLES
A.B.C. ..Z and two letter variables
The above can all be subscripted when used in an array. String variables use above names plus $ e.g A$.

*8K Microsoft Basic means conversion to and from Pet, Apple and Sorcerer easy. Many compatible programs already in print.

SPECIAL CHARACTERS
@ Erases line being typed, then provides carriage return, line feed.
← Erases last character typed.
CR Carriage Return — must be at the end of each line.
: Separates statements on a line.
CONTROL/C Execution or printing of a list is interrupted at the end of a line.
"BREAK IN LINE XXXX" is printed, indicating line number of next statement to be executed or printed.
CONTROL/O No outputs occur until return made to command mode. If an Input statement is encountered, either another CONTROL/O is typed, or an error occurs.
? Equivalent to PRINT

Simple Soldering due to clear and consise instructions compiled by **Dr. A.A. Berk,** BSc.PhD

NO EXTRAS NEEDED JUST HIT 'RETURN' AND GO.

Build, understand, and program your own computer for only a small outlay.

KIT ONLY **£219** + VAT
including RF Modulator & Power supply.
Absolutely no extras.

Available ready assembled and tested, ready to go for
£269 + VAT

FUNCTIONS
ABS(X) ATN(X) COS(X) EXP(X)
LOG(X) PEEK(I) POS(I) RND(X)
SPC(I) SQR(X) TAB(I) TAN(X)
FRE(X) INT(X)
SGN(X) SIN(X)
USR(I)

STRING FUNCTIONS
ASC(X$) CHR$S(I) FRE(X$) LEFT$(XS.I)
RIGHT$(X$.I) STR$(X)
LEN(X$) MID$(X$.I.J)
VAL(X$)

COLOUR ADD-ON CARD AVAILABLE SOON

Enables you to choose your foreground the background colour anywhere on the screen. Flash any character on the screen at will. Full documentation and parts in kit form.

THE ATARI VIDEO COMPUTER SYSTEM

Atari's Video Computer System now offers more than 1300 different game variations and options in twenty great Game Program™ cartridges!
Have fun while you sharpen your mental and physical coordination. You can play rousing, challenging, sophisticated video games, the games that made Atari famous.

£138 + VAT

You'll have thrill after thrill, whether you're in the thick of a dogfight, screeching around a racetrack, or dodging asteroids in an alien galaxy. With crisp bright color (on color TV) and incredible, true-to-life sound effects. With special circuits to protect your TV.

Cartridges now available in stock:

Basic Maths — Hunt & Score* — Space War —
Video Olympics — Outlaw — Surround — Sky Diver
Basket Ball — Air Sea Battle — Black Jack — Breakout
*Codebreaker — Miniature Golf.
} **£13.90** each. + VAT

Extra Paddle Controllers — **£14.90** + VAT
*Keyboard Controllers — **£16.90** + VAT

SPECIAL OFFER WHILE STOCKS LAST:
Free extra cartridge of your choice please state 1st 2nd and 3rd preference.

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Please add VAT to all prices — Delivery at cost, will be advised at time of purchase. Please make cheques and postal orders payable to COMPSHOP LTD., or phone your order quoting BARCLAYCARD, ACCESS, DINERS CARD or AMERICAN EXPRESS number.
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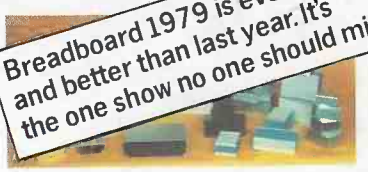
MAPLIN

A 63-key ASCII keyboard with 625-line TV interface, 4-page memory and microprocessor interface. Details in our catalogue.

Our catalogue even includes some popular car accessories at marvellous prices.

A 10-channel stereo graphic equaliser with a quality specification at an unbeatable price when you build it yourself. Full specification in our catalogue.



These are just some of the metal cases we stock. There are dozens of plastic ones to choose from as well.
See pages 52 to 57 of our catalogue.

A massive new catalogue from Maplin that's even bigger and better than before. If you ever buy electronic components, this is the one catalogue you must not be without. Over 280 pages – some in full colour – it's a comprehensive guide to electronic components with hundreds of photographs and illustrations and page after page of invaluable data.

Our bi-monthly newsletter contains guaranteed prices, special offers and all the latest news from Maplin.

Mobile amateur radio, TV and FM aerials plus lots of accessories are described in our catalogue.

A digitally controlled stereo synthesiser the 5600S with more facilities than almost anything up to £3,000. Build it yourself for less than £700. Full specification in our catalogue.

A superb range of microphones and accessories at really low prices.
Take a look in our catalogue – send the coupon now!

An attractive mains alarm clock with radio switching function and battery back up! Complete kit with case only £15.92 (incl. VAT & p & p) MA1023 module only £8.42 (incl. VAT).

Post this coupon now for your copy of our 1979-80 catalogue price 70p.
Please send me a copy of your 280 page catalogue. I enclose 70p (plus 37p 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 U.K. send £1.35 or ten International Reply Coupons.
I enclose £1.07.

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ETI 12/79

A hi-fi stereo tuner with medium and long wave, FM stereo and UHF TV sound! Full construction details in our catalogue.

Breadboard 1979 is even bigger and better than last year. It's the one show no one should miss!

BREAD BOARD 1979

4th – 8th December,
Royal Horticultural Halls,
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(Nr. St. James' Park Underground)

Maplin will be there in force with all our projects on permanent demonstration. There will be plenty to see and many of our interesting lines will be on sale.

A superb technical bookshop in your home! All you need is our catalogue. Post the coupon now!

Add-on bass pedal unit for organs. Has excellent bass guitar stop for guitarists accompaniment.
Specification in our catalogue.

MAPLIN

ELECTRONIC SUPPLIES LTD

All mail to:–
P.O. Box 3, Rayleigh, Essex SS6 8LR.
Telephone: Southend (0702) 554155.
Shop: 284 London Road, Westcliff-on-Sea, Essex.
(Closed on Monday).
Telephone: Southend (0702) 554000.

Core Blimey

Walmore Electronics have introduced a new range of transformer cores for switched mode power supplies. The range includes toroidal cores and three sizes of E core.

The cores are made from iron powder, the advantage over ferrite being that high saturation flux density is maintained to unit operating temperatures. Because of this, inductors can also often be reduced in size. The use of a distributed gap enables a reduction to be made in the external flux leakage. Other core materials need large lumped air gaps to maintain incremental inductance at high DC bias levels.

Also from Walmore are three new ranges of power Darlington transistors in TO-92 miniature plastic packages. The devices are Unitrode types U2TA506/508/510 and feature a current gain of 500 at a collector current of 3A and a saturation voltage of only 1V5 at 3V. They are planar NPN devices, each consisting of a two transistor circuit on a single monolithic clip which also includes an integral bias resistor and protective diode. Each type is specified according to its maximum collector-emitter voltage – 60V for the 506, 80V for the 508 and 120V for the 510. These new Darlingtons are ideally suited to pulse power applications in power supplies, printers, solid state relays, etc.

The new ranges of cores and power Darlingtons are available from Walmore Electronics, 11-15 Betterton Street, Drury Lane, London WC2H 9BS.

Oops OOPS Microwave Oven Leakage Detector

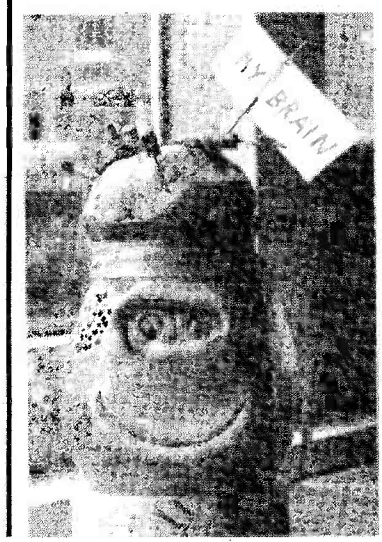
This has proved to be a very popular project. We've had a lot of inquiries about the diode used. If you're having trouble finding one, you can get it from Brian J. Reed, 161 St. John's Hill, Battersea, London SW11 1TQ. Mr Reed's catalogue is 75p + a large stamped (27p) addressed envelope. If you just want one diode, send 30p + a 10p s.a.e.

Motor Speed Controller

Let's see if we can get it right this time. The unmarked resistor above Q2 on the overlay on page 49 should be marked R11. Now, if we take the overlay labelling on page 49 as correct, let's alter the circuit diagram to agree with it. The first column shows the published resistor labelling and the second column shows the corrected version.

R10	R11
R11	R13
R13	R14
R14	R15

Also, a resistor has been omitted from the circuit diagram. R10, a 2M2 resistor, should be shown between pin 2 of IC4 and the OV line ie in parallel with C5. These changes in resistor labelling also apply to the parts list.



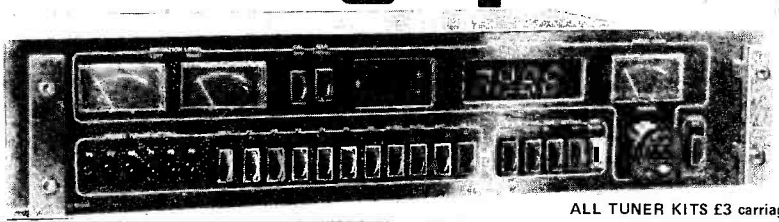
Typical Reader Competition

We're interested to know what our readers think of us. We don't usually hear what readers think of themselves, though. This is what Mr. O'Donohoe figures a typical ETI reader looks like. Wot — no suspenders and stockings? You've shattered my illusions, Mr. O'Donohoe. But you've started something. Let's see what the rest of you think (or hope) the typical ETI reader looks like. If we get any photos that are printable, there could be a few free T shirts in the post.

Tecknowledgey for sale.

The Mark III FM Tuner

DIY Hi-Fi will never seem the same again. Ambit's Mark III tuner system is electrically and visually superior to all others. Some options available, but the illustrated version with reference series modules: £149.00 + £22.35 VAT
With Hyperfi Series modules £185.00 + £27.75 VAT



ALL TUNER KITS £3 carriage

Features of the system:

* Precision construction & design of all parts
* Time/frequency display
* State of the art performance with facilities for updates, using modular plug in systems.
* Deviation level calibrator for recording
* All usual tuner features

Digital Dorchester All Band Broadcast Tuner: LW/MW/SW/SW/SW/FM stereo

A multiband superhet tuner, constructed using a single IC for RF/IF processing - but with all features you would expect of designs of far greater complexity. The FM section uses a three section (air gang) tuned FET tunerhead, with ceramic IF filters and interstation mute; AM employs a double balanced mixer input stage, with mechanical IF filters - plus a BFO and MOSFET product detector for CW/SSB reception. Styled in a matching unit to the Mark III FM only tuner, employing the same degree of care in mechanical design to enable easy construction. MW/LW reception via a ferrite rod antenna.

Electronics only (PCB and all components thereon) £33.00 + £4.95 VAT
Complete with digital frequency readout/clock-timer hardware £99.00 + £14.85 VAT
Complete with MA1023 clock/timer module with dial scale £66.00 + £9.90 VAT
'Hardware packages are available separately if you wish to house your own designs in a professional case structure. Please deduct the cost of electronics from complete prices.

LW/MW/FM LCD Digital Frequency Display - July PW feature

Update your old radio, or build this into a new design. Or use it as a servicing aid - this low power unit with LCD display reads direct frequency in kHz/MHz, or with usual AM/FM IF offsets for received frequency. Low power LCD means no RFI - 15-20mA at 9v even with the divide by 100 prescalar. FM resolution is 100kHz, AM 1kHz. Sensitivities better than 10mV
Complete kit £19.50 + £2.93 VAT, built and tested module £27.00 + £4.05VAT
Ambit stocks and distributes a wide range of frequency counter LSI for all types of DFM- part two of the catalogue contains details of the MSM5523/4/5/6 range, and the versatile MSL2318 divide by ten or hundred prescalar IC. The DFM1 combined counter for AM,FM SW and direct/clock/stopwatch/timers - details available, but SAE please !

PW SANDBANKS PI METAL LOCATOR

Maintaining our professional approach to home constructor kits, we offer the pulse induction 'Sandbanks'. Now with injection molded casing for greatly improved enviromental sealing. £37.00+£5.55vat

VHF MONITOR RX WITH PLESSEY IC

4/9 channel version of the PW design but using standard (fundx9) crystals, and TOYO 8 pole crystal filter with matching transformers. Coil sets from our standard range to cover bands from 40 to 200MHz. Complete module kit £31.25 +**£4.68**vat

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OSTS overflow:

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

RADIO and AUDIO MODULES : Consistently the most advanced

FOR FM

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

FOR 30-200MHz
The EF series are available on special order to cover bands (usually approx 20% of the centre frequency) in the range described. Details in our price list.

FOR FM IFs at 10.7MHz
7030 single 6 pole linear phase filter IF with HA1137£10.95 + 1.64VAT
7130 two 6 pole linear phase filter IF with CA3189E £16.25 + 2.44VAT
7230 Hyperfi IF, switched bandwidth, AGC IF preamp, linear phase ceramic filters with diode switched narrow filter £24.95+3.74VAT

DECODERS for MPX (STEREO)
Various types, guaranteed the world's biggest and best ranges

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

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

COMPONENTS FOR RADIO/COMMUNICATIONS/AUDIO/TV etc.

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

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

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

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

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

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

OSTS: Remember all OSTS stocks are obtained from BS9000 approved sources - your assurance that all devices are very best first quality commercial types. Some LPSN TTL is presently in great demand, so please check by phone before ordering .

TTL: Standard AND LP Schottky

All prices listed in pence *

	'N'	'LSN'		'N'	'LSN'		'N'	'LSN'		'LSN'
7400	13	20	7472	28		74142	265		74257	108
7401	13	20	7473	32	38	74143	312		74260	153
7402	14	20	7474	27	38	74144	312		74273	124
7403	14	20	7475	38	40	74145	65	97	74283	120
7404	14	24	7476	37	38	74147	175		74293	95
7405	18	26	7478		38	74148	109	191	74365	49
7406	38		7480	48		74150	99		74366	49
7409	17	24	7481	86		74151	64	84	74367	43
7410	15	24	7482	69		74153	64	54	74368	49
7411	20	24	7485	104	99	74154	96		74373	77
7412	17		7486		40	74155	54	110	74374	77
7413	30		7489	205		74156	80	110	74377	124
7414	51		7490	33	90	74157	67	55	74379	130
7415		24	7491	76	110	74158		60	74393	140
7416	30		7492	38	78	74159	210			
7417	30		7493	32	99	74160	82	130		
7420	16	24	7494	78		74161		78		
7421	29	24	7495a	65	99	74162		130		
7423	27		7496	58	120	74163	92	78		
7425	27		7497	185		74164	104	130		
7426		27	741XX series			74165	105			
7427	27	29	74107		32 38	74167	20			
7428	35	32	74109		63 38	74169		200		
7430	17	24	74110		54 54	74170	230	200		
7432	25	24	74111		68	74172	625			
7437	40	24	74112		38	74174	87	120		
7438	33	24	74113		38	74175	87	110		
7440	17	24	74114		38	74176	75			
7441	74		74116	196		74177	78			
7442	70	99	74118		83	74181	165	350		
7443	115		74120		115	74183		210		
7444	112		74121		25	74184	135			
7446	94		74122		46	74185	134			
7446	94		74123		46	74188	275			
7447	82	89	74124		137	74190		92		
7448	56	99	74125		38 44	74192	105	180		
7449		99	74126		57 44	74193	105	180		
7451	17	24	74128		74	74194	105			
7453	17		74132		73 78	74196	99	110		
7454	17	24	74136		40	74197		110		
7455	35	24	74138		60	74198	150			
7460	17		74139		60	74199	160			
7463		124	74141		56	74247		90		
7470	28					74253		105		

VOLTAGE REGS:

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

MAINS EMI FILTERS
(BS etc approved types)

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

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

NE555 30p NE556 78p NE558 180p
LM3909 72p
95H90DC divide by 10/11 to 320MHz 780p
11C90DC divide by 10/11 to 650MHz 1400p
8629 divide by 100 to 175MHz min 420p
MSL2318 divide by 10/100 to 175MHz min 420p
ICM7216BIPI : 8 decade 10MHz DFM counter and full function timer, with direct drive for an LED display (mpx). Uses 10MHz xtal 1982p
ICM7217AIBI : 4 decade programmable counter with direct LED drive 950p
ICM7207 clock pulse generator 495p
ICM7208 : 7 decade counter display 1495p
ICM7106CP : LCD DVM (3½ digit) 955p
ICM7106CPK : evaluation kit for 7106 24.80
ICM7107CP : LED DVM (3½ digit) 955p
ICM7107CPK : LED DVM kit for 7107 20.65
OKI MSM5523/4 : LED/Fluorescent display driver IC for time/timer/stopwatch/ AM/FM received frequency display and direct counter (use MSL2318 prescalar) inc Crystal 1400p
MSM5525 : AM/FM frequency only couner, for fluorescent displays (6LT06) inc xtal 1100p
MSM5526 : as MSM5525 but for LCD 1100p
4 digit LCD for ICM7106 or MSM5526 1100p
10 LED (2½x5mm) bar graph driver PCB for LOG or LIN (specify). Kit ex leds 300p

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

CD4000

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

LINEARS

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

7 SEG DISPLAYS

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

MORE FROM THE GENERAL AMBIT CATALOGUE RANGES:

Varicap tuning diodes for AM/FM/TV :
1-9 v AM tuning (Cr 15:1) from TOKO--

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

PIN DIODES, BANDSWITCH types

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

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

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

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

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

FUTABA FLUORESCENT VACUUM DISPLAYS for CLOCKs etc

5LT02	clock display (static drive) with AM/PM flags	£9 + 1.35
5LT03	DFM display for MSM5525 LSI counter	£9.45 + 1.42 vat
6LT06	5 digit DFM display (GI AY58100) mpxed	£9.75 +1.46 vat

TOKO COILS, FILTERs, CHOKES, etc for AM/FM/TV comms--

TYPE	Size: 5mm	7mm	10mm	(please add VAT @15%)
AM IF	55p	33p	30p	Various for ICs, transistor etc.
FM IF	55p	33p	33p	Various for ICs, transistor etc.
SW coils			33p	Two impedance series
OSC coils	55p	33p	33p	For LW, MW, SW
TV vif/sif			35p	

Various coils in the range 20kHz to 300MHz - see TOKO catalogue

CERAMIC and MECHANICAL FILTERS (inc MURATA TYPES)

CFT455B/ CFT455C 60p; CFX014 -180p: CFU455C - 85p
CFT470C - 60p; CFU470C -65p
MURATA CFU455H and CFU455F ceramic block filters 1.95ea
MURATA CFM455 series ladder filters. D,E,F,G,H bandwidths available now (20,16,12,8,6 kHz) £8.35 ea (metal encapsulated)
SFD455B, SFD470B, SFD472B 85p ea
CFM2 series mechanical elements types A,B,C,D (4-10kHz bandwidth) - 65p ea. As used in RCME feature)

MULTIPLEX/PILOT TONE FILTERS. FM IF FILTERS (see cat and:)

CFSE10.7/SFE10.7 - stereo FM IF ceramic filters (sim FM4 etc) 50p
CFSB10.7/SFE10.7MJ - mono bandwidth ceramic FM IF filters 50p
SFE10.7ML - ultra linear phase stereo ceramic IF filters 70p
CDA10.7 - 10.7MHz ceramic discriminator for CA3089 etc) 70p

Current news: A PCB for the Mullard DC tone and volume control system is now available £3 + 0.45 VAT. HMOS PA modules for 60-100W - kit £14 +£2.10VAT, heatsink £4.10+0.61. FM radio control system crystals £3.75 pair inc VAT (Sept on). MK50366N: static drive clock/timer IC £3.78 + 0.57 VAT. 12½kHz channel spacing 8 pole 10.7MHz XTAL filter by TOYO type H4402 £15.50 + £2.32VAT. A further updated pricelist is now available, and we would like to remind you that enquiries can only be answered if accompanied either by an official business letterhead, or an SAE. STOP PRESS: TOKO's new split-apart triple AM tuning diodes are in stock £2.45 + 37p VAT, (KV1215). S BL1 diode DBM 1-500MHz - £4.25+0.64p.

Terms: CWO please. Account facilities for commercial customers OA. Postage 25p per order. Minimum credit invoice for account customers £10.00. Please follow instructions on VAT, which is usually shown as a separate amount. Overseas customers welcome - please allow for postage etc according to desired shipping method. Access facilities for credit purchases.

Catalogues: Ambit Part 1 45p, Part 2 50p 90p pair. TOKO Euro shortform 20p. Micrometals toroid cores 40p. All inc PP etc. Full data service described in pricelist supplements.

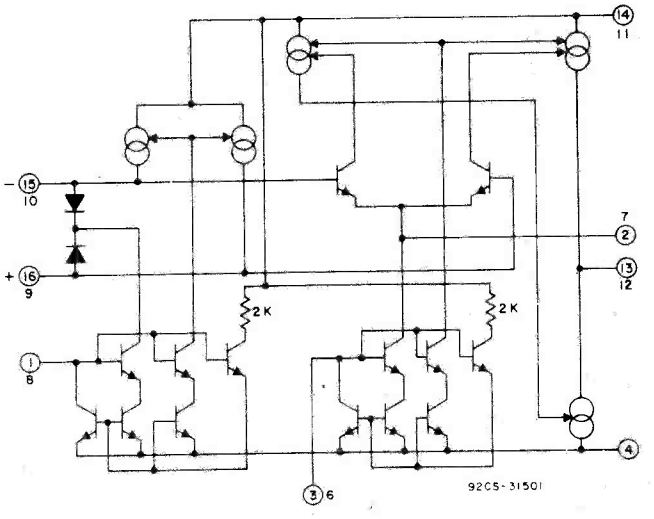
Hours/phone: We are open from 9am -7pm for phone calls. Callers from 10am to 7pm. Administrative enquiries 9am to 4.30pm please (not Saturdays). Saturday service 10am to 6pm.

ambit international ®

AMBIT catalogues are guaranteed to contain the most up-to-date and best informed comment on modern developments and advances in the field of radio and audio. There is no competetive publication that even approaches the broad range of parts/information on modern techniques.

2 Gresham Road, Brentwood, Essex. (0277) 227050

14



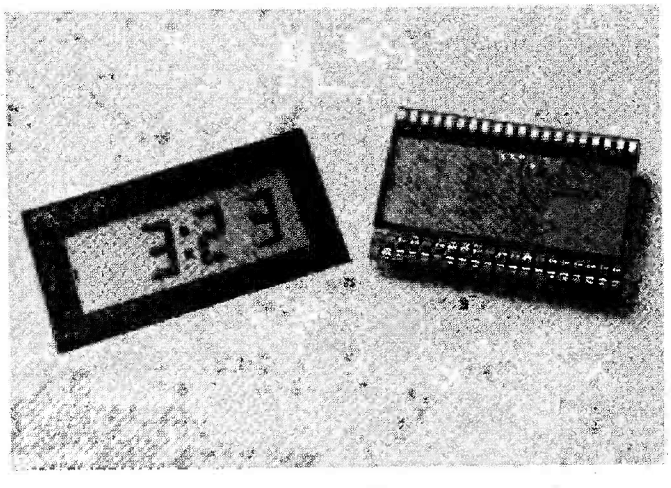
Happy Families

The latest offspring of RCA Solid State is a new family of dual variable operation amplifiers. The CA3280G Series combines two operational transconductance amplifiers in a single package.

The two amps are independent, differential input types and the output is a current proportional to the differential input voltage and the transconductance, which is programmable via a separate input terminal.

All characteristics of the two amplifiers are matched to within 5%. Peak output current can be as high as 650 uA at a bias current of 500 uA and operating bandwidth is 9MHz at a bias current of 1mA.

Applications include voltage-controlled amplifiers, voltage controlled filters, voltage controlled oscillators, function generators, etc. The devices are supplied in 16 lead DIL plastic packages and are available with operating temperature ranges of −55 to +125°C (CA3280 AG) and 0 to +70°C (CA3280) from RCA Solid State — Europe, Sunbury on Thames, Middlesex TW16 7HW.



Display Giants

New from Fairchild are a range of large area liquid crystal displays, suitable for clock and digital panel meter purposes.

There are two versions — 3½ digit (FLB 3513) and 4 digit (FLB 4013), both featuring 0.5 inch digits. The inclusion of a colon allows the displays to be used in timekeeping applications. Decimal point and polarity signs are included for digital panel meter use.

Power requirements? — 5V typical with a maximum drive current requirement, at 3V with all segments on, of 5uA.

You can find out more about these LCDs from Fairchild Camera & Instrument (UK) Ltd, 230 High Street, Potters Bar, Herts EN6 5BU.

Quartz Melody Multi-Alarm Chrono
For 1980 Try this 34 Function
for only £26.95

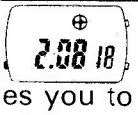
Count-down Timer

Can be used for a host of applications from boiling an egg to warning you your parking meter is expired.
The timer is presettable to 23 hours 59 mins. 00 secs. in 1 min. steps and counts down in 1 sec. steps. It operates quite independently of the other counters and the watch can be in any other mode whilst it is being used.
At the preset time the musical tone will sound for 1 minute.

Alarm

The alarm can be set at 1 minute intervals to any time within the 24 hour period.
A clear firm musical tone sounds for 1 minute at the appointed time. An automatic roll-over to the normal time is a feature after the alarm has been read. A clear indicator displays whether the alarm is set or not.

Time Zone



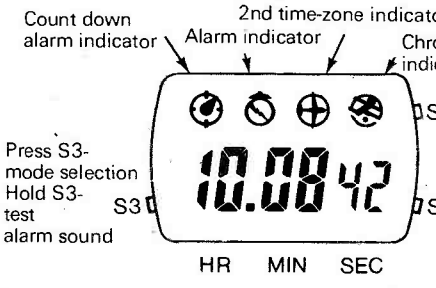
The time zone enables you to tell the time in two places at once. It can be useful on holiday or business trips. Just programme the second time zone and it will be permanently recorded for your easy reference.

Chronograph

This watch incorporates a sophisticated and very accurate stop/start counter which has many applications in sporting events and timing for recordings etc.
Mode 1: Is the normal stop-watch mode. Stop-Start-Zero.
Mode 2: The lap timer enables first and second past the post times to be recorded. The display is frozen but the counter continues to count.
Mode 3: Longer timing intervals, such as journey times, can be recorded whilst the watch is reading its normal time, or the count-down is being used. The counter counts to 1 hour in 1/100 sec. steps in all its modes.

MODEL M30

Display Format (NORMAL TIME DISPLAY)



Display indicators (not all shown)

5 independent working modes
i) Normal watch
ii) Count down alarm
iii) Alarm
iv Dual time zone
v) 1/100 sec. chronograph

A very impressive new watch at a superbly low price from Metac. This super slim watch is only 7mm thick (that's thinner than most mechanical tick-tocks), but its microprocessor heart packs 34 different features.

In addition to those listed on the left the watch can display the day of the week in French or German or English (just select the one that suits you).

It has fast and slow setting rates for the counter and the alarm as well as the normal time setting.

There are 7 display indicators, 6 digits and a back light for night viewing. The 5 working modes are independent of each other, and the watch can be operated in all 5 modes at once.

FOR ORDERING INFORMATION PLEASE SEE OVER

Metac ELECTRONICS & TIME CENTRES

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

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

QUARTZ LCD
5 Function

Hours, mins, secs, month, date, auto calendar, back light, fully adjustable bracelet to fit all wrists.

£6.65

Guaranteed same day despatch.

Very slim, only 6mm thick.

M1

SOLAR QUARTZ LCD
5 Function

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

£8.65

Guaranteed same day dispatch.

M2

QUARTZ LCD
11 Function SLIM CHRONO

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

£10.65 Thousands sold!

Guaranteed same day dispatch

M3

QUARTZ LCD
ALARM 7 Function

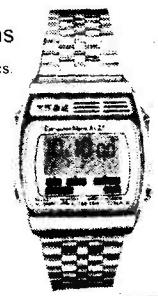
Alarm Hours, mins., secs. Month, date, day. 6 digits. 3 flags plus continuous display of day and date or seconds. Back-light. Only 9mm thick

£12.65

Guaranteed same day dispatch

M4

MULTI ALARM
6 Digits
10 Functions



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

£18.65

M5

FRONT-BUTTON ALARM
Chrono Dual Time

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

Fully adjustable open bracelet.

£22.65

Guaranteed same day dispatch

M6

SOLAR QUARTZ LCD
Chronograph with Alarm Dual Time Zone Facility

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

£27.95

M7

ALARM CHRONO
with 9 World Time Zones

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

£29.65

M8

SOLAR QUARTZ LCD
Chronograph

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

£13.65

Guaranteed same day dispatch.

M9

LADIES DAY WATCH
QUARTZ LCD

Ladies Day Watch only 25×20mm and 6mm thick. Hours, minutes, seconds, day, date, backlight and auto calendar. Elegant metal bracelet in silver or gold fully adjustable to suit very slim wrists. State colour preference.

£9.95 Guaranteed same day despatch

M15

LADIES FASHION WATCH
QUARTZ LCD

Lady's Fashion Watch. Elegant bracelet in bronze/gold finish or silver colour. Hours, minutes, seconds, day, date, backlight and auto calendar. Adjustable for the slimmest of wrists.

State colour preference.

£14.95

Guaranteed same day despatch

M17

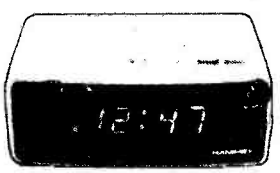
LADIES COCKTAIL WATCH
QUARTZ LCD

Lady's Cocktail Watch Highly functional watch which also suits those special occasions. Beautifully designed with a very thin bracelet which retains strength as well as elegance. Hours, mins., secs., day, date, backlight and autocalendar. Bracelet fully adjustable to suit slim wrists. State gold or silver finish. **£19.95**

Guaranteed same day despatch

M18

HANIMEX
Electronic
LED Alarm Clock



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

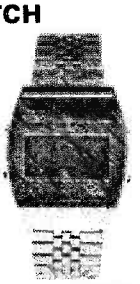
£10.20 Thousands sold!

Mains operated.

Guaranteed same day despatch.

M13

EXECUTIVE
ALARM WATCH



6 functions plus alarm: Conference signal, 5 minute snooze alarm. Conference signal sounds 4 secs. before main alarm to give advance warning and option to cancel. Snooze sounds 5 mins. after main alarm and is always preceded by the conference signal.

£14.95

M60

MACY QUARTZ
ANALOGUE

Automatic calendar day and date, infinite bracelet. This man's watch has elegance as well as the robust appearance provided by a watch with traditional features. Accuracy is provided by a quartz crystal powered by a long life miniature battery.

£24.95

M21

Metac price breakthrough for an Alarm Chronograph with Dual Time

Only £16.95

OUTSTANDING FEATURES

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

Guaranteed same day despatch

M16

HOW TO ORDER

Payment can be made by sending cheque, postal order, Barclay, Access or American Express card numbers. Write your name, address and order details clearly, enclose 40 pence per single item for post and packing or the amount stated in the advert. All products carry 1 year written guarantee and full money-back 10 day reassurance. Battery fitting and electronic calibration service is available to customers at any Metac shop. All prices include VAT currently at 15%.

Metac Wholesale:
Trade enquiries — send for a complete list of prices for all the goods advertised plus many more not shown, also minimum order details.

Telephone orders: Credit card customers can telephone orders direct to Daventry (03272) 76545 or Edgware Road 01-723 4753 24 hours a day.

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SEIKO MEMORY BANK

Calendar watch M354
Hours, mins., secs.
Month, day, date in 12 or 24 hour format all indicated continuously.
Monthly calendar display month, year and all dates or any selected month over 80 year period.
Memory bank function. Any desired dates up to 11 can be stored in advance.
2 year battery life.
Water resistant.

Metac Price **£79.50** **M11**

SEIKO ALARM CHRONOGRAPH

With WEEKLY Alarm.
Hours, mins, Secs, month, date, day, am/pm.
Weekly alarm — can be set for every day at designated time, e.g. 6.30am on Mon., Wed. and Friday.
Alarm set time displayed above time of day.
Full stopwatch functions, laptime, split, etc.

Price £89.95 **M10**

SEIKO MELODY ALARM CHRONOGRAPH

Chiming Alarm, plus chrono. Hours, mins, secs, date, day, 24-hour alarm, 12 hour chronograph, 1/10th secs, laptime, back light, stainless steel, mineral glass.

Metac Price £92.95 **M19**

SEIKO CALCULATOR WATCH

Full specification calculator with memory, plus multi function watch.
Hours, mins, secs, day, date, backlight.
Automatic calendar.
Long-life battery.

Price £96.20 **M27**

CASIO CHRONO 95QS-3LB

Stainless steel case, water resistant to 66 feet. Hours, mins, secs, am/pm, year, month, date, day. Auto-calendar pre-programmed until year 2029. 12/24 hour stopwatch function. Range 7 hours, 1/100 sec. (Mode), Net time/lap-time/1st-2nd place times. Dual time function. Accuracy 15secs. per month. Battery life approx. 4 years.

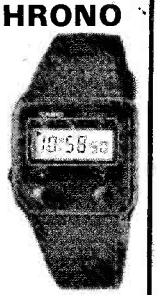
Price £22.95 **M22**

CASIO LADIES 86CL-23B-1

Elegant slim line stainless steel bracelet, fully adjustable. Hours, mins, 10 sec. symbol second by flash, am/pm. Month, date, day. Auto-calendar pre-programmed for 28th day in Feb. Accuracy per month 15 secs., battery life approx. 15 months.

Price £29.95 **M23**

CASIO F-200 SPORTS CHRONO



Attractive man's watch in black resin with mineral glass. Hours, mins, secs, am/pm. Month, date, alpha-numeric day. Auto-calendar set 28th Feb. Stopwatch working range 1 hour units 1/100 sec. Mode, Net time/lap time/1st-2nd place times. Accuracy approx. 15 secs. per month. Battery 12 months.

Price £14.95 **M24**

CASIO ALARM CHRONO 81CS-36B

Hours, mins, secs, day, and also day, month and year perpetual automatic calendar. 100th sec chronograph to 7 hours. Net time/lap time/1st and 2nd place times. User optional 12/24 hr. display. 24 Alarm. User optional, hourly chime. Backlight, mineral glass, stainless steel. Water resistant to 100ft. Battery life approx. 4 years.

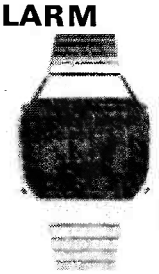
Price £34.95 **M25**

BELTIME CHRONOGRAPH

9 Functions
Hours, mins, secs, day, date, month, interchange feature, automatic calendar, backlight, net time/lap time. Stainless steel bracelet. Battery life 1 year.

Price £14.95 **M34**

BELTIME MULTI ALARM

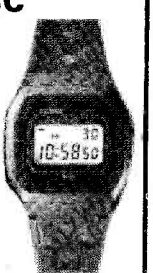


29 Functions
Hours, mins, secs, date, day. Alarm, chronograph, light. Watch 8 functions, Alarm 4 functions, chronograph 17 functions. Stainless steel bracelet.

Price £29.95 **M35**

CASIO F-8C

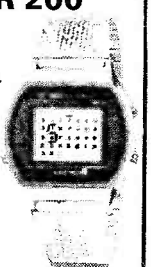
3 Year Battery Life



Hours, mins, secs, am/pm, date, day. Auto calendar set 28th Feb. Stopwatch function. Accuracy 15 secs. per month. Battery life approx. 3 years.

Price £9.95 **M36**

CASIO CALENDAR 200



47CS-23B-1Black
Stainless steel. Hours, mins, 10 second symbol, second (by flash), am/pm. Month, day, date. Auto calendar set from1901 to 2009. Full month calendar display, dual time function. Accuracy 10 secs. per month. Battery life approx. 15 months.

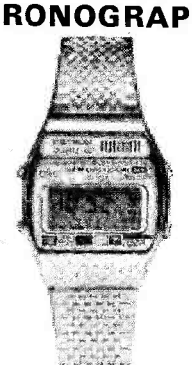
Price £59.95 **M37**

MELODY MULTI-ALARM CHRONOGRAPH

Hours, mins, secs, day, date, countdown alarm, dual time zone, 1/100th sec stopwatch. Lap/split time, 1st and 2nd place times. Melody test function.

Price £26.95 **M30**

DUAL TIME-ALARM CHRONOGRAPH



Incorporating module of world-famous Japanese watch manufacture. Hours, mins, secs, day of week, month, day and date, 24 hour alarm, 12 hour chronograph, 1/10th secs, lap time, backlight, stainless steel case and bracelet, mineral glass, battery hatch, long life battery.

Price £35.00 **M12**

PICOQUARTZ MICROPROCESSOR ALARM CHRONOGRAPH

Multi-language — day of the week can be set to English, French, German, Italian or Spanish. Chime — every full hour combined with a response signal, beebing at every pressing of the functions. Can be switched off. 12-24 hour format, backlight, Chrono — 1 full-scale chrono with lap, counting hours, up to 24 hours. Minutes, secs, 1/100th secs. Two Alarm systems. Two time zones.

Price £37.95 **M32**

SEIKO CHRONOGRAPH

Hours, mins, secs and day of the week. Month, date and day of the week. Stopwatch display: hours mins secs up to 12 hours minutes secs 1/100 secs up to 20 minutes. Lap timing, continuous time measurement of two competitors. Stainless steel, mineral glass.

Price £56.00 **M33**

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LONDON W.2
Telephone: (01) 723 4753

DIGITAL CLOCK RADIO

Mains. AM/FM/LW radio. Green digital display. Snooze alarm. Auto switch off. Clock dimmer. External FM Aerial.

£19.95

plus £1.30 Post & Packing

M40

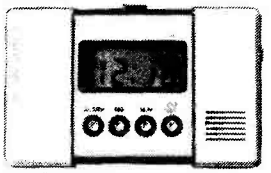
Portable LCD Clock Radio

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

£17.95

M41

DIGITAL CLOCK LCD Travel

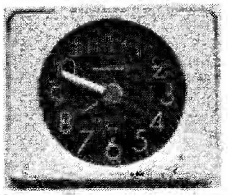


Hours, mins. 24 hour time and Alarm. Snooze timer. Large 12.5mm display. Night light. Size: 120mm x 74mm x 19mm.
Weight: 120 grams.

£17.65

M42

QUARTZ ANALOGUE CLOCK TRAVEL

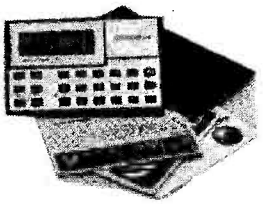


Mini Quartz Alarm clock. Complete with travel pouch. Features loud alarm and operates from 1½ volt battery.

£9.95

M43

LCD Calculator

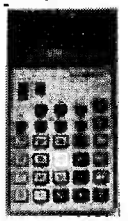


Credit Card size
Memory % ect plus auto power off.

£7.95

M44

Digital Clock/Alarm/ Calculator/ Stopwatch

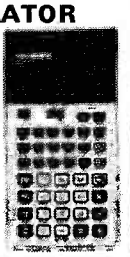


Calculator with % and memory. Continuous clock with hours, mins., secs., day, month, day of week, Alarm, Stopwatch, split-time. 1 year battery. Leatherette wallet.

£17.95

M45

LCD CALCULATOR SCIENTIFIC



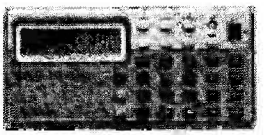
8-digit mantissa, 2-digit exponent electronic calculator on one single chip.

Functions-SIN, COS, TAN, SIN-1, COS-1, Tan-1, SINH, COSH, TANH, e^x, 10^x, Ln, Log, Y^x, 1/x.
Statistical functions

£16.95

M46

LCD CALCULATOR CASIO MELODY 80



Full calculator spec 3 independent musical alarms time, stop-watch, count-down timer

£23.95

M47

TV GAMES

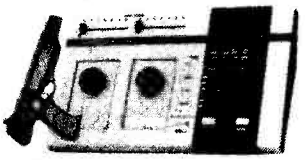
Black & White or Colour.
4 game, 2 ball speed, 2 ball angles, 2 battery sizes. Tennis, Hockey, Football, Handball, Practice.

£11.95 Colour
£8.95 B/W

plus 54p Post & Packing

M48

TV GAME WITH GUN



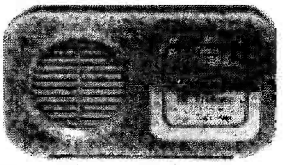
Colour. 6 games. Moving target, Football, Target, Tennis, Squash, Practice. Battery or main.

£17.95

plus £1.25 Post & Packing.

M49

AIR FRESHENER Electronic



Timer can be set to emit nice smells when required or running permanently to remove really bad smells. Battery operated.

Price £4.95

M50

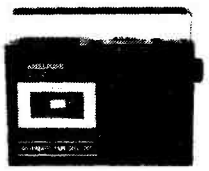
DIGITAL CLOCK

LED Display.
Features Hours/mins.
Display Alarm with snooze.
Mains operated excellent value for money. Compact size only 6 in x 2½in x 3 in.

£6.95

M51

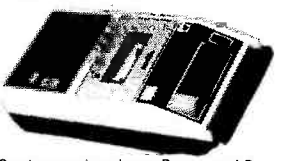
RADIO/CASSETTE 3-Band/LW-MW-FM



Auto stop. DC6V, AC Power 220V. Built-in condenser microphone. High power output.

M52

RADIO/CASSETTE 1-Band/MW



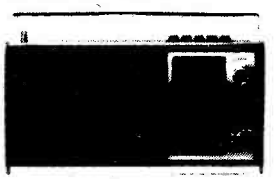
Condensor microphone. Battery or AC. Pushbutton key operation. Auto level control. Retractable handle. Eject equipment.

£17.95

plus £2.00 Post & Packing

M53

MAINS/BATTERY Portable Radio



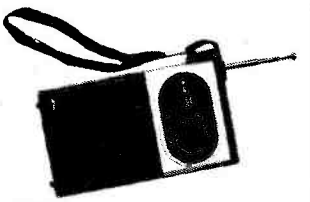
4 Bands, LW/MW/SW/FM. Teak finish case.

£19.95

plus 85p Post & Packing

M54

AIRCRAFT RADIO



AM/FM.
Receives Police/Aircraft frequencies. Battery operation. Retractable aerial.

£9.95

M55

RADIO CONTROLLED CAR

Formula One Racer.
4 function, forward, reverse, steering left to right. No wires, remote control.

£19.95 **M56**

MODEL CAR RADIO

Scale model car incorporating single band radio. Excellent quality sound with clever design of controls incorporated in the car components.

£5.95 **M57**

ELECTRIC CAR AERIAL

Sonix automatic motor antenna. 5 sections. One meter in length. Excellent value at

£10.95 **M58**

CAR RADIO/ CASSETTE

2 band car radio/stereo cassette player. Long and Medium waveband coverage. Rotary controls for on-off/volume, tone, balance and tuning. Push-button control for cassette eject and fast forward wind. Output 2×3 Watts (music) 12 volts.

£34.95 **M59**

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FUNCTION GENERATOR

A wide range (1 Hz - 100 kHz) sine/triangle and square wave generator with built-in analogue frequency meter.

A really nice piece of test gear from ETI.

The main characteristic of a function generator is that it produces a basic fixed-amplitude waveform other than a sine wave, from which a fixed-amplitude sine wave is then synthesised. The main advantage of this technique is that the resulting output waveforms of the generator are immune to amplitude 'bounce' when they are swept through their frequency ranges, thus enabling amplifier or filter gain/frequency tests, etc. to be carried out very rapidly. The only disadvantage of the technique is that the resulting sine wave has an inherently higher degree of distortion than is obtainable from good 'Wien bridge' and similar 'tuned' oscillator circuits.

The ETI function generator produces three output waveforms (sine, triangle and square) and covers the frequency range 1 Hz to 100 kHz in five decade ranges. The sine wave output typically produces a THD (total harmonic distortion) value of only 0.5%, has a maximum amplitude of 2 volts rms, and is ideal for general purpose testing. The triangle output has a typical linearity of 1%, a maximum peak-to-peak amplitude of 5V6 and is ideal for cross-over distortion testing of class-AB amplifiers, etc. The square wave output is positive-going, has a maximum peak amplitude of 8 volts, has typical rise and fall times of less than 200 nS and is ideal for testing digital circuits. All ouput waveforms of the generator are DC coupled, with the sine and triangle waveforms swinging symmetrically about the zero volts line.

