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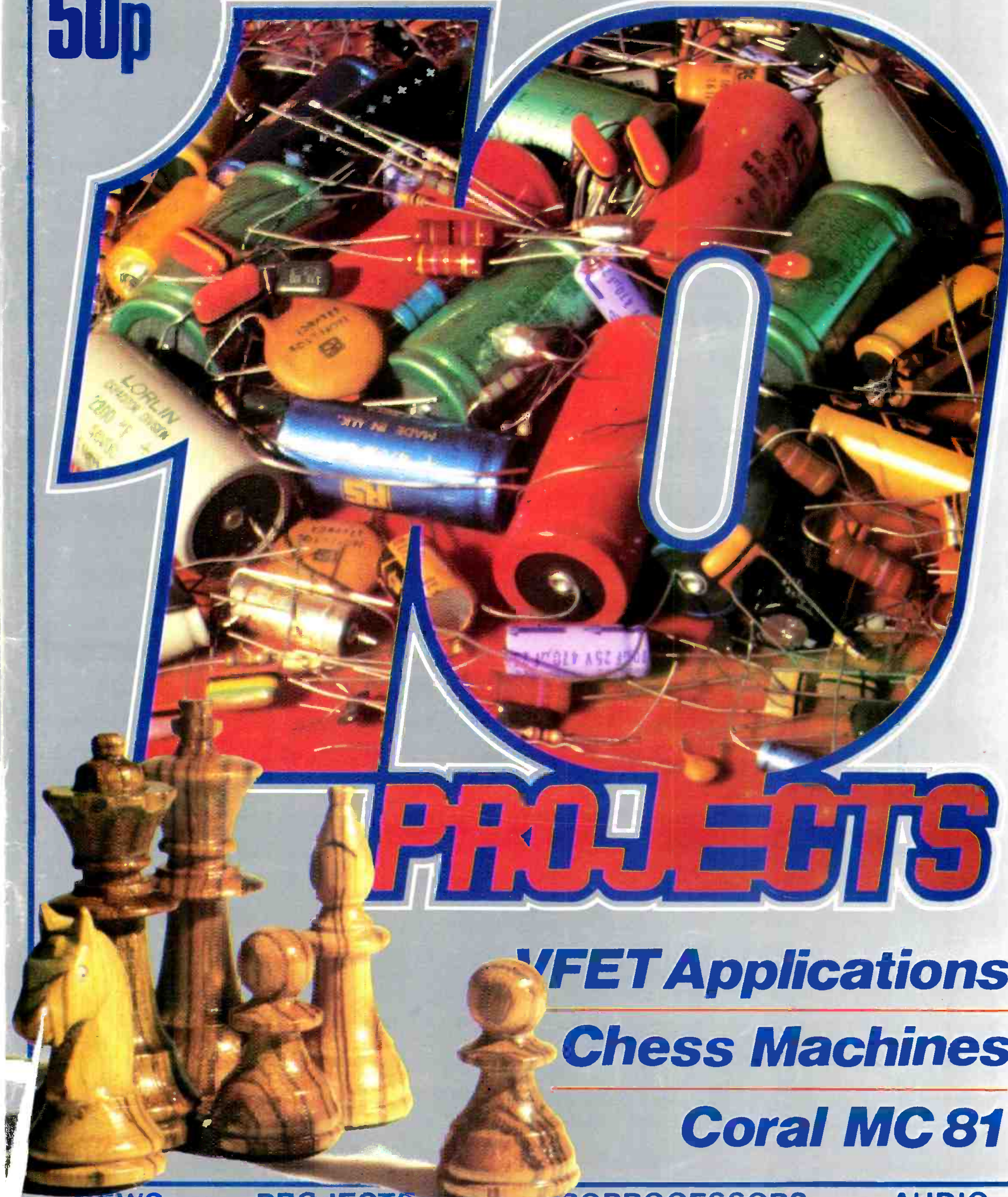
DECEMBER 1979

50p



10 PROJECTS

VFET Applications

Chess Machines

Coral MC 81

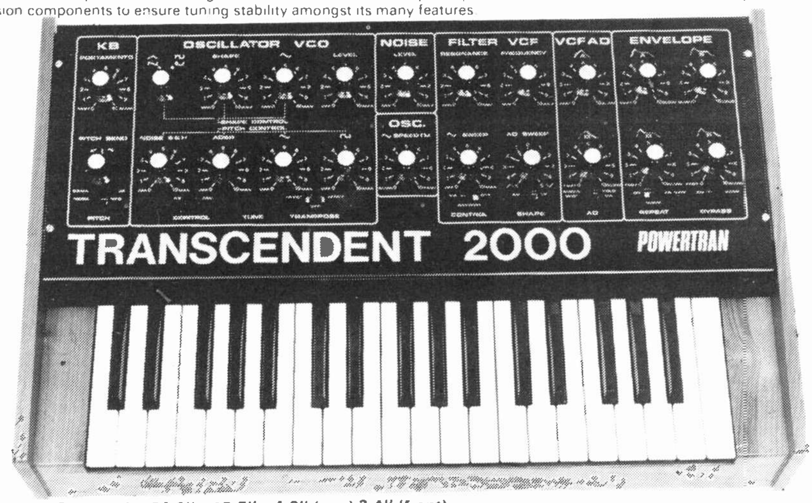
... NEWS.... PROJECTS.... MICROPROCESSORS.... AUDIO...

TRANSCENDENT 2000
SINGLE BOARD SYNTHESIZER

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

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

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



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

COMPLETE KIT ONLY £172.00 + VAT!

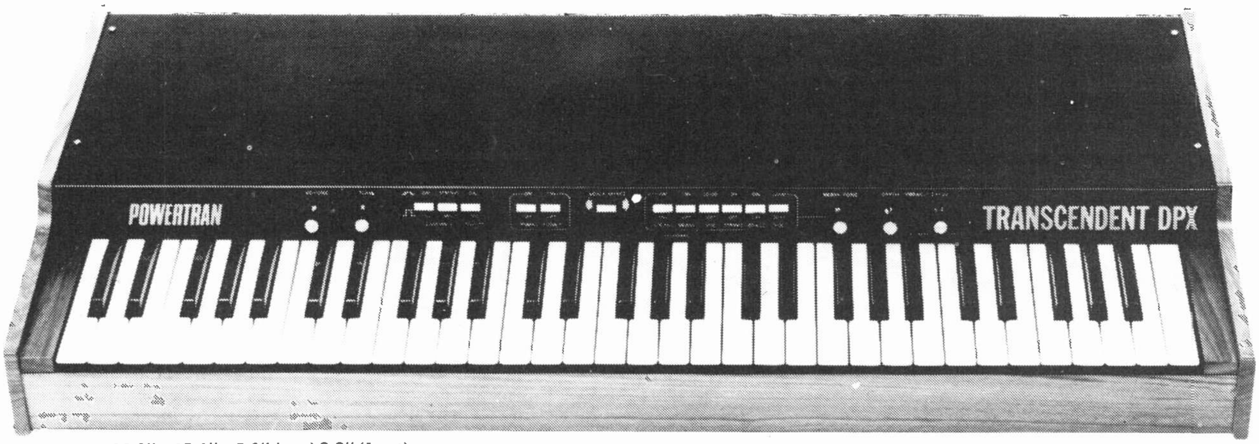
Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesizer with nothing more elaborate than a multi-meter and a pair of ears!

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 pitch or key change, computer composing etc etc) and an interface socket (25 way D type) is provided for this purpose

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

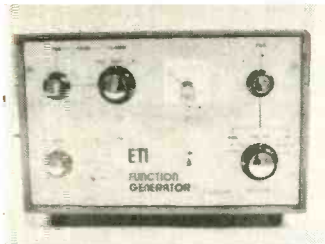
The kit includes fully finished metalwork solid teak cabinet professional quality components (all resistors 2% metal oxide) nuts bolts etc even a 13A plug — you need buy absolutely no more parts before plugging in and making great music! When finished you will possess an instrument comparable in performance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

POWERTRAN

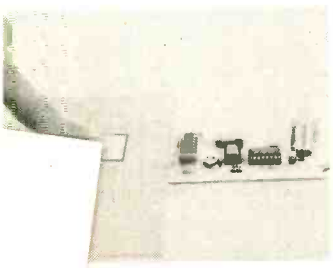
ORDERING INFORMATION AND MORE KITS ON PAGE 8

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

Square sines and triangles p.20



Electronic playmates p.61



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DECEMBER 1979 VOL 8 NO 12

FEATURES

PROJECTS

INFORMATION

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TRANSISTORS

Type	Price
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AC113	£0.23
AC115	£0.23
AC117	£0.35
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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
AC141K	£0.35
AC142	£0.42
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AC151	£0.23
AC153	£0.25
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AC156	£0.23
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AC168	£0.29
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AC171	£0.29
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AC180K	£0.32
AC181	£0.23
AC181K	£0.32
AC187	£0.21
AC187K	£0.32
AC188	£0.21
AC188K	£0.32
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ACY18	£0.40
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ACY20	£0.40
ACY21	£0.40
ACY22	£0.40
ACY27	£0.40
ACY28	£0.37
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
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AF124	£0.35
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AF127	£0.37
AF139	£0.40
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TIP41C	£0.55
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UT46	£0.23
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ZTX302	£0.10
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ZTX304	£0.23
ZTX330	£0.17
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ZTX501	£0.14
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ZTX504	£0.29
ZTX531	£0.29
ZTX550	£0.18
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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
2S403	£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	£0.46
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	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0.10	7427	£0.28	7473	£0.29	74110	£0.41	74166	£0.90
7401	£0.13	7428	£0.30	7474	£0.29	74111	£0.57	74174	£0.75
7402	£0.13	7430	£0.15	7475	£0.33	74118	£0.92	74175	£0.71
7403	£0.13	7432	£0.25	7476	£0.29	74119	£1.36	74176	£0.67
74D4	£0.13	7433	£0.35	7480	£0.51	74121	£0.28	74177	£0.67
7405	£0.13	7437	£0.24	7481	£0.98	74122	£0.45	74180	£1.73
7406	£0.25	7438	£0.24	7482	£0.78	74123	£0.46	74181	£0.67
7407	£0.25	7440	£0.14	7483	£0.87	74136	£0.60	74182	£0.81
7408	£0.15	7441	£0.58	7484	£1.01	71411	£0.63	74184	£0.81
7409	£0.15	7442	£0.46	7485	£0.78	74145	£0.63	74190	£0.78
7410	£0.13	7443	£0.81	7486	£0.25	74150	£0.78	74191	£0.71
7411	£0.20	7444	£0.81	7489	£1.96	74151	£0.55	74192	£0.69
7412	£0.17	7445	£0.75	7490	£0.37	74153	£0.55	74193	£0.67
7413	£0.28	7446	£0.69	7491	£0.74	74154	£0.94	74194	£0.71
7414	£0.58	7447	£0.55	7492	£0.40	74155	£0.58	74195	£0.09
7416	£0.26	7448	£0.64	7493	£0.35	74156	£0.58	74196	£1.21
7417	£0.26	7450	£0.13	7494	£0.86	74157	£0.58	74197	£1.21
742D	£0.13	7451	£0.13	7495	£0.58	74160	£0.67	74198	£2.13
7421	£0.23	7453	£0.13	7496	£0.58	74161	£0.71	74199	£2.13
7422	£0.18	7454	£0.13	74100	£0.96	74162	£0.71		
7423	£0.24	7460	£0.13	74104	£0.45	74163	£0.71		
7425	£0.22	7470	£0.29	74105	£0.44	74164	£0.78		
7426	£0.26	7472	£0.23	74107	£0.28	74165	£0.78		

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.16	CD4015	£0.94	CD4026	£1.38	CD4043	£1.01	CD4070	£0.20
CD4001	£0.18	CD4016	£0.49	CD4027	£0.58	CD4044	£0.94	CD4071	£0.20
CD4002	£0.18	CD4017	£0.94	CD4028	£0.76	CD4045	£1.01	CD4072	£0.20
CD4006	£1.06	CD4018	£0.98	CD4029	£0.98	CD4046	£1.50	CD4081	£0.20
CD4007	£0.20	CD4019	£0.48	CD4030	£0.55	CD4047	£1.00	CD4082	£0.25
CD4008	£1.06	CD4020	£1.04	CD4031	£2.30	CD4049	£0.55	CD4510	£1.27
CD4009	£0.52	CD4021	£0.94	CD4035	£1.38	CD4050	£0.55	CD4511	£1.44
CD4010	£0.55	CD4022	£0.94	CD4037	£1.00	CD4054	£1.27	CD4516	£1.15
CD4011	£0.23	CD4023	£0.22	CD4040	£1.01	CD4055	£1.15	CD4518	£1.15
CD4012	£0.22	CD4024	£0.75	CD4041	£0.87	CD4056	£1.55		
CD4D13	£0.48	CD4025	£0.22	CD4042	£0.83	CD4069	£0.20		

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
CA3D52	£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
MC135D	£1.38
MC1352	£1.01
MC1469	£3.30
MC1496	£1.04
NES36	£3.06
NE550	£1.09
NE555	£0.28
NE556	£0.69
NE565	£1.38
NE566	£1.73
NE567	£1.96
UA7D2C	£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
741P	£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
TBA820	£0.81
TBA9200	£2.88
TCA270S	£2.30
TBA800	£0.92

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA110	£0.09	BAX13	£0.08	BY164	£0.59	OA10	£0.40	SD10	£0.07
AA120	£0.09	BAX16	£0.09	BY176	£0.86	OA47	£0.09	SD19	£0.07
AA129	£0.09	BY100	£0.25	BY206	£0.35	OA70	£0.09	IN34	£0.08
AAY30	£0.10	BY101	£0.25	BYZ10	£0.52	OA79	£0.12	IN34A	£0.08
AAZ13	£0.17	BY105	£	BYZ11	£0.52	OA81	£	IN914	£0.07
BA100	£0.12	BY114	£0.25	BYZ12	£0.46	OA85	£0.12	IN916	£0.07
BA102	£0.37	BY124	£0.25	BYZ13	£	OA90	£0.12	IN4148	£0.07
BA148	£0.17	BY126	£0.17	BYZ16	£0.47	OA91	£0.12	IS44	£0.06
BA154	£0.14	BY127	£0.18	BYZ17	£0.41	OA95	£0.12	IS920	£0.07
BA155	£0.16	BY128	£0.18	BYZ18	£0.41	OA182	£0.15		
BA173	£0.17	BY130	£0.20	BYZ19	£0.41	OA200	£0.09		
BB104	£0.46	BY133	£0.24	OA5	£0.69	OA202	£0.09		

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		
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		
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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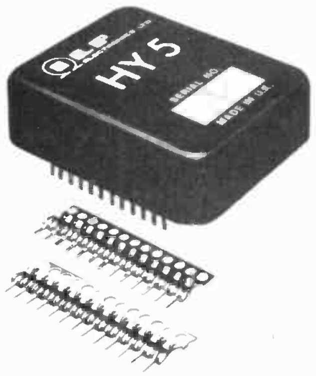
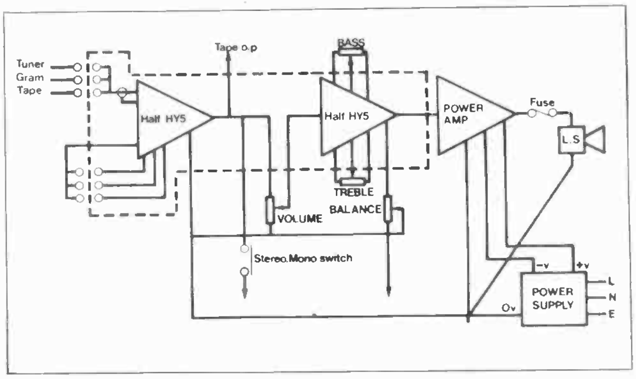
PERFORMANCE MODULAR UNITS

HY5 PRE-AMPLIFIER

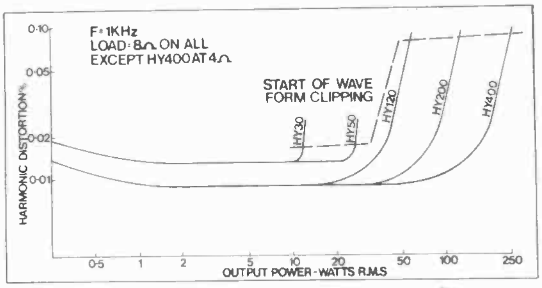




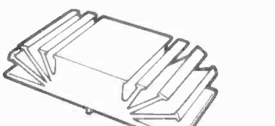
The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm. and provides multi-function equalisation for Magnetic/ Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion 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.

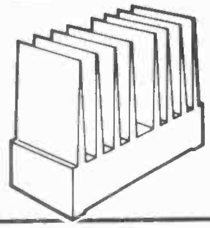
£4.64 + 74p VAT

THE POWER AMPLIFIERS



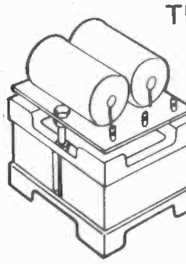
Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/ Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105x50x25	155	£6.34 + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0- +25	105x50x25	155	£7.24 + £1.09
HY120	60 W into 8 Ω	0.01%	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 amplifiers 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
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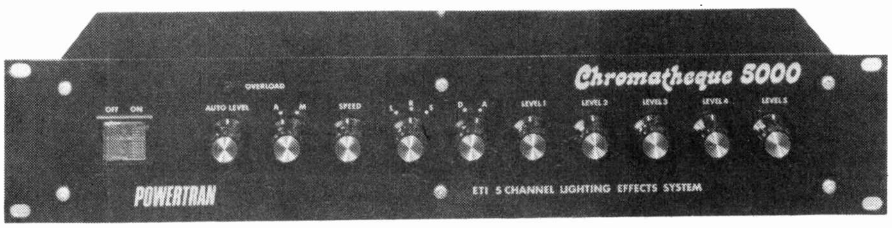

Panel size 19.0" x 3.5". Depth 7.3"

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

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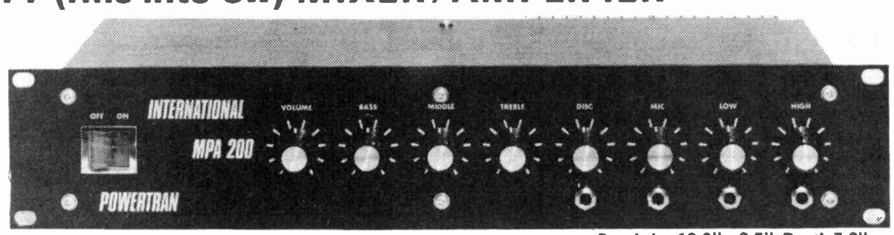
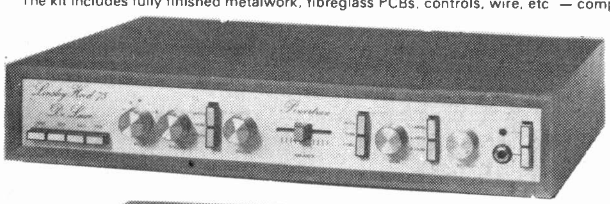
MATCHES THE CHROMATHEQUE 5000 PERFECTLY!



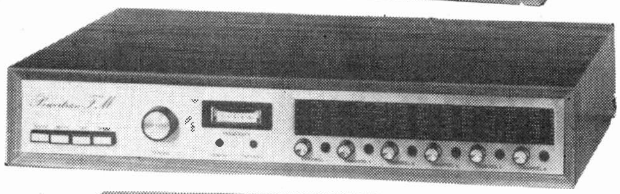
Panel size 19.0" x 3.5". Depth 7.3"

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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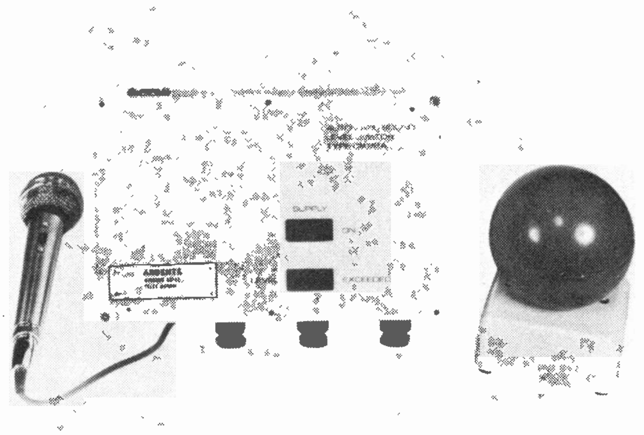


Silence Is Golden

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.

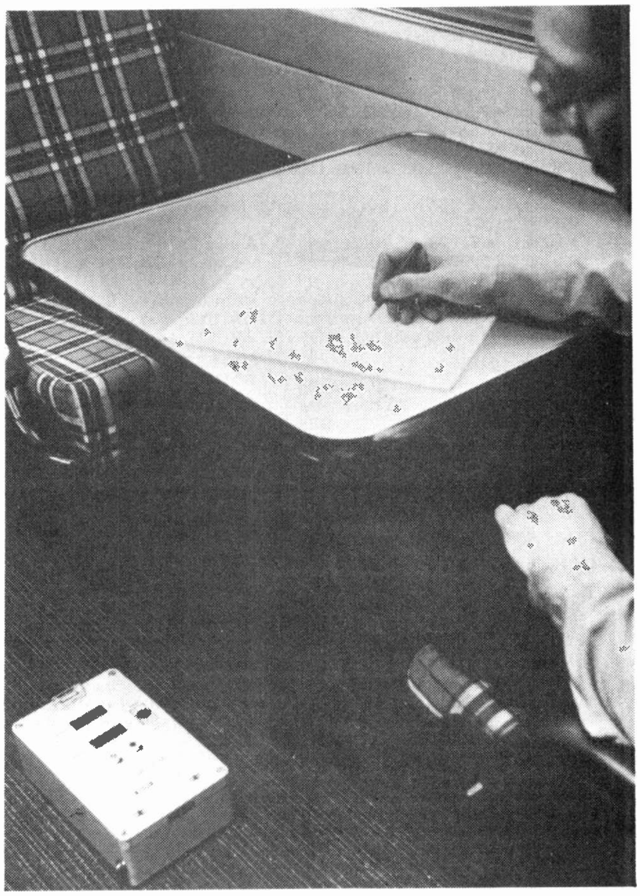
Sitting Comfy?

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.

TTLs by TEXAS

7400 11p, 74S00 60p, 7401 12p, 7402 12p, 7403 14p, 7404 14p, 74S04 90p, 7405 18p, 7406 32p, 7407 32p, 7408 17p, 7409 19p, 7410 15p, 7411 24p, 7412 20p, 7413 30p, 7414 50p, 74C14 90p, 7416 27p, 7417 27p, 7420 17p, 7421 40p, 7422 22p, 7423 34p, 7425 30p, 7426 40p, 7427 34p, 7428 367430 17p, 7432 30p, 7433 40p, 7437 35p, 7438 35p, 7440 17p, 7441 70p, 7442A 60p, 7443 112p, 7444 112p, 7445 100p, 7446A 93p, 7447A 50p, 7448 80p, 7450 17p, 7451 17p, 7453 17p, 7454 17p, 7460 17p, 7470 36p, 7472 30p, 7473 34p, 7474 30p, 7475 30p, 7476 35p, 7480 50p, 7481 100p, 7482 84p, 7483A 90p, 7484 100p, 7485 110p, 7486 34p, 7489 175p, 7490A 30p, 7491 80p, 7492A 48p, 7493A 30p, 7494 84p, 7495A 70p, 7496 65p, 7497 180p, 74100 130p, 74104 65p, 74105 65p, 74107 34p, 74109 55p, 74110 55p, 74111 70p, 74116 200p, 74118 130p, 74119 210p, 74120 110p, 74121 28p, 74122 48p, 74123 48p, 74125 55p, 74126 60p, 74128 75p, 74132 75p, 74135 50p, 74136 75p, 74137 50p, 74141 50p, 74142 200p, 74145 90p, 74147 190p, 74148 150p, 74150 100p, 74151A 70p, 74153 70p, 74154 100p, 74155 90p, 74156 90p, 74157 70p, 74159 190p, 74160 100p, 74161 100p, 74162 100p, 74163 100p, 74164 120p, 74165 130p, 74166 120p, 74167 200p, 74170 240p, 74172 450p, 74173 120p, 74174 90p, 74175 85p, 74176 90p, 74177 90p, 74178 160p, 74180 93p, 74181 160p, 74182 90p, 74184A 150p, 74185 150p, 74186 500p, 74188 325p, 74190 90p, 74191 90p, 74192 90p, 74193 90p, 74194 90p, 74195 95p, 74196 95p, 74197 80p, 74198 150p, 74199 150p, 74200 £10, 74221 160p, 74251 140p, 74259 250p, 74278 290p, 74279 110p, 74283 160p, 74290 150p, 74293 150p, 74298 200p, 74365 100p, 74366 100p, 74367 100p, 74368 100p, 74390 200p, 743o3 200p, 74490 225p

74LS SERIES

74LS00 14p, 74LS02 16p, 74LS03 18p, 74LS04 16p, 74LS05 25p, 74LS08 22p, 74LS10 20p, 74LS11 40p, 74LS13 40p, 74LS14 72p, 74LS15 45p, 74LS20 20p, 74LS21 40p, 74LS27 38p, 74LS30 20p, 74LS32 27p, 74LS42 70p, 74LS47 90p, 74LS51 24p, 74LS55 30p, 74LS73 50p, 74LS74 36p, 74LS75 40p, 74LS76 45p, 74LS83 110p, 74LS85 100p, 74LS86 40p, 74LS90 40p, 74LS92 70p, 74LS93 60p, 74LS96 110p, 74LS107 45p, 74LS109 80p, 74LS112 100p, 74LS113 90p, 74LS114 45p, 74LS122 80p, 74LS123 70p, 74LS124 180p, 74LS125 60p, 74LS126 60p, 74LS132 95p, 74LS133 30p, 74LS136 55p, 74LS138 75p, 74LS139 75p, 74LS145 120p, 74LS147 220p, 74LS148 175p, 74LS151 100p, 74LS153 60p, 74LS154 200p, 74LS155 90p, 74LS156 90p, 74LS157 60p, 74LS158 90p, 74LS160 130p, 74LS161 100p, 74LS162 140p, 74LS163 100p, 74LS164 120p, 74LS165 160p, 74LS166 180p, 74LS173 110p, 74LS174 110p, 74LS175 110p, 74LS181 320p, 74LS190 100p, 74LS191 100p, 74LS192 100p, 74LS193 100p, 74LS195 140p, 74LS196 120p, 74LS197 120p, 74LS221 140p, 74LS240 175p, 74LS241 175p, 74LS242 170p, 74LS243 170p, 74LS244 195p, 74LS245 250p, 74LS247 140p, 74LS248 140p, 74LS249 140p, 74LS251 140p, 74LS253 140p, 74LS257 120p, 74LS258 160p, 74LS259 160p, 74LS266 100p, 74LS273 175p, 74LS279 90p, 74LS298 249p, 74LS324 200p, 74LS348 200p, 74LS365 100p, 74LS367 100p, 74LS368 100p, 74LS373 180p, 74LS374 195p, 74LS378 200p, 74LS390 160p, 74LS393 160p, 74LS445 140p, 74LS668 100p, 74LS669 100p, 74LS670 400p

4000 SERIES

4000 15p, 4001 17p, 4002 17p, 4006 95p, 4007 18p, 4008 80p, 4009 40p, 4010 50p, 4011 17p, 4012 18p, 4013 50p, 4014 84p, 4015 84p, 4016 45p, 4017 80p, 4018 89p, 4019 45p, 4020 100p, 4021 110p, 4022 100p, 4023 22p, 4024 50p, 4025 20p, 4026 130p, 4027 50p, 4028 84p, 4029 100p, 4030 55p, 4031 200p, 4033 180p, 4034 200p, 4035 110p, 4036 295p, 4037 115p, 4038 120p, 4039 295p, 4040 100p, 4041 80p, 4042 80p, 4043 90p, 4044 90p, 4046 110p, 4047 100p, 4048 55p, 4049 40p, 4050 49p, 4051 80p, 4052 80p, 4053 80p, 4054 150p, 4055 125p, 4056 135p, 4059 600p, 4060 115p, 4063 120p, 4066 55p, 4067 450p, 4068 22p, 4069 20p, 4070 30p, 4071 22p, 4072 22p, 4073 22p, 4075 22p, 4076 107p, 4081 22p, 4082 22p, 4086 72p, 4089 138p, 4093 80p, 4094 250p, 4095 95p, 4096 95p, 4097 340p, 4098 107p, 4099 200p, 40100 220p, 40101 132p, 40102 180p, 40103 180p, 40104 99p, 40105 99p, 40106 80p, 40107 60p, 40108 470p, 40109 100p, 40110 300p, 40114 250p, 4411 1100p, 4502 120p, 4503 70p, 4507 55p, 4508 290p, 4510 99p, 4511 150p, 4512 80p, 4514 265p, 4515 300p, 4516 110p, 4518 100p, 4520 100p, 4526 108p, 4527 150p, 4528 100p, 4538 120p, 4543 180p, 4553 450p, 4556 72p, 4560 250p, 4569 250p, 4572 40p, 4583 90p, 4584 90p, 4724 250p, 40014 90p, 40085 200p, 40097 90p, 14411 1100p, 14412 1100p, 14433 1100p, 14500 700p, 14599 290p, CD22100 350p, CD22101 700p, CD22102 700p

INTERFACE ICs

DM8123 175p, MC1488 100p, MC1489 100p, 25S10 350p, 75107 160p, 75150 175p, 75154 175p, 75182 230p, 75322 300p, 75324 375p, 75325 375p, 75361 300p, 75363 400p, T5365 350p, 75451 72p, 75491/2 96p, 8T26 250p, 8T28 300p, 8T95 200p, 8T97 200p, 81LS95 140p, 81LS96 140p, 81LS97 140p, 81LS98 140p, 9601 110p, 9602 220p, 9603 160p

93 SERIES

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

VEROBOARDS

(copper clad)	0.1	0.15
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

LINEAR ICs

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, LF358P 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, 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 675p, XR2240 400p, ZN414 90p, ZN419C POA, ZN424E 135p, ZN425E 400p, ZN1034E 200p, 95H90 800p, 11C90 1400p

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, OCP71 130p, ORP12 90p, ORP60 90p, ORP61 90p, TIL78 70p

OPTO-ISOLATORS: ILD74 130p, MCT26 100p, MCS2400 190p, TIL111 90p, TIL112 90p, TIL116 90p

LEDS 0.125": TIL32 75p, TIL209 Red 13p, TIL211 Gr 20p, TIL212 Ye 25p, TIL216 Red 16p; 0.2": TIL220 Red 16p, TIL222 Gr 18p, TIL228 Red 22p, MV5491 TS 120p, Clips 3p

DISPLAYS: 3015F 200p, DL704 140p, DL707 Red 140p, 707 Gr 140p, DL747 Red 225p, 747 Gr 225p, FND357 120p, FND500 120p, FND507 120p, MAN3640 175p, MAN4640 200p, NSB5881 570p, TIL311 600p, TIL312/3 110p, TIL321/2 130p, TIL330 140p, 7750/60 200p

DRIVERS: 9638 200p, 9370 200p, UDN6118 320p, UDN6184 320p

TRANSISTORS

AC126 25p, AC127/8 20p, AC176 25p, AC187/8 25p, AF116 50p, AD149 70p, AD161/2 45p, AU107 200p, BC107/8 11p, BC109 11p, BC117 20p, BC147/8 9p, BC149 10p, BC157/8 10p, BC159 11p, BC169C 12p, BC172 12p, BC177/8 17p, BC179 18p, BC182/3 10p, BC184 11p, BC187 30p, BC212/3 11p, BC214 12p, BC237 15p, BC327 16p, BC337 16p, BC338 15p, BC461 36p, BC477/8 30p, BC516/7 50p, BC547B 16p, BC548C 9p, BC549C 18p, BC557B 16p, BC559C 18p, BCY70 18p, BCY71/2 22p, BD131/2 50p, BD135/6 54p, BD139 56p, BD140 60p, BD189 60p, BD232 95p, BD233 75p, BD235 85p, BD241 70p, BD242 70p, BDX53B 150p, BDY56 200p, BF200 32p, BF244B 35p, BF256B 70p, BF257/8 32p, BF259 36p, BFR39 25p, BFR40 25p, BFR41 25p, BFR79 25p, BFR80 25p, BFR81 25p, BFX29 30p, BFX30 34p, BFX84/5 40p, BFX86/7 30p, BFX88 30p, BFW10 90p, BFY50 30p, BFY51/2 30p, BFY56 33p, BFY90 90p, BRY39 45p, BSX19/20 20p, BU104 225p, BU105 190p, BU108 250p, BU109 225p, BU205 200p, BU208 200p, BU406 145p, E300 50p, E308 50p, E310 50p, MJ2501 225p, MJ2955 90p, MJ3001 225p, MJE340 50p, MJE2955 100p, MJE3055 70p, MPF102 45p, MPF103/4 40p, MPF105/6 40p, MPS6531 50p, MPS6534 50p, MPSA06 30p, MPSA12 50p, MPSA13 50p, MPSA20 50p, MPSA43 50p, MPSA56 32p, MPSA70 50p, MPSU06 63p, MPSU07 90p, MPSU45 90p, MPSU65 78p, OC28 130p, OC35 130p, R2008B 200p, R2010B 200p, TIP29A 40p, TIP29C 55p, TIP30A 48p, TIP30C 60p, TIP31A 58p, TIP31C 62p, TIP32A 68p, TIP32C 82p, TIP33A 90p, TIP33C 114p, TIP34A 115p, TIP34C 160p, TIP35A 225p, TIP35C 290p, TIP36A 270p, TIP36C 340p, TIP41A 65p, TIP41C 78p, TIP42A 70p, TIP42C 82p, TIP54 160p, TIP120 120p, TIP122 130p, TIP142 160p, TIP147 160p, TIP2955 78p, TIP4055 70p, TIS43 34p, TIS93 30p, ZTX108 12p, ZTX300 13p, ZTX500 15p, ZTX502 18p, ZTX504 30p, 2N457A 250p, 2N696 35p, 2N697 25p, 2N698 45p, 2N706A 20p, 2N708A 20p, 2N918 45p, 2N930 18p, 2N1131/2 20p, 2N1613 25p, 2N1711 25p, 2N2102 70p, 2N2160 350p, 2N2219A 30p, 2N2222A 30p, 2N2369A 16p, 2N2484 30p, 2N2646 45p, 2N2904/5 25p, 2N2906A 24p, 2N2907A 30p, 2N2926 9p, 2N3053 27p, 2N3054 65p, 2N3055 48p, 2N3442 140p, 2N3553 240p, 2N3565 30p, 2N3584 250p, 2N3643/4 48p, 2N3702/3 12p, 2N3704/5 12p, 2N3706/7 14p, 2N3708/9 12p, 2N3773 300p, 2N3819 25p, 2N3820 50p, 2N3823 70p, 2N3866 90p, 2N3902 700p, 2N3903/4 18p, 2N3905/6 20p, 2N4037 65p, 2N4058/9 12p, 2N4060 12p, 2N4061/2 18p, 2N4123/4 27p, 2N4125/6 27p, 2N4401/3 27p, 2N4427 90p, 2N4871 60p, 2N5087 27p, 2N5089 27p, 2N5172 27p, 2N5179 90p, 2N5191 83p, 2N5194 90p, 2N5245 40p, 2N5296 55p, 2N5401 50p, 2N5457/8 40p, 2N5459 40p, 2N5460 60p, 2N5485 44p, 2N5875 250p, 2N6027 48p, 2N6107 65p, 2N6247 190p, 2N6254 130p, 2N6290 65p, 2N6292 65p, 2SC1172 150p, 3N128 120p, 3N140 100p, 3N141 110p, 3N201 110p, 3N204 100p, 40290 250p, 40360 40p, 40361/2 45p, 40364 120p, 40408 70p, 40409 85p, 40410 85p, 40411 300p, 40594 97p, 40595 105p, 40673 75p, 40841 90p, 40871/2 90p

DIODES

BY127 12p, BYX36-300 20p, OA47 9p, OA81 15p, OA85 15p, OA90 9p, OA91 9p, OA95 9p, OA200 9p, OA202 10p, 1N914 4p, 1N916 7p, 1N4148 4p, 1N4001/2 5p, 1N4003/4 6p, 1N4005 6p, 1N4006/7 7p, 1N5401/3 14p, 1N5404/7 19p, IS920 9p

HEAT SINKS

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

BRIDGE RECTIFIERS

1A 50V 19p, 1A 100V 20p, 1A 400V 25p, 1A 600V 30p, 2A 50V 30p, 2A 100V 35p, 2A 400V 45p, 3A 200V 60p, 3A 600V 72p, 4A 100V 95p, 4A 400V 100p, 6A 50V 80p, 6A 100V 100p, 6A 400V 120p, 10A 400V 200p, 25A 400V 400p

ZENERS

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

TRIACS PLASTIC

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

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, 82S16 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, 6502 £10, 6800 900p, 6802 1250p, 8080A 550p, INS8060 £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, RO-3-2513 L.C 650p, SN74S262AN 1350p

KEYBOARD ENCODER: AY-5-2376 £9

TRANSFORMERS

(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).

