ISSN. 0142-7229

electronics today INTERNATIONAL

NOVEMBER 1981 ONLY 65p

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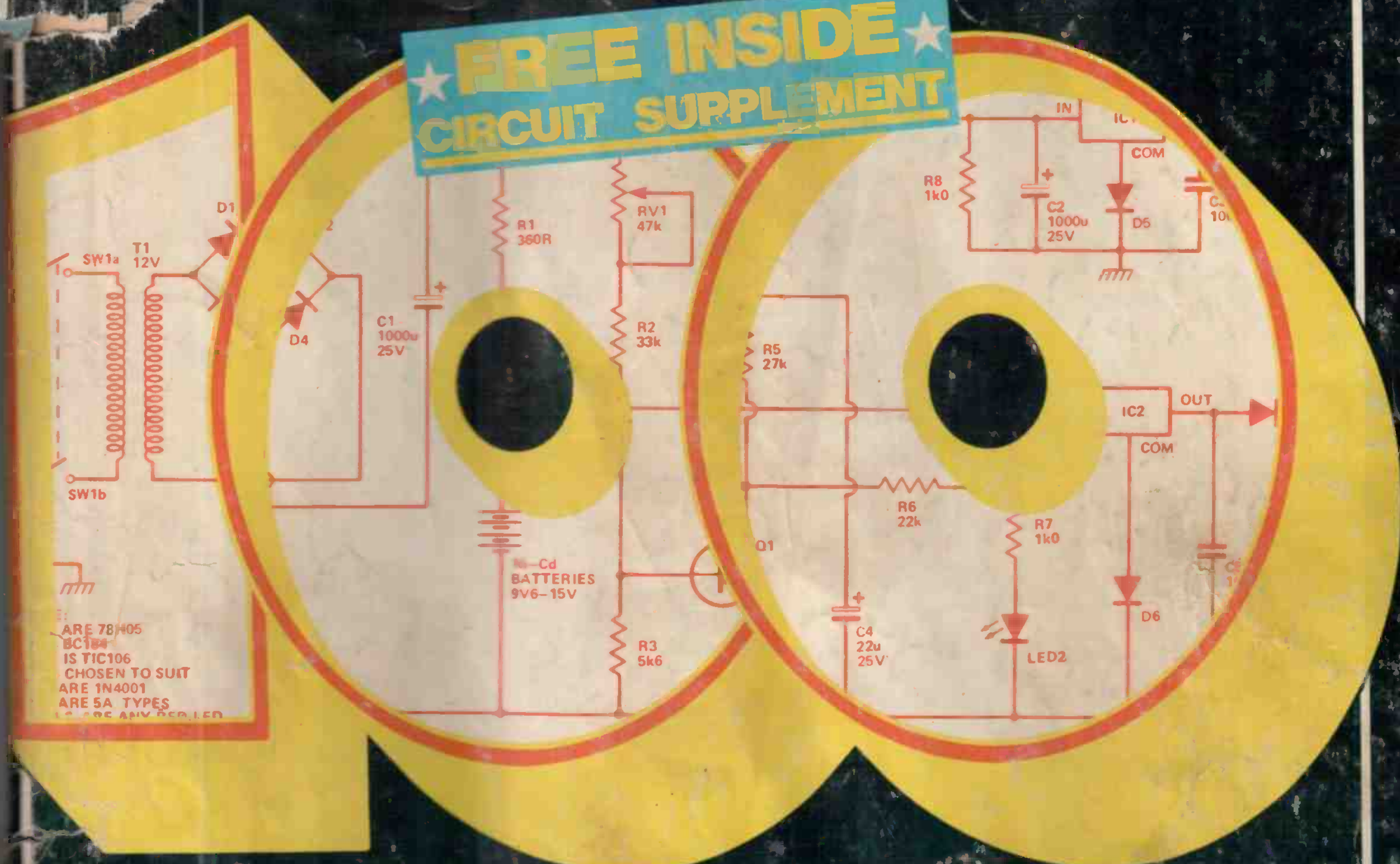

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DIY MUSIC PROCESSOR TO BUILD

VOICE-OVER UNIT FOR DJ's

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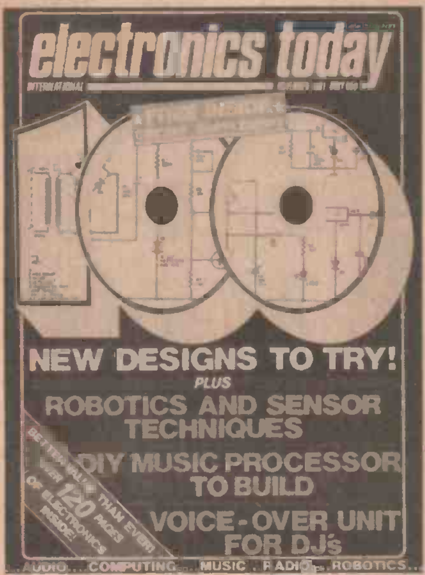

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NOVEMBER 1981 VOL 10 NO 11

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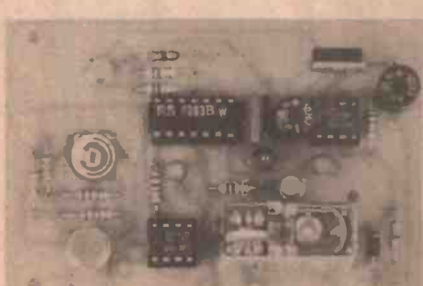
New choices from Telecom p.19

PROJECTS

INFORMATION

For fading DJs p.26

Effects unit extraordinaire p.38


Drive thieves away p.94

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SWITCHES

TOGGLE: 2A, 250V.	
SPST	33p
DPDT	44p
SUB-MIN TOGGLE	
SPST on/off	54p
SPDT c/over	60p
SPDT centre off	85p
SPDT biased both ways	105p
DPDT 6 tags	75p
DPDT centre off	88p
DPDT biased both ways	145p
DPDT 3 positions on/on/on	185p
3-pole 2 way	205p
SLIDE 250V:	
DPDT 1A	14p
DPDT 1A c/off	15p
DPDT 1/2A	13p
PUSHBUTTON 6A with 10mm Button	
SPDT latching	99p
DPDT latching	145p
SPDT moment	99p
DPDT moment	145p
Mini Non Locking	
Push to Make	15p
Push to Break	25p

DIL SWITCHES
(SPST) 4 way 70p; 6 way 85p; 8 way 90p; 10 way 145p. (SPDT) 4 way 190p.

ROTARY SWITCHES:
(Adjustable Stop type)
1 pole/2 to 12 way; 2p/2 to 6 way; 3 pole/2 to 4 way; 4p/2 to 3 way 45p

ROTARY: Mains DP 250V 4 Amp on/off 56p

ROTARY: (Mak-a-switch)
Make a multiway switch. Shafting assembly has adjustable stop. Accommodates up to 6 wafers (max. 6 pole/12 way + DP switch). Mechanism only 90p

WAFERS: (make before break) to fit the above switch mechanism.
1 pole/12 way; 2 pole/6 way; 3 pole/4 way; 4 pole/3 way; 6p/2 way 56p
Mains DP 4A Switch to fit 45p
Spacers 4p. Screen 6p

ROCKER: 5A/250V SPST	28p
ROCKER: 10A/250V SPDT	38p
ROCKER: 10A/250V DPDT c/off	95p
ROCKER: 10A/250V DPST with neon	85p

VEROBOARD 0.1in

	clad	plain
2½ × 3¾"	73p	52p
2½ × 5"	83p	
3¾ × 3¾"	83p	
3¾ × 5"	95p	79p
3¾ × 17"	326p	211p
4¾ × 17"	426p	–
Pkt. of 100 pins	50p	
Spot face cutter	118p	
Pin insertion tool	162p	

VQ Board	150p
DIP Board	330p
Vero Strip	144p
PROTO-DECs	
Veroblock	375p
S-Dec	350p
Eurobreadboard	520p
Bimboard 1	785p
Superstrip SS2	998p

VERO WIRING
PEN + Spool 310p
Spare Spool 75p
Combs 6p

DALO ETCH RESIST PEN
+ Spare tip 90p

FERRIC CHLORIDE
1 lb bag Anhydrous 195p + 50p P&P

ULTRASONIC TRANSDUCER
40KHz 395p pr

COPPER CLAD BOARDS

Fibre glass	Single-sided	Double-sided	S.R.B.P.
6" × 6"	90p	110p	9.5" × 8.5"
6" × 12"	150p	195p	95p

DIL SOCKETS (TEXAS)

	Low Prof.	Wire Wrap
8pin	8p	25p
14pin	10p	35p
16pin	10p	42p
18pin	16p	52p
20pin	22p	60p
22pin	25p	70p
24pin	25p	70p
28pin	28p	80p
36pin	–	109p
40pin	30p	99p

EDGE CONNECTORS: (Double type)

	.1	.156
2×10 way	–	120p
2×15 way	–	135p
2×18 way	140p	145p
2×22 way	160p	165p
2×25 way	180p	175p
2×30 way	199p	–
2×36 way	235p	–
2×40 way	265p	–
2×43 way	280p	–

PLUGS & SOCKETS

	Plug	Socket	In-line
JACK			
2.5mm (plastic)	8p	–	10p
Metal	15p	8p	16p
3.5mm (plastic)	10p	15p	12p
Metal	16p	10p	18p
1/4in Mono			
Plastic	15p	20p	15p
Metal	36p	14p	30p
1/4in Stereo			
Plastic	22p	24p	22p
Metal	36p	20p	39p
DIN			
2 pin	8p	6p	14p
3 pin	13p	10p	15p
4 pin	16p	12p	15p
5 pin	13p	12p	15p
BANANA			
1mm	9p	9p	–
2mm	13p	13p	–
3mm (wander)	11p	11p	–
4mm	13p	14p	–
CO-AXIAL (TV)			
Plastic	10p	16p	8p
Metal	19p	20p	40p

UHF Connectors (50Ω-CB)
plug PL259 40p; Reducer 14p;
Socket SO239 Round Chassis 40p
Socket SO239 Square Panel....... 38p

BULGIN OCTAL 250V-6A/pin
Plug P551 199p; Socket 68p

IEC 3 pin 250V/6A
Plug, chassis mounting 40p
Socket, free hanging 70p
Socket, with 2 metre lead 150p

PANEL METERS
FSD
60x46x35mm
0-50μA
0-100μA
0-500μA
0-1mA
0-5mA
0-10mA
0-50mA
0-100mA
0-500mA
0-1A
0-2A
0-25V
0-50V AC
0-300V AC
"S"
"VU"
445p each

RELAYS
REED, Encapsulated, Single Pole, 5W Normally Open, 200mA, 50V DC.

RL12	700Ω 6V to 9V	120p
RL13	1KΩ 9V to 12V	120p
RL14	1K7Ω 12V to 18V	120p
RL15	3KΩ 18V to 30V	135p
Single Pole, Change Over		
RL16	1KΩ 4V to 10V	295p
RL17	1KΩ 9V to 12V	295p
Double Pole, Normally Open		
RL18	350Ω 9V to 12V	200p

Miniature, enclosed, PCB mount. Our RL6 series.
S.P.C.O.
RL6-91 170Ω coil, 7V5 to 12V DC; 380V/6A AC; 1300VA/50W 210p
D.P.C.O.
43Ω coil, 4V2-7V DC; 250V AC; 5A; 1100VA/150W 218p
RL6-111 170Ω coil, 8V-14V; 250V AC 5A 220p
RL6-114 740Ω coil, 17V5-29V 250V 5A AC. 222p

CONTINENTAL Cradle Type Relays.
Miniature Plug-in relays. 110V DC; 12V AC. 2A/DC; 2.5A.AC 30W/100VA.
2 pole c/over 185Ω; 6V-18V. RL201 180p
2 pole c/over 13V to 35V; 700Ω; RL202 180p
4 pole c/over 9V to 18V; 185Ω. RL211 220p
High Power "Heavy Duty" PCB Mounting, Cradle type.
S.P.C.D. Power Gain 1:8000 380V AC/16A; 3.5K VA. 8 to 19V; 190Ω 295p

DIL PLUGS

14pin	44p
16pin	49p
24pin	88p
40pin	250p

Ribbon Cable ft

10 way	20p
20 way	40p

JUMPER LEADS (Ribbon Cable Assembly)
Single ended DIP Jumpers 24 Inches 14 pin 145p; 16 pin 165p; 24 pin 240p; 40 pin 385p.

Double ended DIP Jumpers

Length	14 pin	16 pin	24 pin	40 pin
6in	185p	205p	300p	465p
12in	195p	215p	315p	490p
24in	215p	235p	350p	540p
36in	230p	250p	375p	595p

AMPHENOL PLUGS IEEE 675p; Centronics llel 657p

D CONNECTORS (Cannon type)

Pins	Plugs	Sockets	Covers
9way	95p	125p	145p
15way	135p	198p	150p
25way	198p	284p	170p
37way	290p	398p	185p

Soldercon Pins
100 pins 70p
500 pins 325p

ZERO INSERTION FORCE
DIL SOCKETS 24 way 650p
28 way 820p; 40 way 975p

CRYSTALS

100KHz	290
200KHz	370
455KHz	383
1MHz	300
1.008M	395
1.28MHz	392
1.6MHz	323
1.8MHz	323
1.8432MHz	300
2MHz	305
2.4576MHz	300
3.2768M	240
3.57954M	150
3.6864MHz	300
4.000MHz	200
4.032	290
4.19430M	200
4.433619	120
5.0MHz	240
5.185M	300
5.24288M	390
6.0MHz	240
6.144MHz	240
6.5536MHz	200
MHz	200
7.168MHz	290
7.680M	200
8.0MHz	200
8.08333M	362
8.867237M	240
9.375M	323
10.0MHz	240
10.7MHz	270
12MHz	290
14.31818M	320
16.0MHz	275
18MHz	240
18.432M	240
19.968MHz	300
20.0 MHz	323
26.0 MHz	383
26.69 MHz	290
27.145MHz	240
27.648M	323
38.6667M	290
48.0MHz	270
100.00MHz	323
116.0MHz	300

PIEZO TRANSDUCERS
Type
PB-2720 75p

BUZZERS, miniature, solid-state 6V; 9V & 12V 70p

LOUDSPEAKERS
Miniature, 0.3W; 8Ω. 2in, 2¼in, 2½in, 3in 80p
2½in 40Ω, 64Ω or 80Ω 80p

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The new Radio microphone that transforms your FM radio into a cordless PA System. Just tune-in your radio on to 90MHz, turn on the Wander Mike and you have instant high quality sound reproduction, PA System. Has a range of 100 feet +. Also supplied is a 5-metre cable with jack plug, should you wish to use it as a standard microphone. Ideal for singers, musicians, conferences, lectures, discos, clubs etc.
ONLY £39.50

SPEAKING CLOCK
Complete Kit of parts available for this clock Only £37.50

TRANSFORMERS: Prim. 240V

6-0-6V; 9-0-9V; 12-0-12V 100mA 98p
pcb mounting, Miniature, Split Bobbin
3VA: 2x6V-0.25A; 2x9V-0.15A; 2x12V-0.12A; 2x15V-0.1A 200p
6VA: 2x6V-0.5A; 2x9V-0.3A; 2x12V-0.25A; 2x15V-0.2A 270p
Standard Split Bobbin type:
6VA: 2x6V-0.5A; 2x9V-0.4A; 2x12V-0.3A; 2x15V-0.25A 220p
12VA: 2x4.5V-1.3A; 2x6V-1A; 2x9V-0.6A; 2x12V-0.5A; 2x15V-0.4A; 2x20V-0.3A 275p (35p p&p)
24VA: 2x6V-1.5A; 2x9V-1.2A; 2x12V-1A; 2x15V-0.8A; 2x20V-0.6A 320p (60p p&p).
50VA: 2x6V-4A; 2x9V-2.5A; 2x12V-2A; 2x15V-1.5A; 2x20V-1.2A; 2x25V-1A; 2x30V-0.8A 400p (60p p&p).
100VA: 2x12V-4A; 2x15V-3A; 2x20V-2.5A; 2x25V-2A; 2x30V-1.5A; 2x50V-1A 920p (75p p&p charge to be added over and above our normal postal charge).

VOLTAGE REGULATORS

1A TO3 metal case

	+ve		–ve	
5V	7805	145p	7905	220p
12V	7812	145p	7912	220p
15V	7815	145p		–
18V	7818	145p		–

1A TO220 Plastic Casing

5V	7805	50p	7905	55p
12V	7812	50p	7912	55p
15V	7815	50p	7915	55p
18V	7818	50p	7918	55p
24V	7824	50p		

100mA TO92 Plastic Casing

5V	78L05	30p	79L05	60p
6V	78L62	30p		–
8V	78L82	30p		–
12V	78L12	30p	79L12	60p
15V	78L15	30p	79L15	60p

CA3085	95p
LM304H	170p
LM309KP	99p
LM300H	170p
LM305H	140p
LM309K	135p
LM317K	350p
LM317H	280p
LM323K	550p
LM325N	240p
LM326N	240p
LM327	270p
LM723	35p
TAA550	50p
TBA625B	75p
TOA1412	150p
78HO5 + 5V/5A	550p
78HG +5V to +25V 5A	650p
79HG-2.25V to 24V 5A	800p

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Professional quality. Gold plated contacts.
8 pin 450p; 14 pin 275p; 16 pin 290p; 18 pin 599p; 20 pin 699p
22 pin 795p; 24 pin 845p; 28 pin 925p; 36 pin £12; 40 pin £13.

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CCN-15W 440p; CX25W 445p.
Spare tips, assorted sizes 50p
Spare Elements 210p
Iron stand with sponge 160p

SOLDER (Multicore)
18SWG
Size 5 Dispenser 75p
Size 12 Reel 360p
22SWG
PC115 Dispenser 100p
Size 10 Reel 360p

CMOS

4000	14	4073	20	4536	295
4001	14	4075	20	4538	115
4002	14	4076	60	4539	115
4006	66	4077	26	4541	140
4007	18	4078	26	4543	135
4008	62	4081	26	4544	150
4009	35	4082	21	4549	395
4010	40	4085	65	4553	299
4011	15	4086	70	4554	190
4012	18	4089	140	4555	50
4013	34	4093	43	4556	55
4014	75	4094	168	4557	320
4015	66	4095	90	4558	120
4016	32	4096	90	4559	395
4017	48	4097	320	4560	180
4018	68	4098	88	4561	104
4019	42	4099	95	4562	495
4020	61	4160	95	4566	175
4021	70	4161	99	4568	250
4022	66	4162	99	4569	175
4023	20	4163	99	4572	36
4024	45	4174	99	4580	460
4025	19	4175	105	4581	250
4026	130	4194	105	4582	99
4027	38	4408	790	4583	99
4028	58	4409	790	4584	48
4029	77	4410	725	4585	99
4030	50	4411	695	4597	330
4031	170	4412	800	4598	290
4032	125	4415	480	4599	595
4033	165	4419	280	40097	88
4034	195	4422	770	40100	215
4035	95	4433	770	40101	130
4036	275	4435	850	40102	180
4037	115	4440	999	40103	175
4038	110	4450	350	40104	95
4039	290	4451	350	40105	115
4040	59	4490	350	40106	75
4041	78	4500	675	40107	60
4042	60	4501	28	40108	450
4043	70	4502	90	40109	100
4044	65	4503	50	40110	300
4045	170	4504	105	40114	240
4046	75	4506	65		
4047	75	4507	40		
4048	55	4508	265		
4049	30	4510	68		
4050	30	4511	68		
4051	78	4512	75		
4052	78	4513	199		
4053	78	4514	195		
4054	125	4515	198		
4055	125	4516	75		
4056	120	4517	415		
4057	1915	4518	42		
4059	480	4519	29		
4060	90	4520	78		
4061	1225	4521	200		
4062	995	4522	125		
4063	99	4526	95		
4066	36	4527	115		
4067	399	4528	80		
4068	22	4529	150		
4069	20	4530	90		
4070	26	4531	130		
4071	20	4532	110		
4072	20	4534	500		

OPTO ELECTRONICS

LEDs with Clips	
TIL209 Red	13
TIL211 Grn.	17
TIL212 Yel.	18
TIL220 .2" Red	14
.2" Green, Yellow or Amber	18
0.2" Bi colour Red/Green	65p
Green/Yelow	65p
0.2" Tri colour Red/Green/Yellow	85p
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LD271 Infra Red	46
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TIL32 Infra Red	58
TIL78 Detector	60
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ORP12	86
ORP61	85
2N5777	45
ISOLATORS	
IL74	55
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TIL307	675
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TIL313 .3" CC	105
TIL321 .5" CA	115
TIL322 .5" CC	115
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DL707 .3" CA	99
DL747 .6" CA	180
.8" Orange CA	250
FND357 Red	120
FND500	115
.3" Green CA	150
.6" Green CA	215
.3" ±1 Red CA	150
.3" ±1 Green CA	150
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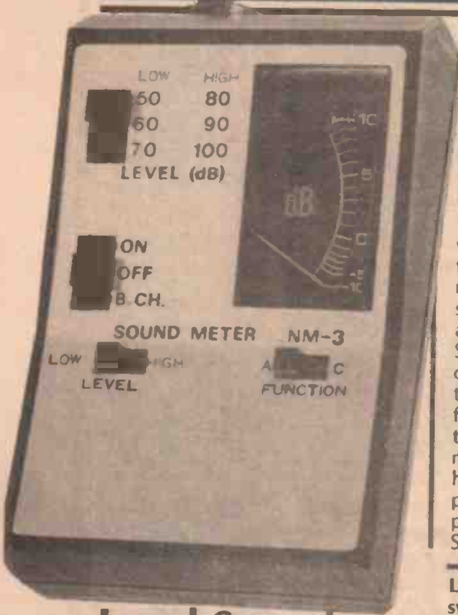


Chess Choice

Vulcan Electronics Ltd have launched three chess computers simultaneously and in conjunction with the major international manufacturer SciSys. The range has been endorsed by the World Chess Federation FIDE, and each of the three offer a different form of high technology which makes them the most advanced chess computers seen in this country. The Chess Champion Mark V is an up-market chess computer and is more powerful than the average home computer as well as being the strongest micro chess computer yet developed. It retails at £249 which is about half the normal price for such an advanced model. The Super System IV offers a free conventional chessboard and pieces for its price of £119 and is very near to the Mark V in terms of sophistication. It uses the standard co-ordinate system of chess notation with an LCD display for each move. Accessories are also available, including an LCD electronic chessboad and a separate printer. Executive Chess is a hand-held model with a price tag of £89.95 and can be battery or mains operated. It has advanced technical features and makes a good 'second' chess computer for the travelling chess enthusiast. Further information on the computers is available from Vulcan Electronics, 45 South Street, Bishop's Stortford, Herts.

Level Sound

A new Sound Level Meter is now available from B.K. Electronics. Its a very useful gadget, essential for checking conformance of sound levels to legal and medical requirements, and to correct sound distribution with regard to sound pressure level and frequency response in theatres, conference auditoriums and discotheques etc — as well as to direct sound pressure levels and frequency characteristics of loudspeakers, not to mention correcting setting of professional and domestic graphic equalisers, etc. The Sound Level Meter incorporates two switched weighting networks 'A' and 'C', built-in condenser microphone, battery check facilities, 150 hour battery life and a measuring range of 40-110 dB in six steps. The weighting networks are thus: 'A' weighting incorporates a filter which simulates the response of the human ear and is useful for checking general environmental sound levels; 'C' weighting filter provides a flat response and is used for direct sound pressure measurement. The unit is available direct from B K Electronics for £33 including VAT, at 37 Whitehouse Meadows, Eastwood, Leigh-on-Sea, Essex SS9 5TY.