Our function generator incorporates a number of additional, very attractive features. It has a built-in analogue frequency meter, for ease of calibration. It has two output terminals, each with its own attenuator network. A sine or triangle waveform is available from one output and a

PARTS LIST

RESISTORS All ¼W, 5%

R1,2,14	10k
R3,17	1k0
R4,5,10	2k2
R6,7,9	22k
R8	470R
R11,18	100R
R12,13,15, 16	47R
R19	11R

POTENTIOMETERS

RV1,2	47k cermet multiturn (3/4")
RV3	22k cermet multiturn (3/4")
RV4	470R cermet multiturn (3/4")
RV5	4k7 cermet multiturn (3/4")
RV6	100k lin dual gang
RV7-10	10k
RV11	100k cermet multiturn (3/4")
RV12,13	1k0 lin

CAPACITORS

C1,2	100u 25V electrolytic
C3,9	150p polystyrene
C4,13	10n polyester
C5,10,14,11	100n polyester
C6,15	1u0 polycarbonate
C7,8	10u 25V electrolytic
C12	1n0 polystyrene

SEMICONDUCTORS

IC1	XR2206CP
IC2	NE555
Q1,3	BC182L
Q2,4	BC212L
D1-3	1N4148
ZD1	BZY885V6

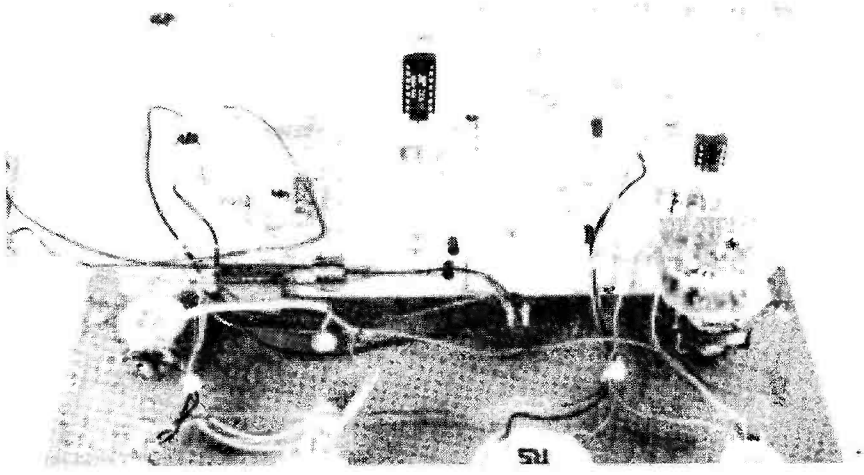
MISCELLANEOUS

SW1	DPDT (PCB type) toggle.
SW2	4 pole 5 way wafer switch assembly and 2 PCB wafers (2 pole 6 way)
SW3	DPDT toggle
SW4	1 pole 3 way rotary switch

2 BNC connectors, 2 PP7 batteries, case to suit, PCB.

square wave is available from the other. The square wave output is available at all times, is synchronous with the sine/triangle waveform and can thus be used to provide synchronisation signals to an oscilloscope timebase during sine wave testing, etc. The unit is battery powered, for maximum user convenience.

A fine unusual feature is that the frequency ranges are alternately contra-connected, so that to increase frequency you turn the 'fine' control clockwise on one range, anticlockwise on the next range and clockwise on the next range, etc. This facility enables the frequency to be swept through several decades very rapidly when testing the frequency response of amplifiers and filters, etc. As we said in the introduction, this is a really nice piece of test gear.

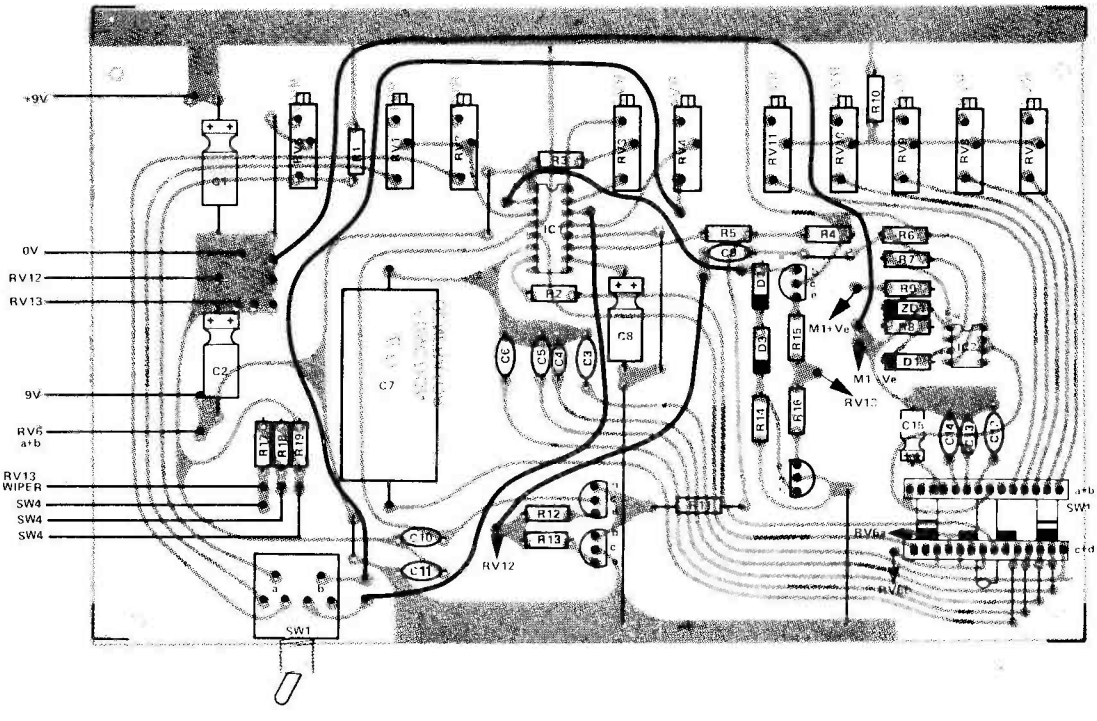


Construction

Most of the circuit is built up on a single large PCB. Various points should be noted before starting construction. First, note that 4-pole 5-way range switch SW1 is mounted directly on the PCB and in fact is a 6-way PCB type (see Buylines) with one of the 'ways' unused. The next point to note is that the C6 (1uO) and C7 (10u) main timing capacitors are non-electrolytic types. We obtained ours from Electrovalue. ▶

SPECIFICATION

Frequency range	1 Hz to 100 kHz in 5 decade ranges.
Output waveforms:	
Sine: distortion (typical)	0.5% at 1 kHz.
Triangle: linearity (typical)	1% at 1 kHz.
Square: rise/fall times (typical)	less than 200 nS.
Waveform stability (typical)	.002% per °C.
	.01%/V supply sensitivity.
Maximum output levels (with 9-0-9 V supply).	Sine = 2 V rms.
	Triangle = 5V6 pk-pk.
	Square = 8 V peak.
Supply	Two 9 V batteries.
Total current consumption	30 mA typical.



At this stage access to a distortion meter is desirable, so that RV3 and RV4 can be trimmed for minimum distortion. With care, a thd figure of 0.5% can be obtained. In the absence of a distortion meter, the simple twin-T 1 kHz filter of Fig. 2 can be used in conjunction with the oscilloscope or with a milivoltmeter to set the generator for minimum distortion at 1 kHz. The procedure is to apply the sine wave output of the generator to the input of the filter at about 1 volt rms at approximately 1 kHz and take the output of the filter to the input of the 'scope or millivoltmeter. Next, adjust the generator frequency and R4 of the filter to give minimum output indication and, finally, adjust RV3 and RV4 of the generator to reduce the output indication of the filter to the minimum possible value. At final balance, the output of the filter corresponds to approximately 0.1% thd per mV rms of indicated reading, ie if the indicator shows a reading of 5 mV rms, the thd of the generator approximates 0.5%. Now retrim OFFSET control RV5.. The sine wave calibration procedure is then complete.

(3). Set the unit to TRIANGLE mode. Monitor the waveform on the 'scope and adjust RV2 for a pk-pk amplitude of 5V6.

(4). Check that the unit is functional on all ranges, in all waveform modes.

(5). Switch the unit to its top frequency range, set the output frequency to 100 kHz and adjust RV7 for full scale deflection. If necessary, slightly reduce the value of C3 so that 100 kHz can be obtained.

(6). Repeat the frequency calibration procedure on all ranges, using the appropriate pre-set (RV8 to RV11), noting that a very 'Jerky' reading will be obtained on the lowest (1 Hz to 10 Hz) range. The calibration procedure is then complete, and the unit is ready for use.

A final point to note is that we used 10-turn cermets for all pre-sets on our prototype unit. A slight touch of luxury, this. You can get away with ordinary presets, if you prefer, but in this case you'll have to make slight modifications to the PCB.

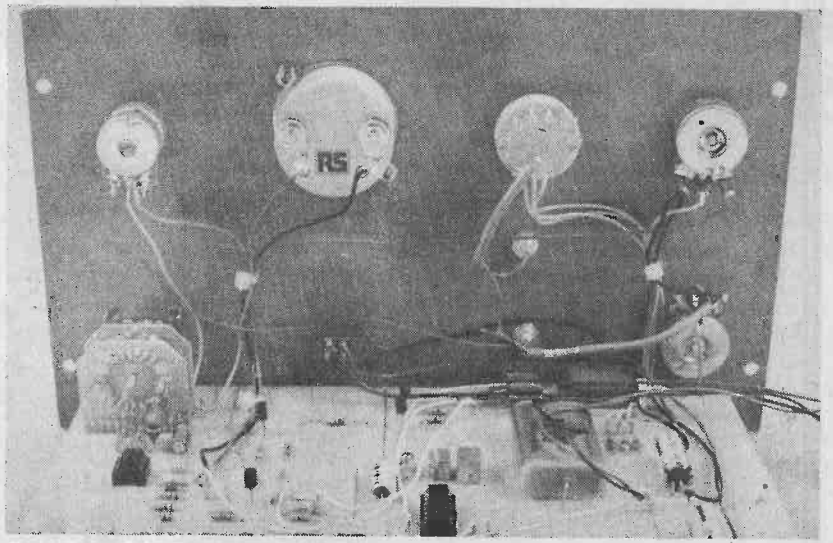
Actual construction on the PCB is fairly straightforward, but take extra care to observe the polarities of all electrolytics and all semiconductor devices. When construction is complete, fit the board into a suitable case and complete the interwiring to the remaining switches, pots and to the moving coil meter. The unit is then ready for testing and calibration.

CALIBRATION

Calibration of the unit is fairly tricky and requires access to an oscilloscope and some kind of frequency reference (you can use the 'scope timebase as a reference if it is known to be reasonably accurate). The calibration procedure is as follows:

(1). Set the unit to the SINE mode. Set the attenuator controls for maximum output. Set the frequency controls for approximately 1 kHz on the 1-10 kHz range. Set all pre-set pots at mid value. Switch the unit on, and use a 'scope to check that some kind of waveform is available (the waveform may be pretty awful at this stage). Check that the frequency is variable via RV6.

(2). Reset RV6 for a 1 kHz output and adjust RV1 for a pk-pk amplitude of about 5V6. Adjust RV4 for a 'passable' sine wave, and then readjust RV1 for 5V6. Now alternately adjust RV4 for MINIMUM DISTORTION and RV3 for best SYMMETRY, occasionally readjusting RV1 for 5V6 pk-pk until a good sine wave is produced. Adjust RV5 for zero offset (so that the output waveform swings symmetrically about the zero volts level) and retrim RV3 and RV4 for a good sine wave.



Rear view of the front panel controls.

HOW IT WORKS

There is not an enormous amount we can say here, since most of the work of the circuit is carried out inside IC1, which is a special function generator chip that produces a square wave output from pin 11 and a sine or triangle wave from pin 2. The purity of the sine wave can be trimmed via RV3 and RV4 and the maximum amplitude can be pre-set via RV1. The maximum triangle amplitude can be pre-set via RV2 and both waveforms can be offset via RV5. The sine/triangle waveforms are made available to the outside world via buffer amplifier Q3-Q4 and the associated attenuator network. The square wave is made available, in positive-going form only, via the Q1-Q2 buffer and RV12.

The operating frequency of the generator is variable via timing capacitors C3 to C7 and via resistor network R2-RV6. The frequency is monitored on a simple analogue frequency meter that is designed around 555 timer IC2, which is triggered via the square wave output of the Q1-Q2 buffer amplifier.

The entire circuit is powered from two 9 volt batteries, and the circuit consumes a typical total current of about 30 mA.

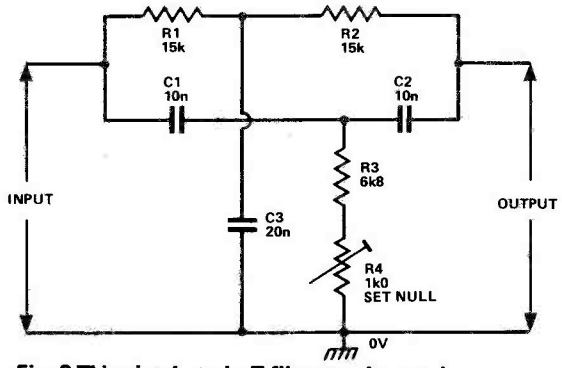


Fig. 2 This simple twin-T filter can be used to set the generator for minimum distortion.

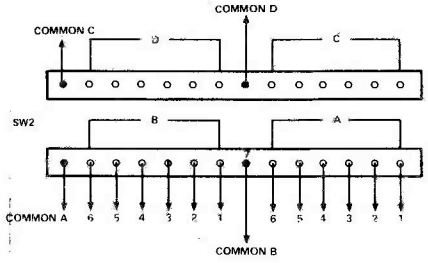


Fig 3 Range switch wafer pin-out.

BUYLINES

The 10u (C7) capacitor c be purchased from Electrovalue Ltd. All other components used in the function generator should be readily available from major mail order companies that advertise in this issue.

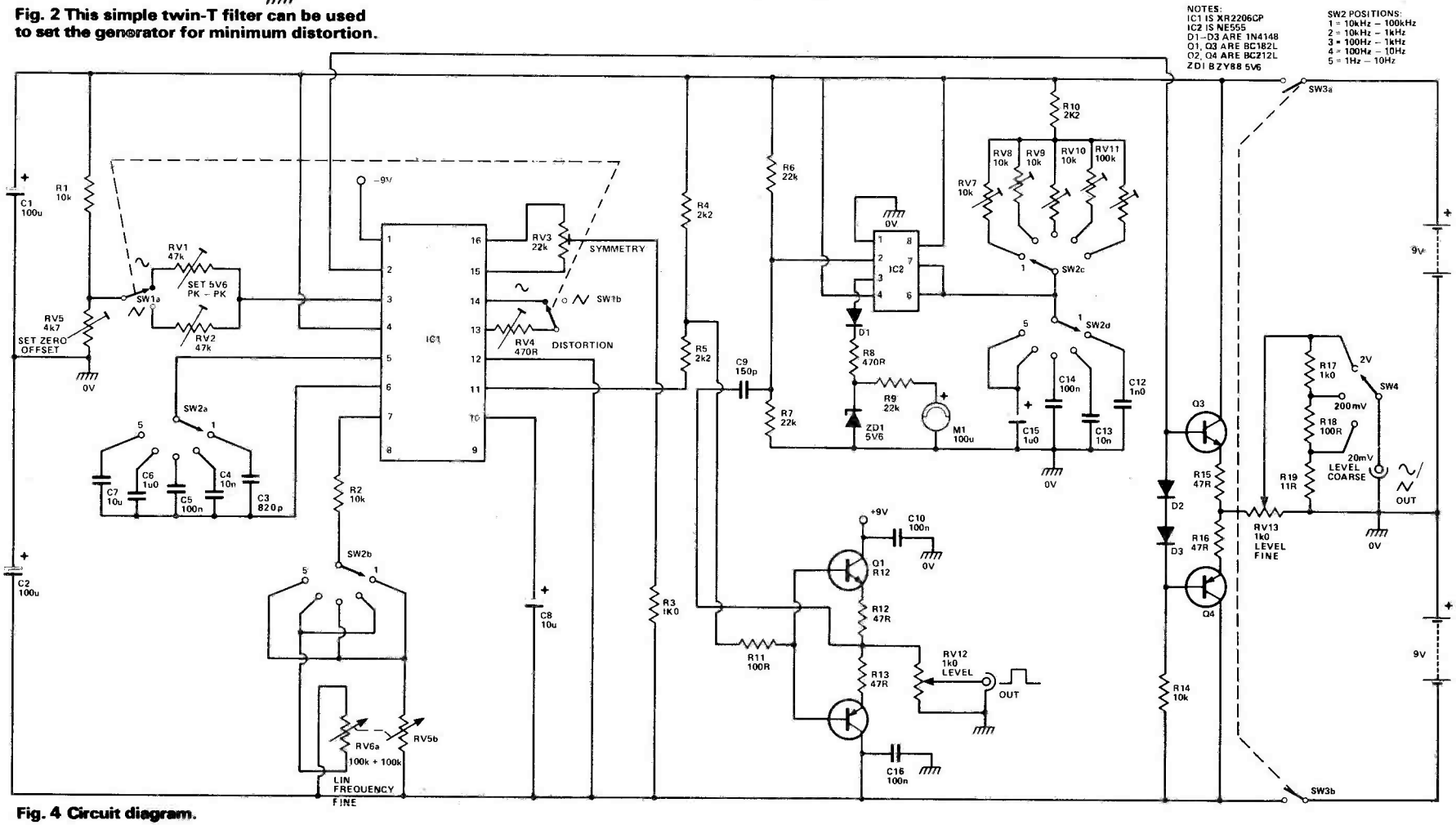


Fig. 4 Circuit diagram.

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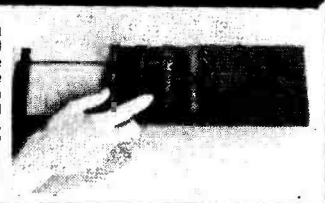

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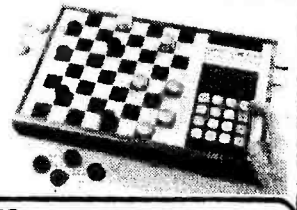

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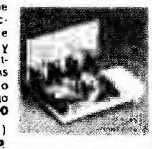

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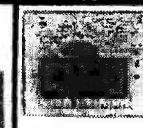

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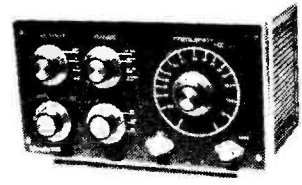

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VFET APPLICATIONS

Is the VMOS power FET a really important device, or a mere flash-in-the-pan? In the next few pages Project Editor Ray Marston appraises the device.

IMAGINE a power transistor that has virtually infinite input impedance, 'beta', and power gain which has a bandwidth extending from DC to 600 MHz and which can switch 1 A on or off in a mere four nanoseconds. Imagine also that this device is immune to secondary breakdown and has a negative temperature coefficient that minimises thermal runaway problems and enables devices to be directly parallelled for increased power handling capability.

The above 'miracle' device already exists, and is readly avaibale at fairly low cost. It is known as a VMOS Power FET. VMOS Power FETs were first introduced by Siliconix in 1976. At that time they were hailed as ''the most revolutionary semiconductor in decades — likely to eliminate bipolars within five years''. Now, three years on, VMOS still hasn't made a great impact on the industrial or consumer market.

What Is It?

The term 'VMOS power FET' stands for 'Vertical structured Metal-Oxide Silicon power Field-Effect Transistor'. Conventioal MOSFETs use the form of construction shown in Figure 1, in which current flows *Horizontally* from source to drain through the channel, which is induced on the top surface of the silicon substrate. This form of structure results in low current densities, poor heat dissipation capabilities, very limited power handling capacity and relatively large chip capacitance.

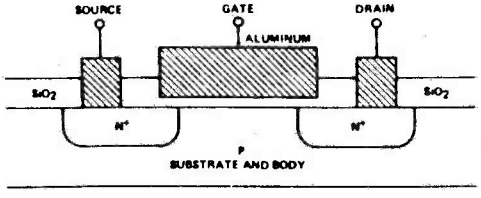


Fig 1. Cross Section of a conventional FET.

VMOS power FETs, on the other hand, use the form of structure shown in Figure 2, in which current flows *vertically* from source to drain. This structure results in high current densities, low saturation resistance, excellent heat dissipation and power handling capabilities, low chip capacitance and excellent wide band performance.

VMOS power FET technology has been pioneered by Siliconix, who currently produce a variety of such devices

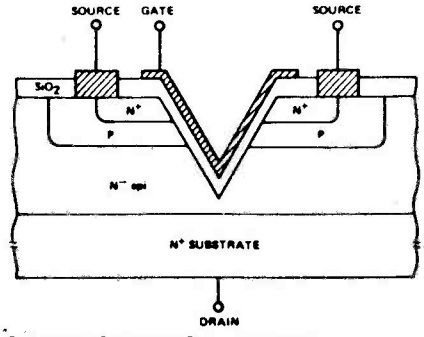


Fig 2. Cross Section of a VMOS power FET.

with maximum continuous drain current ratings ranging from a modest 500 mA up to a hefty 12A5, and with maximum drain-to-source voltage ratings ranging from 35 to 90V. All the products in their present VMOS range are n-channel enhancement-mode devices, in which the source-to-drain path is normally closed but can be opened by applying a positive gate voltage. The gate has a near-infinite input impedance.

A major defect of the existing VMOS technology is that it is not readily compatible with the production of p-channel devices. This factor greatly reduces the devices' attractions in audio power amplifier applications, where calss-AB output stages are currently in vogue.

A more detailed account of VMOS construction and operation theory is given in the July '78 edition of ETI.

Characteristics

Figure 3 shows typical output and saturation characteristics of the type VN67AF VMOS power FET. Note the following points:

1 The device passes negligible drain current until the gate voltage reaches a threshold value of approximately 1 volt The drain current then increases non-linearly as the gate is varied up to approximately 4 volts, at which point the drain current has a value of about 400 mA. The device, in fact, has square law transfer characteritics below 400mA.

2 The device has a highly linear transfer characteristic above 400mA (4V on the gate) and thus offers great potential as a low-distortion class-A power amplifier.

3 The drain current is controlled almost entirely by the gate voltage and is almost independent of the drain voltage so long as the device is not saturated. A point not shown in the diagram is that, for a given value of gate voltage, the

▶

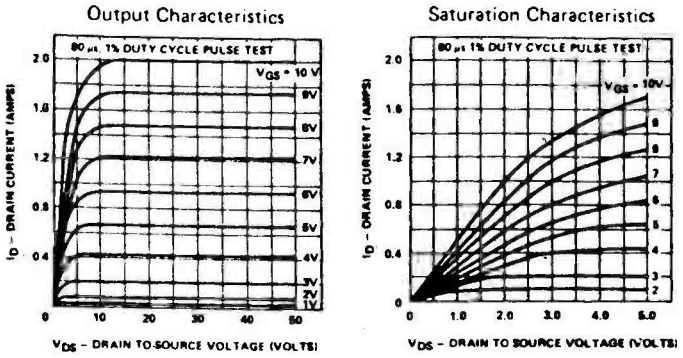


Fig 3. Output and saturation characteristics of the VN67AF VMOS power FET.

drain current has a negative temperature coefficient of about 0.7% per °C so that the drain current decreases as temperature rises. This characteristic gives a fair degree of protection against thermal runaway.

4 When the device is saturated (switched fully on) the drain-to-source path acts as an almost pure resistance with a value controlled by the gate voltage. The resistance value is typically 2RO when 10 volts are on the gate, and 10R when 2 volts are on the gate. The off resistance of the device is in the order of megohms. These characteristics make the device highly suitable for use as a low-distortion high-speed analogue power switch.

Figure 4 shows the circuit symbol and the case outline of the VN67AF, which incorporates a 15V input-protection

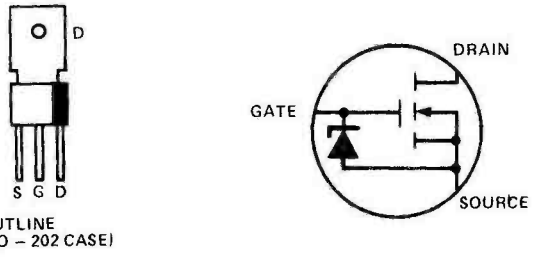


Fig 4. Symbol and outline of the VN67AF.

Zener and Fig. 5 summarises the static and dynamic characteristics of the device. Points to note here are that the input (gate-to-source) signal must not be allowed to exceed the 15V Zenerating of the device and that the device has a typical dynamic input capacitanceof only 50 p: this capacitance dictates the dynamic input impedance of the device. The static input impedace is of the order of a million megohms.

Digital Circuits

VMOS is delightfully easy to use in digital switching and amplifier applications. Figure 6 shows the basic connections. The load is wired between the drain and the positive supply rail and the digital input signal is fed directly to the gate. Switch-off occurs when the input goes below the gate threshold value (typically 1V2). The drain on current is determined by the peak amplitutde of the gate signal, as shown in Figure 3, unless saturation occurs. In most digital applications the on current should be chosen to ensure saturation.

STATIC	Maximum Drain-Source Voltage	60V
	Maximum Drain-Gate Voltage	60V
	Maximum Continuous Drain Current	2.0 A
	Maximum Pulsed Drain Current	3.0 A
	Maximum Continuous Forward Gate Current	2 mA
	Maximum Pulsed Forward Gate Current	100 mA
	Maximum Continuous Reverse Gate Current	100 mA
	Maximum Forward Gate-Source (Zener) Voltage	15V
	Maximum Reverse Gate-Source Voltage	–0.3V
	Maximum Dissipation at 25°C Case Temperature	15W
	Temperature Operating and Storage Range	–40 to +150°C
	Gate Threshold Voltage	0.8V min, 1.2V typical
	Zero Gate Voltage Drain Current	10uA Max at 25°C
	ON-state Drain Current at V_{GS}=10V	1.0A min, 2.0A typical
DYNAMIC	Forward Transconductance	250 millimhos typical
	Input Capacitance	50pF typical
	Reverse Transfer Capacitance	10pF typical
	Common-Source Output Capacitance	50pF typical
	Typical switching times, 25 volt supply 23R load, 0–10V gate drive from a 50R source	Turn-ON Delay 2 nS Rise Time 2 nS Turn-OFF Delay 2 nS Fall Time 2 nS

Fig 5. Summary of the static and dynamic characteristics of the VN67AF.

The static input impedance of VMOS is virtually infinite, so zero drive power is required to maintain the VN67AF in the on or off state. Drive power is, however, required to switch the device from one state to the other. This power is absorbed in charging or discharging the 50p input capacitance of the VN67AF.

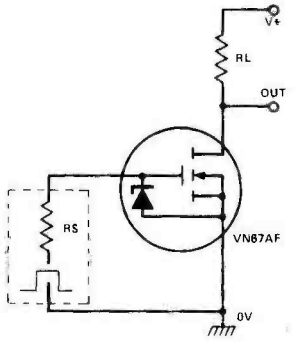


Fig 6. Basic VMOS digital switch or amplifier.

The rise and fall times of the output of the circuit are determined by the source impedance of the input signal, the input capacitance and forward transconductance of the VMOS device and the value of R_L. If R_L is large compared to R_S the VN67AF gives rise and fall times of roughly 0.11 nS per ohm of R_S resistance. Thus, a 100R source impedance gives an 11 nS rise or fall time.

If R_L is not large compared to R_S these times may be considerably changed. A point to note when driving the VN67Af is that it's input Zener forward and reverse ratings must never be exceeded. Also, because of the very high frequency response of VMOS, the device is prone to unwanted oscillations if circuitry is improerly designed. Gate leads should be kept short, or be protected with a ferrite bead or small resistor in series with the gate.

VMOS can be interfaced directly with the output of CMOS, as shown in Figure 7. Rise and fall times of about 60 nS can be expected, due to the limited output currents available from a single CMOS gate. Rise and fall times can be reduced by driving the VMOS from a number of CMOS gates in parallel, as shown in Figure 8, or by using a special high-current driver.

VMOS can be interfaced with TTL (either standard or LS type) by using a pull-up resistor on the TTL output, as shown in Figure 9. The 5 volt TTL output of this circuit is

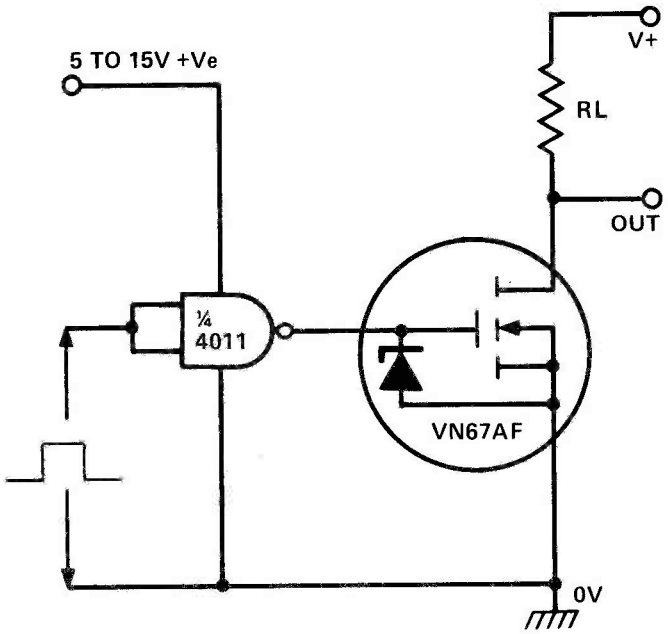


Fig 7. Method of interfacing VMOS with CMOS!

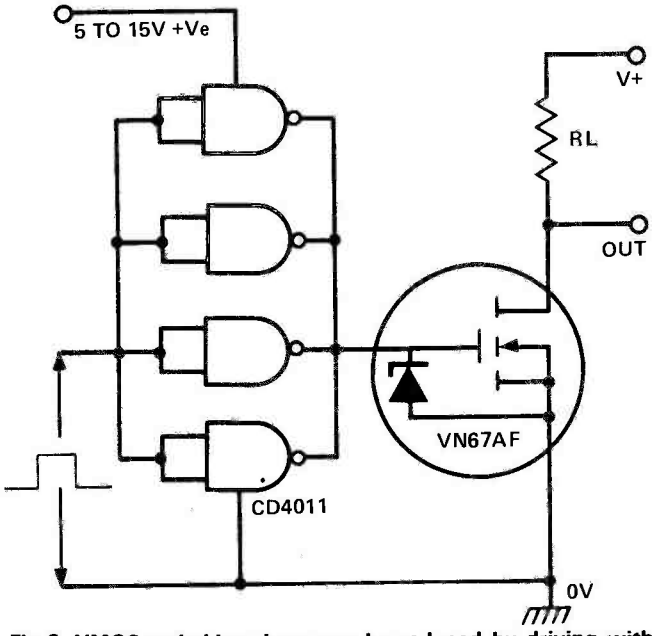


Fig 8. VMOS switching times can be reduced by driving with a number of gates in parallel. Typical R_T = 25 nS.

sufficient to drive 600 mA through a single VN67AF. Higher currents can be obtained either by wiring a level shifter between the TTL output and the VN67AF input, or by wiring a number of VN67AFs in parallel as shown in Figure 10.

Analogue Circuits

VMOS power FETs can be used with relative ease in either the common source or common drain (voltage follower) modes. The voltage gain in the common source mode is equal to the product of RL and the devices gm or forward transductance. In the case of the VN67AF, the device gives a voltage gain of 0.25 per ohm of R_L value, i.e., a gain of 4.0 with 16R load, or a gain of 25 with a 100R load. The voltage gain in the common drain mode is slightly less than unity.

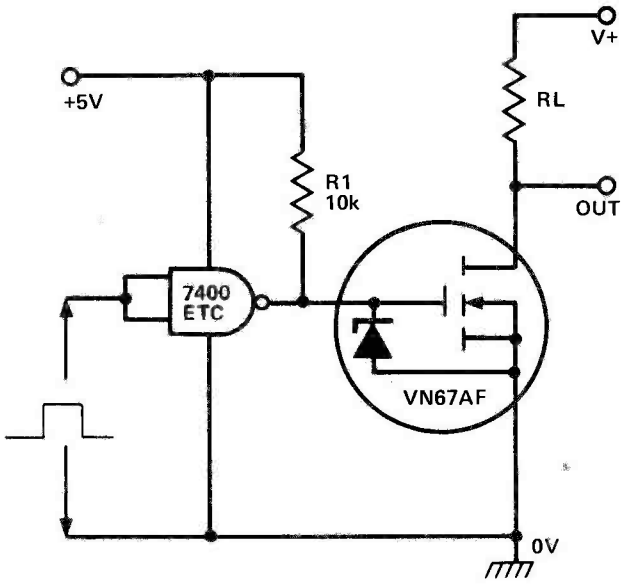


Fig 9. VMOS can be driven from the output of TTL if a pull-up resistor (R1) is used.

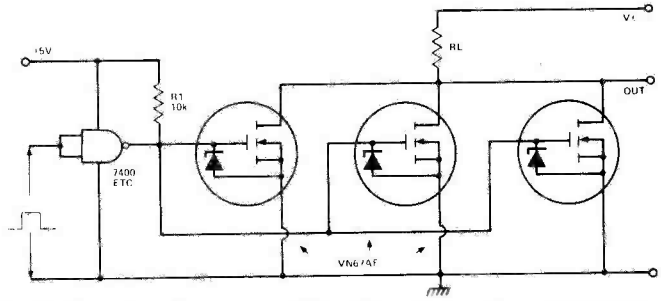


Fig 10. Boosting the output of Fig 9 by driving three VN67AF in parallel.

Fig. 11 shows three alternative basic ways of biasing the VMOS power FET for common source operation. In most practical applications, the device will be biased into the linear mode, with the drain at a quiescent value of approximately $V_{supply}/2$, so that maximal signal swings can be accommodated between the cut-off and saturation clipping levels.

In Fig 11a the gate is biased at a supposedly fixed level by potential divider R1-R2. The input impedance of the circuit is (at low frequencies) equal to the parallel values of R1 and R2. Defects of this simple biasing arrangement are that the voltage biasing level varies with the supply voltage, and the drain current biasing level depends on the characteristics of the individual VN67AF that is used in the circuit. An advantage of the circuit is that the quiescent drain voltage can be biased below that of the gate.

The alternative circuits of Figs. 11b and 11c can be used in cases where the quiescent drain voltage is greater than that of the gate. In Fig 11b, potential divider R1-R2 is fed from the drain of the VN67AF, and DC negative feedback makes the quiescent drain current substantially independent of variations in supply voltage and device characteristics. AC negative feedback also occurs, and reduces the effective input impedance to a value approximating the parallel values of R1 and R2 divided by the voltage gain ($gm \times R_D$) of the circuit.

Figure 11c is a simple modification of the Fig 11b circuit, and results in increased input impedance. R3 is wired ▶

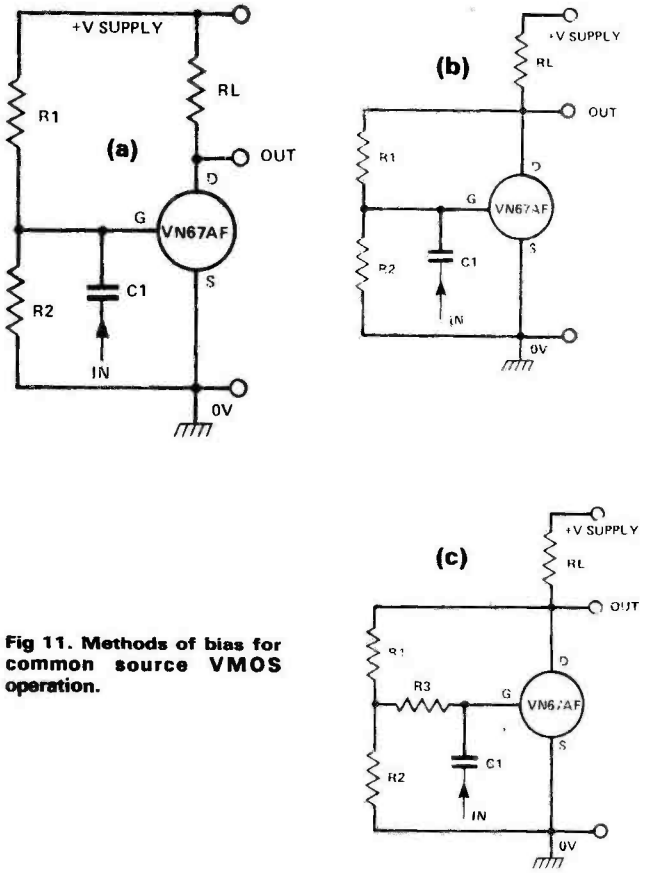


Fig 11. Methods of bias for common source VMOS operation.

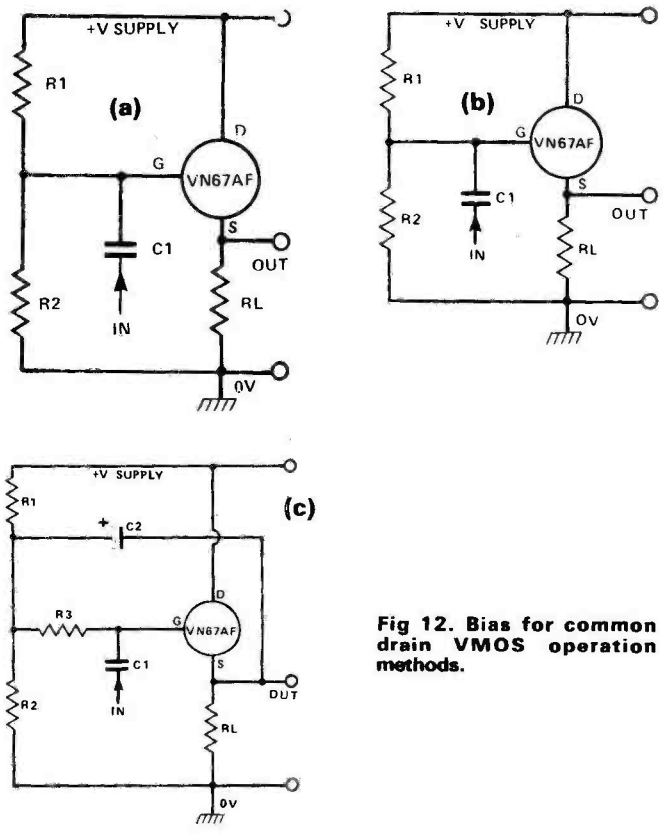


Fig 12. Bias for common drain VMOS operation methods.

between the gate of the VN67AF and the junction of R1-R2. R3 does not effect the biasing of the circuit, but if its value is large relative to that of R1 and R2 it raises the input relative to that of R1 and R2 it raises the input impedance to a value approximating that of R3. If the source impedance of the input signal is low relative to R3, the AC negative feedback effects of the circuit are virtually eliminated and the input impedance is further increased. If. in the Fig 11c circuit, the drain is likely to swing below the desired gate bias level under active conditions, a capacitor can be wired across R2 to preserve stable biasing conditions.

Fig. 2 shows methods of biasing VMOS power FETs for common drain operation. In Fig. 12a the circuit is biased by a simple potential divider (R1-R2), and the source takes up a value a few volts below that of the gate. Because of the inherently high level of negative feedback of this configuration, the resulting bias (quiescent) source/drain current of the circuit is substantially independent of the characteristics of the individual VN67AF that is used. The input impedance of this circuit is equal to the parallel values of R1 and R2.

Figures 12b and 12c show how the input impedance of the basic Fig 12a circuit can be increased. In Fig 12b, R3 is given a value that is large relative to R1 and R2, thereby raising the input impedance to a value approximating that of R3 without effecting the biasing of the circuit. In Fig 12c the value of R3, and thus the input impedance, is effectively increased by a factor of $1/(1 - Av)$ via bootstrap capacitor C2. Thus, if R3 is 10M and Av is 0.95, the input impedance is raised to 20M. If R3 is 1MO and Av is 0.99, the input impedance is raised to 100M. C2 must have the impedance that is low relative to R1 and R2 over the required bandwidth of the amplifier.

Practical Circuits

The best way to get to know VMOS power FETs is to experiment with them in a few practical circuits. With this in mind, Figs. 13 and 22 show a few simple designs that you can play with. All of these circuits are based on the VN67AF, which typically costs less than a pound in one-off quantities.

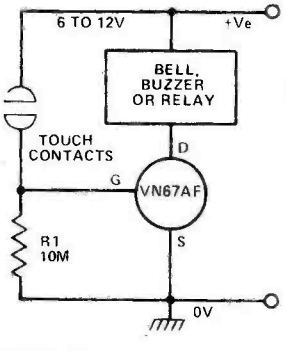


Fig 13. Touch switch.

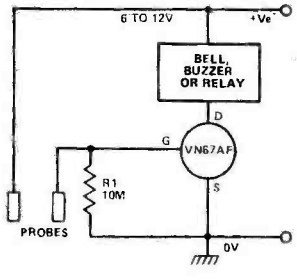


Fig 14. Water switch.

Figs, 13 and 14 couldn't be simpler. When the contacts/probes are open, zero volts are on the gate of the VN67AF and the device passes zero current. When a resistance (zero to tens of megohms) is placed across the contact/probes (by contrast with skin resistance, water, etc), a substantial gate voltage is developed by potential dividier action and the VN67AF passes a high drain current.

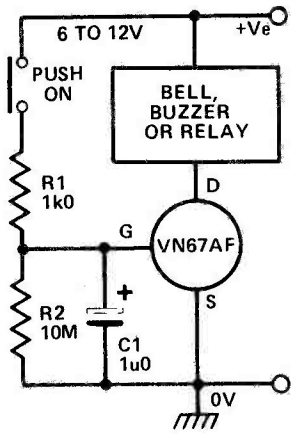


Fig 15. Delay turn off switch.

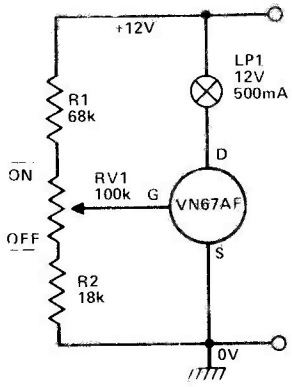


Fig 16. DC lamp dimmer.

In the Fig. 15 circuit, C1 charges rapidly via R1 when S1 is closed and discharges slowly via R2 when S1 is open Thus, the load activates as soon as S1 is closed, but does not deactivate until some tens of seconds after S1 is released.

Figs. 16 to 18 are lamp control circuits. In Fig. 16 the drain current and lamp brightness is controlled via RV1. In

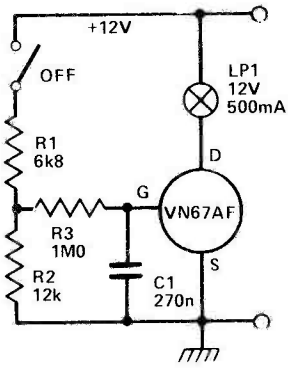


Fig 17. Soft-start analogue lamp switch.

Fig. 17 the lamp turns on slowly when the switch is closed as C1 charges up via R3, and turns off slowly when the switch is opened as C1 discharges via R3.