RESISTORS High Stab 5% E12

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

Miniature Presets Hor/Vert 100R-1M 12p

Carbon Track Pots 5K-1M Log or Lin: 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, 14 pin 11p, 16 pin 12p, 18 pin 22p, 20 pin 25p, 22 pin 28p, 24 pin 30p, 28 pin 38p, 40 pin 48p

WIRE WRAP SOCKETS BY TEXAS

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

ANTEX SOLDERING IRONS

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

SPARE BITS: C/CX/CCN 46p, X25 50p

SPARE ELEMENTS: C/CX/X25 180p, CCN 200p

ADCOLA IRONS: K1000 550p, K2000 550p

CRYSTALS

100KHz 300p, 1MHz 370p, 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

VEROBOARDS

DIP Breadboard 4.15 × 6.15 270p (Suitable for 20 × 14 pin or 16 × 16 pin DIL ICs)
DIP Breadboard as above with tracks for 31 way connector 340p
V-Q Boards for ICs (No track cutting) 105p

CONNECTOR PLUGS

31 way Plug 110p, 31 way Socket 110p, S-100 Busboard £12

EDGEBOARD CONNECTORS 0.156" PITCH

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

COUNTERS

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

TTL & ECL

MC4024 325p, MC4044 325p, 10116 70p, 10231 350p

DATA BOOKS

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

BREADBOARDS

EXP350 3.6" x 2.1" (Up to 3 x 14 pin ICs) £3.15
EXP650 3.6" x 2.4" (Up to 1 x 40 pin IC) £3.60
EXP300 6" x 2.1" (Up to 6 x 14 pin ICs) £5.75
EXP600 6" x 2.4" (Up to 1 x 40 pin DCs) £6.30

PROTOBOARD (R) SOLDERLESS BREADBOARDS

Socket Strips/Bus Strips/Binding Posts mounted on sturdy base plate
PB6 6 x 14 DIL ICs £9.20
PB100 10 x 14 DIL ICs £11.80
PB102 12 x 14 DIL ICs £22.95
PB103 24 x 14 DIL ICs £34.45
PB104 32 x 14 DIL ICs £45.95
(The above boards are suitable for all DIL ICs.)

IC TEST CLIPS

14 pin £2.60, 16 pin £2.75, 24 pin £2.90, 40 pin £2.90

16 KEY KEYPAD (Reed Switches) £4.00
UHF Modulators £3.75
Reed Switches (12VA) £0.25
LOGIC PROBE £18.00
MULTIMETERS: SUPERTESTER 680R £33.00, MICROTEST 80R £17.00, TMK500 £22.00, Pocket multimeter £4.75

COMPUTER KITS

MEMORY MAPPED VDU INTERFACE KIT £45.00
SERIAL I/P VDU INTERFACE KIT £56.00
ELF II MICROCOMPUTER KIT £79.95
ELF II WIRED AND TESTED £99.95
GIANT MONITOR BOARD KIT FOR ELF II £35.00
4K STATIC RAM BOARD FOR ELF II £69.44
ASCII KEYBOARD KIT £50.58
(Please add 75p p&p to all above items).

We carry a large stock of 74 and 74LS TTLs, CMOS, Linears, Memories, etc. and can normally offer ex-stock deliveries. We welcome inquiries for volume quantities both from local and overseas buyers.

VAT RATE: Please add VAT at 15% on total order value.
Access and Barclaycard accepted
Please send SAE for list

Please add 30p p&p & VAT.
Government, Colleges, etc. Orders accepted.
CALLERS WELCOME — Mon.-Fri. 9.30-5.30, Saturday 10.30-4.30

TECHNOMATIC LTD.

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

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 + £4.68vat

MICROMARKET — OSTS overflow:

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

RADIO and AUDIO MODULES : Consistently the most advanced

FOR FM

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

FOR 30-200MHz

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

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

DECODERS for MPX (STEREO)

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

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

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

COMPONENTS FOR RADIO/COMMUNICATIONS/AUDIO/TV etc.

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

RADIO ICs for FM		vat	SL1600 series			Audio preamps		vat
CA3089E	1.94	29	SL1610	1.60	24	LM381N	1.81	27
CA3189E	2.45	37	SL1611	1.60	24	LM382N	1.65	25
HA1137W	2.20	33	SL1612	1.60	24	KB4436	2.53	38
HA11225	2.20	33	SL1613	1.89	28	KB4438	2.22	33
SN76660N	0.75	11	SL1620	2.17	33	TDA1028	3.50	53
RADIO ICs for AM/FM			SL1621	2.17	33	TDA1029	3.50	53
TDA1090	3.35	50	SL1623	2.44	37	TDA1074	3.75	56
TDA1083	1.95	29	SL 624	3.28	49	Audio power		
TDA1220	1.40	21	SL1625	2.17	33	TBA820M	0.75	11
IF AMPLIFIERS			SL1626	2.44	37	TBA810AS	1.09	16
KB4406	0.50	07	SL1630	1.62	24	LM380N	1.00	15
MC1350	1.20	18	SL1640	1.89	28	ULN2283	1.00	15
see comms ics also			SL1641	1.89	28	TDA2002	1.95	29
COMMUNICATIONS			SL6640	2.75	41	HA1370	2.99	45
KB4412	2.55	38	SL6690	3.20	48	TDA2020	2.99	45
KB4413	2.75	41	MC3357	3.12	47	FETs, MOSFETs, bipolars, and various others: see PL.		
SD6000	3.75	56	MC1496	1.25	19			
			NE544	1.70	25			

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

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

TTL:Standard AND LP Schottky

All prices listed in pence *

	'N'	'LSN'
7400	13	20
7401	13	20
7402	14	20
7403	14	20
7404	14	24
7405	18	26
7406	38	
7409	17	24
7410	15	24
7411	20	24
7412	17	
7413	30	
7414	51	
7415		24
7416	30	
7417	30	
7420	16	24
7421	29	24
7423	27	
7425	27	
7426		27
7427	27	29
7428	35	32
7430	17	24
7432	25	24
7437	40	24
7438	33	24
7440	17	24
7441	74	
7442	70	99
7443	115	
7444	112	
7445	94	
7446	94	
7447	82	89
7448	56	99
7449		99
7450	17	24
7453	17	
7454	17	24
7455	35	24
7460	17	
7463		124
7470	28	

	'N'	'LSN'
7472	28	
7473	32	38
7474	27	38
7475	38	40
7476	37	38
7478		38
7480	48	
7481	86	
7482	69	
7485	104	99
7486		40
7489	205	
7490	33	90
7491	76	110
7492	38	78
7493	32	99
7494	78	
7495a	65	99
7496	58	120
7497	185	
741XX series		
74107	32	38
74109	63	38
74110	54	54
74111	68	
74112		38
74113		38
74114		38
74116	198	
74118	83	
74120	115	
74121	25	
74122	46	
74123	46	
74124		137
74125	38	44
74126	57	44
74128	74	
74132	73	78
74136		40
74138		60
74139		60
74141	56	

	'N'	'LSN'
74142	265	
74143	312	
74144	312	
74145	65	97
74147	175	
74148	109	191
74150	99	
74151	64	84
74153	64	54
74154	96	
74155	54	110
74156	80	110
74157	67	55
74158		60
74159	210	
74160	82	130
74161		78
74162		130
74163	92	78
74164	104	130
74165	105	
74167	20	
74169		200
74170	230	200
74172	625	
74174	87	120
74175	87	110
74176	75	
74177	78	
74181	165	350
74183		210
74184	135	
74185	134	
74186	275	
74190		92
74192	105	180
74193	105	180
74194	105	
74196	99	110
74197		110
74198	150	
74199	160	
74247		90
74253		105

	'LSN'
74257	108
74260	153
74273	124
74283	120
74293	95
74365	49
74366	49
74367	43
74368	49
74373	77
74374	77
74377	124
74379	130
74393	140

VOLTAGE REGS:

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

MAINS EMI FILTERS (BS etc approved types)

1 Amp in IEC chassis connector	4.83
6 Amp in IEC	5.83
5 Amp wirein	3.87

(Toroid cores in Cat no. 2)

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

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

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

CD4000

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

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
5mm	14p	16p	15p	20p
3mm	13p	15p	18p	19p
2½x5	17p	20p	20p	24p

Quantity discounts for LEDs:
10 per type - less 10%
100 per type - less 30%
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 cermic block filters 1.95ea
MURATA CFM455 series ladder filters. O,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
COA10.7 - 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 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.

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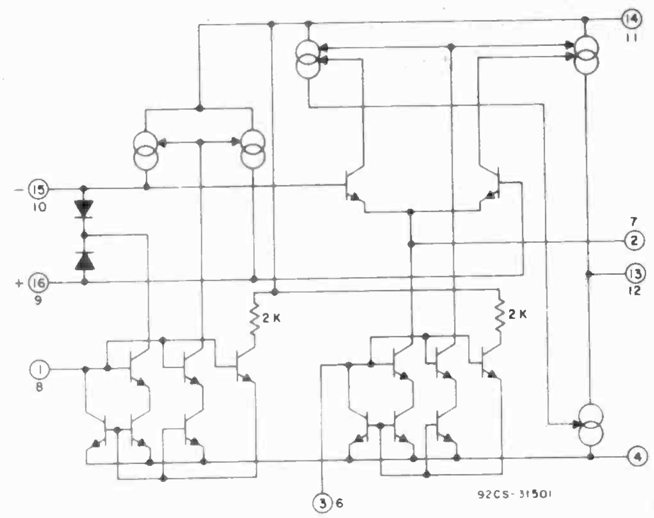


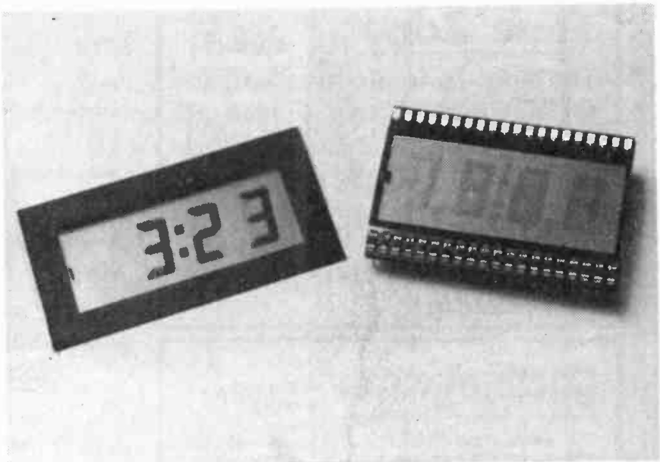
Happy Families

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 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

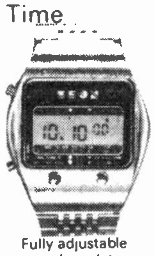
* Hours, mins., secs
* Month, date, day
* Basic alarm
* Memory date alarm
* Timer alarm with dual time and 5 country zone
* Back light
* 8mm thick

£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

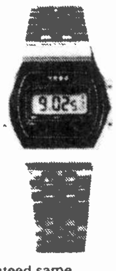
* 6 digits, 5 flags
* 6 basic functions
* 8 further time zones
* Count-down alarm.
* Stop-watch to 12 hours 59.9 secs. in 1/10 sec. steps
* Split and lap timing modes
* Alarm.
* 9mm thick
* Back-light
* Fully adjustable bracelet

£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.

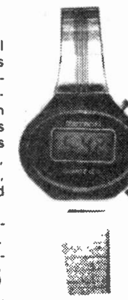
£14.95

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.

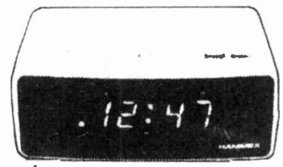


£19.95

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.

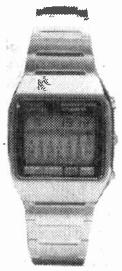
Service Enquiries: 03272-77659
CALLERS WELCOME. Shops open 9.30am-6.00pm.

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

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.

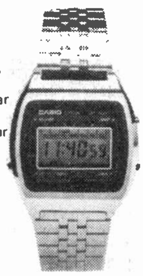
Metac Price **£92.95** **M19**

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**

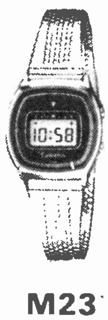
CASIO CHRONO 95QS-3LB



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.

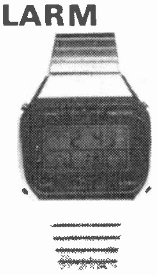
Price **£34.95** **M25**

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.

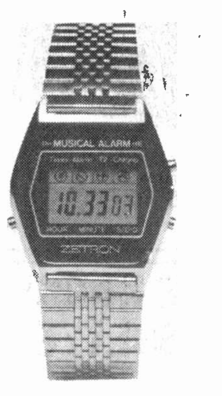
Price **£9.95** **M36**

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

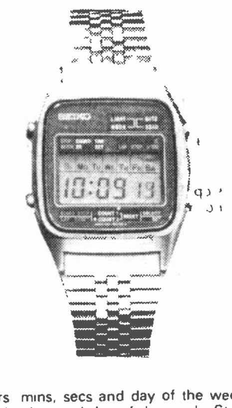
Price **£35.00** **M12**

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

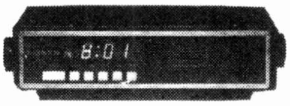
Price **£56.00** **M33**

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

DIGITAL CLOCK RADIO



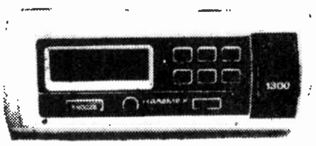
Mains. AM/FM/LW radio. Green digital display. Snooze alarm. Auto switch off. Clock dimmer. External FM Aerial.

£19.95

plus £1.30 Post & Packing

M40

Portable LCD Clock Radio

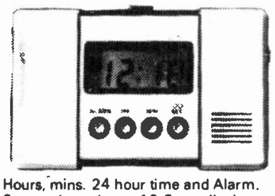


★ Back-light.
★ Batteries supplied free.
★ Quartz crystal controlled.

£17.95

M41

DIGITAL CLOCK LCD Travel

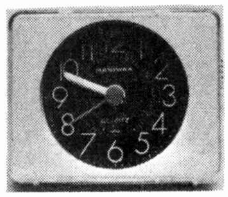


Hours, mins. 24 hour time and Alarm. Snooze timer. Large 12.5mm display. Night light. Size: 120mm x 74mm x 19mm.
Weight: 120 grams.

£17.65

M42

QUARTZ ANALOGUE CLOCK TRAVEL

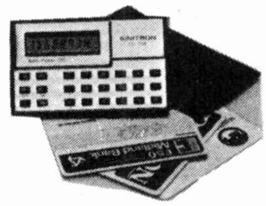


Mini Quartz Alarm clock. Complete with travel pouch. Features loud alarm and operates from 1½ volt battery.

£9.95

M43

LCD Calculator

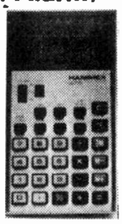


Credit Card size
Memory % ect plus auto power off.

£7.95

M44

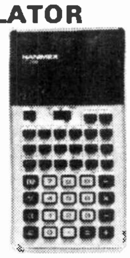
Digital Clock/Alarm/Calculator/Stopwatch



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

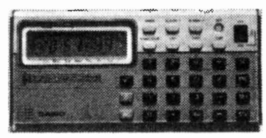


8-digit mantissa, 2-digit exponent electronic calculator on one single chip.

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

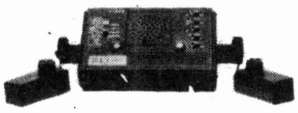


Full calculator spec 3 independent musical alarms time, stop-watch, count-down timer

£23.95

M47

TV GAMES



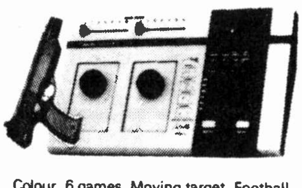
Black & White or Colour.
4 game, 2 ball speed, 2 ball angles, 2 battery sizes. Tennis, Hockey, Football, Handball, Practice.

£11.95 Colour
£8.95 B/W

plus 54p Post & Packing

M48

TV GAME WITH GUN



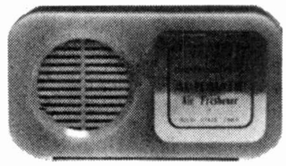
Colour. 6 games. Moving target, Football, Target, Tennis, Squash, Practice. Battery or main.

£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

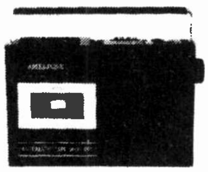
DIGITAL CLOCK

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

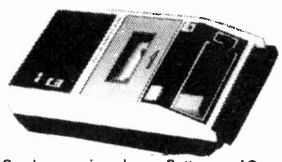
RADIO/CASSETTE 3-Band/LW-MW-FM



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

M52

RADIO/CASSETTE 1-Band/MW



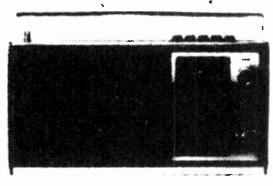
Condensor microphone. Battery or AC. Pushbutton key operation. Auto level control. Retractable handle. Eject equipment.

£17.95

plus £2.00 Post & Packing

M53

MAINS/BATTERY Portable Radio



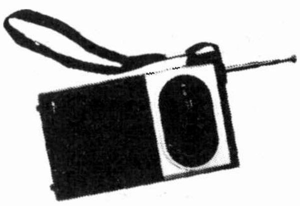
4 Bands, LW/MW/SW/FM. Teak finish case.

£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**

Metac ELECTRONICS & TIME CENTRES

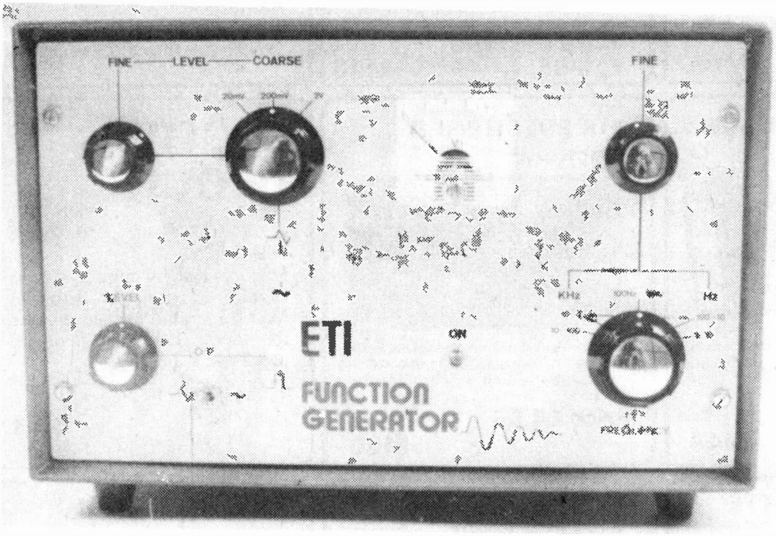
North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

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

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 multi-turn (3/4")
RV5	4k7 cermet multiturn (3/4")
RV6	100k lin dual gang
RV7-10	10k
RV11	100k cermet multi-turn (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

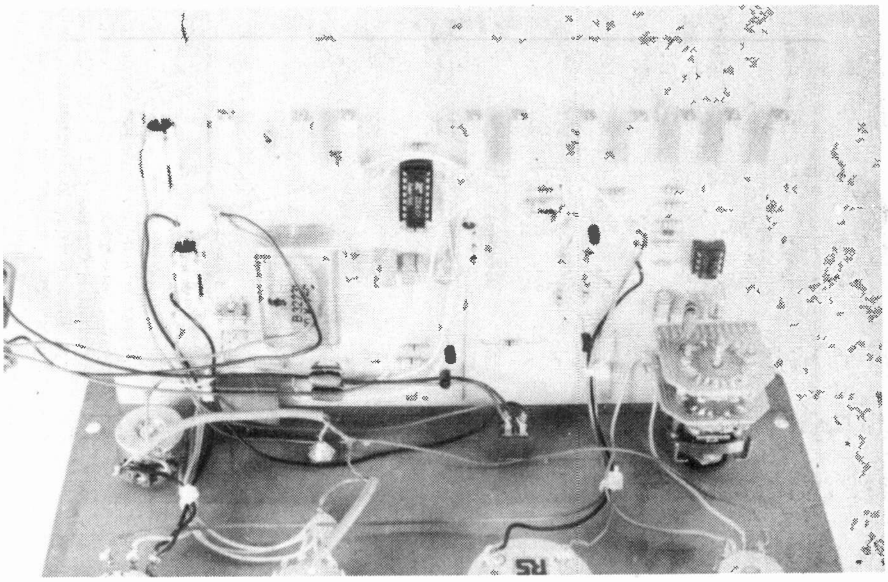
2 BNC connectors, 2 PP7 batteries, case to suit, PCB.

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.

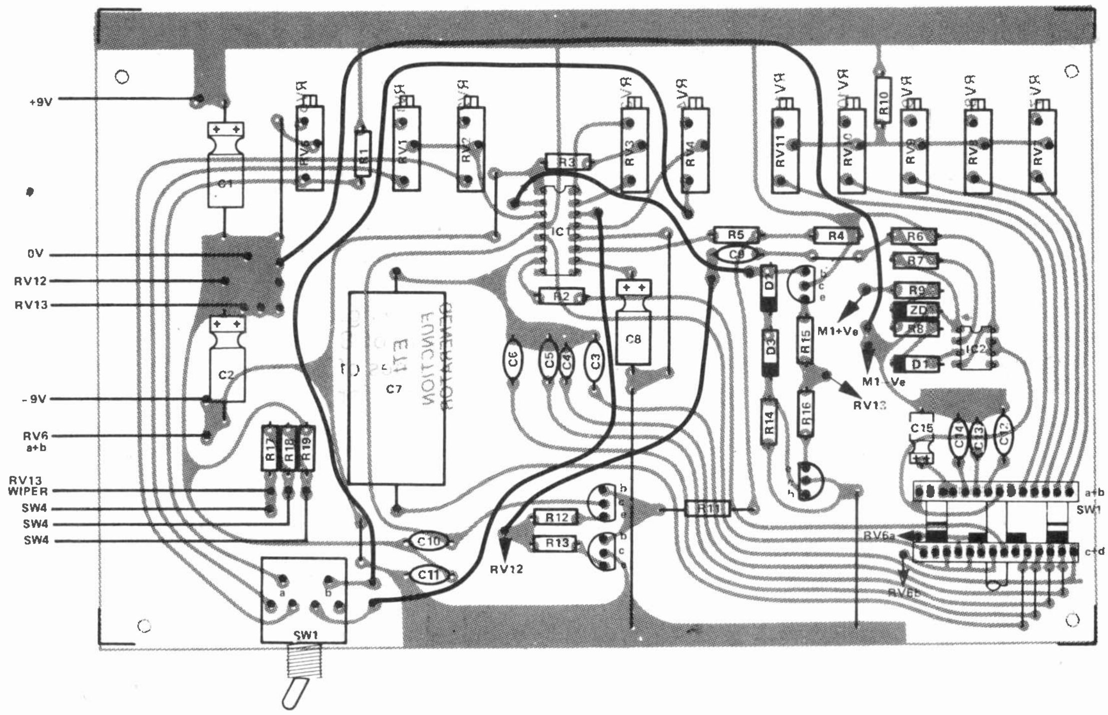
Construction

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 (1u0) 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.

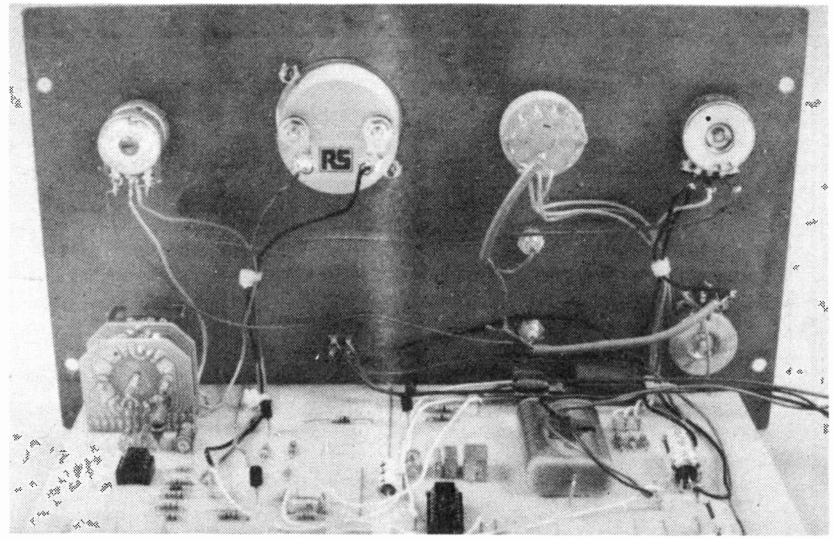
Actual construction on the PCB is fairly straightforward, but take extra care to observe the polarities of all electrolytics and all semiconductor devices. When construction is complete, fit the board into a suitable case and complete the interwiring to the remaining switches, pots and to the moving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

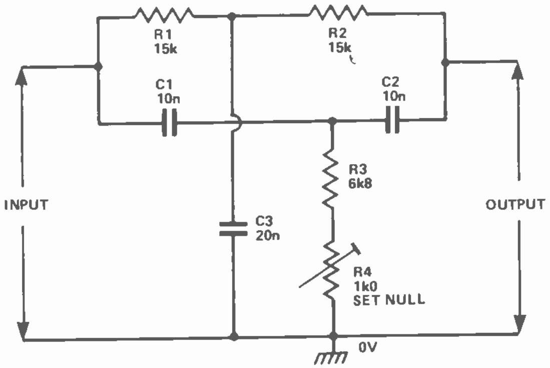


Fig. 2 This simple twin-T filter can be used to set the generator for minimum distortion.

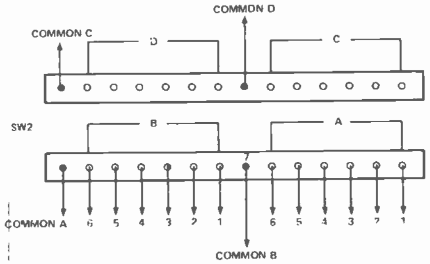


Fig 3 Range switch wafer pin-out.

BUYLINES

The 10u (C7) capacitor can 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.

NOTES.
IC1 IS XR2206CP
IC2 IS NE555
D1–D3 ARE 1N4148
Q1, Q3 ARE BC182L
Q2, Q4 ARE BC212L
ZD1 BZY88 5V6

SW2 POSITIONS:
1 = 10kHz – 100kHz
2 = 10kHz – 1kHz
3 = 100Hz – 1kHz
4 = 100Hz – 10Hz
5 = 1Hz – 10Hz

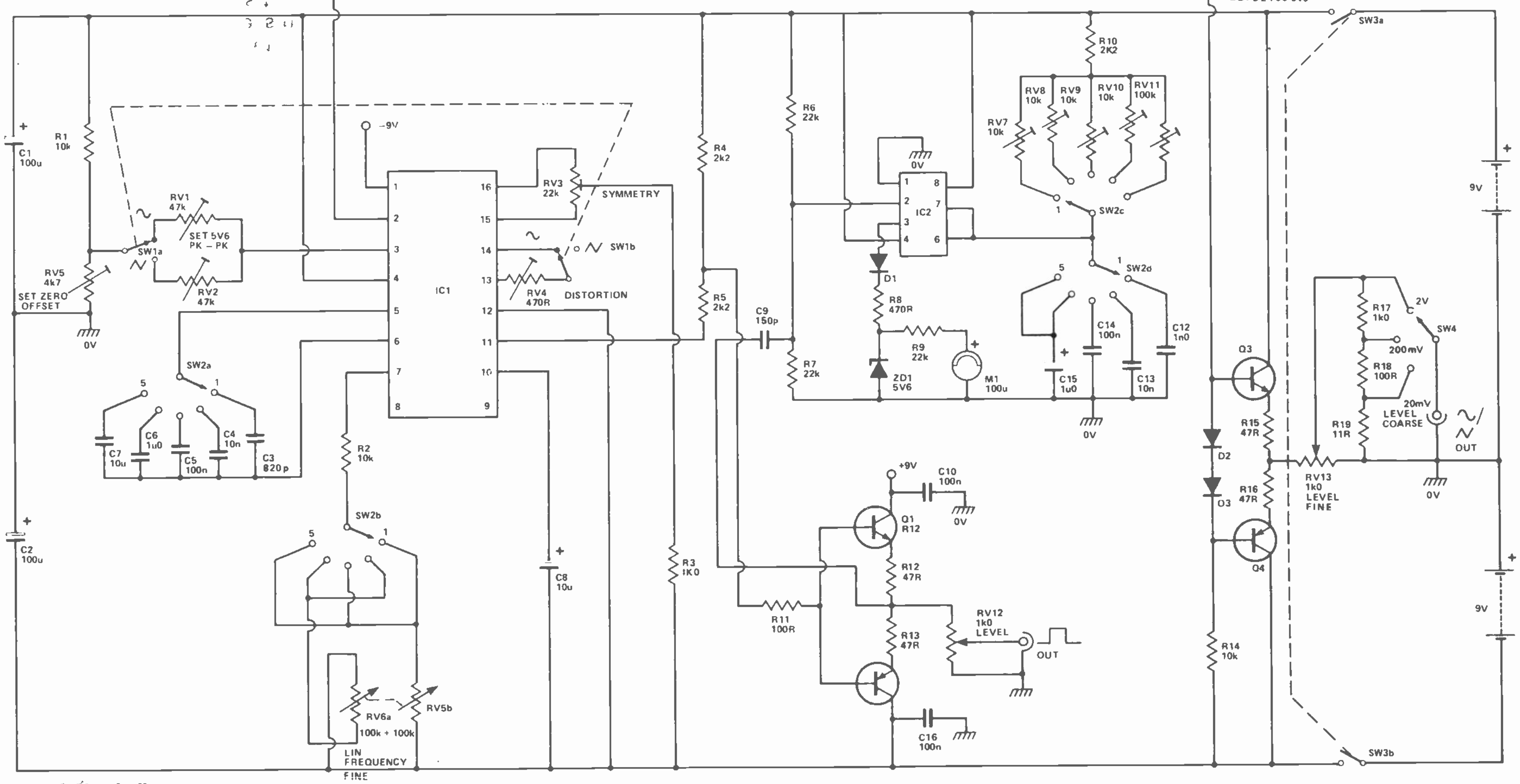


Fig. 4 Circuit diagram.

ADVERTISERS PLEASE NOTE

DUE TO CHRISTMAS AND NEW YEAR WOULD ADVERTISERS PLEASE NOTE THAT THE COPY DEADLINE FOR THE FEBRUARY ISSUE HAS BEEN BROUGHT FORWARD ONE WEEK TO NOVEMBER 30TH

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.

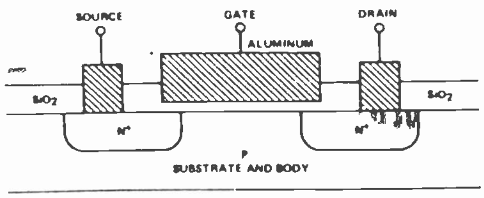


Fig 1. Cross Section of a conventional FET.

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

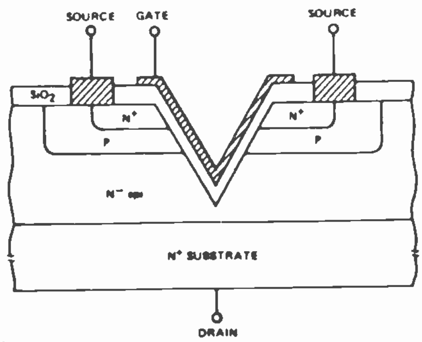


Fig 2. Cross Section of a VMOS power FET.

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

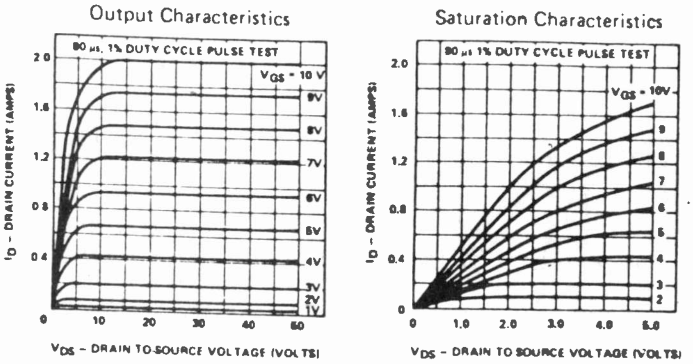


Fig 3. Output and saturation characteristics of the VN67AF VMOS power FET.

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 2R0 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

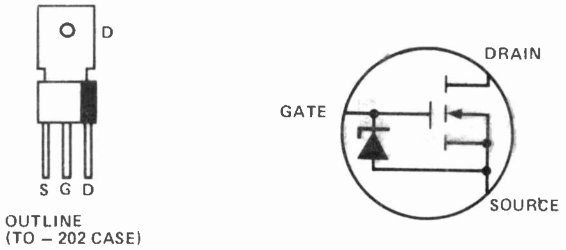


Fig 4. Symbol and outline of the VN67AF.

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

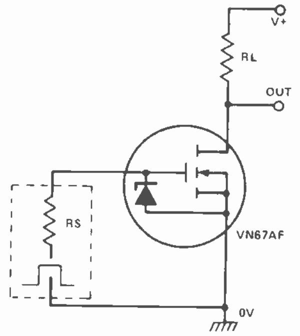
VMOS is delightfully easy to use in digital switching and amplifier applications. Figure 6 shows the basic connections. The load is wired between the drain and the positive supply rail and the digital input signal is fed directly to the gate. Switch-off occurs when the input goes below the gate threshold 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

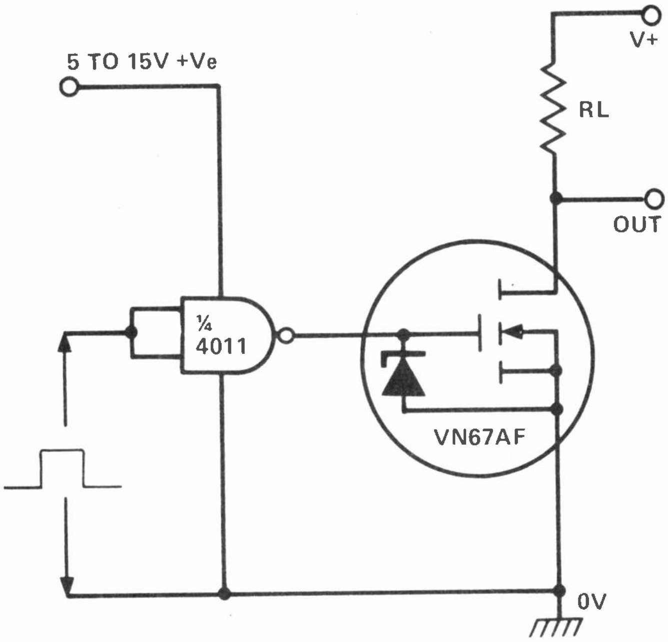


Fig 7. Method of interfacing VMOS with CMOS!