Changing Names

Don't get too confused — the publishers haven't done a moonlight flit — It's just that we've changed our name! We are now called ARGUS SPECIALIST PUBLICATIONS LTD so can you make any cheques for our company payable to A.S.P. Ltd, in future. The reason for the change? Well, our offices are in Soho, and our former name, 'Modmags', seemed to attract a lot of men to our office in dirty raincoats, complaining about the content of our magazines!

Watch This!

If you're sick of digital watches, how about taking a look at this watch from Casio. Its all analogue, but with a difference. It's fully electronic and has no moving parts. It uses LCD and has conventional hours, minutes and sweep seconds hands. The Model AN8GL is designed to be attractive and fashionable, face colour matches the synthetic strap. Hour positions are marked by standard Roman numerals and all the time settings and adjustments are handled by two buttons, keeping the compact gold-plated watch case simple and uncluttered. The display shows hour and minute hands, and seconds indication is by a third sweep hand or as a series of marks on the face edge to show accumulated seconds. Accuracy is to within 15 seconds a month. RRP is £27.95, but products of this type are often sold cheaper. Further information can be obtained from Casio Electronics Co Ltd, 28 Scrutton Street, London EC2A 4TY.

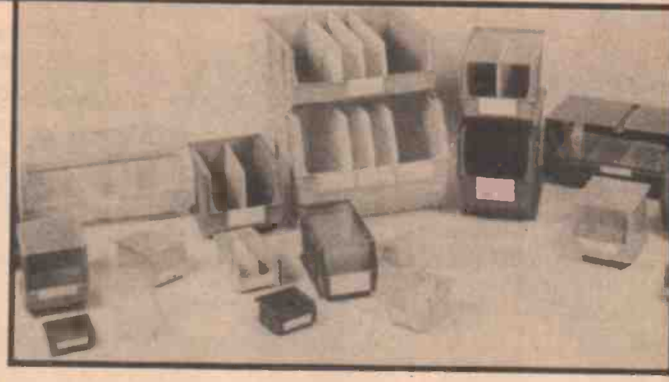
Breaker 19!

If you've got a taste for CB, then CB now has a taste for you! The world's first restaurant for Citizens' Band enthusiasts has just opened in Princes Street, London W1. The Eyeball Bistro offers a wide choice of sensibly priced meals and drinks, as well as having the unique feature of enabling CBers to listen into their favourite channels while they eat (once CB is made legal, of course!) There is a powerful receiver behind the bar and speakers at each table will allow the customers to listen while they eat. There will also be a display of the latest CB equipment for customers to test or even buy there and then. Dishes on the menu have been given names using CB slang and here are a few mouth-watering examples: a Home Office Special is a prawn cocktail, while Old Smokey (the term for the police) is slices of smoked ham served with a slice of pineapple, a Low Gain Fruit Platter is a tropical fruit salad with ice sorbet or cottage cheese topping. Drinks, both alcoholic and non-alcoholic, have names in the same style. Among them is the Good Buddy cocktail — Southern Comfort, pineapple juice and lime; or the Eyeball Special, a blend of advocaat, white rum, cherry brandy and pineapple juice. The aim of the bistro is to enable CBers to meet each other in person after having chatted over the airwaves. So if you want to pop along for an 'eyeball', make sure you get a 'good copy' on the address: The Eyeball Bistro Club, 2 Princes Street, London W1, phone 01-629 8516.

Components

Illuminations

Perdix Components Ltd announce a new range of illuminated push-button switches which offer a very low profile (29 mm) and three tyeps of illunination — LED full face, LED spot and filament lamp styles. Actuation is either momentary or latching and the swtiches are offered with three types of contact and choice of side or double pole configurations. The contacts are designed with a precision snap mechanism and have a life of around 2,000,000 operations. For ease of mounting a range of mounting barriers are also available. For further details contact: Perdix Components Ltd, 98 Crofton Park Road, London SE4.



Self-contained

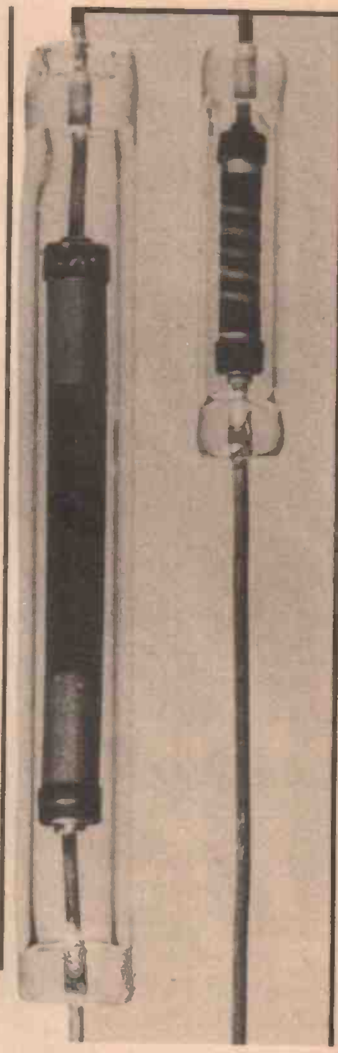
Linvar Ltd are announcing their range of 'Linbin' containers, suitable for small parts storage, materials handling, display equipment and work centres. Linvar manufacture 20 types of container, all of which fit into the Linvar louvred panel. They are all manufactured from a high density anti-static polypropylene and are available in eight colours. They have identification cards, can be sub-divided and have lids attached, resulting in their selection by the Design Council. Further details can be obtained from: Linvar Ltd, Barkby Road, Leicester, LE4 7LL.

A Case In Point

Hot off the press and available for immediate delivery is the new comprehensive spring catalogue from West Hyde Developments. in this catalogue you will find many new products which have been added to their current range. These include a complete series of optoelectronics components from Mentor, together with a selection of high quality computer terminal enclosures from Bopla. The catalogue is also presented in a new easy to read, three-column format. For further information contact West Hyde Developments Ltd, Unit 9, Park Street Industrial Estate, Aylesbury, Bucks, HP20 1ET.

Solder Power

Multicore Solders of Hemel Hempstead have just introduced Xersin IPC30, a multipurpose compound containing solder powder for making a printed circuit and soldering it with just one material. This process, using screen printing or stencilling methods, provides a protective coating of copper laminate, thus ensuring good solderability. Xersin IPC30 acts as an etch-resist, surface preservative, flux and solder, and enables a seven-stage process to be reduced to just two stages. It eliminates the need for separate applications of etch-resist remover, surface preservative, flux and solder, and the subsequent cleaning of single-sided PCBs. Multicore developed Xersin using pure chemicals instead of natural rosin as the basis for a flux, these being environmentally safer and not needing removal after soldering. This makes Xersin particularly suitable for short production runs or prototypes. Further information can be obtained from Multicore Solders Ltd, Maylands Avenue, Hemel Hempstead, Herts HP2 7EP.



Resist Them!

A series of high resistance, high voltage resistors, encased in a hermetically sealed glass envelope and believed to be the smallest of their type currently available, comes from Rhopoint Ltd. They are designed to meet the requirements of professional and laboratory applications and provide rugged stable high resistance elements unaffected by the environment. The ultra stable 'High Megohm' HR series from Component General Inc has a resistance range from 10^6 ohms to 10^{14} ohms. Operating voltages of up to 5 kV can be handled and in the event of a voltage overload, its non-spiral construction merely results in arcing across the terminals, leaving the element undamaged and immediately re-usable. The HR series includes the HR600 resistors with body dimensions of 0.562 x 0.110", maximum voltage of 1000 V and a power rating of ⅛ W and the HR1250 with body dimensions of 1.25 x 0.156" and a 5 kV voltage handling and ¼ W rating. Each resistor is processed for high reliability and performance. The resistance element is an inorganic film deposited on a ceramic rod and the element is hermetically sealed in a glass envelope with all exposed areas fire-polished and annealed. Protection of the element is ensured by filling the envelope with dry gas and coating the resistor with silicone to reduce surface leakage due to water absorption. For further information on all Rhopoint resistors contact them at Delta House, 118 Station Road East, Oxted, Surrey RH8 0AY.

Defence Digest

This new regular feature is devoted to defence electronics, its equipment techniques and application. Defence remains one of the largest growth areas in UK industry, with much of the real innovation and investment taking place there.

Defence Digest will thus act as a news (and views) section, containing up-to-date information and explanation of some of the happenings in the different sectors of the defence industry.

Companies with information and articles for these columns are invited to submit them direct to Defence Digest at our editorial address. Indeed, anyone with anything to say on the subject, be it information or opinion, is a potential contributor and should not refrain from putting pen to paper.

Rocket Missile

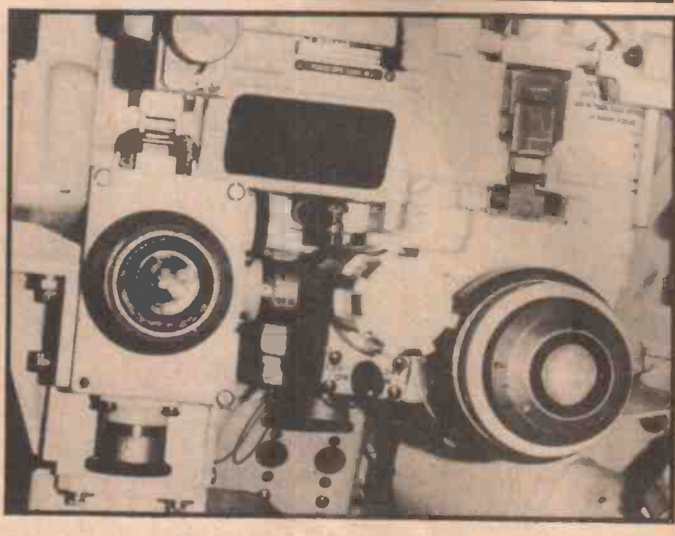
The AGM-65 Maverick is the US Air Force's versatile rocket-propelled air-to-surface missile designed for launching from tactical aircraft against hardpoint targets such as field fortifications, bunkers, tanks, armoured personnel carriers, parked aircraft and radar or missile sites. New versions will expand the use of Maverick to the US Marine Corps and the Navy. Mavericks currently operational are the television-guided AGM-65A and the longer range TV-guided AGM-65B. They carry an electro-optical seeker in the nose which produces a TV image on cockpit display. Two other guidance systems currently in development to give the missile day-or-night capability are an imaging infra-red seeker, and a laser-seeking system. The Maverick delivers a warhead with a forward-firing conical shaped charge designed for high penetration, and can be launched at various ranges and speeds. The picture shows the new AGM-65E laser guided version of the missile as it neared the side of the target ship Ozark and then penetrated its hull before detonating. Launched from a US Air Force F-4 the mission was intended as a test of the missile's new 300-pound class penetrator/blast warhead's effectiveness against naval targets. The missile guided itself to a laser spot illuminated by a laser designator. The missile then penetrated through the hull of the former US Navy minesweeper, causing it to sink.

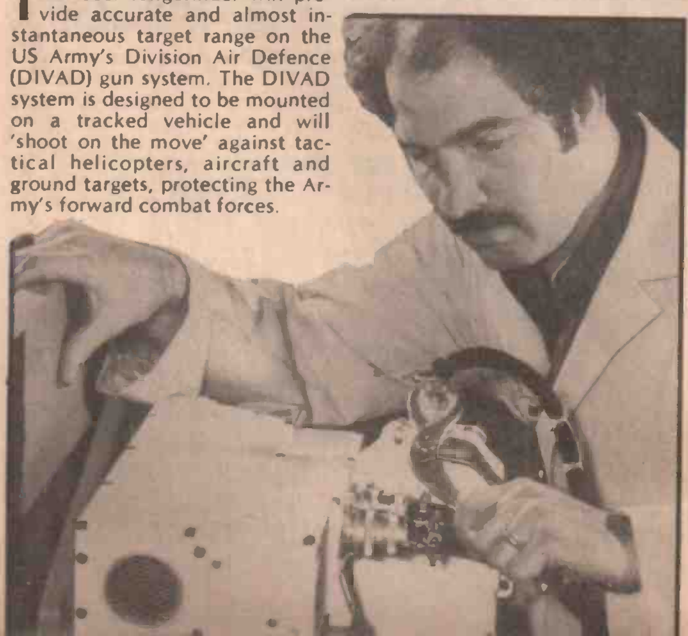
Minehunting

A labelled plan display and associated FM1600B computer suite which forms part of the Ferranti Mine Counter Measures Control System is shown here undergoing final test and inspection in a special commissioning area at Cairo Mill in Lancashire. The first two of these systems has already been accepted by the Royal Navy and are at sea in the 'Hunt' class minehunters HMS Brecon and HMS Ledbury. (They feature wholly Glass Reinforced Plastic (GRP) hulls). The Control System pictured and another from the same order are destined for installation on board minehunters HMS Cottismore and HMS Chattistock, at present being built.

Rangefinder

This laser rangefinder will provide accurate and almost instantaneous target range on the US Army's Division Air Defence (DIVAD) gun system. The DIVAD system is designed to be mounted on a tracked vehicle and will 'shoot on the move' against tactical helicopters, aircraft and ground targets, protecting the Army's forward combat forces.





Tank Telescope

The Ferranti Type 521 laser body assembly has been designed by the Company's Electro-optics Department to replace directly the existing Day Body Assembly in the M32 Gunner's Periscope, usually installed in M48 and M60 main battle tanks. The system gives a 'times 8' sighting telescope and laser ranging with a readout of target range in the eyepiece. The type 521 can be interfaced directly with a fire control computer, by displaying an offset aiming mark in the eyepiece. This is all achieved without internal modification to the M32 Head Assembly which need not even be removed during the replacement of the existing day assembly. The picture shows it installed in a Type M48A5 tank during field trials. The heart of the 521 is the Ferranti Type 520 laser range-finder, and advanced third generation NdYAG laser. The aim of achieving a single correct range to the target is met by first having a very narrow emitted beam divergence (typically 0.4 milliradians), and second, providing flexible receiver electronics that can be optimised to particular climatic and tactical situations. The Type 520 is packaged in a pre-aligned, plug-in module for ease of maintenance.

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Pak No.	Qty	Description	Price
SX10	400	Mixed "All Type" Resistors	£1
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SX19	100	Mixed Ceramics 470pf-.047uf	£1
SX20	100	Assorted Polyester/Polystyrene Capacitors	£1
SX21	60	Mixed C280 type capacitors metal foil	£1
SX22	100	Electrolytics, all sorts	£1
SX23	50	Quality Electrolytics 50-100mfd	£1
SX24	20	Tantalum Beads, mixed	£1

Quantities approximate, count by weight.

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SX28	4 Phono plugs and 2 dual phono connectors	30p
SX29	1 x 2.5mm Plug to 3.5mm Socket adaptor	20p
SX30	1 x 3.5mm Plug to 2.5mm Socket adaptor	20p
SX31	1 x 3.5mm Plug to Phono Socket adaptor	20p

SX32	1 x Standard Jack Plug to Phono Socket adaptor	25p
SX33	1 x Toggle Switch SPST Miniature. 125v 10A	40p
SX34	1 x Toggle Switch SPDT Miniature. 125v 10A	40p
SX35	1 x Rocker Switch SPDT Miniature. 240v 5A	40p
SX36	1 x Right Angle Mono Jack Plug.	15p
SX37	20 pieces. 1, 2 & 4mm plugs and sockets (Banana). Matching colours and sizes	£1
SX50	10 Assorted Switches. Toggle. Slide. Rocker. Push button	£1

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SX44	10 5A SCR's TO64. 3 x 50v. 3 x 100v. 2 x 200v. 2 x 400v. Super value less than ½ price	£2
SX45	10 5A SCR's TO66. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a give away at	£2

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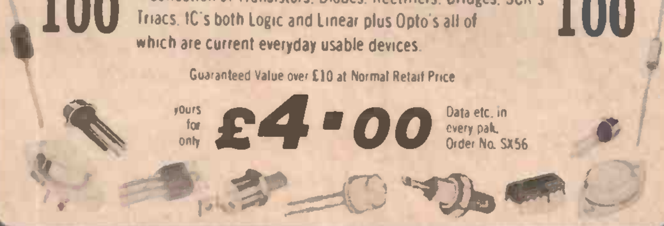

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SX47	4 Black Instrument Knobs—winged with pointer ¼" Standard screw. Fit size 29 x 20mm	50p
SX48	5 Chrome knobs, standard push fit 15mm	50p
SX49	20 Assorted Slider Knobs Black/Chrome, etc	£1

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SX51	60 metres PVC covered Hook-up wire single and stranded. Mixed colours	£1
SX58	25 Assorted TTL Gates 7400 Series 7401-7460	£1
SX59	10 Assorted flip Flops and MSI TTL	£1
SX60	20 Assorted Slider Potentiometers	£1
SX61	25 Assorted Potentiometers, Rotary, Dual, etc	£1
SX62	40 Assorted Pre-Sets Hor/Vert etc.	£1

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Plastic 40mm Travel Mono

SX63 5 x 470 ohms Lin	SX67 5 x 47k Lin
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SX65 5 x 22k Lin	SX69 5 x 100k Lin
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All at 50p per pack.

SX71	50 BC108 "Fallouts". Manufacturers out of spec on volts or gain. You test.	£1
SX72	A mixed bundle of Copper clad Board, Fibre glass and paper. Single and double sided. A fantastic bargain	£1

SX52	6 Black Heatsink will fit TO-3 and TO-220. Ready drilled. Half price value.	£1
SX53	1 Power finned Heatsink. This heatsink gives the greatest possible heat dissipation in the smallest space owing to its unique staggered fin design, pre drilled. TO-3 Size 45mm square x 20mm high	40p
SX54	TO-66 size 35mm x 30mm x 12mm	35p
SX55	1 Heat Efficiency Power Finned Heatsink 90mm x 80mm x 35mm High. Drilled to take up to 4 x TO-3 devices	£1.50 each

5 watt (RMS) Audio Amp

High Quality audio amplifier Module. Ideal for use in record players, tape recorders, stereo amps and cassette players, etc. Full data and back-up diagrams with each module.

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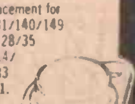

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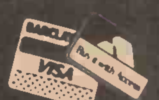

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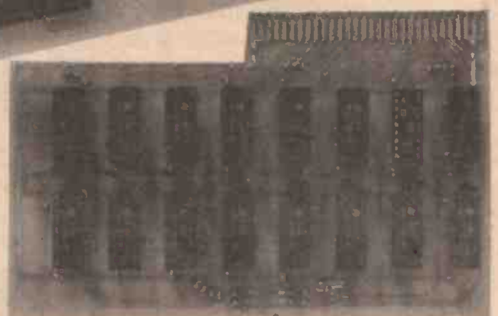


CROSSOVER NETWORKS

Crossover filters play an enormously important part in the quality of the sound you get from your loudspeaker; they must be precisely designed to suit the characteristics of the drive units, the enclosure and even the power amplifier being used. This article gives some insight into the modern approach to crossover design from the people who ought to know — KEF Electronics. It's bad news for suck-it-and-see home designers.

ALCOHOMETER

An entertaining little gadget for those readers who, like the ETI staff, have a certain fondness for the products of fermentation. This crystal-locked reaction timer will give a digital display of your steadily deteriorating reflexes as you imbibe at your local hostelry; although an accurate indication of your sobriety, or lack of it, isn't possible (despite our repeated attempts at calibration), it should prove to you that alcohol affects your co-ordination and doesn't really mix with driving. Alternatively you could play the new game we've invented in the office, where a group of people sit round a table with the tipple of their choice and an Alcohometer. The first person has a drink, tests his reaction time, places the Alcohometer back on the table and passes the bottle to his left. The winner is the last person still able to find the table. . .

COMPONENT TESTER

This handy little piece of test gear will tell you all you need to know about your semiconductors. Designed with simplicity of use in mind, it will test transistors, diodes, LEDs and standard op-amps (eight pin DIP). Any transistors, small signal or power, may be tested, and if you plug them in the wrong way round this unit lets you know; once the leads are sorted out it tells you whether the polarity is NPN or PNP. If the transistor is OK the box bleeps at you, with a frequency that depends on the gain — shorted and open-circuit devices are also indicated. Similar information is provided for diodes and LEDs; polarity, short, open-circuit or OK. Op-amps are checked for adequate gain. Build one next month and you'll wonder how you ever lived without it.

BODYWORK CHECKER

Is your body in good condition? Can you be sure it will stand up under stress, or will it collapse if you ask too much of it? Don't worry, we're not getting personal — it's your car we're concerned about. ETI fearlessly probes behind the paintwork to discover how much of your vehicle is metal and how much is plastic filler. The ETI Bodywork Checker is a small, easy-to-use unit; you simply run its sensor over the bodywork and two LEDs indicate whether it's GOOD or BAD. The prototype was tested on a fleet of lorries and quite a few of the drivers got upset at the results. An invaluable aid to the second-hand car buyer.

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

UNIVERSAL MEMORY EXPANSION

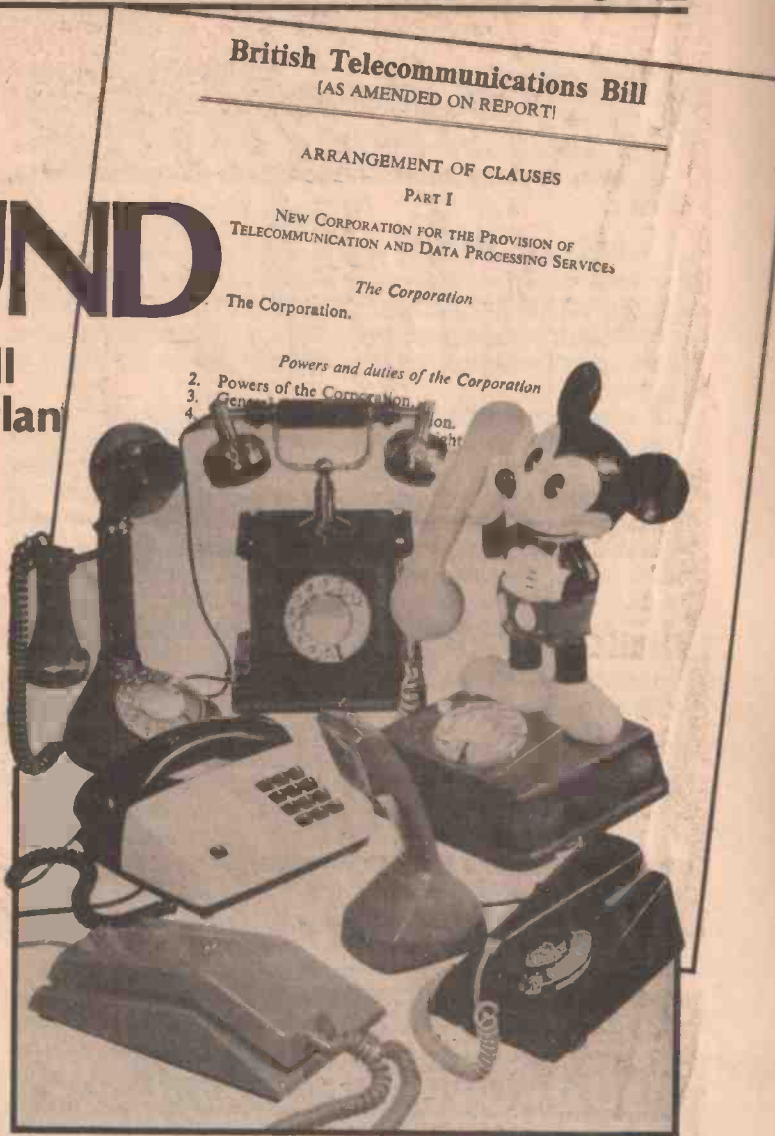
Have you got a home computer? Then the chances are it's based on the 6502, one of the most popular microprocessors in current use. Are you poor, starving, and trying to decide which piece of furniture to burn first this winter to keep warm (just like us)? Then the chances are your computer has fairly limited capabilities — 8 to 16K of memory, say, and no peripherals. Next month we can change all that with a universal expansion system at a price that won't give your bank manager apoplexy.