The Fig. 18 circuit is a highly efficient 'digital' lamp dimmer. The two 4011 gates are connected as an astable

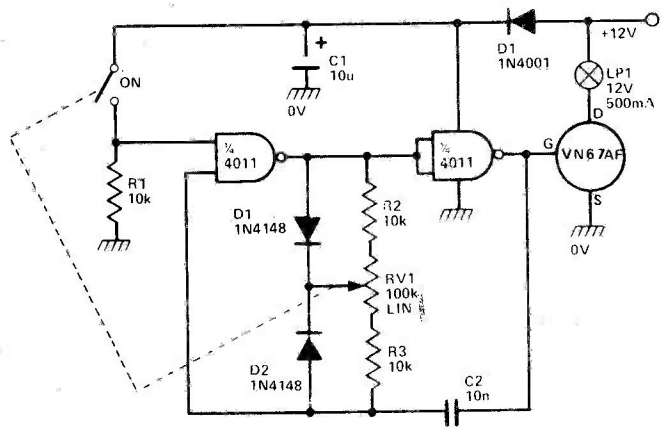


Fig 18. Digital DC lamp dimmer.

multivibrator that has a mark/space ratio that is variable from 10:1 to 1:10 via RV1, and has it's output fed to the gate of the VN67AF, thereby enabling the 'mean' lamp

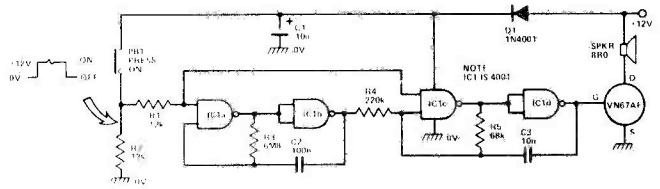


Fig 19. Warble-tone alarm (2 tone output).

brightness to be varied from virtually full-off to full-on.

Fig. 19 is an inexpensive but very impressive alarm-cell generator circuit that produces a police-like 'dee-dah' sound. The alarm can be turned on by closing PB1 or by feeding a 'high' voltage to the R1-R2 junction. The circuit is used with an 8RO speaker, and generates roughly 6 watts of output power.

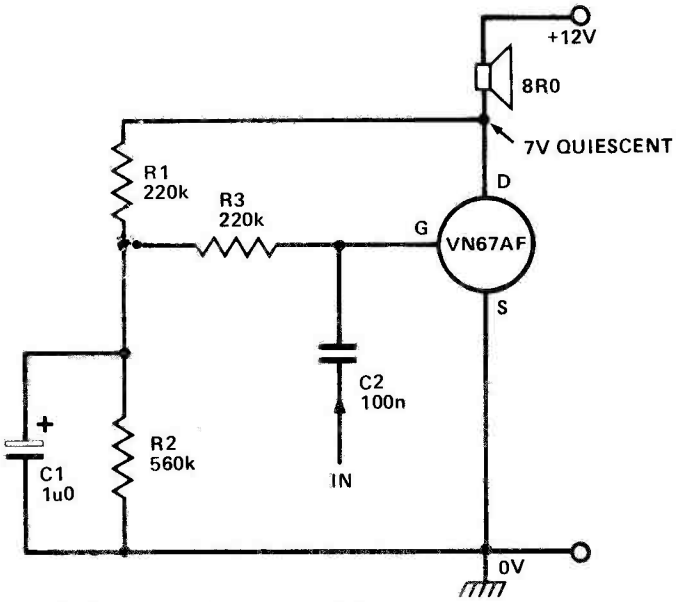


Fig 20. Super simple class-A amplifier.

The Fig. 20 class-A power amplifier gives an incredibly impressive performance, but is very inefficient. The VN67AF must be mounted on a decent heat sink. Since the amplifier is used in the class-A mode, it produces a valve sound output. Because of the excellent linearity of the VN67AF, the apparent distortion of the amplifier is remarkably low. When used with 8RO resistive load, the amplifier has a bandwidth that extends up to 10 MHz.

The Appraisal

VMOS is undoubtedly a remarkable technology with many great advantages over conventional bipolar technology. Latest reports indicate that at least five major semiconductor companies other than Siliconix are now actively researching into or actually manufacturing VMOS power FETs, so that technology is clearly not just a 'flash in the pan'. Each of these companies is apparently developing it's own particular version of the technology and preliminary reports indicate that the Siliconix technology is still way ahead of the competition in most areas (switching speeds, device linearity, high voltage rating, etc.).

Siliconix are expected to announce a 400 volt 8 amp device, which can switch 8 amps in less than 100 nanoseconds, within the next few months. They already have a 65 volt 8 amp 100 watt device on the stocks that can give a 10 dB gain at 175 MHz. ▶

The simple circuit of Fig. 21 makes an excellent radio control or CW transmitter output stage. The L1-C2 and L2-C3 values must be chosen to suit the required operating frequency.

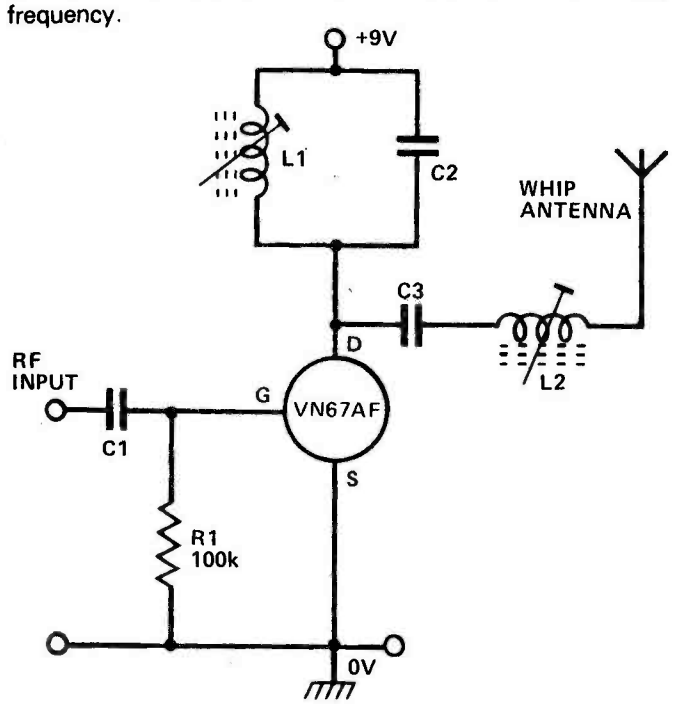


Fig 21. 60mW R/C or CW transmitter L1-C2 is tank circuit, C3-L2 is the antenna circuit.

Finally, Fig. 22 shows the basic circuit of a 20-watt class-D audio power amplifer using a pair of VN67AF's. We hope to publish a practical version of this circuit in ETI in the near future, so keep your eyes open.

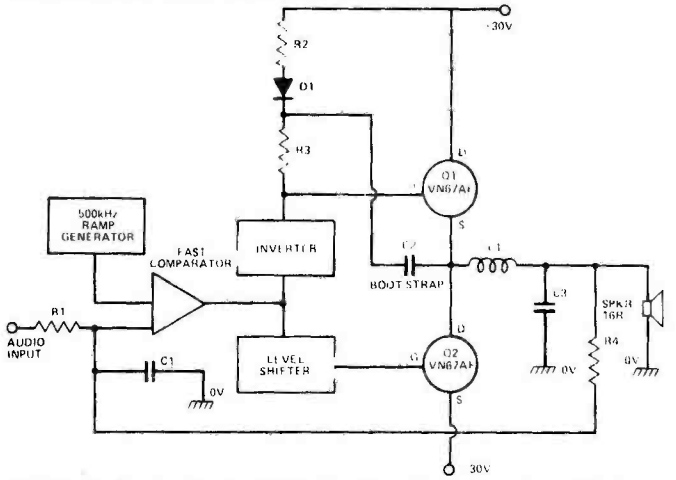
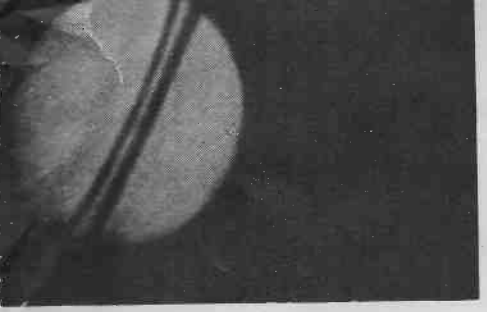
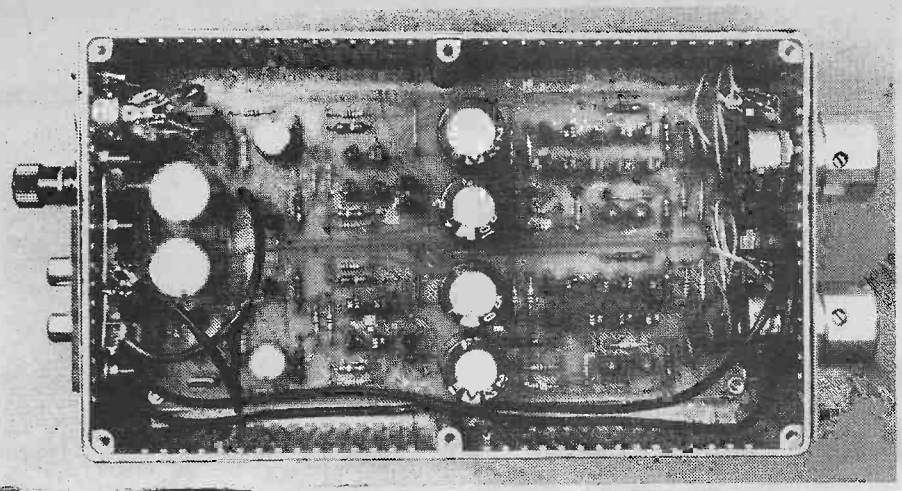


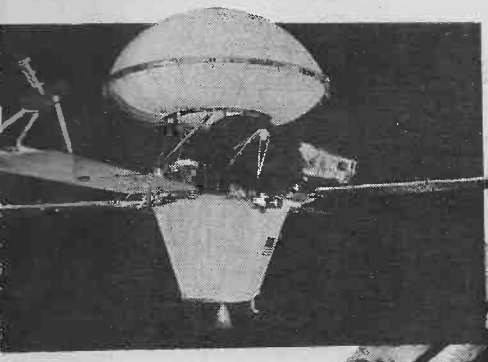
Fig 22. Basic circuit of a 20W clas-D switched-mode audio power amplifier. An ideal application for VMOS.

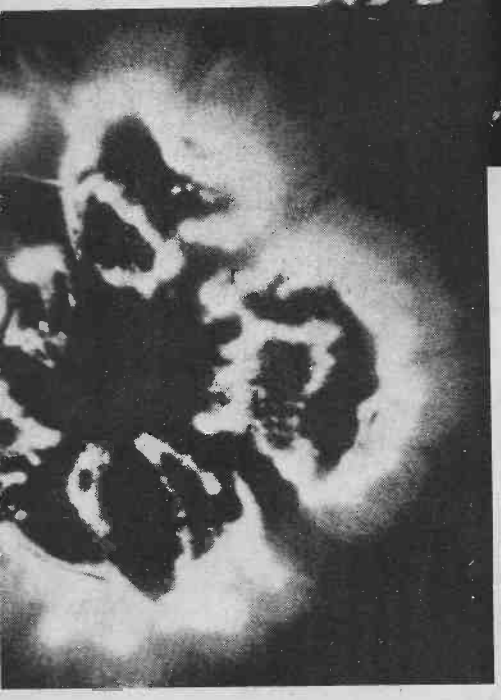
The only criticism that we've been able to make against the Siliconix VMOS power FET technology concerns the present total lack of p-channel devices. Our spies tell us, however, that Siliconix are already working on that problem, and will have it beaten within a year. If that is so, we reckon that the 1976 prediction that "VMOS may eliminate bipolars within five years" could still come true.

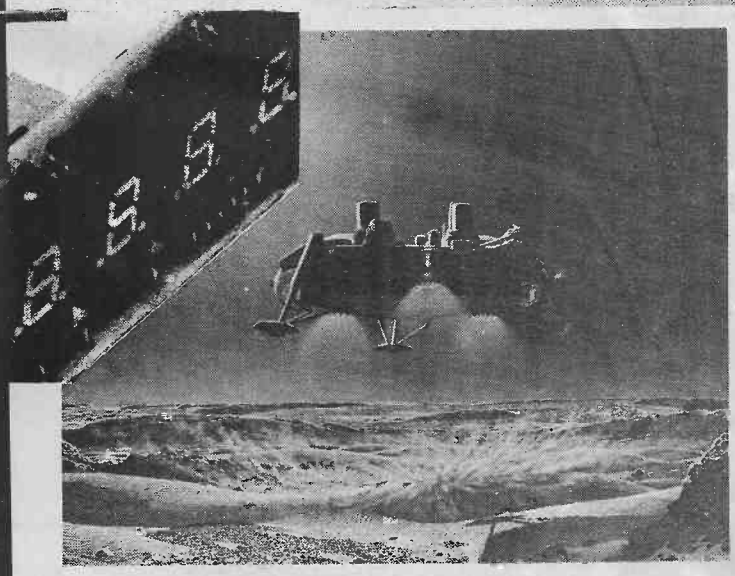
In the meantime, we at ETI are already 'sold' on VMOS, and plan to use a good deal of it in the coming year. We reckon that once you've started using it, you'll like it as much as we do. ETI







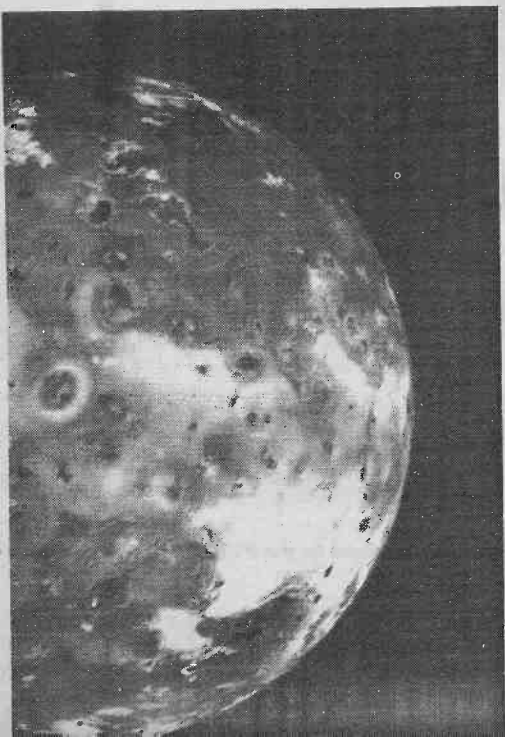




electronics today international

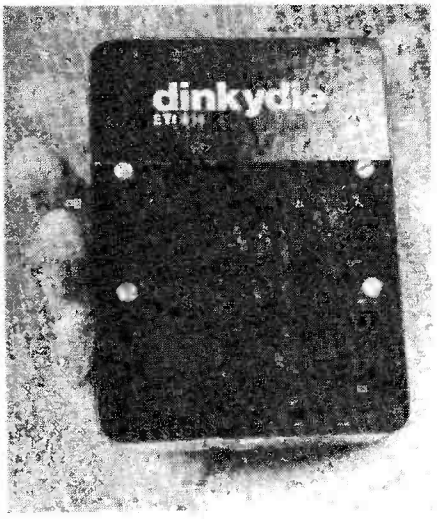
January issue on sale December 7th

Containing constructional details of five projects including a superb DIGITAL FREQUENCY METER and a very hi-fi MOVING COIL PREAMP. Amongst the usual array of brilliant features you will find KIRLIAN PHOTOGRAPHY full explained and DEEP SPACE PROBES beautifully detailed. Miss a single page and you will weep long into the cold winter nights.



DIE

Liven up your Ludo with the ETI Dinkydie. Throw away that Block of wood with dots on and bring your board games into the twentieth century.



Fed up with shaking rattling and rolling that boring set of wooden dice? Need something to brighten up that game of which the kids have grown tired?

We've spent some time designing this little project – an example of just how difficult it can sometimes be to get something 'just right': As few components as possible, all the desirable features, no obscure parts and nice low price for the constructor.

Operation couldn't be simpler: To 'throw' the dice, touch two fingers across one set of screw heads seen either side of the front panel in the picture here. Your 'throw' then appears in a dice pattern on the LEDs behind the perspex.

To throw again, touch the pair of screw heads once more.

If you leave the dice 'un-thrown' for a few seconds, the display fades and the circuit switches itself off, drawing only a miniscule current in its quiescent state.

Mount all the components on the board, placing the LEDs last. These should be spaced off the board by about 3 mm so to ensure that they are the highest components. If the bolts are level no spacers are needed as they can be tightened just enough to hold the LEDs hard against the perspex. If you wish, a piece of block cardboard may be cut to cover the other components to obscure the board.

Once the board is assembled the battery clip and battery may be connected and the device tested. Once bolted in the nuts on the underside of the board should be quickly soldered to the pads to ensure good contact. To complete the assembly the bottom of the case can be screwed in, and the battery jammed in place with a small piece of foam rubber or styrofoam. (Use the bit the CMOS IC's came in perhaps). Finally, if you fear for the coffee table top, four adhesive rubber feet on the bottom would be a good idea? ETI

BUYLINES

All the components used in the Dinkydie should be readily available from your favourite mail order supplier.

PARTS LIST

Resistors all ¼W, 5%

R1	2M7
R2,7	10k
R3	100k
4	56k
R5	4k7
R6	70k
R9-R11	270R
R12	330R

Capacitors

C1,C2	33u 10V tantalum
C3	10n polyester

Semiconductors

D1	1N914
LED1-LED7	Red LEDs, TIL220R
Q1,Q2	BC558
Q3-Q6	BC548
IC1	4011B
IC2	4029B

Miscellaneous

Case 9V battery clip, glue, four 6BA nuts and 20 mm bolts. PCB.

An LED sandwich — make sure the LED's are the highest components on the PCB.

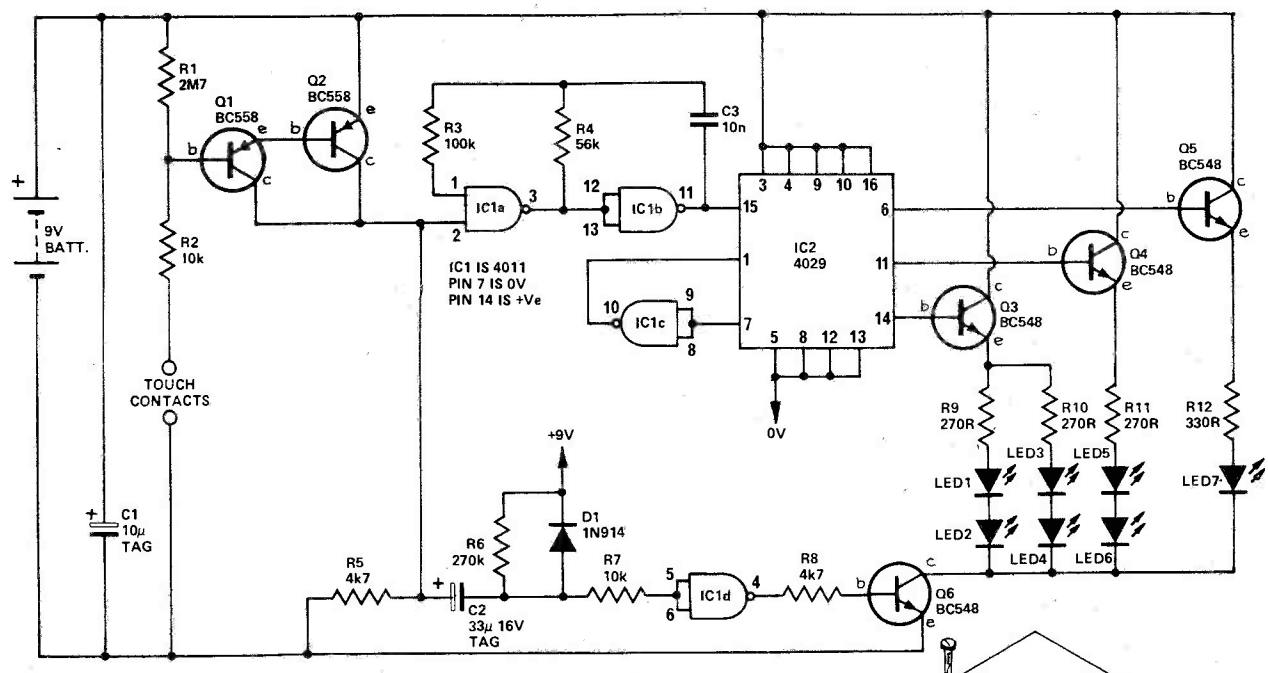


Fig.1. Circuit diagram.

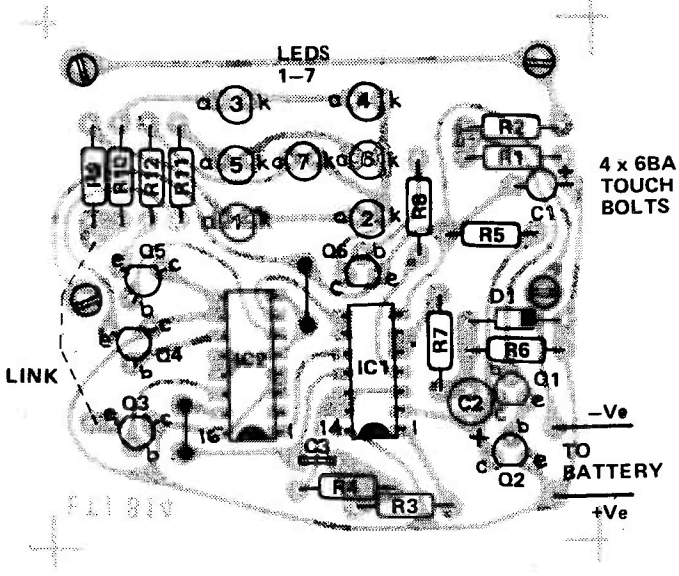


Fig.2. Component overlay.

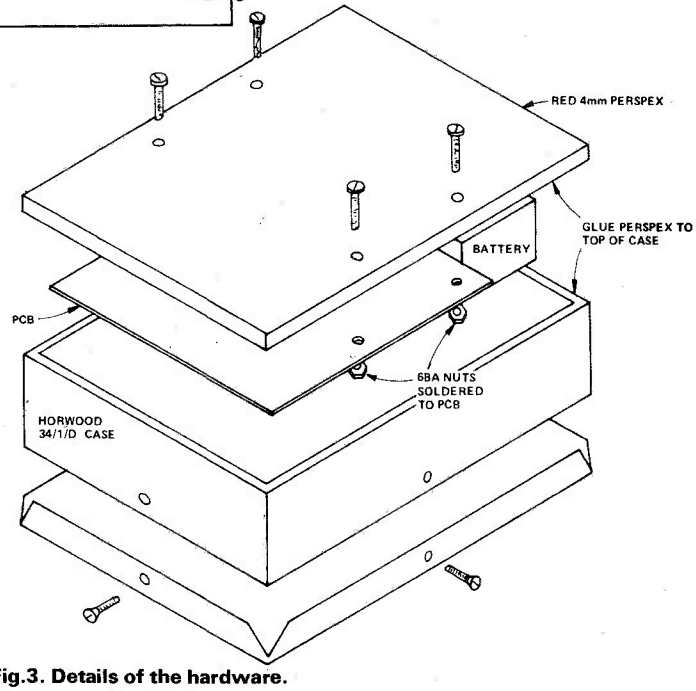


Fig.3. Details of the hardware.

HOW IT WORKS

This device simulates a single dice 'die electronically by illuminating LEDs in a die face pattern after you have held your fingers on two sensor contacts for a period to 'throw' the dice. The device operates by counting pulses from a free running astable multivibrator, hence the number finally displayed is defined by the duration of the touch.

As the quiescent current is well below 1uA, no power switch is used.

Initially, Q1 and Q2 are biased off. The astable multivibration, formed by IC1a and b, is disabled and the display driver Q6 is also off. When the sensor contacts are touched, a small leakage current flows into the base of Q1/Q2, which form a Darlington pair, and the collectors go high.

This has two effects. Firstly, the astable multivibrator made up of two nand gates (IC1a and b) is enabled and clocks the counter, IC2, at about 1 kHz. Secondly, C2 is discharged via D1, in preparation for initiating the display delay period. The duration of the touch defines the number which results, but the clock is sufficiently fast to prevent any form of cheating.

When the touch contacts are released the clock stops and the inputs of IC1d are pulled low. The gate is connected as an inverter, and the output thus sources current to Q7 which enables the display by pulling the LED cathodes low. The contents of counter IC2 are thus displayed in die-face format by the LEDs. When C2 recharges to above the threshold of IC1d via Q5 the display fades. Quiescent current is well below 1uA, so no power switch is required. The "all ones" state (i.e. 1111) is detected by the carry output and causes 1001 to be loaded by the parallel load input, IC1c does the required logic inversion for the parallel load function.

DIODES/ZENERS

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

SOCKETS/BRIDGES

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

TRANSISTORS, LEDS, etc.

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

9000 SERIES

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

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

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

C MOS

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

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QTY.		QTY.		QTY.		QTY.	
7400	.20	7492	.45	74H20	.25	74LS76	.70
7401	.20	7493	.35	74H21	.25	74LS86	.95
7402	.20	7494	.75	74H22	.40	74LS90	.85
7403	.20	7495	.60	74H30	.30	74LS93	.85
7404	.20	7496	.80	74H40	.35	74LS96	2.00
7405	.35	74100	1.15	74H50	.30	74LS107	.90
7406	.25	74107	.35	74H51	.30	74LS109	1.50
7407	.55	74121	.35	74H52	.20	74LS123	1.95
7408	.20	74122	.55	74H53	.25	74LS138	2.00
7409	.25	74123	.55	74H55	.25	74LS151	.95
7410	.20	74125	.45	74H72	.35	74LS153	1.15
7411	.25	74126	.45	74H74	.35	74LS157	1.15
7412	.25	74132	.75	74H101	.95	74LS160	1.15
7413	.45	74141	.90	74H103	.55	74LS164	2.90
7414	.75	74150	.85	74H106	1.15	74LS193	2.00
7416	.25	74151	.95	74L00	.30	74LS195	1.15
7417	.40	74153	.95	74L02	.30	74LS244	2.90
7420	.25	74154	1.15	74L03	.35	74LS259	1.50
7426	.25	74156	.70	74L04	.40	74LS298	1.50
7427	.25	74157	.65	74L10	.30	74LS367	1.95
7430	.20	74161/9316	.75	74L20	.45	74LS368	1.25
7432	.30	74163	.85	74L30	.55	74LS373	2.50
7437	.20	74164	.75	74L47	1.95	74S00	.45
7438	.30	74165	1.10	74L51	.65	74S02	.45
7440	.20	74166	1.75	74L55	.85	74S03	.35
7441	1.15	74175	.90	74L72	.65	74S04	.35
7442	.55	74176	.95	74L73	.70	74S05	.45
7443	.45	74177	1.10	74L74	.75	74S08	.45
7444	.45	74180	.95	74L75	1.05	74S10	.45
7445	.75	74181	2.25	74L85	2.00	74S11	.45
7446	.70	74182	.75	74L93	.75	74S20	.35
7447	.70	74190	1.25	74L123	1.95	74S22	.55
7448	.50	74191	1.25	74LS00	.40	74S40	.30
7450	.25	74192	.75	74LS01	.40	74S50	.30
7451	.25	74193	.85	74LS02	.45	74S51	.35
7453	.20	74194	.95	74LS03	.45	74S64	.15
7454	.25	74195	.95	74LS04	.45	74S74	.70
7460	.40	74196	.95	74LS05	.45	74S112	.60
7470	.45	74197	.95	74LS08	.45	74S114	.85
7472	.40	74198	1.45	74LS09	.45	74S133	.85
7473	.25	74221	1.50	74LS10	.45	74S140	.75
7474	.30	74298	1.50	74LS11	.45	74S151	.95
7475	.35	74367	1.35	74LS20	.45	74S153	.95
7476	.40	75491	.65	74LS21	.45	74S157	.98
7480	.75	75492	.65	74LS22	.45	74S158	.80
7481	.85	74H00	.20	74LS32	.50	74S194	1.50
7482	.95	74H01	.30	74LS37	.45	74S196	2.00
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7489	1.05	74H10	.35	74LS51	.75		
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LM309 (340K-5)	1.50	LM339	.75	LM380 (8-14 Pin)	1.19
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LM311 (8-14 Pin)	.75	LM340T12	.95	LM711	.45
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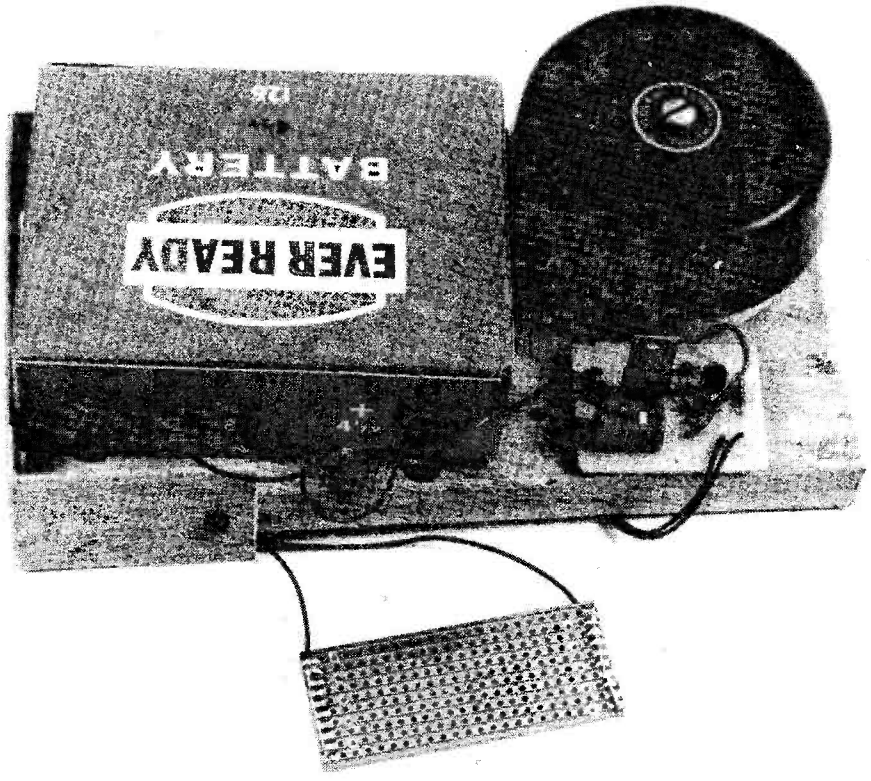
RAIN ALARM

Don't get wet feet, don your wellies and come and see the Rain in Spain fall Mainly on the ETI Rain Alarm. - By George, we've got it!

Have you ever been tied up with other jobs, such as polishing the furniture, doing the washing up, etc while your washing is out drying on the line? Then, just as you are finishing your present chore you look out of the window and see that the heavens have opened on your nearly dry washing. Well, this happens virtually every Monday (being washing day) to the ETI Project Team and we were just about getting fed up with it . . . .

. . . .so we had a conference!

It became apparent, after we had looked in the piggybank and found we didn't have enough for a second-hand tumble dryer, that we should do something constructive (for a change). We decided that even we couldn't design a machine to stop it raining on Mondays (though officially we won't admit it) so the alternative was the ETI Rain Alarm, which, at the vaguest hint of rain, will ring out loud and clear so that the pots and pans can be dropped while we run outside and fetch in the washing from the line. ▶



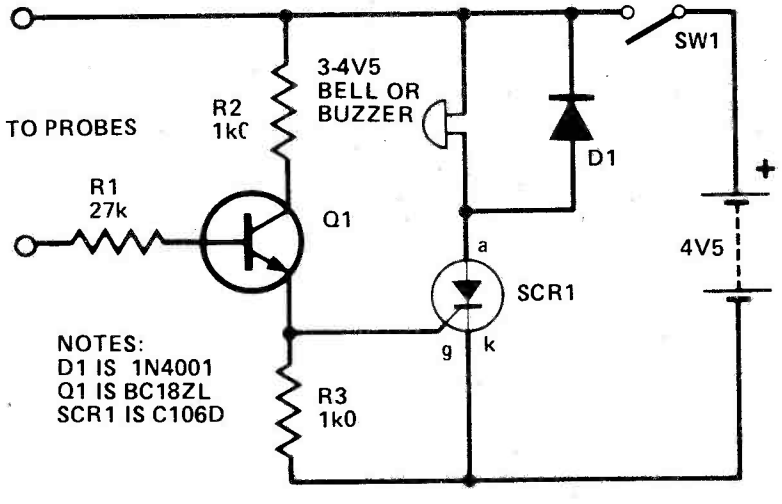


Fig. 1. Circuit diagram.

HOW IT WORKS

The heart of the rain alarm lies around the thyristor SCR 1 which switches the bell or buzzer on. Normally, in D.C. mode a thyristor is switched on by a small gate current. It will not switch off however, until the voltage applied across the whole device reduces to near zero, at which point it will remain off until the voltage at the gate increases enough to switch it on again.

When used with a make and break device such as a bell or buzzer the applied voltage momentarily decreases to zero at whatever frequency the bell or buzzer is operating at. This will in turn, switch off the SCR. This gives us a non-latching D.C. switch, operated by applying a small D.C. voltage to its gate.

Q1 provides switching action in that as the resistance across the probes decreases from infinity to a comparitively low value (ie. as rain falls on them) then the voltage across R3 increases from near zero to above the threshold voltage necessary to switch SCR1 on.

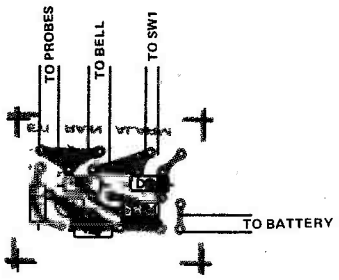


Fig. 2. Component overlay.

PARTS LIST

RESISTORS All ¼W, 5%
R1 27k
R2,3 1k0

SEMICONDUCTORS
Q1 BC182L
D1 1N4001
SCR1 C106D

MISCELLANEOUS
SW1 SPST switch
3–4½V Bell or buzzer 4½ volt battery.
Small piece of stripboard

BUYLINES

All parts should be easily obtainable from your local stockists. However, any of the mail order firms advertising in ETI should be able to help, if you are stuck.

Of course detecting rain to keep your washing dry needn't be its only function. Anywhere a device to detect the presence of water is required, then the Rain Alarm will do it. It takes only minimal current when in standby mode so can quite happily be left on for long periods without significantly battery wastage.

Construction

As the whole rain alarm only contains seven components, including the on/off switch, it fits very neatly onto a small PCB only about 1 inch by 1½ inches (or 25 mm by 40 mm if you have already been metricated by the vet). In fact, the 4½ volt bell battery is by far the biggest item in the project.

The construction of the circuit on our PC layout will present no difficulties — just take care that the semiconductors are inserted correctly. Use a printed circuit mounting switch for SW1 if you can obtain one — it makes a neater job, but if not, any SPST switch will do.

The probes in our prototype were constructed from a small piece of commercially available stripboard, the two leads soldered to alternate copperstrips, providing an interleaving of the copper. Any small drop of water landing on the copper side of the stripboard will automatically bridge at least two of the strips, therefore operating the alarm.

And, now that you have finished the ETI Rain Alarm, you can go — in the words of the immortal and legendary Gene Kelly (Ray's hero) — Ringing in the Rain.

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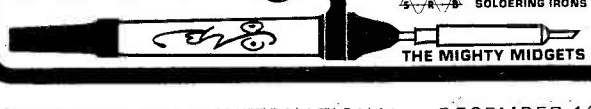

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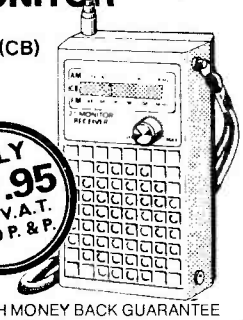

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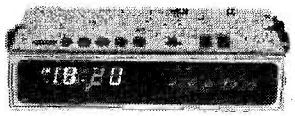

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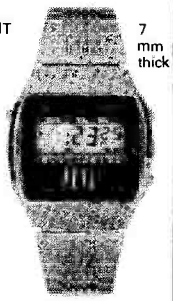

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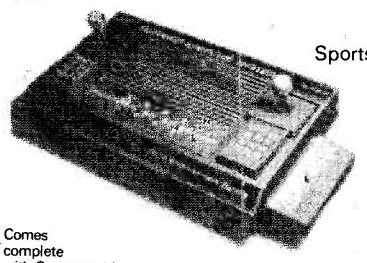

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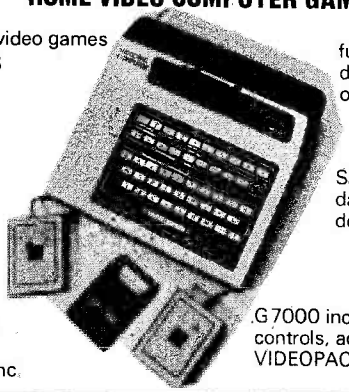

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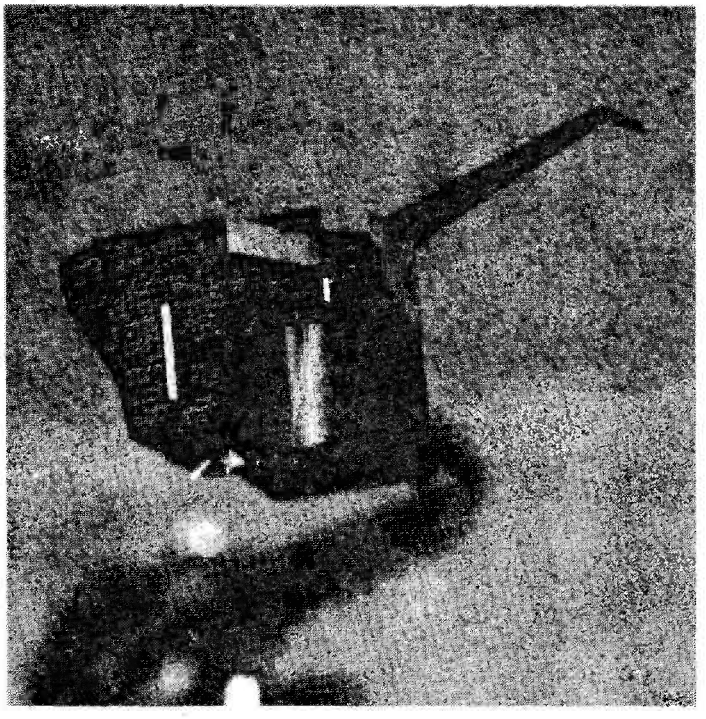
AUDIOPHILE

Having spent a month coiled up with a lump of Coral (well each to his own) Ron Harris presents a review of the new MC81 pick up.



IT has been a month of musical evenings. The television has remained off, the soldering iron cold, the wargames unplayed and the books unopened. Meanwhile the power amp glows red in the night and my neighbours have taken to wearing ear defenders and shaking their fists at my approach.

Ah, the fools, they know not the delights they scorn. . . .

You see. I have been playing a lot of records this month, all due to this MC81 device I mentioned when last you read Audiophile. They should put a warning on the side of the box — "This cartridge can seriously damage your social life."

At first glance it is a most unimpressive blob of black plastic, but that in itself brought to mind something someone once told me about not covering judges with books — or something like that anyway.

Book Covers

Being of the moving coil strain, the Coral MC81 needs a head amp, or pre-pre-amp as some people with stutters persist in calling them, to increase the voltage level to around 3mV in order that a normal RIAA input can process the signal.

The unit designed to work with the MC81 in this manner is the H300, which possesses a few unusual points itself. There *are* head amps on the market which will work with the majority of cartridges, but none are totally satisfactory with all. The best of these is possibly the Sony HA55, (which is mains powered). The H300 has a variable input impedance facility which suggests that it too is aimed this way and it will be interesting to see if it gains acceptance on the end of cantilevers other than the MC81. I confess I did not audition it any other way myself, but I will get around to that. . . .

Back to the cartridge. It weighs a puny 5g, but is surprisingly large for this weight as you can see from the photos. Set up in the SME III the Coral tracked most material happily at 1.8g, and took everything (just!) at 2.0g. The damping option on the SME should be exercised, although the fluid may need thinning for best results.

One good point about the cartirdge body itself is that the top is sensibly large and flat — allowing for a large contact area with the headshell and thus good mechanical coupling between the two. At least it *would* do if the SME headshell was long enough!

Coiled Up

Initially I had the MC81 operating through a HA55, while the H300 was getting over its birth pains and into this cruel world. In this configuration the cartridge worked well, but I was less than happy with the lowest bass registers. The mid-range, however, came as a revelation. It was crystal clear and sharp and 'opened out' relative to the other cartridges I was comparing with it (Coral's own 777EX and the Entré 1). Treble quality was all I'd hoped for, being both accurate and extended without either emphasising surface noise or wielding that steel edge with which some moving coils cut through the music. I was impressed!

I was further beguiled once I had the MC81 and H300 operating together, a combination which went a long way to taking the ground from under my objections to the bass. It was never that the unit lacked bass at all, but that I had a feeling that the level was down upon what I would have expected. ▶

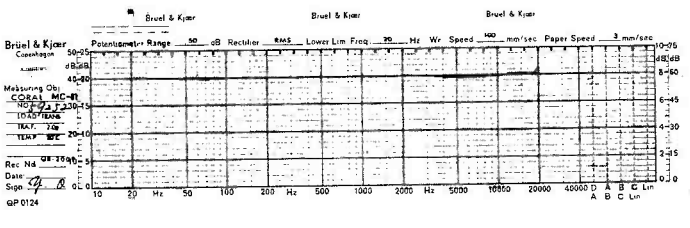


Fig. 1. Frequency response of the MC81. If you can't see it that's because it's so straight it's hidden behind the graph paper. What happened to all those nice dips and peaks reviewers could have such fun commenting on?

Bass *quality* was immaculate. Each instrument, bass guitar, drum, double bass or whatever was clearly and precisely identified and distinguishable. If you think that's easy, try it with your own cartridge — now — can you absolutely distinguish the different notes from a bass guitar for instance? Is the bass drum in full possession of it's transients?

As regards this aspect the Coral has the *best* bass I've heard and I'm not prepared to trade that quality back in for a bit more quantity of a less than equal pedigree.

Timely Decision

Running through an evening of the best recorded LPs I had soon convinced me that any initial unease I had experienced was groundless. Direct comparison between the V15 IV, the Entré an FR1 and the MC 91 led to others being employed in ever shorter bursts and, before the day was through, left alone.

In each comparison there were differences. The FR1 had a 'sweeter' mid-range but *not* the incredible detail. The Shure had for more bass signal present but *not* the attack and the Entré just didn't measure up at all — with either or any head amp.

In fact it was probably the V15 IV's slight bass emphasis that had led me up the garden path in the first place.

Talking Of Heads

Consider the H300 for a moment. The input of this device has variable gain and variable capacitance facility. Loading can be switched from 5000p to 20000p in steps of 5n. Gain can be switched up from 23-30dB.

Both these are controlled by DIL switch banks on the front of the PCB, but can only be accessed by removing the front panel entirely. That same panel contains the power switch and 'charge' light.

The H300 takes its electrons from a Ni-Cad source, and when switched off the batteries go on trickle charge. It takes (say Videotone) twelve hours to deplete the storage — I didn't fancy staying awake long enough to get an accurate figure — and forty eight hours to replace the power once used up. The charge light (LED) comes on when the box is switched off, a changeover relay diverts the input from a separate mains adaptor to the charger. This same relay operates as a switch-on delay system to prevent a 'thump' which is potentially dangerous to amp, ears and cones.

Unfortunately this relay doesn't seem to work on switch off and I got a loud 'whoop' if I did things in the wrong order! It could all lead to a flat cell and no music tonight, Josephine.

All in all, even weighing the advantages of reduced hum and lower source resistance (hence less RF interference etc), I think I prefer a plain mains supply with the extra costs that infers.

Still the H300 system works, and works well. The head amp sounds very fine indeed, and on audition proved indistinguishable from the Sony HA55 at a fraction of that unit's cost.

Full marks for circuit design and final performance Videotone but the grumble on supply you'll have to live with — it's an odd solution albeit one that works.

System Round-Up

Taken together the MC81/H300 system is an impressive and exciting new pickup system. The cartridge is well-nigh excellent and does not entail a second mortage on the

Above: the H300 sat sitting between the MC81 in SME dressing and an ACI it fed. Small is it not?

mortage to afford it, like some Oriental Offerings I could name (It costs about £90 in the shops).

The H300 sounds very healthy indeed, but has that quirky PSU arrangement. This should give no trouble but does not make life as ''thought-free'' as it could. (Cost circa £60).