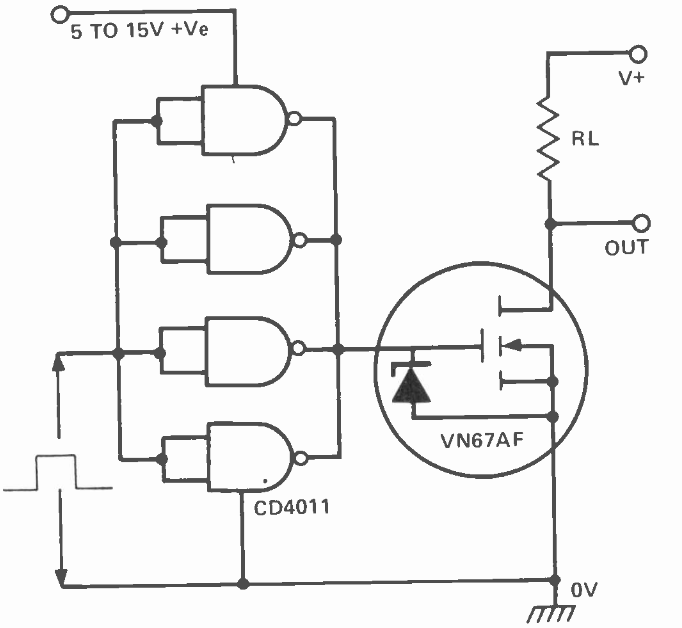


Fig 8. VMOS switching times can be reduced by driving with a number of gates in parallel. Typical R_T = 25 nS.

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.

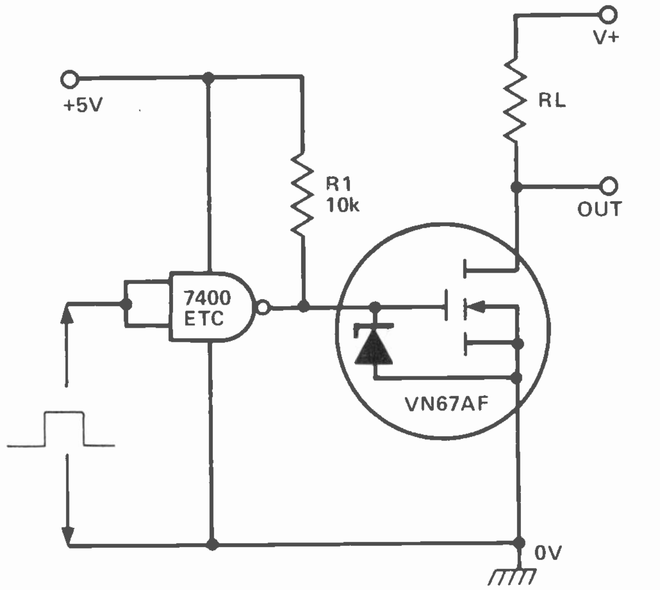


Fig 9. VMOS can be driven from the output of TTL if a pull-up resistor (R1) is used.

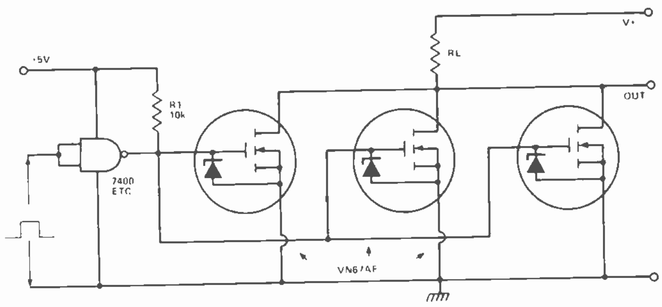


Fig 10. Boosting the output of Fig 9 by driving three VN67AF in parallel.

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 x R_L) of the circuit.

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

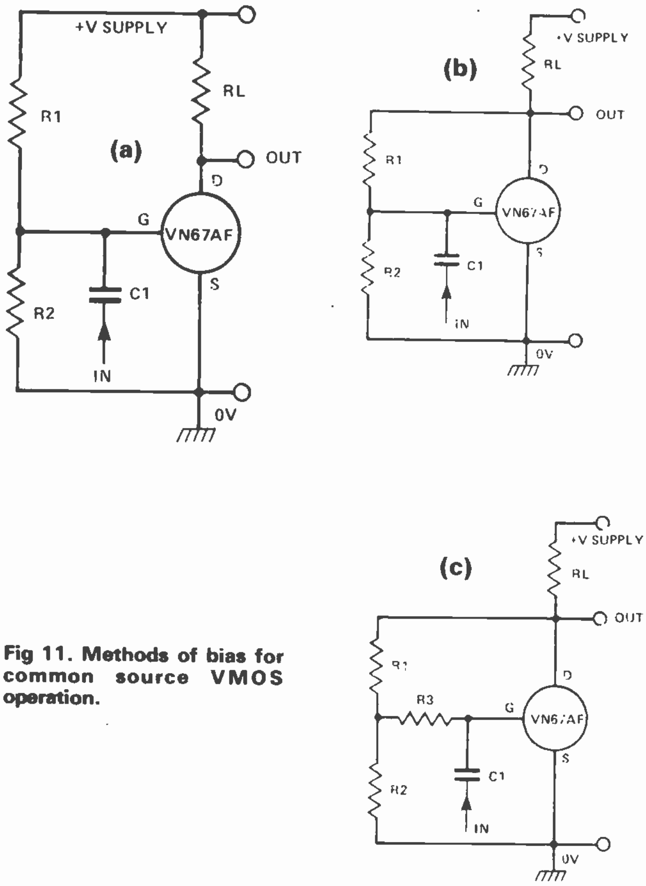


Fig 11. Methods of bias for common source VMOS operation.

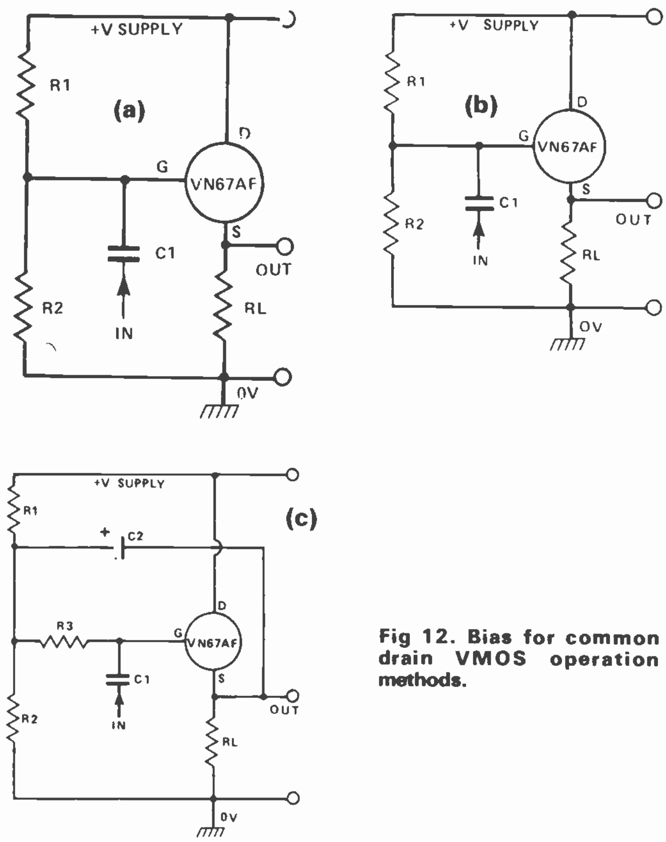


Fig 12. Bias for common drain VMOS operation methods.

impedance that is low relative to R1 and R2 over the required bandwidth of the amplifier.

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

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.

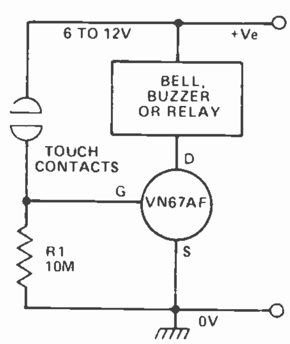


Fig 13. Touch switch.

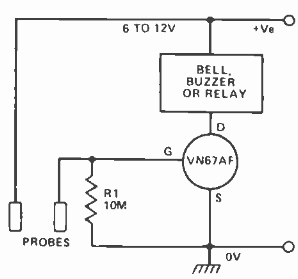


Fig 14. Water switch.

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.

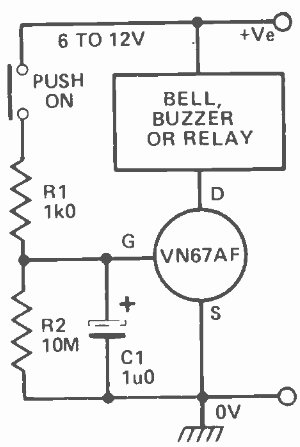


Fig 15. Delay turn off switch.

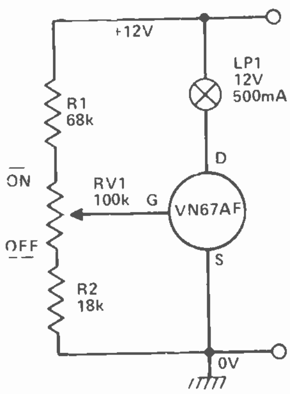


Fig 16. DC lamp dimmer.

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

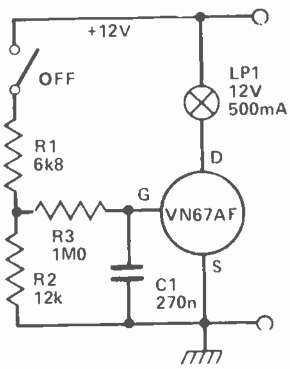


Fig 17. Soft-start analogue lamp switch.

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

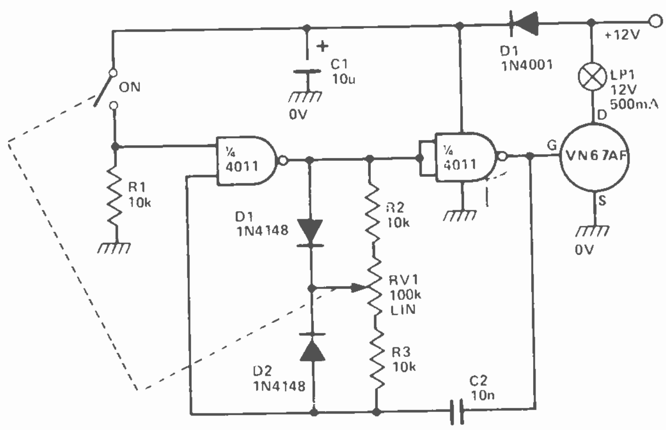


Fig 18. Digital DC lamp dimmer.

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

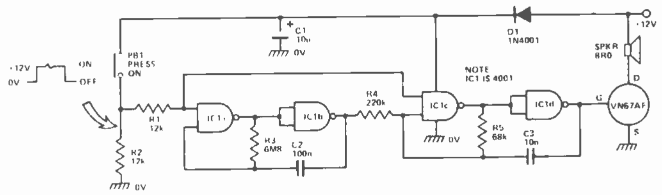


Fig 19. Warble-tone alarm (2 tone output).

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.

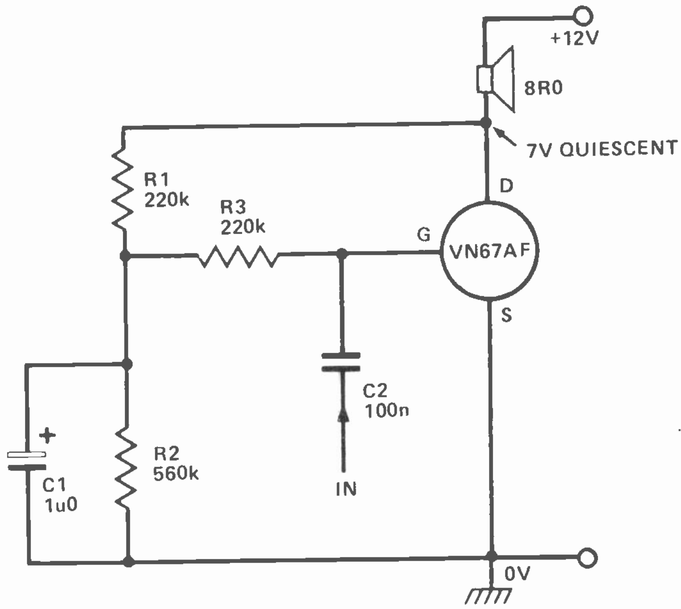


Fig 20. Super simple class-A amplifier.

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. ▶

FEATURE: VFET Applications

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.

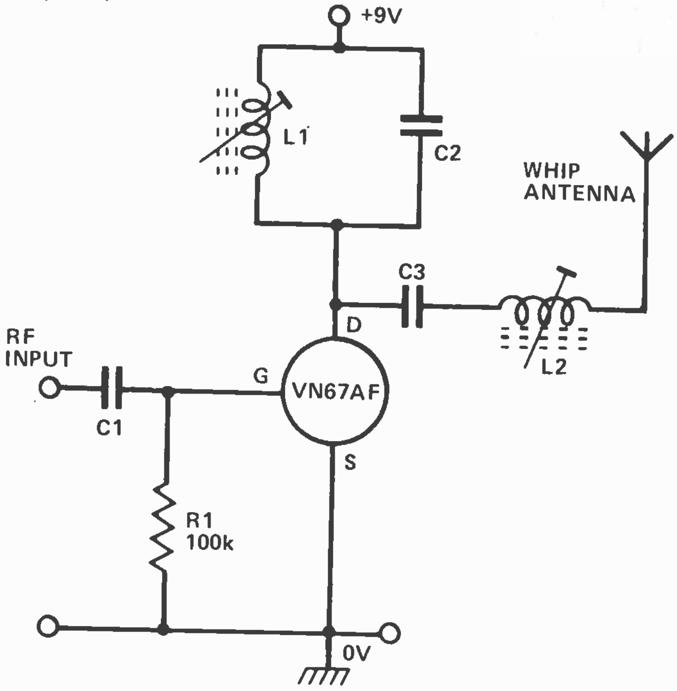


Fig 21. 60mW R/C or CW transmitter L1-C2 is tank circuit, C3-L2 is the antenna circuit.

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.

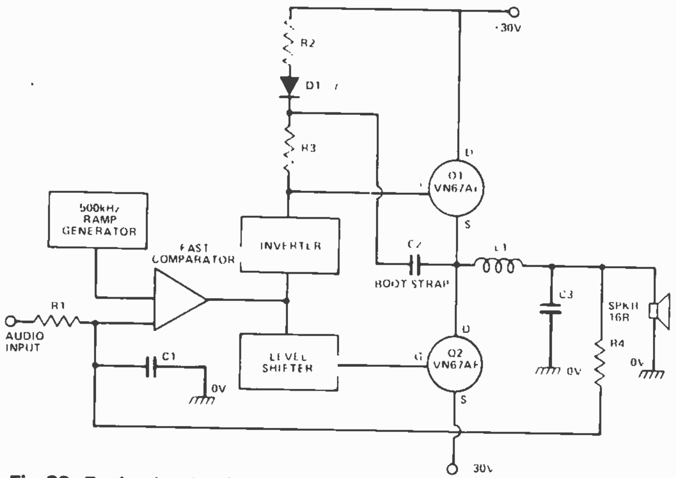
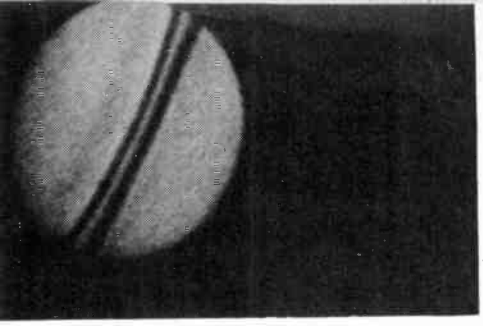


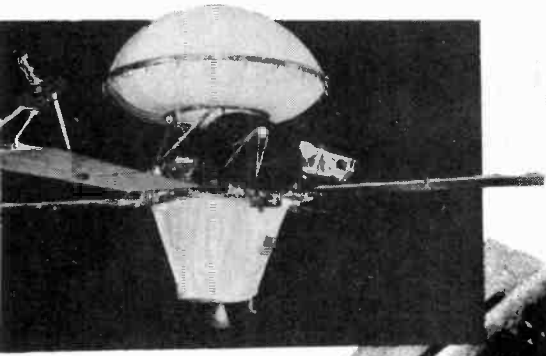
Fig 22. Basic circuit of a 20W clas-D switched-mode audio power amplifier. An ideal application for VMOS.

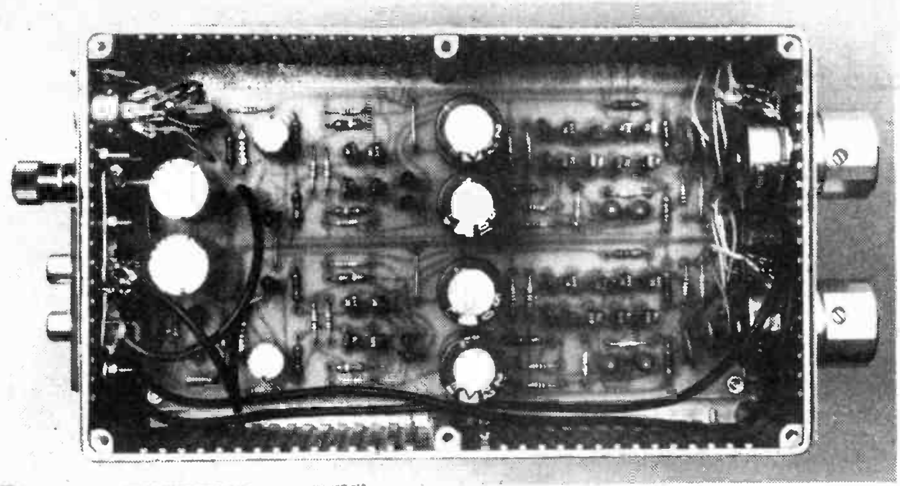
The only criticism that we've been able to make against the Siliconix VMOS power FET technology concerns the present total lack of p-channel devices. Our spies tell us, however, that Siliconix are already working on that problem, and will have it beaten within a year. If that is so, we reckon that the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

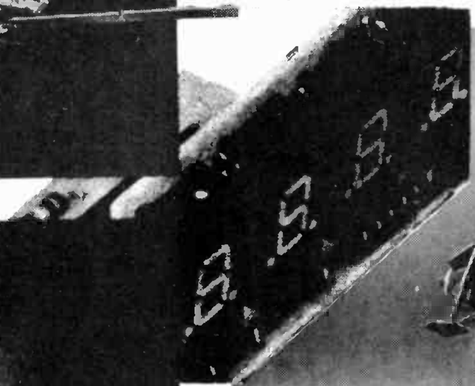
In the meantime, we at ETI are already 'sold' on VMOS, and plan to use a good deal of it in the coming year. We reckon that once you've started using it, you'll like it as much as we do.

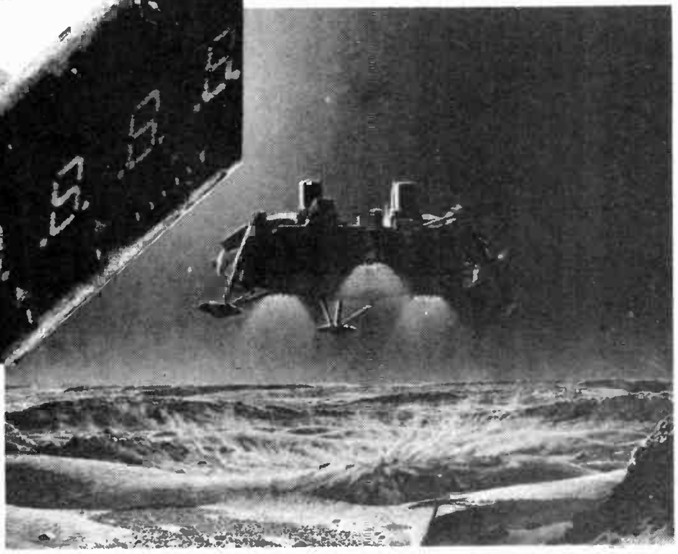
ETI

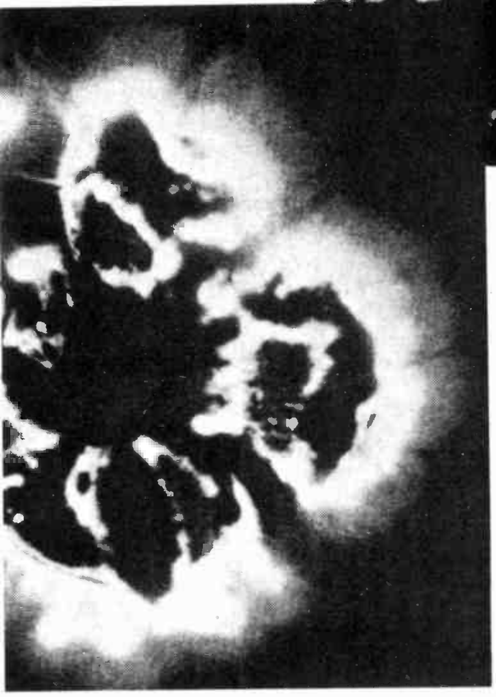


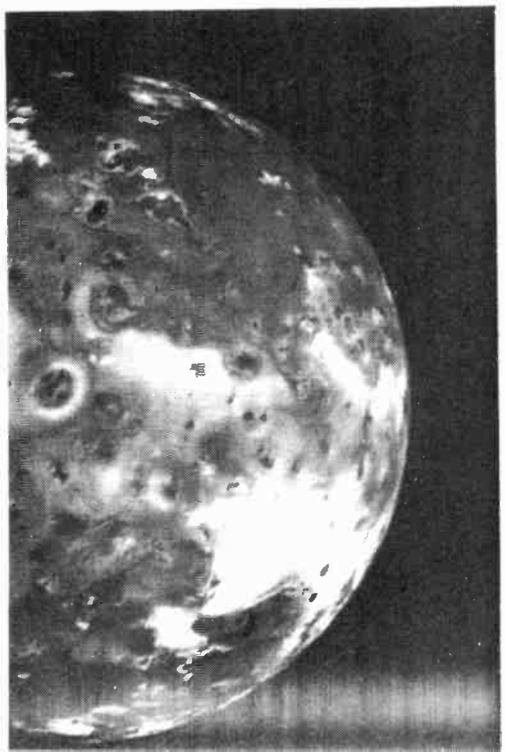






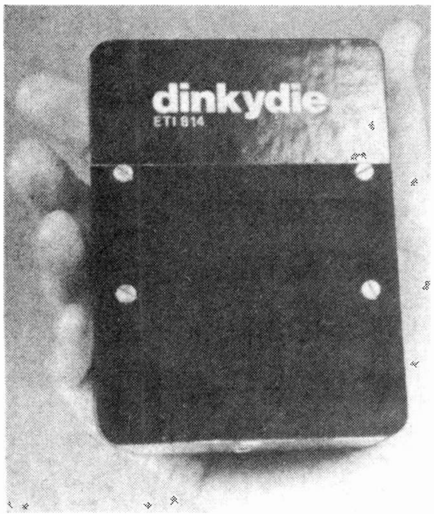






DIE

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
R4	56k
R5	4k7
R6	270k
R9-R11	270R
R12	330R

Capacitors

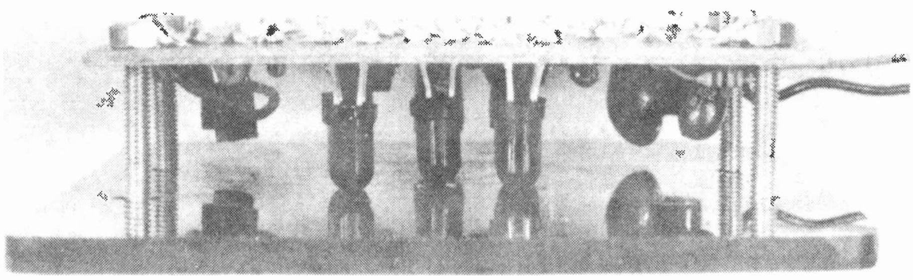
C1,C2	33u 10V tantalum
C3	10n polyester

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.

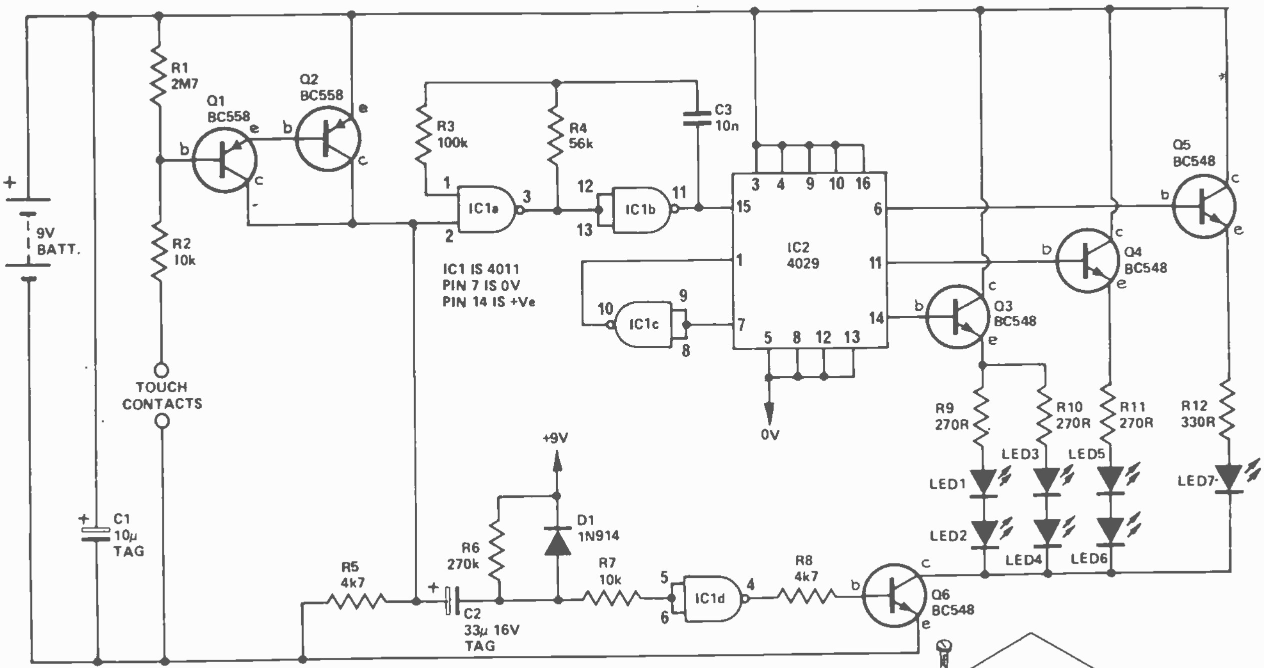


Fig.1. Circuit diagram.

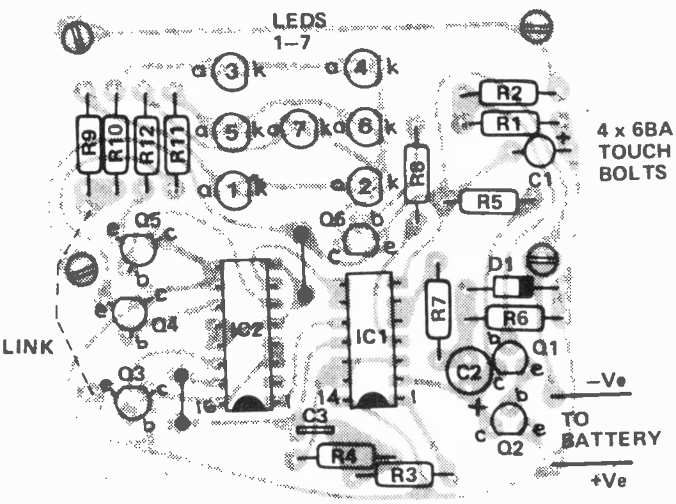


Fig.2. Component overlay.

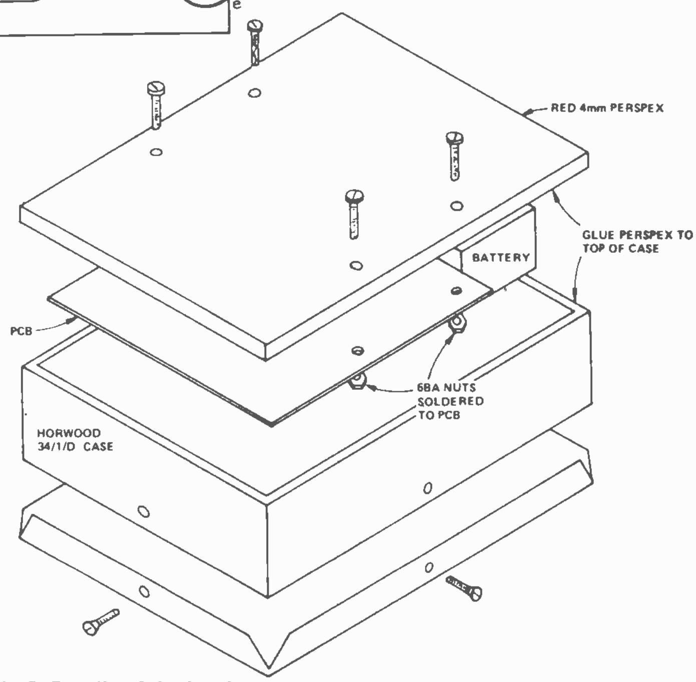


Fig.3. Details of the hardware.

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 Zener	.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

– T T L –

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

I²L, LINEARS, REGULATORS, ETC.

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

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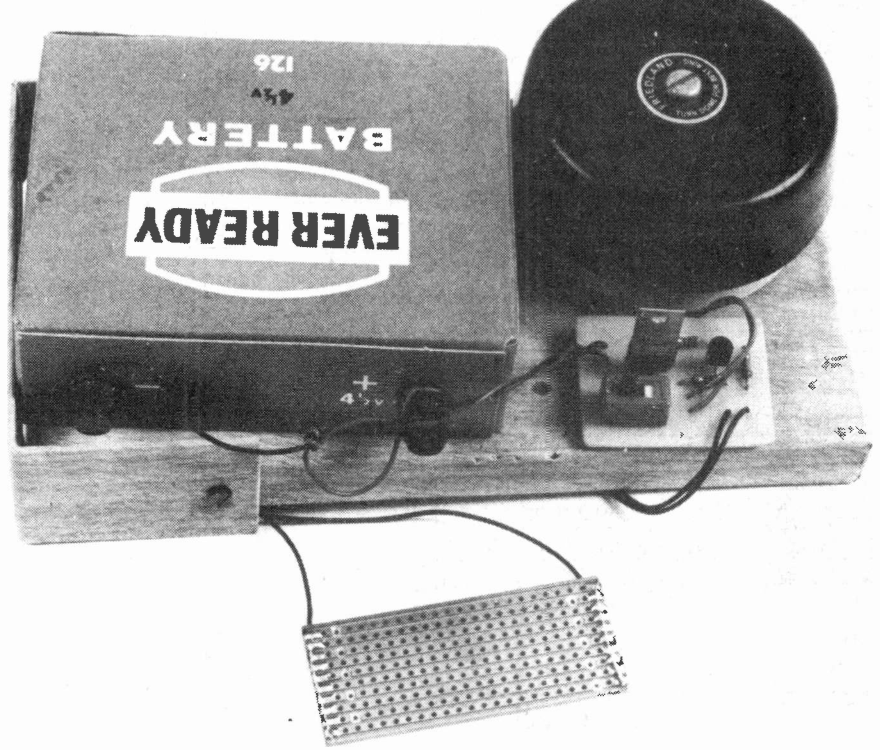
RAIN ALARM

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. ▶



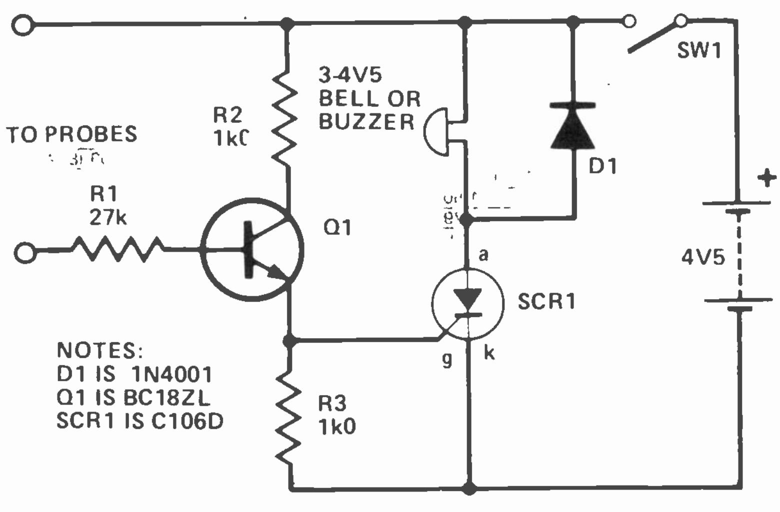


Fig. 1. Circuit diagram.

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.

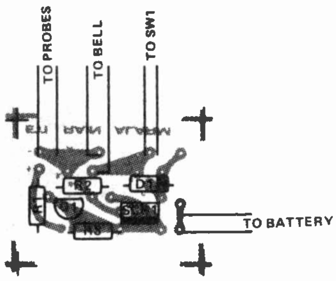


Fig. 2. Component overlay.

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.

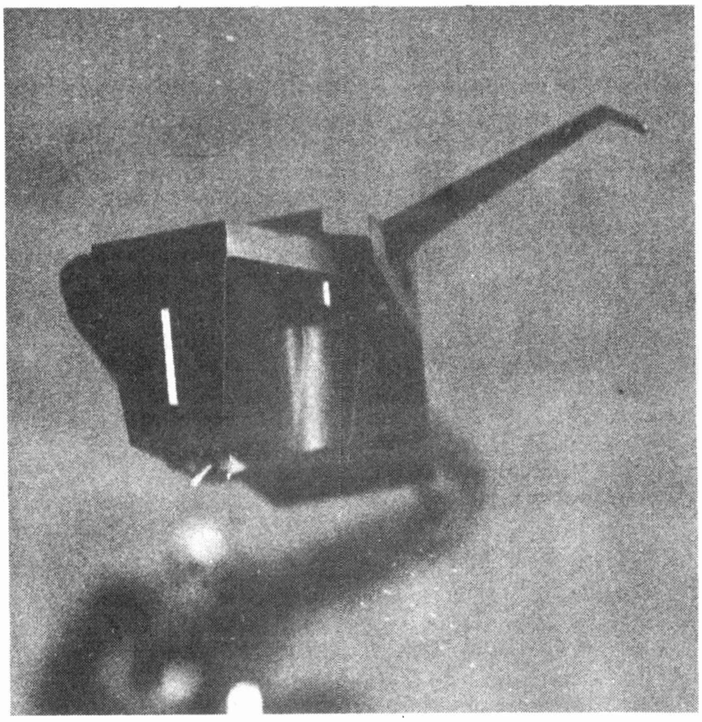
The construction of the circuit on our PC layout will present no difficulties — just take care that the semiconductors are inserted correctly. Use a printed circuit mounting switch for SW1 if you can obtain one — it makes a neater job, but if not, any SPST switch will do.

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. ETI

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. ▶

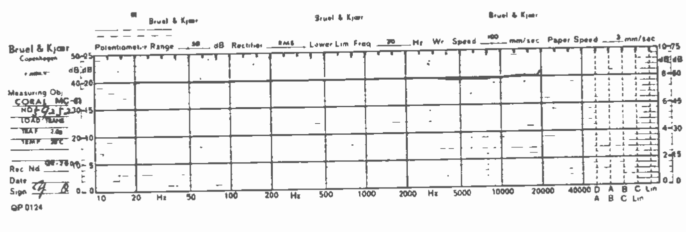


Fig. 1. Frequency response of the MC81. If you can't see it that's because it's so straight it's hidden behind the graph paper. What happened to all those nice dips and peaks reviewers could have such fun commenting on?

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

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

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?

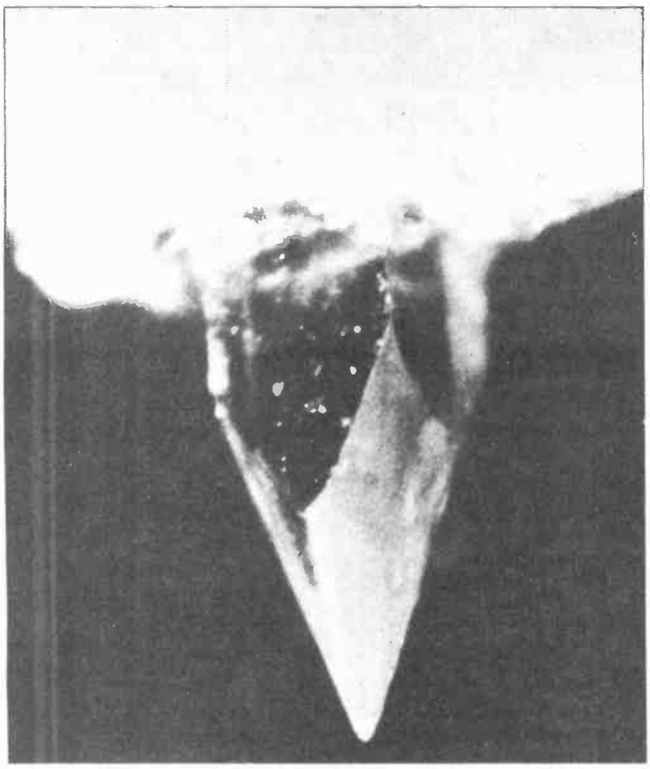
The point on the right has a point to it. A very strange shaped point—but a point nonetheless, a Van den Hul point in fact. After many months of trial and tribulation Goldring have fitted said sharp bit to a cantilever for their new G900IGC pick-up cartridge.