The system consists of a motherboard (containing the decoding circuitry) and smaller plug-in boards which you insert into multi-way sockets on the motherboard. The first article will give full constructional details of the motherboard and an 8K RAM module — in the coming months we'll present other modules, including an EPROM card, programmable sound generator, parallel I/O card and a low cost disc interface. *You* decide which modules to fit, and where; *you* customise your computer to suit your own requirements. For ease of construction and a professional finish, good quality double-sided plated-through PCBs will be available, as well as complete kits of parts. This is the age of computing — make the most of it with ETI.

LOOK OUT FOR THE DECEMBER ISSUE ON SALE NOVEMBER 6th

TELECOM TURNROUND

The British Telecommunications Bill becomes law this autumn. Tina Boylan investigates its implications for the poor Buzby-berated consumer.



The range of telephone attachments currently available from British Telecom.

The Post Office has been running Britain's telecommunications since their inception. British Telecom (BT) is the name of the subsidiary responsible for this aspect of our country's communications and has total responsibitly for approving, supplying, installing and monitoring all equipment for use in the UK. This effectively gives them a total monopoly, which infringes both UK and EEC law. This situation has brought about the necessity for new regulations governing communications in Britain.

Liberalisation

On 21st July 1980, the Secretary of State for Industry, Sir Keith Joseph, announced a proposal for relaxing the BT monopoly. Part of his statement included:

> "We are going to allow people more freedom to use British Telecommunications circuits to offer services to third parties which are not currently provided by British Telecommunications, for example in the data processing field. I expect this change to lead to a significant growth in information, data transmission, educational and entertainment services provided over telephone circuits and to the emergence of new business. I have also decided to commission an *independent economic assessment* of the implications of allowing complete liberalisation of what are commonly referred to as value added network services"

The 'independent economic assessment' referred to in the speech was started in September 1980, after the Department of Industry commissioned Professor Michael Beesley to undertake it and it is his report, completed in January 1981, which constitutes the basis of the British Telecommunications Bill which is due to become law at the end of November this year.

In order to compile the report certain terms of reference were used viz:

To examine the scope for, and means of realising, profitable leasing of the network to users who would have unrestricted use of the capacity to provide services, taking account of:

a) the need for such arrangements to operate to the benefit of the consumer;

b) the effect of such arrangements on BT's present pricing structure and profitability.

During the course of the three month study, evidence was heard from many organisations and individuals, both in the UK and abroad, where communications networks are run differently.

Findings

British Telecom put the case that there should *not* be freedom to resell, because of estimated losses in revenue from trunk calls being diverted to leased lines. They also believe that resale would deny the advantages of what they consider to be their *natural* monopoly, and that competition would ultimately increase costs.

Another of their arguments was that design standardisation and compatibility would cause problems. However, the Beesley report refutes these arguments stating that prospective losses which BT has estimated are exaggerated, particularly as they do not account for the price rises recently announced, which are effective from November 1981. The arguments over standardisation and compatibility were also considered to be easily solvable.

Although BT is constrained through Government policy on prices and investment (which is in itself economically incompatible with freer competition) it was still decided that even with these constraints maintained there would be a net profit from resale.

From the consumer's point of view, evidence was gained from European countries and the United States that liberalisation of voice services and development of highly advanced data transmission are closely connected. For example, the USA is the most liberal of all the countries surveyed and is also the farthest ahead in the non-voice data services. Its projected rate of development in the next few years is also expected to exceed that of the larger European countries.

British Telecom also felt that royalty payments would help to decrease their losses, but this suggestion was rejected by the report because of the conditions it would impose on the lessee.

Instead tariffs would be set by BT alone, which would not discriminate between customers according to whether they intend to resell circuit capacity. In any case, if allegations are made against BT of discriminatory treatment they would be referred to the Department of Industry for independent assessment.

Here On In

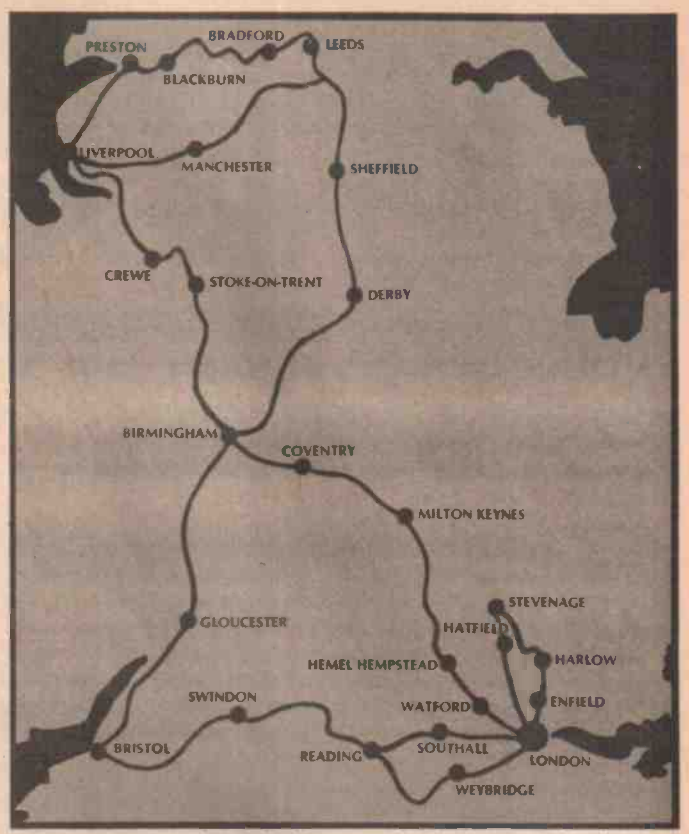
The findings of the report and the subsequent Bill seem quite straightforward, but in real terms how will they be implemented? What effect has the Bill already had on interested parties, and what is already being done behind the scenes at British Telecom?

In the area of data transmission, things are already happening fast, as various companies jostle for position in a race that they consider has been neglected by BT in the past. An example of this keen attitude is shown by a consortium formed by the companies of Cable and Wireless, British Petroleum and Barclays Merchant Bank. This triumvirate aim to establish a new service called 'Mercury', which they hope to start just as soon as the new liberalisation comes into effect

Mercury will be based on a system of fibre optic networks employing Inter-City trunk routes throughout the UK. The optical fibres will be laid alongside existing British Rail Inter-City railway tracks, using their existing ducts. The advantage of this is that no planning permission will be needed to lay the new links. The service uses bit-streams of 64 kilobits compared with 9.6 KB for conventional copper cable transmission. Each stream can be subdivided into separate voice channels, allowing nearly 1,000 phone calls to be carried down each hair-thin strand of glass. They can also be used as wideband circuits for very fast data transfer speeds.

Once the transmissions have left the railways they will be transferred by microwave (eventually satellite transmissions will be used over distances greater than 400 Km) and then (hopefully) will be interfaced to BT's PSTN (Public Switched Telephone Network) using the proposed leased private lines.

One of the new range of office telephones soon to be available from British Telecom.



A map of England showing the proposed Mercury network.

If's And But's

The consortium of the three companies hope to have their service running by mid 1983, but this timescale greatly depends on BT's willingness to implement the Bill speedily. The chances are that they will procrastinate, only partly because of difficulties in the administration needed to allow a successful and smooth transition into competition. Not surprisingly BT are aggrieved that a system like Mercury will 'cream off' the lucrative trunk network traffic, which currently subsidises the loss-making local networks. British Telecom also allege that Mercury will slow down their change to the new 'System X' exchangeds, which will take over from the present Strowgers which have been in existence since 1920.

Mercury, however, will undoubtedly supply a better service in an area where existing services *do not* reflect the latest technology; increased prices *do not* reflect improved services; very high speed data transmission is *simply not* available and new circuits or re-routes are *not available* at short notice.

The consortium must also have a licence from the Home Office to use microwaves before the end of the year so that they can begin to order apparatus and fibre. So far this licence is not forthcoming.

It would be unfair to judge BT too harshly in the light of the Mercury project without also mentioning their plans for fibre-optic links, for they too will be converting their trunk networks during this decade, though their projections are slightly less optimistic. They estimate that by 1990 over half the UK long distance network will be fibre optic. They also stress that any benefits to private operators using fibre optics are due to their own research and investment in this area.

The Mercury consortium are also testing a plan to use laser and microwave communications betwen specific buildings over short distances in the London area. Again licences are needed before these can be used, and again British Telecom are setting up plans for their own rival network on the same lines. These will effectively become secondary networks in the large cities of the UK.

Nearer Home

In our everyday contact with British Telecom changes will also occur, mostly in the supply of equipment from other companies.

The range of telephones currently on offer from BT includes models from outside manufacturers, including some foreign ones. These models are included because BT considers that they conform to their current standards and specifications. Once the Bill is made law, BT is determined that there will not be a 'free for all' in the supply of any and all types of telephone attachment. BT is, at the moment, negotiating terms and standards for the supply of telephones, as well as organising an independent body to monitor them.

It is expected that immediately after the Bill is passed at the end of November, BT itself will administer this aspect until a purpose-designed body can be initiated. It is not expected that this body, which will probably be part of the BEAB (British Electro-Technical Approval Board) or the BSI (British Standards Institution) will be in existence until early next year, when they will take over from BT.

Even with these integration plans imminent, not all the new equipment will become immediately available. The Department of Industry Consultative Committee on Telecommunications recommends the phasing in of new equipment over a period of about three years. This is in order to create an orderly transition into the competitive environment, where new suppliers as well as BT itself will have an opportunity of researching new products as well as improving the old ones over this transitional period.

The phasing is expected to follow roughly this pattern;

Phase 1, First Year
Internal wiring
Jack plugs (and hence sockets)
Telephone handsets, based on 'special range' specification, and intelligent telephones
Explosive atmosphere telephones
Telephone answering machines
Modems and, where appropriate, multiplexors
Callmakers (ie repertory diallers)
Flexibility switches and patching frames
Network management systems

Phase 2, Second Year
Lift telephones
Weather telephones
Multiterminal telephones
Trunk barring devices
Bells
Diversion switches
Flexibility, fallback devices
Teleprinters
Radiophones
Radio paging receivers
House exchange systems (Keyphones)
Key and lamp units
Call diversion equipments
Alarms using PSTN
Specialist telephones (eg for the handicapped)
Loud speaking telephones

Phase 3, During Third Year
Conference telephones
Cordless telephones
Private payphones
Private meters
Private branch exchanges (including ancillary equipment such as automatic call distributors, or other items where they arise)
Private Telex branch exchanges
Facsimile machines
Other interconnect equipment (eg control and processing equipment for radiophone services)
Error detection units
Autosender
Broadcast units

British Telecom is obviously concerned that any future standards for equipment supplied for use in conjunction with their apparatus will give the consumer the highest quality of transmission and reliability.

Stepping Up

But why is all this closely monitored standardisation necessary, you might think? Any why this 'orderly transition' business? After all, it is already quite easy to obtain telephones which are *not* BT approved in high-street shops throughout the UK, and there does not appear to be any problem getting them wired in.

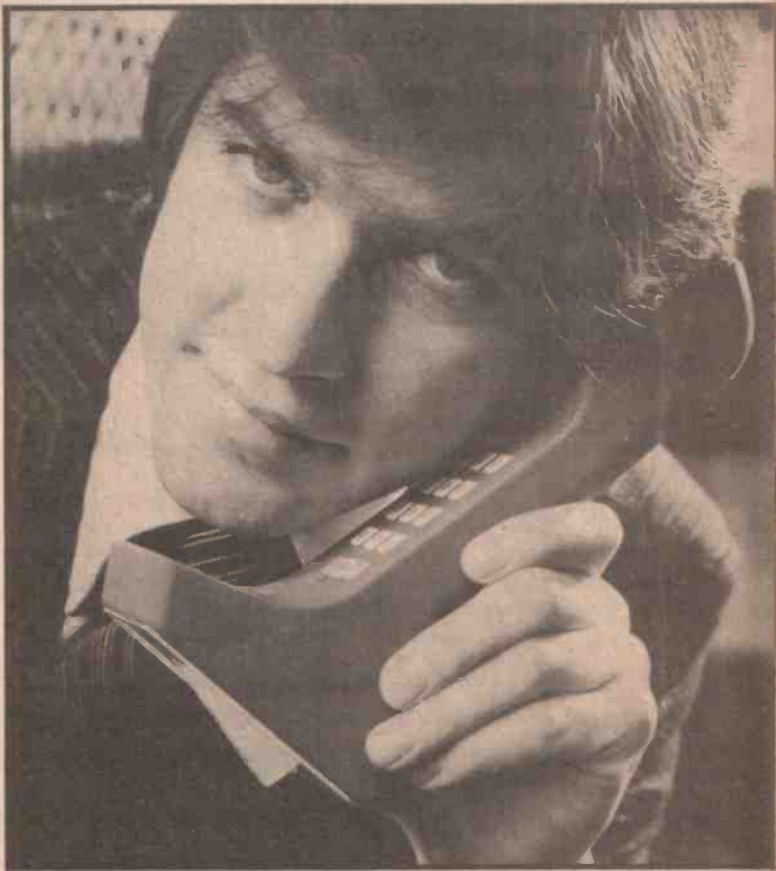
Telecom is aware of this problem, but until now has tended to turn a blind eye to it. This may be because there is no legislation which allows them to prevent this equipment being sold, their only power is to prevent you using it on their lines.

Or is it?

British Telecom, in association with the Newspaper Publishers' Association have, until now, effectively prevented any advertising of illegal equipment such as answering machines and private telephones. They have managed to do this partly because, in order to advertise it, there would have to be a warning included saying that it was not suitable for connection to the UK system. Doing this would render the advertisement invalid, so the association agreed not to accept any advertising from them.

If equipment is bought from an illegal supplier and the impression is given that it *can* be connected, then action can be taken through the Trading Standards Officers under the Trades Descriptions Act by BT, or by the purchaser himself under the Sale of Goods Act. BT's only effective power is to withdraw the telephone service after 48 hours if they find an illegal telephone in your possession and you refuse to disconnect it.

Recently BT has decided to enforce their (limited) powers strongly over these illegal phones. In a directive to their employees as well as free pamphlets for the public (you may



One of the new range of British Telecom hand-held phones.

have had one with your telephone bill) they emphasise the risks to their staff of coming into contact with wrongly connected apparatus as well as the damage it can do to the network, **even though there is no evidence to back up this assumption.** It also emphasises that once the Bill is law, customers will not be allowed to connect apparatus without their approval. They also stress the point once more of the importance of 'orderly transistion'.

Despite the fact that illegal suppliers cannot advertise their products, BT itself is investing £100,000 in advertising in the Daily and Sunday newspapers — some might describe this as saturation advertising — maybe BT is more than a little worried about what will happen once the flood gates of reform have been opened.

All Sewn Up

British Telecom is currently experiencing some very bad publicity, and the public is in uproar about what can only be considered to be inconsistencies in their policy. The first storm of protest was towards the end of August, when price increases due to start at the end of November were announced. Some of these effectively totalled 115%. Coincidentally the Bill is to be made law at exactly this time. Approximately two weeks later it was announced that BT's profits for the year totalled £180.7 million (the figure was described by the Government as lower than expected).

A BT spokesman, when asked to comment about the Bill and its effects, pointed out that it was not BT's idea, but something the Government had decided although BT had to put it into action. Perhaps with the General Election only three years away, BT are hoping to stall liberalisation plans long enough to see a Labour Government in power. They, after all are not quite so keen on free enterprise as the Conservatives. With a few delays here and there, perhaps the third stage of their integration plan will not even have started when the Election comes round, and afterwards may not need to be started at all.

It seems only time and experience will tell how smoothly and quickly we will get our improved telecommunications network, and hopefully the consumer will not be the last party considered in the legal wrangles which are bound to ensue whatever happens.


The Newspaper Publishers Association Limited.
6 BOUVERIE STREET
LONDON EC4Y 8AY
TELEPHONE: 01-583 8132
ADVERTISING DEPARTMENT

REPORT on a Meeting with Post Office Telecommunications,

Use British Telecom Certified Attachments

This pamphlet explains why apparatus attached to telephone exchange lines is certified by British Telecom and why uncertified apparatus should not be used by the public.

It also explains the way in which certification would change under the Government's current proposals and suggests remedies available to users who feel they have been misled.

Why telephone apparatus is certified by British Telecom

This ensures:

- Technical compatibility with our complex network of switching, signalling and transmission equipment.
- Minimum risk of causing injury to our staff or damage to the system.
- Other users' lines are not subjected to interference.
- Connection

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7403	14p
7404	14p
7405	18p
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7407	27p
7408	16p
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LM3302	100p	UAA170	175p
LM3900	55p	ULN2003	100p
LM3909	70p	UPC1156H	300p
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TIL209 Red	13p	TIL222 Gr	18p
TIL211 Gr	20p	TIL228 Red	22p
TIL212 Ye	25p	Rectangular LEDs (R, G, Y)	30p
TIL216 Red	18p	NSB5881	570p
		TIL311	600p
DISPLAYS		TIL312/3	110p
3015F	200p	TIL321/2	130p
DL704	140p	TIL330	140p
DL707 Red	140p	7750/60	200p
FND357	120p	**DRIVERS**	
FND500	110p	9368	250p
FND507	110p	9370	300p
MAN3640	175p	UDN6118	320p
MAN4640	200p	UDN6184	320p

TRANSISTORS									
AC126	25p	BFR40	25p	TIP30A	48p	2N3442	140p	3N141	110p
AC127/8	20p	BFR41	25p	TIP30C	60p	2N3553	240p	3N201	110p
AC176	25p	BFR79	25p	TIP31A	58p	2N3584	250p	3N204	120p
AC187/8	25p	BFR80	25p	TIP31C	62p	2N3643/4	48p	40290	250p
AF116	50p	BFR81	25p	TIP32A	68p	2N3702/3	12p	40361/2	75p
AD149	70p	BFX29	40p	TIP32C	82p	2N3704/5	12p	40408	90p
AD161/2	45p	BFX30	34p	TIP33A	90p	2N3706/7	14p	40409	100p
AU107	200p	BFX84/5	40p	TIP33C	114p	2N3708/9	12p	40410	100p
BC107/8	13p	BFX86/7	30p	TIP34A	115p	2N3773	300p	40411	300p
BC109	14p	BFX88	30p	TIP34C	160p	2N3819	25p	40594	120p
BC117	20p	BFW10	90p	TIP35A	225p	2N3820	50p	40595	120p
BC147/8	9p	BFY50	30p	TIP35C	290p	2N3823	70p	40673	75p
BC149	10p	BFY51/2	30p	TIP36A	270p	2N3866	90p	40871/2	100p
BC157/8	10p	BFY56	33p	TIP36C	340p	2N3902	700p		
BC159	11p	BFY90	90p	TIP41A	65p	2N3903/4	18p		
BC169C	12p	BRY39	45p	TIP41C	78p	2N3905/6	20p		
BC172	12p	BSX19/20	24p	TIP42A	70p	2N4037	65p		
BC177/8	17p	BU104	225p	TIP42C	82p	2N4061/2	18p		
BC179	18p	BU105	190p	TIP54	160p	2N4123/4	27p		
BC182/3	10p	BU108	250p	TIP120	120p	2N4125/6	27p		
BC184	11p	BU109	225p	TIP122	130p	2N4401/3	27p		
BC187	30p	BU126	150p	TIP142	130p	2N4427	90p		
BC212/3	11p	BU180A	120p	TIP147	130p	2N4871	60p		
BC214	12p	BU205	200p	TIP2955	78p	2N5087	27p		
BC237	15p	BU208	200p	TIP4055	70p	2N5089	27p		
BC327	16p	BU406	145p	TIS93	30p	2N5172	27p		
BC337	16p	E300	50p	ZTX108	12p	2N5191	90p		
BC338	16p	E308	50p	ZTX300	13p	2N5194	90p		
BC461	36p	E310	50p	ZTX500	15p	2N5245	40p		
BC477/8	30p	MJ2501	225p	ZTX502	18p	2N5296	55p		
BC516/7	40p	MJ2955	90p	ZTX504	30p	2N5401	50p		
BC547B	16p	MJ3001	225p	2N457A	250p	2N5457/8	40p		
BC548C	9p	MJE340	60p	2N696	35p	2N5459	40p		
BC549C	18p	MJE2955	100p	2N697	25p	2N5460	60p		
BC557B	16p	MJE3055	70p	2N698	45p	2N5485	44p		
BC559C	18p	MPF102	45p	2N706A	30p	2N5875	250p		
BCY70	18p	MPF103/4	40p	2N708	30p	2N6027	48p		
BCY71/2	22p	MPF105/6	40p	2N918	45p	2N6041	160p		
BD131/2	50p	MPS6531	50p	2N930	18p	2N6044	160p		
BD135/6	54p	MPS6534	50p	2N1131/2	36p	2N6052	300p		
BD139	56p	MPSA06	30p	2N1613	25p	2N6059	325p		
BD140	60p	MPSA12	50p	2N1711	25p	2N6107	65p		
BD189	60p	MPSA13	50p	2N2102	70p	2N6247	190p		
BD232	95p	MPSA20	50p	2N2160	350p	2N6254	130p		
BD233	75p	MPSA42	50p	2N2219A	30p	2N6290	65p		
BD235	85p	MPSA43	50p	2N2222A	30p	2N6292	65p		
BD241	70p	MPSA56	32p	2N2369A	25p	2SC1172	150p		
BD242	70p	MPSA70	50p	2N2484	30p	2SC1306	150p		
BDY56	200p	MPSU06	63p	2N2646	45p	2SC1307	250p		
BF200	32p	MPSU07	60p	2N2904/5	30p	2SC1957	90p		
BF244B	35p	MPSU45	90p	2N2906A	30p	2SC1969	200p		
BF256B	70p	MPSU65	78p	2N2907A	30p	2SC2028	120p		
BF257/8	32p	OC28	130p	2N2926	9p	2SC2029	250p		
BF259	36p	OC35	130p	2N3053	30p	2SC2078	200p		
BFR39	25p	TIP29A	40p	2N3054	65p	3N128	120p		
		TIP29C	55p	2N3055	54p	3N140	120p		

6A 50V	80p
6A 100V	100p
6A 400V	120p
10A 400V	200p
25A 400V	400p

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

DIODES	
BY127	12p
BYX36-300	20p
DA47	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

HEATSINKS
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

TRIACS PLASTIC	
3A 400V	60p
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	70p
1A 400V	90p
3A 400V	100p
8A 600V	140p
12A 400V	160p
16A 100V	160p
16A 400V	180p
BT106	110p
C106D	40p
MCR101	36p
TIC44	27p
2N3525	130p
2N4444	140p
2N5060	34p
2N5064	40p

LOUD-SPEAKERS		
Size		
2½	64R	80p
2½	8R	80p
2	8R	90p
1½	8R	100p

MODULATORS	
6MHz UHF	375p
8MHz UHF	450p

MEMORIES			
2101-4L	400p	TMS9918	POA
2102-2L	120p	Z80P10	400p
2107B	500p	Z80AP10	450p
2111-4	300p	Z80CTC	400p
2112-4	300p	Z80ACTC	500p
2114L	130p	Z80ADART	£8
2114-2L	160p	Z80ADMA	£12
4027-3	300p	Z80S10-1	£20
4044	700p	**UART**	
4116	200p	AY-3-1015P	300p
4118	500p	AY-5-1013P	350p
5101	300p	IM6402	450p
6116 (150ns)	£9	**CHARACTER GENERATORS**	
6514-45	£4	RO-3-2513 U.C.	750p
6810	200p	RO-3-2513 L.C	700p
ROM/PROMs		SN74S262AN	£10
71301	700p	**KEYBOARD ENCODER**	
74S188	225p	AY-5-2376	700p
74S287	350p	74C922	500p
74S471	650p	**CRYSTALS**	
74S571	650p	32.768KHz	250p
CPUs		100KHz	300p
1802CE	750p	200KHz	370p
2650A	£16	1.0MHz	320p
6502	450p	1.008MHz	350p
6800	370p	1.8432MHz	250p
6802	500p	2.00MHz	250p
6809	1260p	2.45760MHz	250p
8080A	450p	3.276MHz	250p
8085A	550p	3.5795MHz	175p
1NS8060	1000p	4.00MHz	250p
TM59980A	£20	4.194MHz	250p
Z80	370p	4.43MHz	125p
Z80A	500p	5.0MHz	250p
EPROMs		6.0MHz	250p
1702A	500p	6.144MHz	250p
2708	300p	7.0MHz	250p
2716 (+5V)	400p	7.168MHz	250p
2532	600p	8.00MHz	250p
2732	600p	8.867MHz	250p
SUPPORT DEVICES		10.00MHz	250p
3242	800p	10.7MHz	250p
3245	450p	1p.0MHz	350p
6522	500p	16.00MHz	250p
6532	775p	18.00MHz	250p
6824	160p	18.432	250p
6845	£10	19.968MHz	390p
6850	180p	26.690MHz	300p
6852	250p	27.145MHz	250p
6875	600p	38.6667MHz	350p
8154	950p	48.0MHz	300p
8155	800p	55.5MHz	400p
8205	320p	116MHz	350p
8212	180p		
8216	180p		
8224	250p		
8226	250p		
8228	250p		
8251	400p		
8253	800p		
8255	400p		
8257	800p		
8259	800p		
8279	950p		

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WIRE WRAP SOCKETS BY TEXAS					
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16 pin	40p	22 pin	65p	40 pin	100p

HEADER PLUGS	
14 pin	40p
16 pin	50p
24 pin	90p
40 pin	250p

COUNTERS		TTL & ECL		DISC IC	
74C925	550p	MC4024	325p	FD1771	£20
74C928	600p	MC4044	325p	FD1791	£30
MK50398	£8	10116	70p	WD1691	£15
ZN1040E	£7	10231	350p	WD2143	550p

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	1-24	25-99	100
2114L (450ns)	1.00	0.95	0.90
2716 (+5V)	2.50	2.25	2.10
4116 (200ns)	0.80	0.70	0.65

ACORN ATOM. Supplied with full size QWERTY Keyboard, 8K ROM, 2K RAM and can be expanded to 12K ROM, 12K RAM. Included are UHF Modulator for connection to domestic TV and Free manual on Programming in BASIC or Machine Code.
Kit £129. Built £150. P&P £2.50.