I would heartily recommend anyone interested in a new cartridge to head for an MC81 with open ear, and try and get a good listen.

If Felicity Kendal was interested, I'm sure I could find SOMEONE willing to extend the hospitality of his hi-fi for an evening or two (thousand!).

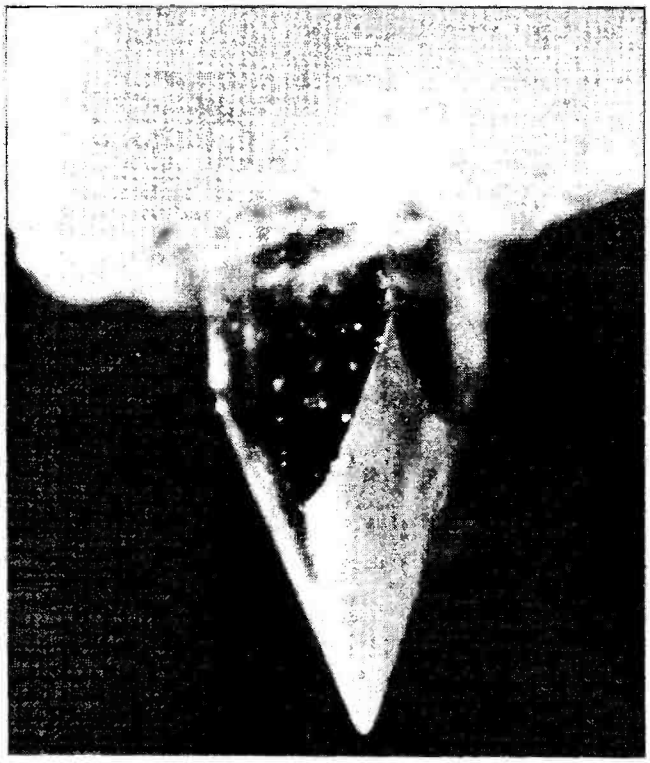
A Gold Ring To It?

The point on the right has a point to it. A very strange shaped point—but a point nonetheless, a Van den Hul point in fact. After many months of trial and tribulation Goldring have fitted said sharp bit to a cantilever for their new G900IGC pick-up cartridge.

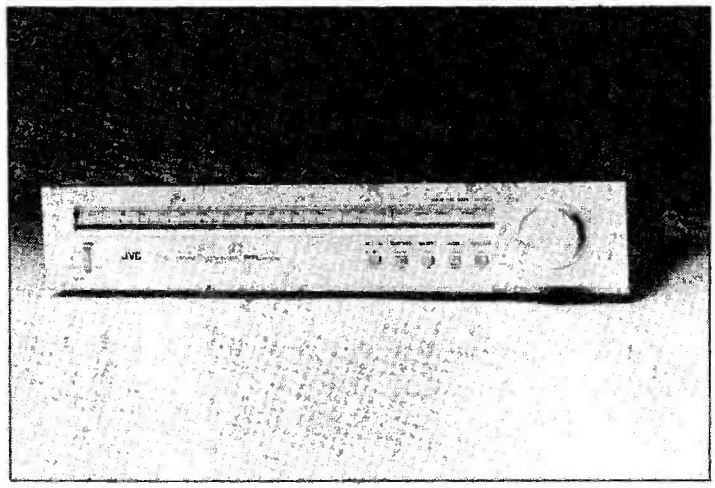
To all things under heaven there is a season, eh?
Welcome to the pickup season. After the Coral cometh the IGC and lo, music was bountiful upon the ears of Man and he heard that it was good.

The new G900 is claimed to exhibit greatly reduced distortion when compared to either a conventional ellipital point or the Shibata variation upon the theme. This is claimed to be due to the straight line of contact between stylus and groove and the smaller minor radius of the Van den Hul design.

The finish and presentation of the cartridge is superb, but up to now I haven't had a chance to listen to my sample at all. So once again its next month folks . . .



Above: the point of Goldring's new G900IGC is easily seen.



Tuning In JVC

Interesting looking new tuner from JVC, the TX5, features their award winning Phase Tracking Loop detector stage. Naturally PTL is claimed to improve everything from AM objection to sliced bread — and judging by the details I've seen could be Wonderloaf are in for a hard time.

The TX5 also has two patented ideas incorporated — a 'quieting slope' control which acts as a sort of signal sensitive noise reducer, and a new tuning system. The price is around £250. ETI

STEVENSON
Electronic Components

CMOS

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

FULL DETAILS IN CATALOGUE!

TTL

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

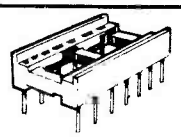
OPTO

	0.125in.	0.2in	each	100+
LED's				
Red	TIL209	TIL220	9p	7.5p
Green	TIL211	TIL221	13p	12p
Yellow	TIL213	TIL223	13p	12p
Clips	3p	3p		

DISPLAYS

DL704	0.3 in CC	130p	120p
DL707	0.3 in CA	130p	120p
FND500	0.5 in CC	100p	80p

SKTS



Low profile by Texas

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

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

PCBS

VEROBOARD

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

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

RESISTORS

Carbon film resistors. High stability, low noise 5%

E12 series. 4.7 ohms to 10M. Any mix

	each	100+	1000+
0.25W	1p	0.9p	0.8p
0.5W	1.5p	1.2p	1p

Special development packs consisting of 10 of each value from 4.7 ohms to 1 Megohm (650 res) 0.5W £7.50. 0.25W £5.70.

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

TRANSISTORS

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

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1N4001	4p	1N5401	13p
1N4002	4p	BZY88 ser.	8p

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4.7, 6.8, 10uF @ 25V	13p
22 @ 16V, 47 @ 6V, 100 @ 3V	16p

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0.068, 0.1	4p

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0.15, 0.22	7p
0.33, 0.47	10p
0.68	14p
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			22	33	47		7p
	100						13p
			220				20p
25V	10	22	33	47			5p
	100						8p
		220					10p
				470			15p
	1000						23p

CONNECTORS

JACK PLUGS AND SOCKETS

	screened	unscreened	socket
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3.5mm	9p	14p	8p
Standard	16p	30p	15p
Stereo	23p	36p	18p

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2pin	7p	7p	7p
3pin	11p	9p	14p
5pin 180°	11p	10p	14p
5pin 240°	13p	10p	16p

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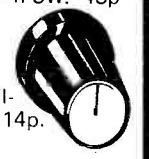

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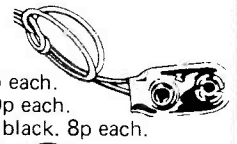

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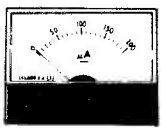

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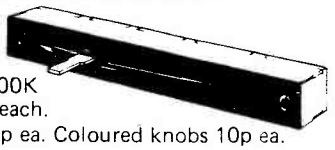

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7441	70p	74132	75p	74199	150p	4069	20p	LM309K	140p	NE562B	420p	TBA560C	240p	XR4212	150p
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7445	100p	74141	70p			4075	25p	LM324	70p	SAS560	155p	TBA750Q	200p	95H90	800p
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HUM FILTER

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Our natty notch filter cuts the moronic mains monotone down to size.

The magnetic field around the transformer in the power amplifier can couple to the preamp or tape deck. Also, the location of nearby 240V mains wiring can cause problems that can be very difficult to overcome. In theory, if the equipment and leads have been properly shielded and earthed this problem shouldn't exist. In practice it's a very different story.

This project aims at overcoming some of the problems of mains induced hum by using a notch filter at the hum frequency of 50 Hz. At this frequency any signal present will be attenuated. At frequencies either side of the notch the response should return to the unattenuated input level.

The 'Q', or Quality Factor, of a tuned circuit — which the RC network in this circuit forms, determines the bandwidth, or narrowness, of the amplitude response of the circuit (see the diagram). As this circuit forms a notch filter, the Q of the circuit determines the narrowness of the notch.

With a high-Q notch the frequency response of the circuit will dip suddenly around the notch frequency. Frequencies a little either side of the notch centre frequency will be little affected. If the Q is low, frequencies some way either side of the notch frequency will be attenuated. The actual attenuation at the notch frequency is greater with a high-Q circuit than with a low-Q circuit.

High-Q circuits have the disadvantage that slight changes in component values, due to temperature changes etc, will affect the centre frequency. Tuning of the circuit to frequency is also quite critical. Lower-Q circuits do not suffer

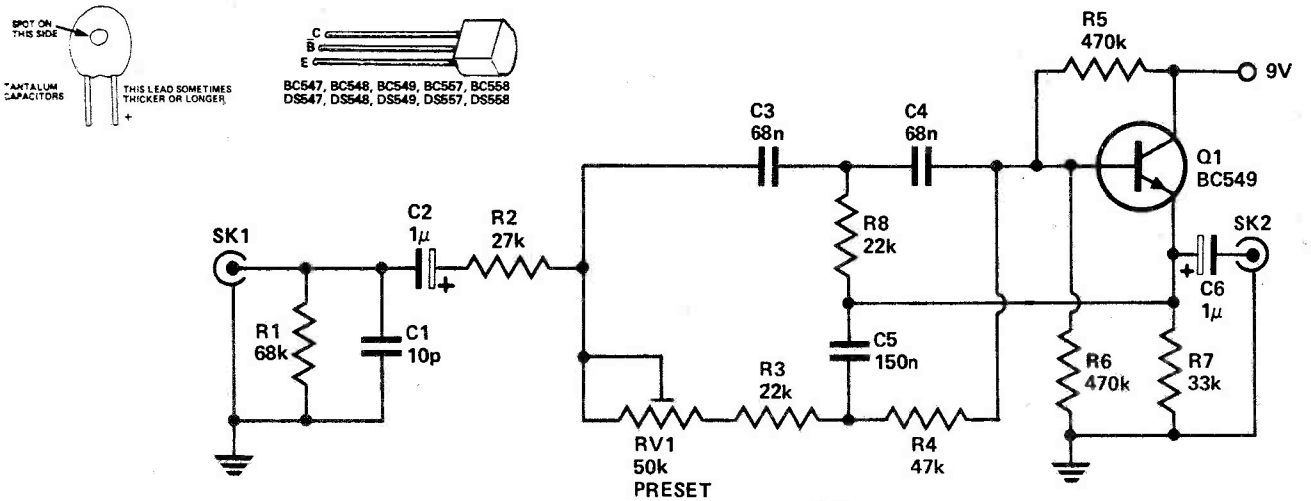


Fig.1. Circuit diagram of one channel of the hum filter.

so much from this disadvantage.

The design Q chosen for this project was a compromise between the constraints of critical tuning and drift effect and good attenuation at the notch with little affect on nearby frequencies. Peak attenuation at the notch centre frequency of 50 Hz is around 80 dB while attenuation of only 3 dB is obtained at 40 Hz and 58 Hz. There is some audible effect on the bass response of a system, but this is minimal.

Construction

Mount the resistors and capacitors on the board first. Be sure the orientation of the tantalum capacitors is correct. These are polarized and can only be installed one way round. Next, install the preset pot. Finally, solder the transistor in place.

The circuit is run from a single nine volt battery. The current consumption of the prototype was 200 uA so the battery life should be good for several months. If it is found that battery life is not long enough a power switch could be fitted.

The filter can be used almost anywhere in the amplification chain since its overload margin is very high (typically 8 V p-p). It should obviously be placed after the point where the hum is being picked up. If the hum is in the turntable and the magnetic phono input of the amplifier since the input impedance is 47 k shunted by 10 pF, which should suit most magnetic cartridges.

Once the filter is in place, the presets are adjusted so that the hum is brought to a minimum by adjusting each channel independantly.

HOW IT WORKS

The circuit consists of a "Twin-T" notch filter formed by capacitors C3, C4 and C5 and resistors R3, R4, R8 and preset PR1.

The operation of the Twin-T requires that $C_3 = C_4 = C_5$

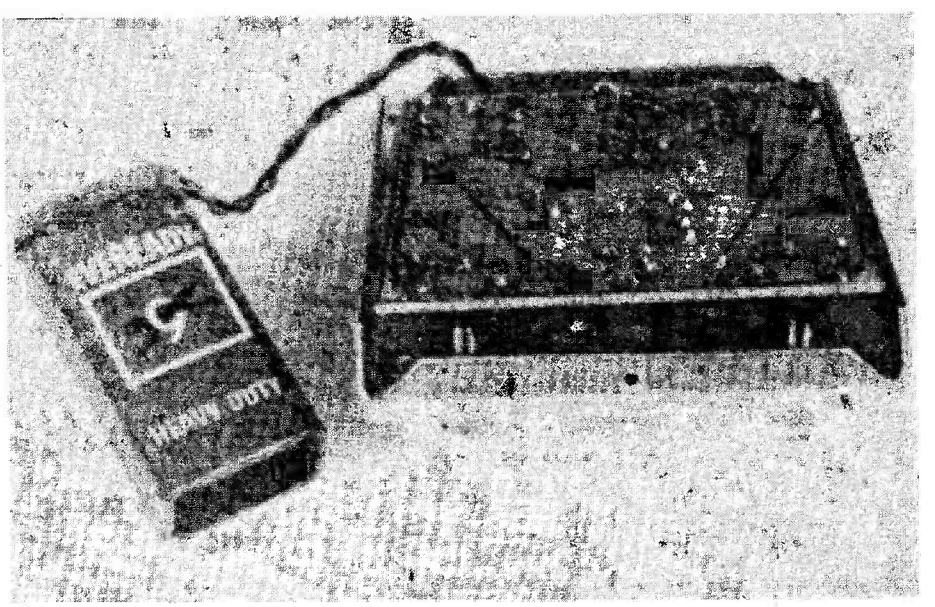
and $R_3 + PR1 = R_4 = 2R_8$

These conditions must be met with reasonable accuracy if a good, deep notch is to be obtained. The preset corrects to a certain extent for errors due to component mis-match and assumes that the notch can be adjusted to the exact frequency of the hum to be rejected.

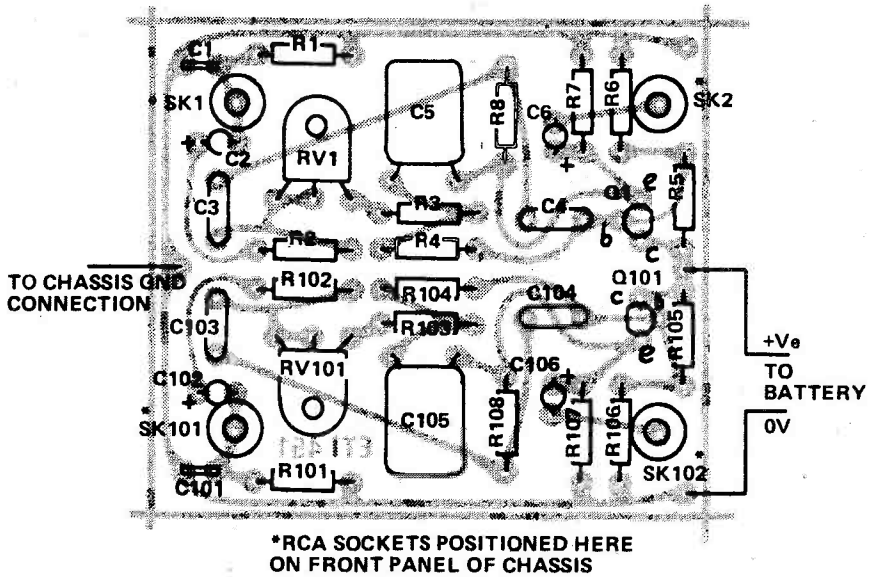
The frequency of the notch is then given by

$$f = \frac{1}{2\pi R_4 C_4 \sqrt{2}}$$

The transistor is operating as an emitter follower, giving zero voltage gain, but providing feedback int the notch to increase the Q to acceptable limits.

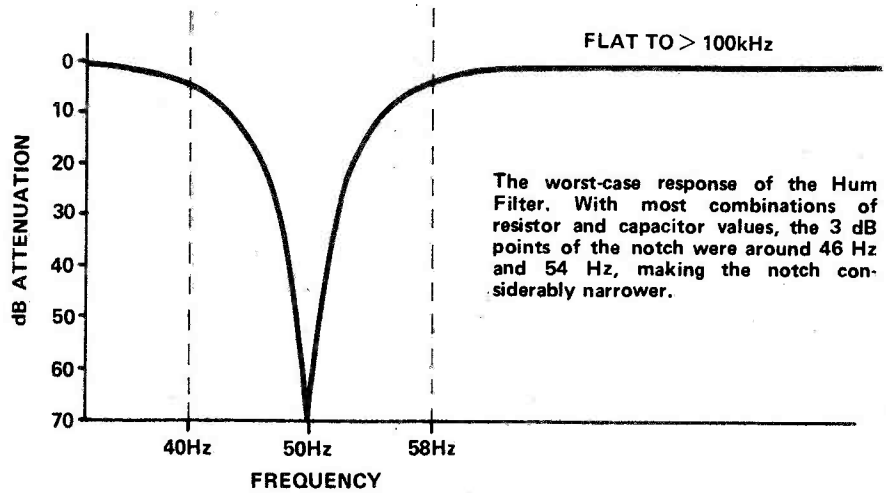


The finished PCB fitted to the front panel, with the battery on flying leads.

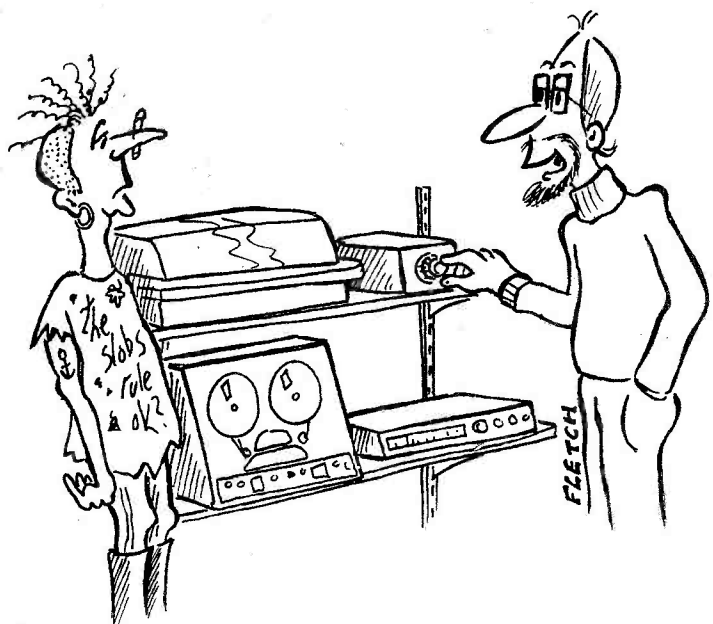


*RCA SOCKETS POSITIONED HERE ON FRONT PANEL OF CHASSIS

Fig.2. Component overlay.



The worst-case response of the Hum Filter. With most combinations of resistor and capacitor values, the 3 dB points of the notch were around 46 Hz and 54 Hz, making the notch considerably narrower.



"IT'S A GREAT HUM FILTER - WON'T LET ANY PUNK ROCK THROUGH AT ALL!"

PARTS LIST

Resistors all ¼W, 5%
- R1,R101 — 68k
- R2,R102 — 27k
- R3,R103,8, 108 — 22k
- R4,R104 — 47k
- R5,R6,R105, R106 — 470k
- R7,R107 — 33k

Capacitors
- C1,C101 — 10pf ceramic
- C2,C102,6, 106 — 1u tantalum
- C3,C4,C103, C104 — 68n polyester
- C5,C105 — 150n polyester

Potentiometers
- RV1,RV101 — 50k min preset

Semiconductors
- Q1,Q101 — BC549, BC109

Miscellaneous
- ETI 451 PCB; box to suit, 4 panel mounting.

Components for 100 Hz operation
- R4,R104 — 22k
- R8,R108 — 10k

Replace R3 with wire link.

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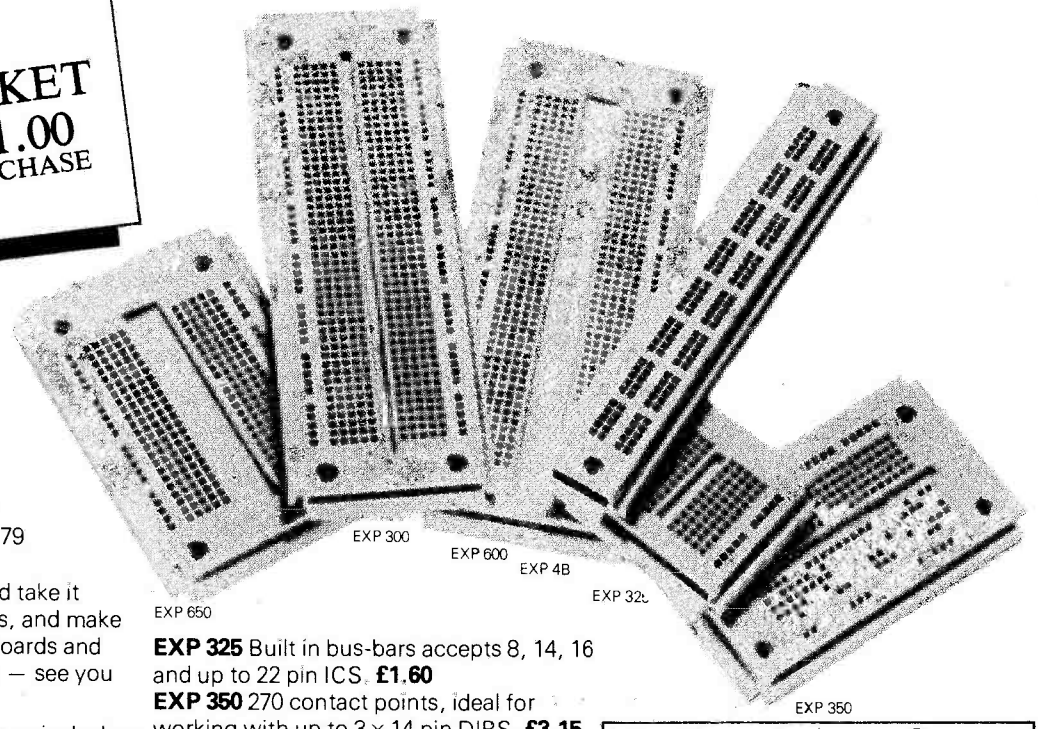

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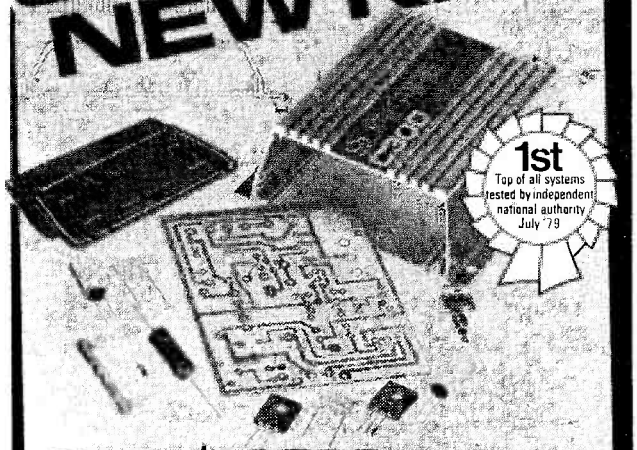

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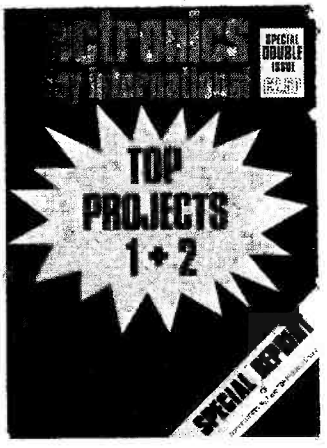

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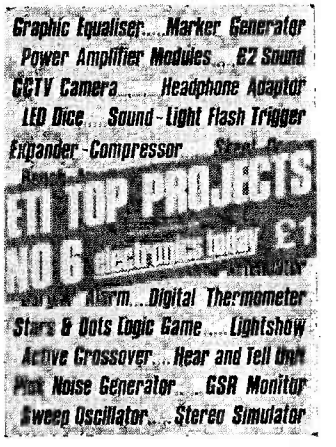

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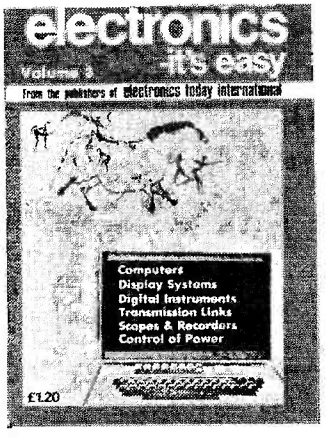

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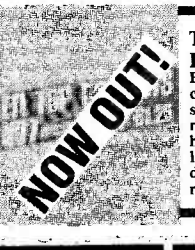

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from ETI

RAVEN ON...

This month Dave Raven, of Metac Electronics, has a bash at crystal gazing into the future of computers and delves into chip reliability.

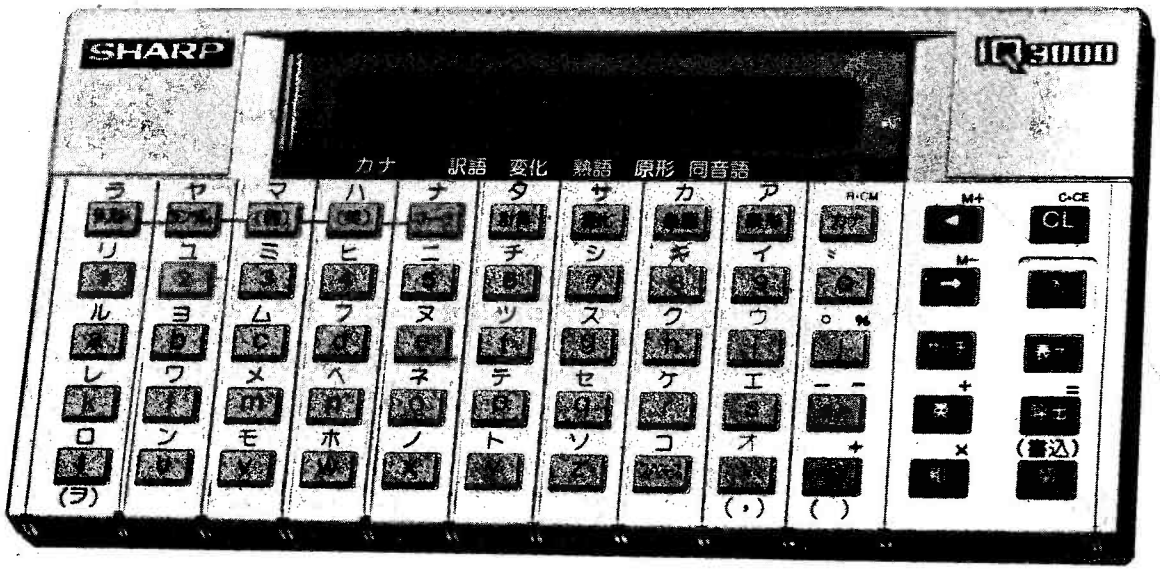
Predicting the future in electronics is a regular feature of TV and the press with "Tomorrows World" and newspaper features on technology. People not involved in science probably have difficulty believing the forecasts since they are quite often so far outside what we already understand.

Home computers and Robotics are two areas which receive quite a lot of attention since they are predicted to be areas which will have major effects on the ways in which we work and live. At a recent symposium held in France by a computer manufacturer, experts assembled to discuss the future. It was predicted that there will be at least four major computer revolutions during the 1980s. The component processors revolution forecast for 1979/80 begins with the basic building blocks for computers and communication systems, large scale integration and very large scale integration of devices, hardware, intelligent machine products, people appliances, digital automation products, communications ICs and intelligent data communication satellite systems. All this resulting in components becoming the end product.

Phase two will begin 1981/83 with the Component Computer revolution. This will provide intelligent data management systems and communications subsystem components with the machine/computers becoming just components. Carrying on in 1983/85 we should have the component memory age. This kicks off with the basic building block for information systems, distributed memory, a system component revolutionising communications, information appliances, a data base computer and knowledge based systems. This results in memory becoming components and offices becoming portable machines. Phase four brings the component systems revolution forecast for 1985/88. The component systems will further revolutionise our institutions leading to the end of the main frame computer and allow factories to become machines. The era will be the "system on a wafer technology", communications will substitute for travel and buildings and an information society will emerge. Computers become components and factories become machines. Computer evolution is increasing tenfold every decade and chip technology at 100x/decade while innovation is going at 1000x/decade.

Robots for Robots

People amplifier appliances, the knowledge based system and robots. In the 1990s we can expect intelligent robots, androids and world linked robots. Also, would you believe worker/slave robots for robots. If you find a credibility gap emerging between yourself and the prophets of the future it may be of interest to read this extract from The Times of January 28th 1926 — "Members of the Royal Institution and other visitors to a laboratory in an upper room in Frith Street, Soho, on Tuesday, saw a demonstration of apparatus invented by Mr J. L. Baird. For the purpose of the demonstration the head of a ventriloquist's doll was



manipulated as the image to be transmitted through the human face was also reproduced, first on a receiver in the same room as the transmitter and then on a portable receiver in another room. The visitors were shown recognisable reception of the movement of the dummy head and a person speaking. The image transmitted was faint and often blurred, but substantiated a claim that through the 'televisor' as Mr Baird has named his apparatus, it is possible to transmit and reproduce instantly the details of movement and such things as the play of expression on the face."

The Cathode Ray tube was of course still only a suggestion made back in 1907 by Cambell Swinton in England and Boris Rosing in Russia. So far, though, this suggestion had produced no satisfactory system of television.

Global Games

Electronic home entertainment equipment is largely imported into the UK from Japan and Hong Kong. Some items are made in Taiwan and South Korea. However, these two countries have stronger links with America. Several European firms have set up manufacturing in special export zones in India which have very attractive tax benefits. Both Philips and Rank Radio are in India, also many other companies have goods manufactured in the Far East with their own brand name on. Hong Kong is particularly strong in exporting to England due mainly to our colonial ties. Goods from Hong Kong have been much maligned over the years for low quality probably due to the cheap plastic toy image they are best known for. Early electronic products were of varying quality but since this new technology was not completely debugged it was not only Hong Kong that had problems (reference UK made TV games, calculators and electronic watches).

The high failure rate of electronic goods at the onset of production is nearly always caused by the chip. The low yields of TV game, calculator and watch chips is well documented but as usual the problems are eventually solved and the yield dramatically improves. Now with calculators, TV games and many watch chips the producer just cranks the handle and out they come by the bucketful.

Nipon Word Box

Having referred to the possibility of an electronic dictionary last month it is not surprising that one has now appeared, such is the speed of development in electronics. Made in Japan this time by Sharp it will be going on sale next month.

It features 48 kilobytes of read-only meory together with logic and display control circuits. The liquid crystal display is in dot-matrix and this enables it to run for about 1,000 hours on three silver-oxide batteries.

The dictionary is for Japanese-English, English-Japanese and is intended primarily for Japanese people learning English. It has a central processing unit, two display-control chips and four 12-kilobyte ROMs encoded with a total of 2,500 English words, 300 English compounds and 5,000 Japanese words. Conjugations of English verbs are provided and the dictionary form can be called up from another tense at the push of a button. One further novel feature is a test key for checking the spelling of an English word with a reply of "good" or "wrong". It can also process incorrect or incomplete information. If a user tries to translate "speake" the display will respond with "speak?"

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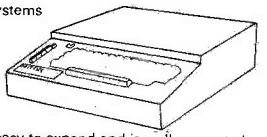

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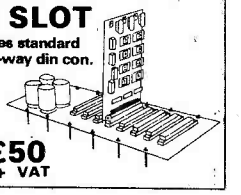

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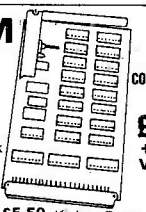
8K RAM CARD



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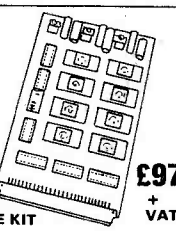

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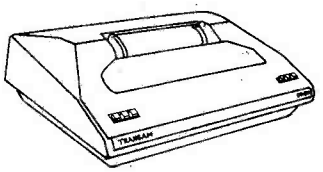

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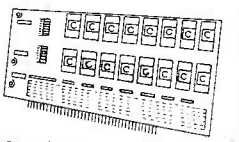

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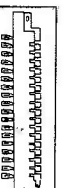

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- SINGLE STEP
- TRACE
- PROGRAMME LOAD
- MONITOR

Development System

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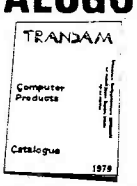

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Analogue-scale timer circuits have the advantage of low cost. Most previously published circuits of this type, however, have had very restricted maximum timing ranges (fifteen minutes or less) and have suffered from very poor long-term accuracy (20%, or worse), due to the use of electrolytic timing capacitors and high-value timing resistors. Digital-scale timer circuits, on the other hand, have the advantage of high accuracy, but the disadvantage of relatively high cost.

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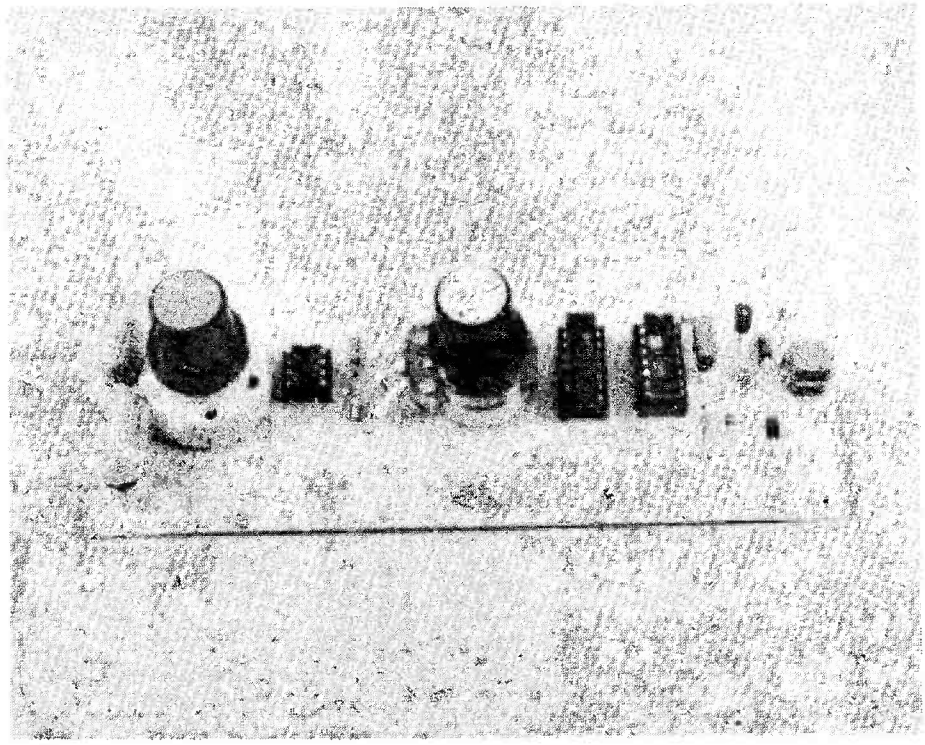

CONSTRUCTION

All of the components of this unit (including the switches and the pot but excluding the relay) are assembled on a single PCB and construction should present few problems. The three ICs should be mounted in suitable holders. The two switches are PCB-mounting types (see components list). Note that we have made up the 1 2 value of C2 by wiring two capacitors in parallel.

Take special care to relate the circuit diagram to the PCB overlay when connecting the relay and the power supply to the unit. The PCB is provded with five external connection points (one is rather sneakily hidden to the left of push-button PB1 on the overlay). Two of these connections go to the relay coil, one goes to supply zero, one goes to one of the relay contacts, and the remaining connection goes to the other relay contact and also to the supply positive. If the relay fails to latch on when you first give the unit a functional check, suspect an incorrect connection to the relay.

When construction is complete, check that the unit is fully functional by momentarily closing PB1 and checking that the relay locks on for the timing period. You can then, if you wish, mount the unit in a suitable box and calibrate the RV1 scale against a clock on the two lowest timing ranges. The calibration of the top (100min-20 hours) timing range will be a factor of precisely ten above the middle (10 min - 2 hours; timing range.

BUYLINES

There should be no problems in obtaining any of the components used in the timer.

All ICs are common types available from most components shops.

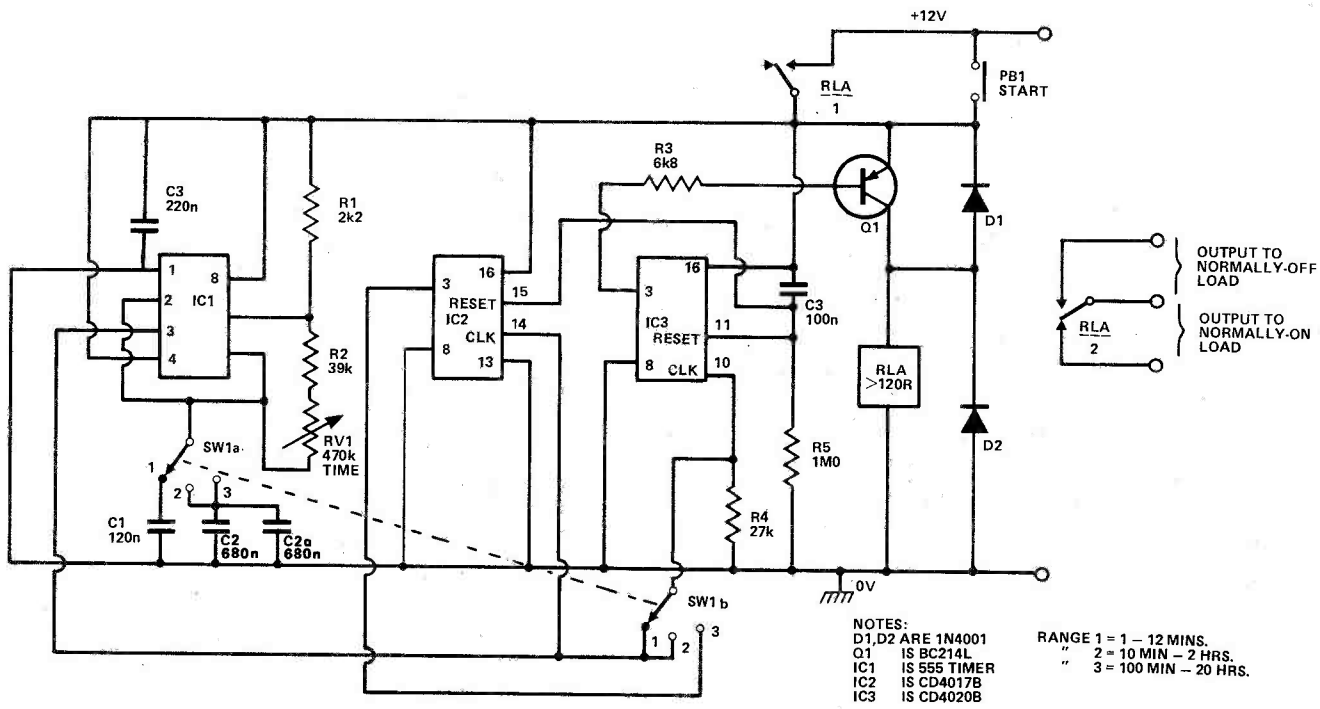

Fig. 1. Circuit diagram.

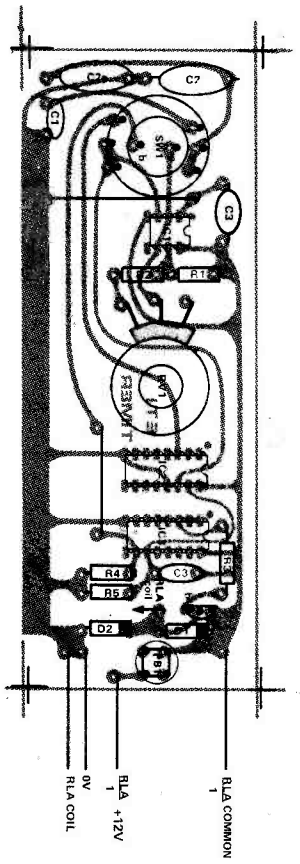

Fig. 2. Component overlay.

PARTS LIST

RESISTORS All ¼W, 5%	
R1	2k2
R2	39k
R3	6k8
R4	27k
R5	1M0
POTENTIOMETER	
RV1	470k
CAPACITORS	
C1	120n polycarbonate
C2,a	680n polyester
SEMICONDUCTORS	
IC1	NE555
IC2	CD4017B
IC3	CD4020B
Q1	BC214L
D1,2	1N4001
MISCELLANEOUS	
PB1	momentary push button
SW1	2 pole 3 way rotary switch

Relay to suit.
Foil pattern.

NOTE: The value of C3, shown on the circuit diagram and component overlay, is 220n.

HOW IT WORKS

In this circuit IC1 is a 555 timer, connected in the astable mode, and is used as a clock generator for the IC2 and IC3 frequency divider circuitry. IC2 is a 4017 decade divider. IC3 is a 4020 14-stage binary counter and in this particular application effectively divides the clock frequency by a factor of 8192.

Power is applied to the circuit by momentarily closing PB1, at which moment the two counters are set to zero via C3 and the relay is driven on via Q1. As the relay turns on it's contacts change over and maintain the power supply connections to the unit when PB1 is subsequently released. The IC1 astable starts to generate clock pulses as soon as power is applied.

On range 1 (1–12 mins) the astable period is determined by C1 and R2–RV1. The clock signal is divided down by IC3, which changes state on the arrival of the 8192nd pulse and turns the relay off and breaks the supply connections to the circuit. A similar action takes place on range 2 (10 mins – 2 hours), except that the clock frequency is determined by C2 and R2–RV1.

On range 3 (100 mins to 20 hours) the clock frequency is again determined by C2 and R2–RV1, but in this case the frequency is divided by both IC2 and IC3, so that the relay turns off and breaks the supply connections on the arrival of the 81920th clock pulse.

The spare (RLA/2) set of RLA changeover contacts can be used to control external circuitry.

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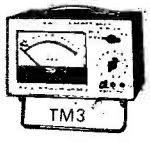

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CHESS MACHINES SURVEY

With the Christmas of the chess computer rapidly approaching, Ian Graham has been mating his way through the electronic playmates.

Well, not much mating actually. I did manage to mate with a couple of the computerised companions on their lowest level.

As my chess isn't up to comparing the programs these machines use, I decided to play them off against one another. On their lowest level, the games were evenly matched. There were lots of stalemates. The Voice Chess Challenger managed to win all but one of its games. So, once, and once only, I heard the Voice Chess Challenger announce 'I lose'.

Perhaps more differences would have shown up at higher levels of play. However (and it's a big however), if all the games were playing at a ten minute response time and if one assumes 25 moves each for black and white in each game, the E T I chess computer league would have taken over three weeks of button-pushing, 24 hours a day, to play. No thank you.

Whether you're looking for a portable or desk top game, one complete with board or complete without one, or even a game that talks to you, there's one in our survey.

At the end of the survey you'll find a table bringing together the chess games, their suppliers, prices and their most important features. Prices are changing so often that, if you're thinking of buying a system, give a few of the suppliers a ring to confirm the latest prices.

BORIS

Boris is probably the most infuriating of the computer opponents. **It comments on your game.** After considering your next move at length and finally plucking up enough courage to actually move the piece, you sit back with a smug grin on your face. Then the machine responds with 'RUBBISH', flashing on its display. It's enough to shake anyone's confidence in his game.

One welcome feature on both Boris and the Boris Diplomat is an easy way of checking where the pieces are on the board. There's nothing worse than manoeuvring into position to take the computer's Queen to find that it wasn't where you thought it was anyway. All the playmates will allow you to check the state of the board. Usually they assign a numerical value to each piece. The display shows the position of each square and the value of the piece on it. The two Boris's go one better. They display the square location and a stylised outline of the piece on it. The outlines are difficult to decipher at first, but soon become familiar.