To all things under heaven there is a season, eh?

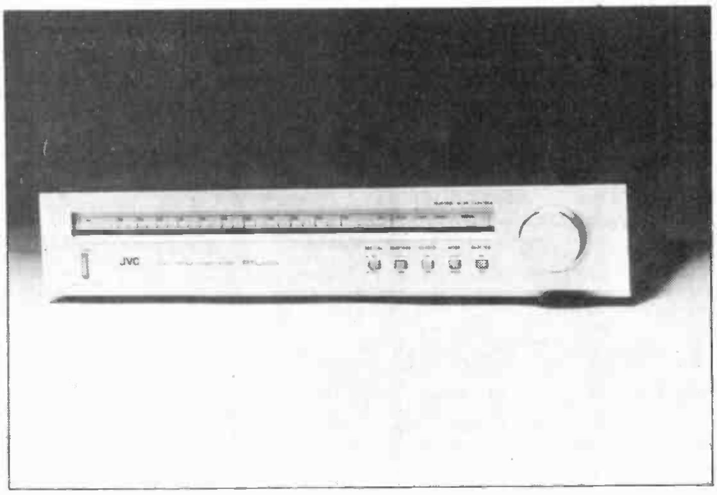
Welcome to the pickup season. After the Coral cometh the IGC and lo, music was bountiful upon the ears of Man and he heard that it was good.

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 MARKET PLACE

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This is no ordinary watch. It's a slim, multi-function, dual time LCD alarm chronograph.
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Hours, minutes, seconds and day of the week are displayed continuously, while the date will appear at the touch of a button. The alarm is beefy enough to wake you up in the morning and get you to work on time (or wake you up when it's time to go home).

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HUM FILTER

Got a hum problem that's making your hi-fi distinctly lo-fi? Our natty notch filter cuts the moronic mains monotone down to size.

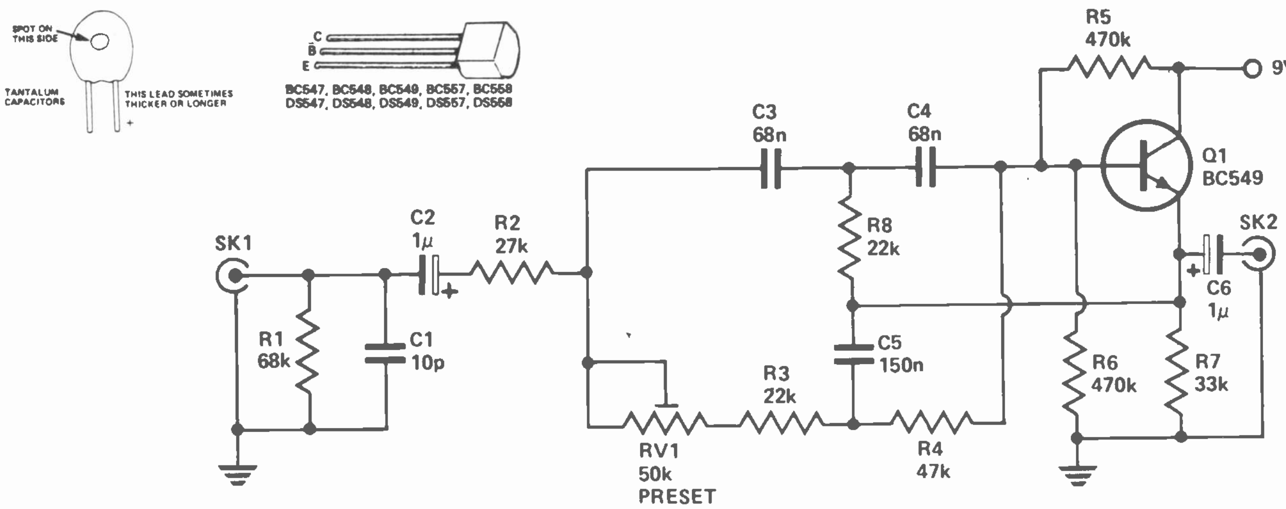
The magnetic field around the transformer in the power amplifier can couple to the preamp or tape deck. Also, the location of nearby 240V mains wiring can cause problems that can be very difficult to overcome. In theory, if the equipment and leads have been properly shielded and earthed this problem 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



NOTE
ONLY ONE CHANNEL HAS BEEN SHOWN FOR CLARITY. THE COMPONENT NUMBERING OF THE OTHER CHANNEL BEGINS at 101 i.e. R101 R102 etc.

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 $C_3 = C_4 = \frac{C_5}{2}$

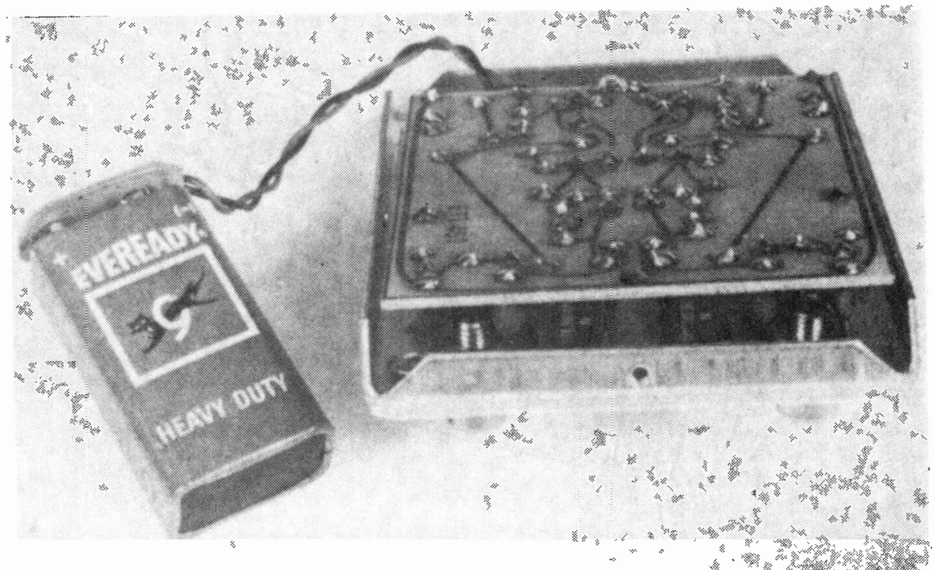
and $R_3 + PR1 = R_4 = 2R_8$

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.

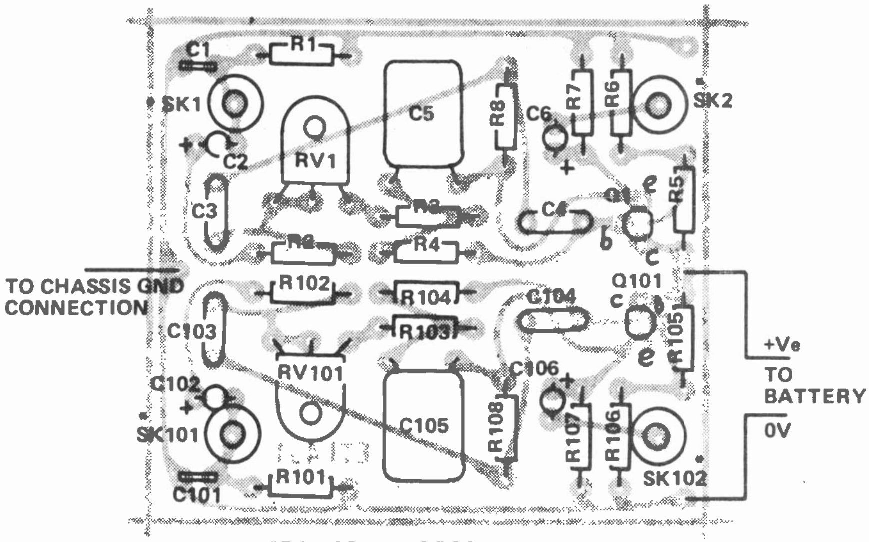
The frequency of the notch is then given by

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

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

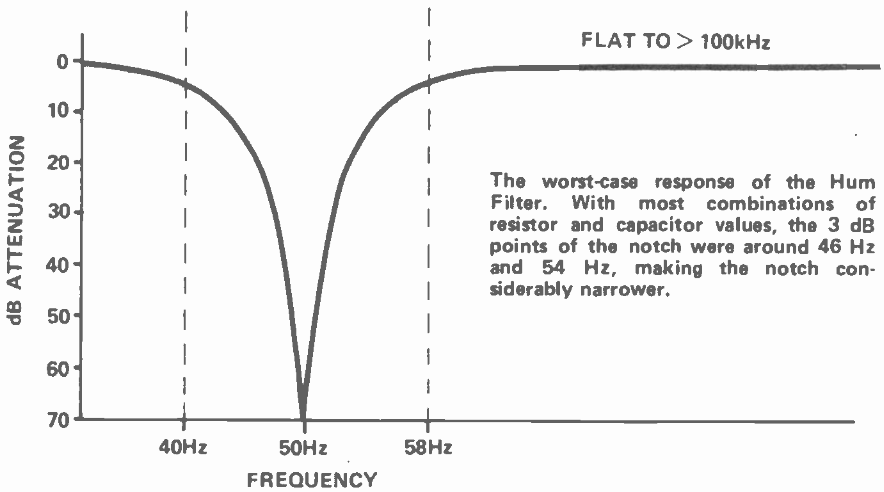


The finished PCB fitted to the front panel, with the battery on flying leads.



*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.

BUYLINES

You shouldn't have any difficulty in getting hold of any of the components for this project. We haven't bothered to box our prototype. You can use anything from a plain aluminium box to a classy wooden case — whatever takes your fancy.

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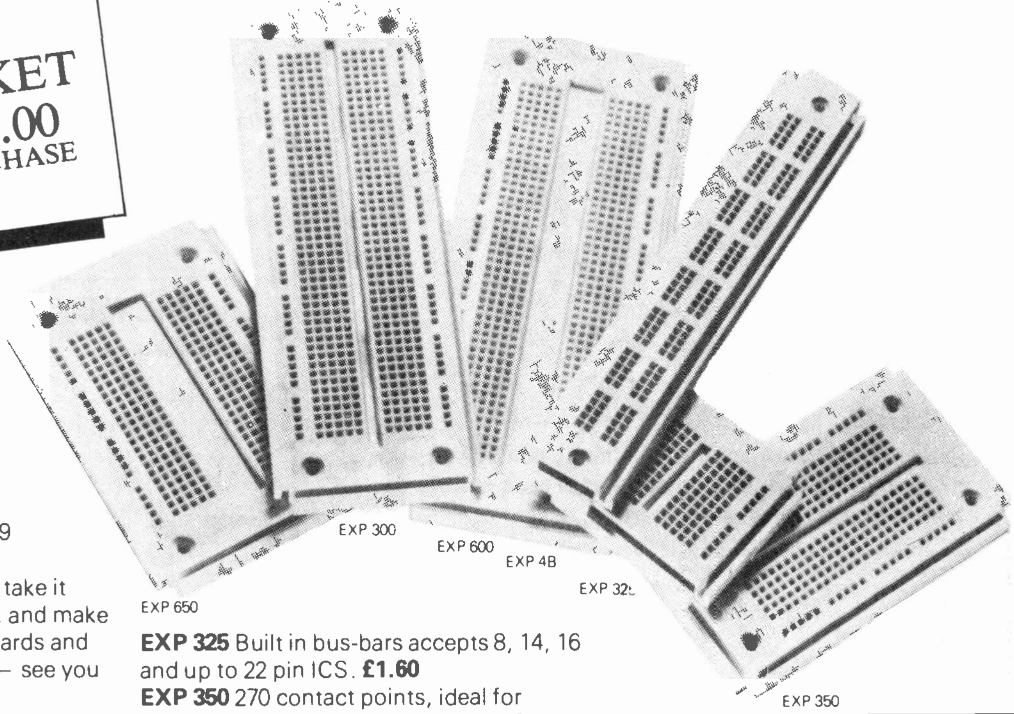

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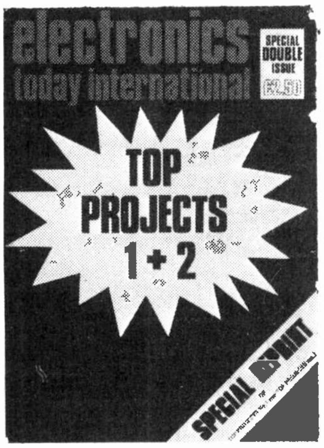

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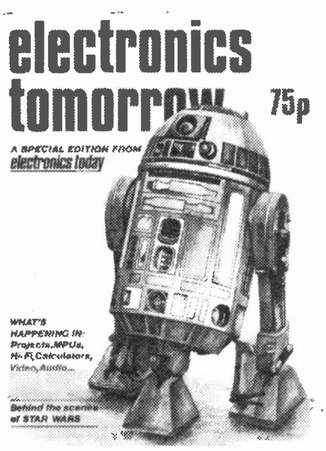

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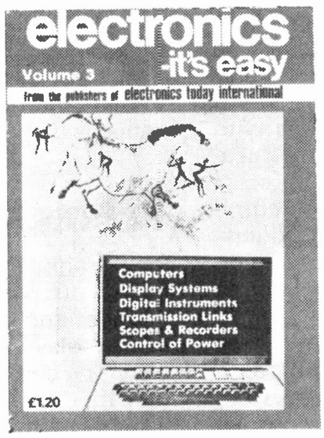

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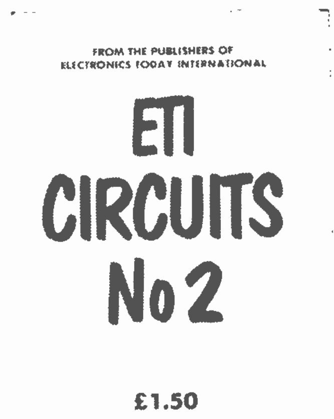

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from ETI

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.

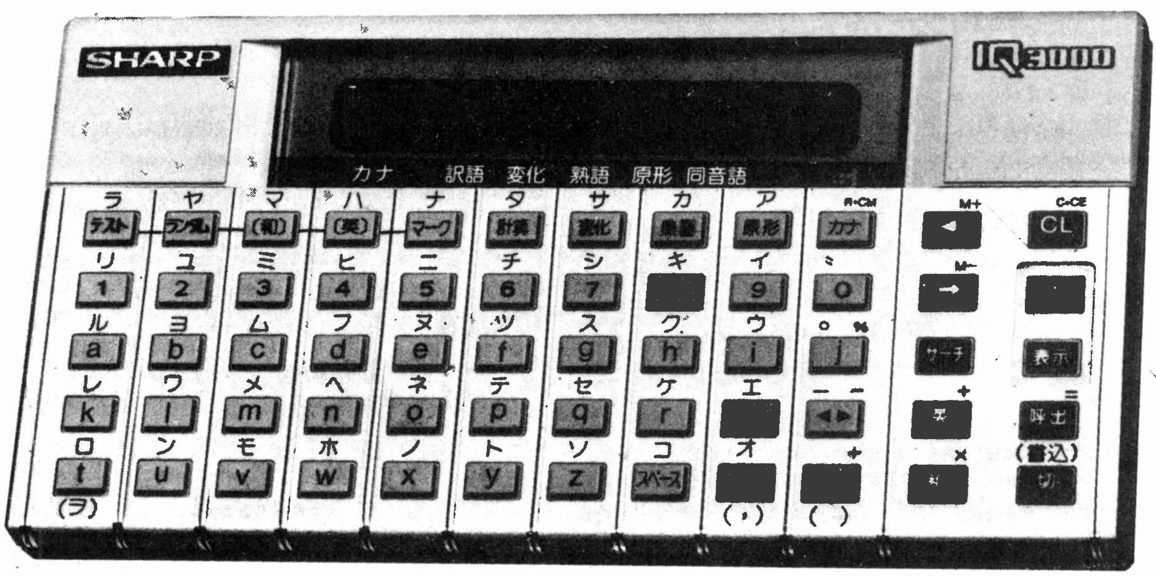
Predicting the future in electronics is a regular feature of TV and the press with "Tomorrows World" and newspaper features on technology. People not involved in science probably have difficulty believing the forecasts since they are quite often so far outside what we already understand.

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?'' ETI

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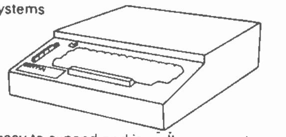

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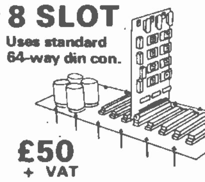

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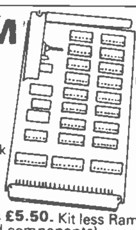

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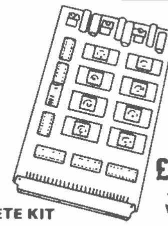

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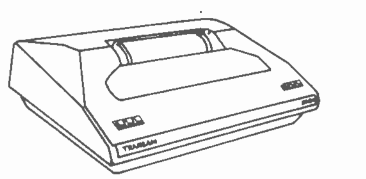

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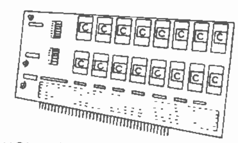

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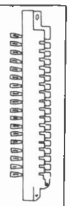

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- DISASSEMBLER
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- CREATE
- BREAKPOINT
- SINGLE STEP
- TRACE
- PROGRAMME LOAD
- MONITOR

Development System

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SN74LS04N	.20	SN74LS74N	.40	SN74LS151N	.85	SN74LS240N	2.20	SN74LS353N	1.50
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SN74LS10N	.18	SN74LS83AN	1.15	SN74LS156N	1.25	SN74LS244N	2.10	SN74LS368N	.65
SN74LS11N	.26	SN74LS85N	1.10	SN74LS157N	.60	SN74LS245N	3.60	SN74LS373N	1.75
SN74LS12N	.25	SN74LS86N	.40	SN74LS158N	.90	SN74LS247N	1.25	SN74LS374N	1.70
SN74LS13N	.55	SN74LS90N	.65	SN74LS160N	1.15	SN74LS248N	1.99	SN74LS375N	.72
SN74LS14N	.89	SN74LS91N	.90	SN74LS161N	1.15	SN74LS249N	1.30	SN74LS377N	1.75
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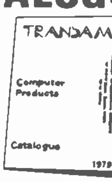

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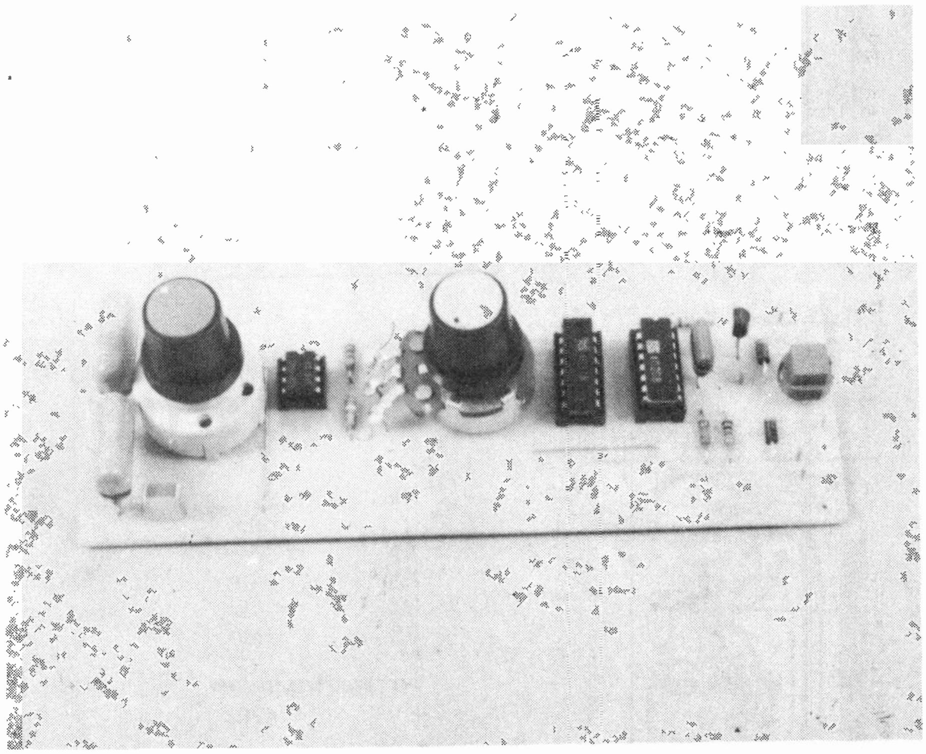
Electronic timer units have numerous home, hobby and engineering applications. They can be designed to have either analogue or digital "Time set" indicators or scales, on which the required timing period is initially set. Their relay-contact outputs can be used to control lamps, heaters, battery chargers, photographic enlargers etc.

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.

Our new wide-range timer gives you the best of both worlds. It is an analogue-scale device that uses digital frequency division techniques to give a very wide timing range (1 minute to 20 hours), but uses a basic clock generator with non-electrolytic timing capacitors and consequently has a high degree of intrinsic long-term accuracy (better than 1%). The timer is inexpensive, having a typical component cost (excluding the relay) of three or four pounds. The unit consumes zero current when it is in the 'standby' mode and thus does not need a separate on / off switch.



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.

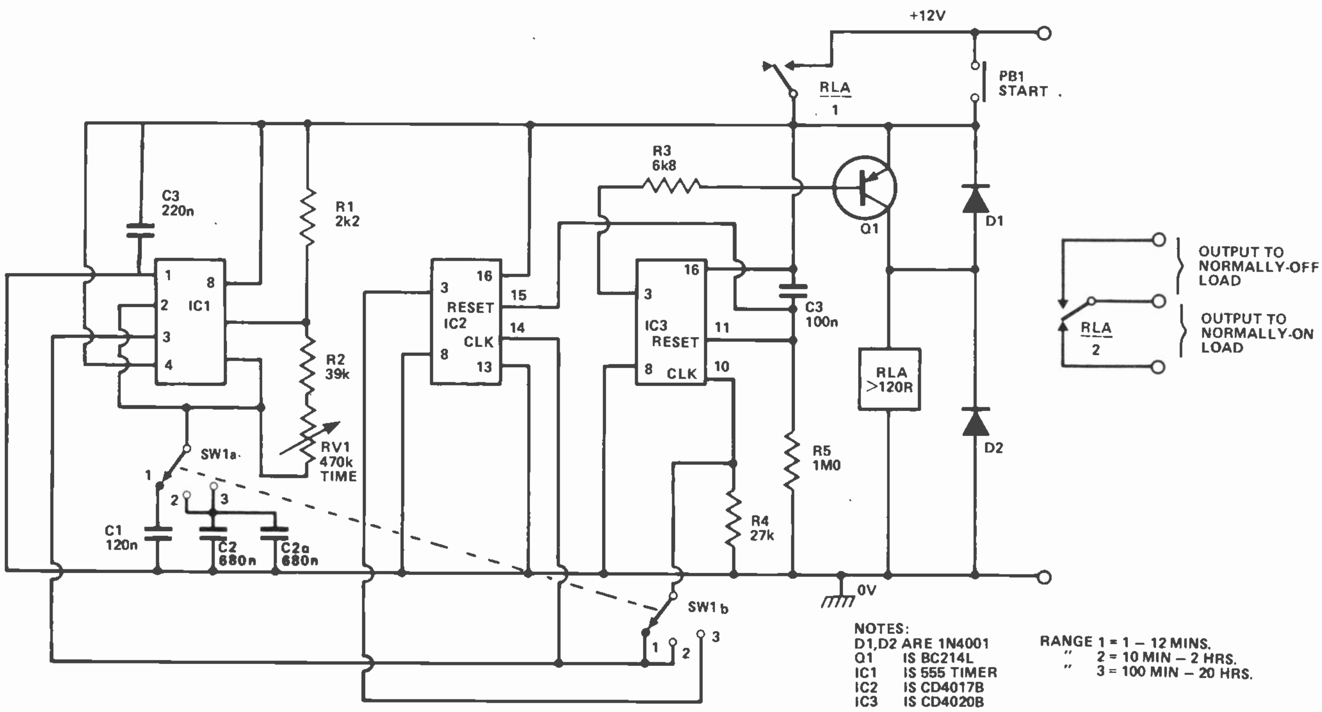


Fig. 1. Circuit diagram.

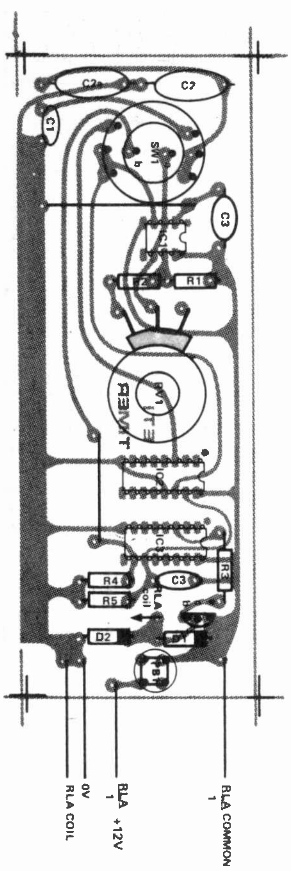


Fig. 2. Component overlay.

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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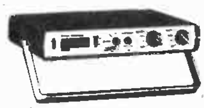
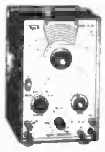

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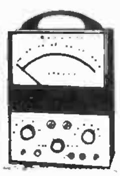

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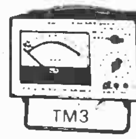

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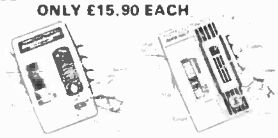

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CHESS MACHINES SURVEY

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.

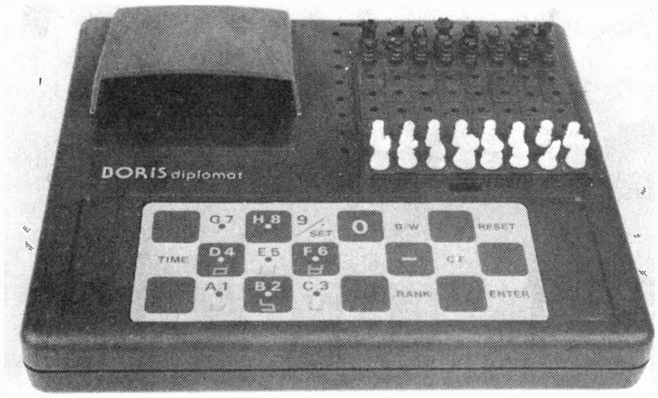
Unlike the other games, which have a series of levels of play to choose from, Boris has a built-in 100 hour timer. The longer a response time you set on the timer, the longer Boris has to think about his/it's next move and the higher the level at which it plays.

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

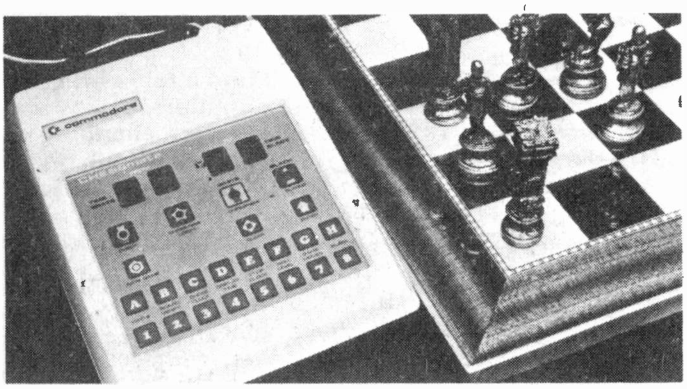


My first impressions of the Boris Diplomat were less than favourable. I found that the flickering LED display was set at an awkward viewing angle. The keyboard, although large and clearly laid out, was unsatisfactory in use. It was absolutely rigid and, in the absence of sound effects, I had to glance 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.

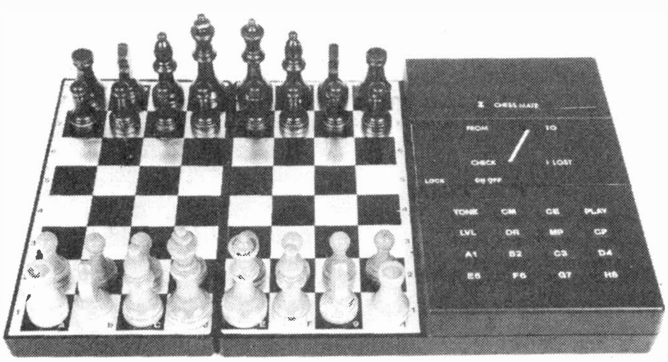
My only criticism is that there is no on/off switch for the sound effects. They *do* become a little irritating after a couple of games. The control panel is well laid out and more colourful than most.

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.

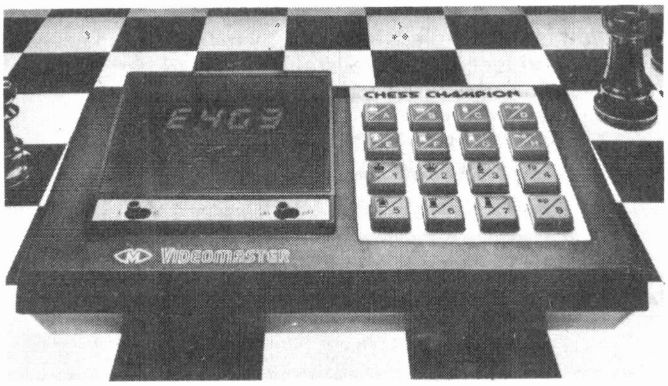
CHESS MATE



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

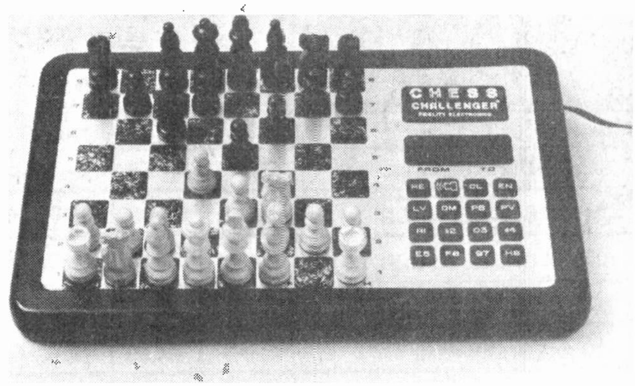
This latest addition to the Chess Challenger range is a bit special. It talks to you. It not only repeats every move, it tells you which piece it's moving and, if it's taking something, which piece it's taking. If you're stuck for a move, the Voice C.C. will even whisper a few suggestions in your shell-like. 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

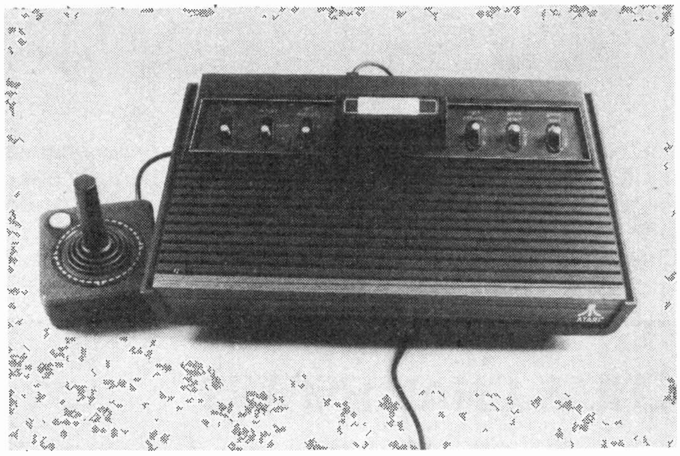
If you're buying a programmable TV games centre, or if Santa Claus is bringing you one, you've probably got you eyes on the Atari Video Computer Systems. It's an expensive way of playing chess — over £200, including £45 just for the chess cartridge.

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.



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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

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.

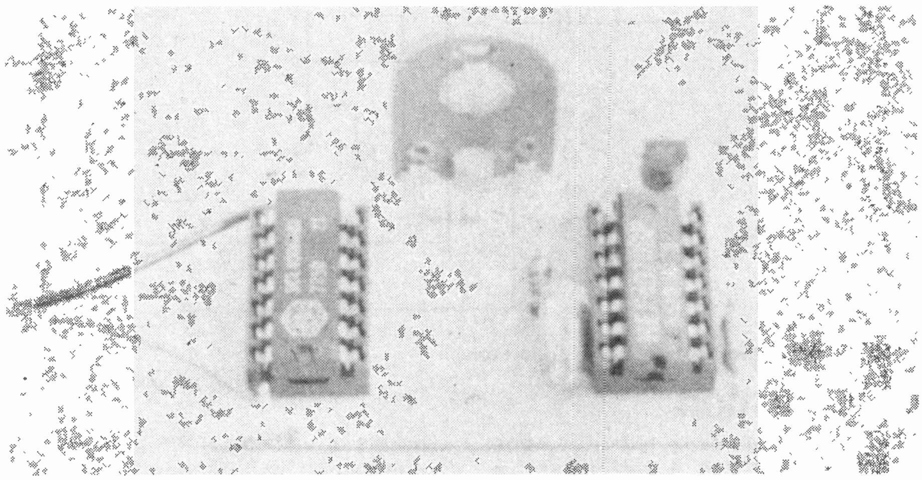
V — Videotime Products
56 Queens Road
Basingstoke
Hants RG12 1REA
Tel: (0256) 56417
(0256) 26620

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

ETI

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.

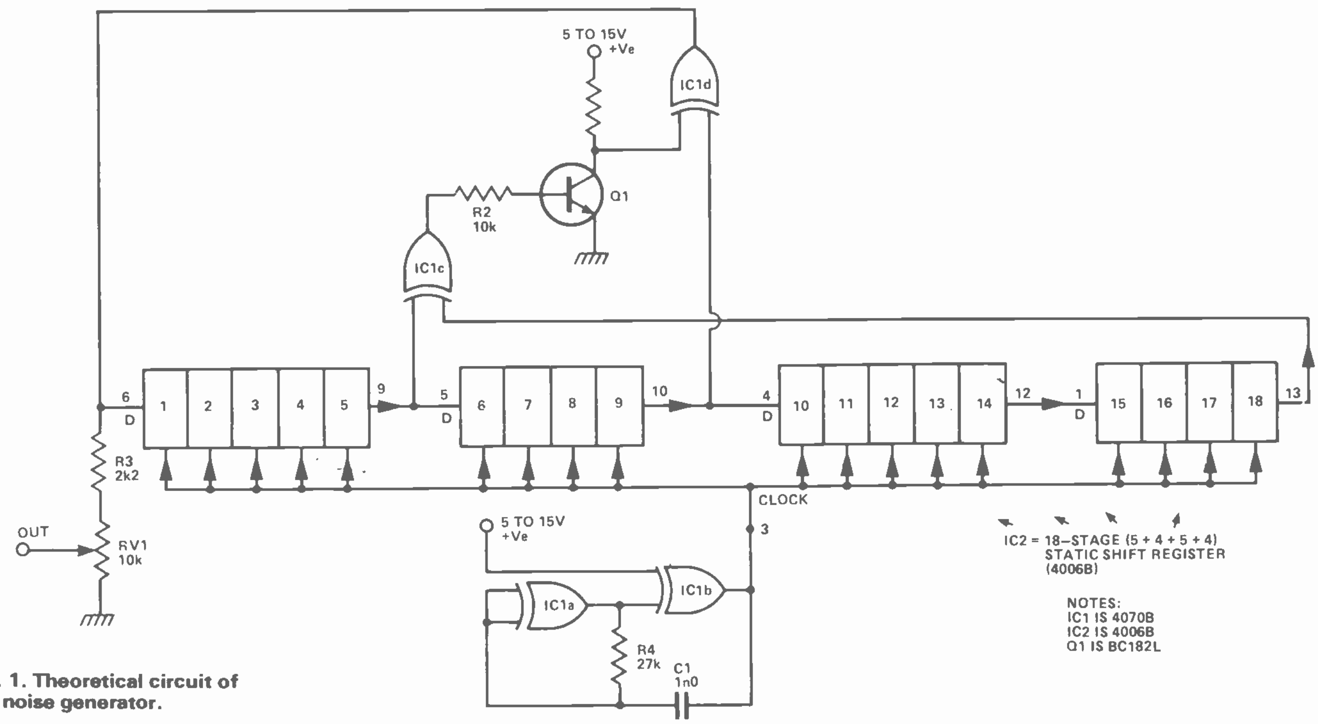


Fig. 1. Theoretical circuit of the noise generator.