UK 101/OHIO II TWO BOARD HARDWARE INTERFACE

DECODING BOARD plugs into UK 101/OHIO II socket to provide 16 bit user port plus a wide variety of decoded lines for interfaces (inc. full decoding for AY3-8910/12 PSG) and a 40-pin socket for further expansion. Kit £27.50.
Analogue Board plugs into decoding board to provide D/A converter, 8-channel multiplexed A/D converter, AY3-8910 PSG plus 6522 timer IC allowing complex timing and counting functions, plus 16-bit port. Kit £39.95.
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(as described in "P.C.W." Oct. '81)

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This disco project automatically fades the music down when the DJ talks into his microphone, then gently restores the music level when the chatting is finished. Design by Ray Marston. Development by Steve Ramsahadeo.

VOICE-OVER UNIT

A minor hassle facing the disco DJ is that whenever he needs to make a mid-music announcement, he has to go through a fiddly procedure of first turning down the music level and raising the microphone level at the start of the announcement, and subsequently reducing the microphone level and restoring the music signal when the announcement is complete. ETI's new Voice-over Unit is designed to overcome this trifling little problem.

Our stereo voice-over or ducking unit is an inexpensive mains-power project that is meant to be fitted ahead of the main power amplifier system. The unit has a pair of music input and output terminals, plus a microphone input socket, and its action is such that the microphone signal passes directly through the unit but the amplitude of the music signal is controlled by the amplitude of the microphone signal. When the microphone signal is below a preset threshold value, the music signal passes directly through the unit but when the microphone signal exceeds the threshold value the music signal amplitude is automatically reduced or ducked to a preset level, so that the DJ's voice signal automatically overrides the music.

The switching action of our unit is such that the music signal is faded down smoothly but rapidly as soon as an adequate microphone signal is applied, but returns to its original level relatively slowly (over a period of a few seconds) once the microphone input is removed, thereby giving a smooth fade-over action. The unit is provided with only two front-panel controls, these being the microphone sensitivity pot, which controls the unit's switching level, and a ducking level pot, which enables the music attenuation level to be preset to any desired value.

The music input levels to the unit should have nominal peak-to-peak values of about 1 V maximum. The microphone input signal also needs a peak-to-peak value of about 1 V nominal, so the microphone signal to the unit will probably have to be taken from a simple preamplifier circuit or be tapped off from an existing preamplifier.

Construction

Before starting the actual construction, check that the PCB slides comfortably into the locating slots that are moulded inside the specified case and, when all is well, proceed with the assembly of the electronic components on the PCB, noting the use of Veropins to facilitate the off-board interwiring.

Next, drill the front panel to accept control pots RV1 and RV2 and LED1 and the set of four input/output (music) sockets, then fit these components into place and wire them to the PCB.

At this stage, temporarily connect mains transformer T1 to the PCB and give the complete unit a functional test, noting that all inputs need nominal amplitudes of 1 V peak-to-peak. Check that the microphone signal effectively passes directly through the system: check that the music signals pass directly through the system when no microphone signal is present, but duck down to a preset level (adjustable by RV2) when a strong microphone signal is applied. When correct functioning is confirmed, complete the construction as follows.

First, drill a hole in the side of the case to accept the microphone input socket, taking care to allow clearance for the PCB, then wire the socket to RV1. Next, test-bolt transformer T1 into the rear of the case, taking care to scrape the black anodising away from the case below the transformer fixing lugs (to allow a good ground connection). Now complete the transformer connections to the PCB, connect a mains lead to the transformer (taking care to ensure that adequate insulation is provided) and bolt the transformer firmly into place. Finally, drill a hole in the rear panel to allow passage of the mains lead, then screw the front and rear panels into place. The construction is then complete and the unit is ready for use at your next disco session.

BUYLINES

The NE570 can be obtained from Watford Electronics. The case used in the prototype is a Sink Box, available from West Hyde Developments Ltd, Unit 9, Park Street Industrial Estate, Aylesbury, Bucks (order as Sink Box 150K). See our PCB Service advert on page 76 if you don't want to etch the board yourself.

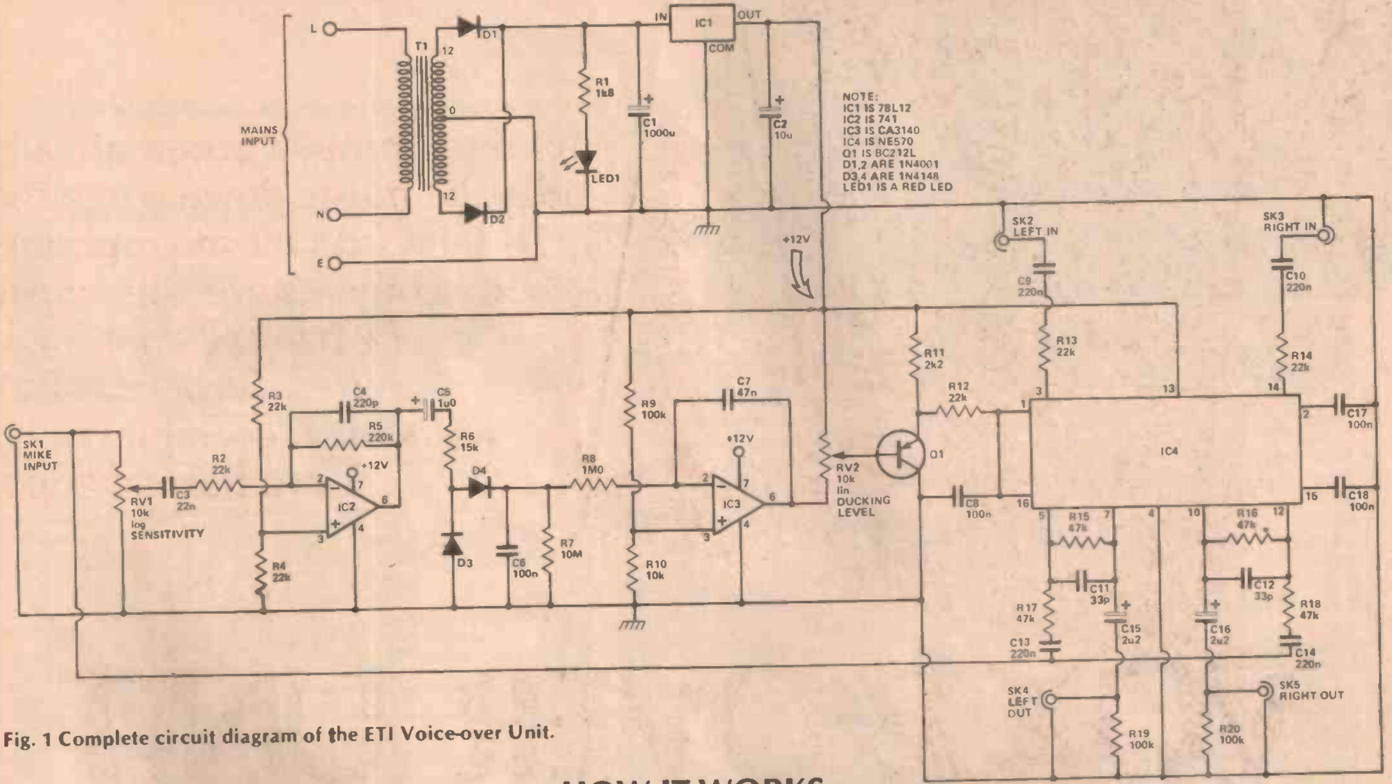


Fig. 1 Complete circuit diagram of the ETI Voice-over Unit.

HOW IT WORKS

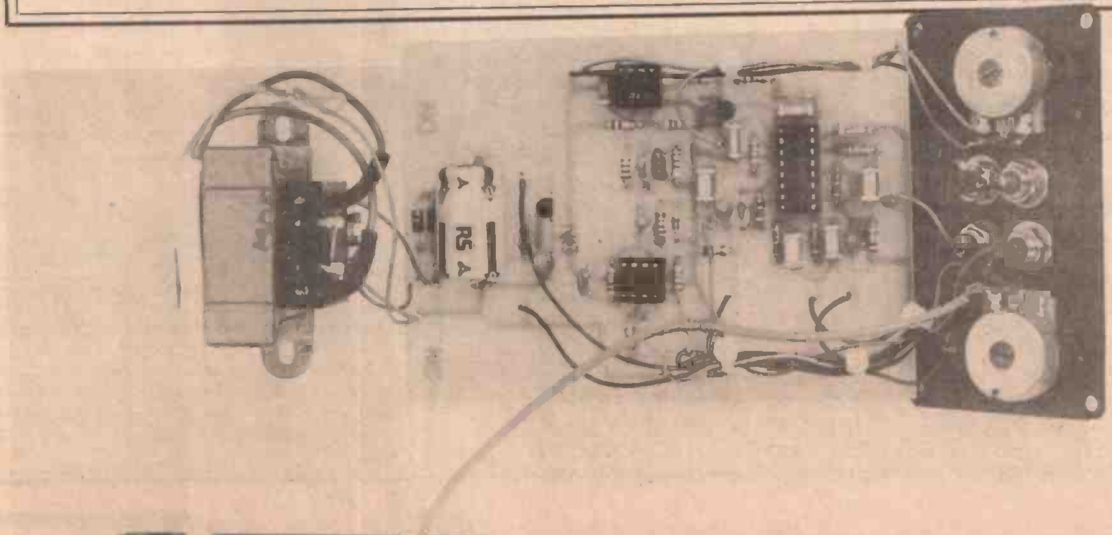
The heart of this unit is IC4 (NE570), which can be regarded as a dual voltage-controlled amplifier. Basically, each half of this chip contains a voltage-controlled variable-gain cell with its output fed to the outside world via a built-in inverting op-amp stage. The gain-cell control voltages are connected to pins 1 (left) and 16 (right) via R12, and the AC (music) input signals are connected to pins 3 (left) and 14 (right): the gain-cell outputs are available at pins 5 (left) and 12 (right) and the op-amp inputs and outputs are available at pins 5 and 7 (left) and 12 and 10 (right) respectively. In our application, the built-in op-amps are each used as two-channel audio mixers, which use the gain-cell outputs as one input and the microphone signal as the other input, and the gains of the gain-cells are controlled from the microphone input signals via the IC2-IC3-Q1 network.

The overall basic circuit action is such that, when no microphone input signal is present, Q1 is cut off and almost the full supply-rail voltage is applied to R12, so the gain-cells each give an overall gain of a few dB to the music signals, which appear at full volume at the two output terminals of IC4. When a high and continuous microphone signal is present, however, Q1 is driven to saturation and its emitter is pulled down to near-zero volts: under this condition the music signal is reduced to −80 dB but the microphone signal is unattenuated, so only the microphone signal appears at the output. In practice, the actual ducking or music-attenuation level can be fully varied by RV2, so the music and microphone signals can be mixed if required, and the microphone-derived gain-control voltage is arranged to give a fade-over, rather than a switching action, with a simple integrating network, as follows.

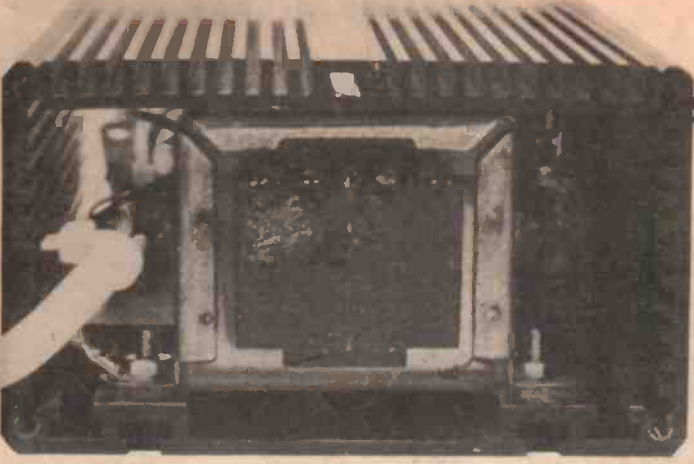
The microphone signal is fed to sensitivity control RV1 and is then passed on to speech-bandwidth (350 Hz to 3.5 kHz) amplifier IC2, which has a mid-band gain of 20 dB and is DC-biased for single-supply operation by R3-R4. The AC output signal of IC2 is then effectively peak-detected by the R6-D3-D4-C6-R7 dual-time-constant (quick charge, slow discharge) network and the resulting DC signal is applied to one input of IC3 via R8. IC3 is wired as a voltage comparator, with a fixed reference of 1V1 applied to its non-inverting terminal and with the DC input signal applied to its inverting terminal via the R8-C7 integration network. This causes the op-amp output to swing linearly (rather than switch abruptly) from one state to the other during the transition period. The output of IC3 is fed to ducking level control RV2 and a proportion of the resulting DC voltage is tapped off from the slider, buffered by emitter follower Q1, and used to provide the DC control voltage to IC4.

The net action of the IC2-IC3-Q1 network is such that the output of IC3 is driven high in the absence of a microphone signal, or low in the presence of a strong microphone signal. When a strong microphone signal first becomes available, the peak detection circuitry rapidly activates IC3, and the IC3 output swings smoothly from the high to the low level, with a time constant of roughly 100 ms (due to R8-C7). When the microphone signal is subsequently removed the output of IC3 swings back to the high level with a time constant of a few seconds (controlled by R7-R8-C7), thus giving a slow fade-back of the music signal.

The entire stereo voice-over circuit is powered from a single-ended 12 V supply derived from the mains by T1-D1-D2-C1 and voltage regulator IC1.



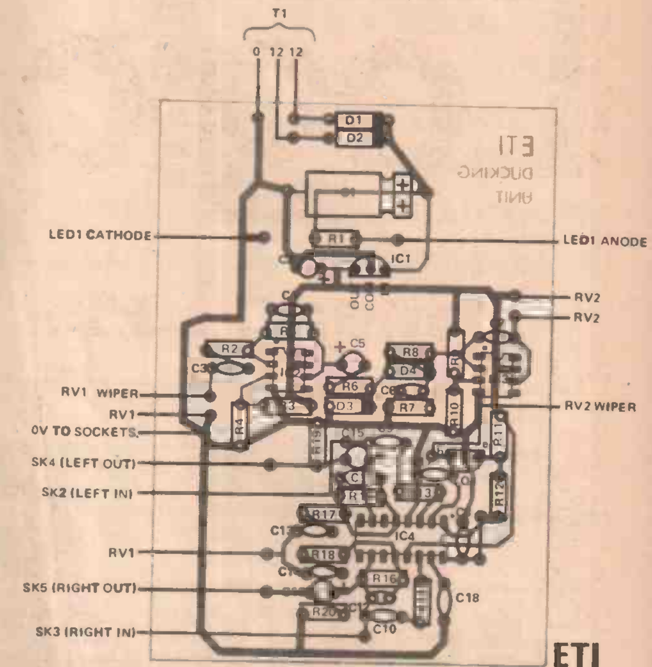
We've pulled everything out of the Sink Box for this photograph, which shows how the interwiring is made.



PROJECT : Voice-over Unit

(Left) The transformer is bolted into the case just inside the rear panel.

Fig. 2 Component overlay for the unit.



ETI

PARTS LIST

Resistors (all ¼ W, 5%)	
R1	1k8
R2,3,4, 12,13,14	22k
R5	220k
R6	15k
R7	10M
R8	1M0
R9,19,20	100k
R10	10k
R11	2k2
R15,16,17,18	47k
Potentiometers	
RV1	10k logarithmic
RV2	10k linear
Capacitors	
C1	1000u 25 V axial electrolytic
C2	10u 35 V tantalum
C3	22n polycarbonate
C4	220p ceramic
C5	1u0 16 V tantalum
C6	100n ceramic
C7	47n polycarbonate
C8,17,18	100n polycarbonate
C9,10,13,14	220n polycarbonate
C11,12	33p ceramic
C15,16	2u2 16 V tantalum
Semiconductors	
IC1	78L12
IC2	741
IC3	CA3140
IC4	NE570
Q1	BC212L
D1,2	1N4001
D3,4	1N4148
LED1	0.125" red LED
Miscellaneous	
T1	12-0-12 6VA
SK1	¼" jack socket
SK2-5	phono sockets
Case (see Buylines);	
PCB (see Buylines).	

The Logic Probes

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The LP-1 has a minimum detachable pulse width of 50 nanoseconds and maximum input frequency of 10MHz. This 100 K ohm probe is an inexpensive workhorse for any shop, lab or field service tool kit. It detects high-speed pulse trains or one-shot events and stores pulse or level transistions, replacing separate level detectors, pulse detectors, pulse stretchers and pulse memory devices.
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Model LP 3 illustrated

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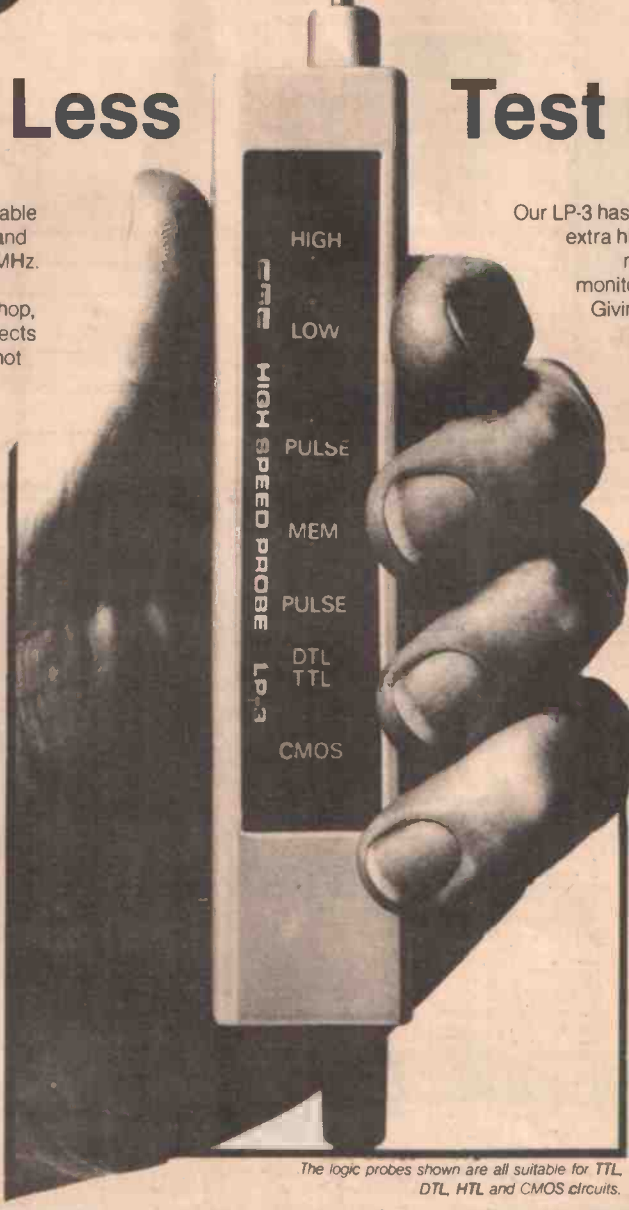
Model LP-3 illustrated

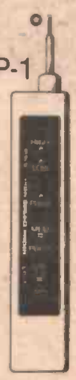


LP-2 Logic Probe

The LP-2 performs the same basic functions as the LP-1, but, for slower-speed circuits and without pulse memory capability. Handling a minimum pulse width of 300 nanoseconds, this 300 K ohm probe is the economical way to test circuits up to 1.5 MHz. It detects pulse trains or single-shot events in TTL, DTL, HTL and CMOS circuits, replacing separate pulse detectors, pulse stretchers and mode state analysers.
(Available in kit form LPK-1 £11-92)

£18.00*

Model LP 3 illustrated



The New Pulser DP-1

The Digital Pulser: another new idea from G.S.C. The DP-1 registers the polarity of any pin, pad or component and then, when you touch the 'PULSE' button, delivers a single no-bounce pulse to swing the logic state the other way. Or if you hold the button down for more than a second, the DP-1 shoots out pulse after pulse at 1000 Hz. The single LED blinks for each single pulse, or glows during a pulse train. If your circuit is a very fast one, you can open the clock line and take it through its function step by step, at single pulse rate or at 100 per second. Clever! And at a very reasonable price.