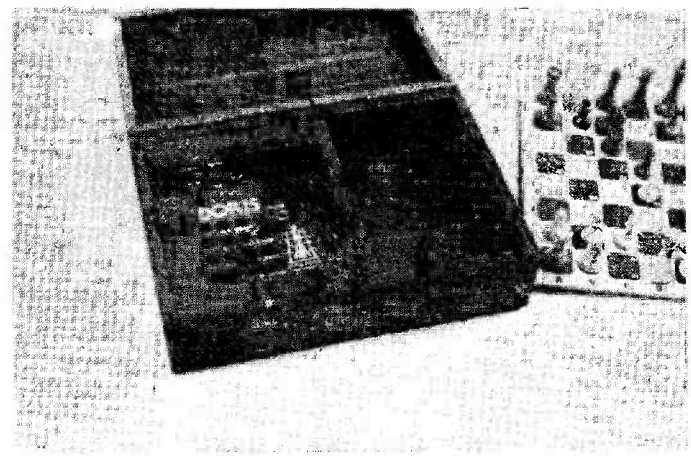
A card board (a cardboard what? — No, a chess board made from card) is supplied with Boris, but I think it's totally unnecessary. If you can afford the £165 or so for Boris you're likely to have enough pennies left over for a decent board, if you haven't got one already.

Unlike the other games, which have a series of levels of play to choose from, Boris has a built-in 100 hour timer. The longer a response time you set on the timer, the longer Boris has to think about his/it's next move and the higher the level at which it plays.

Boris can be set to play either white or black. If you don't like the situation you've played yourself into, you can change sides and make Boris take over your pieces.

You don't have to start every game from the beginning. Any problem or advanced stage of play can be set up on the board and entered rank by rank into Boris's memory. If Boris's response to one of your moves is rather disturbing, you can go back to where you were and try a different move.

As you can see, Boris comes in an attractive walnut case, with a compartment for the pieces and mains adaptor. ▶

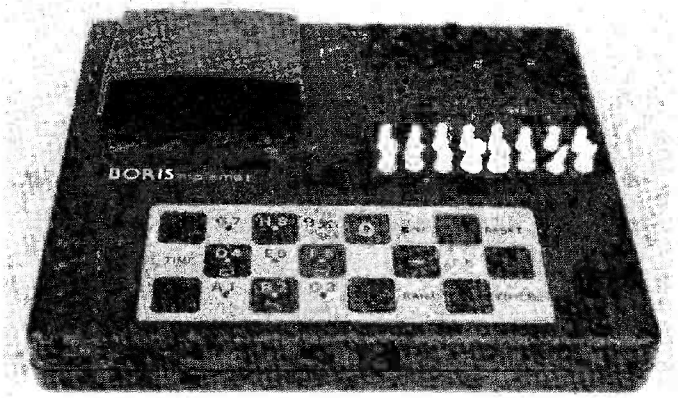


BORIS DIPLOMAT

My first impressions of the Boris Diplomat were less than favourable. I found that the flickering LED display was set at an awkward viewing angle. The keyboard, although large and clearly laid out, was unsatisfactory in use. It was absolutely rigid and, in the absence of sound effects, I had to glance at the display after each key pressing to ensure that the move had, in fact, been successfully entered. The chess board itself is even smaller than the keyboard and the pieces almost microscopic.

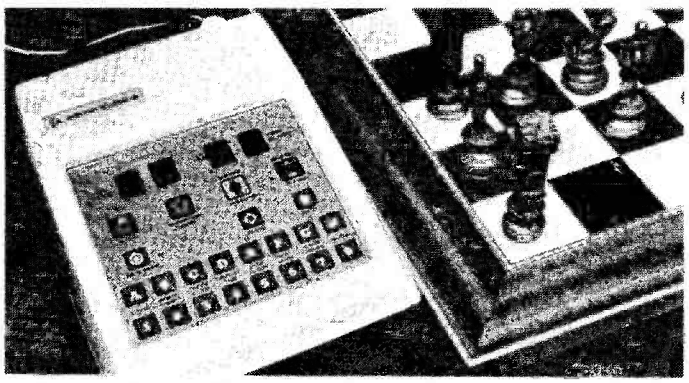
Having got all that off my chest, let me now say that I think Boris Diplomat is the perfect travelling chess computer. It's completely self-contained. You could quite happily sit on the BA shuttle to Glasgow or the 8.20 from Staines to Waterloo (the sardine special) with Boris Diplomat on your knee flashing it's gems at you.

The Diplomat shares the features of its big brother Boris. It doesn't have a series of levels. Instead it has an internal timer which can be set to give a response time of up to 100



hours. The longer you give the Diplomat to think, the higher the level of its play.

COMMODORE CHESSMATE



Commodore's Chessmate is another newcomer to the market. This computerised mate didn't stir any great feelings either for or against it, on the whole. Although it employs the same control method as Chess Champion (separate keys/touch pads for the letter and number of each square location) I didn't find it at all awkward to use. On pressing each touch pad, a trill of tones signals successful pressing. Another trill accompanies the appearance of Chessmate's response on the display.

My only criticism is that there is no on/off switch for the sound effects. They *do* become a little irritating after a couple of games. The control panel is well laid out and more colourful than most.

There are eight levels of play *and* internal black and white 60 minute timers. Unlike all the other systems, which automatically reset to level one at the beginning of each new game, Chessmate resets to level 4 — its average level.

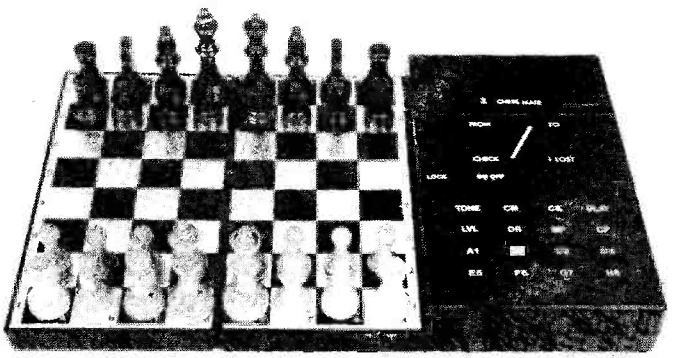
Chessmate copes quite happily with castling and en passant but it trusts you to observe the correct rules of castling. It will also check where the pieces are on the board, assigning a numerical value to each piece for identification. An illegal move is answered by a pair of flashing question marks on the display.

The computer companion's memory stores 32 familiar chess openings — from the Bishop's game to the Nimzo-Indian defence. It chooses one of these at random and tries to follow it for 16 moves, after which it has to think for itself.

CHESS MATE

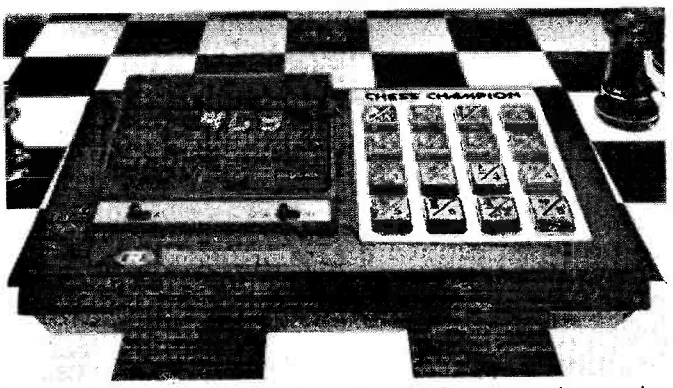
Not to be confused with Commodore's Chessmate, this Chess Mate isn't on the market yet. It's a battery (rechargeable)/mains game complete with fold out board. It will play at ten levels with average response times of from eight seconds to a day and a half. As with all the other games in our survey you can set up any problem on the board, so you don't have to start every game at the beginning.

The prototype I saw had one minor disadvantage. The board folds away very neatly to make a compact portable game. No, that's not the disadvantage. Unlike the Boris Diplomat which is self-contained with its set of on-board pieces, this game has no provision for carrying pieces. So, you have to carry around a little bag of pieces separately. However, there may be enough space in the folding board



to accommodate them when the game finally appears on the market.

CHESS CHAMPION



You have to supply your own board when you play against the Champion. The good news is that the Champ's price has come down recently. ('Wonder if it's anything to do with the competition from the new Commodore Chessmate?) It has six levels of play — from an instant response beginners level to the marathon 2-day computing time level (for correspondence chess).

As chess computers go, the Champion is a simple animal. It will only play black. Special moves need special treatment. The execution of the en passant move is a little puzzling. To take the Champion's black pawn en passant, you enter your white pawn's diagonal move. Now, you have to remove the black pawn from the board as seen by C.C., so you have to enter what appears to be an illegal sideways move to erase the C.C.'s pawn from it's memory. Castling? The Champ castles at the first opportunity.

You may have noticed that Chess Champion has more keys than most of it's brethren. Whereas one key usually serves for both the letter and number of a square's location eg C3, Chess Champion has a separate key for each. In my humble opinion, as a fully paid up member of the button-pusher's union, the Champ would be a much more attractive proposition if it incorporated dual-function buttons or touch pads, perhaps with a button-press sound effect.

CHESS CHALLENGERS

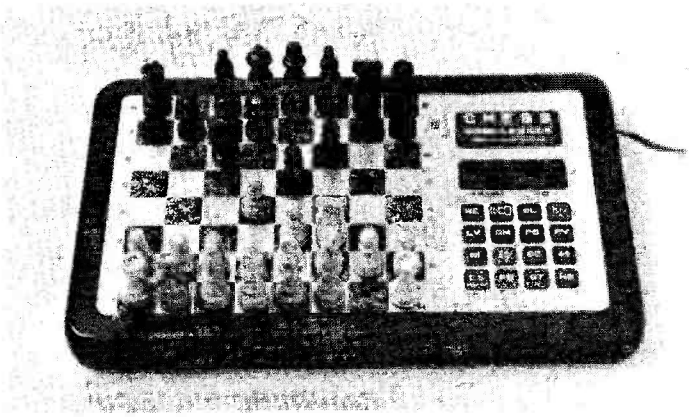
This latest addition to the Chess Challenger range is a bit special. It talks to you. It not only repeats every move, it tells you which piece it's moving and, if it's taking something, which piece it's taking. If you're stuck for a move, the Voice C.C. will even whisper a few suggestions in your shell-like. If you're a bit slow off the mark, the machine will remind you that you really ought to get a move on. It's no slow-coach itself, with response times of about half those of its predecessors.

There are nine levels of play plus an H level. If you select H, the chatty Challenger goes on thinking about it's next move until you tell it to stop. Checking the position of pieces on the board is simplicity itself. Each time you press the PV key, the computer-generated voice tells you which piece is on each square and whose piece it is. Positions are also shown on the display. Like Chess Challenger 10, the Voice C.C. comes with magnetic pieces. However, the usual Challenger touch keypad for a pushbutton pad with a click action.

For all the Micro-men (and women) in Readerland, the Voice Challenger uses 96K of ROM for program and operational stages, 32K bits of ROM for voice generation and 8K bits of RAM for scratch pad and intermediate storage. The heart of the clever bits is a Z80-A, 8-bit CPU. The unit is preprogrammed with 48 standard opening moves which it will select either randomly or under your command.

This is by far the most expensive chess computer on sale now, but it *does* have the most powerful program yet to appear on the market. If you're a serious club player, and a wealthy one at that, the Voice Chess Challenger is the most competent opponent (non-human, that is) you can face today.

I hoped this Challenger would make full use of it's voice and show a little character by blowing a raspberry when it won, but it just said 'check and mate', like a well programmed American dalek.



Chess Challenger 10 is a ten level opponent in an attractive package with an integral board and magnetic pieces. The calculator-style touch pad has a positive click action *and* sound effects. The manufacturers — Fidelity Electronics of Miami — have included a sound off switch. Whilst sound effects are useful to indicate successful key pressing, they can get rather monotonous and irritating after a while. The challenger 10 has one big advantage over its star successor, the voice box — it's around £80 cheaper — but its chess program is not as powerful or as fast.

Chess Challenger 7 was the first of the Challenger series to retail at under £100 and the last to appear before the Challenger acquired the power of speech.

It incorporates all the features of its predecessors plus a few extras. It will play against you (naturally), but it will also play against itself (if you're into spectator chess). You can change sides in mid-game and see how the Challenger gets out of the mess you got into. Not surprisingly, it looks very like its predecessor, the Challenger 10. ▶

ATARI CHESS CARTRIDGE

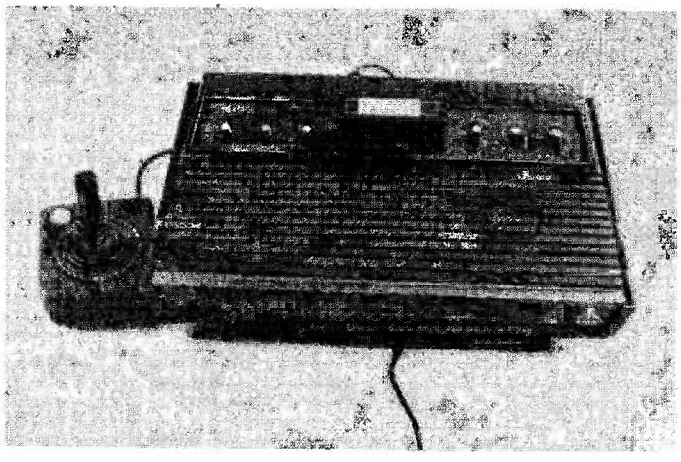
If you're buying a programmable TV games centre, or if Santa Claus is bringing you one, you've probably got you eyes on the Atari Video Computer Systems. It's an expensive way of playing chess — over £200, including £45 just for the chess cartridge.

I thought it would be unfair to test the chess cartridge only. To give the system a fair and complete trial I decided to try out all the games cartridges I could get my hands on. There were air-sea battles, space wars, golf, basketball, breakout and many more cartridges. About a month later I thought I was sufficiently familiar with the system to try the chess cartridge. My eyes resumed their by now customary square shape as the board appeared on the screen.

My first criticism is that the board could be much larger. It sits in the middle of the screen with a large unused border round it. The pieces are controlled by a joystick with a push button. When the cursor is moved onto a piece, the piece is 'picked up' by pushing the button, then moved with the joystick and finally 'released' by pushing the button again. This sort of control method always seems at first to be a bit of a long-winded business, but soon becomes second nature. You have to decide for yourself whether it will interfere with your game.

There are eight levels of play. I assumed that level one was the simplest and level eight the most difficult. Silly me. Level eight is the simplest followed by levels one to seven.

The Atari Videocomputer system and chess cartridge are available from Videotime Products, who can supply the full range of games cartridges. The cartridges are mostly £14.95 each. The exceptions are chess at £45 and backgammon at £34.50.



	SUPPLIERS AND PRICES					GAME FEATURES				
	K	AJD	NIC	CGL	V	POWER	LEVELS	INTEGRAL BOARD	CONTROLS	SOUND
BORIS	169.95	187.50	•	•	•	M	T	NO	PB	NO
BORIS DIPLOMAT	94.50	94.77	•	•	•	M/B	T	YES	TP	NO
CHESS CHALLENGER 7	98.50	99.65	99.95	99.95	•	M	7	YES	TP	NO
CHESS CHALLENGER 10	155.25	159.50	169.95	169.95	•	M	10	YES	TP	NO
VOICE CHESS CHALLENGER	229.95	245.00	249.95	249.95	•	M	10	YES	PB	YES/S
CHESS CHAMPION	•	54.50	54.95	•	•	M	6	NO	PB	NO
COMMODORE CHESSMATE	59.95	•	59.95	•	•	M	8	NO	TP	YES
CHESS MATE	95.00	•	•	•	•	M/B	10	YES	PB	YES/S
ATARI CHESS CARTRIDGE	45.00	•	•	•	45.00	M	8	YES	JB	YES

Power: M — mains; B — battery
Levels: T — internal timer
Sound: YES/S — sound effect may be switched off.
Controls: PB — push buttons; TP — touch pads; JP — joystick and push-button

NIC — N.I.C. Models
27 Sidney Road
London N22 4LT
Tel: 01-889 9736

AJD — AJD Direct Supplies Ltd
102 Bellegrove Road
Welling
Kent DA16 3QD
Tel: 01-303 9145

CGL — Computer Games Ltd
Spectrum House
48 Cambridge Road
Barking
Essex
Tel: 01-591 5654

V — Videotime Products
56 Queens Road
Basingstoke
Hants RG12 1REA
Tel: (0256) 56417
(0256) 26620

K — Kramer & Co
9 October Place
Holders Hill Road
London NW4 1EJ
Tel: 01-203 2473
(mail order only)

The list of suppliers is by no means exhaustive. Many of the High Street hi-fi stores will have a chess machine or two in the window. Prices vary a lot, so it's worth shopping around, especially with Christmas coming up and some prices coming down. STOP PRESS — Latest prices from Mountaindene: Commodore Chessmate — £58.00, Boris — £155.25, Boris Diplomat — £90.00, Challenger 10 — £155.25, Challenger 7 — £88.00, Voice Challenger — £230.00.

ETI

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9-0-9	100	13	**1.95**	.60
9-0-9, 9-0-9	330 330	235	**1.80**	.60
0-8-9, 0-8-9	500 500	207	**2.40**	.65
0-8-9, 0-8-9	1A 1A	208	**3.50**	.65
0-15, 0-15	200 200	236	**1.80**	.60
0-20, 0-20	300 300	214	**2.40**	.80
20-12-0-12-20	700(DC)	221	**3.15**	.80
0-15-20, 0-15-20	1A 1A	206	**4.25**	.95
0-15-27, 0-15-27	500 500	203	**3.70**	.80
0-15-27, 0-15-27	1A 1A	204	**5.75**	.95

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16	8	17	**10.50**	1.20
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Sec: 0-12-15-20-24-30V

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1.0	79	**3.25**	.80
2.0	3	**5.25**	.95
3.0	20	**5.95**	1.10
4.0	21	**6.25**	1.10
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50 VOLT (Pri: 220-240V)
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Amps	Ref. No.	£	P&P
0.5	102	**3.25**	.80
1.0	103	**4.25**	.95
2.0	104	**6.95**	1.10
3.0	105	**8.25**	1.10
4.0	106	**10.50**	1.20
6.0	107	**14.75**	1.40
8.0	118	**19.85**	1.60
10.0	119	**23.75**	2.10

60 VOLT (Pri: 220-240)
Sec: 0-24-30-40-48-60

Amps	Ref. No.	£	P&P
0.5	124	**3.50**	.80
1.0	126	**5.25**	95
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3.0	125	**10.75**	1.20
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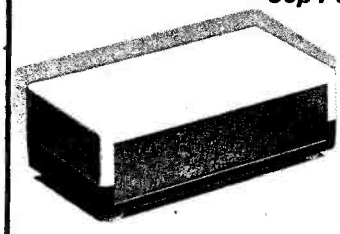

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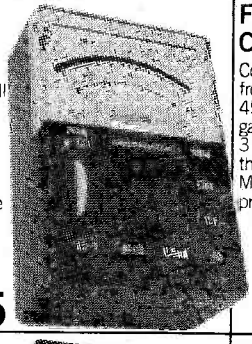

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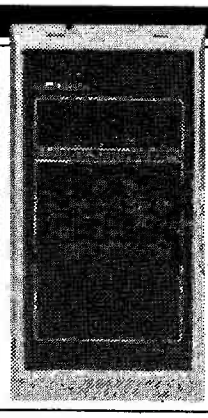

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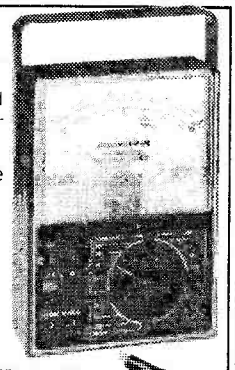

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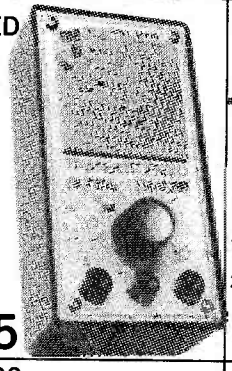

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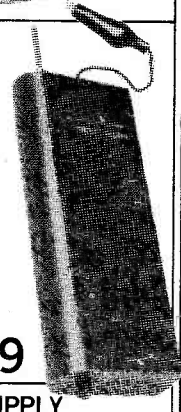

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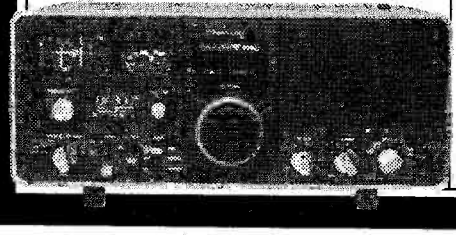

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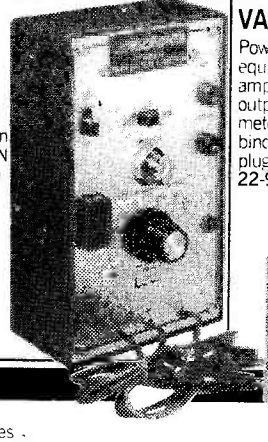
Shows current gain and electrode open and short circuit. Tests low, medium or high power PNP or NPN types. Go/no-Go test from 5-50mA on power types. **22-024.**

REG. PRICE

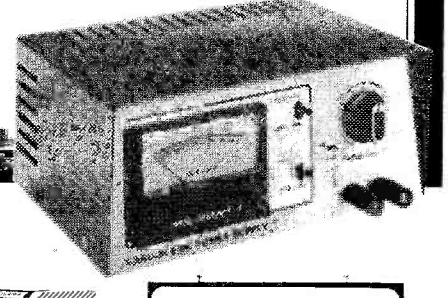
£9.95



VARIABLE POWER SUPPLY

Power project boards. IC's, other low-voltage DC equipment. Load regulation: less than 450mV at 1 amp at 24V DC. Ripple: less then 25mV. Maximum output current: 1.25 amps. Switchable colour-coded meter reads 0-25V. DC and 0-1.25 amps. Three-way binding posts take wires, banana plugs or dual banana plugs with 0.75" centres. For 220/240V AC. **22-9123**

REG. PRICE **£35.95**



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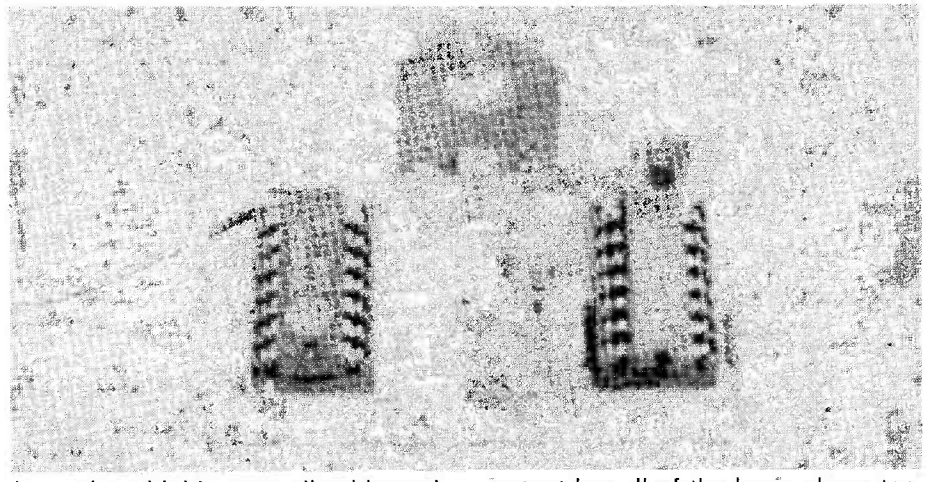
NOISE GENERATOR

An inexpensive unit that produces white noise digitally and can be used as the basis of a special sound effects system.



'White' noise can be simply described as a signal containing a full spectrum of quite randomly generated frequencies or tones, all with randomly determined amplitudes, but which have equal mean power when averaged over a reasonable unit of time. The basic sound of white noise resembles that of hissing steam, but this sound can be greatly modified, to give a variety of special sound effects (such as wind, waves, surf, jet roar, etc), by passing it through low-pass or narrow-band filters.

Most of the white noise generator circuits that have been published in the electronics press in recent years have been analogue designs. They have taken the relatively low-level white noise outputs of selected 'leaky' Zener diodes or of special (and expensive) 'noise' diodes and then amplified these signals to a level suitable for general use. A major problem with these circuits has been that they have given highly unpredictable end results, with circuits of identical designs giving outputs that range from non-existent to excellent.

Our new ETI design is a digital unit, and does not suffer from the deficiencies of the earlier analogue circuits. Its output is produced via a clock generator and a pseudo- or apparently-random shift register. The output has all of the basic characteristics of a conventional white noise signal, but in reality has a pre-programmed pattern that is faithfully reproduced in all units that are built from the design. The amplitude of the output signal is inherently large, and required no further amplification before being fed to external filter networks. ▶

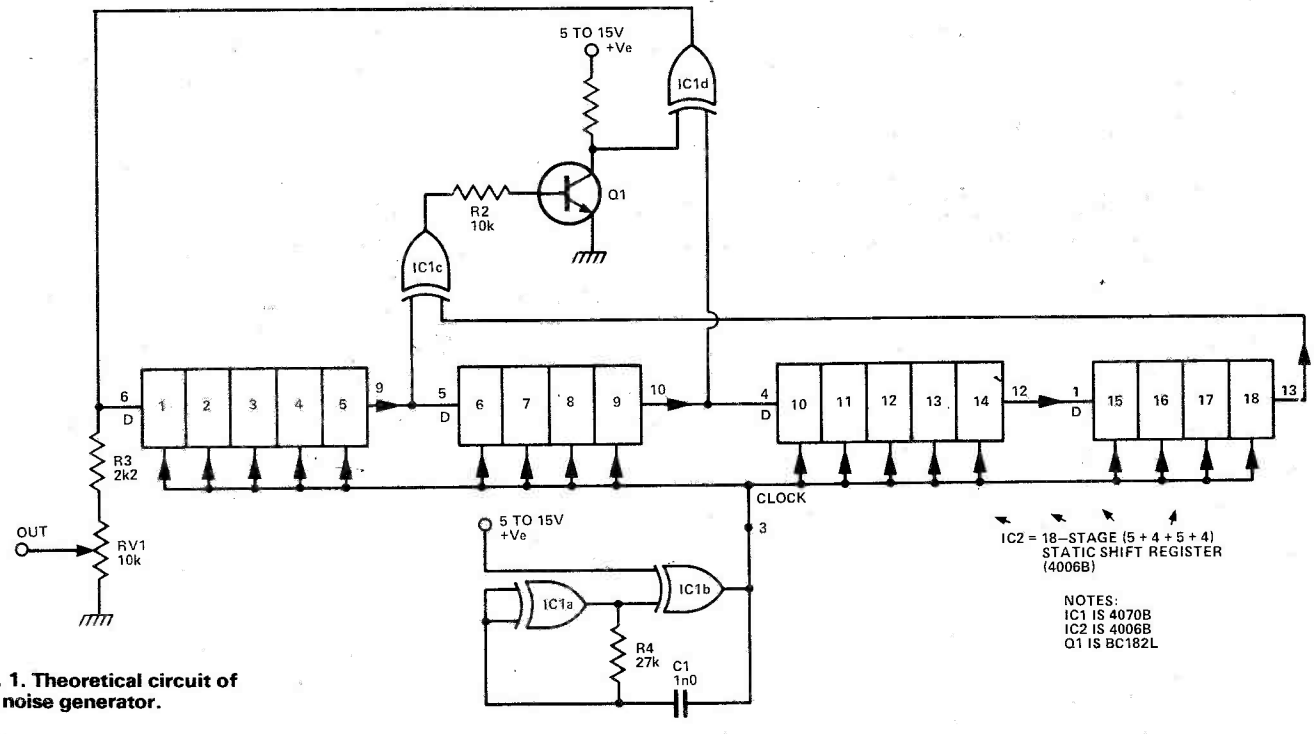


Fig. 1. Theoretical circuit of the noise generator.

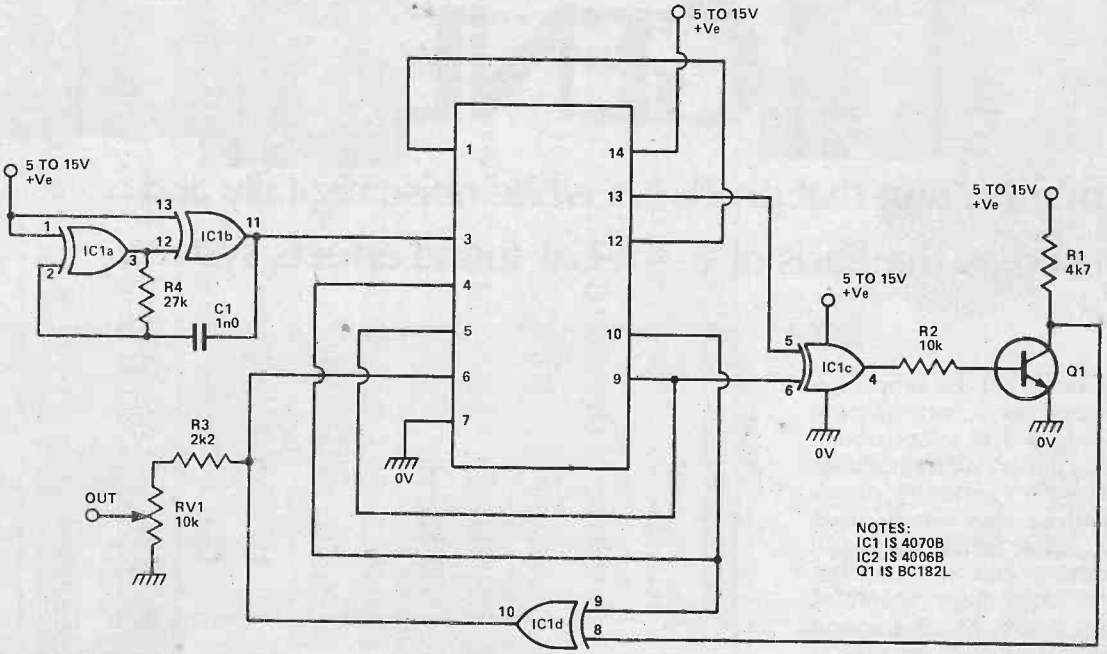


Fig. 2. Practical circuit of the noise generator.

Construction

The circuit uses only two IC's, one transistor, and half a dozen passive components, so construction is simplicity itself. As the ICs are CMOS devices, they should be handled with due care, and preferably should be mounted on the PCB via suitable sockets or via Soldercon pins. When construction is complete, check the performance by connecting a crystal earpiece or microphone across the output terminals, and switch on. If all is well, the unit will produce a hissing noise like escaping steam. ETI

BUYLINES

No problems here. All components are standard parts, available from most mail-order suppliers advertising in this issue.

HOW IT WORKS

The theoretical circuit of the generator is shown in Figure 1, and a more practical representation is shown in Fig 2. IC2 is an 18-stage (5 + 4 + 5 + 4) static shift register, in which the logic (0 or 1) information on the Data terminal is fed forward one step on the arrival of each new pulse from the IC1a-IC1b 30 kHz clock generator. IC1c and IC1d are Exclusive-OR gates, and are used in conjunction with inverter-connected Q1 to feed various outputs of IC2 back to the Data terminal in such a way that the data feeds through the register in an APPARENTLY random or jumbled fashion.

In reality, a complex sequence of 0's and 1's flows through the register, repeating once every few seconds and producing an apparently random jumble of fundamental frequencies. Since these fundamental frequencies are produced digitally, however, they each produce a vast number of harmonics which, when subsequently (externally) filtered, produce a signal that appears to vary randomly in both frequency and aplitude, and thus to have all the basic characteristics of white noise.

PARTS LIST

RESISTORS All ¼W, 5%		CAPACITOR	
R1	4k7	C1	1n0 polystyrene
R2	10k		
R3	2k2		
R4	27k	SEMICONDUCTORS	
		IC1	4070B
POTENTIOMETER		IC2	4006B
RV1	10k	Q1	BC182L

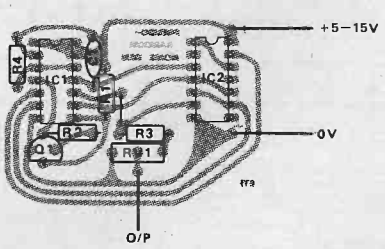


Fig. 3. Component overlay.

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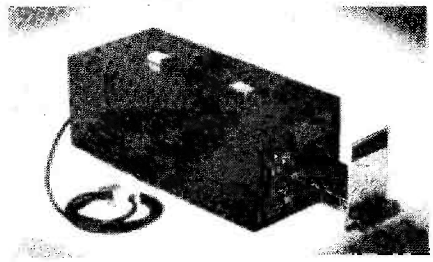
(Polys, universities, govt depts, etc can telephone their orders for immediate despatch on account.)

PROMBOX 12



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Features

- Can erase up to 12 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 with carrying handle and feet.
- Complete instructions supplied.

Supplied complete with mains plug and two metres of flex

£63.63

COMPUTER BOARDS

The following is an extract from our leaflet ref. 'MP4', which is available free on request (a 9" x 6" SAE helps, but is not essential). See Microprocessor section to the right for board prices.

For many people the wide choice of micro-processors now available presents a difficult choice. To understand any particular microprocessor in depth a development system is almost essential, however in the past to understand more than one several separate development systems have had to be purchased.

The reason that separate systems, one for each processor, have been necessary is due to the fact that individual microprocessors have their own individual features: in one case to access memory a separate read strobe and write strobe is required, in another a 'read/write' line is used in combination with a combined strobe called 'valid memory address and phi-2'. With some processors, the same address bus can be used for both memory and 'input/output ports', under the control of a 'memory request' or an 'input/output request' control line.

Naturally, if a development system takes advantage of any of the particular unique features of any particular microprocessor, this makes it more difficult to graft some other unrelated microprocessor onto the same bus at a later date.

A Universal Micro System provides a basic bus structure on which any one micro-processor can be connected. The system uses a CPU (Central Processor Unit) card which is separate from the rest of the system, and this allows the same memory and interfaces to be retained when a different MPU is used.

The basic system bus consists of data and address buses together with read and write strobes. By locating the data input (Keyboard) and output (VDU) in the memory space then such chips as the 8080/Z80 family, which normally use input/output ports, can now be used without any fundamental change to the bus (and as a bonus, users of these MPU's have all the ports entirely free for their own purposes).

The range of p.c.b.'s includes boards to implement a memory-mapped VDU, cassette interface, keyboard interface, PROM programmer, and a number of RAM and ROM cards. All the cards are of International Size 114 x 203 mm (4½" x 8") except for the larger power PSU. A power supply card. This latter card is sized so that it can be bolted to the side of a standard 4" chassis module which is then compatible with the other cards. The cards have a standard 43-way edge connector, with one position used for polarisation.

We do not propose to defend the (relatively) small number of bus-connexions (42), against such standards as the 'S100' 100-position bus. The S-100 bus, as it originated in America, is bigger and better. It is also more expensive. In the same way, a Ford 'Granada' is bigger and better than a Ford 'Cortina', but it doesn't mean a Cortina isn't good value for money, who knows — it may even be better value!

The International Size card is the recommended size for most '3U' 19" rack systems. These racks are made by Vero, Critchley, etc., and a variety of modules and blank cards are obtainable to aid individuals in customising their own system. (A convenient trade source of suitable hardware is the firm 'R.S. Components', but we would be happy to supply in case of difficulty.)

It is appropriate to mention that this range of cards is not meant to compete with any of the excellent computer kits which can be obtained. The purchaser of these types of kits simply acts as an unpaid (or at least underpaid) assembly worker. If the standard components are put together correctly the computer works, if they're not it doesn't. In the end each and every one is virtually identical.

The range of boards in the Universal Micro System are entirely different: You choose your microprocessor, memory, interfaces, etc., what addresses will be used, you choose whether or not to use our software, somebody else's, or indeed your own. (Don't be too alarmed if your level of experience does not permit you to take this sort of decision with confidence — we are always here to offer guidance if asked, we'll even tell you if the system is unsuitable for your needs, in the unlikely event that it is.)

As mentioned on the last page, a brave attempt has been made to begin the design of a Universal Micro System, to provide a sufficiently flexible arrangement to permit the system to grow over the years, and not to become obsolete overnight. To permit this flexibility, wherever possible 'patch areas' have been provided on the boards. A 'patch area' is an undedicated dual-in-line pattern which can accommodate an extra integrated circuit for your own use. Often these can be used to add some extra memory, or some extra address decoding. An extra supply voltage can be developed using an integrated circuit regulator, or gates can be added to allow separate 'Memory Request' and 'Input/Output Request' control lines on a memory card which does not already have this facility.

Of course we know that there are many people who would faint clean away at the thought of cutting printed circuit tracks, adding extra integrated circuits and bits of wire in the way described above, but it is not for these people that this sort of system has been designed. We would like to think of this system as basis on which you can build your own personal design, perhaps as an alternative to the use of 'Veroboard' or etching your own pcb's.

(Further sections give an outline of each card in turn. Although we have in mind all sorts of exotic future developments (e.g. high resolution graphics, floppy disc controllers, dynamic high-density RAM cards, programmable VDU formats, colour displays, Light pens, sound generators etc.) we prefer to keep quiet about them until they actually exist. All of the cards described actually exist, and at the time of writing (September 1979) most are in stock. (We plan it so they are all in stock, but people will insist on buying them, without caring what havoc they wreak in our stock control!!)

CMOS

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

4000	15p	4042	75p	4089	£1.50	4419	£2.68
4001	17p	4043	94p	4093	63p	4422	£5.00
4002	17p	4044	90p	4094	£1.90	4431	TBA
4006	£1.05	4045	£1.45	4095	£1.05	4433	£11.32
4007	19p	4046	£1.28	4096	£1.05	4435	£7.93
4008	87p	4047	87p	4097	£3.72	4440L	£11.58
4009	50p	4048	58p	4098	£1.10	4450	£2.67
4010	50p	4049	48p	4099	£1.45	4451	£2.67
4011	18p	4050	48p	40061	N/S	4452	TBA
4012	18p	4051	72p	40100	£2.50	4461	£2.18
4013	42p	4052	72p	40101	£1.61	4462	£2.42
4014	86p	4053	72p	40102	£2.12	4490FP	£6.54
4015	89p	4054	£1.10	40103	£2.12	4490VP	£3.48
4016	45p	4055	£1.28	40104	£1.09	4500	£6.95
4017	89p	4056	£1.34	40105	£1.06	4501	17p
4018	89p	4057	£25.70	40106	61p	4502	91p
4019	48p	4059	£4.80	40107	68p	4503	69p
4020	99p	4060	£1.15	40108	£5.36	4505	£5.71
4021	91p	4061	£15.67	40109	£1.02	4506	51p
4022	86p	4062T	£10.00	40181	£3.39	4507	55p
4023	20p	4063	£1.09	40182	£1.40	4508	£2.48
4024	66p	4064	N/S	40192	£1.40	4510	99p
4025	19p	4065	N/S	40193	£1.40	4511	£1.38
4026	£1.80	4066	57p	40194	£1.18	4512	81p
4027	45p	4067	£3.80	40257	£1.48	4514	£2.65
4028	81p	4068	22p	4160	£1.08	4515	£2.99
4029	99p	4069	20p	4161	£1.08	4516	£1.08
4030	58p	4070	23p	4162	£1.08	4517	£3.82
4031	£2.05	4071	21p	4163	£1.08	4518	£1.02
4032	£1.00	4072	21p	4174	£1.08	4519	51p
4033	£1.45	4073	21p	4175	99p	4520	£1.08
4034	£1.96	4075	23p	4194	£1.08	4521	£1.88
4035	£1.11	4076	85p	4408	£6.59	4522	£1.08
4036	£2.45	4077	23p	4409	£6.59	4524	N/S
4037	£1.00	4078	21p	4410	£5.73	4526	£1.08
4038	£1.08	4081	20p	4411	£9.58	4527	£1.52
4039	£2.45	4082	21p	4412VP	£9.43	4528	99p
4040	£1.05	4085	74p	4415V	£7.50	4529	£1.14
4041	80p	4086	73p	4415F	N/S	4530	85p

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74C00	24p	74C83	£1.29	74C164	£1.04	74C905	£7.26
74C02	24p	74C85	£1.29	74C165	£1.04	74C906	54p
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74C08	24p	74C89	£4.38	74C174	£1.51	74C908	96p
74C10	24p	74C90	85p	74C175	90p	74C909	£1.63
74C14	£1.41	74C93	85p	74C192	£1.10	74C910	£6.78
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74C30	24p	74C107	£1.22	74C195	£1.04	74C912	£7.13
74C32	24p	74C150	£4.12	74C200	£6.78	74C914	£1.41
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74C76	54p	74C161	£1.10	74C902	54p	74C923	£3.73
		74C162	£1.10	74C903	54p	74C924	TBA
		74C163	£1.10	74C904	54p	74C925	£4.84

74C926	£4.84	80C85	54p
74C927	£4.84	80C96	61p
74C928	£4.84	80C97	54p
74C929	£11.93	80C98	61p
74C948	TBA	82C19	£4.13
74C950	£1.93	88C29	£1.93
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Z80-CTC (2½MHz)	£5.95
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(Add £1 for the 4MHz version of any of the above 3 chips.)

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INS 8154 RAM I/O	£7.75

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6800 MPU	£6.55
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6A10 (128 × 8 RAM)	£3.75
6820, 6821 PIA	£3.96
6850 ACIA	£3.08
MC6880	£2.64

6502

6502	£12.00
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CMOS

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74LS03	16p	74LS32	27p	74LS85	£1.18	74LS136	55p	74LS166	£2.26	74LS243	£2.32	74LS295	£1.85	74LS379	£2.15
74LS04	16p	74LS33	39p	74LS86	43p	74LS138	85p	74LS170	£2.88	74LS244	£1.76	74LS298	£1.68	74LS384	86p
74LS05	20p	74LS37	39p	74LS90	60p	74LS139	85p	74LS173	£1.05	74LS245	£2.70	74LS324	£2.40	74LS386	.86p
74LS08	22p	74LS38	39p	74LS91	£1.04	74LS145	£1.08	74LS174	£1.06	74LS247	£1.90	74LS325	£2.90	74LS390	£2.30
74LS09	22p	74LS40	28p	74LS92	89p	74LS147	£1.70	74LS175	£1.10	74LS248	£1.90	74LS326	£2.94	74LS393	£2.30
74LS10	20p	74LS42	98p	74LS93	89p	74LS148	£1.73	74LS181	£3.98	74LS249	£1.90	74LS327	£2.86	74LS395	£2.18
74LS09	22p	74LS47	90p	74LS95	£1.16	74LS151	96p	74LS183	£2.98	74LS251	£1.34	74LS347	£1.48	74LS396	£2.15
74LS10	20p	74LS48	£1.20	74LS96	£1.16	74LS153	76p	74LS190	£1.40	74LS253	£1.42	74LS348	£1.86	74LS398	£2.76
74LS11	22p	74LS49	£1.20	74LS107	44p	74LS154	£1.70	74LS191	£1.40	74LS257	£1.10	74LS352	£2.28	74LS399	£2.30
74LS12	23p	74LS51	24p	74LS109	55p	74LS155	96p	74LS192	£1.30	74LS258	£1.46	74LS353	£2.28	74LS445	£1.50
74LS13	38p	74LS54	28p	74LS112	55p	74LS156	96p	74LS193	£1.30	74LS259	£1.60	74LS365	65p	74LS447	£1.44
74LS14	75p	74LS55	30p	74LS113	50p	74LS157	76p	74LS194	£1.66	74LS261	£4.50	74LS366	65p	74LS490	£1.80
74LS15	30p	74LS63	£1.50	74LS114	50p	74LS158	96p	74LS195	£1.36	74LS266	52p	74LS367	65p	74LS668	£1.82
74LS20	20p	74LS73	46p	74LS122	70p	74LS160	£1.28	74LS196	£1.00	74LS273	£2.44	74LS368	66p	74LS669	£1.82
74LS21	22p	74LS74	41p	74LS123	70p	74LS161	98p	74LS197	£1.40	74LS275	£2.50	74LS373	£1.80	74LS670	£2.48
74LS26	48p	74LS75	48p	74LS124	£1.80	74LS162	£1.38	74LS221	96p	74LS279	66p	74LS374	£1.95		

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
1.8432 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
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
4.915 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
8.388608 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
27.0MHz	£3.92
27.640 MHz	£3.62
36.6666 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)	74p
2½" × 3½"	53p
2½" × 5"	62p
2½" × 17"	£1.86
3½" × 3½"	62p
3½" × 5"	69p
3½" × 17"	£2.40
4.7" × 17.9"	£3.14

0.1" Plainboard (no strips)

3½" × 2½"	38p
3½" × 5"	59p
3½" × 17.0"	£1.56
Terminal pins	£1.50/500
V-Q DIP board	£1.17
DIP breadboard	£2.91
Spot face cutter	93p
Pin insertion tool	£1.28

SOLDERCON PINS

100 50p 1000 £3.95

DIL SOCKETS

8/14/16 pin 10p/12p/13p
18/20/22 pin 18p/20p/25p
24/28/40 pin 30p/40p/50p

TIMER ICs

NE555/556 29p/49p

OP-AMPS (All Mini dips)

CA 3130E	84p
CA 3140E	35p
UA 741 (Texas)	22p

4 DIGIT LED DISPLAY

Multiplexed, common cathode, prime quality.