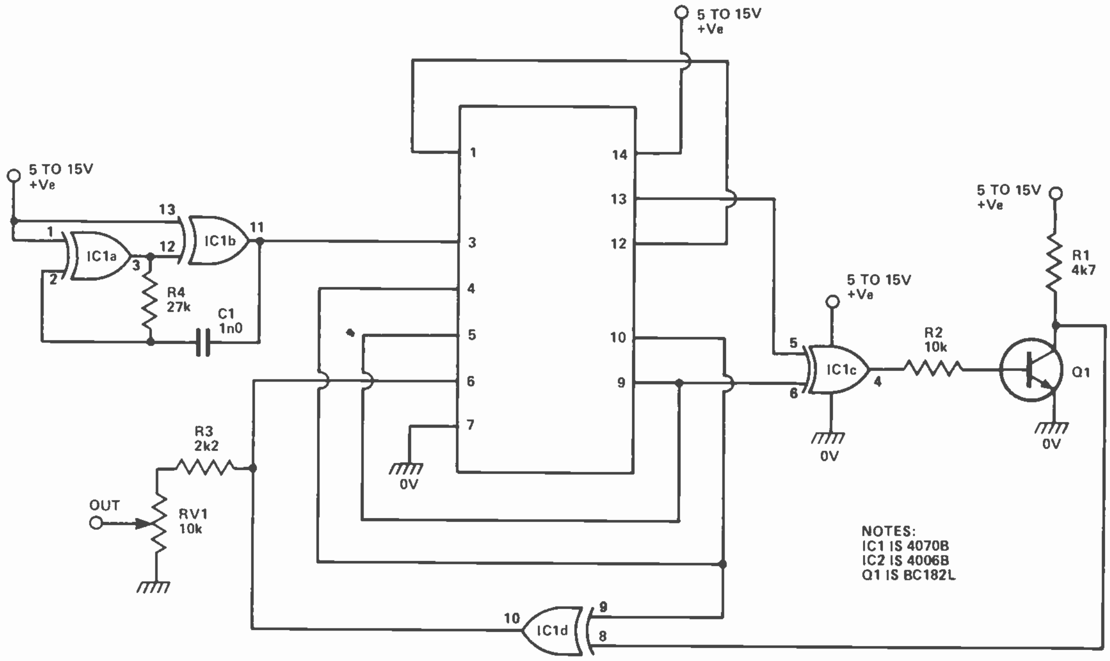


Fig. 2. Practical circuit of the noise generator.

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

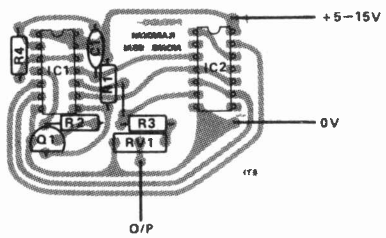


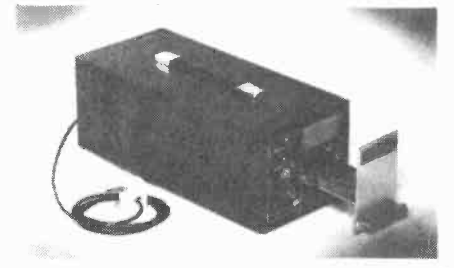
Fig. 3. Component overlay.

Greenbank

Greenbank Electronics
(Dept T12E) 92 New Chester Road, New Ferry
Wirral, Merseyside L62 5AG
(Tel: 051-645 3391)

TERMS, VAT, CWO. Cheques etc payable to Greenbank Electronics. Add VAT to all prices at 15% except where stated otherwise. Post etc: UK 30p (+5p VAT = 35p) per order. Export: NO VAT but add 30p (Eire), 75p (Europe) and £2.50 elsewhere.
(Polys, universities, govt depts, etc can telephone their orders for immediate despatch on account.)

PROMBOX 12



An easy to use unit designed for both the professional and amateur UV-prom user

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	4531	£1.45
4001	17p	4043	94p	4093	63p	4422	£5.00	4532	£1.27
4002	17p	4044	90p	4094	£1.90	4431	TBA	4534	£5.13
4006	£1.05	4045	£1.45	4095	£1.05	4433	£11.32	4536	£3.69
4007	18p	4046	£1.28	4096	£1.05	4435	£7.93	4537L	£13.23
4008	87p	4047	87p	4097	£3.72	4440L	£11.58	4538	£1.25
4009	50p	4048	58p	4098	£1.10	4450	£2.67	4539	91p
4010	50p	4049	48p	4099	£1.45	4451	£2.67	4541	£1.14
4011	18p	4050	48p	40061	N/S	4452	TBA	4543	£1.59
4012	18p	4051	72p	40100	£2.50	4461	£2.18	4549	£3.69
4013	42p	4052	72p	40101	£1.61	4462	£2.42	4552	£10.55
4014	86p	4053	72p	40102	£2.12	4490FP	£6.54	4553	£3.87
4015	89p	4054	£1.10	40103	£2.12	4490VP	£3.48	4554	£1.19
4016	45p	4055	£1.28	40104	£1.09	4500	£6.95	4555	78p
4017	89p	4056	£1.34	40105	£1.06	4501	17p	4556	78p
4018	89p	4057	£25.70	40106	61p	4502	91p	4557	£3.86
4019	48p	4059	£4.80	40107	68p	4503	69p	4558	£1.14
4020	99p	4060	£1.15	40108	£5.36	4505	£5.71	4559	£3.68
4021	91p	4061	£15.67	40109	£1.02	4506	51p	4560	£1.84
4022	86p	4062T	£10.00	40181	£3.39	4507	55p	4561	65p
4023	20p	4063	£1.09	40182	£1.40	4508	£2.48	4562	£5.33
4024	66p	4064	N/S	40192	£1.40	4510	99p	4566	£1.59
4025	19p	4065	N/S	40193	£1.40	4511	£1.38	4568	£2.38
4026	£1.80	4066	57p	40194	£1.18	4512	81p	4569	£2.57
4027	45p	4067	£3.80	40257	£1.48	4514	£2.65	4572	25p
4028	81p	4068	22p	4160	£1.08	4515	£2.99	4580	£5.74
4029	99p	4069	20p	4161	£1.08	4516	£1.08	4581	£2.62
4030	58p	4070	23p	4162	£1.08	4517	£3.82	4582	98p
4031	£2.05	4071	21p	4163	£1.08	4518	£1.02	4583	76p
4032	£1.00	4072	21p	4174	£1.08	4519	51p	4584	43p
4033	£1.45	4073	21p	4175	99p	4520	£1.08	4585	£1.01
4034	£1.96	4075	23p	4194	£1.08	4521	£1.88	4595	£1.20
4035	£1.11	4076	85p	4408	£6.59	4522	£1.08	4597	£2.32
4036	£2.45	4077	23p	4409	£6.59	4524	N/S	4598	£2.65
4037	£1.00	4078	21p	4410	£5.73	4526	£1.08	4599	£6.95
4038	£1.08	4081	20p	4411	£9.58	4527	£1.52	4700	£1.75
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		

74C

		74C63	£1.29	74C164	£1.04	74C905	£7.26	74C926	£4.84
		74C85	£1.29	74C165	£1.04	74C906	54p	74C927	£4.84
74C00	24p	74C86	64p	74C173	90p	74C907	54p	74C928	£4.84
74C02	24p	74C89	£4.38	74C174	£1.51	74C908	96p	74C929	£11.93
74C04	24p	74C90	85p	74C175	90p	74C909	£1.63	74C948	TBA
74C08	24p	74C93	85p	74C192	£1.10	74C910	£6.78	80C95	54p
74C10	24p	74C95	£1.04	74C193	£1.10	74C911	£7.13	80C96	61p
74C14	£1.41	74C107	£1.22	74C195	£1.04	74C912	£7.13	80C97	54p
74C20	24p	74C150	£4.12	74C200	£6.78	74C914	£1.41	80C98	61p
74C30	24p	74C151	£2.46	74C221	£1.36	74C915	£1.10	82C19	£4.13
74C32	24p	74C154	£3.67	74C373	£1.73	74C918	£1.06	88C29	£1.93
74C42	92p	74C157	£2.20	74C374	£1.73	74C921	£11.83	88C30	£1.93
74C48	£1.38	74C160	£1.10	74C901	54p	74C922	£3.66		
74C73	54p	74C161	£1.10	74C902	54p	74C923	£3.73		
74C74	56p	74C162	£1.10	74C903	54p	74C924	TBA		
74C76	54p	74C163	£1.10	74C904	54p	74C925	£4.84		

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UM111: E36 UHF Ch.36 Vision Modulator £2.50
UM1231 UHF Ch.36 Vision Modulator wide bandwidth (for computers etc.) £4.70
UM1263 FM Sound Sub-carrier Modulator £2.50

NEW SWITCH MODE PSUs

AC 5221S 5v/10A remote sense £63.25
AC 8221S 5v/5A, +12v/1A, −12v/1A £78.90
AC 9221S as 8221 but also −5v/0.1A £84.30
Typically 70% efficient. Dims. 4"×8½"×2"

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114 x 203 mm fibreglass, with gold plated edge connector.
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SC/MP Protoboard £5.95
Z80 CPU card £7.50
VDU 'A' } set } £7.50
VDU 'B' } of } £7.50
VDU 'G' } three } £7.95
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4k PROM board (5204s) £5.95
8k PROM board (2708s) £7.95
2k RAM board (2102s) 1K-2K £7.95
8k RAM board (2114s) 1K-8K £7.95
TAPE interface .. £7.50
Keyboard interface £7.50
PSU 5v, +12v, −12v board £7.50
PSU 5v, −12v board £4.95
Further details on request

Z80
Z80 CPU (2½MHz) £9.90
Z80-CTC (2½MHz) £5.95
Z80-P10 (2½MHz) £6.60
(Add £1 for the 4MHz version of any of the above 3 chips.)

SC/MP II RAM I/O
SC/MP II (4MHz) £8.82
INS 8154 RAM I/O £7.75

6800
6800 MPU £6.55
6802 MPU £9.95
6810 (128 × 8 RAM) £2.97
68A10 (128 × 8 RAM) £3.75
6820, 6821 PIA £3.96
6850 ACIA £3.08
MC6880 £2.64

6502
6502 £12.00
6520 PIA £6.22

CMOS
COSMAC 1802 £9.85
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STATICS (Mostly 450nS)
2101—256 x 4 £2.25
21L02—1K x 1 £1.20
2111—256 x 4 £1.75
2112—256 x 4 £2.25
2114—1K x 4 £4.56
21L14—1K x 4 £5.50
4118—1K x 8 (2708 Compatible) £18.50

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MK 4027 4K 250nS £3.50
MK 4116 16K 250nS £6.95
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TMS 2716 £16.95
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AY-5-1013A £4.70
AY-3-1014A £5.60
AY-3-1015 £5.60

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MCM 6571/4/5/6 £9.50
MCM 66750 £9.75
MK 5302 £15.20
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MIKBUG 80-7 £13.70
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7805 75p
7905 £1.00
7812 87p
7912 £1.00
LM 323K £5.61

74LS

		74LS27	28p	74LS76	40p	74LS125	60p	74LS163	£1.18	74LS240	£2.36	74LS283	£1.92	74LS375	£1.60
		74LS28	48p	74LS78	40p	74LS126	60p	74LS164	£1.14	74LS241	£2.32	74LS290	£1.28	74LS377	£2.12
74LS00	14p	74LS30	22p	74LS83	£1.15	74LS132	95p	74LS165	75p	74LS242	£2.32	74LS293	£1.28	74LS378	£1.84
74LS01	14p	74LS32	27p	74LS85	£1.18	74LS136	55p	74LS166	£2.25	74LS243	£2.32	74LS295	£1.85	74LS379	£2.15
74LS02	16p	74LS33	39p	74LS86	43p	74LS138	85p	74LS170	£2.88	74LS244	£1.70	74LS298	£1.68	74LS384	86p
74LS03	16p	74LS37	39p	74LS90	60p	74LS139	85p	74LS173	£1.05	74LS245	£2.70	74LS324	£2.40	74LS386	.86p
74LS04	16p	74LS38	39p	74LS91	£1.04	74LS145	£1.08	74LS174	£1.06	74LS247	£1.90	74LS325	£2.90	74LS390	£2.30
74LS05	20p	74LS40	28p	74LS92	89p	74LS147	£1.70	74LS175	£1.10	74LS248	£1.90	74LS326	£2.94	74LS393	£2.30
74LS08	22p	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
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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
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c104 page Machine Language Programming for Beginners by Ron Santore (Dilithium) £5.10
c225 page Understanding Computers by Paul Chirlian (Dilithium) £6.50

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

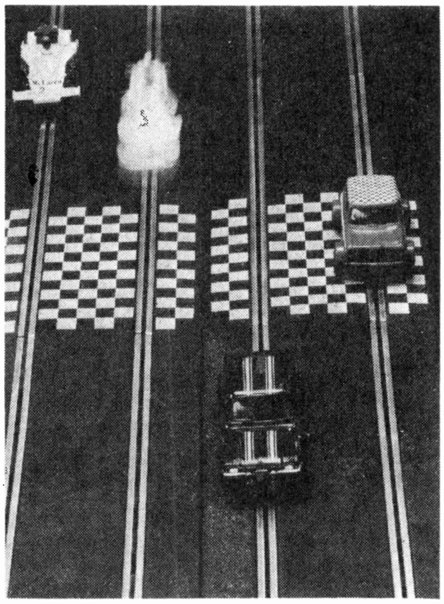
Next Month

Hobby Electronics

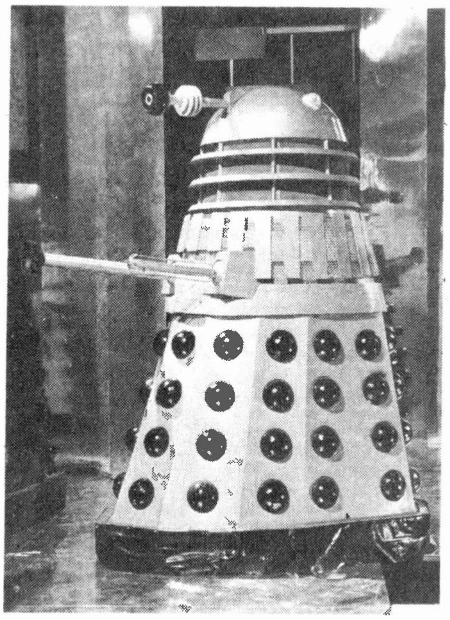
Have we got an issue for you next month? Yes of course we have, just cast your tired eyes over this little lot. (Tired eyes can be avoided by refraining from reading lesser electronic magazines)

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.

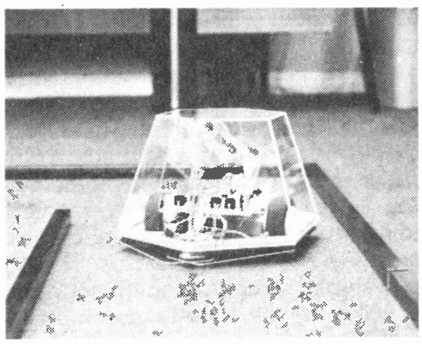
TV-THE CONTINUING STORY

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

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4 year battery, 1/10th second chrono to 12 hrs., measuring net, lap and 1st and 2nd place times. 24 hour alarm. Hourly chimes. Backlight. Mineral glass. Stainless steel encased. Water resistant to 66 feet (RRP £31.95)

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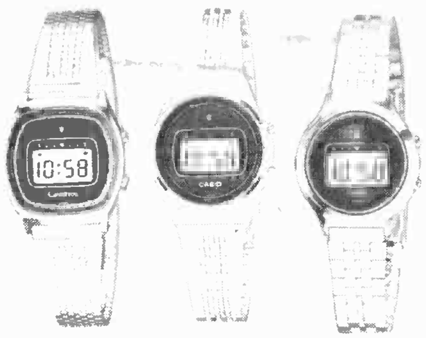

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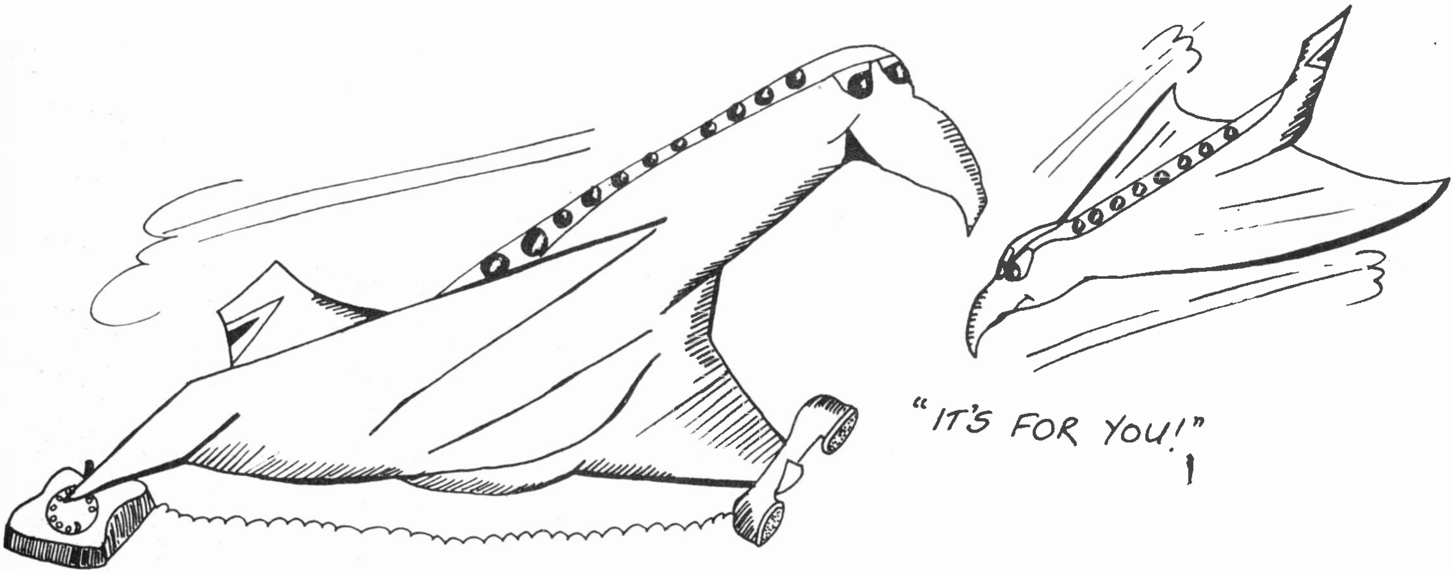


Domestic aircraft communications, both private and commercial, generally involve a pilot talking from his plane to a traffic controller at an airfield as well as talking to other pilots. Signals from aircraft can be heard over quite long distances as they are flying quite high and thus the horizon, from 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

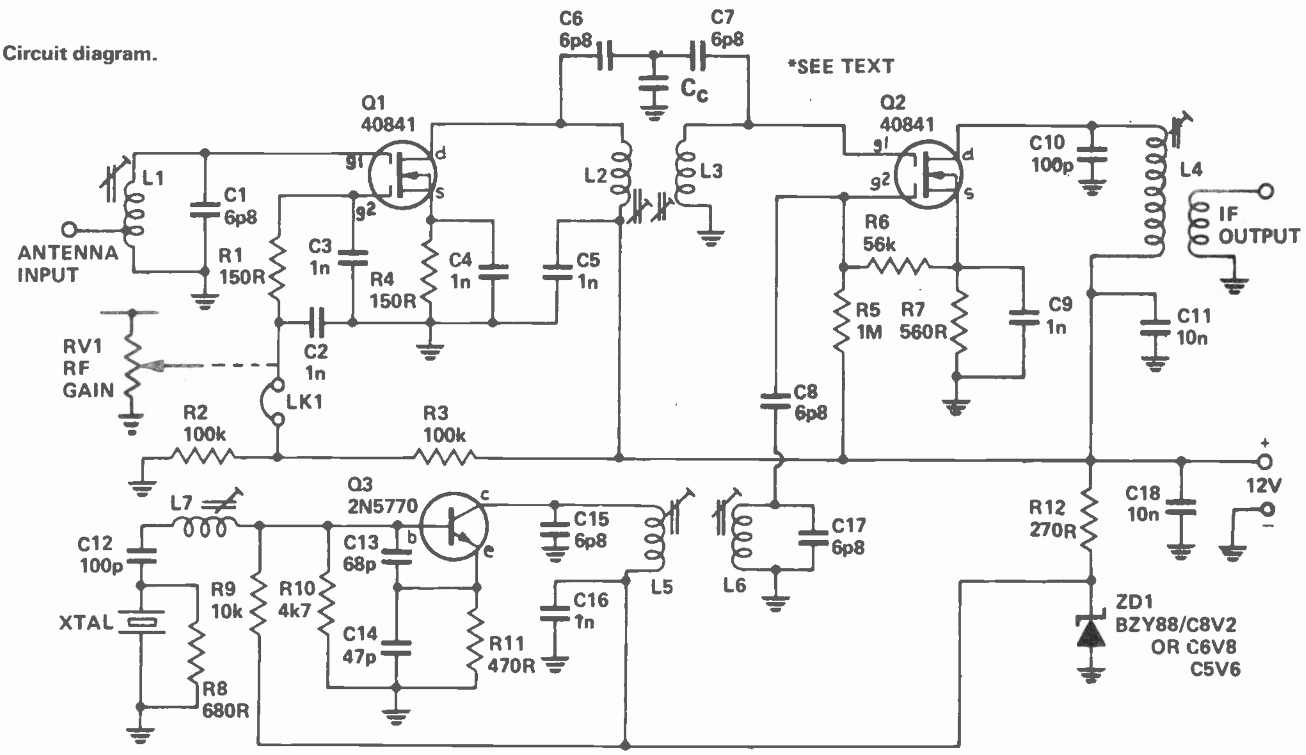
Why a converter — why not a complete receiver? Firstly, a shortwave listener will already have a receiver. A converter to 'change down' the aircraft band frequencies to a suitable band between 3 MHz and 30 MHz is a simple, and inexpensive, solution. For those wishing to monitor some portion of the aircraft 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.

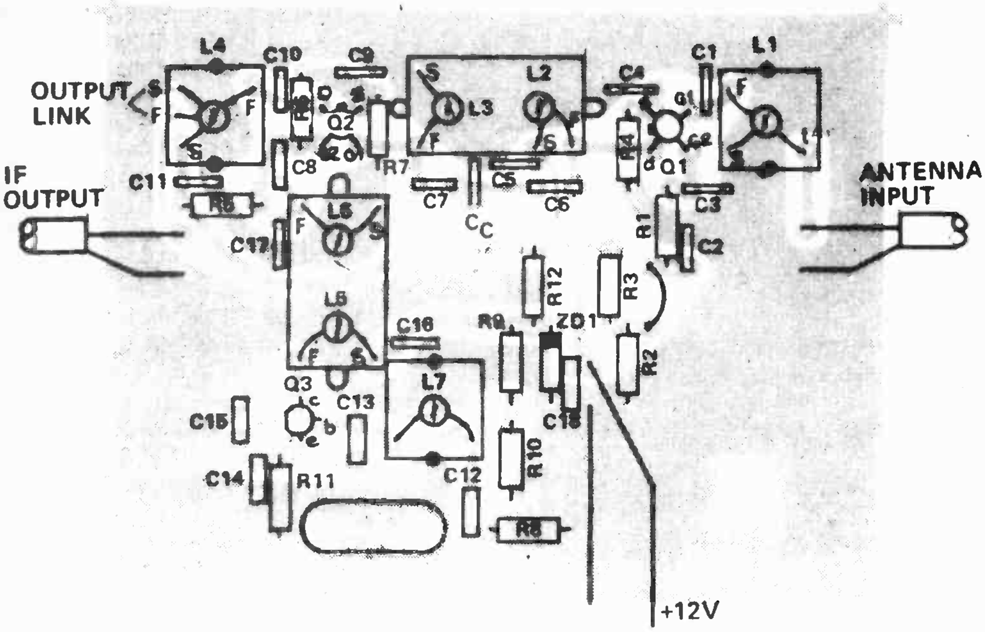
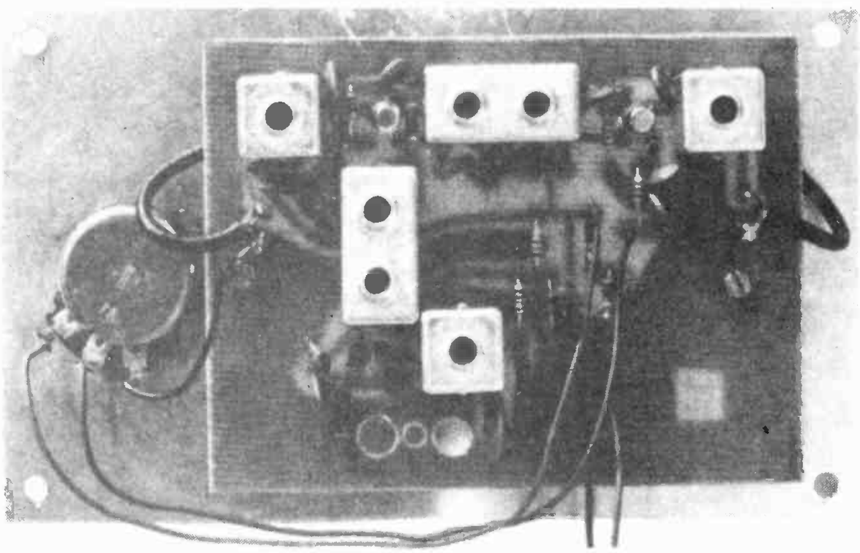


Fig.2 Component overlay.



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-C8	6p8 ceramic
C10,12	100p ceramic
C11,18	10n ceramic
C13	68p ceramic
C14	47p ceramic
C16	1n ceramic
C18	10n ceramic

Semiconductors

Q1,2	MFE131, 40673, 40841
Q3	2N3563, 2N3564, 2N5770
ZD1	BZY88/C8V2 or /C6V8 or /C5V6 or /C5V1

Miscellaneous
- 7 x 722/1 Neosid coil formers
- 3 x 7100 Neosid screening cans
- 2 x 7300 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.

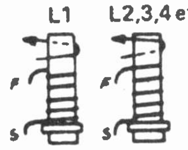
BUYLINES

Components for this project are available from Catronics Ltd, Communications House, 20 Wallington Square, Wallington, Surrey SM6 8RG.

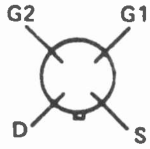
Coil Data

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.

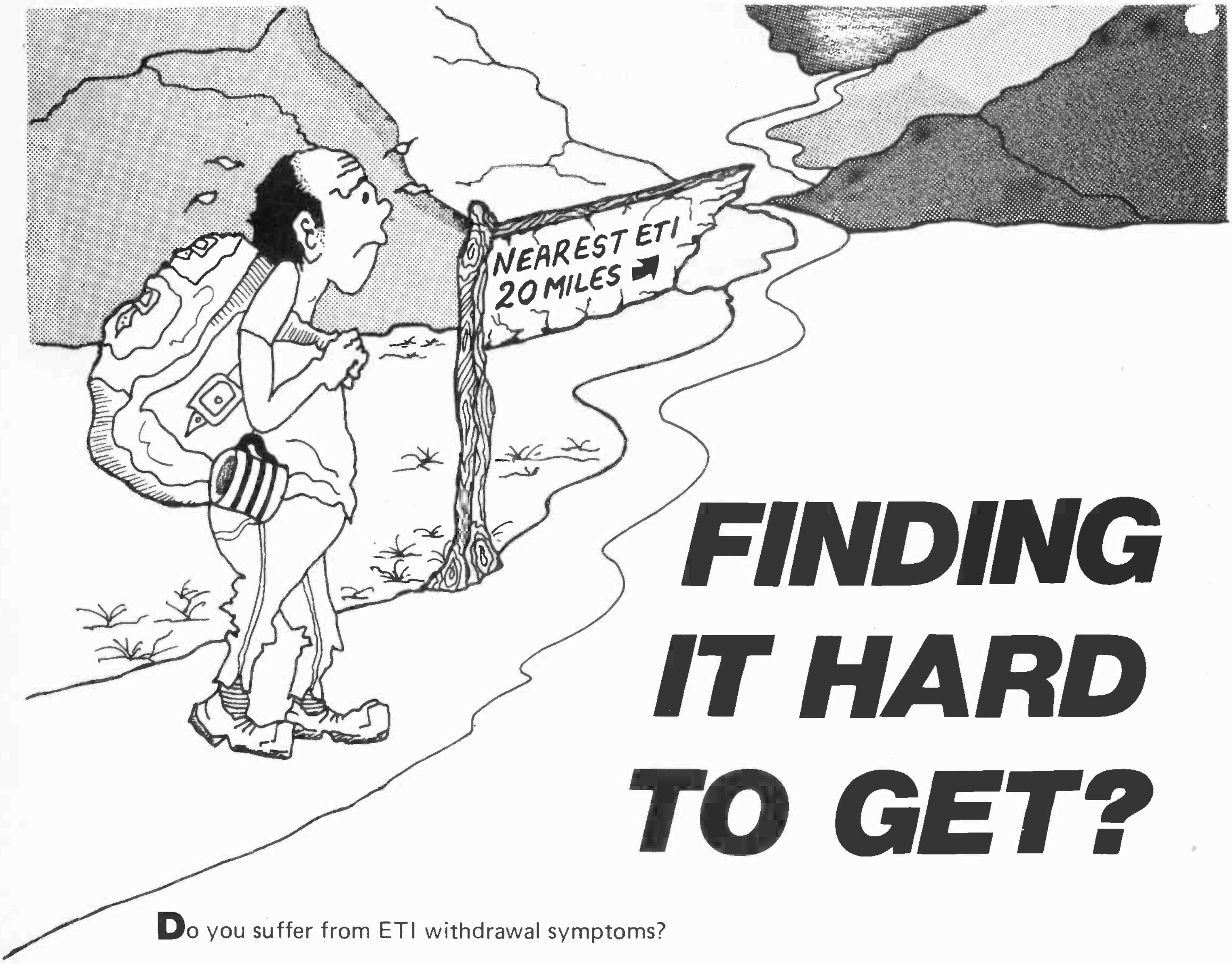
L1	5 turns, 22 B & S tinned copper wire spaced over 10 mm, tap at 2 turns from cold end.
L2, L3	6½ turns, 22 B & S enamelled wire, spaced over 8 mm.
L4	25 turns closewound with enamelled wire, any gauge between 25 and 30 B & S, 5 turn link at top of former.
L5, L6	5½ turns, 22 B & S enamelled wire, closewound.
L7	*10 turns, 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.



WINDING DIRECTION



UNDERSIDE VIEW



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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.

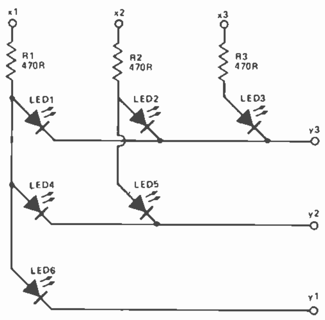


Fig. 1. A simplified view of the original Ambush LED lines.

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

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

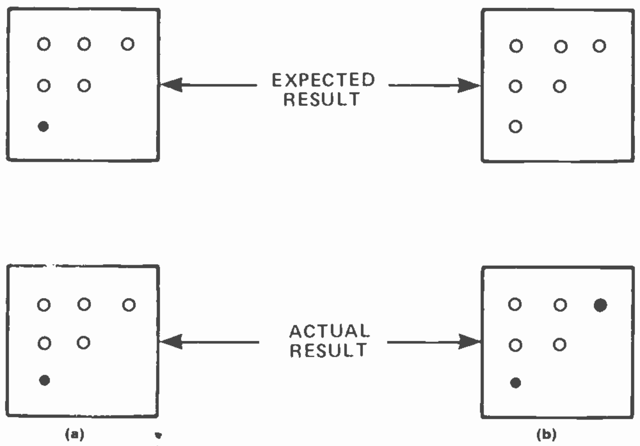


Fig. 2. Given the operating conditions, shown (top), these are the results which were expected (middle) and actually obtained (bottom).

and the yl line was coupled to zero volts. As expected, LED 6 illuminated.

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 ▶

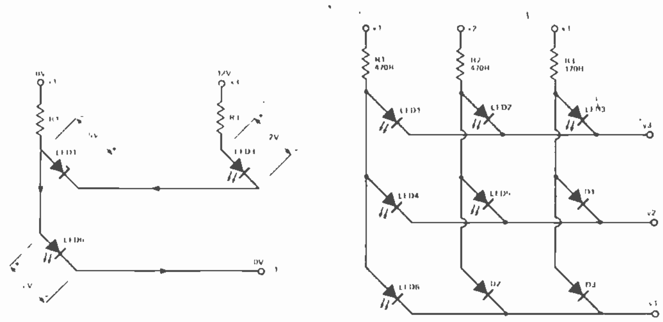


Fig. 3 (left) Low reverse breakdown voltages cause the problem here. Fig. 4 (right). Replacing absent LEDs with ordinary diodes is the solution here.

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.

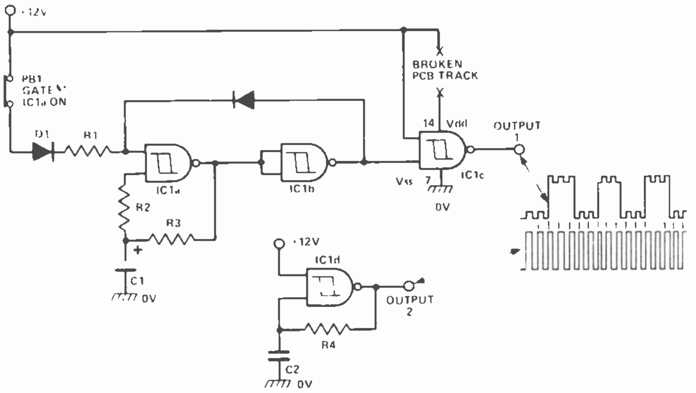


Fig. 5. A broken track caused problems in this 4093B dual oscillator, but proved difficult to find.

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.

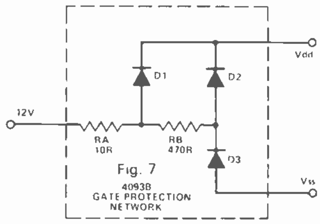
Fig. 6. (Below). A rationalised comparative summary of the bipolar and CMOS 5555.

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



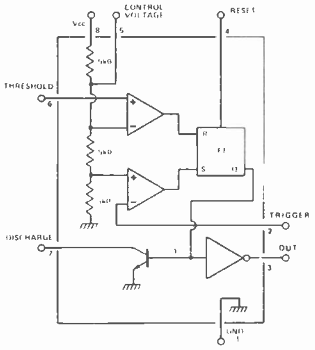


Fig. 7 (left) the internal gate protection network of the 4093B. Fig. 8 (right) The internal circuitry of the familiar bipolar 5555.

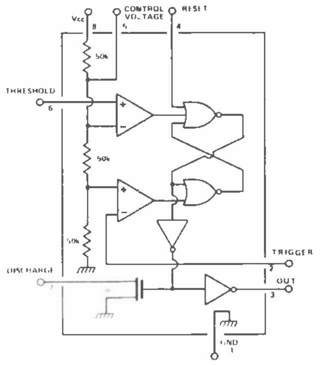


Fig. 9. The internal circuitry of the CMOS 555.

has worse propogation delay and pulse-triggering characteristics. A 'rationalised' comparative summary of the characteristics of the two devices is shown in Figure 6.