£51.00*

Model LP-3 illustrated

*price excluding P.&P. and 15% VAT.

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MODEL NO.	MODULE	DESCRIPTION/FACILITIES	CURRENT REQUIRED	PRICE	VAT
HY6	MONO PRE AMP	Mic/Mag. Cartridge/Tuner/Tape/ Aux + Volume/Bass/Treble	10mA	£6.44	£0.97
HY7	MONO MIXER	To mix eight signals into one	10mA	£5.15	£0.77
HY8	STEREO MIXER	Two channels, each mixing five signals into one	10mA	£6.25	£0.94
HY9	STEREO PRE AMP	Two channels mag. Cartridge/ Mic + Volume	10mA	£6.70	£1.01
HY11	MONO MIXER	To mix five signals into one + Bass/Treble controls	10mA	£7.05	£1.06
HY12	MONO PRE AMP	To mix four signals into one + Bass/Mid-range/Treble	10mA	£6.70	£1.01
HY13	MONO VU METER	Programmable gain/LED overload driver	10mA	£5.95	£0.89
HY66	STEREO PRE AMP	Mic/Mag. Cartridge/Tape/Tuner/Aux + Volume/Bass/Treble/Balance	20mA	£12.19	£1.83
HY67	STEREO HEADPHONE	Will drive headphones in the range of 4Ω – 2KΩ	80mA	£12.35	£1.85
HY68	STEREO MIXER	Two channels, each mixing ten signals into one	20mA	£7.95	£1.19
HY69	MONO PRE AMP	Two input channels of mag. Cartridge/ Mic + Mixing/Volume/Treble/Bass	20mA	£10.45	£1.57
HY71	DUAL STEREO PRE AMP	Four channels of mag. Cartridge/Mic + Volume	20mA	£10.75	£1.61
HY72	VOICE OPERATED STEREO FADER	Depth/Delay	20mA	£13.10	£1.97
HY73	GUITAR PRE AMP	Two Guitar (Bass/Lead) and Mic + separate Volume/Bass/Treble + Mix	20mA	£12.25	£1.84
†HY74	STEREO MIXER	Two channels, each mixing five signals into one + Treble/Bass	20mA	£11.45	£1.72
†HY75	STEREO PRE AMP	Two channels, each mixing four signals into one + Bass/Mid-range/Treble	20mA	£10.75	£1.61
†HY76	STEREO SWITCH MATRIX	Two channels, each switching one of four signals into one	20mA	*To be announced*	
†HY77	STEREO VU METER DRIVER	Programmable gain/LED overload driver	20mA	£9.25	£1.39

†Ready September — may be ordered now

All the above modules operate from +15V minimum to +30V maximum — higher voltages being accommodated by use of dropper resistors. HY67 can only be used with the PSU 30 power supply unit

The modules are encapsulated and include latest design high quality clip-on edge connectors.

For easy mounting we recommend
B6 Mounting board for modules HY6 – HY13
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All I.L.P. modules include full connection data.

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FASTER-THAN-LIGHT TRAVEL

Captain Kirk used it, the Nostromo needed it, and the Empire couldn't exist without it. But A.S. Lipson, light-sabre in one hand and phaser in the other, lays waste to the plots of countless space operas.

One of the most popular themes chosen by science fiction writers is that of the Galactic Empire. The scene is thus; centuries in the future, man has spread out through the galaxy, colonising planets in other star systems, and has built up an empire, simultaneously solving the problem of overpopulation on Earth. But the stars are all an awfully long way away — even the relatively close ones. If a light year is the distance light travels in a year (and light travels at about 299,793,000 metres per second, or, if you prefer, 186,000 miles per second — fast enough to circle the equator seven and a half times in one second!), so even the nearest star is nearly four and a half light years away. The distances from us of the 10 nearest stars are given in Table 1.

TABLE 1

Star	Distance In Light Years
Proxima Centauri	4.3
Alpha Centauri (A and B)	4.4
Barnard's star	5.9
Wolf 359	7.6
HD 95735	8.1
Sirius (A and B)	8.6
UV Ceti (A and B)	8.9
Ross 154	9.5
Ross 248	10.3
Epsilon Eridani	10.8

As you can see, the stars seem uncomfortably far away. If we start to consider stars at the far side of the galaxy, we find that we are talking about distances of the order of 80,000 light years! The problem with such unimaginably great distances, of course, is that travelling them takes rather a long time. If we are to colonise the stars, then either we need to develop some means of travelling faster than light, or our astronauts are going to get either very bored or very dead on the way to wherever they're going.

Conversation Stopper

Even supposing that we could overcome the problem of boredom, there would still be a communication problem. Supposing you wish to talk to old Aunt Ethel at Alpha Centauri (say); once you've said 'hello' over the radio, it's another 4.4 years before Aunt Ethel will hear you, because radio signals travel at the same speed as light, and Alpha Centauri is 4.4 light years away. It takes the same time for the reply to get back. All in all, it takes nearly nine years to get a reply, even from the nearest star systems! This is clearly no way to run a conversation. The same problem also operates with any interstellar communication. Radio, light, or anything slower, just isn't fast enough for the sort of communication needed for our new Galactic Civilisation. Unfortunately, we don't have anything faster.

So what's the big problem? We can just let the boffins get on with it, and they can invent us a faster-than-light (FTL) drive! Or can they . . . ?

Speed Limit

There is, of course, a slight snag (nothing's ever *that* easy). In 1905, a gentleman by the name of Albert Einstein published a paper laying down the foundations of what is now known as Special Relativity. Among the many interesting results of special relativity is the following — it is impossible to accelerate any body to the speed of light, let alone beyond. You can get close; in big particle accelerators, electrons have been made to move at more than 99.99% of light velocity — but never quite 100%. This obviously creates a slight problem with our ideas about interstellar travel, and unfortunately, there is now relatively (oh, dear) little doubt that Einstein's results are correct. They are among the most thoroughly tested conclusions in the history of physics, and so far no-one has been able to fault them. There have been one or two occasions when people *thought* that they'd proved Einstein wrong, but it always turned out that they had mucked up their experiments, or misinterpreted their readings. So far Einstein seems quite safe.

While destroying most of our hopes of an FTL drive, relativity also provided us with a partial solution to our problems. You remember that one of the reasons we wanted a faster-than-light drive in the first place was to reduce the length of time that our travellers would have to spend on the journey, and hence reduce not only the boredom of such voyages, but also the amount of food needed (not forgetting little things like oxygen, as well). Well, we may not need a faster-than-light drive after all! Because according to relativity theory, when you travel at high velocities, time starts to do funny things. Measured by an observer on Earth, time on a fast-travelling spaceship appears to have slowed down. (A more detailed treatment of this is really the province of another article, so we won't go into it very thoroughly.) If someone was to set off in a

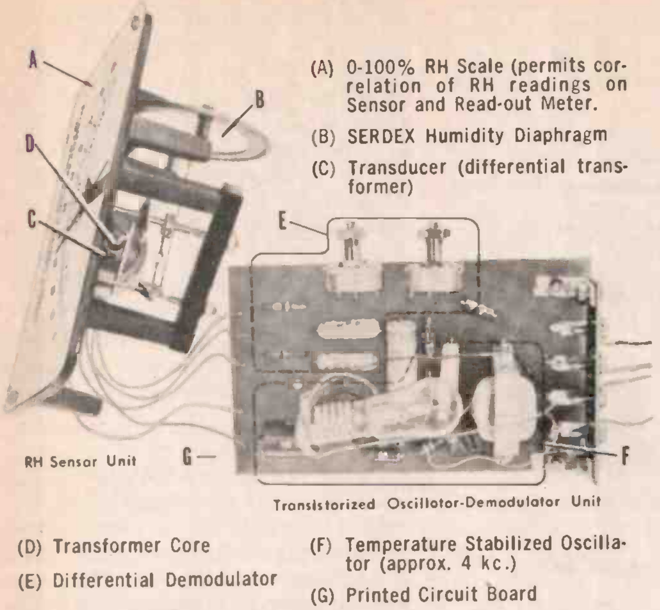

Fig. 2. Operation of this SERDEX humidity sensor is based upon a hygroscopic animal membrane forming a diaphragm.

RELATIVE HUMIDITY, RH for short – this expresses the amount of water vapour present, compared with the maximum that could be at the temperature of interest. (The quantity of water vapour present would only apply for a stated temperature). RH is expressed as a percentage. For example, a dry day in the summer could be as low as 20% whereas when it is actually raining, it rises to 100%. The need for this relative unit occurs because many processes do not depend upon the absolute water content, but on the amount that could be absorbed or liberated from the air. RH is probably the most commonly used unit outside of process control areas.

PARTS PER MILLION, PPM – this expresses the water content by virtue of the weight of water, PPM_W or its volume, PPM_V, so it is either the ratio of the partial pressure of the water vapour to the total pressure, or else the PPM_V value multiplied by the ratio of the molecular weights of water to the other gas to yield the first value. Care is needed to define which is intended, for both units are dimensionless, and appear the same unless qualified with a (by weight) or (by volume) statement.

WET BULB TEMPERATURE (no accepted abbreviation exists) – if a thermometer has its sensing area wetted with water (usually with a saturated wick) and air is passed rapidly over it, the thermometer reads a value less than that of an identical dry thermometer by an amount depending upon the relative humidity. If the air is 100% saturated, no more moisture can be taken up so the bulb is not cooled at all. (The same reason is why evaporative air coolers do not give as much cooling in humid weather). This concept is used in the wet-and-dry bulb hygrometer.

MIXING RATIO – the ratio of weight of water vapour to dry carrier gas.

POUNDS/KILOGRAMS PER HOUR – this expresses the absolute amount of water vapour supplied per hour. For example, heat treatment of metals requires knowledge of the water content in the furnace as this controls the carburizing process reaction rate.

RELATIVE EQUILIBRIUM MOISTURE (rem or em) – in the paper industry, it is the ability of the fibres to lose or absorb water (the sorption process) that decides the shrinkage, tearability, etc. Equilibrium will eventually occur between the air humidity and the paper content. To make it clear that it is the paper moisture content that is stated, em is quoted. Hence a lower em than RH means the paper takes in moisture.

LIMITATIONS OF DEW POINT MEASUREMENT

Not all moisture measurements make direct use of the dew point phenomena but it is instructive to consider the limitations of the process for the effects are present in most procedures.

THE KELVIN EFFECT – In 1870, Lord Kelvin arrived at the conclusion that the vapour pressure over a concave liquid surface is less than that over a plane surface of the same material. Water condensing on a surface forms droplets which produce a curved interface surface with the surrounding vapour. It has not been an easy matter to prove Kelvin's theory, for the effect is small, but convincing electron microscope studies of evaporating lead, carried out at Imperial College in London, have shown it to be true for lead and gold. The Cambridge Systems Company of Massaçhusetts have estimated the depression in dew point temperature due to 30 μm dropsize condensation as 0.005K. Few people would find the Kelvin effect error a problem.

THE RAOULT EFFECT – In 1887 Raoult produced a law governing the

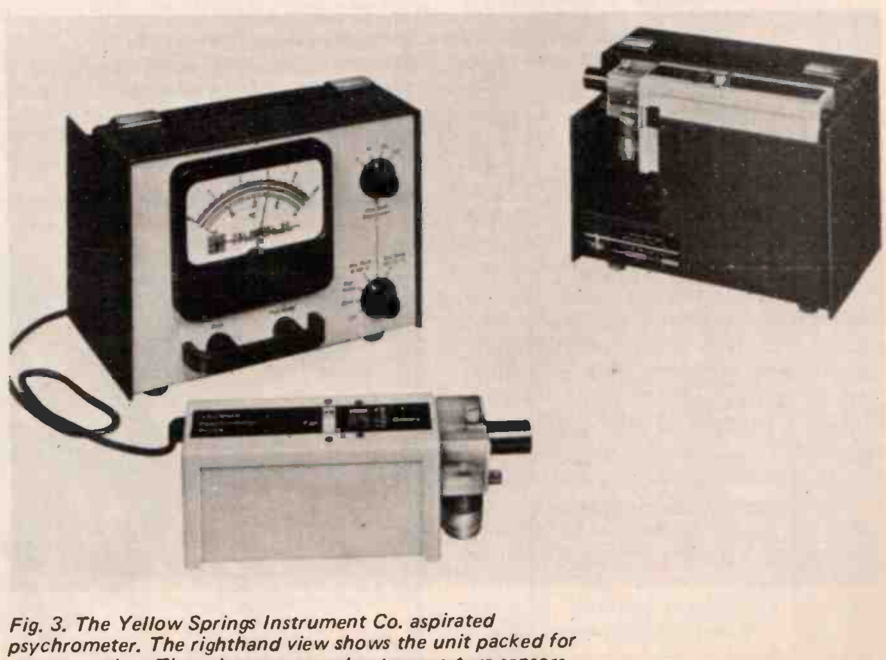

Fig. 3. The Yellow Springs Instrument Co. aspirated psychrometer. The righthand view shows the unit packed for transportation. Thermistors are used as temperature sensors.

Sinclair ZX81 Personal Comp
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80'

New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

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Mostly Motorola, RCA

Offered as an alternative to the well established International Size Computer Cards.

NEW EUROCARD Z80 COMPUTER BOARDS, CUSTOM 80 SYSTEM

The Custom 80 System has been designed as a fully expandable modular computer system. The circuits are supplied as a full kit of parts, all you need are tools and solder.

The colour VDU card gives a teletext format, 24 lines of 40 characters, upper case, lower case, pixel graphics, contiguons, non contiguons, single height, double height, memory mapped etc. The kit is supplied with all the components for colour and is used with your own colour or monochrome T.V. set.

The keyboard Port card is used to interface the ASCII keyboard to the computer. It is Interrupt driven giving fast response to keystrokes. On this card is included 1K of user RAM (this is in addition to the 1K of VDU text RAM) and space for a 2K EPROM such as the CSYS operating system. The ROM and RAM can be switched by software, which is desirable if full use if to be made of the dynamic RAM expansion cards.

The CPU board uses the high speed version of the Z80 microprocessor and operates at full 4MHz. Full use can be made of the Z80A's powerful interrupt structures, including mode 2 (vectored) interrupts. The CPU can insert wait states when requested and utilises pulsed reset for use with dynamic RAM's.

For a full 64K system two RAM expansion cards are required. (These may be purchased singly if required. For example if 32K is sufficient for your initial needs).

The microcomputer cards plug into the Custom 80 Micro Bus circuit board which is mounted in the high quality Custom 80 rack, which is in turn fitted with a case conversion kit or a good looking instrument case.

For high speed machine code work the CSYS operating system has been designed to allow maximum use to be made by the user's own programs, of the various subroutines and utilities contained in the firmware.

Programs can be stored using named files on cassette. The dual cassette interface includes facilities for an RS232 or 20 mA. current loop to drive a printer. The band rate is software selectable between 300 and 2400 baud. The card also has a Z80A counter timer circuit.

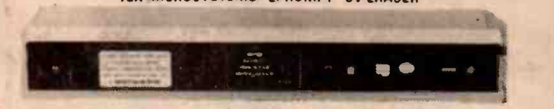
For users who would prefer to write programs in BASIC there is a 4K integer BASIC supplied on cassette tape. It includes commands for setting colour, black and white, graphics etc. PLOT (a point), draw (a line), erase (a line) etc. A 12K Custom 80 BASIC is in development and this will be produced in both Interpreting and compiling versions.

Also in development is an interface to floppy disks (and disk operating systems).

If you are working on a tight budget, the various kits of parts can be purchased one at a time, prices range from £34.09 (for the Micro Bus kit with 5 connectors) or £43.22 (for the CPU kit) up to £74.55 (for the colour VDU kit.)

Send for more details (a large SAE is not essential but helps us) and a comprehensive Custom 80 price list.

TEX MICROSYSTEMS "EPROMPT" UV ERASER



A low-cost alternative to the above erasers (UV 140/141) claimed by the manufacturer to erase up to 32 chips in 15-30 mins. This is the cheapest eraser we have seen. The unit has no timer, power switch or safety interlock switch. The user places up to 32 chips into loose conducting foam in the erasure tray (16 along the base, 8 on each side). The chips are held in place by the UV tube which sits in the tray. (Unlike the UV 140/141, no special precautions have been taken to prevent the seepage of UV light, but the manufacturers state that "Incident light from this device is quite safe at distances above 12 inches.")

(Dimensions – 325 × 64 × 38mm) EPROMPT ERASER Price £33

MODULAR COMPUTER SYSTEM CARDS

A range of 'International' (114 × 203mm) size cards which may be purchased individually as desired, or to build up a complete system. Further details available on request. All boards are epoxy glass with gold-plated edge plug.

VDU A, B, G (set of 3)	£27.20
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MPA-7 Buffered SC/MP CPU	£9.40
MZB-3 Z80 CPU	£9.40
MXA-1 2K of 2102	£9.40
MXA-3 8K of 2114	£9.40
MXD-2 16K of 4116	£9.40
PRM-2 4K of 5204	£9.40
PRM-8 8K of 2708	£9.40
RRM-14 8K of 2516 6K of 2114	£14.95
S10-2 RS-232 (two)	£9.40
TPA-2 Tape Interface	£8.90
IP-2 Input Port	£9.40
DCR-6 Keyboard Input	£8.90
OP 3 Output Port	£9.40
PP-2 PROM Programmer	£9.40
PSU-A4 Power Supply	£8.90
13 slot blockboard, can be used with most of the above boards. 13" × 4½" ISBUS-11	£11.50

UV 141, UV ERASER

Two easy-to-use units designed for both the professional and amateur UV-prom user.

Features:

- Can erase up to 14 proms.
- Special shortwave ultra-violet tube.
- Erase time variable between 5 and 50 minutes in 5-minute steps (preventing over-exposure which may shorten prom life).
- Sliding tray carries proms on conductive foam.
- Safety interlock switch prevents the timing circuit from operating and switching on the tube with the tray open.
- "Mains On" and "Tube On" indicators.
- Smart textured case.
- Complete instructions supplied.

Supplied complete with mains plug and flex.

Model UV 141 - Price £77.70
Also available without timer as
Model UV 140 - Price £61.20

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FLOPPY DISK CONTROLLER BOARD

This is used in conjunction with 'Kemitron' Z80 boards to interface to twin single density S/S 8" floppy disks. It is not available as a bare board, but only built and tested. Regrettably Kemitron do not supply circuit diagram £165.00

To run CP/M on the system a serial interface (e.g. SIO board) to some sort of VDU or terminal is required, and 48K of RAM (e.g. three MXD-2 boards). The MZB-3 board has facilities for power on jump and a boot prom to load the CP/M operating system from the disk

Boot PROM (2708) £19.95
CP/M 8" floppy disk £99.00

8" FLOPPY DISK DRIVES
DRE Model 7100 £350.00

T.V. MONITOR P.C.B. for OEM users

This is an assembled P.C.B. size 130 × [illegible] which you add to your own 12" 14" black and white C.R.T. (90 degree 20mm dia. neck) to obtain a T.V. monitor at modest cost. (Regrettably we cannot supply the C.R.T. at present.)

Preset controls: contrast, brightness etc. are included, and the only inputs needed are 15 [illegible] +12V DC at 1.5 amps and 1 volt pk-pk composite video input.

Supplied with [illegible] £33.50

52-KEY CASED ASCII KEYBOARD

Compact, low cost, 52 keys, ASCII Code, power indicator. Fixed in vacuum formed ABS case, 20 pin ribbon cable connector, TTL outputs, stepped key caps, rigid chassis mounted. Power supplies +5V @ 130mA −12V @ 10mA.

Suitable for data entry to computers, especially suitable for Custom 80 System (see above).

The keyboard is supplied fully assembled and includes circuit diagram.

ORDER AS CUSTOM 80 KEYBOARD TYPE 1. PRICE £[illegible]

NEW RRM-14 ROM/RAM CARD

This new international size, combined 8K ROM (2516) and 6K RAM (2114) circuit board has been designed for flexibility. The memory is organised as 4K of contiguous ROM, 4K of contiguous RAM, 4K of ROM/ROM, RAM, these 4Ks are located on any 4K boundaries. Additional decoding is provided to use the memory devices not used above. One 24 pin DIL and one 66 pin DIL patch areas are provided for 0.3" and 0.6" devices. Board is epoxy glass, 203 × 114mm, tinned, double sided gold plated edge plug, plated through holes, solder mask on back of board. For 16 bit data applications two of these boards can be used together.

Bare P.C.B. price	£14.95
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DIN 41612 Eurocard Connectors

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MUSIC PROCESSOR

We're pretty generous people here at ETI. We don't just give you an echo unit, or a phaser, or a flanger, or a chorus unit — this project has got the lot! Design by Ray Marston. Development by Steve Ramsahadeo.

The ETI Music Processor is designed to add any of four switch-selected effects to any musical or audio signal, these effects being double-tracking (mini-echo), auto-double-tracking or ADT (mini-chorus effect), phasing and flanging. None of these effects can be claimed as unique; it is, however, pretty rare to be able to get all four effects from a single unit. The unique feature of our unit, however, is the way in which its scanning circuit works.

In conventional ADT, phasing and flanging units a low-frequency oscillator is used to scan the selected effect up and down the audio band, and in all the commercial units that we've seen this oscillator simply free-runs so that, for example, a phaser unit phases continuously and thus eventually tends to produce a rather tedious musical effect. Our unit is different, because the scan oscillator can be operated in one of three basic modes — manual scan, one-shot scan, or free-run scan. In the first two of these modes the scanning can be initiated by either a push-button or a foot switch, and in each of the three modes a range of four different scan speeds are available.

A Passing Phase

Because of the unusual scanning generator used in our unit the processor produces the kinds of operating effects that all musicians dream of. Suppose, for example, that you are using the unit as a phaser in the one-shot scanning mode; in this case your musical instrument will normally play straight through the unit with no special effects being added. As soon as you want to add the phasing effect to a musical passage you simply press the scan button or the foot switch once, at which point the unit will noiselessly switch over (using built-in electronic switches) to the phasing mode until one complete phase-down/phase-up scan cycle is complete, and then revert to the straight-through mode.

A similar effect is obtained in the manual scan mode, except that the unit scans down only while the scan button or foot switch is held closed and scans back up again as soon as the button/foot switch is released. A red LED illuminates if the unit reaches a self-imposed limit in the scan-down mode, and a green LED illuminates when the scanner reaches its upper limit and returns to the straight-through or normal mode of operation.

Similar kinds of action occur when the processor is used in the ADT and flanging modes, with special effects being imposed on the music only when the scanning action is initiated by the press button or foot switch. When the scanner is used in the free-running mode, of course, the special effects are imposed continuously, as in a conventional unit, and when the unit is used in the simple double-tracking (echo) mode the scan generator is switched out of circuit and the echo is permanently present.

MP Use

The complete processor unit is mains-powered, contains a total of 10 ICs, and is easy to use: the music signal (with a nominal peak-to-peak amplitude of at least a few hundred millivolts) is simply connected to the unit's input, and the output of the unit is then taken to a suitable power amplifier. The desired musical effects and scan speed and mode are then selected by panel-mounted switches and the input level is adjusted by RV1 so that straight-through operation is obtained with minimal distortion. When the unit is used in the double-tracking and ADT modes, the echo depth can be varied with RV2: when the unit is used in the flanging mode, the flanging level or depth is varied with RV3.