NSB 3881 (0.3")	£4.25
NSB 5681 (0.5)	£5.75

LED DISPLAYS

DL-704E/707E	85p
DL-727E/728E	£2.00
DL-747E/750E	£1.80
FND 500/660	£1.20

LIQUID CRYSTAL DISPLAY

4 × 0.5" Digits 40 pin DIL £9.95

CLOCK CHIPS

AY-5-1224A	£2.60
MK 50253	£5.50
MK 50362/50366	£6.50
MC 14440/(LCD)	£11.58

SIX DECADE COUNTERS

MK 50395/6/7	£8.75
MK 50398/9	£6.20

DATA

Note: in this section all data books are subject to 0% VAT. For postage see 'Terms' at top of page.

113 page Electronic Projects Index 72-77 (North Tyneside Libraries)	£1.50
c650 page COSMOS Databook (RCA)	£4.95
c31 page 'A Guide to SC/MP Programming' by Dr. Drury (Kembrae)	£3.75
c20 page 'A Guide to Kilbug' (Kemitron)	75p
c24 page NIBL Reference Guide (National)	£3.45
Data for 4116 (Mostek)	50p
c6 page data for MK 4118	25p
16-page data for INS 8154 (ISP-8A/650) (National)	50p
20-page data for SC/MP II (National)	50p
c100 page CDP 1802 MPU User Manual (RCA)	£4.50
c45 page Fixed Point Binary Arithmetic Routines for COSMAC	£4.50
c31 page Floating Point Arithmetic Routines for COSMAC (Listings excluded)	£4.50
c43 page COSMAC MPU Product Guide (RCA)	75p
c15 page CDP 1802 Instruction Summary	25p
c70 page Understanding CMOS (RCA)	£1.50
1 page COSMOS Pocket Selection Guide (RCA)	25p
c21 page COSMOS Digital Integrated Circuits (RCA)	75p

SPECIAL: Z80 DATA PACK £14.95
A set of the following 5 Z80 data manuals and all the related data we can find of interest to the Z80 user. Approximate weight 1.75kg

- c90-page Z80 CPU Technical Manual
- c10-page Z80-CTC Product Specification
- c25-page Z80-PIO Technical Manual
- c200-page Z80 Programming Manual
- c25-page Z80 Micro Reference Manual

c100-page Starship Simulation by Roger Garrett (Dilithium)	£5.10
c50-page Finite State Fantasies (Cartoons putting programming on human level) (Matrix Press)	£2.00
c225-page Home Computers: 2^{10} Questions and Answers. Vol. 1: Hardware by Rich Dalley (Dilithium)	£5.70
c175 page Home Computers: 2^{10} Questions and Answers. Vol. 2: Software by Rich Dalley (Dilithium)	£4.95
c175 page Home Computers: Beginner's Glossary and Guide by Miller and Sippl (Dilithium)	£4.95
c104 page Machine Language Programming for Beginners by Ron Sanders (Dilithium)	£5.10
c225 page Understanding Computers by Paul Chirlian (Dilithium)	£6.50

SERVICE TRADING CO

FT3 NEON FLASH TUBE
High intensity, multi-turn, high voltage, neon glow, discharge flash tube. Design for ignition timing etc. £1 50 P&P 25p (**£2.01** inc. VAT). 3 for **£3**, P&P 50p (**£4.03** inc. VAT & P).

WHY PAY MORE?!

MULTI RANGE METERS Type MF15A. AC/DC volts 10, 50, 250, 500, 1000, Ma. 0-5, 0-10, 0-100. Sensitivity 2000V. 24 ranges, dimensions 133 × 93 × 46mm. Price **£7.00** plus 50p P&P (**£8.63** inc. VAT & P).

TRIAC.
Raytheon tag symmetrical Triac. Type Tag 250/500V. 10 amp 500 piv. Glass passivated plastic triac. Swiss precision product for long term reliability **£1.25** P&P 10p (**£1.55** inc. VAT & P) (inclusive of date and application sheet). Suitable Diac **22p.**

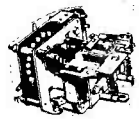
0 to 60 MINUTES CLOCKWORK TIMER.
Double pole 15 amp 230V AC. Contacts (no dial). **£1.50.** P&P 30p (**£2.07** inc. VAT & P). N.M.S.

MERCURY SWITCH


Size 27m x 5mm, 10 for **£5.00** P&P 30p, total including VAT **£6.10.** Min. quantity 10. N.M.S.

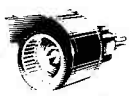
230 VOLT AC FAN ASSEMBLY


Powerful continuously rated AC motor complete with 5 blade 6½" or 4 blade 3" aluminium fan. New reduced price **£3.00** P&P 65p (**£4.20** inc. VAT & P). N.M.S.

21-WAY SELECTOR SWITCH with reset coil


The ingenious electro mechanical device can be switched up to 21 positions and can be reset from any position by energising the reset coil. 230/240V AC operation. Unit is mounted on strong chassis. Complete with cover. Price **£5.50** P&P 75p (**£7.19** inc. VAT & P). N.M.S.

A.E.G. CONTACTOR
Type LS6/L11. Coil 240V 50Hz. Contacts — 3 make: 600V.: 20 amp. 1 break: 600V.: 20 amp. Price: **£5.50** + 50p P&P (**£6.90** inc. VAT. & P) N.M.S.

TORIN BLOWER


220/240V AC Aperture 10×4½cm overall size 16×14cm. Price **£3.75** P&P 75p (incl VAT **£5.18**). Other types available, SAE for details. N.M.S.

24V DC BLOWER UNIT
USA made 24V DC 0.8 amp blower that operates well on 12V 0.4 amp DC producing 30 cu ft min at normal air pressure. Maximum housing dia 110mm, depth inc motor 75mm, nozzle length 19mm, dia 22mm. Ideal for cooling mobile equipment, car, caravan, etc. **£4.50** P&P 75p (**£6.04** inc VAT & P). N.M.S.

SMITH BLOWER.
Type FFB 1706. Small quiet smooth running, 240V, AC operation Output aperture 45×40cm. Overall size 135×165cm. Flange mounting. Price **£4.25** P&P 75p. (Total. **£5.75** incl. P & VAT). N.M.S.

MINIATURE UNISELECTOR
12V 11 way 4 bank (3 non-bridging, 1 homing). **£3.00** P&P 35p (**£3.85** inc. VAT & P).

MICRO SWITCHES


Sub min lever m/switch type MML46. 10 for **£2.50** +VAT=**£2.88** (**£3.22** inc. VAT & P).
Type 3 115M 906T 10 for **£2.50** post paid (**£2.88** inc. VAT & P).
BF lever operated 20A. c/o. mf. Unimax USA. 10 for **£4.00** P&P 50p (min. order 10) (**£5.18** inc. VAT & P).
D.P. C/O lever m/switch, mfg. by Cherry Co. USA. Precious metal, low resistance contacts. 10 for **£2.50.** P&P 30p. Total inc. VAT **£3.22** (min 10). N.M.S.

HEAVY DUTY SOLENOID


Mfg. by Magnetic Devices. 240V AC. Intermittent operation. Approx. 20lb. pull at 1.25in. Ex. equip. Tested. Price **£4.75** + 75p P&P (**£6.33** inc. VAT & P). R & T.
PYE EYTHER
240V AC Solenoid. Approx 1lb pull, ¼" travel, intermitant rating. Price **£1.00** P&P 20p (**£1.38** inc VAT & P) N.M.S.
WESTOOL TYPE MM8 MODEL 2
240V AC. Approx. 1¾ lb pull at ½ inch. Rating 1. Price **£1.50** P&P 20p (**£1.96** inc. VAT & P). N.M.S.
18-24V DC 70 ohm Coil Solenoid. Push or Pull. Adjustable travel to 3/16in. Fitted with mounting brackets and spark suppressor. Size: 100 × 65 × 25mm. Price: 3 for **£2.40** + 30p P&P (min. 3 off) (**£3.10** inc. VAT & P)

240V AC SOLENOID OPERATED FLUID VALVE


Rated 1 p.s.i. will handle up to 7 p.s.i. Forged brass body, stainless steel core and spring ½ in. b.s.p. inlet outlet. Precision made. British mfg.
Price **£3.50** Post 50p (**£4.60** inc. VAT & P). N.M.S.

INSULATION TESTERS (NEW)


Test to IEE spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L. 8in. W. 4in. H. 6in, weight 6lb.
500 VOLTS 500 megohms
£49.00 Post 80p (**£57.27** inc. VAT & P)
1000 VOLTS 1000 megohms
£55.00 Post 80p (**£64.17** inc. VAT & P)
SAE for leaflet.

YET ANOTHER OUTSTANDING OFFER
New IMFD 600V Dubilier wire ended capacitors, 10 for **£1.50** P&P 50p. (**£2.30** inc. VAT + P&P). (Min 10). N.M.S.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230V AC 50/60
OUTPUT VARIABLE 0/260V AC
BRAND NEW. All types.
200W (1 Amp) fitted A/C volt meter **£14.50**
0.5 KVA (Max. 2½ Amp) . . **£17.00**
1 KVA (Max. 5 Amp) **£22.50**
2 KVA (Max. 10 Amp) **£37.00**
3 KVA (Max. 15 Amp) **£45.50**
5 KVA (Max. 25 Amp) **£74.00**
10 KVA (Max. 50 Amp) . . **£168.00**
17 KVA (Max. 75 Amp) . . **£260.00**
Carriage and VAT extra

LT TRANSFORMERS
0-10V-15V at 3 amp (ex new equip) **£2.50** P&P 50p (**£3.45** inc. VAT)
13-0-13V at 1 amp **£2.50** P&P 50p (**£3.45** inc VAT)
25-0-25V at 2½ amp **£4.50** P&P 75p (**£6.04** inc. VAT & P)
0-4V/6V/24V/32V at 12 amp **£18.50** P&P £1.90 (**£23.46** inc. VAT & P)
0.6V/12V at 20 amp **£14.70** P&P £1.50 (inc. VAT **£18.63**)
0-12V at 20 amp or 0-24V at 10 amp **£12.00** P&P £1.50 (**£15.53** inc. VAT & P)
0-6V/12V at 10 amp **£8.25** P&P £1.25 (inc. VAT **£10.93**)
0-6V/12V/17V/18V/20V at 20 amp **£19.00** P&P £1.50 (**£23.58** inc. VAT & P)
0-10V/17V/18V at 10 amp **£10.50** P&P £1.50 (inc. VAT **£13.80**)
JOB LOT! Primary 240V. Secondary 6V at 1.66 amp. Size: 3×2×2in. Price: **£1.50** P&P 50p. (Total **£2.30** incl. P & VAT). N.M.S.
Other types in stock, phone for enquiries or send SAE for leaflet.

POWER RHEOSTATS

New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.
25 WATT 10, 25, 100, 150, 250, 500, 1k, 1.5k ohm **£2.40** Post 20p (**£2.99** inc. VAT & P). **50 WATT** 250 ohm **£2.90** Post 25p (**£3.62** inc. VAT & P). **100 WATT** 1/5/10/25/50/100/250/300/500/1k/1.5k/2.5k/5k ohm. **£5.90** Post 35p (**£7.19** inc. VAT & P).
Black Silver Skirted Knob calibrated in Nos. 1-9, 1½ in. dia brass bush. Ideal for above Rheostats, **28p ea.**

SPECIAL OFFER
BERCO type L RHEOSTAT
85 ohm 300 watt 1.86 amp **£7.50** P&P 50p (Total **£9.20** inc VAT). N.M.S.

BLOWER/VACUUM PUMP
3 phase AC motor, 220/250V or 380/440V, 1,425 rpm ⅛ hp cont. Direct coupled to William Allday Alcosa carbon vane blower/vacuum pump. 0.9 cfm 8 hg. **Price £22.00** P&P £2.00 (**£27.60** inc. VAT & P) N.M.S.

STROBE! STROBE! STROBE!

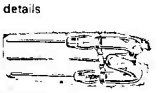
HY-LIGHT STROBE KIT Mk. IV
Latest type Xenon white light tube. Solid state timing and triggering circuit, 230/240V AC operation. Speed adjustable 1-20 fps. Designed for large rooms, halls, etc. Light output greater than many (so-called 4 Joule) strobes. Price **£19.00** post £1.00 (**£23** inc. VAT & P). Specially designed case and reflector for Hy-Light **£8.80** Post £1.00 (**£11.27** inc. VAT & P).

ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES
4ft 40 watt £8.70 (callers only **£10** inc VAT). **2ft 20 watt £6.20.** Post 75p (**£7.99** inc. VAT & P). (For use in stan bi-pin fittings). Mini **12in 8 watt £2.80.** Post 35p (**£3.62** inc. VAT & P). **9in 6 watt** £2.25 Post 35p (**£2.99** inc. VAT & P). **6in 4 watt £2.25** Post 35p (**£2.99** inc. VAT & P).
Complete ballast unit for either 6", 9" or 12" tube 230V AC op. **£3.50** plus P&P 45p (**£4.54** inc. VAT & P). Also available for 12V DC op. **£3.50** plus P&P 45p (**£4.54** inc. VAT & P).
400 watt uv lamp and ballast complete **£31.50.** Post £3 (**£39.68** inc. VAT & P). 400 watt UV lamp only **£11.25.** Post £1.20. (**£14.32** inc. VAT & P).

SQUAD LIGHT


A new conception in light control. Four channels each capable of handling 750 watts of spotlights or dozens of small mains lamps. Seven programs all speed controlled plus flash modulation, effectively giving 14 different displays. Makes sound-to-light obsolete. Completely electrically and mechanically noise free. Price only **£60.70** (**£69.81** inc VAT & P).
S.A.E. (Foolscap) for further details. Post 75p

WIDE RANGE OF DISCO LIGHTING EQUIPMENT
S.A.E. (Foolscap) for details

XENON FLASH GUN TUBES


Range of Xenon tubes available from stock. S.A.E. for full details.

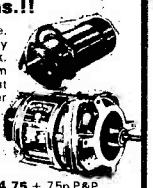
RELAYS
Wide range of AC and DC relays available from stock. Phone or write in your enquiries.

230/240V AC Relays: Arrow. 2 c/o. 15 amp **£1.50** (**£1.96** inc. VAT & P).
T.E.C. open type 3 c/o. 10 amp **£1.10** (**£1.50** inc. VAT & P).
DC Relays: Open type 9/12V 3 c/o 7 amp **£1.00** (**£1.38** inc. VAT & P). Sealed 12V 1 c/o 7 amp octal base, **£1.00** (**£1.38** inc. VAT & P). Sealed 12V 2 c/o 7 amp octal base, **£1.25** (**£1.67** inc. VAT & P). Sealed 12V 3 c/o 7 amp 11-pin, **£1.35** (**£1.78** inc. VAT & P). 24V. Sealed 3 c/o 7 amp 11-pin **£1.35** (**£1.78** inc. VAT & P) (amps = contact rating). P&P on any Relay 20p.
Other types available — phone for details. N.M.S.
Very special offer. 9-12V D.C., 2 make contacts, new ITT3 for **£1.75** + 25p P&P (inc. VAT **£2.30**).
Diamond H heavy duty AC relay 230/240V AC, two c/o contacts 25 amps res at 250V AC **£2.50** P&P 50p. (**£3.45** inc. VAT + P&P). Special base **50p.**

METERS (New) — 90mm DIAMETER


AC Amp., Type 62T2: 0-1A, 0-5A, 0-20A. **AC Volt.** 0-15V, 0-300V. **DC Amp.** Type 65C5. 0-2A, 0-10A, 0-20A, 0-50A **DC Volt.** 0-15V, 0-30V. All types **£3.50** ea. + P&P 50p. (**£4.60** incl. VAT). 0-50A DC, 0-100A DC. Price **£5.00** + 50p P&P (**£6.33** inc. VAT).

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



115 lb. ins., 110 volt, 50Hz, 2.8 amp, single phase, split capacitor motor. Immense power. Continuously rated. Totally enclosed. Fan cooled. In-line gearbox. Length 250mm. Dia. 135mm. Spindle Dia. 15.5mm Length 115mm, ex-equipment tested **£12.00** Post £1.50 (**£15.53** inc. VAT & P). Suitable transformer 230/240 volt **£8.00** Post 75p (**£10.06** inc. VAT & P). R&T

GEARED MOTORS

28 r.p.m., 20lb. inch 115V AC Reversible motor.
71 r.p.m. 10 lb. inch. 115V AC Reversible motor.
Both types similar to above drawing. Price either type **£4.75** + 75p P&P. (**£6.33** inc. VAT + P&P)
Supplied with transformer for 240V AC operation **£7.25** + P&P £1. (**£9.49** inc. VAT + P&P).
N.M.S.

FRACMO MOTOR


56rpm 50lbs inch 240V AC reversible, 0.7 amp, sharplength 35mm, dia. 16mm, weight 6 kilos 600 grams. Price **£15.00** P&P £1.50 (**£18.98**). N.M.S.

FRACMO MOTOR
1400 rpm HP 1-30 continuously rated 115V AC fitted with anti-vibration cradle mounting. Supplied complete with transformer for 230-240V AC op. **£10.00** P&P £1.00 (Total **£12.65** inc. VAT). N.M.S.

PARVALUX MOTOR TYPE S.D.2
12V DC shunt 1/30th ph motor. Continuously rated 4,000 rpm. **Price £10.00** P&P 75p (**£12.36** inc VAT & P). N.M.S.

PARVALUX 230/250V AC MOTOR


Type SD18 240V AC reversible **30 rpm 50lbs** inch. Price **£15.00** P&P £1.50 (**£18.98** inc. VAT). N.M.S.

CITENCO


FHP motor type C 7333/15 220/240V AC 19 rpm reversible motor, torque 14.5 kg. Gear ratio 144:1. Brand new incl. capacitor, our price **£14.25** + £1.25 P&P (**£17.83** inc. VAT & P). N.M.S.

CROUZET — 230/240V AC **2 rpm** synchronous geared motor **£2.90** P&P 30p (Total **£3.68** inc VAT). N.M.S
HAYDON — 230/240V AC **1 rpm** synchronous geared motor **£2.90** P&P 30p (Total **£3.68** inc VAT) N.M.S.

REVERSIBLE MOTOR 230V AC
General Electric 230V AC, 1,600 r.p.m. 0.25 amp. Complete with anti-vibration mounting bracket and capacitor. O/A size 110mm × 90mm. Spindle 5/16 dia. 20mm long. Ex-equipment tested **£3.00.** Post 50p (**£4.03** inc. VAT & P).

BIG INCH
Tiny precision-built 3 rpm USA motor size only 1 x 1," 100V. AC operation supplied with resistor for 230V. AC. Price: **£2.00** P&P 20p (**£2.53** incl. P & VAT). 4 for **£5.00** postpaid (**£5.75** incl. VAT). N.M.S

12V DC GEARED MOTOR
Precision built miniature motor, 6/12V DC operation. Incredibly powerful for size.
Approx speed at 6V 60 rpm 40 ma
Approx speed at 9V 80 rpm 50 ma
Approx speed at 12V 120 rpm 60 ma
Size 27mm dia. 38mm length, weight 55 gram. Drive spindle 5 mm x 2 mm dia.
Price: £2.50 post paid (**£2.88** inc. VAT).

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

'VENNER TYPE' ERD TIME SWITCH


200/250V AC 30 amp. 2 on/2 off every 24 hrs. at any manually pre-set time. 36-hour spring reserve and day omitting device. Built to highest Electricity Board specification. Price **£9.00** P&P 75p. (**£11.21**). R & T.

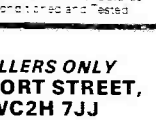
SANGAMO WESTON TIME SWITCH
Type S251 200/250V AC 2 on 2 off every 24 hours. 20 amps contacts with override switch, diameter 4" x 3", price **£8.00** P&P 50p (**£9.78** inc. VAT & P). Also available with solar dial. R & T.

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

AC MAINS TIMER UNIT


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

2-CAM PROGRAMMER
Crouzet 1 rpm, 115V. A.C. Motor operating 2 Precision Micro switches (5 amp). Can be used on 240V AC with either C.25 mfd 600V. Capacitor or 5.6K wirewound Resistor 7 watt (not supplied). Price **£2.50** + 50p P&P (**£3.45** inc. VAT & P)

MINIATURE 24-HOUR TIMESWITCH (German mfr.)


240V A.C. operation. Spring reserve. 16 amp contacts, one on-off every 24 hours. Calibrated in two hour steps. Minimum on-off period 6 hours. **Day Omission.** Unusual feature with these switches is that trips may be removed at will, to effect individual days to be programmed as required. Size only 3" x 4" Depth 2½". Price **£6.50** + 50p P&P (**£8.05** inc. VAT & P

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MICROFILE

Henry Budgett's comments last month spurred some of you to take up pen and phone. This month micro-man brings news from the North and gives the Beeb a plug.

My little plea for help over the problems involved in modem style connection of home computers has borne some fruit. A very helpful gentleman, who just happens to work for the PO, wrote in with a few comments. Apparently the Post Office regard acoustic modems as attachments in much the same way as answering machines and there are a considerable number of specifications to be met. Such items are the maximum sound level of —13 dBm and the maximum sound pressure at the transmitter of 0.5 Newtons per square metre. Type approval for these kinds of devices should be obtained and I gather that ad-lib experimentation may be frowned on, so take care!

It should also be noted that hard wiring of a computer to the PO lines is definitely *not* on. I didn't suggest it last month, but just in case it has crossed your mind . . . . forget it.

One other comment that was thrown in from another PO person was that there is a rather critical frequency around 2200 Hz. A tone of this frequency will cause the exchange to close down your call, slightly embarrasing. You have a bandwidth of 300 to 3500 Hz to play with so steer clear of this area. Full technical details of the specifications are contained in Technical Guide No 11, which should be obtainable from the telephone section of the Post Office.

And finally on this subject, I understand that Greenbanks cassette interface for their SCMP system has provision for an op-amp to be connected for direct tape head drive. It should prove possible to use this to drive a loudspeaker for our purposes. The board is currently being re-designed so contact them soon for details. Many thanks to Mike for his helpful comments on the Post Office's position.

Standard Letters

A vast epistle squeezed its way into my mailbag this week after my diatribe on standards last month. One problem . . . there was a lot in it about misspeling and general missuse of Her Britannic Majesty's English but not a sausage (courtesy of That's Life) on computer jargon. Have you no shame, or perhaps you were all stunned into silence? Please will someone say something, hopefully polite, as the article was supposed to inspire general comment.

Plea For Clubs

Not a single word from anyone this month. Are you all too busy to write to Microfile with your news? Many thanks to those who have filled in the little form and sent it back. If any club hasn't had one please let us know as we are trying to produce a second Club Directory for CT and we go to press in four weeks. After all, if the Beeb think it's good enough to use what have you got to lose, poetic stuff.

BBC Speaks Out

A superb pair of programmes were boradcast this month on Radio 4. Called "Machines with Mouths" and "Machines with Ears" they dealt with speech synthesis and recognition systems and techniques which are currently being used. Having worked in this area for a number of years I found them to be excellently produced and most enjoyable. A definite pat on the back for the Science Department. What was even more impressive was that it was done on radio. One would expect this mind of subject to be tackled on a programme such as Horizon. It was also amusing to hear many voices from the past (such as my old boss) expounding their views on the subject. A repeat soon one hopes, how about it?

News From The North

Microdigital have released the first of a series of Nasbus based general purpose interface boards. This one has sixteen relays and is addressable to any two consecutive ports on the Nascom. Power requirements are a modest 250 mA on both the +12 and +5 volt rails and the unit is supplied as a kit complete with sockets for all IC's along with a manual and sample software. Price is around the £50 mark.

The ACFA single board computer that we had a slight mix-up over a month or so back is currently being re-engineered for the new 6809 CPU and some more I/O. The problems caused by the NTSC (Nasty Television System for Computers) have now been overcome and a demo model will shortly be going round the shows. Look out for it, it may suit your needs.

The Liverpool software gazette has just been launched priced at 50p per issue or £6 per year for twelve copies. It is packed with software and reviews, including a look at Pascal on the Apple. One of the most interesting items is the complete listing of the M5 language, which has now gone public, for the Nascom. For more details on the language see our review in CT May. The magazine is not intended for the beginner as it assumes a reasonable knowledge of computers. Details on all these products can be obtained from Microdigital at 25 Brunswick Street, Liverpool 2. ETI

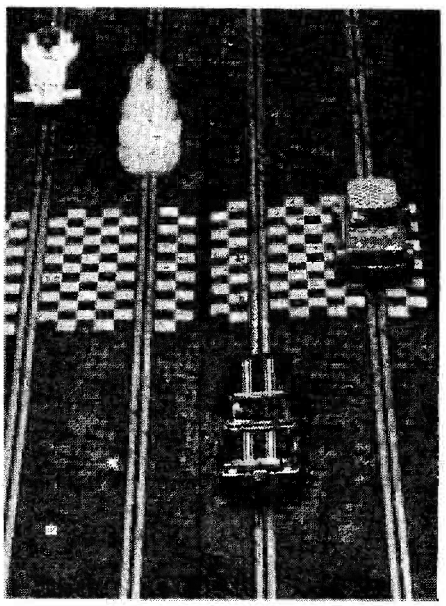
Next Month

Hobby Electronics

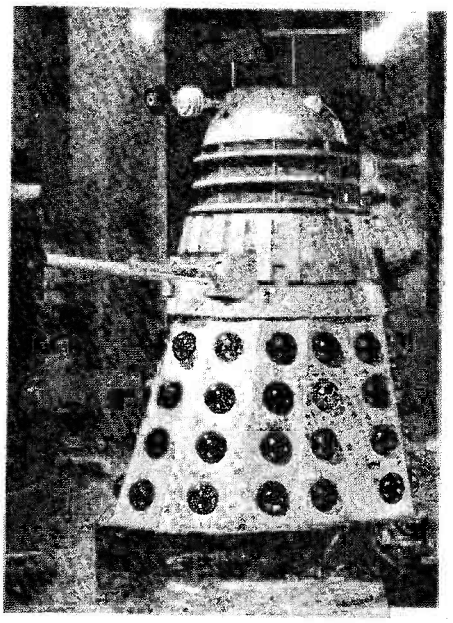
Have we got an issue for you next month? Yes of course we have, just cast your tired eyes over this little lot. (Tired eyes can be avoided by refraining from reading lesser electronic magazines)

SCALEXTRIC SPECIAL

Yes folks, HE's done it again. Just in time for Christmas. The HE workshop staff have been really getting their noses to the grindstones and have tirelessly, without any regard for personal health, been playing with their Scalextric set. Whilst they were doing so one of them had a bright idea, 'how about doing some projects on this lads?' He was quickly silenced and play recommenced. A little while later, after this momentous statement sunk in, they thought about it and actually all agreed, it was a good idea. So now we proudly present the last word in electronic Lap Counters, Precision Hand Controllers and other amazing things to grace your layout. Miss it at your peril.



RING MODULATOR



Where do we get them from? Now you can really sound like a Dalek. This neat little unit, designed for use on stage, at home, or just for good old fashioned fun will faithfully reproduce the dulcet tones of those amiable creatures from the planet Skaro. If you don't want to be a Dalek then it will create an interesting range of other effects too. Maybe we'll hang one on HEBOT. You never Know . . . .

UNIJUNCTION TRANSISTOR

Our brainy chief designer Ray Marston takes time off from his train controller to look at those oft maligned, collectorless transistors that are known to all and sundry as Unijunctions. So pay attention because we might be coming round your house to ask you questions about them.

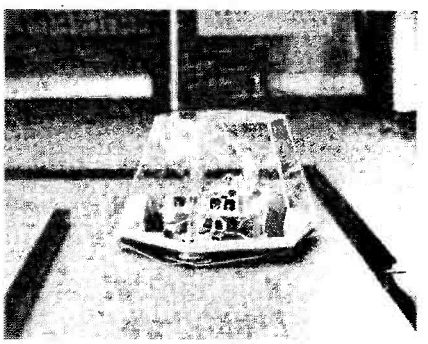
TV-THE CONTINUING STORY

This month Rick Maybury looks at the other end of the TV system, the box that sits in the corner of your living room. Find out just what happens when the on off switch is twiddled, the educated electron strikes again.

PROJECT FAULT FINDING

Gasp . . . your project didn't work, if it wasn't our fault (is it ever?) then it must be your fault. Keith Brindley, who has had to deal with one or two faulty projects in his time discusses the heart wrenching subject of dead projects.

HEBOT GROWS UP



We are expecting HEBOT to start a craze (seriously) the combination of a really well designed, sturdy chassis at a very reasonable price, coupled with our unique electronic circuitry, brings the world of advanced robotics to within everyones grasp. This month after completing the basic drive circuitry we go on to explore tactile senses, optical stimuli and self survival instincts. HEBOT is the first serious attempt in this country to bring the world of Robotics into the seventies. others have tried and failed, we know we are going to succeed. Frighten the cat, amaze the neighbours but above all DO NOT MISS IT.

The December issue will be on sale November 9th

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

WE'VE MOVED

Special just in full spec. 1702A (intel) £2.50 each p/p 20p. 74125 (tri-state buffers) 4 for £1.00. P&P 20p.

IS423 STUD MOUNTING RECTIFIERS 10A 400V. Silly price, 10 for £2 P&P 20p.

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

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

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SUPERSAVER 4. RS338-383 miniature decade thumbwheel switch £1.35 P&P 20p.

SUPERSAVER 5. SN74116 (dual 4 bit latch) 75p P&P 20p. SN74181 Arithmetic logic unit/function generator 80p P&P 20p. SN74194 (4 bit shift register) 50p P&P 20p. SN74198 (8 bit shift register) 75p P&P 20p.

SUPERSAVER 6. BC108B 8p 100 for £7.00 P&P 20p.

SUPERSAVER 7. 4 digit 7 segment bubble display (NSA1540A) ex-equipment 5 for £1.00 P&P 20p.

9-WAY MALE/FEMALE connector (Elco 8129) 0.1 inch pitch, PCB mounting ideal for bussing two PCBs together 35p/pair P&P 20p.

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Happy Christmas to all our customers and ETI staff.

All enquiries, SAE please. P&P same for quantities except where greater than £1.
Due to move we have no catalogue. A new one is being produced, available shortly.
Rush orders as some stocks are limited.
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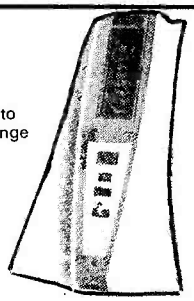

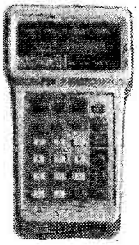

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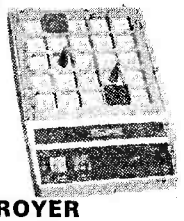

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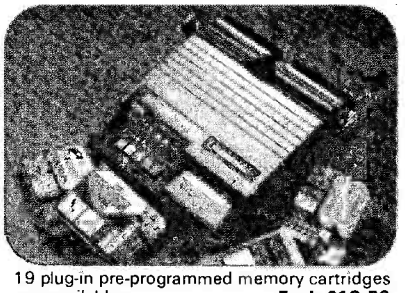

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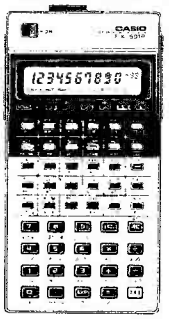

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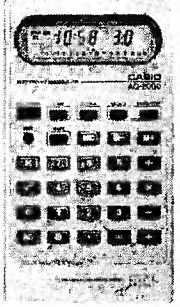

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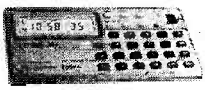

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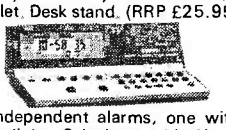

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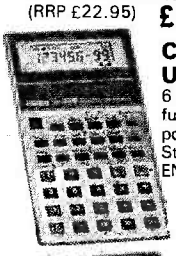

CASIO FX-2600 Ultra slim—5/32in

6 + 2 digit LC Display. 43 scientific functions. Non volatile memory. Auto power off 6 levels parenthesis. Standard deviations. R to P, O to R, ENG, FIX, SCI, RND and Random number keys. 5/32in x 2¾ x 4⅞in.

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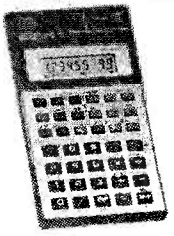

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As above but 10 digits

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STAR BUY

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As above but: Stainless steel case, water resistant to 100ft. (RRP £39.95.)

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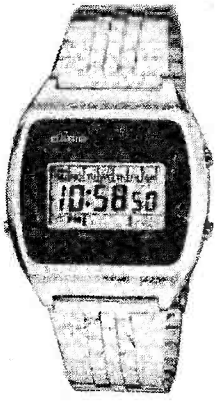

95QS-31B

4 year battery Stainless steel encased. Water resistant to 66 feet. (RRP £27.95.)

£23.95

95CS-31B

Solid stainless steel case.

Water resistant to 100 feet.

(RRP £34.95.)

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Time never stands still with Casio

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Hours, minutes, seconds, am/pm; and with day, date and month auto calendar. 1/100 sec chrono to 1 hour. Net, lap and 1st and 2nd place times. Resin case and matching strap. Mineral glass. Water resistant to 66 ft (2 at.). Silver oxide battery. RRP **£17.95**

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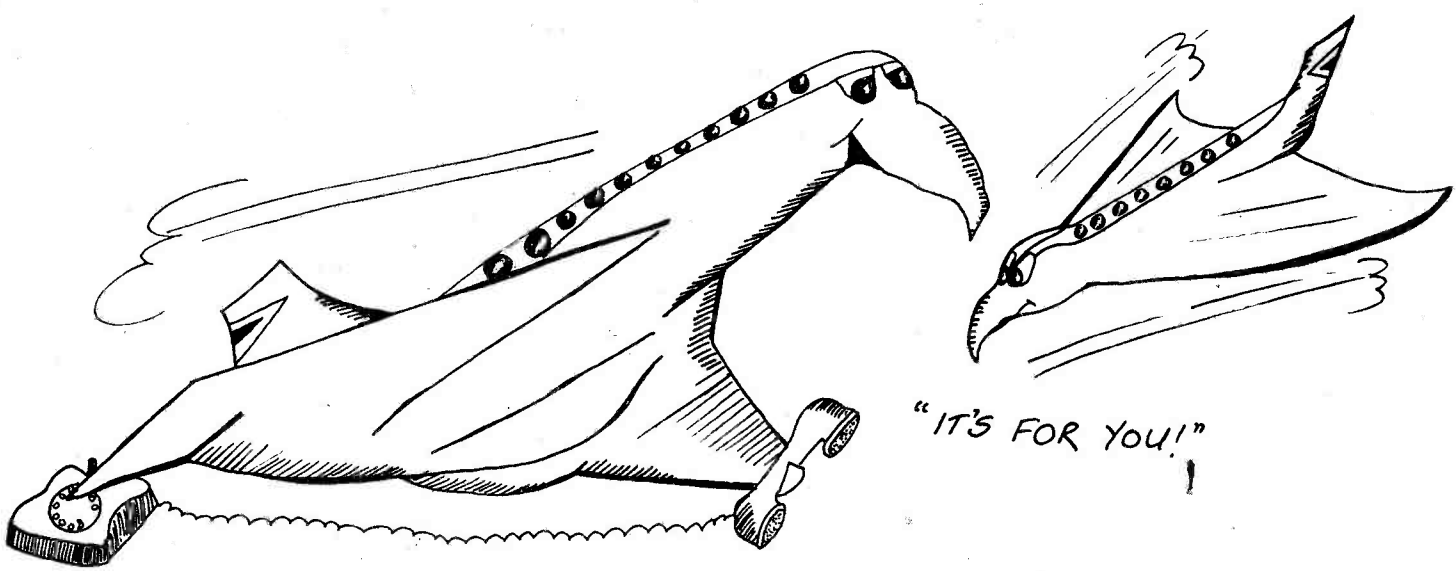


Domestic aircraft communications, both private and commercial, generally involve a pilot talking from his plane to a traffic controller at an airfield as well as talking to other pilots. Signals from aircraft can be heard over quite long distances as they are flying quite high and thus the horizon, from the aircraft, can be up to several hundred miles away.

There are 360 channels allocated in the aircraft band, each assigned a specific use or for use in a particular area. Amplitude modulated (AM) transmission is used which simplifies the requirements for a receiver to listen on this band.

The Convertor

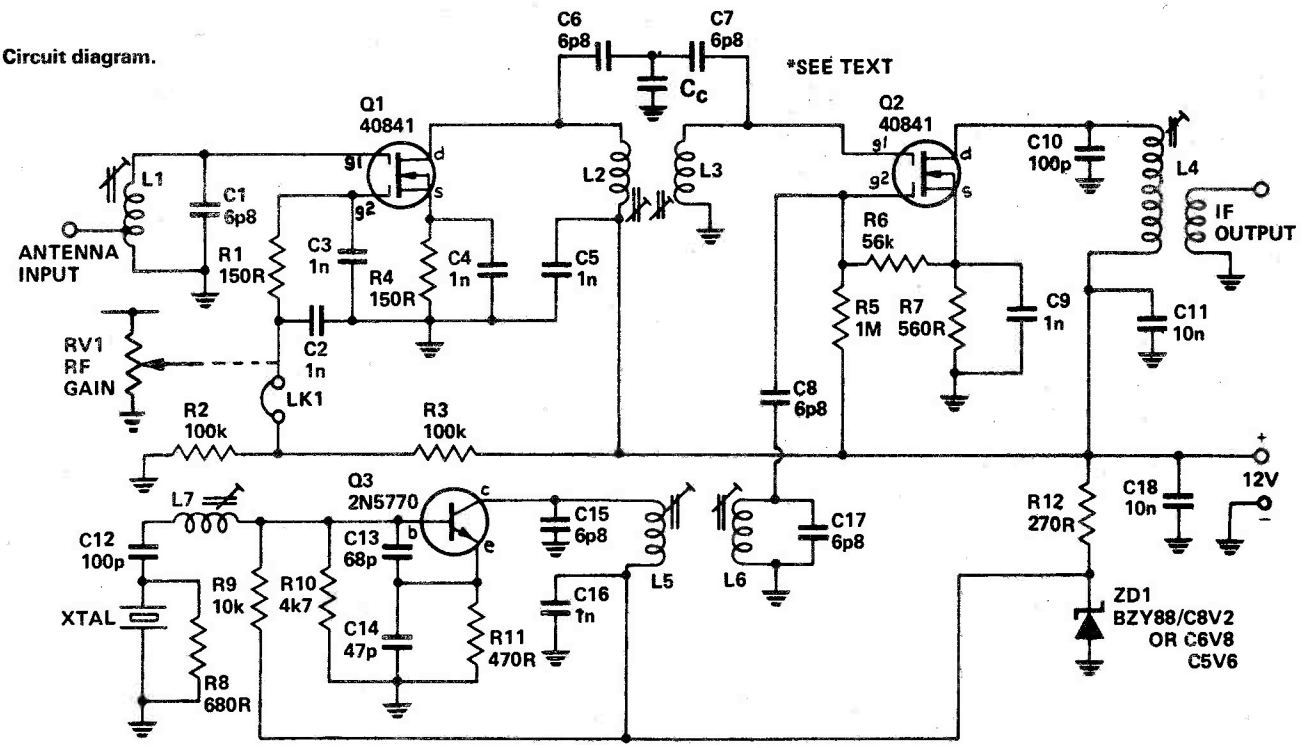
Why a converter — why not a complete receiver? Firstly, a shortwave listener will already have a receiver. A converter to 'change down' the aircraft band frequencies to a suitable band between 3 MHz and 30 MHz is a simple, and inexpensive, solution. For those wishing to monitor some portion of the aircraft band the output of the converter could be connected to an ordinary multi-band transistor portable to provide quite adequate results. Alternatively, a fixed frequency IF (intermediate frequency) strip with detector and audio stages could be constructed.

The converter is crystal locked — that is, a quartz crystal oscillator is mixed with the signals from the antenna, the signals then appearing at a lower frequency at the converter output. The frequency of the crystal used will determine the frequency band of the converter output.

For a number of reasons, we chose the output (or IF) frequency to be around 10 MHz. Inexpensive crystals are available for the aircraft band to give an IF output from the converter of 10.7 MHz — a standard IF frequency. The same crystals can be employed if you wish to use a tunable shortwave receiver following the converter. There is a minor inconvenience though — the tunable receiver's dial has no simple relationship to the input frequency. The advantage is that inexpensive crystals cost around half that of a crystal made to order to provide a direct frequency relationship.

As the converter has quite a deal of gain, resulting in very good sensitivity, an RF Gain control has been provided. Very strong signals on a channel near to the one being monitored may cause interference. Judicious use of the RF gain control will reduce or remove the interference while enabling you to still hear the desired signal. Then again, a very strong signal on the channel you are monitoring may overload your receiver, resulting in very distorted reception. Reducing the RF gain will remove the problem.

Fig.1 Circuit diagram.



Construction

The printed circuit board has been specially designed for this application and no other construction technique should be employed unless you are very experienced in circuit construction at these frequencies.

It is best to commence construction by mounting the coil formers. They may be glued on the board over the pilot holes or the board drilled to the appropriate diameter for the base of the formers and then gluing the formers in place. Use the shield cans to locate and/or hold the formers on the board. It is wise to insert the slugs in the formers *after* gluing to avoid accidentally gluing them to the formers. The best type of glue to use is one of the 'instant' bond glues such as "Superglue". Many glues available will not bond to substrate materials — particularly fibreglass material.

The next step is to wind the coils. They may be wound *in situ* if you wish, alternatively they may be wound on a suitable diameter former (such as a 5 mm or 3/16" drill shank) and then slipped over the formers on the board.

Take careful note of winding direction and the start and finish connections. Refer to the component overlay when soldering the coil leads in place. Do not mount the shield cans until all the minor components have been soldered in place.

When mounting the minor components take particular care with orientation of the transistors, FETs and the zener diode. All components should be mounted right down on the board to minimise lead length. Stakes or pins should be used for the connections to the antenna input, IF output and dc connections.

There is provision on the pc board to mount a crystal socket for a 'style-D' crystal. These have a 12 mm pin spacing and stand about 20 mm high. Alternatively, if the smaller size crystals are used, having a pin spacing of 5 mm or pigtail connections, then they may be soldered in place under the board. Take care when doing this. Do it quickly and use the minimum amount of heat to avoid damaging the crystal.

If desired, the crystal may be mounted separate from the board. Keep lead length between the crystal and the board connections as short as practicable in this case.

The shield cans for the coil assemblies should be mounted last. It may be a wise idea to check that the converter is working before soldering the shield pins to the pc board.

The completed converter may be ▶

HOW IT WORKS

The circuit is quite straightforward, comprising an RF stage (Q1), a mixer (Q2) and an overtone crystal oscillator-multiplier (Q3). Dual-gate MOSFETs are used in the RF and mixer stages as they have good gain, low noise figure and good freedom from crossmodulation and overload problems.