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. ETI

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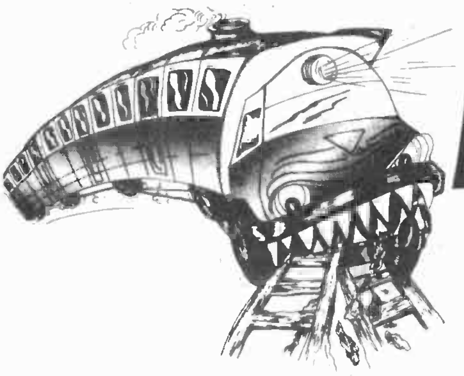
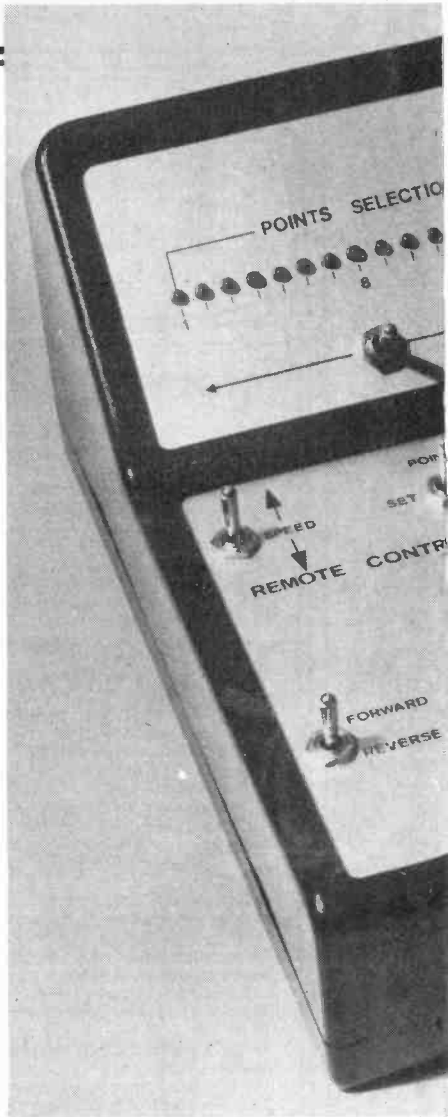


MODEL TRAIN CONTROL SYSTEM



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

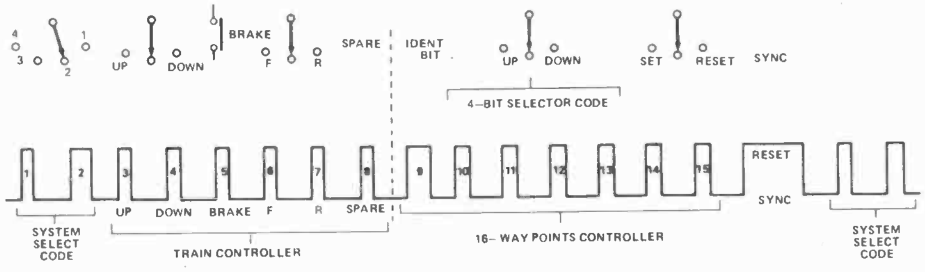
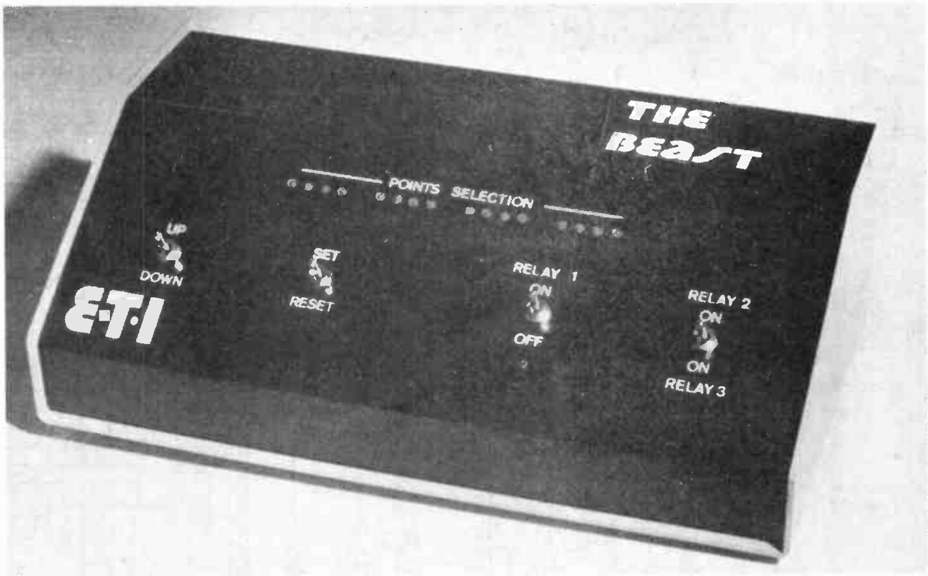


Fig. 1. The 15-bit 'simultaneous' code used by the remote control system.

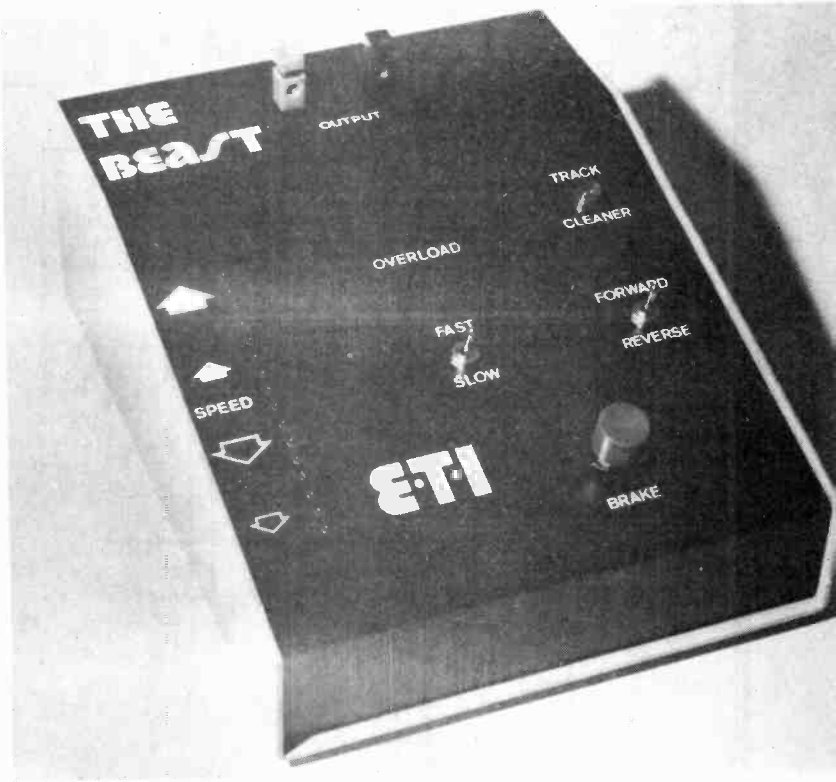


The points controller (above) can control up to sixteen sets of points or relays. It can activate several times per second. The set of points chosen is shown on the row of LEDs on the front panel. Think about your own particular points control needs before you start to build this unit. The data distribution 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

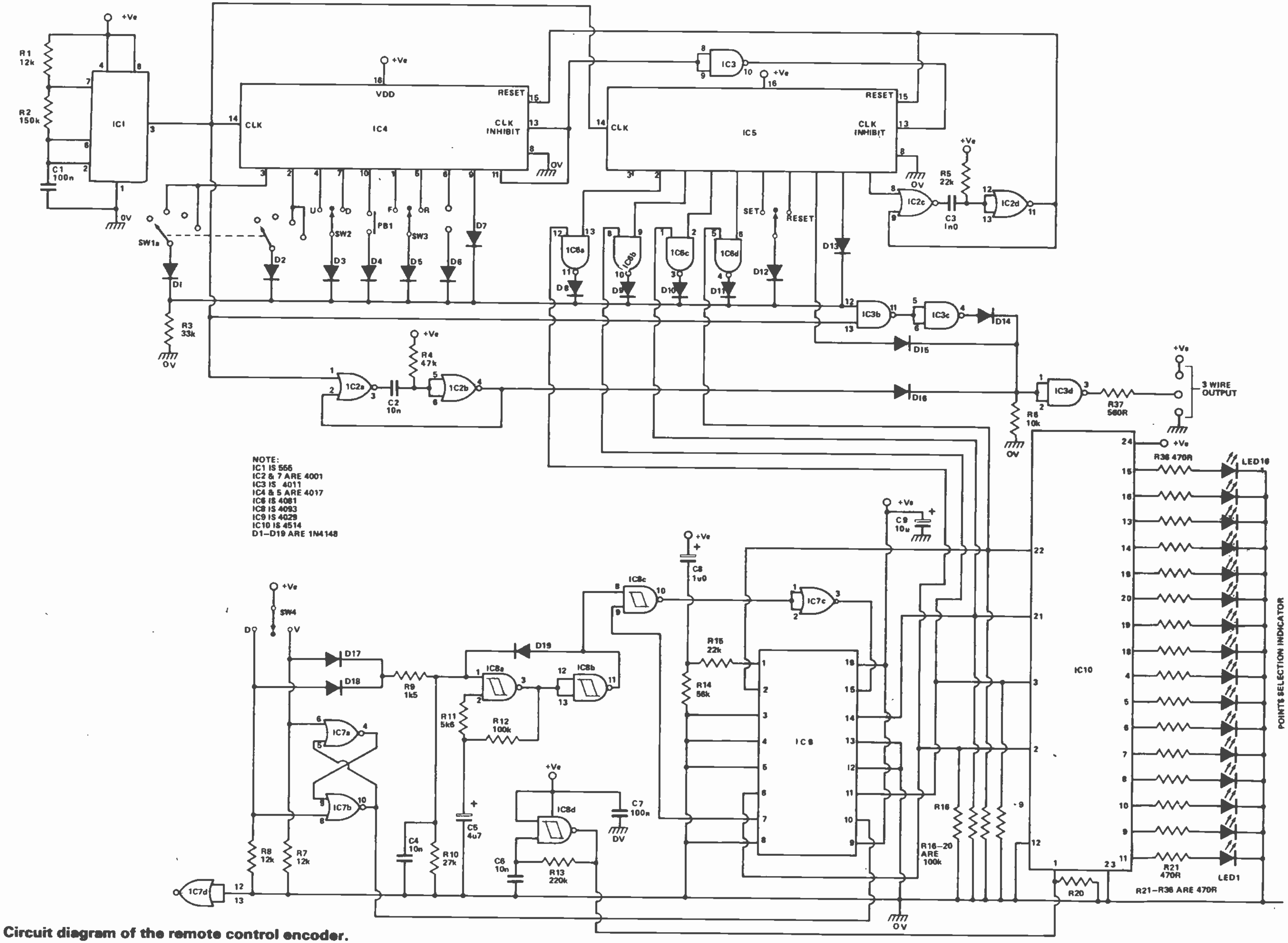


Fig. 2. Circuit diagram of the remote control encoder.

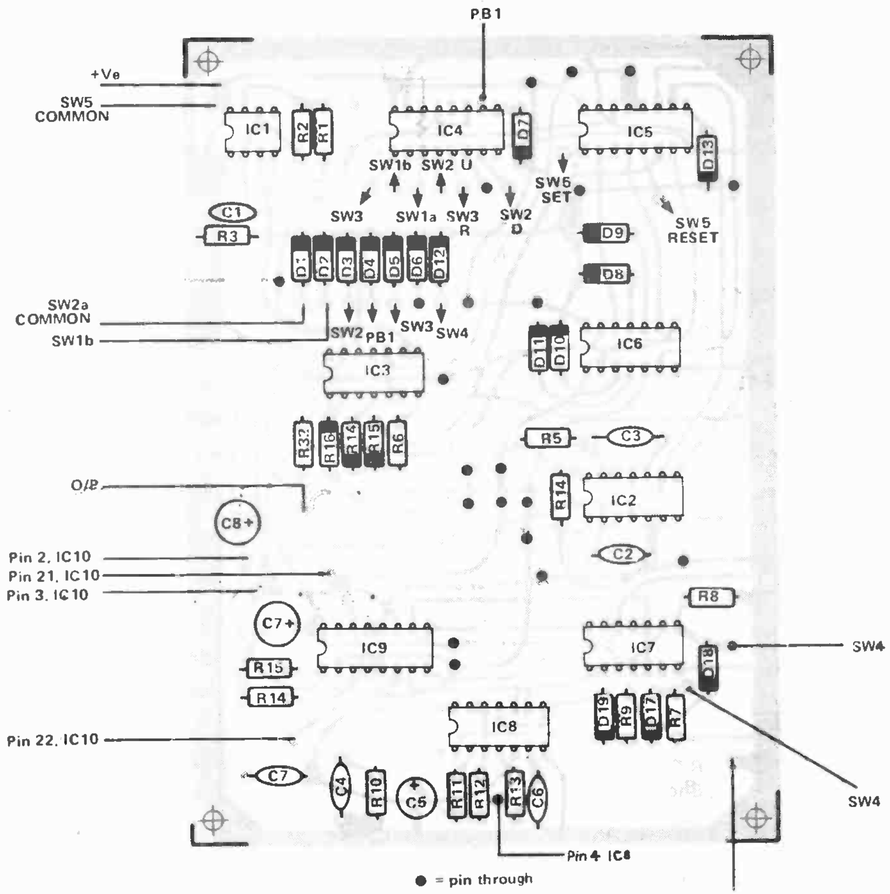
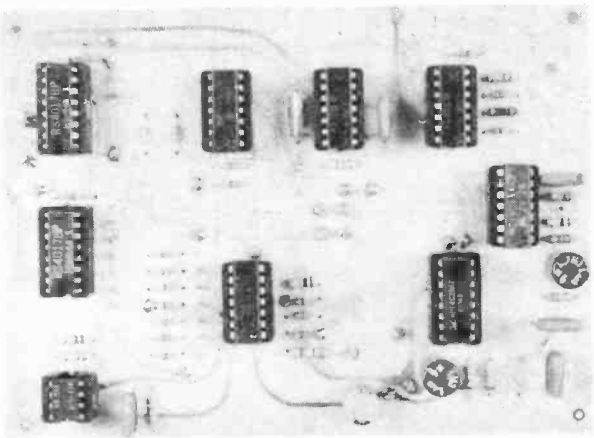


Fig. 3 (above). Component overlay of the remote control encoder. The completed PCB is shown below.



HOW IT WORKS

The circuit of the remote-control encoder is shown in Figure 8. Here, IC4 and IC5, together with IC2c 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 0Red with the outputs of the counter via D14-D15-D16 and R6, to form a serial chain of negative-going output pulses from R32.

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 34 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 train 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 its 12 volt supply from the receiver/decoder unit.

PARTS LIST

Resistors all ¼W 5%	
R1,7,8	12k
R2	150k
R3	33k
R4	47k
R5,15	22k
R6	10k
R9	1k5
R10	27k
R11	5k6
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	4081
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

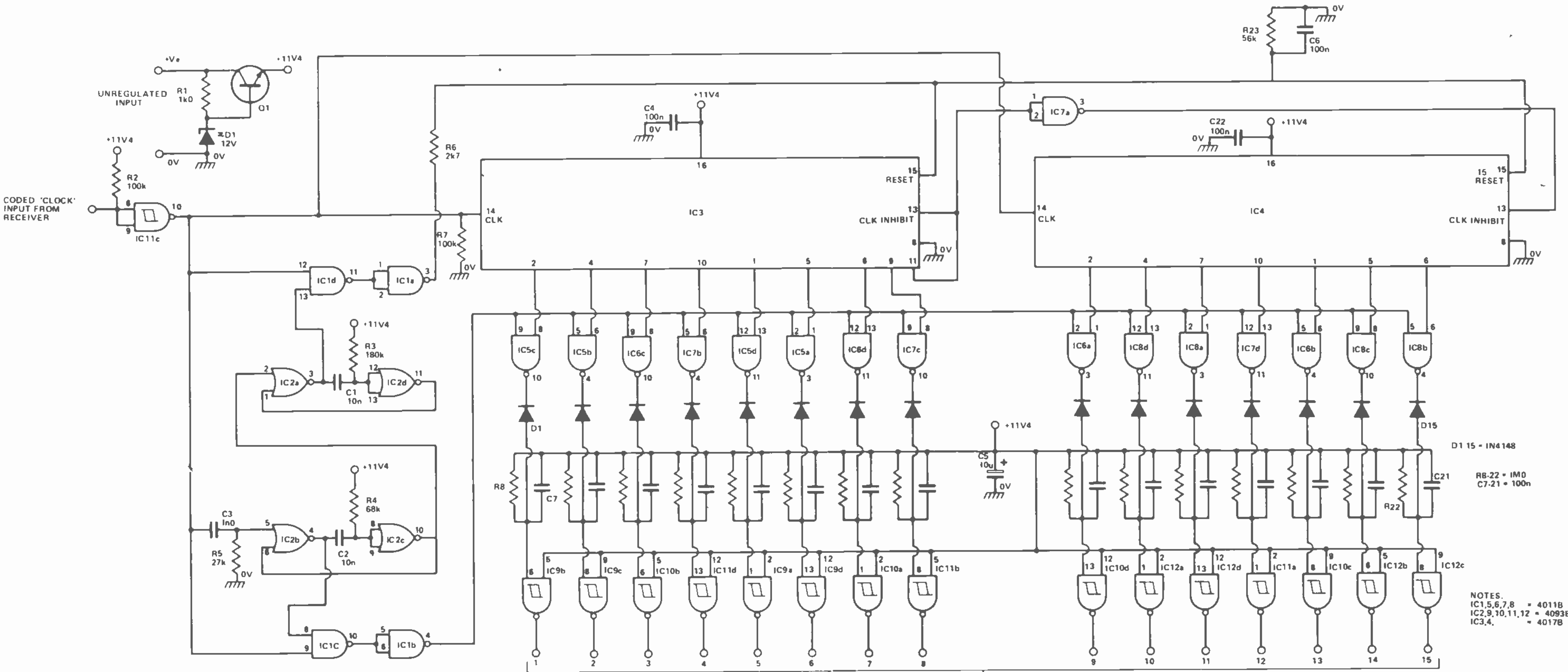
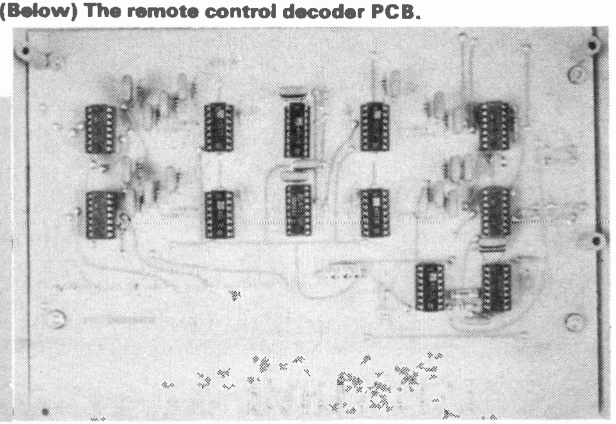


Fig. 4. Circuit diagram of the remote control decoder.

(Below) The remote control decoder PCB.



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 'O' 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.

Q1 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.

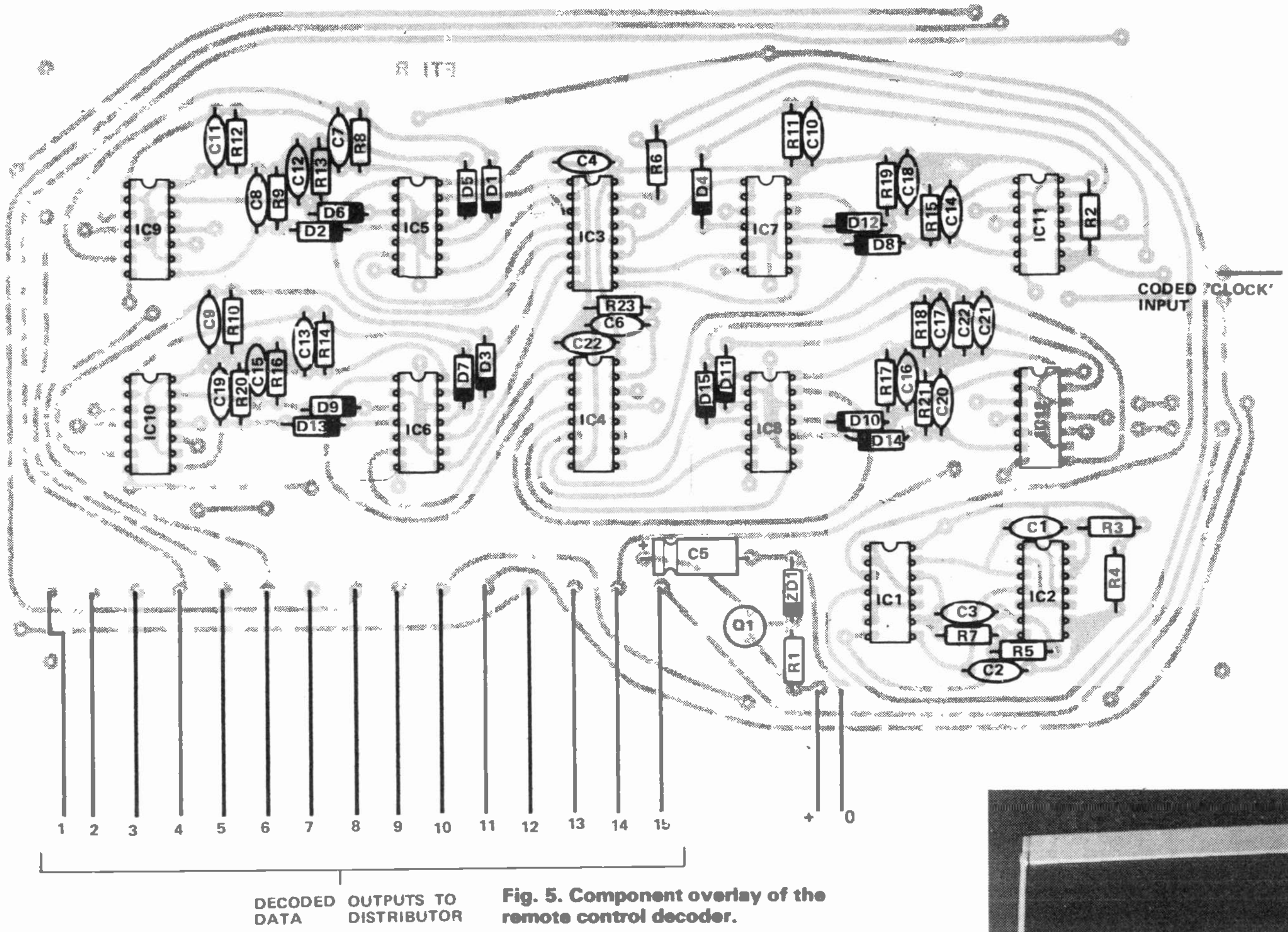


Fig. 5. Component overlay of the remote control decoder.

PARTS LIST

Resistors all ¼W 5%	
R1	1k0
R2,7	100k
R3	180k
R4	68k
R5	27k
R6	2k7
R8-22	1M0
R23	56k
CAPACITORS	
C1,2	10n polyester
C3	1n0 polyester
C4,6,7-22	100n polyester
C5	10u 15V electrolytic
SEMICONDUCTORS	
IC1,5,6,7,8	4011B
IC2	4001
IC3,4	4017B
IC9,10,11,12	4093B
D1-15	1N4148
ZD1	12V, 400mW zener

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!

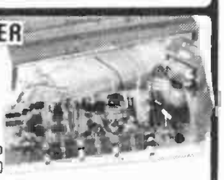
ETI

20 x 20 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet Silver finish rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic magnetic and crystal pickups, tape tuner and auxiliary. Rear panel features fuse holder, DIN speaker and input sockets 20 x 20 watts RMS 40 x 40 watts peak for use with 8 to 15 ohm speakers. Size 14¾" x 3" x 10" approx. *NEW* feature—units now includes a built in four channel stereo sound facility.

£31.90 £3.00 p&p

30x30 WATT AMPLIFIER IN KIT FORM



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

£31.50 p&p £3.00

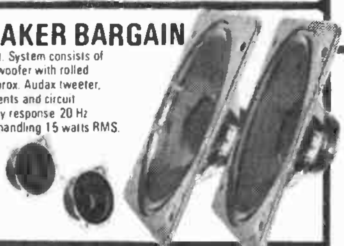
SPECIAL OFFER

30 x 30 WATT AMPLIFIER KIT

with BSR P200 belt drive deck and Shure M75 cartridge.

£57.00 + p&p £6.00

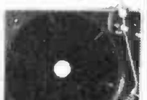
EMI SPEAKER BARGAIN



Stereo pair 350 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.

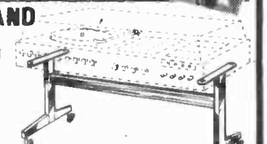
OUR PRICE **£11.25** p&p £2.75

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"

UNIT AUDIO STAND



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

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24" x 12½" x 11½" approx.

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ACCESSORIES

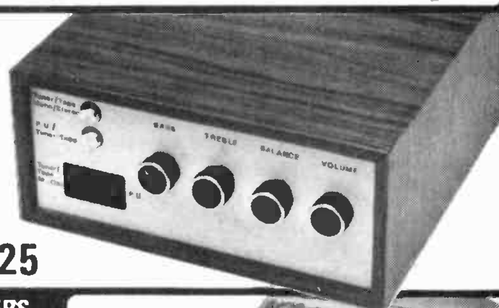
Suitable mains power supply parts, consisting of mains transformer, bridge rectifier, smoothing capacitor and set of rotary stereo controls for treble, bass, volume and balance **£3.00** plus £1.50 p&p

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. Size approximately 9¼" x 8¾" x 4"

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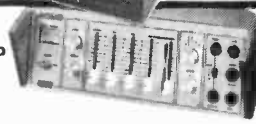
100 Watt Power Amp Module	£14.25
Mains power supply for above unit	£3.60
DECCA 20w Stereo speaker kit comprising 2 8" approx bass units + 2 3½" approx tweeter inc crossovers	£20.45
'VIDEOMASTER' Super Score TV Game with pistol mains operation	£15.95
PORTABLE RADIO/CASSETTE RECORDER, AM/FM with clock. LW, MW, SW, VHF mains/battery operation	£42.90
ISP Radio Cassette recorder Mains/Battery AM/FM built in mic auto stop.	£24.50

100 WATT MONO DISCO AMP



Size approx 14" x 4" x 10¼". Brushed aluminium fascia and rotary controls. Five vertical slide controls, master volume, tape level, mic level, deck level, PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

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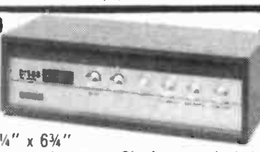
50 WATT MONO DISCO AMP



£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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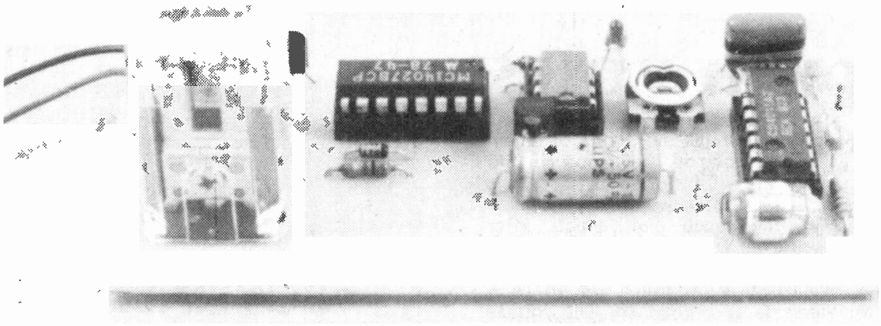
TOUCH SWITCH

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 componênts 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.

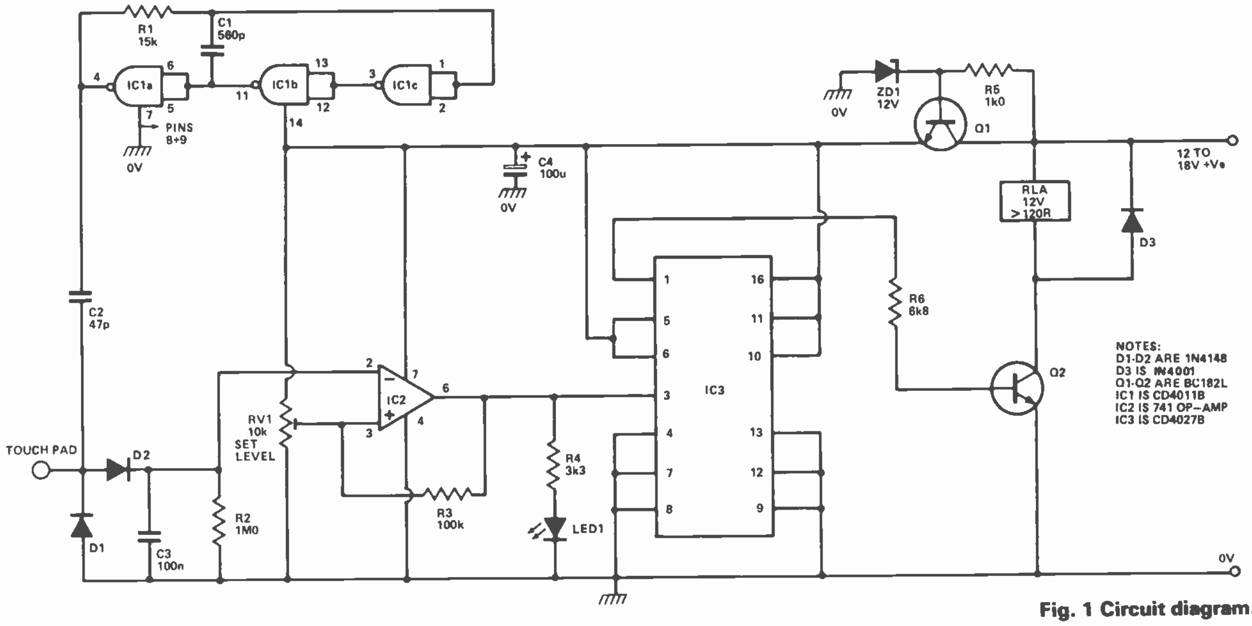


Fig. 1 Circuit diagram.

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

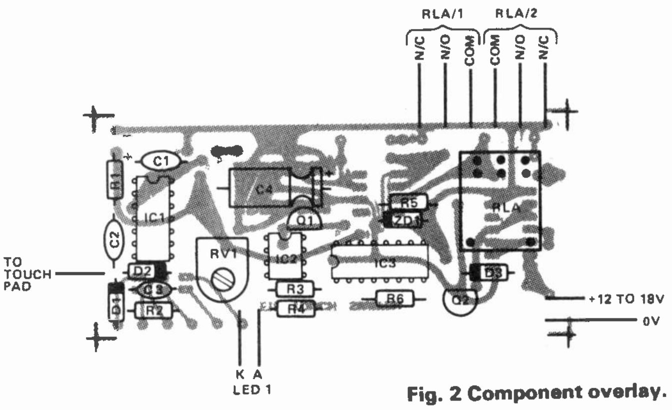


Fig. 2 Component overlay.

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25 germanium diodes **50p.** 10 switching diodes **35p.** Mini slider switches (2 pole change-over) **16p** each. Momentary switches (spring loaded) with 1 n.o. contact **15p** each. Mono jack sockets **23p** each. Stereo jack sockets **25p** each. Slide control knobs (state colour) **12p** each. Rotary control knobs (push-on). Black with coloured cap (state colour) **20p** each.

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LED DISPLAYS (Untested — no guarantees) 10 seven segment LED displays. 0.127" digits common cathode. 1D for **£1.00.** Cat. No. 311

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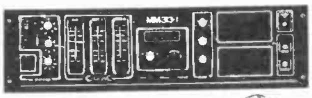

Citronic MM313 Mixer

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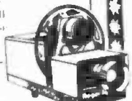

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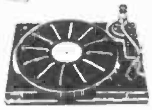

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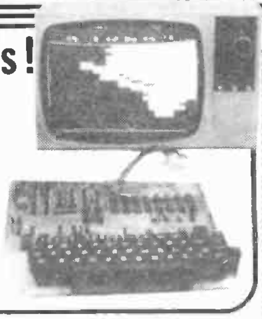

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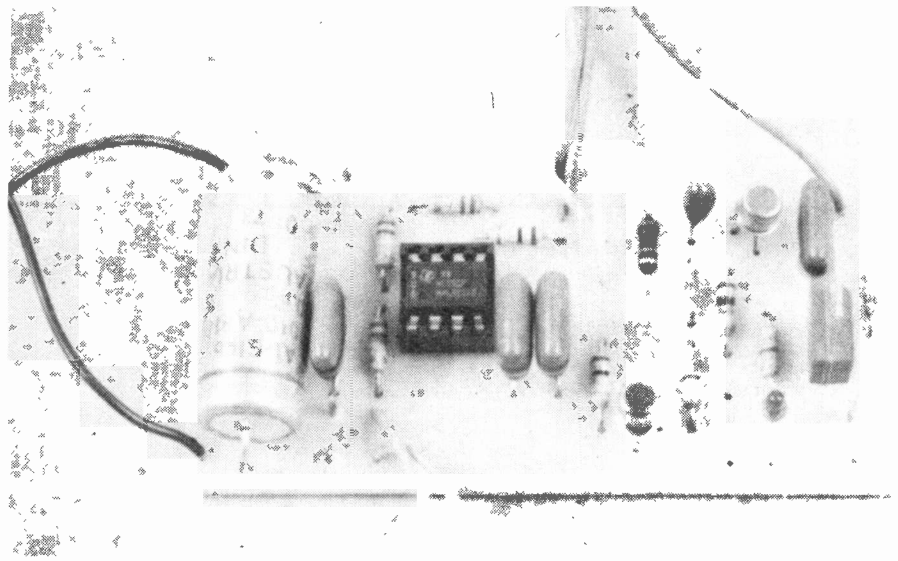
FLASH TRIGGER

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!



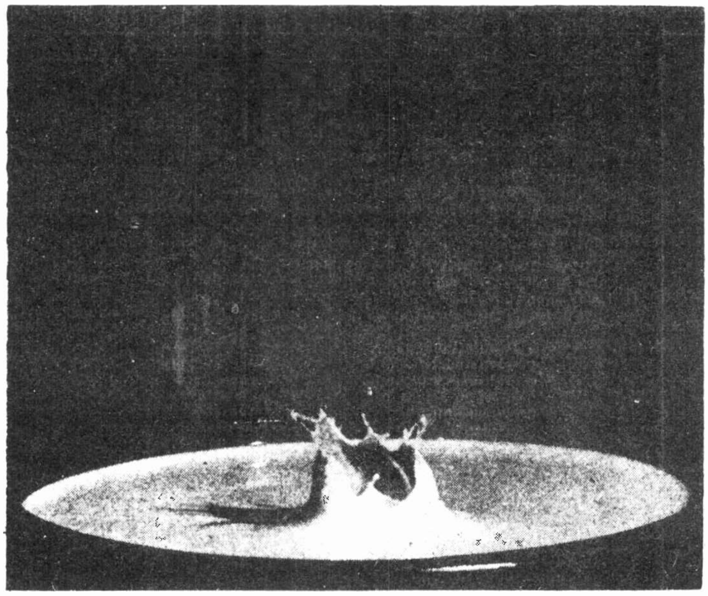
Construction

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!