The complete unit can, if desired, be used to add the specified effects to virtually any audio signal source. The unit does, however, generate a small amount of RFI, and if it is to be used with a radio or tuner-derived audio signal it may be necessary to fit the unit into a well screened metal case, to avoid interference; the unit is provided with a simple RF input filter (activated by a slide switch) that is intended for use with radio-derived input signals.

Construction

There should be no problems in the construction of this project provided you follow the overlay carefully, paying particular attention to the orientation of the electrolytic capacitors and semiconductor devices. All components are mounted on a single PCB except for R24 and C7, which are hardwired between SK1 and SW3.

Start construction by assembling the power supply components. Be sure to insulate the mains terminals on the PCB and SW5 with rubber or PVC sleeving. When this section is built, connect a voltmeter across the output and check you get a reading of 15 V. The remainder of the circuit can now be built.

The Music Processor project is not particularly difficult to build: the circuit does, however, incorporate a couple of preset pots and access to a scope and an audio generator is desirable when adjusting one of these components, so that optimum phasing effects can be obtained.

To adjust PR1, connect a DC voltmeter between PR1 slider and the +15 V rail and then adjust PR1 for a reading of precisely 5 V. To adjust PR2, switch the unit to the double-tracking mode, set RV2 (echo depth) to mid value, and apply a 1 kHz (nominal) sine wave signal of about 1 V peak-to-peak to the unit's input. Use a scope to monitor the two signals on the inputs of R46 and R47 and then adjust PR2 until the magnitudes are equal.

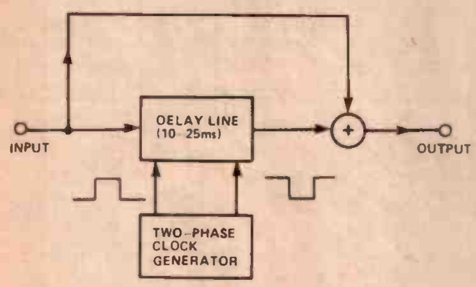


Fig. 1 Block diagram of the double-tracking or echo circuit.

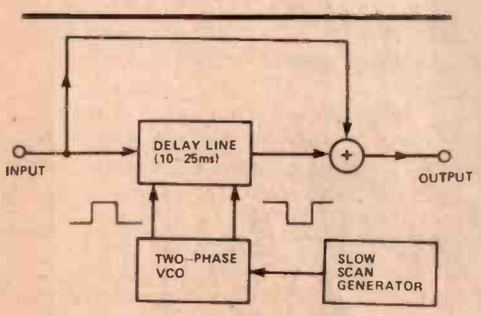
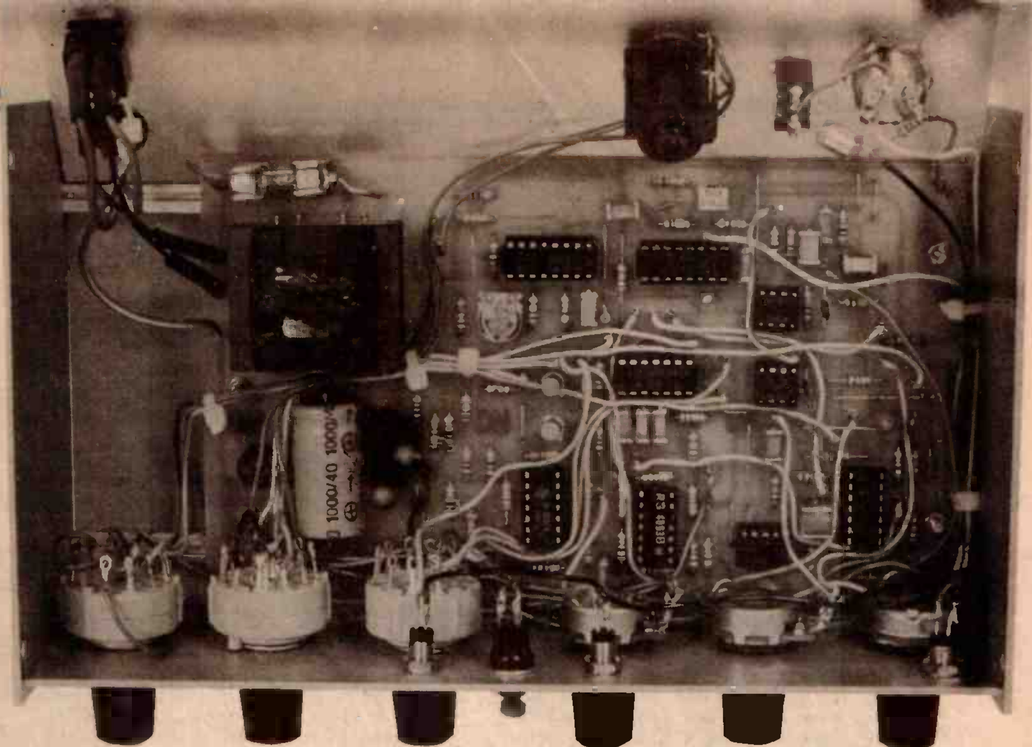


Fig. 2 Block diagram of the auto-double-tracking or mini-chorus circuit.



Inside the Music Processor. It may *look* as if we had an accident with a plate of spaghetti, but you shouldn't have any problems if you follow the overlay methodically.

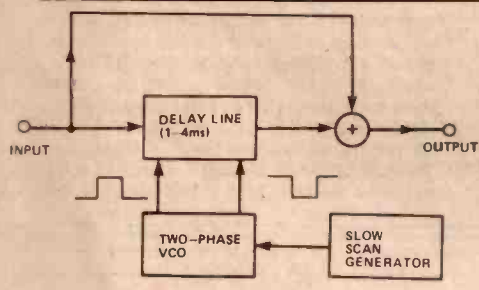


Fig. 3 With a shorter delay time the Fig. 2 circuit becomes a phaser.

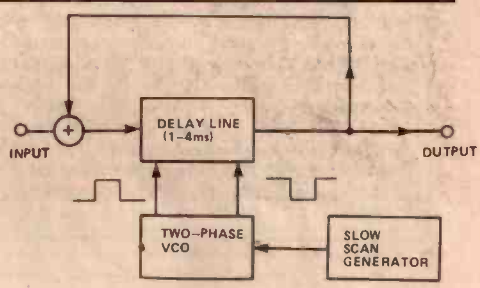


Fig. 4 This configuration of the circuit elements causes flanging.

HOW IT WORKS

BASIC PRINCIPLES

The ETI Music Processor uses a number of basic circuit elements, such as a CCD delay line, a VCO, a couple of audio mixers and low pass filters and and a special slow scan generator to implement the effects that are available from the unit. In each of the four basic operating modes of the unit (double-tracking, ADT, phasing and flanging), these elements are configured by electronic switches to give the desired mode of circuit operation. Figures 1 to 4 show the four basic configurations of the unit.

Thus, in the basic double-tracking mode (Fig. 1) the delay line is clocked by a fixed-frequency two-phase generator to give an overall delay in the range 10 - 25 ms. The audio input signal splits two ways as it enters the unit, one path going directly to one input of an audio mixer and the other going to the remaining mixer input via the delay line. Consequently, the output of the mixer consists of two identical audio signals that are time-displaced by a fixed amount, thus giving a simple echo or double-tracking effect.

The ADT (automatic double-tracking) circuit of Fig. 2 differs from that of Fig. 1 in that the fixed-frequency two-phase clock generator is replaced by a two-phase VCO (voltage controlled oscillator) that can have its frequency (and thus the delay time of the line) varied using a slow scan generator. The ear perceives the audio output signals of this circuit as two distinct signals with a variable time-displacement, this being the so-called 'chorus' effect.

The phasing circuit of Fig. 3 differs from the ADT circuit only in that the VCO frequency is speeded up to give line time-delays in the range 1-4 ms. The effects of this time-delay reduction are quite dramatic; the ear no longer perceives the unit's output as two distinct signals. As the direct and delayed signals are added together in the audio mixer, those signal components that arrive in anti-phase tend to self-cancel, introducing a series of notches throughout the audio frequency band (ie a comb filter). With 1 ms delay the notches are spaced 1 kHz apart, and with 4 ms delay they are spaced 250 Hz apart. These phase-induced notches are relatively shallow (about 20 dB deep), but introduce a pleasing acoustic effect as they are swept up and down through music signals by the slow scan generator.

The flanging circuit of Fig. 4 differs from the phasing circuit in that the audio mixer is placed ahead of the delay line, and part of the delayed signal is fed directly back to one input of the mixer. The consequence of this configuration is that in-phase signal components arriving at the mixer tend to add together regeneratively, introducing a series of comb-like peaks in the audio frequency response. The amplitude of these peaks depends on the degree of feedback and can be made very steep. These phase-induced peaks introduce very powerful acoustic effects as they are swept up and down through a music signal via the slow scan generator.

HOW IT WORKS

THE MAIN CIRCUIT

The main circuit of the unit contains all of the elements described above, except for the slow scan generator. Here, IC5 is the CCD delay line, IC6 is the VCO or clock generator, IC4 and IC8 are two-input audio mixers and IC7 is a low pass amplifier. Input signals are applied to the unit via level control RV1; the unit's clock generator produces a certain amount of RFI, and R24-C7 can be used to prevent this RFI feeding back to the input terminal when the unit is used with a radio music source. ICs 3 and 9 are used in the circuit as voltage-controlled electronic mode selector switches.

In the double-tracking mode, switches IC3d, IC9b and IC9c are open and IC9a is closed. In this case one half of the input signal is fed directly to the R46 side of audio mixer IC8 and the other half is fed to the R47 side of the IC8 mixer via low pass (22 kHz) mixer IC4, delay line IC5, and low pass amplifier IC7. The IC6 clock generator operates at a fairly low frequency, with its rate determined by C15 and the series values of R37 and RV2; the scan generator input is disabled by IC9b, and the second input of mixer IC4 is disabled by IC3d.

Table 1 shows the states of the IC3 and IC9 switches (which are DC-controlled by SW4) in the different operating modes of the circuit. Note here that IC3d and IC9a are activated automatically by the scan generator circuitry (provided they haven't been overridden by SW4), and that these switches are closed when scanning is in progress. Also note that, when the unit is used in the flanging mode and IC3d is closed, the R35-R36-D5-D6-D7-D8 network is used to automatically limit the magnitude of feedback signals from RV3 to R34, so that flanging does not attain uncontrolled levels.

From Table 1 and the above information, the reader should have little trouble in figuring out the precise methods of circuit operation in the other modes. Note that IC9c controls the coarse speed range of the VCO, and IC9b enables or inhibits the input from the scan generator circuit.

THE SCAN GENERATOR CIRCUIT

The scan generator circuit provides a ramp waveform to the input of the VCO and provides control signals to IC3d and IC9a of the main circuit. When the circuit is used in the manual and one-shot modes the scanning is initiated by closing either PB1 or an external foot switch; the circuit action is such that the IC3d and IC9a switches of the main circuit are normally opened and music signals are played straight through the unit (via the delay line) without any special effects being imposed, but as soon as a scan is initiated these two switches are activated by IC2b and special effects are imposed for the duration of the scan.

The operating theory of the scan generator circuit is fairly involved. IC1a is an op-amp integrator circuit and is DC-biased at half-supply volts by R4-R5. In our application, the circuit is used as a ramp waveform generator and its timing action is controlled by R6, capacitors C1 to C3 and by the DC voltage on the R7-R8 junction; normally, this voltage has a value of 5 V but switches to 10 V when PB1 or IC3c are closed. Thus, the output of IC1a (which feeds the VCO input of the main circuit via IC9b) is normally at + 10 V, but starts to ramp down towards + 5 V as soon as the R7-R8 junction is pulled high by PB1 or IC3c. As soon as the R7-R8 junction is allowed to switch to + 5 V, the IC1a output starts to ramp back towards + 10 V again.

The IC1a circuit has four ramp speeds available, which are controlled by switching in different total values of integrating capacitance using SW1. In the fastest ramping speed, only 68n of capacitance (C3) is used; in the next speed, 136n (C2 + C3); in the third speed 218n (C1 + C3) and in the slowest speed 286n (C1 + C2 + C3).

The output of IC1a is fed to inverting amplifier IC1b, which has a DC voltage gain slightly greater than unity, and the output of IC1b is fed to the inputs of non-inverting voltage comparators IC1c and IC1d. IC1c is referenced to + 10 V; IC1d is referenced to + 5 V and has its output inverted by IC2a. The circuit action is such that the output of IC1c switches high whenever the IC1a ramp generator reaches or exceeds the scan-down limit, and the output of IC2a switches high whenever IC1a is not ramping or whenever it reaches or exceeds the scan-up limit; these two states are indicated by LED2 and LED1 respectively.

IC2c-IC2d is a simple bistable circuit, which can be set by a positive pulse applied across R16 or reset by a positive pulse fed to D4; the output of the bistable is used to control switch IC3c. The reset signal of the bistable is derived from the output of IC1c; the set signal is derived from PB1 or from the output of IC2a, depending on the operating mode (selected with SW2) of the

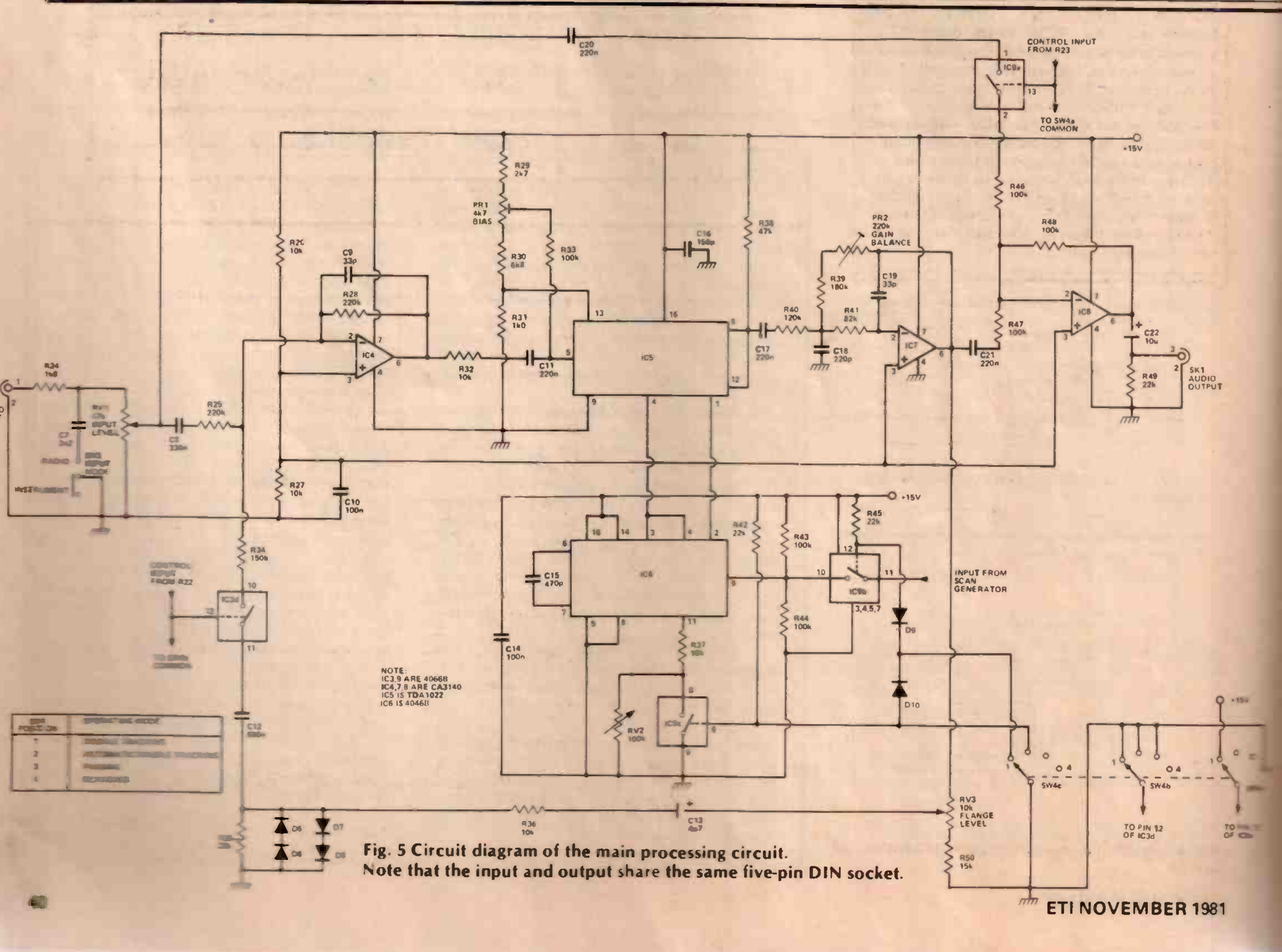


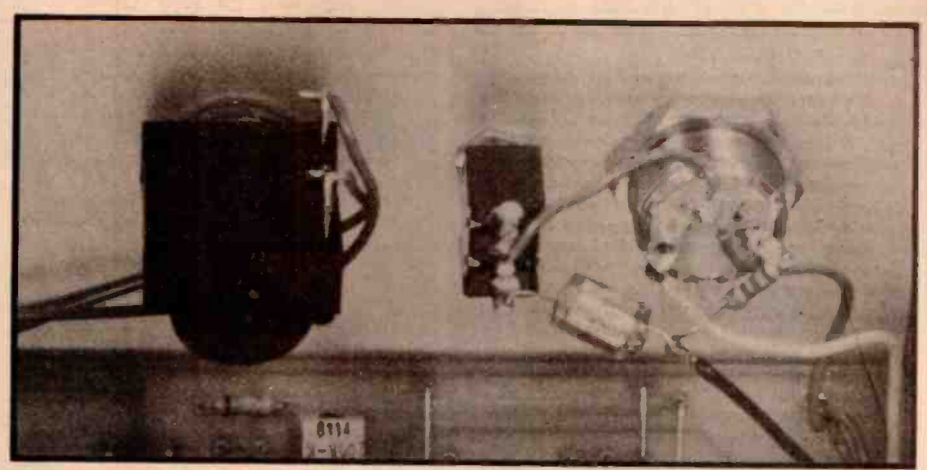
Fig. 5 Circuit diagram of the main processing circuit. Note that the input and output share the same five-pin DIN socket.

scan generator. The output of IC2a is also used to control IC3d and IC9a (in the main circuit) via 10 ms delay/inverter network R19-C6-R20-IC2b and R22 and R23. The overall action of the generator in each of the three different operating modes is as follows.

MANUAL SCAN. In this mode of operation the scanning is entirely controlled by PB1 (or the external foot switch) and the unit simply gives a scan-down action when PB1 is closed, or a scan-up action when PB1 is open. The scan limits are indicated by LEDs 1 and 2; switches IC3d and IC9a receive 'close' control signals when scanning is in progress and 'open' signals when scanning is not in progress. SW4a and SW4b determine whether or not these control signals are acted upon.

ONE-SHOT SCAN. In this mode of operation the output of PB1 is used to feed a set signal to bistable IC2c-IC2d and the input of the IC1a ramp generator is controlled from the bistable output via IC3c. When PB1 is momentarily closed the bistable output is switched high, causing IC3c to close and initiate a ramp-down action; ramp-down is maintained until the scan-down limit is reached. At this point the bistable is reset by IC1c output, causing IC3c to open; the ramp generator then scans back up to the full extent, at which point the one-shot circuit action is complete. IC3d and IC9a are again controlled from the output of IC2b throughout the one-shot action.

FREE-RUNNING SCAN. In this mode of operation the set input of the bistable is controlled from the output of IC2a, the reset input is controlled from the output of IC1c, and the scanning action is controlled from the bistable output via IC3c. The action is such that IC1a ramps down (IC3c closed) until the scan-down limit is reached, at which point the bistable is reset. IC3c then opens and IC1a ramps up until the scan-up limit is reached, at which point the bistable is set again via IC2a output and IC3c closes again, initiating another ramp-down action; this process continues ad infinitum. Note that, because of the delay action of R19-C6-R20 and IC2b, the IC3d and IC9a control signals are continuously maintained when the scan generator is used in the free-running mode.



A detail shot showing how C7 and R24 are mounted. SK1 is on the right, and one end of R24 is soldered to pin 1 (input). The other end of the resistor is soldered to C7 and a wire which goes to RV1 on the front panel. The remaining wires on SK1 are ground (pin2) and output (pin 3). Closing SW3 connects the capacitor to ground to filter RFI at the input. If an external footswitch is to be used, it may be plugged into the mono jack socket on the left of the picture.