Signals from the antenna are first amplified by Q1 and passed to gate-1 of the mixer Q2. The oscillator, Q3, is set to a precise frequency by the crystal. The injection frequency to gate-2 of the mixer is derived from the collector of Q3, being two or three times the crystal frequency. The signal frequency are mixed in Q2, their *difference* is selected by the tuned circuit in the drain — this is the desired output frequency.

A low-Q tuned circuit, L1-C1, is used between the antenna input and gate-1 of Q1. The antenna input impedance is *mismatched* to the impedance of the gate to optimise noise figure. The drain of Q1 is coupled to gate-1 of the mixer, Q2, via a double-tuned, bandpass coupling circuit consisting of L2, C6, Cc, C7 and L3. A combination of inductive coupling and common-capacity coupling is used to achieve a wide bandwidth.

Gate-2 of Q1 requires a bias of +6V for full stage gain. A link between gate-2 decoupling (R1-C2,C3) and the junction of R2-R3 allows for the connection of a gain control potentiometer.

The mixer has above 1V5 of bias applied to gate-2. The conversion frequency is injected at this gate and a small amount of forward bias improves the mixer conversion gain. The output, or IF, is coupled via L4 which is resonant at 10 MHz with C10. This is a low-Q tuned circuit for the broad bandwidth necessary if the tunable IF receiver is used.

The crystal oscillator stage, Q3, is designed to cope with either third or fifth overtone crystals and may double or triple the crystal frequency in the collector. Tuned circuit L5-C15 selects the appropriate harmonic. Energy is coupled from L5 to L6 which is resonated to the required frequency with C17. These two tuned circuits filter the injection frequency. This prevents any spurious mixing occurring in Q2.

Coil L7 is used to 'trim' the crystal

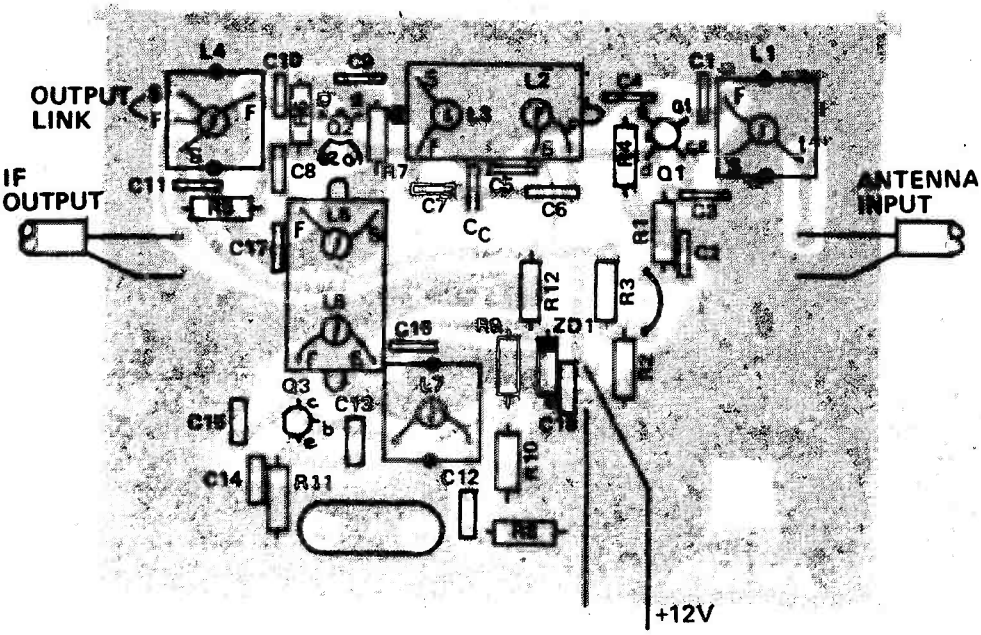
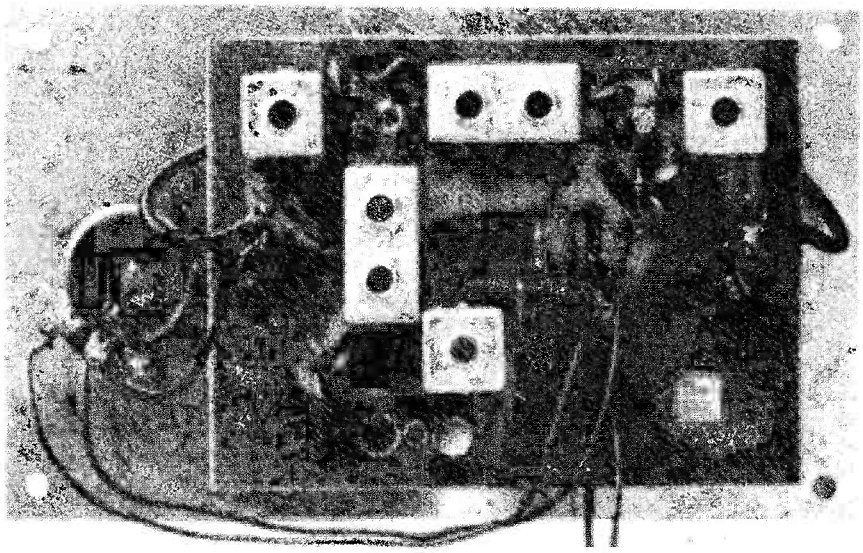


Fig.2 Component overlay.



The PCB fitted to its front panel, showing connections to the gain control, RV1.

PARTS LIST

Resistors all ¼W, 5%*
R1,4 — 150R
R2,3 — 100k
R5 — 1M
R6 — 56k
R7 — 560R
R8 — 680R
R9 — 10k
R10 — 4k7
R11 — 470R
R12 — 270R

Potentiometer
RV1 — 100k

Capacitors
Cc — 22p ceramic
C1,15,17 6p8 ceramic
C2,C5 — 1n ceramic
C6,C9 — 6p8 ceramic
C10,12 — 100p ceramic
C11,18 — 10n ceramic
C13 — 68p ceramic
C14 — 47p ceramic
C16 — 1n ceramic
C18 — 10u ceramic

Semiconductors
Q1,2 — MFE131, 40673, 40841
Q3 — 2N3563, 2N3864, 2N5770
ZD1 — BZY88/C8V2 or /C6V8 or /C5V6 or /C5V1

Miscellaneous
7 x 7122/1 Neosid coil formers, 3 x 7100 Neosid screening cans, 2 x 7100 Neosid screening cans, 7 x Neosid ferrite slugs, 4 x 5 x 10/F29 coil wire, crystal — see text, box (see text), 2 coax sockets, 2 x 20 mm, 6 BA spacers, nuts, bolts, etc.

*Resistor values may be plus or minus one standard value either side of those quoted without ill effect. Capacitor values should not be altered.

mounted, we used a small box measuring 159 x 96 x 50 mm overall. They are available from a number of component suppliers. The board was mounted on the aluminium panel using two spacers. Antenna and IF output sockets, along with the RF gain pot, were also mounted on the panel and power leads taken through a hole in the side of the box. Small lengths of coax cable were used to connect the input and output sockets to to the board connection.

Control

The particular method of alignment will depend on how you will be using the converter. To commence the alignment you will need to have on hand the appropriate aligning tool. You will need a plastic screwdriver-tip alignment tool to suit the Neosid ferrite cores. They are readily available from many suppliers.

You will need a power supply delivering between 12 and 15 volts; the converter will draw between 30 and 50 milliamps. A receiver with a S-meter is a decided advantage when aligning the converter. You will need a signal generator, with AM modulation, covering the range of 118-126 MHz.

If you are using a tunable receiver for the IF, then the following procedure should be followed:

Connect the converter to the receiver. Use a short length of coax cable. If the converter is working you will notice an increase in the noise level on a sensitive receiver when power is applied. You can check that the crystal oscillator is working by removing the crystal temporarily — a decrease in the noise from the receiver will be noticed.

1. Set the receiver frequency to the middle of the tuning range of the converter's output. The converter RF gain should be at maximum all through the alignment procedure.
2. Tune the slug in L4 to obtain a peak in the receiver noise level.
3. Set all the other coil slugs flush with the tops of the coil formers.
4. Using the signal generator, with a fairly high output level, peak L4 again for best signal strength.
5. Set the generator to a frequency near 119 MHz and tune the receiver until you pick up the signal. Now adjust the slugs in L2 and L6 for best signal strength. Decrease the output of the signal generator so that these

adjustments are made on a fairly weak signal.

6. Set the generator to a frequency near 125 MHz, or the highest frequency in which you are interested, and tune the receiver until you pick up the signal. Adjust the slugs in L1 and L5 for best signal strength. Keep the generator output at a low level for best results.
7. Now set the generator to a frequency half way between these two frequencies. Tune the receiver to pick up the signal and adjust the slug in L3 for best signal. Check the adjustment of L4.
8. Return to 119 MHz and peak the slug in L2 again.
9. Repeat the procedure, 'touching up' each slug.

If the converter is to be used on one channel, or a couple of channels less than 1 MHz apart, then all the coils need only be adjusted for best signal strength on one channel.

Overall sensitivity of the converter-receiver system is very good, signals as low as 0.2 uV being clearly audible. The gain control range is about 20 dB.

CHOOSING A CRYSTAL

The frequency injected at gate 2 of the mixer FET, Q2, may be above or below the signal frequency by an amount equal to the IF frequency. For a turnable receiver used as an IF, the injection frequency should be lower than the *lowest* signal frequency by 10 MHz. Thus, as you tune the receiver upwards in frequency from 10 MHz, you will tune signals above the lowest aircraft band frequency (118 MHz). In this way there will be a simple relationship between the signal frequency and the receiver's dial. If 10 MHz equals 118 MHz, 10.5 MHz will equal 118.5 MHz, and so on. For this situation the injection frequency will be 118 – 10 = 108 MHz. As the crystal oscillator output (collector of Q3) is twice the crystal frequency, the crystal frequency should be half of 108 MHz = 54 MHz.

If you use a tunable receiver than a fifth overtone crystal at 54.000 MHz should be ordered. Tolerance and adjustment range also have to be specified. A value of 20 parts per million (ppm) for tolerance and adjustment range is satisfactory. Firms such as Bright Star Crystals or Hy-Q should be able to supply a crystal to order.

Alternatively, a crystal at one-third the injection frequency may be used. Taking the 108 MHz injection frequency, as just illustrated a 36 MHz crystal may be used.

To determine the crystal frequency required for any case, use the following formula:

$$\text{Crystal} = \frac{\text{lowest signal frequency} - \text{IF}}{2 \text{ or } 3}$$

Inexpensive crystals intended for use in 'scanning' receivers are available from Dick Smith's. These provide an injection frequency *above* a particular aircraft channel frequency for the standard IF frequency of 10.7 MHz. For example, for the 125.8 MHz channel, the injection frequency is 136.5 MHz. These crystals have the channel frequency marked on them, not the crystal frequency.

SETTING THE CRYSTAL FREQUENCY

If you require accurate frequency readout then the crystal frequency will need 'trimming'. Coil L7 is provided for this purpose. For best results a digital frequency meter capable of measuring to 150 MHz is necessary.

Lightly couple the DFM to L5 or L6 via a small value capacitor and see if you get a sensible reading. You may need to connect it directly across gate-2 of the mixer, Q2.

Adjust L7 until you obtain the correct injection frequency according to the crystal chosen.

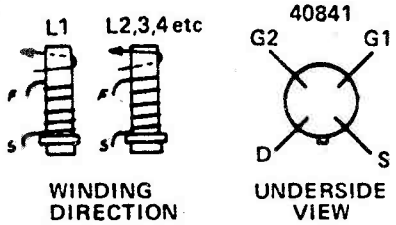
BUYLINES

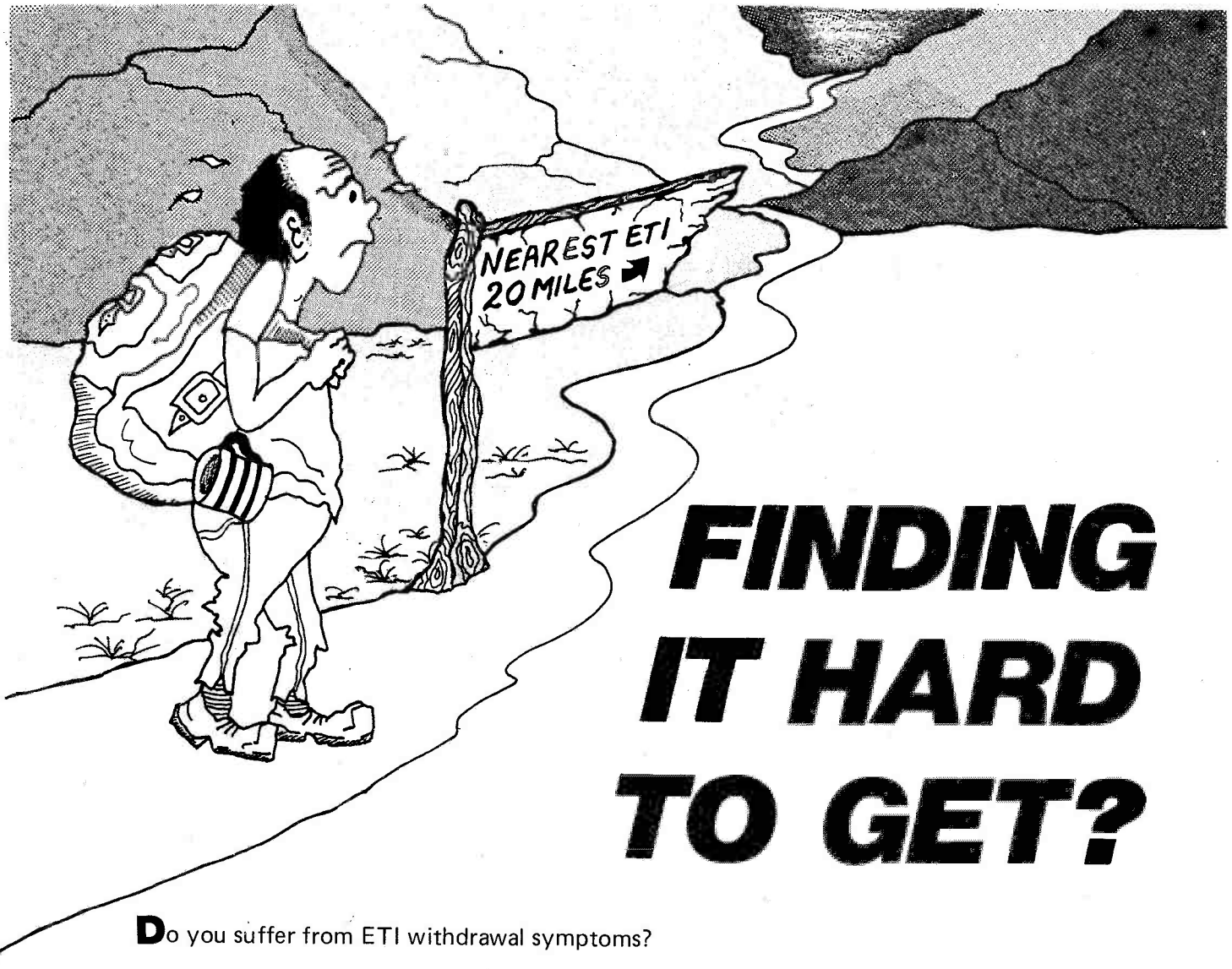
Components for this project are available from Catronics Ltd, Communications House, 20 Wallington Square, Wallington, Surrey SM6 8RG.

Coil Data

Wind L2, L3, L4, L5, L6 and L7 *clockwise* up the former. L1 is wound *anti-clockwise* up the former. The start of each coil is the 'cold' or 'earthy' end. All slugs are F29 type ferrite.

L1	5 turns, 22 B & S tinned copper wire spaced over 10 mm, tap at 2 turns from cold end.
L2, L3	6½ turns, 22 B & S enamelled wire, spaced over 8 mm.
L4	25 turns closewound with enamelled wire, any gauge between 25 and 30 B & S, 5 turn link at top of former.
L5, L6	5½ turns, 22 B & S enamelled wire, closewound.
L7	*10turns, 22 B & S enamelled wire, closewound, for crystals in the range 30 MHz to 50 MHz. *6 turns for crystals in the range 50 to 70 MHz.





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DESIGNER'S NOTEBOOK

Project Editor Ray Marston passes around a few design problems with LEDs and chews a CMOS 555!

The path of the electronics design engineer is fraught with nasty booby traps in the form of seemingly simple little circuits which fail, in practice, to work in the anticipated manner. Take, for instance, one of the problems that faced the ETI projects team when the 'AMBUSH' game was being designed last year (see the April '79 issue).

Ambushed by LEDs

This particular booby trap centred on the LED 'attack' display that was used in the 'ambush' game. In essence, the display comprised four unequal-length lines of LEDs. All LEDs were driven from the outputs of a single 4017, but the lines were selected one at a time by a multiplexer, so that only one LED was on at any given moment. A greatly simplified diagram of the original (defective) version of this display is shown in Fig. 1. Although this diagram shows only three columns of LEDs, with a maximum of three LEDs in any one column, it does illustrate the basic 'trap' perfectly well.

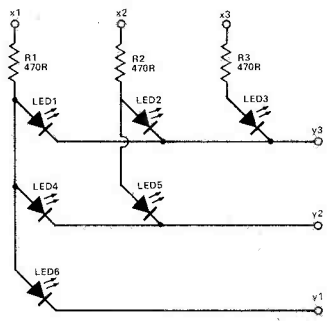


Fig. 1. A simplified view of the original Ambush LED lines.

In this diagram, the 'x' lines are driven by the outputs of the 4017, so that one line is high (at +12V) at any given moment and the other two lines are at zero volts. The 'y' lines are driven by a multiplexer or multi-way single-pole switch, which pulls one line to zero but leaves the other two lines open-circuit at any given moment of time.

Figure 2 shows the results that were (rather naively) expected from the circuit under two specific operating conditions and compares them with the results that were actually obtained. In Fig. 2a, + 12V was fed to the xl line and the yl line was coupled to zero volts. As expected, LED 6 illuminated.

x1	x2	x3
+12V	0V	0V
y1	y2	y3
0V	0/c	0/c

x1	x2	x3
0V	0V	+12V
y1	y2	y3
0V	0/c	0/c

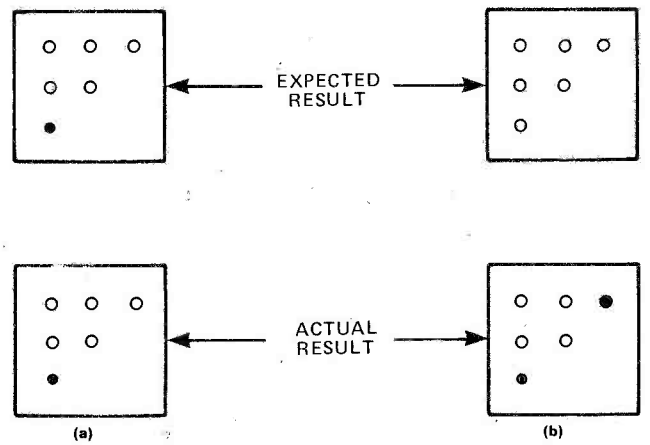
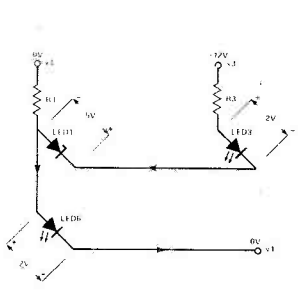


Fig. 2. Given the operating conditions, shown (top), these are the results which were expected (middle) and actually obtained (bottom).

In Fig. 2b, +12V was fed to the x3 line and the y1 line was coupled to zero volts. It was expected that no LEDs would illuminate. In practice, LEDs 3 and 6 illuminated. Equally confusing results were found to occur in certain other combinations of switching position.

If you read last month's 'Notebook,' which dealt with LED pitfalls, you'll have already figured out the cause of the 'ambush' problem(!) If not, Fig. 3. illustrates the cause of the trouble quite well. The problem arises because of the low reverse breakdown voltages (5V in this case) of the LEDs. In this particular instance, forward current was flowing through LEDs 3 and 6 via reverse-biased LED 1, which had gone into the Zener mode.

The solution to this particular design problem is shown in Fig. 4. Here, ordinary diodes are used in place of all absent LEDs in the matrix, so that a ready conducting path exists in all switching positions, and no LEDs therefore become reverse biased. When this circuit is applied to the ▶



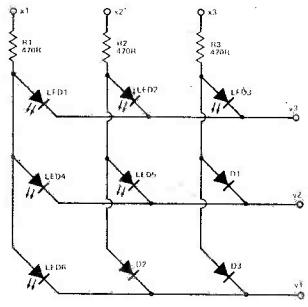


Fig. 3 (left) Low reverse breakdown voltages cause the problem here. Fig. 4 (right). Replacing absent LEDs with ordinary diodes is the solution here.

Fig. 2b situation, D3 conducts and all LEDs remain off.

As we pointed out last month, LEDs can be tricky little brutes.

●

We ran into a rather intriguing little problem when building the hand-held remote-control unit for 'The Beast' that is featured in this month's issue of ETI. The problem was that the unit's up/down counter was giving erratic operation. We knew that the fault was one of construction, rather than design, so laboriously went through all the normal troubleshooting procedures and finally isolated the fault (by intuition, rather than anything else) to the area of the 4093B dual-oscillator circuit shown in Fig. 5.

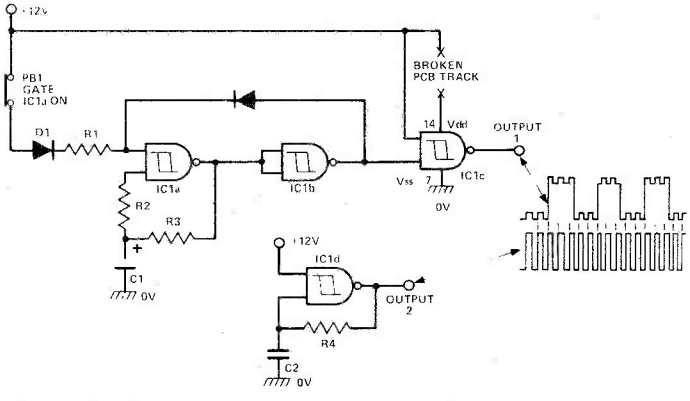


Fig. 5. A broken track caused problems in this 4093B dual oscillator, but proved difficult to find.

As you can see from the circuit, the fault was actually caused by a broken track connection to the IC's positive supply terminal. In practice, however, this simple fault was the devil's own job to find, for the following reasons:

First, the PCB was double-sided, which made it difficult to trace some of the tracks on visual inspection. Next, normal test-meter checks showed that a near-enough 12V supply did in fact appear on positive supply terminal 14 of the IC. Finally, oscilloscope inspection of the output terminals of the IC showed that the two oscillator waveforms of the circuit (see Fig. 5.) were indeed present, further strengthening the belief that the positive supply connection was OK. Suspicion was caused, however, by the fact that the waveform from output 1, which should have been a clean square wave, showed signs of being amplitude modulated by waveform 2. The fault was eventually located visually.

Figure 7 illustrates how the circuit managed to work and produce a ''supply voltage' on it's pin-14 V_{DD} terminal, in spite of the broken supply rail track connection. The diagram shows the internal gate protection network that is fitted to each one of the input terminals of the 4093B. On gates IC1c and IC1d one of these inputs is taken directly to the positive supply rail, enabling supply current to flow to the V_{DD} terminal via RA and D1, and thus power the oscillator circuits!

So how's that for an unusual 'beasty' story?

CMOS 555 -- 7555

If you've ever played with the ubiquitous 555 timer chip (and who hasn't?), you'll know that it has a few inherently unpleasant characteristics, as well as a whole stack of good ones. It does not, for example, like supply voltages that are significantly below 5V, and it typically draws a hefty 10mA of quiescent current when operating from a 15V supply. Worst of all, it draws a massive 400mA 'spike' of current from the supplies as it transitions from one state to another, and this spike tends to play havoc with any digital circuitry that is powered from the same supply lines.

Fig. 6. (Below). A rationalised comparative summary of the bipolar and CMOS 5555.

PARAMETER	TEST CONDITION	BIPOLAR 555	CMOS 555	UNITS
SUPPLY VOLTAGE RANGE		4.5 to 16	2.0 to 18	V
OPERATING TEMP. RANGE		0 to +70	−20 to +70	°C
SUPPLY CURRENT, TYP.	Vcc = 15V, RL = ∞	10	0.1	mA
OUTPUT CURRENT, MAX		200	100	mA
POWER DISSIPATION, MAX		600	200	mW
TRANSITION 'SPIKE' CURRENT, TYPICAL	Vcc = 15V	400	10	mA
TIMING ERROR, MONOSTABLE INITIAL ACCURACY, TYP	R = 2k0 to 100k C = 100n	1	2	%
THERMAL DRIFT, TYP	Vcc = 15V	50	50	ppm/°C
DRIFT WITH Vcc, TYP		0.1	1.0	%/V
THRESHOLD CURRENT		100	.01	nA
TRIGGER CURRENT		0.5	10^{-5}	uA
RESET CURRENT		0.1	2×10^{-8}	mA
OUTPUT RISE TIME, TYP	RL = 10M, CL = 7pF	100	40	nS
OUTPUT FALL TIME, TYP	RL = 10M, CL = 7pF	100	40	nS
PROPAGATION DELAY OF TRIGGER PULSE, TYP	Vtrig MINIMUM LEVEL = 0V, TEMP = 25°C	100	310	nS
MINIMUM PULSE WIDTH REQUIRED FOR TRIGGERING	Vtrig MIN LEVEL = 0V Vcc = 15V, TEMP = 25°C	20	90	nS

You'll be pleased, therefore, to hear that Intersil have recently introduced a CMOS version of the 555 timer, known as the ICM 7555, which does not suffer from the basic defects of the bipolar version. Specifically, it can operate over the supply voltage range 2VO to 18V, typically draws only 100uA quiescent from a 15V supply, and draws a trivial 10mA 'spike' of current when transitioning. Additionally, the required threshold, reset, and trigger currents of the CMOS device are several orders of magnitude down on the bipolar version, enabling timing resistors (for example) to be given values of hundreds of megohms.

Twice As Nice?

On the debit side, this new CMOS chip costs twice as much as the bipolar version, has worse initial-timing-accuracy and drift-with-voltage characteristics, has poorer output current drive and power dissipation capability, and has worse propogation delay and pulse-triggering characteristics. A 'rationalised' comparative summary of the characteristics of the two devices is shown in Figure 6.

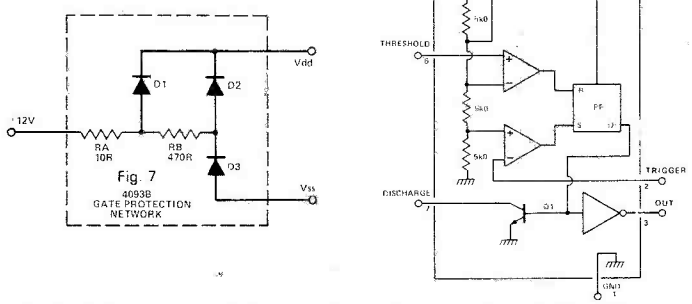


Fig. 7 (left) the internal gate protection network of the 4093B. Fig. 8 (right) The internal circuitry of the familiar bipolar 5555.

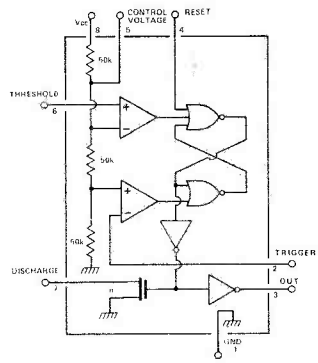


Fig. 9. The internal circuitry of the CMOS 555.

Figures 8 and 9 show the simplified internal circuits of the two devices. Note particularly the great differences in the relative values of the voltage divider chains that are used in the different versions of the IC.

The CMOS and bipolar versions of the IC are housed in identical packages. The CMOS chip can be used as a plug-in replacement in existing 555 bipolar circuits. The reverse is not necessarily the case, since the CMOS version can use timing and other resistance values that are several orders of magnitude greater than is possible with the bipolar version.

If you want to play with the ICM 7555, you can buy it from Watford Electronics, whose advert appears elsewhere in this issue.

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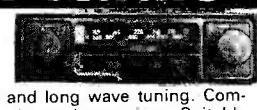

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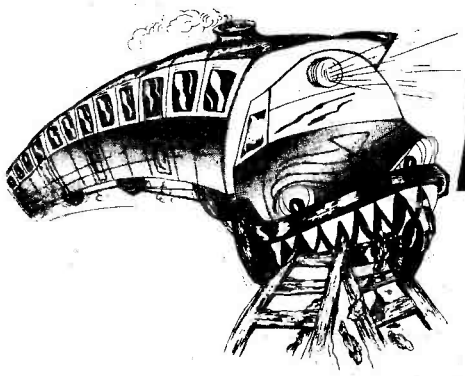


MODEL TRAIN CONTROL SYSTEM

This month you can sink into your armchair and watch the locos locomote under the fingertip command of your remote controller.

Encoder/Transmitter

The major part of the encoder (Fig 2) circuit is wired up on a double-sided PCB, with the LED Readout circuitry implemented on an additional single-sided board. The display board is identical (apart from component numbering) to that used in the Train and Points-Controller units, and construction should present no problems.

The most important point to notice on the double-sided PCB is that wire-wrap IC sockets are used in the construction, to enable solder connections to be made to tracks on either or both sides of the PCB where necessary. All pin-throughs and other components that pass through tracks on both sides of the PCB should, naturally, be soldered to both tracks. Bearing these points in mind, construction should present few problems if the overlay is followed with due care.

When construction of the two boards is complete, you can temporarily interconnect the two circuits and give them a functional check, in conjunction with the 'How It Works' section. The 16-LED display should be fully variable via Points Selector switch SW4. If you have a 'scope, you can check that the output waveform conforms to Fig 1 by triggering the 'scope via pin 9 of IC5.

When the boards have been given a functional check, fit the into a suitable box and couple them up to their controls and indicator LEDs. If you are using a 2-wire control system, you wilo have to fit a couple of 6 volt cells into the controller to provide a 12V supply. In the 3-wire system, the 12V supply is derived from the decoder/data distributor unit via the third wire. You an if you wish, fit the controller with an ON/OFF switch wired in series with the positive supply line.

On our prototype unit we used a 2-pole 4-way DIL switch in the SW1 'System Select' position, the switch is

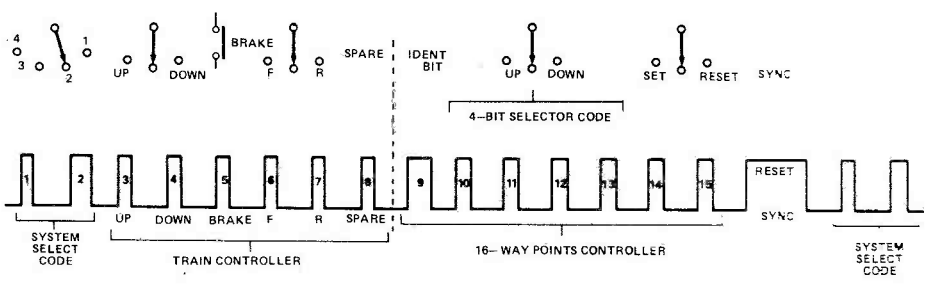
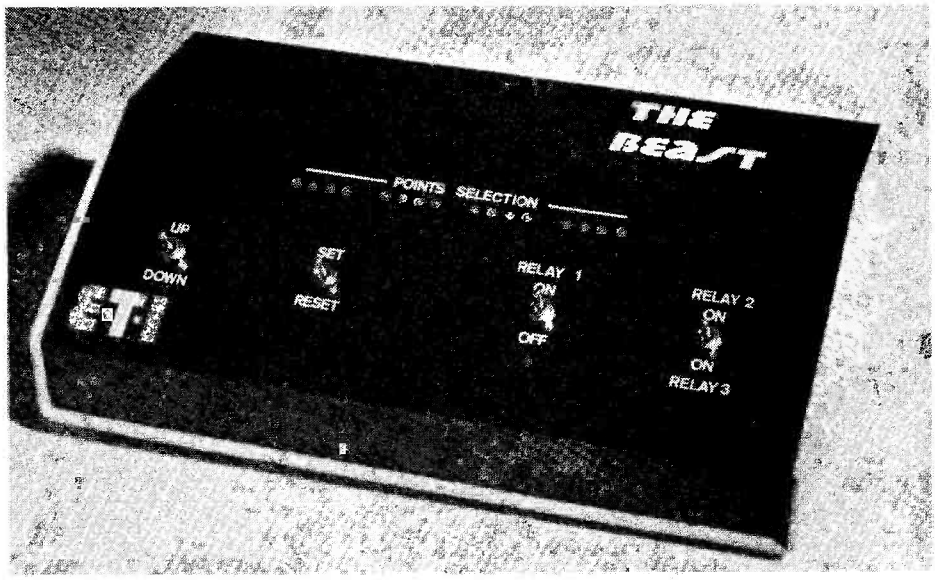


Fig. 1. The 15-bit 'simultaneous' code used by the remote control system.

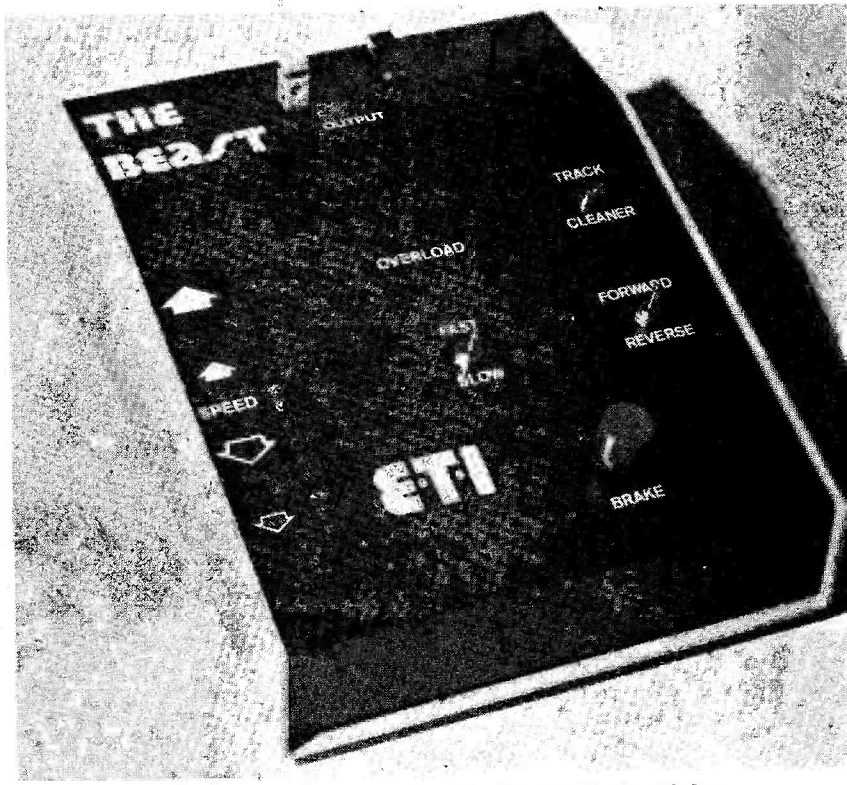


The points controller (above) can control up to sixteen sets of points or relays. It can activate several times per second. The set of points chosen is shown on the row of LEDs on the front panel. Think about your own particular points control needs before you start to build this unit. The data distribution unit is shown on page 91.

epoxied to the front panel. Our controller unit connects to the decoder/data-distributor unit via approximately 3.5 metres of 3-core coiled cable and a 3-pin DIN plug and socket.

▶

The main power supply unit (below) has electronic overload on its output and can power up to four sets of track systems simultaneously.



The train controller (above) gives exceptionally fine speed control, from crawl to supersonic (well nearly). There's also a built-in track cleaner to keep things running smoothly.

REMOTE CONTROL ENCODER

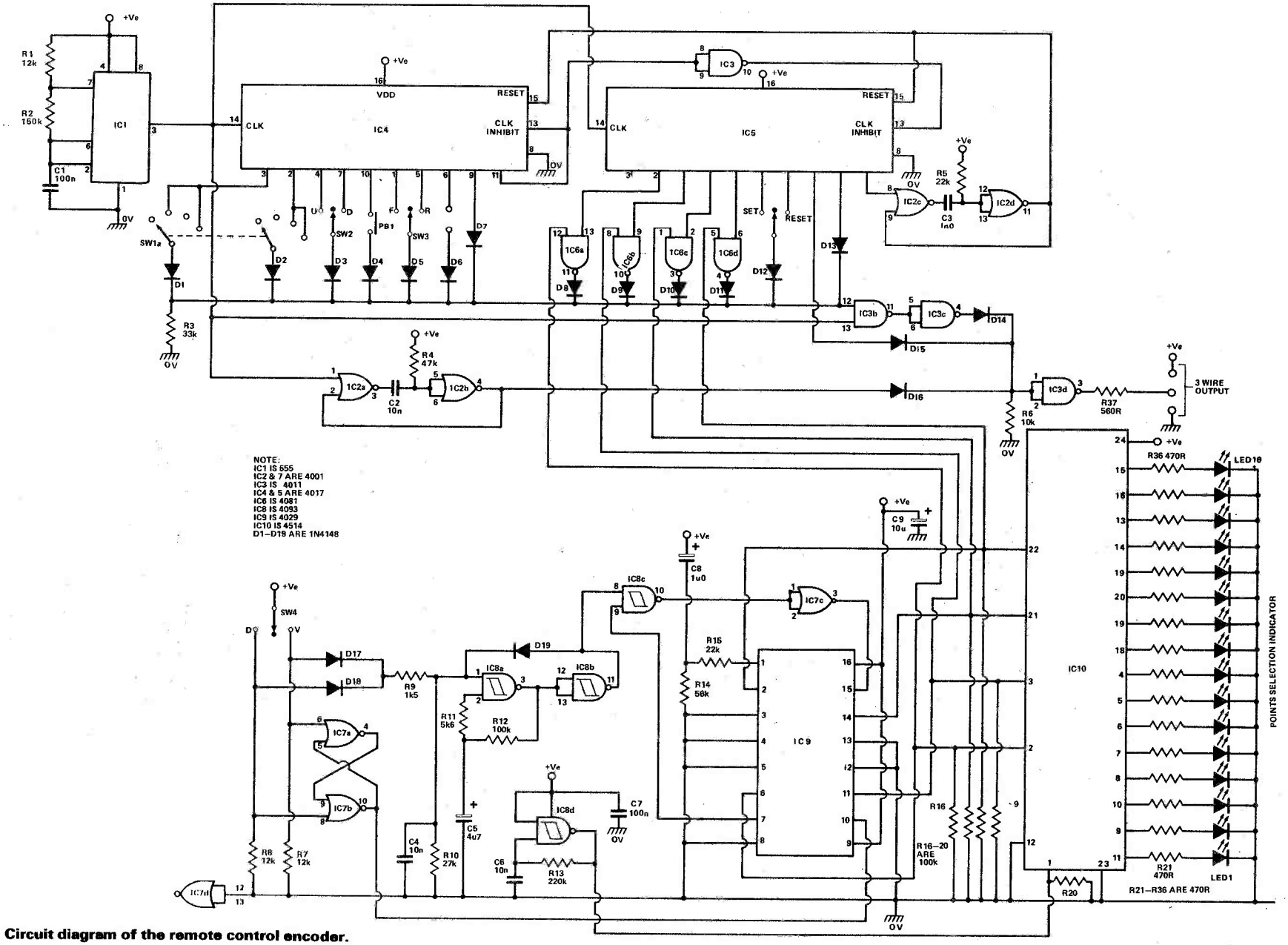


Fig. 2. Circuit diagram of the remote control encoder.

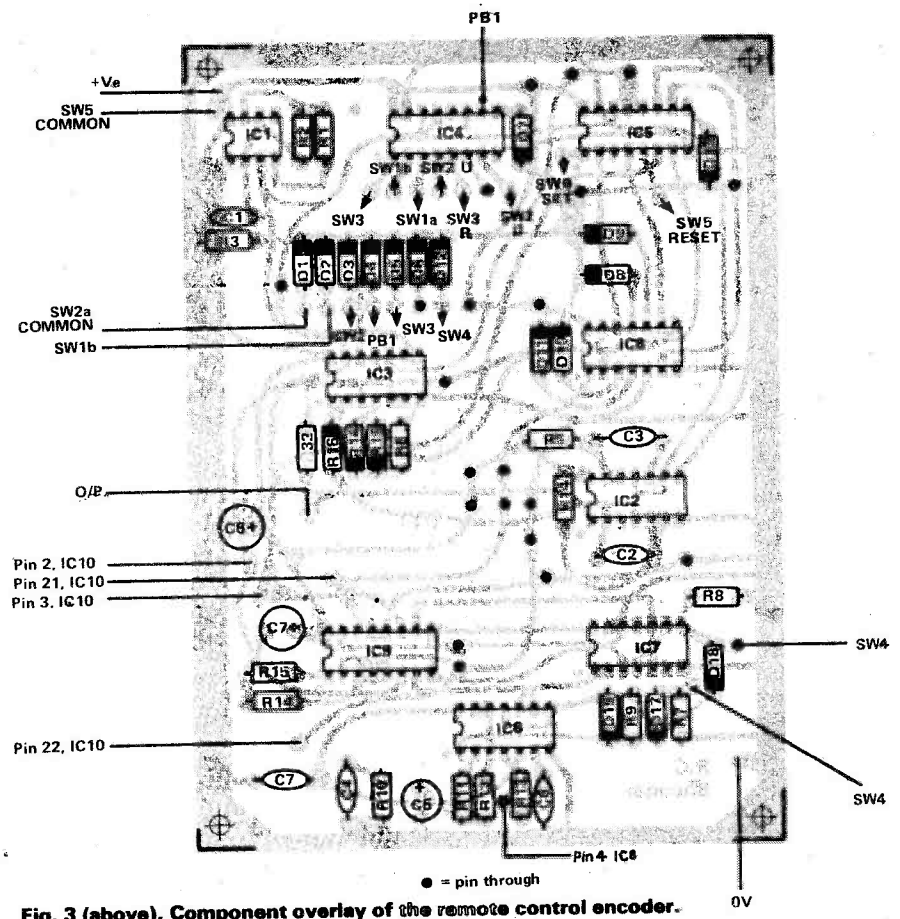
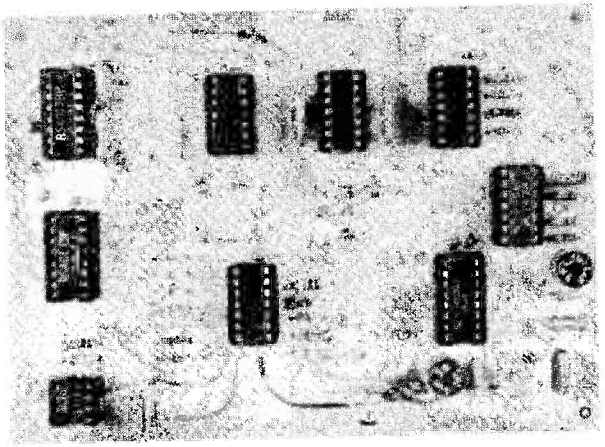


Fig. 3 (above). Component overlay of the remote control encoder. The completed PCB is shown below.



HOW IT WORKS

The circuit of the remote control encoder is shown in Figure 8. Here, IC4 and IC5, together with IC2a and IC2d and IC3a, are wired together as a 17-stage decade counter with 17 decoded outputs and are clocked at a 500 Hz rate via IC1. IC2a and IC2b form a monostable multivibrator that produces a narrow pulse on the arrival of each clock pulse and it's outputs are ORed with the outputs of the counter via D14, D15, D16 and R6, to form a serial chain of negative-going output pulses from R32.a.

Bits 10 to 13 of the code (derived via IC6) originate as the 4-bit outputs of up/down counter IC9 which functions in the same way as the 'Points Select' counter of the F 6 'Power Switch Selector' circuit. The 4-bit output of IC9 is decoded and fed to a 16-LED display on the hand-held transmitter/encoder unit, to give the operator a visual indication of the number of the point that has been selected.