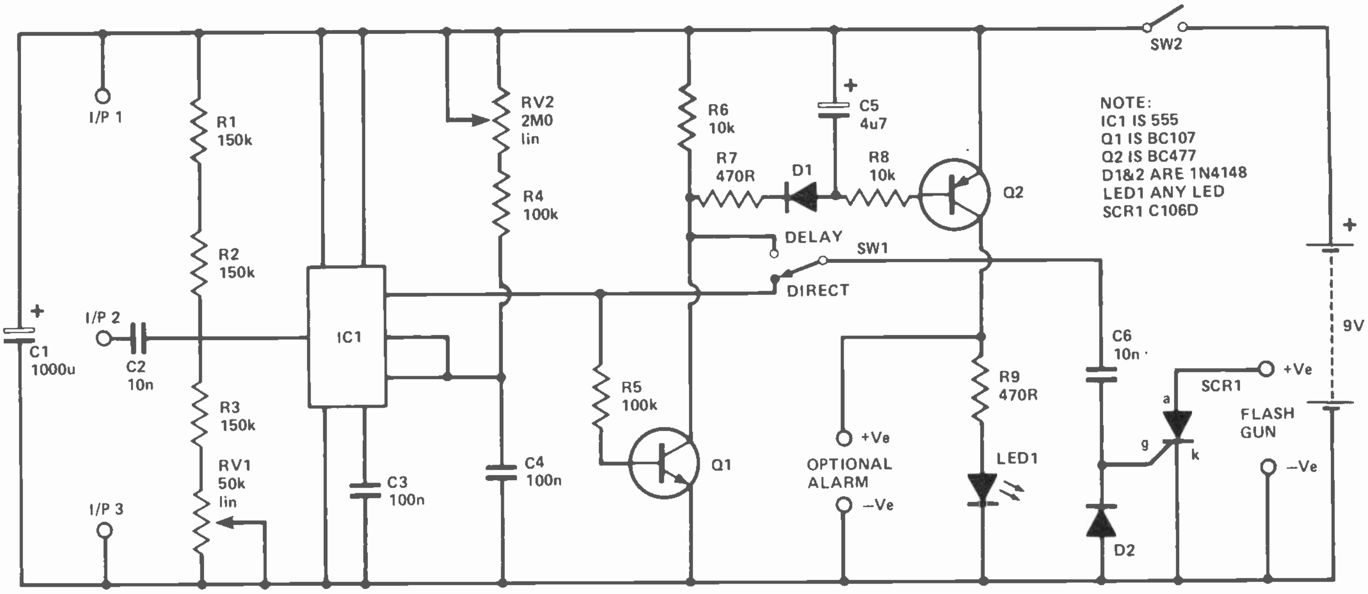


Fig. 1. Circuit diagram for the Flash Trigger project.

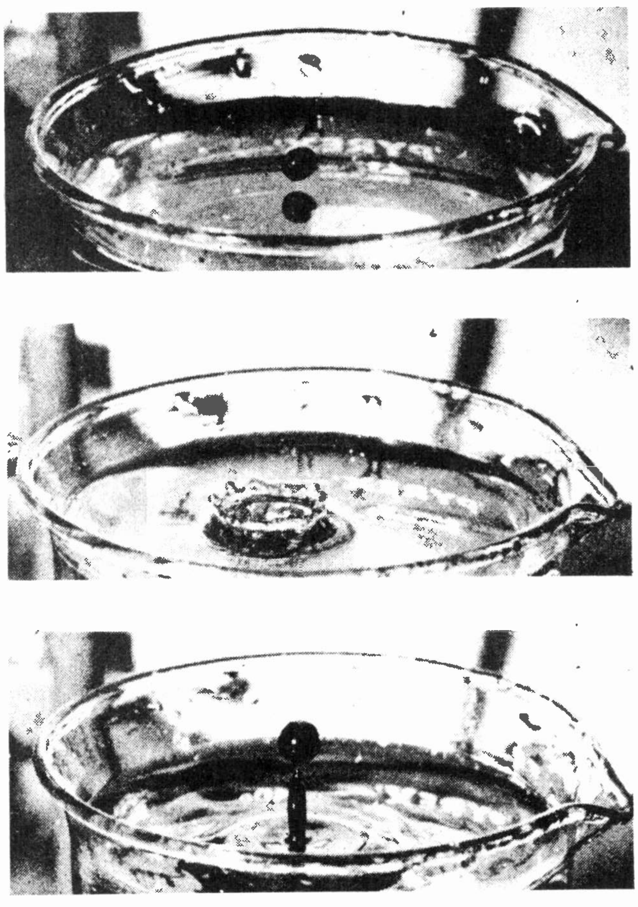
HOW IT WORKS

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

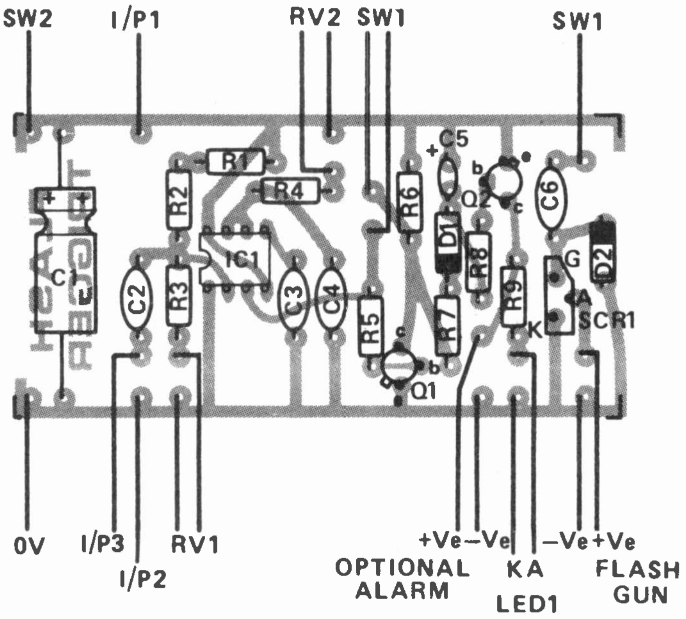
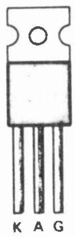


Fig. 3. Component overlay.

C106D



TIL78

BUYLINES

The electronic components will be available from major component suppliers. A suitable flash gun connector should be obtainable from photographic equipment dealers.

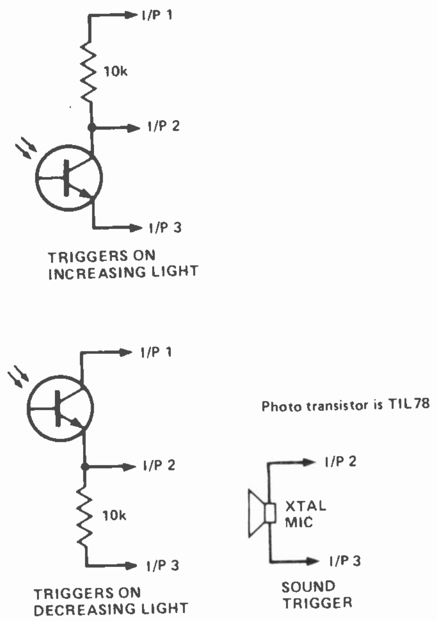
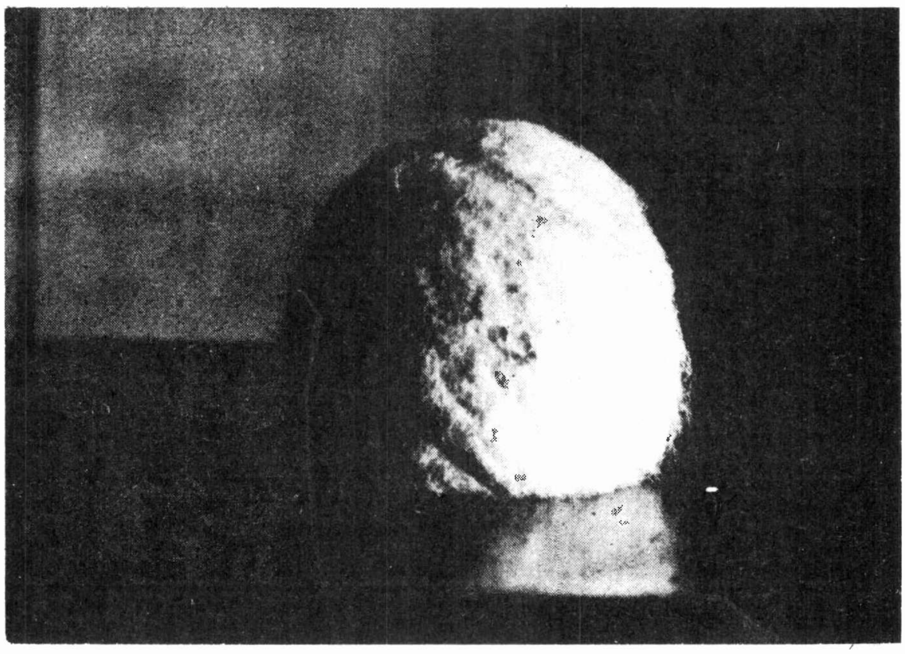


Fig. 2. Wiring details for different triggers.

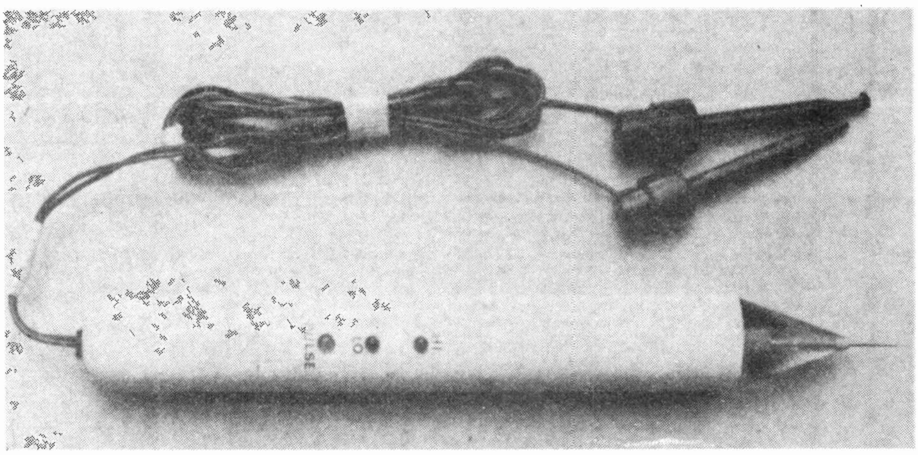


LOGIC PROBE

If you're into TTL or CMOS, you could use a logic probe. Good quality commercial probes don't come cheap. Our probe features high and low indication and detects pulse trains to over 1MHz, for less than a fiver.

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).



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

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.

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 th 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 re-triggering 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.

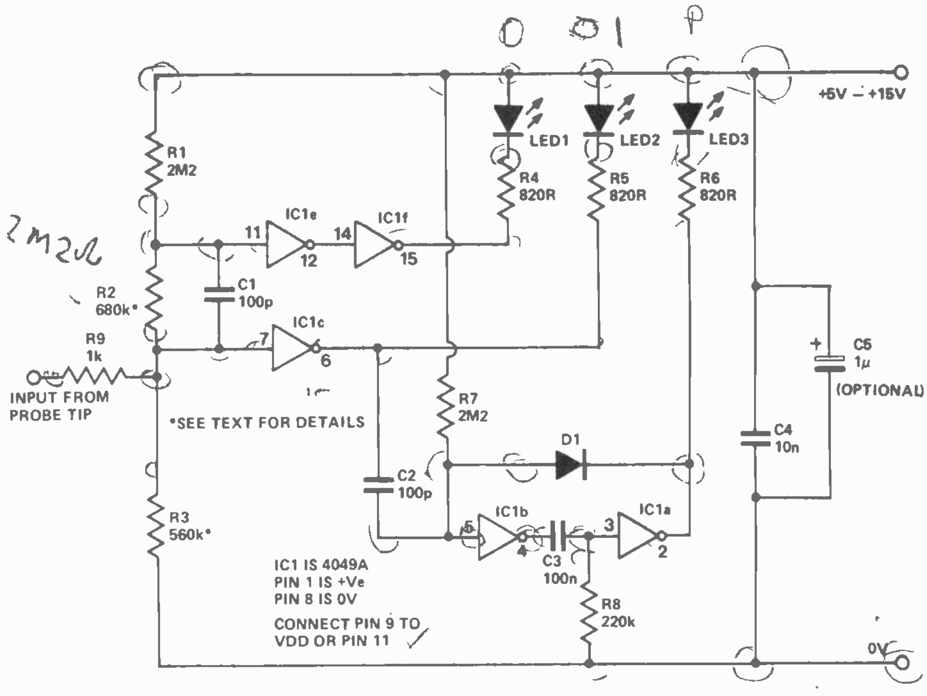
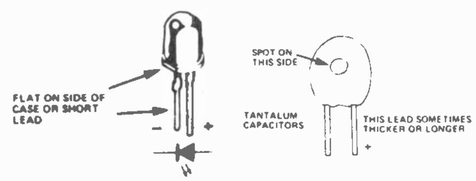


Fig.1. Circuit diagram. Note the polarity of LEDs 1, 2 and 3.



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

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

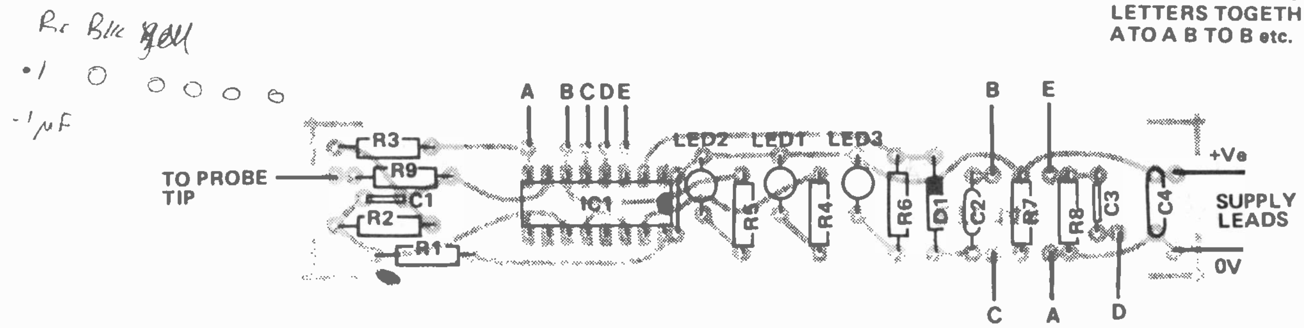


Fig.2. Component overlay.

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)

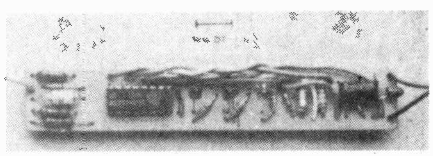
Miscellaneous

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.

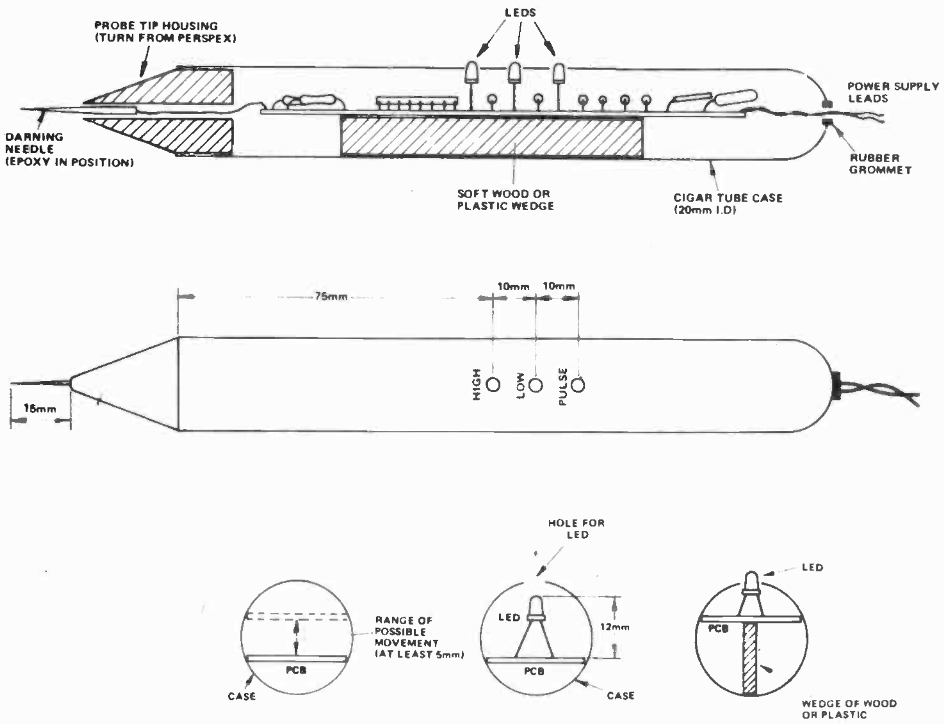


Fig.3. The PCB slides into the cigar tube and rests on a piece of wood or plastic.

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

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CAPACITORS

Electrolytic Axial Leads

−10% to +50% Tol.

Order Code Cap 015 + µF + V d.c.

µF	16 V d.c.	25	40	63
1.0				9
1.5				9
2.2				9
3.3				9
4.7				8
6.8			9	10
10		8		10
15	8		9	11
22		8		13
33	8		9	
47		8	11	13
68	9			
100		9	13	
150	9	10		31
220	13		26	36
330			30	40
470		23	32	47
680	21	30	39	54
1000	25	30	59	
1500	35	39		
2200	42			

Electrolytic Radial Leads

−10% to +50% Tol.

Order Code Cap 034 + µF + Volts

µF	6.3 V d.c.	10	16	25	35	40	50	63
.47								7
.68								7
1.0								7
1.5								7
2.2								7
3.3								7
4.7						7		8
6.8				7			8	9
10			7			8		9
15			7	8			9	11
22		7	8			9	11	
33			8	9		11		
47		8	9		11			
68			9	11				
100		9						
150		11						
220	11							

Electrolytic Can Type

High Ripple, IEC Grade 1, Low E.S.R. Order Code Cap HR + µF + Volts
Supplied complete with Vertical Fixing Clip.

		Ripple 5.8A @ 85°C	8.1A @ 50°C	
10000µF	16V	9.8A	13.7A	238
22000µF	16V	9.8A	13.7A	370
4700µF	25V	4.6A	6.4A	215
10000µF	25V	8.0A	11.2A	282
22000µF	25V	12.8A	17.9A	469
4700µF	40V	5.6A	7.8A	248
10000µF	40V	9.2A	12.8A	393
4700µF	70V	7.5A	10.5A	403

Row 1 reads: 10000µF 16V Ripple 5.8A @ 85°C 8.1A @ 50°C 238

Miniature Low Value

Order Code
Polystyrene, Axial, ±1% Tol., >63V DC Wkg. Cap 424
Ceramic Plate, Radial, Low K, 100V DC Wkg. Cap 632
Ceramic Plate, Radial, Med K, 100V DC Wkg. Cap 630
Ceramic Plate, Radial, High K, 63V DC Wkg. Cap 629
+ Value

pF	424	632	pF	424	632	630	nF	424	629
1			100	18	7		10	27	8
1.2			120	18	9		12	29	
1.5			150	18	9		15	29	
1.8		6	180	18	9		18	31	
2.2		6	220	18	9		22	31	9
2.7		6	270	20	9		27	42	
3.3		6	330	20	9		33	45	
3.9		6	390	20		6	39	50	
4.7		6	470	20		6			
5.6		6	560	20		6			
6.8		6	680	20		6			
8.2		6	820	20		6			
10		6	1000	20		6			
12		6	1200	20		6			
15		6	1500	20		7			
18		6	1800	20		7			
22		6	2200	20		7			
27		6	2700	20		7			
33		6	3300	20		7			
39		6	3900	20		7			
47		6	4700	25		8			
56		7	5600	25					
68		7	6800	25					
82		7	8200	25					

Polyester Radial Leads

Order Code
Dipped Type, C280/352 Style Cap 352
Moulded Type, 10.2mm Pitch Cap 360
+ Value

µF	352	360	µF	352	360
.001		7	.1	7	9
.0015		7	.15	8	10
.0022	6	7	.22	9	11
.0033	6	7	.33	11	
.0047	6	7	.47	14	
.0068	6	7	.68	17	
.01	6	8	1.0	21	
.015	6	8	1.5	30	
.022	6	8	2.2	35	
.033	6	8			
.047	6	8			
.068	7	8			

Trimmers

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

		Order Code
1.4 – 4.1pF	20	Cap 808 A
2 – 8pF	20	Cap 808 B
2 – 20pF	22	Cap 808 C
5.5 – 59.5pF	31	Cap 808 D

Tantalum Bead

20% Tol. Order Code Cap PR + µF + Volts

µF	10 V d.c.	16	25	35
0.1				11
0.22				11
0.47				11
1				11
2.2		11		13
4.7		12	16	18
10	13	16	18	22
22		18		
47	22			

INTEGRATED CIRCUITS

4000 Buffered C-MOS – High Speed

HEF4000	17	HEF4044	84	HEF4512	110
HEF4001	17	HEF4046	106	HEF4514	250
HEF4002	17	HEF4047	87	HEF4515	299
HEF4006	95	HEF4049	45	HEF4516	101
HEF4007	17	HEF4050	45	HEF4517	382
HEF4008	80	HEF4051	69	HEF4518	94
HEF4011	17	HEF4052	72	HEF4519	55
HEF4012	17	HEF4053	72	HEF4520	94
HEF4013	45	HEF4066	49	HEF4521	188
HEF4014	84	HEF4067	380	HEF4528	99
HEF4015	80	HEF4068	17	HEF4532	120
HEF4016	45	HEF4069	17	HEF4534	510
HEF4017	80	HEF4070	17	HEF4539	110
HEF4018	80	HEF4071	18	HEF4543	155
HEF4019	46	HEF4072	18	HEF4555	78
HEF4020	89	HEF4073	18	HEF4556	78
HEF4021	85	HEF4075	18	HEF4557	386
HEF4022	82	HEF4076	104	HEF4585	97
HEF4023	17	HEF4077	17	HEF4724	171
HEF4024	62	HEF4078	18	HEF40097	90
HEF4025	17	HEF4081	18	HEF40098	73
HEF4026	195	HEF4082	18	HEF40106	62
HEF4027	45	HEF4085	64	HEF40160	119
HEF4028	71	HEF4086	64	HEF40161	119
HEF4029	90	HEF4093	50	HEF40162	119
HEF4030	46	HEF4094	175	HEF40163	119
HEF4031	200	HEF4104	166	HEF40174	119
HEF4035	110	HEF4502	91	HEF40175	119
HEF4040	85	HEF4505	571	HEF40192	140
HEF4041	75	HEF4508	184	HEF40193	140
HEF4042	66	HEF4510	108	HEF40194	119
HEF4043	80	HEF4511	125	HEF40195	119

7400 T.T.L.

N7400N	13	N7444N	92	N74122N	40	N74193N	91
N7401N	14	N7445N	85	N74123N	77	N74194N	73
N7402N	14	N7446AN	85	N74125N	37	N74195N	57
N7403N	14	N7447AN	71	N74126N	37	N74198N	135
N7404N	16	N7448AN	92	N74128N	38	N74199N	122
N7405N	16	N7450N	14	N74132N	38	N74221N	77
N7406N	32	N7451N	14	N74145N	57	N74279N	61
N7407N	32	N7453N	14	N74147N	98	N74298N	77
N7408N	16	N7454N	14	N74148N	86	N74365N	59
N7409N	16	N7460N	14	N74150N	91	N74366N	59
N7410N	14	N7470N	28	N74151N	46	N74367N	59
N7411N	16	N7472N	19	N74153N	43	N74368N	59
N7412N	14	N7473N	28	N74154N	91		
N7413N	23	N7474N	24	N74155N	46		
N7414N	31	N7475N	34	N74156N	46		
N7416N	21	N7476N	30	N74157N	43		
N7417N	21	N7480N	32	N74158N	43		
N7420N	14	N7483N	63	N74160N	63		
N7421N	16	N7485N	80	N74161N	63		
N7425N	19	N7486N	25	N74162N	63		
N7426N	20	N7490N	40	N74163N	63		
N7427N	20	N7491AN	57	N74164N	86		
N7428N	23	N7492N	40	N74165N	86		
N7430N	14	N7493N	40	N74166N	86		
N7432N	20	N7494N	57	N74170N	122		
N7433N	23	N7495AN	46	N74173N	77		
N7437N	21	N7496N	57	N74174N	77		
N7438N	21	N74100N	92	N74175N	55		
N7439N	30	N74107N	26	N74180N	57		
N7440N	14	N74109N	45	N74181N	205		
N7442N	51	N74116N	92	N74182N	57		
N7443N	92	N74121N	28	N74192N	91		

74LS

N74LS00N	19	N74LS28N	35	N74LS138N	99	N74LS253N	117
N74LS01N	19	N74LS30N	19	N74LS139N	99	N74LS257N	117
N74LS02N	19	N74LS32N	27	N74LS153N	88	N74LS258N	117
N74LS03N	19	N74LS33N	35	N74LS154N	138	N74LS260N	29
N74LS04N	27	N74LS37N	35	N74LS155N	93	N74LS261N	321
N74LS05N	27	N74LS38N	35	N74LS156N	93	N74LS266N	54
N74LS08N	27	N74LS40N	27	N74LS157N	93	N74LS273N	143
N74LS09N	27	N74LS42N	60	N74LS158N	97	N74LS283N	117
N74LS10N	19	N74LS51N	27	N74LS160N	129	N74LS290N	117
N74LS11N	26	N74LS54N	27	N74LS161N	117	N74LS293N	119
N74LS12N	26	N74LS55N	27	N74LS162N	144	N74LS298N	149
N74LS13N	48	N74LS73N	35	N74LS163N	117	N74LS365N	121
N74LS14N	74	N74LS75N	44	N74LS164N	119	N74LS366N	121
N74LS15N	26	N74LS76N	46	N74LS170N	220	N74LS367N	121
N74LS20N	19	N74LS78N	39	N74LS173N	132	N74LS368N	121
N74LS21N	26	N74LS83AN	106	N74LS174N	141	N74LS373N	173
N74LS22N	26	N74LS85N	104	N74LS175N	119	N74LS374N	173
		N74LS86N	39	N74LS181N	306	N74LS375N	117
		N74LS90N	69	N74LS190N	117	N74LS378N	155
		N74LS92N	76	N74LS191N	117	N74LS386N	56
		N74LS93N	76	N74LS192N	119	N74LS390N	196
		N74LS95BN	82	N74LS193N	119	N74LS393N	196
		N74LS96N	126	N74LS194N	161	N74LS395N	207
		N74LS107N	41	N74LS195AN	119	N74LS490N	143
		N74LS109N	45	N74LS196N	132	N74LS670N	239
		N74LS112N	45	N74LS197N	132		
		N74LS113N	45	N74LS240N	206		
		N74LS114N	45	N74LS241N	206		
		N74LS125N	53	N74LS242N	206		
		N74LS126N	53	N74LS243N	206		
		N74LS132N	78	N74LS244N	206		
		N74LS136N	49	N74LS251N	117		

LINEAR

CA3046	84
CA3080E	77
CA3130E	99
CA3140E	48
CA3189E	293
LM301AN	34
LM339N	78
LM380N	104
LM381AN	198
LM3900N	75
MC3403P	156
NE531	131
NE536T	259
NE555N	28
NE556N	66
NE566N	171
NE570N	485
NE671N	505
RC4136	146
TBA120S	88
TDA1022	713
TDA1034B	239
TL081CP	84
TL084CN	156
UA741CN	20
UA741CT	47
UA748CN	39

Voltage Regulators

LM309DA(K)	119
UA723CN	42
UA7805CU	78
UA7812CU	78
UA7815CU	78
UA7912CU	97
UA7915CU	97
UA78L05CS	38
UA78L12CS	38
UA78L15CS	38

Zener Diodes

400mW C4V7-C33
BZY88/BZX79
+ Voltage 9

Plessey I/C's

SL440	331
SL445	182
SL610	245
SL612	245
SL620	369
SL621	369
SL622	910
SL624	342
SL630	232
SL640	409
SL680	245
SL1610	177
SL1611	177
SL1612	177
SL1621	239
SL1626	267
SL1630	177
SL1640	206
SL1641	206
SL6640	270
SP8629	475

CASES – Boss Industrial Mouldings

Small Desk Console – Boss Industrial Mouldings

Slope Front Console, Recessed Top
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

		Order Code
W161, D96, H39 (57)	214	Case BIM1005 OR
W215, D130, H47 (73)	308	Case BIM1006 OR

Plastic Boxes – Boss Industrial Mouldings

Moulded Box and Close Fitting Flanged Lid
ABS Box, C/W Brass Bushes, and Lid In Orange

		Order Code
L112 W62 O31	99	Case BIM2003 OR
L150 W80 O50	131	Case BIM2005 OR
L190 W110 D60	223	Case BIM2006 OR

Plastic Boxes with Metal Lids

Recessed Top Box
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

		Order Code
L85 W56 D29	112	Case BIM4003 DR
L111 W71 D42	150	Case BIM4004 OR
L161 W96 D53	208	Case BIM4005 OR

Diecast Boxes

Diecast Box and Flanged Lid
Aluminium Box and Lid in Natural Finish

		Order Code
L113 W63 D31	124	Case BIM5003 NA
L152 W82 D50	215	Case BIM5005 NA
L192 W113 D61	334	Case BIM5006 NA

Small Desk Consoles

Slope Front Console, Recessed Top
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey
Ventilation Slots In Base

		Order Code
W105 D143 H32 (56)	236	Case BIM6005 OR
W170 D143 H32 (56)	312	Case BIM6006 OR
W170 D214 H32 (82)	431	Case BIM6007 OR

OPTO ELECTRONICS

Light Emitting Diodes, Individual

			Order Code
.125" (3mm)	Red	16	CQY54
	Green	18	CQY95
	Yellow	20	CQY97
Panel Mounting Clip to suit.		3	LED3 Clip
.2" (5mm)	Red	16	CQY24A
	Green	18	CQY94
	Yellow	20	CQY96
Panel Mounting Clip to suit.		5	LED5 Clip

Photoresistors

ORP12	95	ORP12
ORP61	95	ORP61

Phototransistors

OCP71	220	DCP71
BPX25	195	BPX25
BPX29	195	BPX29

Photocoupler

FCD820	165	FCO820

HARDWARE

D.I.L. Sockets

		Order Code
8 Pin Low Profile Socket Tin	12	DIL SKT 8
14 Pin Low Profile Socket Tin	14	DIL SKT 14
16 Pin Low Profile Socket Tin	16	DIL SKT 16

Heatsinks

Individual Type for 1 × T05 50°C/W	12	Sink 5F
Individual Type for 1 × T066 10.5°C/W	28	Sink TV2
Individual Type for 1 × T03 7.2°C/W	26	Sink TV3
Individual Type for 1 × T0126 17°C/W	26	Sink TV4
Individual Type for 1 × T0220 17°C/W	26	Sink TV5

P.C.B. Components

Dalo Pen, Blue Ink, Slow Drying	98	Pen 33PC

SWITCHES

Miniature Toggle – Honeywell

			Order Code
SPDT		67	SW 8A1011
SPDT	C/Off	81	SW 8A1021
SPDT	Double Bias To Centre	90	SW 8A1041
SPDT	Single Bias To Centre	90	SW 8A1051
SPDT	Bias	84	SW 8A1061
DPDT		99	SW 8A2011
DPDT	C/Off	111	SW 8A2021
DPDT	Double Bias To Centre	123	SW 8A2041
DPDT	Single Bias To Centre	123	SW 8A2051
DPDT	Bias	116	SW 8A2061

Miniature Push – C & K

SP	Push To Make, Momentary	62	SW 8531
SP	Push To Break, Momentary	62	SW 8533

MAINS TRANSFORMERS

Order Code

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

6VA – Clamp Type Construction 235 each
Approx. 18% Regulation. F.C. 54, H36, W35

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

20VA – Clamp Type Construction 360 each
Approx. 16% Regulation F.C. 70, H48, W46

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

SEMICONDUCTORS

IN914	5	BC182L	12
IN4001	5	BC184	11
IN4002	5	BC184L	12
IN4004	7	BC212	11
IN4007	9	BC212L	12
IN4148	4	BC214	11
IN5402	15	BC214L	12
2N2218A	31	BC547	13
2N2369	21	BC548	11
2N2646	46	BC549	12
2N2926G	13	BC557	15
2N3053	19	BC558	15
2N3054	55	BCY70	15
2N3055	55	BCY71	15
2N3055	–	BD131	39
Full ISB Test	95	BD132	39
2N3442	155	BD139	39
2N3702	9	BD140	39
2N3704	9	BFR90	333
2N3705	10	BFX85	29
2N3773	297	BFY50	17
2N3819	22	BFY51	17
2N3820	39	BFY52	20
2N3904	9	BLX65	262
2N5457	39	BLY93A	2977
2N5459	35	BRY39	50
40673	88	BSX20	21
AC188	24	CL8960	2850
AD161	42	MPF102	36
AD162	42	OA91	8
BAW95D	1200	OC28	118
BC107	14	OC35	105
BC108	14	TIP31A	48
BC108C	18	TIP32A	54
BC109	14	TIP41C	76
BC109B	19	TIP42C	76
BC109C	20	TIP2955	75
BC148	10	TIP3055	60
BC158	10	TIS43	36
BC177	17	ZTX109C	16
BC179	20		
BC182	11		

RESISTORS

Carbon Film, Fixed

			Order Code
0.25W, E24 Values IRO-10M, 5% Tol.	2 each	100/100 (Mult 10/Value)	Res RD¼
0.5W, E12 Values IRO-4M7, 10% Tol.	3 each	150/100 (Mult 10/Value)	Res RD½ + Value

Metal Film, Fixed

0.5W, E24 Values, SRI-IM, 2% Tol.	8 each	400/100 (Mult 10/Value)	Res MR30
2.5W, E12 Values, 10R-27K, 5% Tol.	16 each	800/100 (Mult 10/Value)	Res PR52 + Value

Metal Glaze, Fixed

0.5W, E24 Values, IM-33M, 5% Tol.	16 each	800/100 (Mult 10/Value)	Res VR37 + Value

VERO ELECTRONICS PRODUCTS

2.5" × 5" .1" pitch Veroboard	71	200-21069J
3.75" × 5" .1" pitch Veroboard	79	200-21072D
2.5" × 1" .1" pitch Veroboard (5)	85/Pack	200-21076C
3.75" × 5" .1" pitch Plain Board	68	200-21078H
5.82" × 2.9" .1" pitch V-Q DIP Board	135	200-21084E
Spot Face Cutter	107	203-21013A
Pin Insertion Tool for .040 type pin	147	203-21015F
DS Pins .040 (100)	44/Pack	200-21087G
SS Pins .040 (100)	44/Pack	200-21017B
Verowire Kit (1-pen, 2-wire, 25-comb)	454/Kit	200-21341D
Verowire Combs (25)	109/Pack	200-21339F
Verowire Wire (2)	109/Pack	200-21340G

Skeleton Presets, Miniature

		Order Code
0.1W, E3 Values, 100R-IM, Lin. Vertical Mounting	8	Min. Preset V
0.1W, E3 Values, 100R-IM, Lin. Horizontal Mounting	8	Min. Preset H + Value

Skeleton Presets, Standard

0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting	11	Std. Preset V
0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mounting	11	Std. Preset H + Value

Potentiometer, Rotary

0.5W, E3 Values, 1K-2M2 Lin.	39	Ro Pot Lin
0.25W, E3 Values, 4K7-2M2 Log.	39	Ro Pot Log + Value

Potentiometer, Slider

0.5W, E3 Values, 2K2-470K Lin.	45	Sl Pot Lin
0.25W, E3 Values, 1K0-1M0 Log.	45	Sl Pot Log + Value

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RESISTORS (¼W E12)	
10 ohm to 10 Mohm	**1.5p**
PRESETS (¼W Horizontal)	
100 ohms to 2 Mohms	**8p**
POTENTIOMETERS (Carbon)	
LOG AND LINEAR	
1 Kohm to 2 Mohms	**28p**
VEROBOARDS (0.1" Copper)	
2.5"×5"	**52p**
3.75"×5"	**62p**
ZENER DIODES (400mW)	
2.7V to 33V	**8p**
TRANSFORMERS (240V)	
9-0-9V, 100mA	**90p**
0-15V, 0-15V, 200mA	**100p**
CERAMIC CAP (50V)	
22pF to 50nF	**2p**
POLYSTYRENE CAP (160V)	
10pF to 1,000pF	**4p**
POLYESTER CAP (100V)	
1nF to 100nF	**4p**
.15, .22, .33, .39uF	**5p**
.47, .68uF	**9p**
1uF : **12p**	2.2uF : **20p**
3.3uF : **26p**	4.7uF : **30p**
ELECTROLYTIC CAP (uF/V)	
1/25V to 50/25V	**5p**
68/50V, 100/25V	**6p**
150/40V, 220/12V	**7p**
220/25V	**8p**
330/12V, 500/30V	**12p**
1,000/10V : **13p**	1,000/25V : **18p**
1,500/25V : **24p**	2,200/6.3V : **20p**

BRIDGE RECTIFIERS	
0.75/200V	**25p**
0.75/600V	**30p**
1A/50V	**22p**
1A/100V	**27p**
1A/200V	**32p**
1A/400V	**34p**
2A/50V	**40p**
2A/100V	**42p**
2A/200V	**48p**
2A/400V	**55p**