TABLE 1

OPERATING MODE	SWITCH STATES IC9a	IC9b	IC3d	IC9c
Double Tracking	Closed	Open	Open	Open
ADT	Closed	Closed	Open	Open
Phasing	Closed	Closed	Open	Closed
Flanging	Open	Closed	Closed	Closed

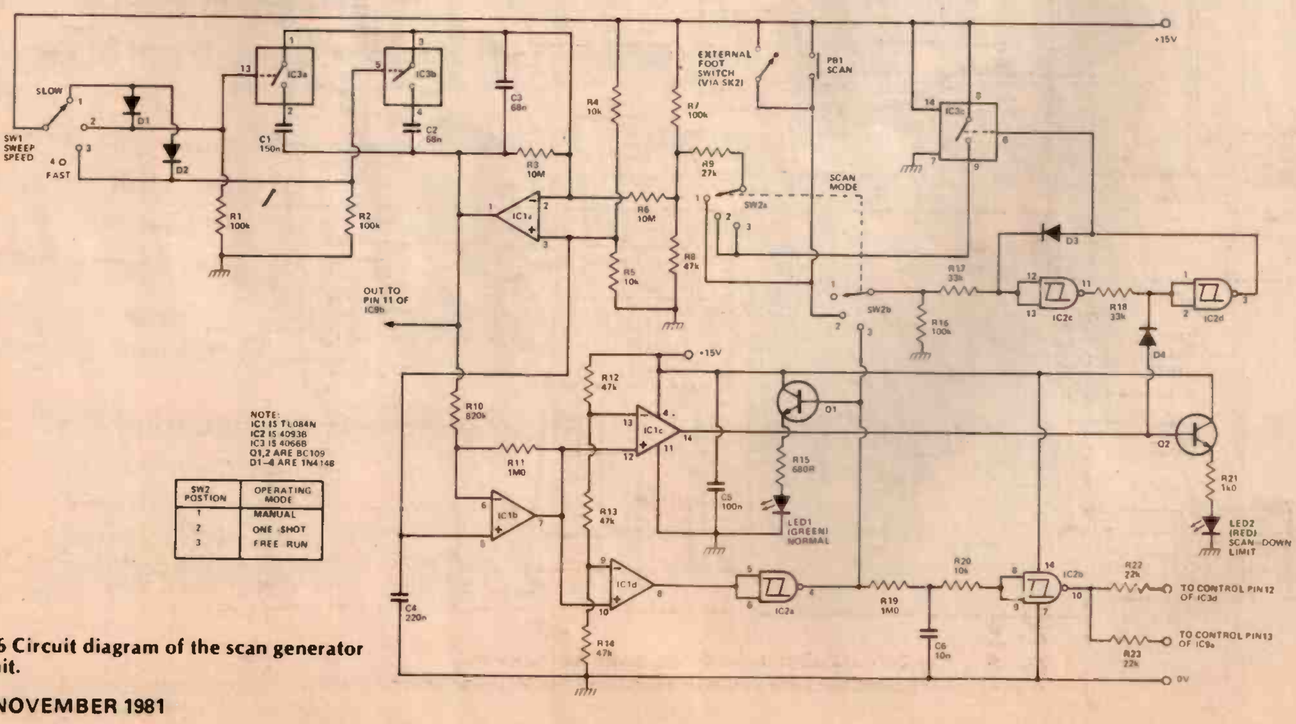
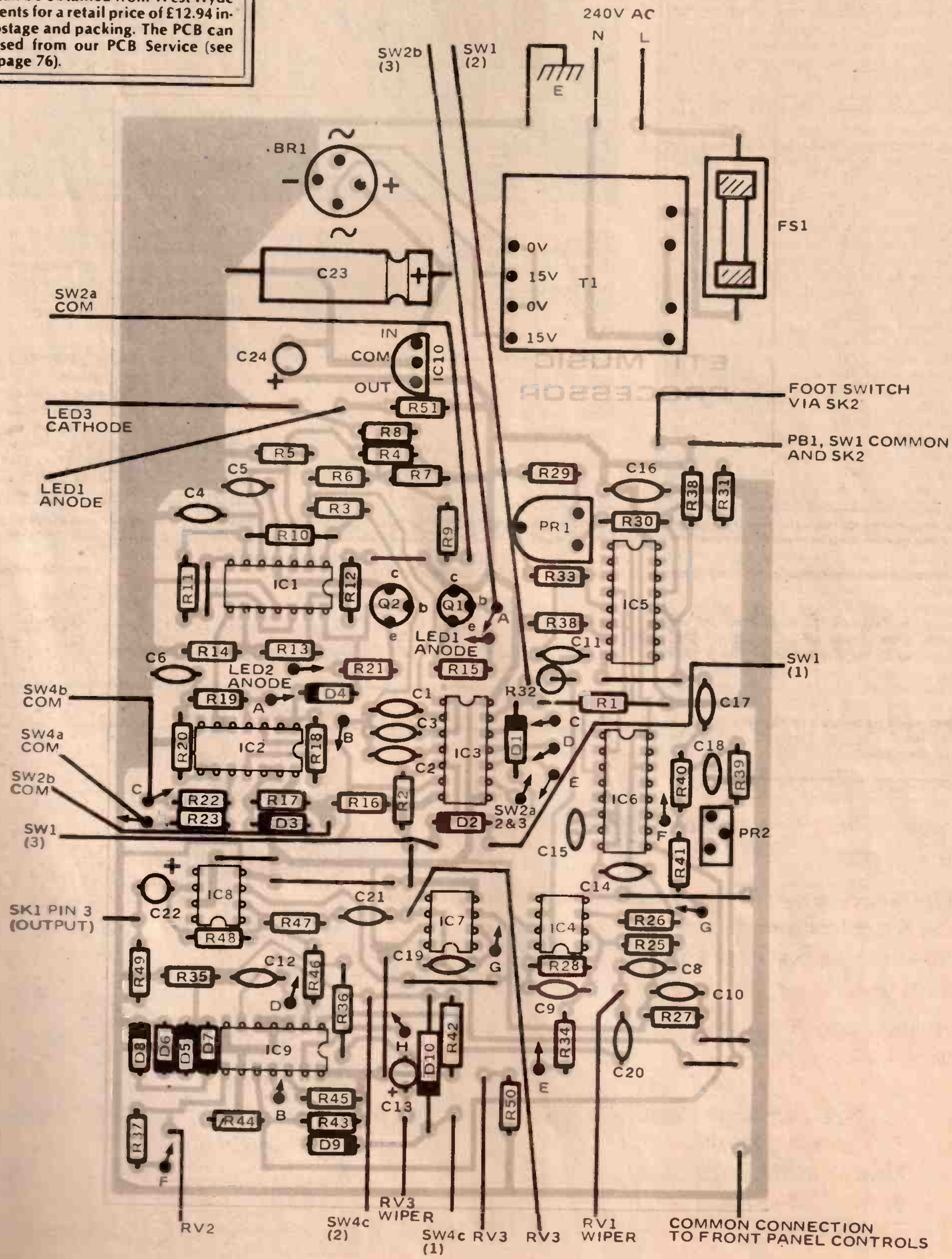


Fig. 6 Circuit diagram of the scan generator circuit.

BUYLINES

Nothing particularly out of the ordinary for this project; most of the components are available from the normal outlets. In case of difficulty, Technomatic and Watford Electronics stock the TL084N, Electrovalue and Watford stock the PCB-mounting transformer, and C23 can be obtained from Electrovalue. The case we used (order no. CL2 ADJ) can be obtained from West Hyde Developments for a retail price of £12.94 including postage and packing. The PCB can be purchased from our PCB Service (see advert on page 76).

Fig. 7 Component overlay of the ETI Music Processor. There's a great deal that fits on the board, and a great deal that doesn't, so take time and care over construction. Note the large number of 'blob and arrow' symbols; some of these represent wiring to off-board components, some are point-to-point connections on the PCB. The latter blobs are the lettered ones; link A to A, B to B and so on. Remember that R24 and C7 are mounted directly on SK1 and SW3.



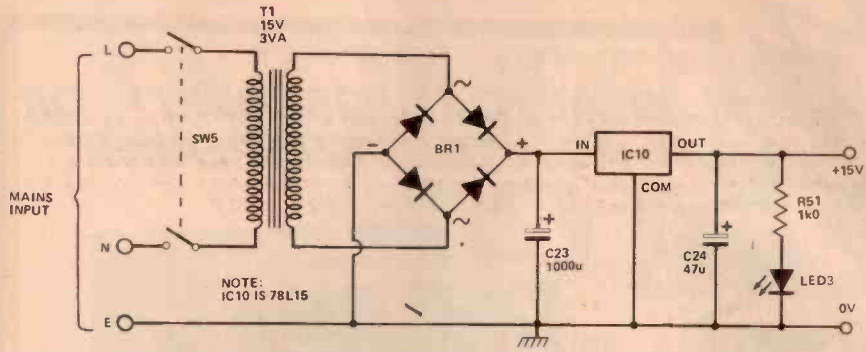


Fig. 8 Circuit diagram of the power supply for the project.

PARTS LIST

Resistors (all ¼ W, 5%)

R1,2,7, 16,33, 43,44, 46,47,48	100k
R3,6	10M
R4,5,20,26, 27,32,36,37	10k
R8,12,13, 14,38	47k
R9	27k
R10	820k
R11,19	1M0
R15	680R
R17,18	33k
R21,31,51	1k0
R22,23,35,42, 45,49	22k
R24	1k8
R25,28	220k
R29	2k7
R30	6k8
R34	150k
R39	180k
R40	120k
R41	82k
R50	15k

Potentiometers

RV1	47k logarithmic
RV2	100k linear
RV3	10k linear
PR1	4k7 miniature horizontal preset
PR2	220k miniature vertical preset

Capacitors

C1	150n polycarbonate
C2,3	68n polycarbonate
C4,11,17, 20,21	220n polycarbonate
C5,10,14	100n polycarbonate
C6	10n polycarbonate
C7	2n2 polystyrene
C8	330n polycarbonate
C9,19	33p ceramic
C12	680n polycarbonate
C13	4u7 35 V tantalum
C15	470p ceramic
C16	150p ceramic
C18	220p ceramic
C22	10u 35 V tantalum
C23	1000u 40 V axial electrolytic
C24	47u 16 V tantalum

Semiconductors

IC1	TL084N
IC2	4093B
IC3,9	4066B
IC4,7,8	CA3140
IC5	TDA1022
IC6	4046B
IC10	78L15
Q1,2	BC109
BR1	50V, 1 A bridge rectifier
D1-10	1N4148
LED1	0.125" green LED
LED2,3	0.125" red LED

Miscellaneous

T1	15-0-15 3 VA PCB-mounting transformer
SW1	1-pole 4-way rotary switch
SW2	2-pole 4-way rotary switch
SW3	SPDT miniature toggle switch
SW4	3-pole 4-way rotary switch
SK1	five pin DIN socket
SK2	¼" mono jack socket

ETI

ENGINEER'S GUIDE TO BASIC

Computing is all about data - numbers to be processed, constants for calculations, strings for the manipulation of groups of characters. Stewart Fleming looks at the various methods of data storage, the limitations that these cause, and how the problems may be overcome.

In this second article an attempt will be made to describe the types of data item that can be handled by BASIC programs, and then to classify BASIC instructions, statements and commands according to their function. Throughout the series comparison will be made between different BASICs and we will describe how particular operations may be effected in different versions of the language. We will also look at some of the ways in which floating-point operations may be carried out using integers and strings only. The topics covered will be illustrated by complete examples, even if this means occasionally 'jumping ahead' a little.

BASIC allows three main types of data: integers, floating-point numbers and strings. For each of these types a code is used to convert the item to be represented into a collection of bits which may be stored and moved around within the computer. Let's look at the three types one by one.

Integers

These are the positive and negative whole numbers including zero. The positive sign, +, is optional when representing the positive numbers or zero both in ordinary arithmetic and in BASIC — thus −37, 42, +42, −0, 0 and +0 are all integers. Computers allow only a subset of the integers — often −32768 to +32767. This is a result of the binary representation of integers within the computer. The binary system is the two's number system — thus using two eight-bit bytes, say:

$$5_{10} = 101_2 = (\underbrace{00000000}_{\text{1st byte}}\underbrace{00000101}_{\text{2nd byte}})_2$$

The subscript after the numbers indicates which base we are counting in.

Negative integers will be represented in a variety of ways. A common one is the 'two's complement' method in which the negative number is represented by the corresponding positive binary number in which the 0s have been converted to 1s and vice versa (a process known as inversion) and 1 added to the result.

$$\text{Hence} \quad -5_{10} = (1111111111111010 + 1)_{2\text{'s complement}}$$
$$= (1111111111111011)_{2\text{'s complement}}$$

(Carrying out this process again on the number just formed gives us the original positive number, as the reader can readily verify.)

The left-hand bit is considered to be a sign bit — 0 means positive and 1 negative. It follows that the largest positive two-byte integer is

$$0111111111111111_2 = 2^{15} - 1 = 32767_{10}$$

and the largest negative one is

$$1000000000000000_2 = -2^{15} = -32768_{10}$$

(as can be verified by inverting the bits and adding one.)

Another method of representing negative numbers known as the 'one's complement' method simply inverts the bits of the corresponding positive number. This time the range will be −32767 to +32767 (one less than the 2's complement system) and there will be two ways of representing zero:

$$+0_{10} = (0000000000000000)_2$$
$$-0_{10} = (1111111111111111)_{1\text{'s complement}}$$

A third way is the 'sign and modulus' method where the most significant bit (the left-most bit) is taken as a sign bit (0 = positive, 1 = negative). Thus:

$$+5_{10} = (0\underbrace{000000000000101}_{\text{MODULUS}})_2$$

SIGN BIT

$$-5_{10} = (1\underbrace{000000000000101}_{})_2$$

Mention should be made of Acorn Atom BASIC which uses four bytes for each integer and therefore has a much larger integer range than most BASICs. Acorn BASIC also allows the representation of integers in the hexadecimal notation (base 16) provided the number is preceded by the hash (#) symbol. Hexadecimal uses the digits 0 to 9, and also the letters A to F for the numbers 10 to 15. An example of a number in hexadecimal is

$$3F_{16} = (3 \times 16 + 15)_{10} = 63_{10}$$

This would be represented in Acorn BASIC by #3F.

The Real Thing

Real numbers are all the numbers that may be represented in decimal notation. (Note, however, that some real numbers — including e and π — would require an infinite series of decimals and hence are not strictly representable). The integers are representable in decimal notation and are therefore included in the real numbers. Examples of real numbers are: 0.25, — 73.420, 5.0, 5, 0.33333.

A common way of representing real numbers is in 'scientific notation' (a form of decimal floating-point), where the number after the letter E is the number of places to the left or right that the assumed or actual decimal point in the number before the E has to be shifted, eg

1E4 = 10,000
1E−4 = 0.0001
2.6E8 = 260,000,000

The ordinary and scientific representations are both allowed by BASIC. Within the computer, however, BASIC will store real numbers using a binary floating-point representation. In this notation, a real number y will be represented by the two numbers a and n where

$$y = a \times 2^n$$

and a is known as the mantissa, n is an integer known as the exponent.

By convention, the magnitude of the mantissa lies in the range $.1 \leq a < 1$ base 2, ie $\frac{1}{2} \leq a < 1$ base 10. This is known as the 'normal' form, and the representation is called 'normalised binary floating point'. Both mantissa and exponent may be positive or negative. The method of representing negative exponents and mantissas may vary from machine to machine — thus a manufacturer might use 2's complement for the mantissa and sign-and-modulus for the exponent. Furthermore, a fixed number of bytes will be allowed for the exponent and for the mantissa.

In binary floating point, the number 5.125_{10} would be represented as

$$\underbrace{.101001}_{\text{mantissa}} \times 2^{011} \leftarrow \text{exponent}$$

The exponent, 011_2 ($=3_{10}$), means that the binary point of the mantissa has to be moved three places to the right to give the number 101.001_2 ($= 5.125_{10}$). Using a one-byte exponent and three bytes for the mantissa would give

exponent	mantissa		
00000011	10100100	00000000	00000000

↑ implied binary point

For example, the PET microcomputer uses five bytes for each floating-point number — four for the mantissa and one for the exponent. Research Machines' BASICs use three for the mantissa and one for the exponent.

The fact that real numbers are represented in the computer's memory in this format has important implications, both for the range of numbers allowed and for the precision with which they are stored.

Range

The range of the numbers is limited by the largest value that the exponent can take. Since this is in binary, and the conversion routine will make some rounding assumptions which may be manufacturer-dependent, the range of real numbers in a particular BASIC will only be specified approximately. For example, the range may be specified as approximately -10^{38} to $+10^{38}$, or even as approximately (-10^{38} to -10^{-38}), (10^{-38} to 10^{38}). In the latter case the number zero has been excluded as it cannot be represented in the strict normalised binary floating-point form, which requires a mantissa with a magnitude between a half and one (base 10).

Some BASICs get round this by using the method of a 'characteristic constant', a fixed value which is added to the exponents of all floating-point numbers in order to make the exponent positive. The number zero is then treated as a special case, being given an exponent of zero, even though its mantissa may be non-zero.

Precision

The precision with which floating-point numbers are stored is also limited. Even granted that a particular real number may fall within the range allowed by a BASIC, the precision with which it is stored may be reduced by:

- the fact that some real numbers are not capable of exact representation as decimals. For example, $\pi = 3.14159$ to six significant figures, but it is not capable of exact representation however many decimal places we take.
- rounding errors which may occur in converting the real number (or its decimal approximation) into binary. This is a consequence of the fact that the normalised binary floating-point representation uses just a subset of the allowable real numbers (for the mathematically minded, it is actually just a subset of the rational numbers occurring within the range specified), and we are limited to trying to find the closest allowed number to the original real number.

We describe this uncertainty by specifying that the real number is represented to a particular number of significant digits — this is known as the precision. The precision will depend on the number of bytes used for the mantissa, and (as one might expect!) the rounding process means that the precision can only be approximately stated; a precision of at least nine significant digits or a precision of six-seven digits, for example. As a result, BASICs restrict the number of digits allowed in the representation of a real number — whether or not scientific notation is being used. In PET BASIC, for example, ordinary real numbers are to be of 10 or fewer digits.

For certain applications (eg the solution of differential equations using finite-difference techniques), high precision is necessary, and this might affect your choice of machine. Some BASICs cater for this by offering a 'double-precision' facility in which real numbers are represented with a much larger mantissa (and therefore more accurately). For example, the TRS-80 normally limits numbers to six significant figures, but a number specified as 'double precision' has 16 significant figures. The inaccuracy involved in the representation of real numbers has important implications for ordinary BASIC programs too, as will be made clear in a later article.

Stringing Along

Strings are groups of characters contained within quotation marks, ie

"FRED 5" "THIS IS A STRING"

Strings may contain the letters A-Z, the digits 0-9 and a number of other characters including space and

, ! ? — * £ ( ) % .

Other characters, some of which cannot be conveniently printed (such as the 'bell' character), may also be included, but not readily represented in a BASIC string.

Some BASICs do not allow quotation marks within the string: for example,

"HE SAID "THIS IS A STRING" "

is not allowed. Others will allow, for example, single quotes as string delimiters, or a double quotation mark within a string bounded by single quotes. Acorn BASIC gets round this by representing a single quotation mark within a string by two quotation marks, thus

"IT""S A KNOCKOUT"

In certain instances (eg in conjunction with a DATA statement) the surrounding quotes may be omitted.

How Long . . .

The length of a string is the number of characters contained within it. A string of length zero is known as a null string, and the maximum length that a string can take may vary between machines, but is usually 255. Each character occupies one byte of storage in memory, and is represented by a numeric code which is usually a superset of the ASCII (pronounced as in Arthur) code (American Standard Code for Information Interchange). Thus, for example,

$$A = 01000001_2 = 65_{10}$$

BASICs will also store a start address (the address of the first character) for any string that occurs within a BASIC program or that is created by a BASIC program, together with some additional information such as the length of the string.

Some BASICs store an 'end-of-string' character as part of the string. Acorn BASIC, for example, adds the 'return' character (ASCII code 13) to its strings, but this is not included in any length-of-string calculations. Some of the characters within a string may be used by BASIC to carry out operations such as editing the screen — these are known as control characters — and others may be used to display particular shapes on the screen (graphics characters). More about them later.

Data Selection

Although there are three types of data item available, integers, floating-point numbers and strings, not all BASICs use all three. PET BASIC does, and stores numbers as integers rather than floating-point wherever possible. Research Machines' BASIC has only strings and floating-point numbers, while Acorn and Apple both offer BASICs with just integers and strings. With the Acorn, the user can purchase an extension ROM that gives him floating-point facilities; the Apple user can purchase a different version of BASIC stored on disc.

We will now consider ways in which floating-point operations may be implemented using an integer BASIC. Possible approaches are:

- writing BASIC subroutines to convert real numbers stored as strings into a decimal floating-point representation which uses the integers 0-9 only, to carry out arithmetic operations on these numbers, and to convert them back. (Such a program, written in Acorn BASIC, is listed in this article. This program will be described fully, and the algorithm it uses discussed, in the next article, which will also deal with structured programming and thus enable the routines to be written in any BASIC supporting integers and strings.)
- writing the subroutines in assembly language or machine code, thereby speeding up the arithmetic operations.

However, if the user requires a lot of floating-point numbers and operations in his applications, he would be well advised to choose a BASIC better suited to his purpose.

The program listed here works for real numbers up to 10 characters long, but not in scientific notation. Numbers are stored to a precision of eight decimal digits. The addition subroutine will register an overflow condition if addition produces a sum greater than 9999999999999999999, or less than −9999999999999999999. The program stores its floating-point numbers in the following format:

3	43	2	4	7	8	0	0	0	0

exponent; ASCII code for +; mantissa

$247.8 = +.2478 \times 10^3$

−2	45	7	8	0	0	0	0	0	0	0

exponent; ASCII code for −; mantissa

$-0.0078 = -.78 \times 10^{-2}$

Sample runs of the program look like the examples below, with the user entries in bold type and the computer responses in medium.

>**RUN**
ENTER FIRST NUMBER
?**56.3**
ENTER SECOND NUMBER
?**−4.7**
ANSWER IS +51.600000
ENTER FIRST NUMBER
?**6666666666666666666**
ENTER SECOND NUMBER
?**5555555555555555555**
OVERFLOW
>

Constants And Variables

Numbers and strings which occur 'as themselves' within a BASIC program are known as constants. Numbers and strings may also be represented symbolically using variables. Variables will be the subject of a later article, but for now, a BASIC variable is a name which represents and identifies an area of storage containing a valid string or number. We may conceptually view the variable as a box containing a value.

X

$\boxed{3.5}$

In this example the variable X has the value 3.5, though at a later stage it may contain a different value — hence the term 'variable'. The BASIC programmer can thus refer to values by symbolic names, and is freed from the task of keeping track of the specific memory locations where his data is stored.

Classified Items

We have already classified BASIC instructions as being either statements or commands (see last month) — broadly speaking, statements are operations to be performed by a program and commands are operations to be performed on a program. In addition, all BASICs offer built-in programs known as functions which carry out useful specific operations on strings and/or numbers. For example, we might have functions to work out the length of a string, or to calculate the tangent of an angle.

So we may classify the items that may occur within BASIC or will be accepted by BASIC as:

- constants
- variables
- commands
- statements
- functions and operators (operators include +, −, /, =, > etc)

Commands may be further classified as creating or modifying programs (eg NEW); executing programs (eg CLEAR, RUN); or storing and retrieving programs (eg LOAD). Statements may be classified as assignment (eg LET); definition (eg DEF FN); control (eg IF . . . THEN); input/output (eg PRINT); graphics (eg SET, PLOT); memory reference (eg PEEK, POKE). During the remainder of this series we will be looking at each of these areas.