The optional remote control system uses a serial 15-bit simultaneous code, as shown in Figure 7. The code comprises the fifteen bits, each separated by 2 mS, plus a 3 mS reset or synchronisation pulse, all transmitted within a 50 mS frame. A narrow code bit represents a '0' or OFF logic state, and a wide code bit represents '1' or ON logic state.

The first two bits of the code are used to select the desired (one of four) track system. Bits 3 to 8 are used to control the track on that track. The remaining seven bits are used to select and activate the (up to 16) points on that track system.

When the remote control system was being developed, we considered the possibility of using an ultra-sonic, infra-red, or radio 'link' between the transmitter/encoder and the receiver/decoder, but rejected all three systems on sound technical and/or ergonomic grounds. We finally settled on the use of a 2- or 3-wire flexible link, that can be simply plugged into any one of a number of jack sockets scattered around the layout at (typically) 4 metre intervals. The two control systems are identical, except that the 2-wire transmitter/encoder uses it's own 12 volt battery supply, while the 3-wire unit derives it's 12 volt supply from the receiver/decoder unit.

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R2	150k
R3	33k
R4	47k
R5,15	22k
R6	10k
R9	1k5
R10	27k
R11	3k6
R12,16-20	100k
R13	220k
R14	56k
R21-36	470R
R37	560R

CAPACITORS

C1,7	100n polyester
C2,4,6	10n polyester
C3	1n0 polyester
C5	4u7 15V electrolytic
C8	1u0 15V electrolytic
C9	10u 15V electrolytic

SEMICONDUCTORS

IC1	555
IC2,7	4001
IC3	4011
IC4,5	4017
IC6	4581
IC8	4093
IC9	4029
IC10	4514
D1-19	1N4148
LED1-16	TIL 209

MISCELLANEOUS

SW1 double pole 4 way rotary switch
SW2-4 single pole changeover switch

REMOTE CONTROL DECODER

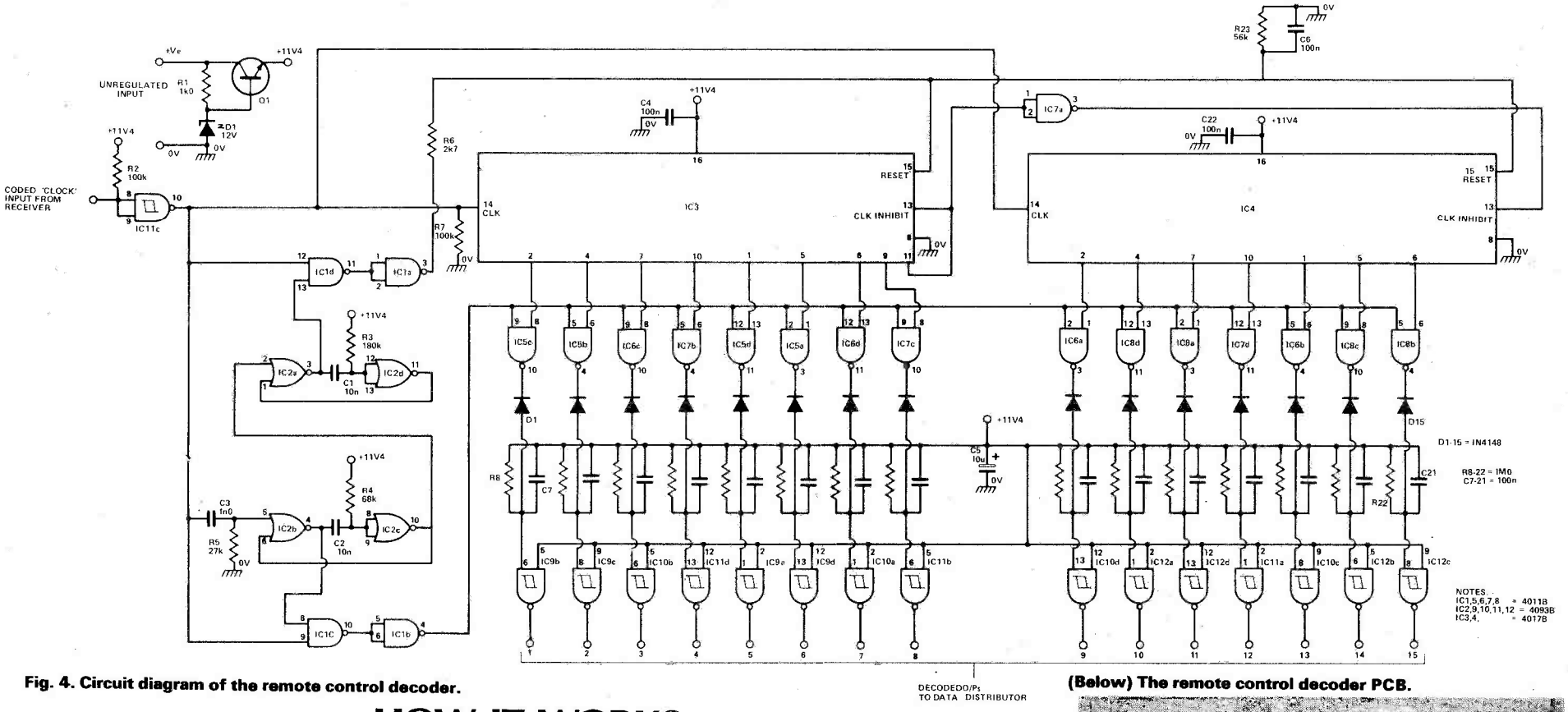


Fig. 4. Circuit diagram of the remote control decoder.

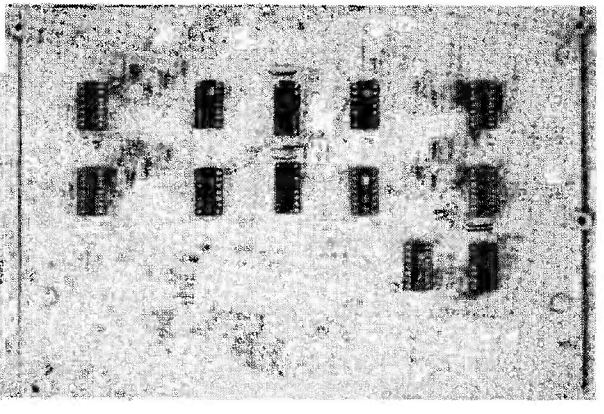
HOW IT WORKS

The 15-bit-plus-sync-pulse serial code signal from the transmitter encoder is received and inverted by IC12d and is then distributed to various points in the circuit. IC3-IC4 and IC5a form a multi-stage 'decade' counter with 15 'decoded' outputs, and is clocked by the IC12d output signal. The synchronisation bit of the code signal is detected by the IC2a-IC2b monostable and the IC1a-IC1b logic network, and is used to reset the counter at the end of each transmission frame.

The IC2c-IC2d monostable produces a narrow 'reference' pulse on the arrival of each code pulse. The width of each incoming code pulse is compared with that of the reference by the IC1c-IC1d logic network, which produces a '0' output if the code pulse is narrow or a '1' output if the code pulse is wide. The output of IC1d is NANDed with each of the outputs of the counter, so that each NAND stage produces a single brief negative-going pulse in each frame only if it's respective 'code' pulse represents a '1' or ON command. Each narrow pulse (if it is present) is expanded to a width greater than that of a single frame by a diode-(D1-D15) resistor (R8-R22) capacitor-(C7-C21) inverter (IC9a-IC12c) network, so that each of the final fifteen decoded outputs of the unit forms a true DC On (high) or OFF (low) representation of the respective command instruction that was given in the transmitter encoder unit. These decoded outputs are fed to the model railway control units via a data distributor unit.

QT is a simple voltage regulator, and provides an 11V4 supply to the decoder and the data distributor, and also to the encoder if a 3-wire control system is used.

(Below) The remote control decoder PCB.



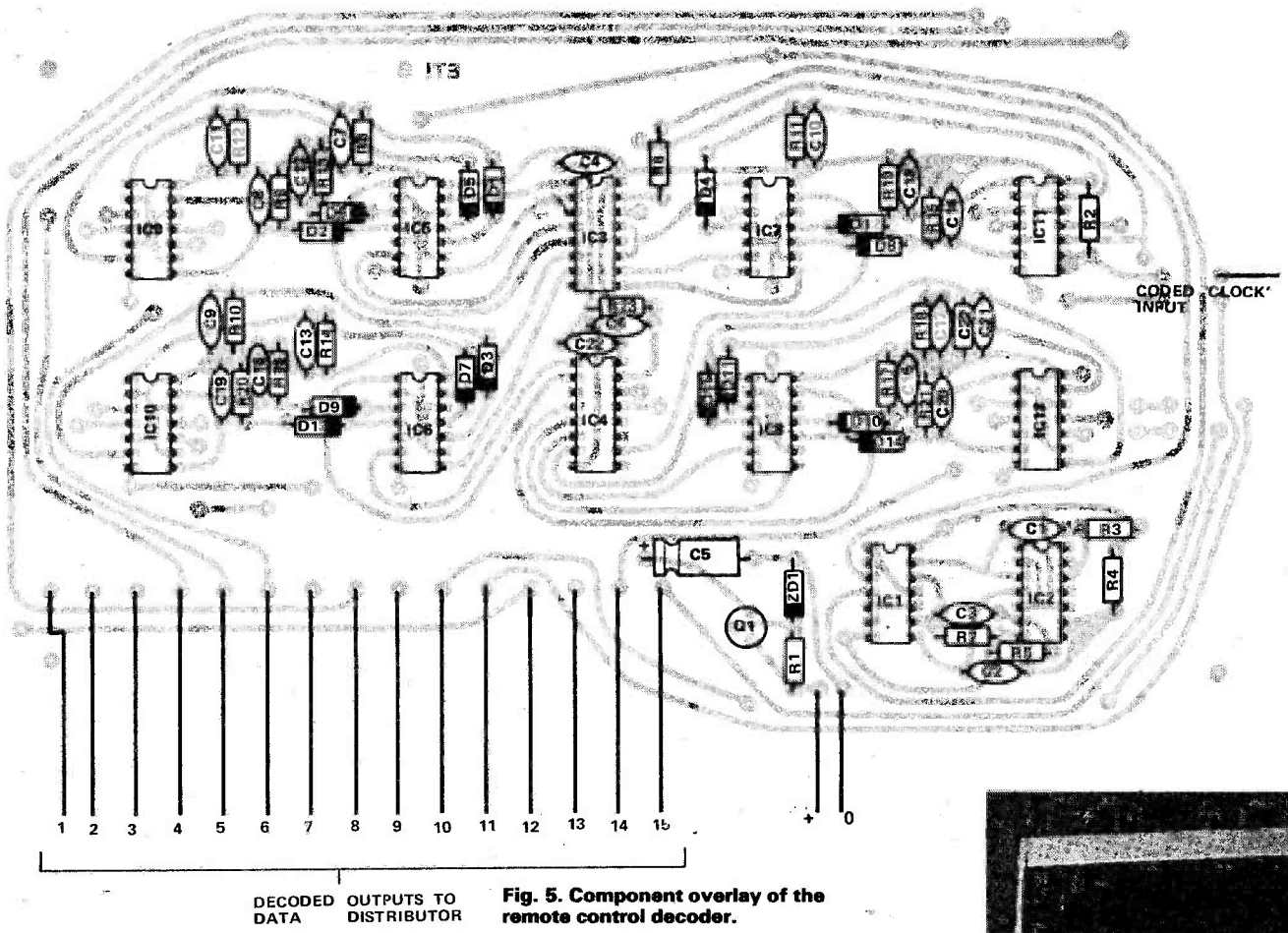


Fig. 5. Component overlay of the remote control decoder.

Remote Control Decoder

The complete decoder (Fig. 4) circuit is built on one double-sided PCB. This board uses conventional IC holders, and construction should present few problems if the overlay is followed with care.

When construction is complete, connect the board to an 18 volt power supply, connect the input signal from the encoder/transmitter, and give the circuit a full functional check in conjunction with the 'How It Works' section. Should the circuit fail to work correctly, suspect (1) a wiring error, (2) a component failure, or (3) and out-of-tolerance component in one of the two monostables built around IC2.

The Beast is then complete and ready to use. If you want to get maximum value from the remote control facility, you can fit a three-wire 'ring' circuit around your complete model railway layout, with 3-pin DIN sockets wired into the ring at roughly 4 metre intervals, so that you can operate the remote controller from any position around the layout!

ETI

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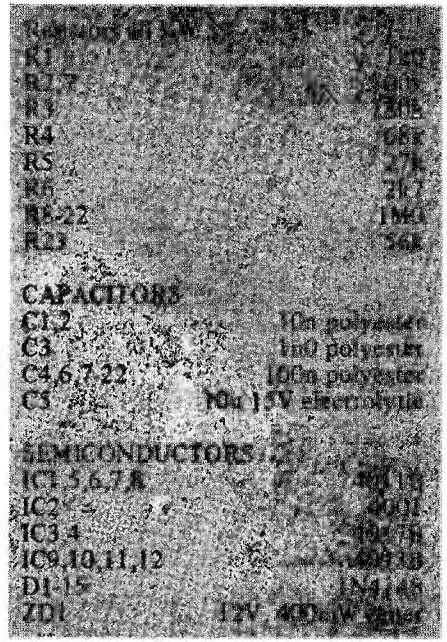

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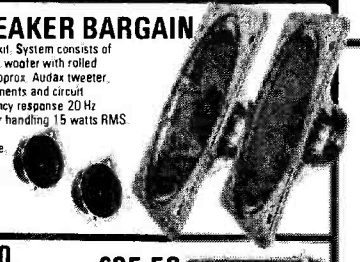


Stereo pair 350 kit. System consists of 13" x 8" approx. woofer with rolled surround; 2½" approx. Audax tweeter, crossover components and circuit diagram. Frequency response 20 Hz to 20 KHz. Power handling 15 watts RMS. 20 watts max. 8 ohm impedance.

£18.25

Per stereo pair £3.65 p&p

BSR P200

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

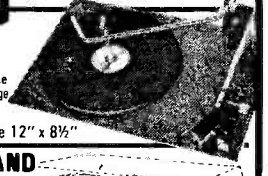
A.D.C. QLM 30 Mk III Magnetic Cartridge to suit. **£7.95**

BSR

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

OUR PRICE **£11.25** p&p £2.75

GARRARD DECK MODEL CC 10A



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

£8.15 p&p £2.05 Size 12" x 8½"

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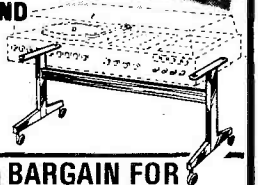

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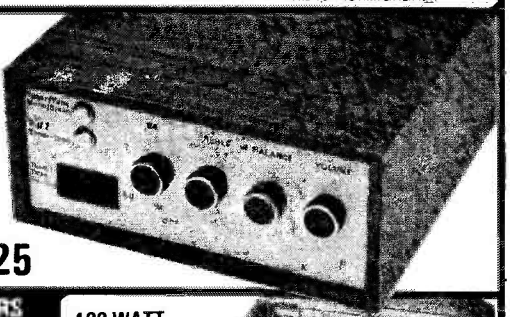
Suitable mains power supply parts, consisting of mains transformer, bridge rectifier, smoothing capacitor and set of rotary stereo controls for treble, bass, volume and balance **£3.00** plus £1.50 p&p

Two Way Speaker Kit

Comprising of two 8" x 5" approx. 4 ohm bass and two 3½" 15 ohm mid-range tweeter with two cross-over capacitors. **£4.05** per stereo pair plus £1.55 p&p

AVAILABLE ALSO TO PURCHASERS OF THE 10 + 10 AMPLIFIER KIT.

10 + 10 AMPLIFIER KIT



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

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p&p £4.05 **£66.45**

50 WATT MONO DISCO AMP

£30.60

p&p £2.70

Size approx. 13⅜" x 5¼" x 6¾"

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

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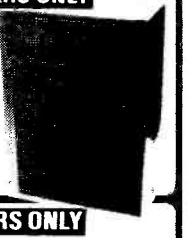
DUO II SPEAKERS



Attractive teak finish, modern design, incorporating 2 speaker units – 8" approx. woofer and 2½" approx tweeter. 45 to 1800 Hz Impedance 8 ohms Power 15 watts RMS

18½" x 13½ x 7¼" approx Per stereo pair **£16.50**

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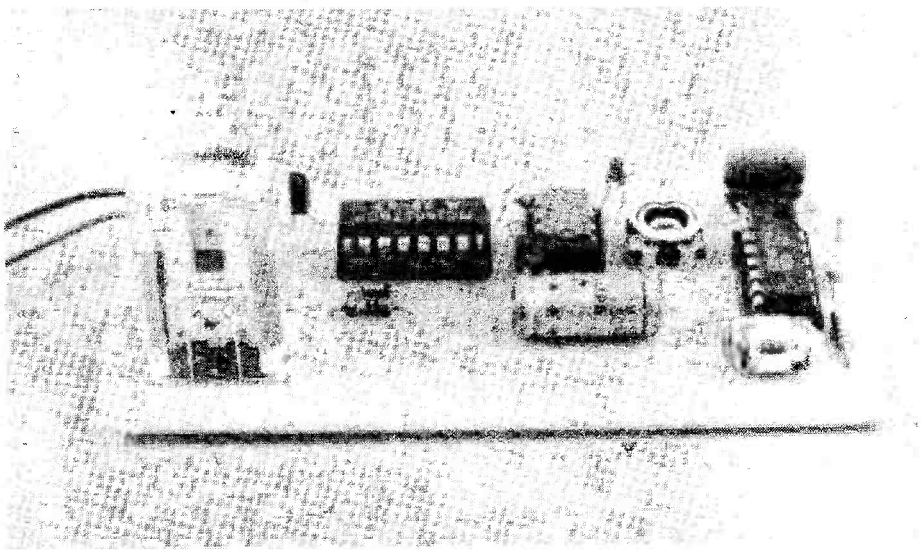
TOUCH SWITCH

A unique relay-output bistable touch switch that works on the capacitive loading principle. It uses a single touch contact, and is unaffected by moisture and dirt.

Most touch switch circuits published in recent years use a pair of metal contacts as sensors. When human skin resistance bridges these contacts, a readily-detectable indication of the touch action is given. A major problem with this type of circuit is that, since it is simply a resistance-sensing system, it can easily be disabled by any conductive medium, such as dirt or moisture, that bridges the contacts.

The ETI touch switch does not suffer from this problem. It is activated via the capacitive loading that occurs when a person touches or is 'coupled' to a single sensor contact. This contact can take any one of a large variety of forms. It can be a piece of metal the size of a pin head, or a piece of wire with a length variable from a fraction of a centimetre to several metres, or a large plain or highly decorated metal plate or printed circuit board. In the latter two cases, the plate or board can even be covered in an insulating material, such as plastic or varnish, since it is not necessary to actually touch the metal of the sensor to cause circuit operation, but merely to be capacitively coupled to it.

Our touch switch has a relay output and gives bistable operation. If you 'touch' the sensor contact once, the relay turns on and latches into that state until the next time you touch the sensor, at which point the relay turns off. You can use the relay contacts to control house lights, etc, in which case you get alternate touch-ON, touch-OFF, touch-ON, etc, operation.



Construction And Use

All electronic components are mounted on a single PCB, leaving only the battery and relay output connections and a single lead to the touch pad to be soldered, so you should have no trouble in construction. Use IC sockets and double check that all semiconductors are inserted correctly before initial switch on. When construction is complete, connect a suitable touch pad (a length of wire, or a metal plate, etc) in place, connect up the relay and apply power to the circuit.

Initial setting up of the circuit is quite simple, but is necessary whenever a different touch pad is connected to the unit. Turn the present pot fully anti-clockwise and then, with the touch pad untouched, adjust the pot clockwise until LED 1 just comes on and the relay is heard to operate. Note the setting of the pot. Now touch the sensor pad firmly, and turn the pot slowly anti-clockwise until the LED just goes out. Note the new setting of the pot. Release the touch pad and adjust the pot to half way between the two settings. You should now find that the LED and relay activate whenever you touch the sensor and that the LED turns off again (but the relay does not) when the sensor is released. This setting up procedure gives an optimum sensitivity/stability performance.

Scope For Proximity

There is plenty of scope for experimenting with this circuit. If a touch pad with a large surface area (a metal plate or an area of foil) is used and the circuit is set for maximum sensitivity, it will act as a proximity switch. The proximity range can be maximised by taking the negative supply line of the circuit to earth via the mains ground line.

You'll notice from the circuit diagram that only one half of dual J-K flip-flop IC3 is used. Consequently, if you want to make two touch switches and are capable of doing a little of your own design work, you can make the second switch by simply duplicating the C2, rectifier, and IC2 circuitry, using the spare half of IC3, and feeding the new C2 from the output of the existing IC1 oscillator circuit.

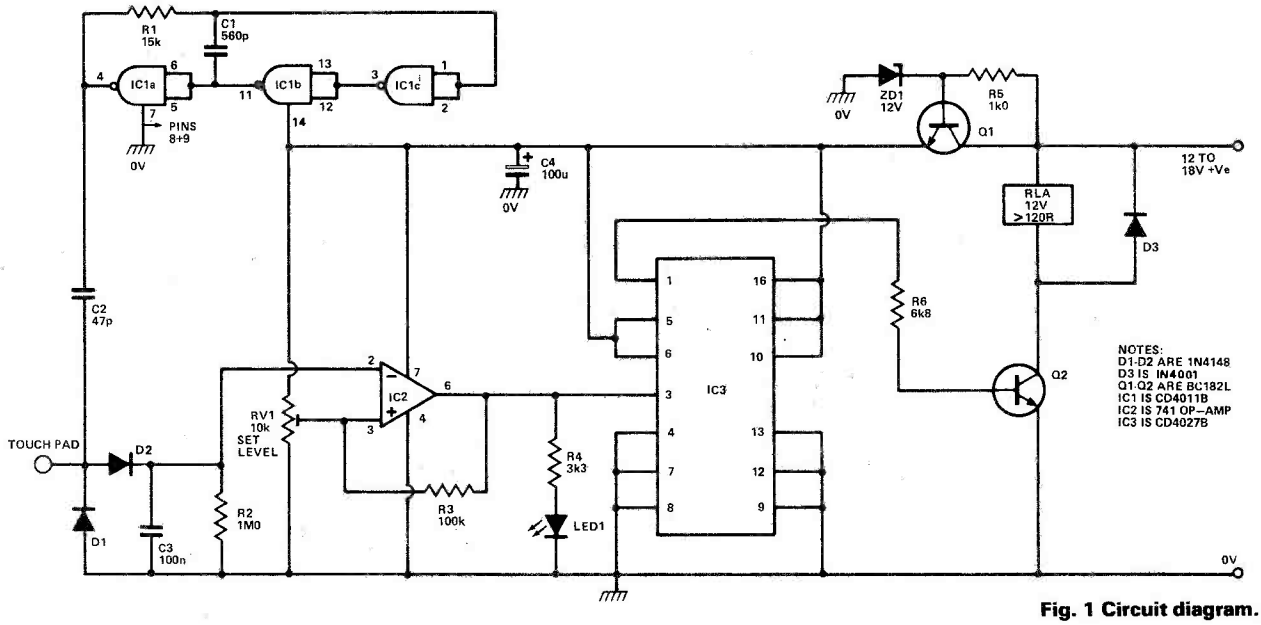


Fig. 1 Circuit diagram.

HOW IT WORKS

IC1 forms an astable multivibrator clocking at a frequency in the region of 100 kHz. Capacitor C1 forms a capacitive voltage divider effect with stray capacitance of the touch pad, which, after rectification via D1 and 2, charges capacitor C2. This voltage varies according to the capacitance of the touch pad, which in turn varies as it is touched. The voltage across C2 is, therefore, dependent on whether the touch pad is touched or not.

IC2 forms a comparator, using only a small amount of positive feedback, which compares the voltage across C2 with that from the wiper of level preset RV1. As the voltages cross, upon touching the pad, the output of IC2 goes high and LED 1 lights. Preset RV1 can be adjusted to suit any form of touch pad.

The output of IC2 is fed to the clock input of IC3, a dual JK type flip-flop. This device output changes state ie on/off or off/on, with every pulse input and consequently turns the relay on and off via transistor switch Q2.

Transistor Q1 forms a series pass regulator with R5 and ZD1 to maintain a stable voltage for the main part of the circuit, so that the delicate balance is not upset with variations in applied voltage.

BUYLINES

There should be no problems in obtaining any components for this project.

PARTS LIST

RESISTORS All ¼W, 5%

R1	15k
R2	1M0
R3	100k
R4	3k3
R5	1k0
R6	1k0

POTENTIOMETER

RV1	10k min horiz preset

CAPACITORS

C1	560p polystyrene
C2	47p polystyrene
C3	100n polyester
C4	100u 16V electrolytic

SEMICONDUCTORS

IC1	4011
IC2	741
IC3	4027
Q1,2	BC182L
D1,2	1N4148
D3	1N4001
ZD1	12 volt 400mW
LED 1	TIL 220 or similar

MISCELLANEOUS

12V relay 120R coil or greater

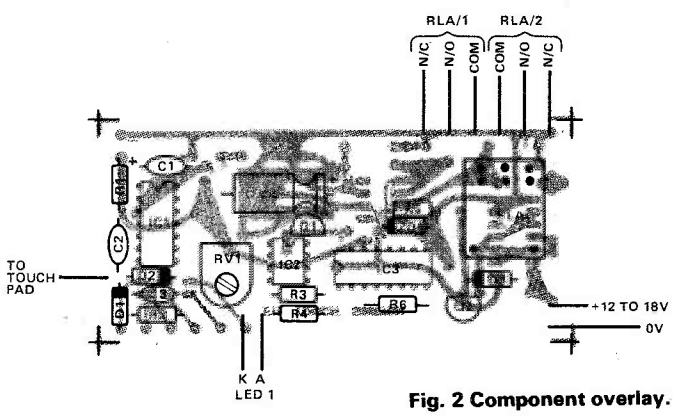


Fig. 2 Component overlay.

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	LS	N
7400	.17	—
7401	.17	.11
7402	—	.11
7403	—	.13
7404	.18	.14
7405	.20	—
7408	.20	.14
7409	—	.15
7410	—	.14
7411	—	.18
7412	—	.18
7413	—	.22
7414	.75	.46
7420	—	.12
7426	—	.22
7427	—	.29
7428	.30	—
7430	.20	.12
7441	—	.53
7442	—	.40
7447A	—	.46
7450	—	.12
7451	.20	.12
7453	—	.12
7454	—	.14
7460	—	.12
7470	—	.22

	LS	N
7472	—	.20
7474	—	.23
7475	—	.29
7476	.34	.20
7478	.34	—
7485	—	1.04
7486	—	.18
7489	—	1.50
7490	—	.28
7492	—	.33
7493	—	.28
7495	.72	.40
7496	—	.48
74107	—	.22
74121	—	.23
74122	—	.33
74126	.35	—
74141	—	.46
74145	—	.46
74150	—	.58
74151	.51	—
74153	—	.43
74154	—	.68
74155	.75	.46
74156	—	.43
74157	—	.40
74160	.98	.57
74161	—	.56
74162	—	.57
73163	.69	.49
74164	—	.60
74165	—	.56
74166	1.69	—
74170	1.31	—
74174	—	.58
74175	—	.58
74180	—	.43
74181	—	1.44
74184	—	1.14
74185	—	1.21
74188	POA	2.02

	LS	N
74190	—	.52
74191	—	.49
74192	.90	.50
74193	.85	.51
74194	.95	.44
74195	.90	—
74196	—	.79
74197	.85	—
74198	—	.99
74221	.95	1.05
74247	—	1.35
74251	—	.81
74253	1.20	—
74273	—	1.27
74279	.55	—
74283	.65	1.13
74293	.80	—
74348	1.31	—
74365	.50	.57
74366	.50	.57
74367	—	.57
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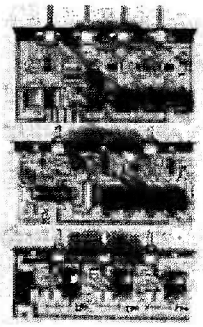

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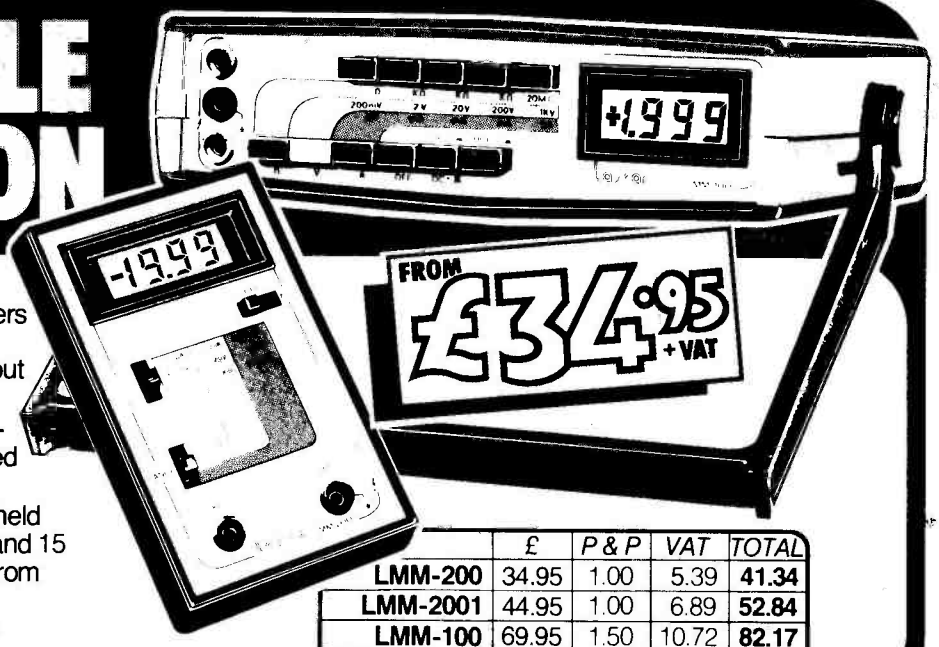

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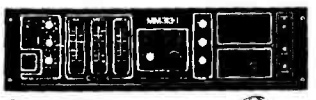

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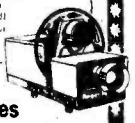
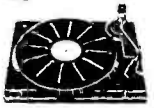


Ropelights Great effect at discos. 7 metres long. Multiway connectors. 4 channel £46.00 (inc.pack of spare bulbs)



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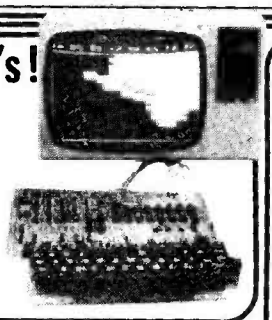

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- Uses the ultra powerful 6502 microprocessor
- 8K Microsoft BASIC-in-ROM
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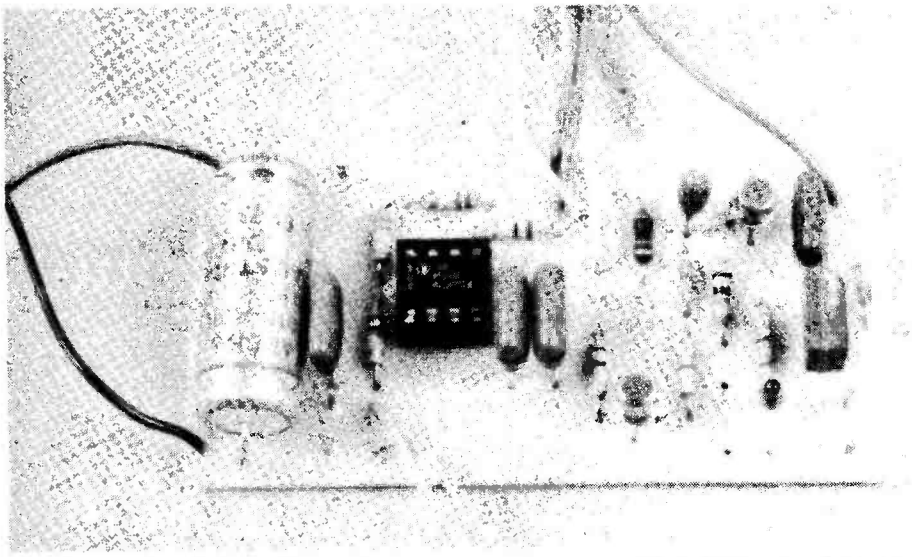
FLASH TRIGGER

Fascinating freeze frame photos from frenetic action with our phenomenal flash trigger.

IF raindrops keep falling on your head, now is the time to build ETI's fabulous flash trigger and catch them bouncing back. See astounding shapes as everyday objects perform a dynamic ballet (Usually too fast for the unaided eye to see).

Of course, you will need a camera and a flash gun. However, even the cheapest electronic flash guns usually have a flash duration of one thousandth of a second or less — fast enough to catch drops of liquid performing their complex aerobatics or freeze a shattering light bulb. If you want to stop a humming bird in flight or investigate instant insects then you will probably have to look elsewhere for your equipment. The attraction of this unit is that it needs no fancy ancillary equipment; you don't need an SLR, just a simple camera whose shutter can be locked open and something to photograph. With a powerful flash gun, even a pinhole camera will do!



Construction

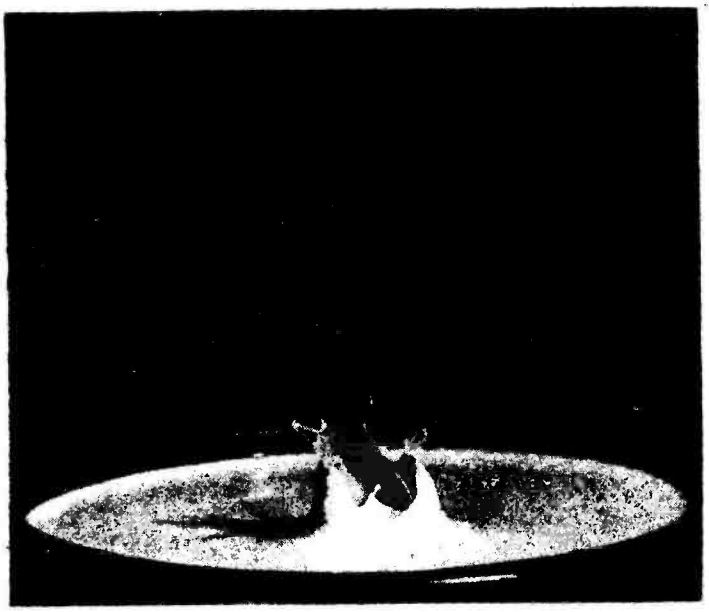
The unit is assembled on one PCB with flying leads connecting the controls. Power is supplied by a PP3 battery or any nine volt DC source.

There are no links to make on the board and none of the components are sensitive to static electricity or otherwise delicate making this an attractive project for assembly by a beginner or student.

A socket is recommended for IC1. These chips do not often fail but it can be infuriating to have to desolder one of you suspect it. In any case, a socket removes any chance of damage from excessive heat. The only point to watch is the orientation of the semiconductors. Use the ones specified; they're cheap and readily available. Make sure you connect the flash gun the right way round across SCR1. Check polarity with a voltmeter but carefully as there may be several hundred volts present.

In use, the unit is switched on and adjusted until it triggers reliably from the chosen sensor. Set up your camera according to the guide table supplied with the flash. Remember that the apertures given relate to the flash-to-subject distance. Place your camera for the best picture (open the shutter) and enjoy instant exposure!

▶



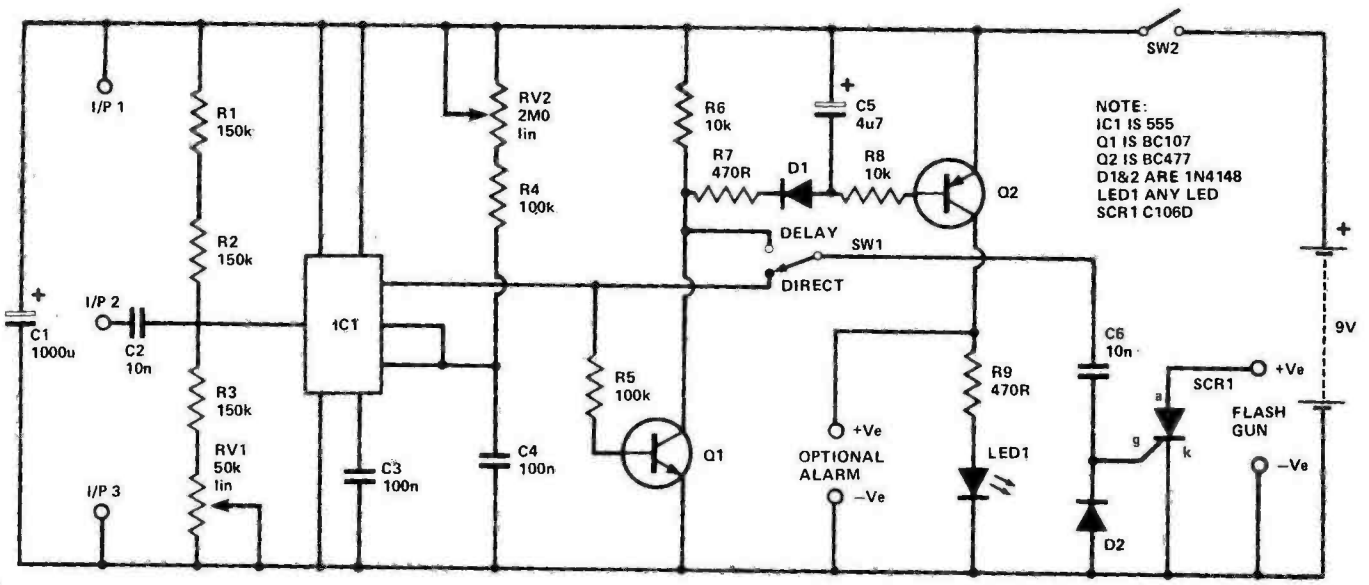


Fig. 1. Circuit diagram for the Flash Trigger project.

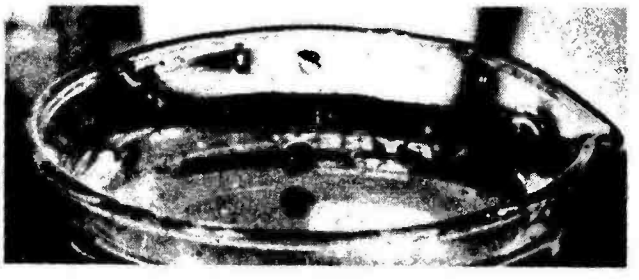
HOW IT WORKS

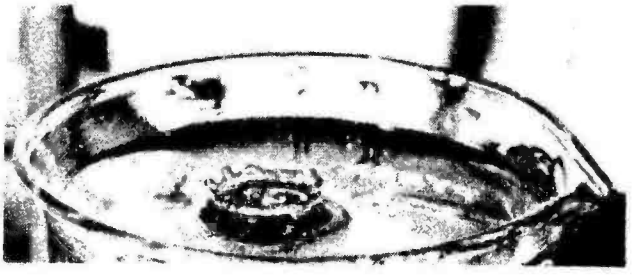
IC1 is a 555 timer connected in the monostable mode. The timing period is determined by RV2, R4, C4 and is adjustable between 11mS and 231mS with the values shown. The trigger input of the chip is held just above its firing potential of one third supply voltage by adjustment of RV1 which acts as a sensitivity control. A negative-going signal is coupled to the input by capacitor C2. Note that the values of R1,2,3,RV1 provide a medium input impedance and screened cable may be required when the sensor must be separated from the unit.

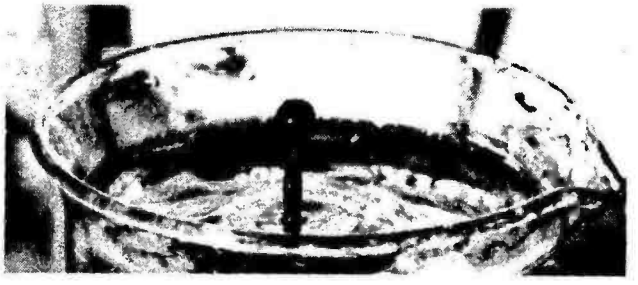
When IC1 is 'fired', its output (pin 3) goes high for the monostable period. With SW1 switched to 'direct', this positive going pulse will fire the SCR and discharge the flash enabling the unit to be used as a slave flash. There will be a finite delay owing to rise time of phototransistor response, propagation delay within IC1 and rise time of its output. However, this will be measurable in microseconds and should be negligible.

When used in the 'delay' mode, the output pulse is inverted by Q1 causing the flash to fire on the trailing edge of the monostable pulse. To avoid repeated use of the flash when setting up the unit, indicator LED 1 is provided. Each negative excursion of Q1 collector causes C5 to charge via R7, D1 effectively stretching the monostable pulse and providing a clearly visible flash. An optional alarm; for example a solid-state-buzzer, can be connected into the circuit providing audible indication of triggering. C1 provides overall decoupling. Supply current is about 10mA.

Below: what to do with it once you've built it. Taken with an ETI Flash Trigger.







PARTS LIST

RESISTORS All ¼W, 5%
R1,2,3 150k
R4,5 100k
R6,8 10k
R7,9 470R

POTENTIOMETERS
RV1 50k lin
RV2 2M lin

CAPACITORS
C1 1000u electrolytic
C2,6 10n polyester
C3,4 100n polyester
C5 4u7 tantalum

SEMICONDUCTORS
IC1 555
Q1 BC107
Q2 BC477
SCR1 C106D
D1,2 1N4148
LED 1 any LED

MISCELLANEOUS
SW1 SPDT SW2 SPST PCB flash-gun-connector, photo-transistor, crystal mic. 9V battery

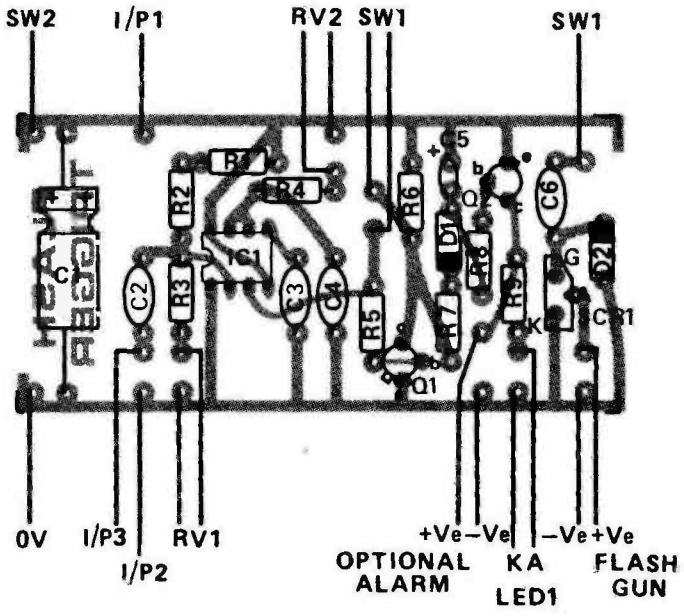


Fig. 3. Component overlay.

BUYLINES

The electronic components will be available from major component suppliers. A suitable flash gun connector should be obtainable from photographic equipment dealers.

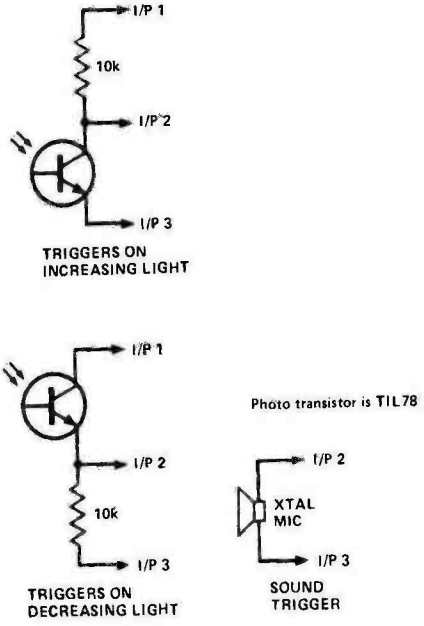


Fig. 2. Wiring details for different triggers.