VOLTAGE REGULATORS	
320H-05	**40p**
320H-24	**40p**
7805	**70p**
7812	**70p**
7815	**70p**
7818	**70p**
7824	**70p**
7905	**90p**
7912	**90p**
7915	**90p**
7918	**90p**
7924	**90p**

OPTO/DISPLAY	
2N5777	**55p**
OCP71	**65p**
ORP12	**60p**
MAN72	**110p**
MAN74	**110p**
.125" & .2"	
LEDs:—	
Red	**10p**
Green	**14p**
Yellow	**14p**
.125" clip	**3p**
.2" clip	**4p**
DIODES	
8Y127	**10p**
OA47	**8p**
OA91	**8p**
OA200	**6p**
OA202	**9p**
1N916	**5p**
1N4148	**4p**
1N4001	**4p**
1N4002	**4p**
1N4003	**5p**
1N4004	**6p**
1N4005	**6p**
1N4006	**8p**
1N4007	**8p**
1N5400	**13p**
1N5401	**14p**
1N5402	**15p**
1N5404	**16p**
DIL SOCKETS	
8 pin	**11p**
14 pin	**13p**
16 pin	**14p**
18 pin	**18p**
22 pin	**22p**
24 pin	**24p**
28 pin	**28p**
40 pin	**40p**
LINEAR CIRCUITS	
709	**40p**
710-14	**33p**
747-14	**48p**
748-8	**44p**
CA3018	**70p**
CA3028A	**85p**

CA3046	**70p**
CA3054	**90p**
CA3080	**75p**
CA3130	**90p**
CA3140	**45p**
LF351N	**65p**
LF356N	**75p**
LM301AN	**32p**
LM308N	**60p**
LM318N	**200p**
LM324N	**74p**
LM339N	**60p**
LM348N	**90p**
LM377N	**175p**
LM380N	**75p**
LM381N	**140p**
LM382N	**130p**
LM1310N	**150p**
LM3900N	**55p**
LM3909N	**70p**
MC1496P	**85p**
NE531	**105p**
NE555	**25p**
NE556	**60p**
NE566	**140p**
TBA641A	**200p**
TBA641B	**200p**
T8A800	**75p**
TBA810S	**110p**
ZN414	**100p**
ZN1034	**200p**
CMOS	
4000	**14p**
4001	**14p**
4002	**14p**
4006	**60p**
4007	**15p**
4008	**84p**
4009	**32p**
4010	**42p**
4011	**15p**
4012	**15p**
4013	**32p**
4014	**85p**
4015	**63p**
4016	**37p**
4017	**57p**
4018	**68p**
4019	**45p**
4020	**92p**
4021	**90p**
4022	**85p**
4023	**18p**
4024	**47p**
4025	**14p**
4027	**32p**
4028	**54p**
4029	**63p**

4030	**48p**
4035	**107p**
4041	**78p**
4042	**58p**
4043	**83p**
4044	**90p**
4047	**90p**
4048	**55p**
4049	**30p**
4050	**30p**
4066	**38p**
4069	**15p**
4070	**15p**
4071	**15p**
4072	**15p**
4073	**15p**
4081	**15p**
4082	**15p**
4086	**66p**
4510	**73p**
4511	**99p**
4516	**95p**
4518	**72p**
4520	**69p**
4528	**99p**
TTL	
7400	**11p**
7401	**11p**
7402	**11p**
7403	**11p**
7404	**13p**
7405	**13p**
7406	**15p**
7407	**20p**
7408	**13p**
7409	**13p**
7410	**13p**
7411	**17p**
7412	**15p**
7413	**27p**
7414	**48p**
7416	**25p**
7417	**25p**
7420	**13p**
7421	**21p**
7422	**16p**
7427	**25p**
7428	**28p**
7430	**13p**
7432	**18p**
7433	**30p**
7437	**15p**
7438	**15p**
7440	**10p**
7441	**56p**
7442	**43p**
7443	**35p**
7444	**78p**

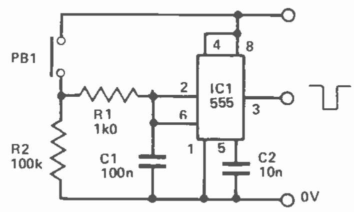
7445	**60p**
7446	**65p**
7447	**53p**
7448	**62p**
7450	**10p**
7451	**12p**
7453	**12p**
7454	**10p**
7460	**12p**
7470	**17p**
7472	**21p**
7473	**24p**
7474	**24p**
7475	**30p**
7476	**26p**
7480	**25p**
7485	**66p**
7486	**22p**
7490	**32p**
7491	**28p**
7492	**17p**
7493	**32p**
7494	**30p**
7495	**30p**
7496	**42p**
7497	**200p**
74100	**60p**
74105	**43p**
74107	**20p**
74109	**25p**
74110	**40p**
74118	**88p**
74121	**26p**
74122	**22p**
74123	**40p**
74125	**34p**
74126	**34p**
74132	**48p**
74141	**45p**
74142	**200p**
74145	**55p**
74150	**69p**
74151	**48p**
74153	**52p**
74154	**89p**
74155	**54p**
74156	**30p**
74157	**52p**
74160	**64p**
74161	**50p**
74162	**66p**
74163	**66p**
74164	**66p**
74165	**45p**
74166	**85p**
74173	**70p**
74174	**50p**
74175	**60p**
74176	**64p**

74177	**53p**
74180	**50p**
74181	**99p**
74182	**30p**
74190	**75p**
74191	**70p**
74192	**50p**
74193	**64p**
74194	**68p**
74195	**65p**
74196	**80p**
74197	**40p**
74198	**107p**
74199	**80p**
TRANSISTORS	
AC126/7	**20p**
AC128	**20p**
AC128/176 Mt. pr.	**40p**
AC176	**20p**
AC187/8	**21p**
AD149	**60p**
A0161/2	**40p**
AF116	**35p**
AF117	**35p**
AF124	**34p**
AF139	**35p**
AF239	**45p**
8C107	**10p**
BC108/9	**10p**
BC147	**8p**
8C148	**10p**
BC149	**9p**
BC157	**10p**
BC158/9	**10p**
BC167	**13p**
8C169C	**13p**
BC173	**6p**
BC177/8	**16p**
BC179B	**18p**
BC182/3	**10p**
BC184	**10p**
BC209	**11p**
BC212/3	**11p**
8C214	**14p**
BC214L	**14p**
BC261B	**14p**
BC461	**34p**
BC477	**23p**
8C478/9	**23p**
BC547/B	**12p**
BC549	**13p**
BC557/8	**13p**
BC559	**15p**
BCY70	**16p**
BCY71	**19p**
8CY72	**18p**
BD115	**40p**

BD131/2	**38p**
BD135/6	**35p**
BD137/8	**35p**
BD139	**35p**
BD140	**35p**
8F180	**24p**
BF181	**8p**
BF184	**21p**
BF185	**25p**
BF194/5	**10p**
BF196/7	**10p**
BF244B	**35p**
BF259	**25p**
8FR39	**32p**
BFR79	**32p**
BFX29	**25p**
8FX84	**25p**
BFX87	**22p**
BFX88	**27p**
BFY50/1	**22p**
BFY52	**18p**
BRY39	**45p**
BSX20	**22p**
BU205	**140p**
BU208	**200p**
MJ2955	**110p**
MJE340	**70p**
MJE2955	**104p**
MJE3055	**85p**
MPF102	**40p**
MPF103	**40p**
MPF104	**40p**
MPF105	**40p**
MPF106	**46p**
MPSA06	**26p**
MPSA56	**26p**
MPSU06	**61p**
OC35	**86p**
TIP29	**35p**
TIP29B	**40p**
TIP30	**35p**
TIP308	**40p**
TIP31	**35p**
TIP32	**35p**
TIP33	**40p**
TIP33C	**60p**
TIP34A	**65p**
TIP35C	**200p**
TIP36A	**220p**
TIP41A	**60p**
TIP42A	**60p**
TIP2955	**70p**
TIP3055	**55p**
ZTX107	**13p**
ZTX108	**13p**
ZTX109	**13p**
ZTX300	**16p**
ZTX301	**18p**
ZTX302	**20p**

ZTX303	**24p**
ZTX304	**27p**
ZTX311	**19p**
ZTX341	**22p**
ZTX500	**16p**
ZTX501	**16p**
ZTX502	**21p**
ZTX503	**17p**
ZTX504	**28p**
2N696	**33p**
2N697	**13p**
2N698	**30p**
2N706	**14p**
2N914	**34p**
2N918	**33p**
2N1131	**20p**
2N1302	**38p**
2N1303	**60p**
2N1304	**55p**
2N1613	**25p**
2N2222A	**21p**
2N2369	**17p**
2N2484	**30p**
2N2646	**50p**
2N2904	**23p**
2N2905	**23p**
2N2906	**17p**
2N2907	**23p**
2N2926G	**11p**
2N3053	**22p**
2N3054	**50p**
2N3055	**50p**
2N3442	**150p**
2N3702 to 2N3711	**11p**
2N3772	**180p**
2N3773	**330p**
2N3819	**21p**
2N3820	**55p**
2N3823	**70p**
2N3866	**60p**
2N3903	**10p**
2N3904	**10p**
2N3905	**10p**
2N3906	**10p**
2N4037	**33p**
2N4058	**14p**
2N4059	**12p**
2N4060	**14p**
2N4061	**14p**
2N5457	**35p**
2N5458	**35p**
2N5459	**35p**
2N6027	**45p**

TECH TIPS



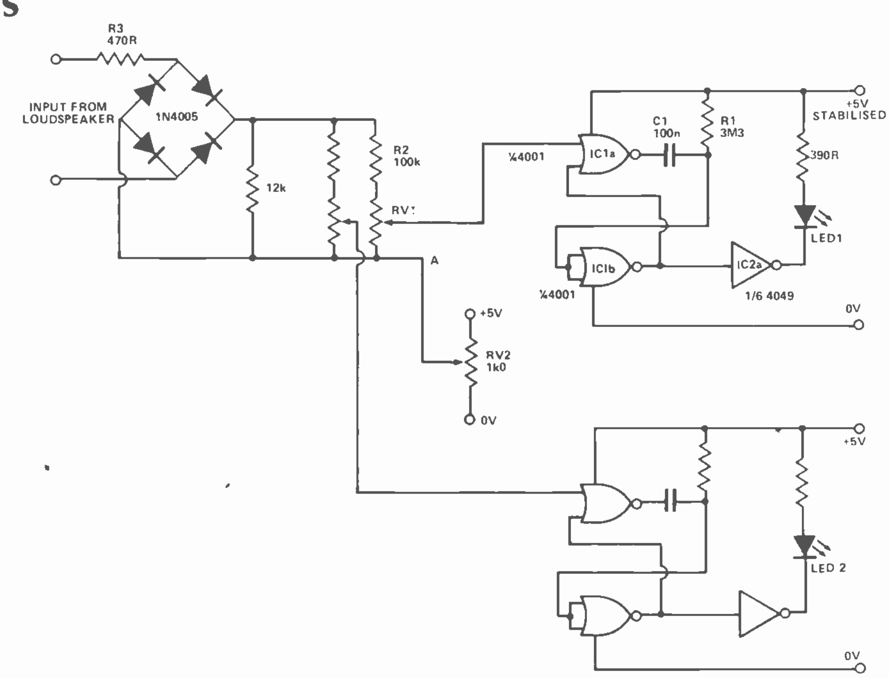
555 Micro Input Reset

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



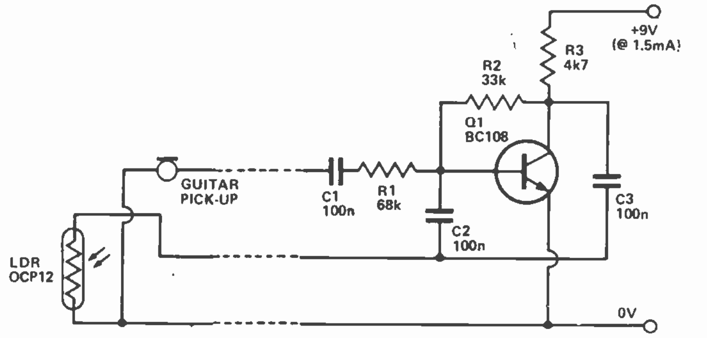
The circuit diagram shows the input circuitry from the loudspeaker terminals. For simplicity only two of the monostable and LED driver cuits are shown. Six of these circuits can be constructred using three 4001s and one 4049 CMOS ICs. The circuit is based on the fact that CMOS has an input threshold 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.

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

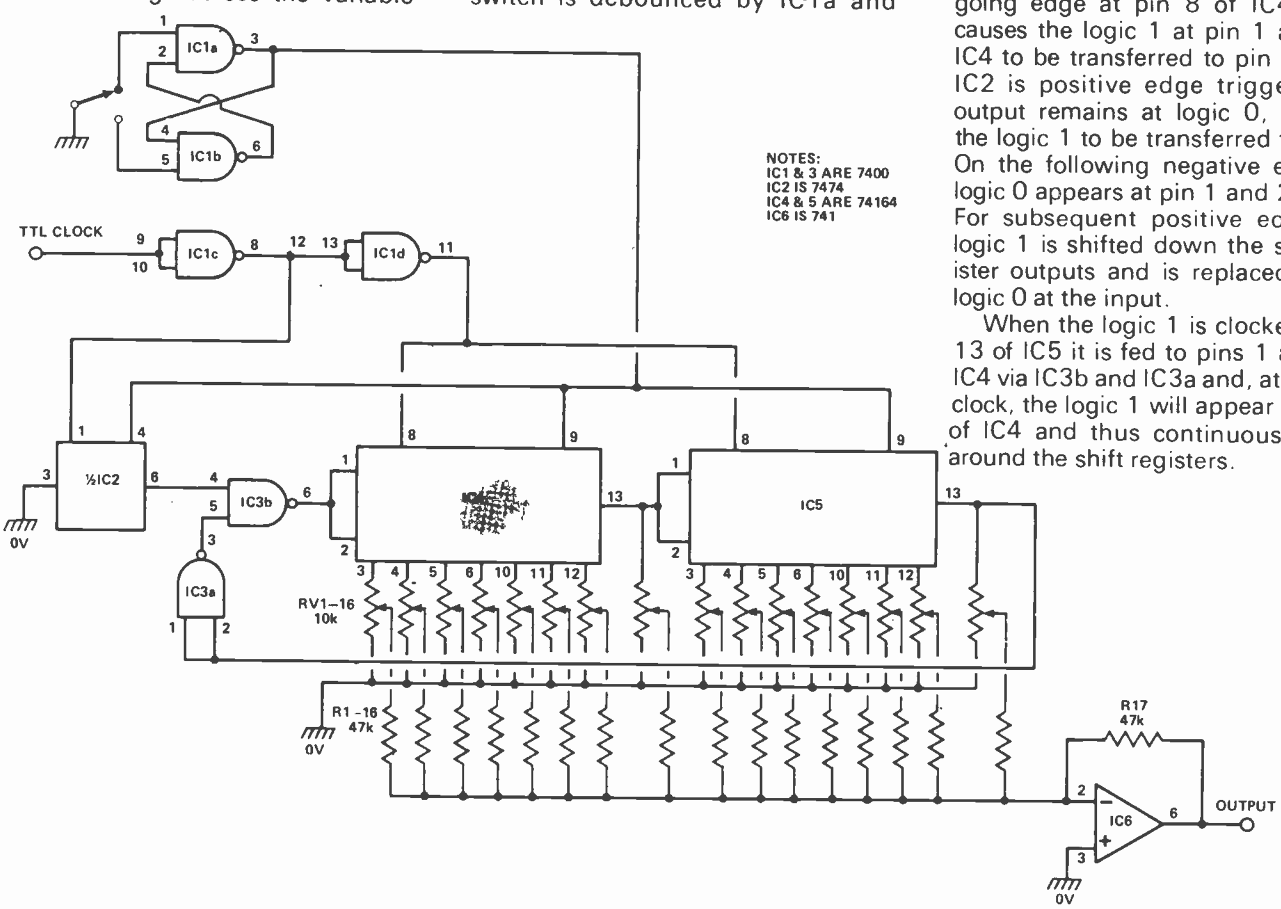
A simple sequencer can be constructed using shift registers.

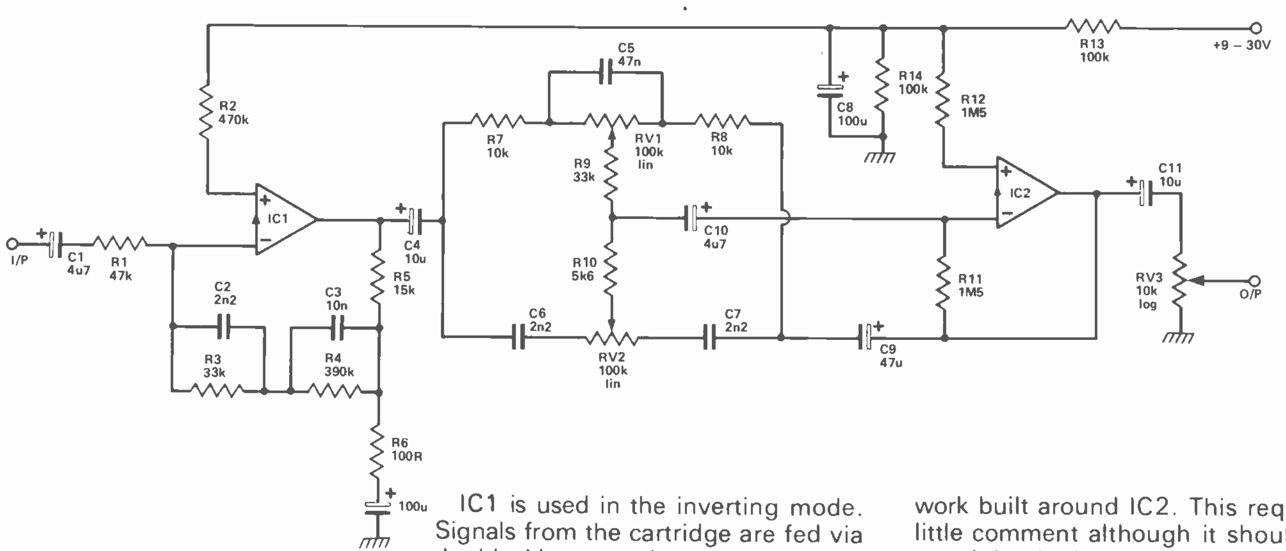
A logic 1 is shifted down the shift registers (IC4, 5) outputs, otherwise at logic 0, at each clock pulse. This places a voltage across the variable resisters RV1 — 16 in turn. A preset DC voltage is thus available at the output, after being buffered by R1 - 16 and IC6 for each clock pulse. A sequence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





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.

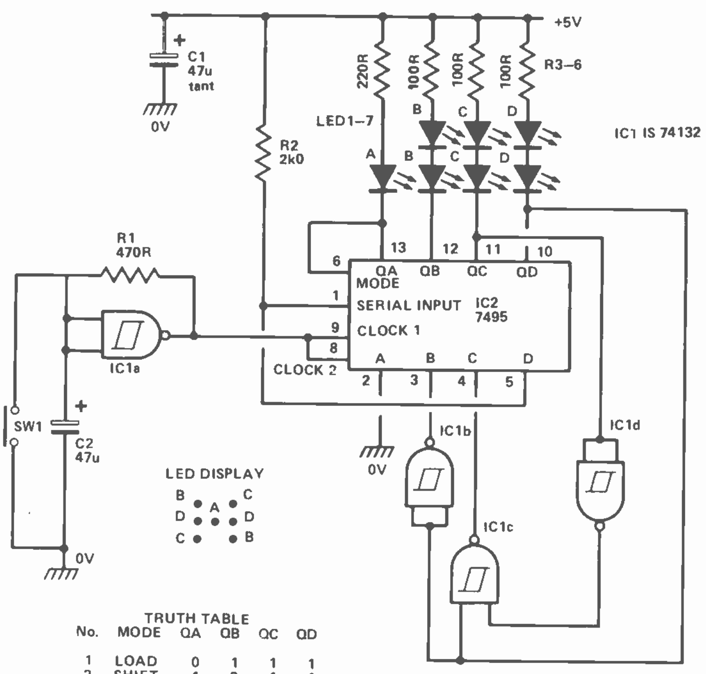
Performance is good with overall distortion below 0.1% and a S/N ratio of —67db unweighted, ref 500 mV out.

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.

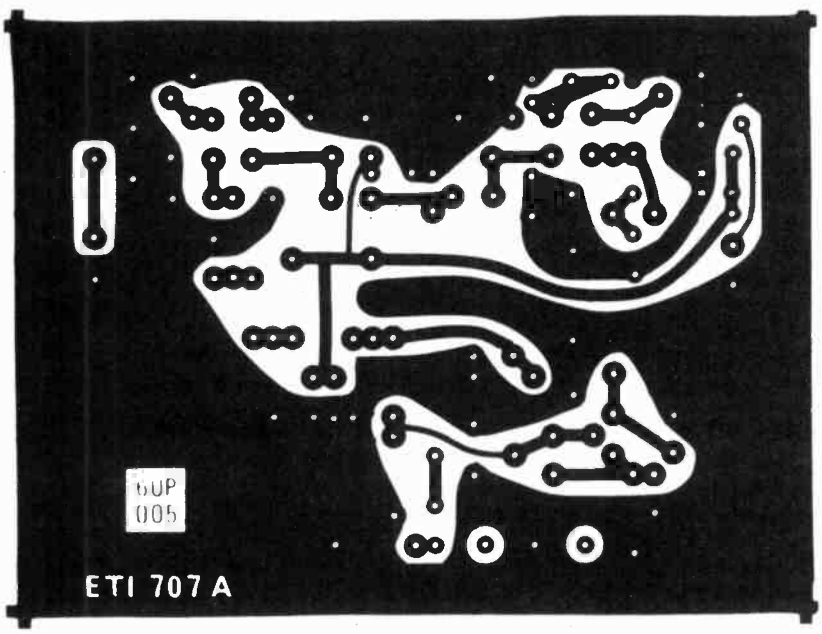


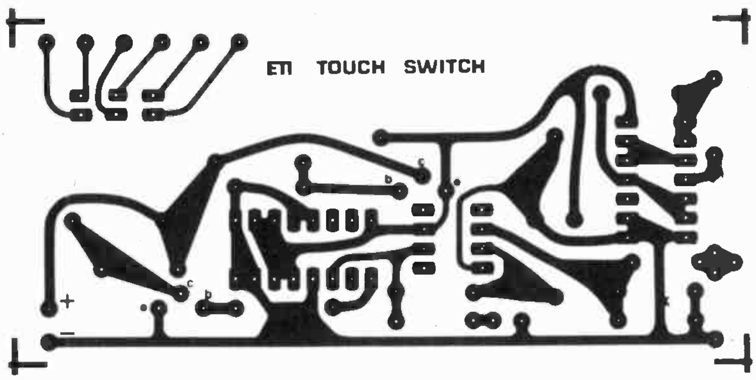
TRUTH TABLE

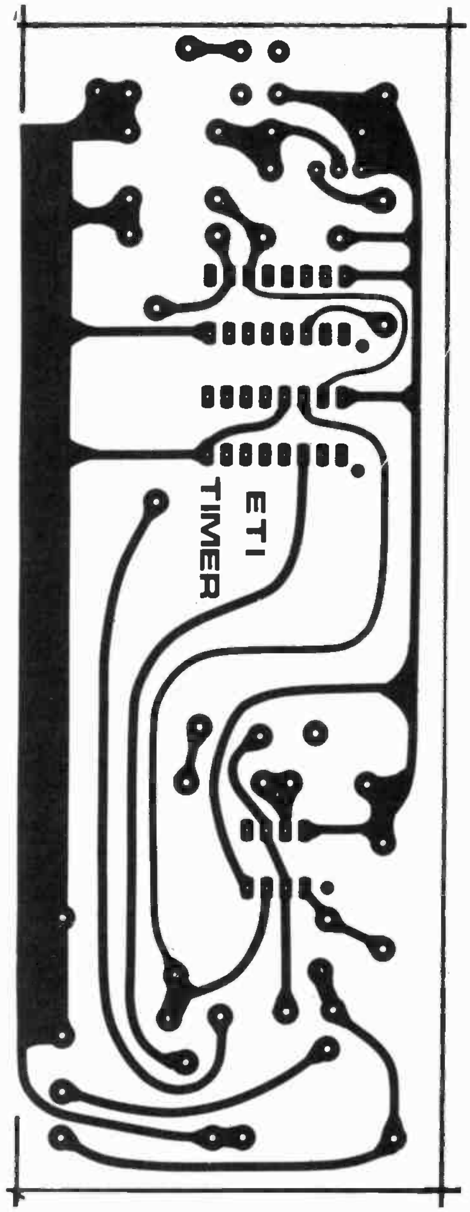
No.	MODE	QA	QB	QC	QD
1	LOAD	0	1	1	1
2	SHIFT	1	0	1	1
3	LOAD	0	0	1	1
4	SHIFT	1	0	0	1
5	LOAD	0	0	0	1
6	SHIFT	1	0	0	0
1	LOAD	0	1	1	1
ETC					

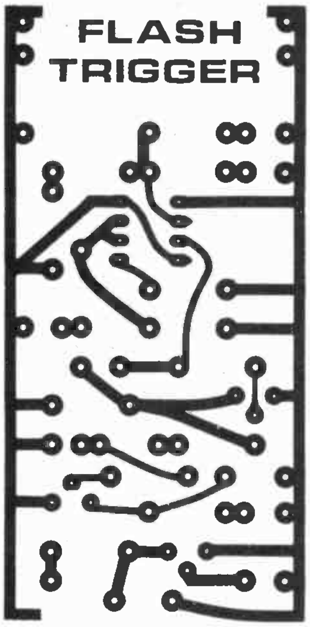
PCB FOIL PATTERNS

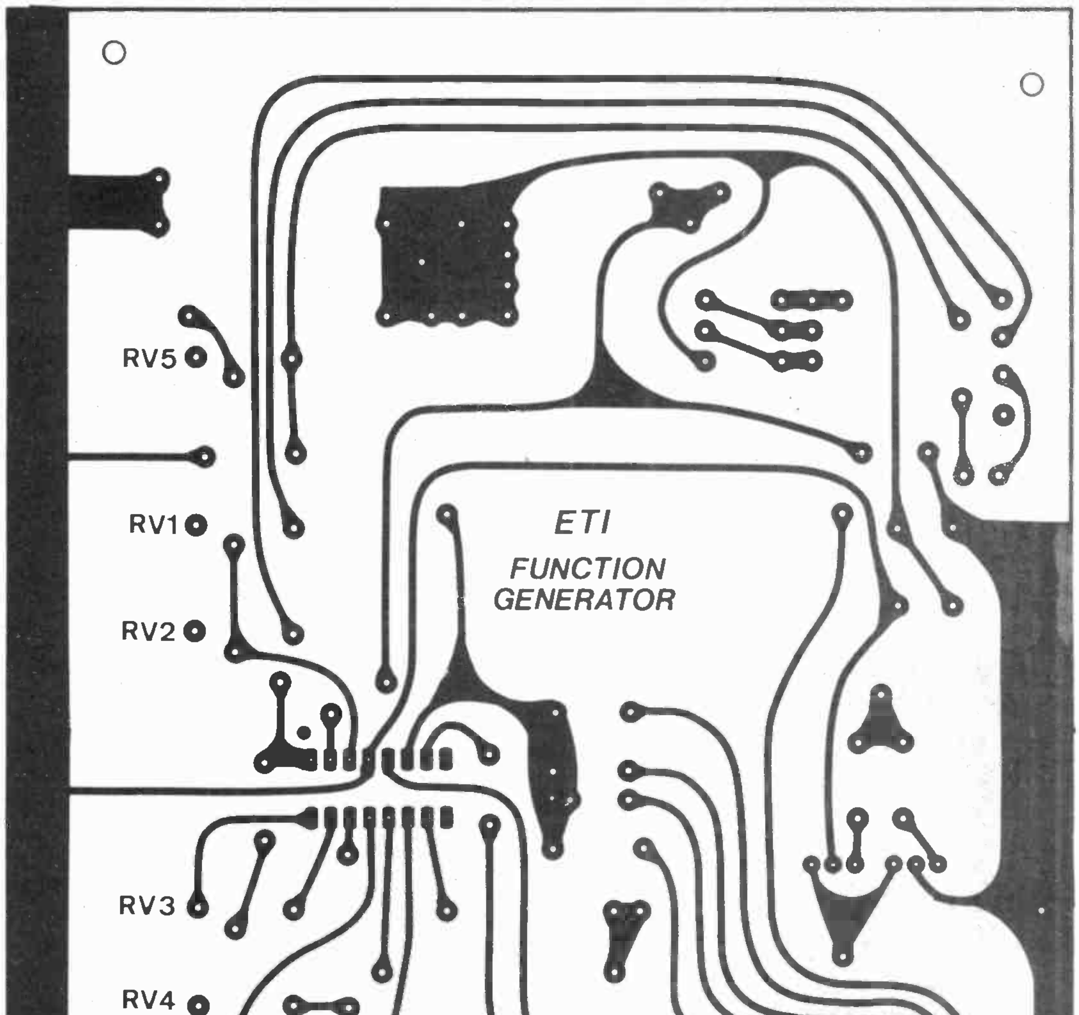
We didn't have room in this issue to pack in all the foil patterns. Never fear, if you're anxious to get started on your PCBs, send us a large sae and they'll be on their way to you. If you can bear to wait until next month's issue, we'll find a little space somewhere for them. Rest assured, they will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








FLASH
TRIGGER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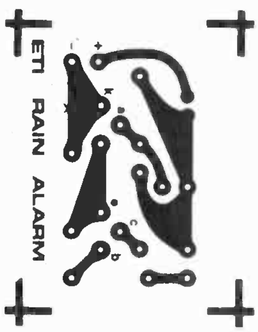
FUNCTION
GENERATOR
RV5
RV1
RV2
RV3
RV4
RV11
RV10
RV9
RV8
RV7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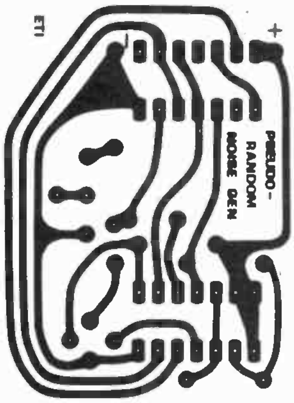
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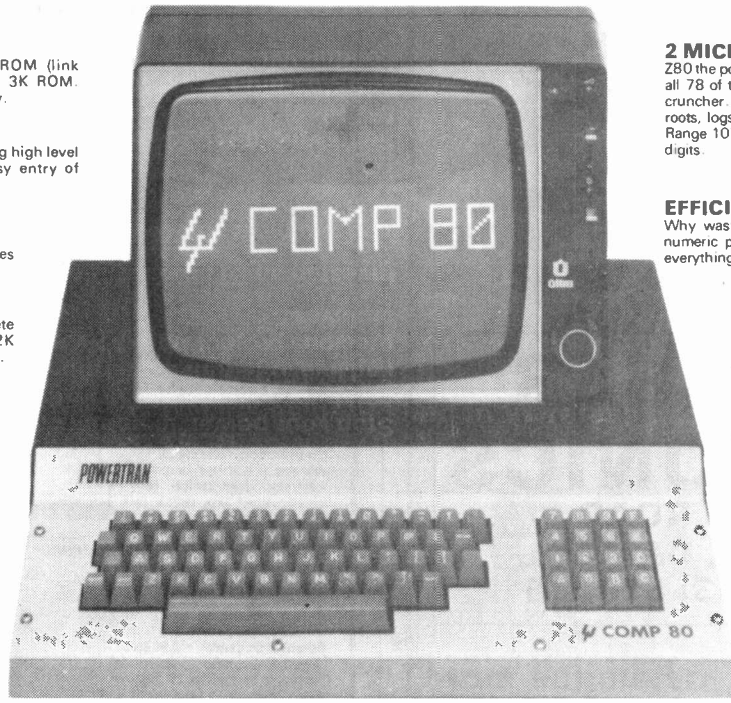

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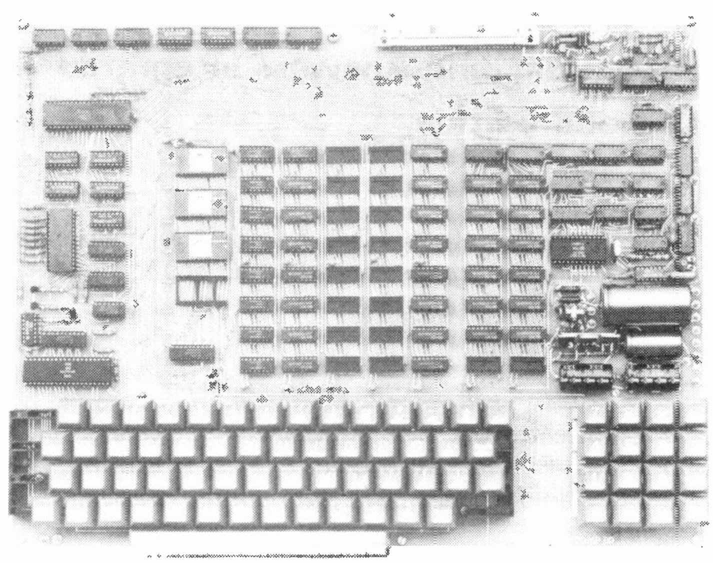

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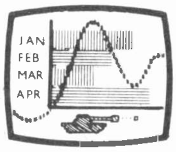

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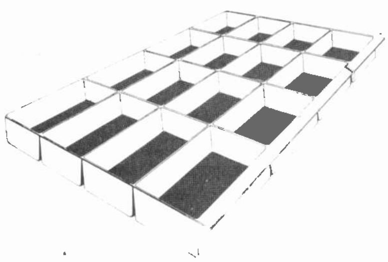

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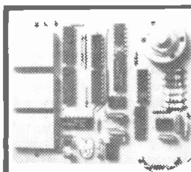

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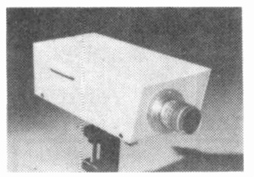

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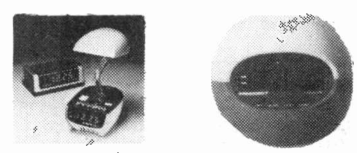

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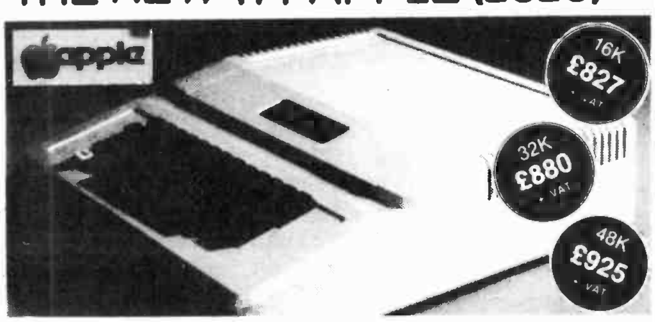

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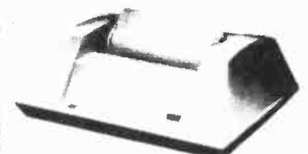

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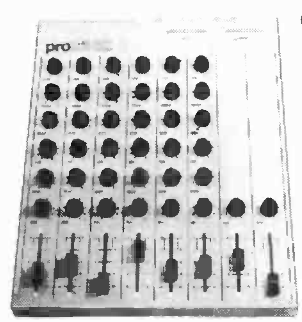

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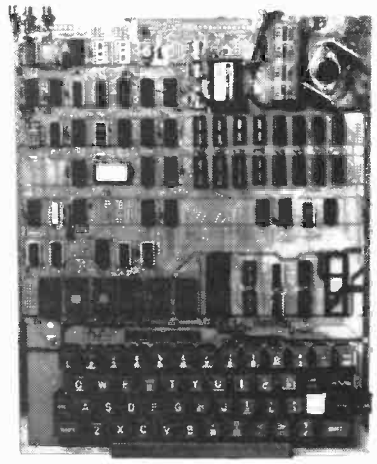

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NEXT	ON GOTO	ON GOSUB	POKE	PRINT	READ
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LOG(X)	PEEK(I)	POS(I)	RND(X)
SPC(I)	SQR(X)	TAB(I)	TAN(X)
FRE(X)	INT(X)		
SGN(X)	SIN(X)		
USR(I)			

STRING FUNCTIONS

ASC(X$)	CHR$S(I)	FRE(X$)	LEFT$(X$ I)
RIGHT$(X$ I)		STR$(X)	
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