A Last Word

Last month's program can be vertically compressed to fit on a smaller screen (eg TRS-80) by inserting the lines
341 LET V=V/2
342 LET W=10
and rewriting
480 FOR K=W TO 1 STEP −1

There was also a small factual error which crept in — the early computers with a 'Harvard' architecture were ENIAC and Mark 1.

```
100   GOSUB 1140
110   PRINT "ENTER FIRST NUMBER"'
120   Z=5; GOSUB i
130   PRINT "ENTER SECOND NUMBER"'
140   Z=8; GOSUB i
150   $O="Z4=Z5+Z8"; GOSUB a
160   Z=4; PRINT "ANSWER IS"; GOSUB p
170   GOTO 110
180   END
189   REM **STRING TO F-P NO.****************************
190i  INPUT $ZZ(Z)
200   LET $X=$ZZ(Z)
209   REM **WORK OUT SIGN*******************************
210   IF CH$X<>45 AND CH$X<>43 THEN YY(Z*10+1)=43;
      GOTO 240
220   YY(Z*10+1)=CH$X
230   $X=$X+1
240   $W=$X
249   REM **WORK OUT EXPONENT AND ELIMINATE DECIMAL
      POINT*********************************************
250   LET M=LEN(X)
260   FOR I=1 TO LEN(X)
270   IF CH$X<>46 THEN GOTO 300
280   LET M=I-1
290   GOTO 320
300   LET $X=$X+1
310   NEXT I
320   LET $W+M=""
330   LET $W+LEN(W)=$X+1
339   REM **ELIMINATE LEADING ZEROS*********************
340   FOR I=1 TO LEN(W)
350   IF CH$W<>48 THEN GOTO 380
360   LET $W=$W+1
370   M=M-1
380   NEXT I
390   YY(Z*10)=M
399   REM **PUT MANTISSA IN ARRAY**********************
400   FOR I=2 TO 9
410   S=CH$W
420   LET S=S-48
430   IF S<0 THEN S=0
440   YY(Z*10+I)=S
450   LET $W=$W+1
460   NEXT I
470   RETURN
478   REM **F-P NO. TO STRING***************************
479   REM **TEST FOR ZERO*******************************
480p  IF YY(10*Z+2)=0 THEN $ZZ(Z)="0.0"; GOTO 630
489   REM **FIND SIGN OF NUMBER*************************
490   IF YY(10*Z+1)=43 THEN $ZZ(Z)="+"; GOTO 510
500   $ZZ(Z)="-"
509   REM **APPEND LEFT DIGITS**************************
510   IF YY(10*Z)<=0 THEN $ZZ(Z)+LEN(ZZ(Z))="0"; GOTO 560
520   FOR I=2 TO YY(10*Z)+1
530   IF I>9 THEN $ZZ(Z)+LEN(ZZ(Z))="0"; GOTO 550
540   $ZZ(Z)+LEN(ZZ(Z))=$UU(YY(10*Z+I))
550   NEXT I
559   REM **APPEND DECIMAL POINT************************
560   $ZZ(Z)+LEN(ZZ(Z))="."
569   REM **APPEND RIGHT DIGITS*************************
570   IF YY(10*Z)+2>9 THEN $ZZ(Z)+LEN(ZZ(Z))="0"; GOTO 620
580   FOR I=YY(10*Z)+2 TO 9
590   IF I<2 THEN $ZZ(Z)+LEN(ZZ(Z))="0"; GOTO 610
600   $ZZ(Z)+LEN(ZZ(Z))=$UU(YY(10*Z+I))
610   NEXT I
620   PRINT $ZZ(Z)'
630   RETURN
639   REM **WORK OUT NUMBERS TO BE ADDED****************
640a  DIM KK(2)
650   L=0
660   IF CH$O<48 OR CH$O>57 THEN GOTO 690
670   S=CH$O
680   KK(L)=S-48;L=L+1
690   $O=$O+1
700   IF L<3 THEN GOTO 660
708   REM **ADDITION OF F-P NOS.************************
709   REM **INITIALIZE ARRAYS***************************
710   FOR I=1 TO 39
720   RR(I)=0
730   SS(I)=0
740   TT(I)=0
750   NEXT I
759   REM ** PUT NOS. IN RR AND SS**********************
760   FOR I=0 TO 7
770   RR(20-YY(10*KK(1))+I)=YY(10*KK(1)+I+2)
780   SS(20-YY(10*KK(2))+I)=YY(10*KK(2)+I+2)
790   NEXT I
799   REM **TAKE 9'S COMPLEMENT WHERE NECESSARY*********
800   IF YY(10*KK(1)+1)=43 THEN GOTO 840
810   FOR I=0 TO 39
820   RR(I)=9-RR(I)
830   NEXT I
840   IF YY(10*KK(2)+1)=43 THEN GOTO 880
850   FOR I=0 TO 39
860   SS(I)=9-SS(I)
870   NEXT I
879   REM **ADD RR AND SS AND PUT RESULT IN TT**********
880   C=0
890   FOR I=39 TO 0 STEP -1
900   TT(I)=SS(I)+RR(I)+C
910   IF TT(I)>9 THEN TT (I)=TT(I)-10; C=1; GOTO 930
920   C=0
930   NEXT I
939   REM **PERFORM END-AROUND CARRY*******************
940   FOR I=39 TO 0 STEP -1
950   TT(I)=TT(I)+C
960   IF TT(I)<10 THEN GOTO 990
970   TT(I)=TT(I)-10; C=1
980   NEXT I
989   REM **TEST FOR OVERFLOW**************************
990   IF TT(0)<>0 AND TT(0)<>9 THEN PRINT "OVERFLOW"';
      STOP
999   REM **TEST FOR SIGN. TAKE 9'S COMPLEMENT IF
      NECESSARY****************************************
1000  IF TT(0)=0 THEN YY(10*KK(0)+1)=45; GOTO 1050
1010  FOR I=0 TO 39
1020  TT(I)=9-TT(I)
1030  NEXT I
1040  YY(10*KK(0)+1)=45
1049  REM **WORK OUT MANTISSA***************************
1050  FOR I=0 TO 39
1060  IF TT(I)<>0 THEN GOTO 1080
1070  NEXT I
1080  FOR J=0 TO 7
1090  IF I+J>39 THEN YY(10*KK(0)+2+J)=0; GOTO 1110
1100  YY(10*KK(0)+2+J)=TT(I+J)
1110  NEXT J
1119  REM **WORK OUT EXPONENT***************************
1120  YY(10*KK(0))=20-I
1130  RETURN
1139  REM **INITIALIZE ARRAYS***************************
1140  DIM YY(99), RR(39), SS(39), TT(39), O(15)
1150  DIM UU(9)
1160  FOR N=0 TO 9; DIM B (1); UU(N)=B; NEXT N
1170  $UU(0)="0"; $UU(1)="1"; $UU(2)="2"
1180  $UU(3)="3"; $UU(4)="4"; $UU(5)="5"
1190  $UU(6)="6"; $UU(7)="7"; $UU(8)="8"; $UU(9)="9"
1200  DIM ZZ(9), X(19), W(19)
1210  FOR N=0 TO 9
1220  DIM J(19)
1230  ZZ(N)=J
1240  NEXT N
1250  RETURN
```

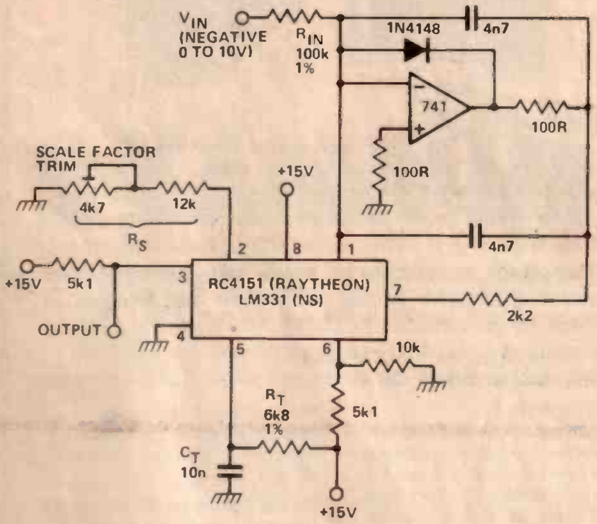
ETI

Program 1. Performing floating-point addition in Acorn Integer BASIC.

100 CIRCUIT

A circuit bonanza in our latest supplement — 100 circuits for designers and experimenters. Tim Orr has been labouring long into the night to produce this comprehensive reference work, covering all aspects of electronics from analogue to digital. If you're stuck for ideas, this is the place to look first.

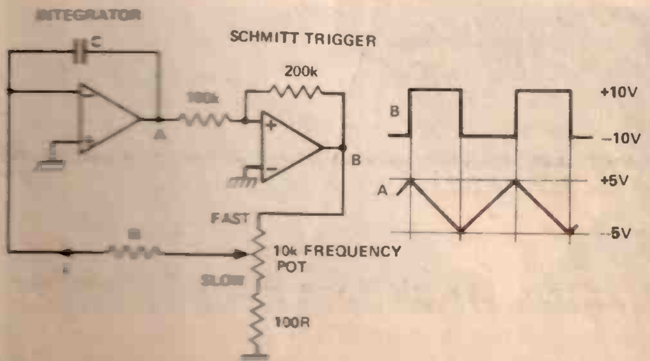
1
Precision VCO



$F = (-V_{IN})/2.09 \times (R_S/R_{IN}) \times 1/(R_T C_T)$ Hz

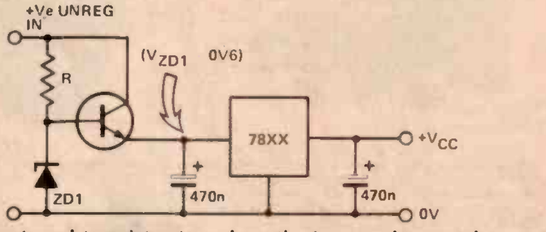
Maximum frequency = 10 kHz
Linearity = 0.05%
Response time = 10 us
Op-amp powered from ± 15 V

2
Triangle/Square Wave Oscillator



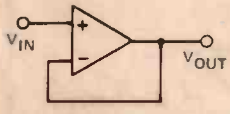
Output frequency F = (pot fraction)/2RC
Pot fraction can be 1/1 to 1/100, giving a 100 to 1 range from the pot
Suitable frequency range = 0.01 Hz to 50 kHz
Run op-amps from ± 12 V

3
Low Dissipation Regulator



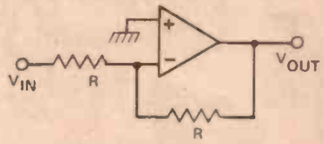
Using an external transistor to reduce the input voltage and power dissipation to a safe level.

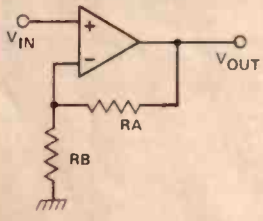
4
Basic Op-amp Building Blocks



Voltage follower/buffer
Input must have a DC path to ground

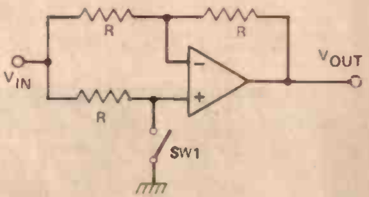
Inverter
Voltage gain = −1
input impedance = R

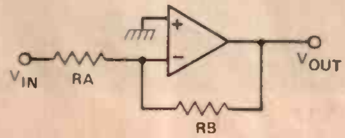




Non-inverting amplifier
Input must have a DC path to ground
Voltage gain = (RA + RB)/RP

Inverter/non-inverter amplifier
Voltage gain = +1 with SW1 open
Voltage gain = −1 with SW1 closed

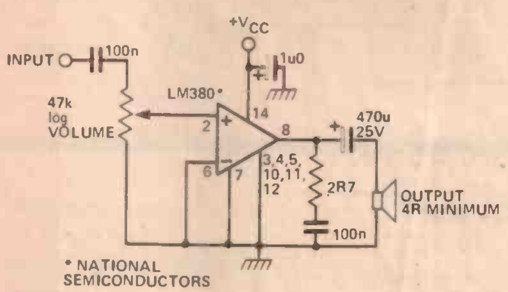




Inverting Amplifier
Voltage gain = −RB/RA
Input impedance = RA

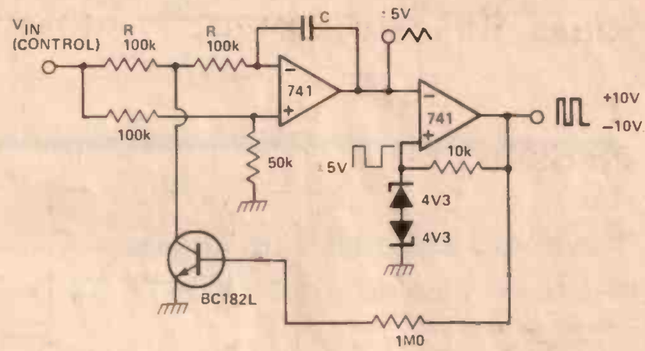
SUPPLEMENT

5
Audio Power Amp



Voltage gain (fixed) = x 50 (34 dB)
$+V_{CC}$ range = +8 V to +22 V
Typical quiescent current = 7 mA
Output power = 2W5 (with speaker = 8R, heatsink fitted)

6
Linear VCO



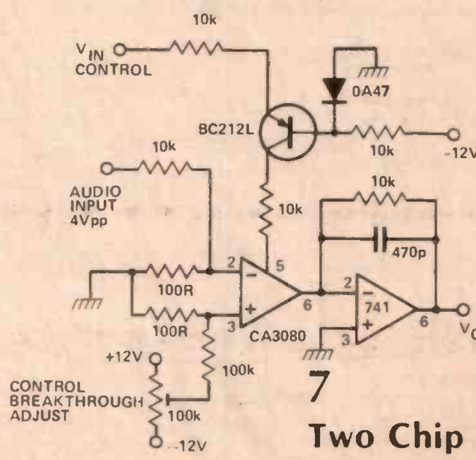
Triangle and square wave outputs

Output frequency $F = (1.667 \times 10^{-7} \times V_{IN})/C$ Hz

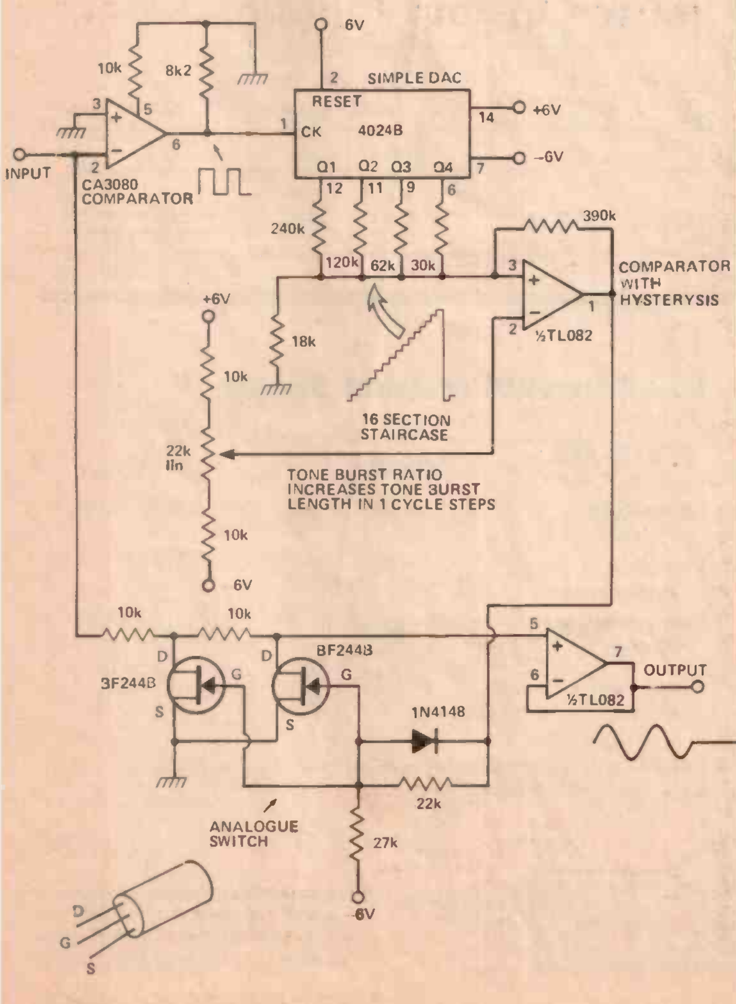
If C = 1n0 and V_{IN} = 10V, then F = 1.66 kHz

Changing both R's from 100k to 10k will increase F by x 10

For low frequencies use TL081 op-amps
Frequency range 0.1 Hz to 10 kHz



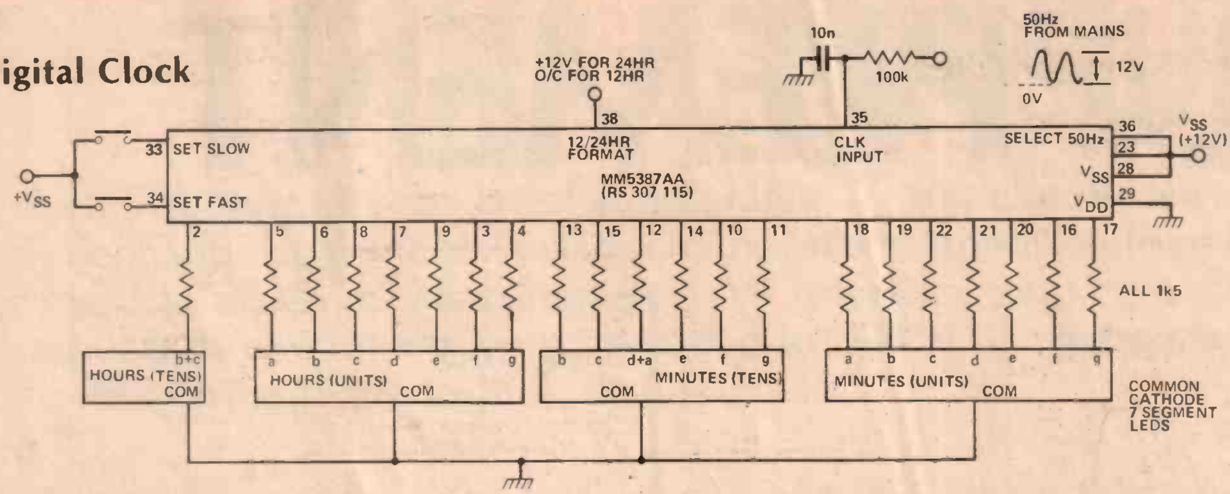
7
Two Chip VCA



8
Variable Length Tone Burst Generator

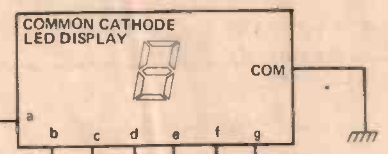
Input is a sinewave or any other periodic waveform, maximum level ± 2 V, maximum frequency 100 kHz
Output is a tone burst variable from one cycle on, 15 cycles off to 15 cycles on, one cycle off
All devices powered from ± 6 V

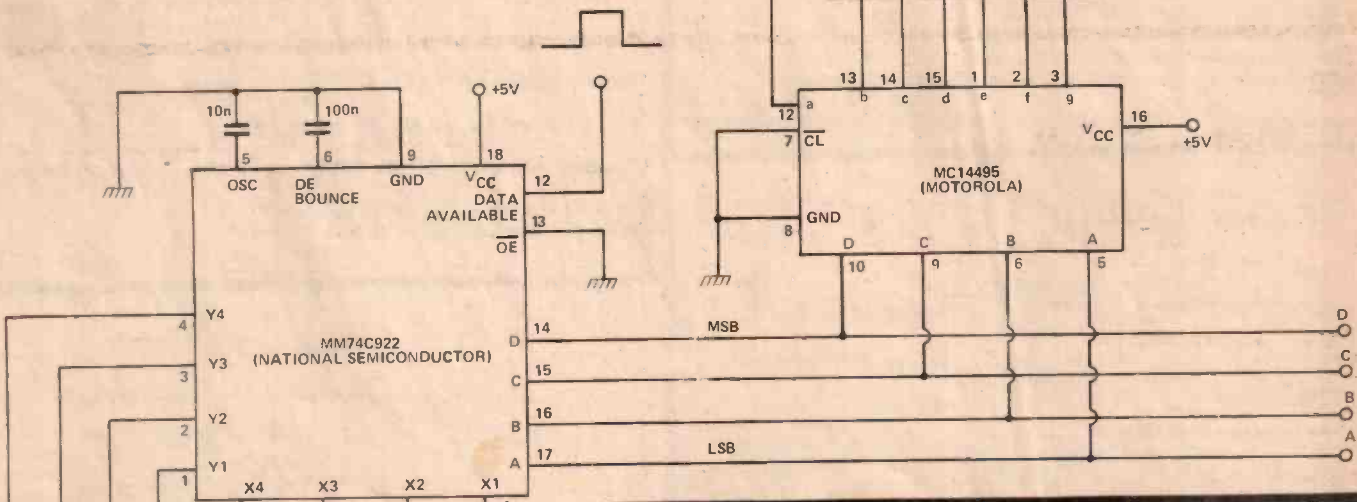
9
Digital Clock

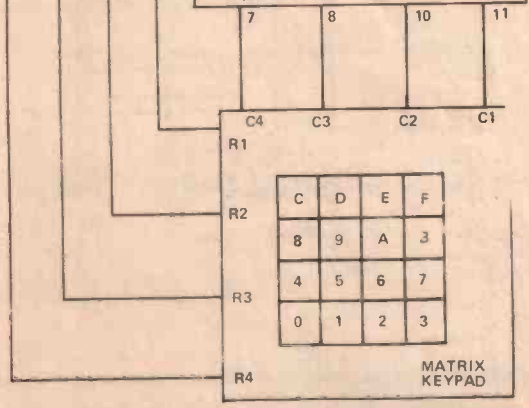


10
Keyboard Encoder And Display

The MC14495 is a latch/decoder/driver. It decodes 0 to 9 and A to F.



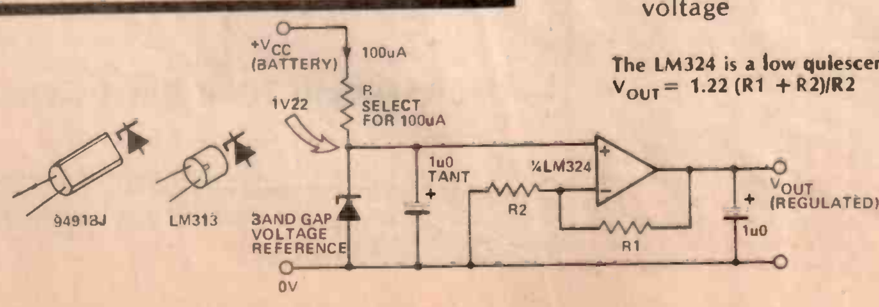




11
Low Current/Precision Supply

Band gap reference	9491BJ	LM313
Operating current	50 uA to 5 mA	500 uA to 20 mA
Dynamic impedance	1R0	0R3
Temperature coefficient	30 ppm/°C	100 ppm/°C
Breakdown voltage	1V22	1V22

The LM324 is a low quiescent current, ground sensing op-amp
$V_{OUT} = 1.22\ (R1 + R2)/R2$

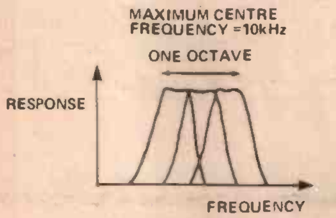


Very useful for battery equipment where only low current and low voltages are available. Also used as voltage references in DVM units.

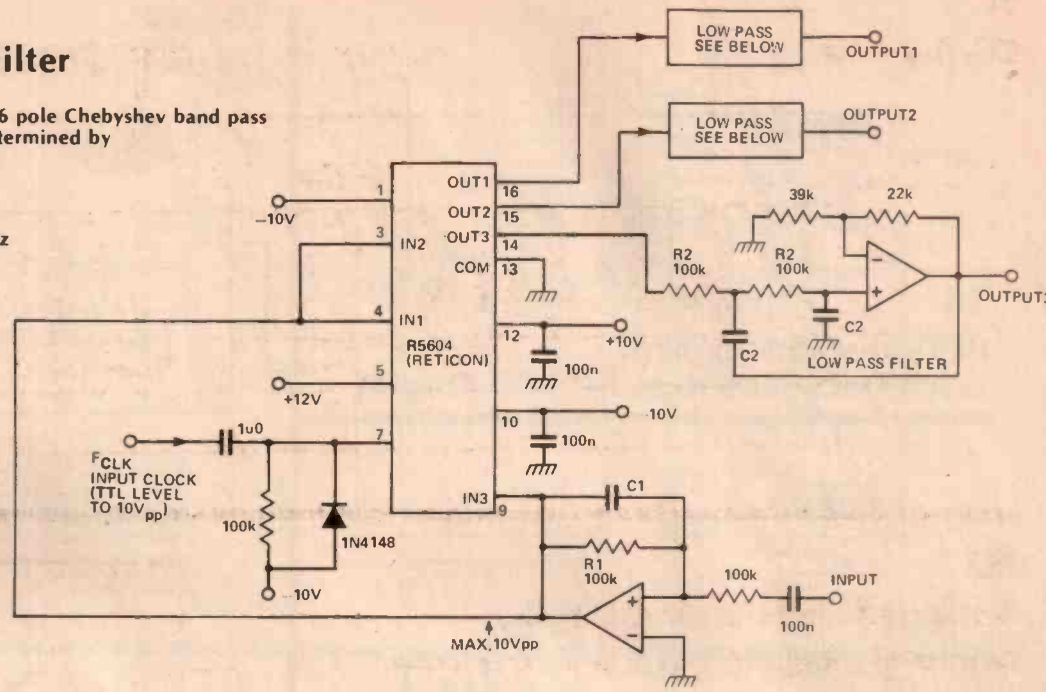
12
Switched Capacitor Filter

The R5604 contains three ⅓ octave, 6 pole Chebyshev band pass filters. The centre frequencies are determined by the relationship $\frac{F_{CLK}}{135}$, $\frac{F_{CLK}}{108}$, $\frac{F_{CLK}}{86.5}$

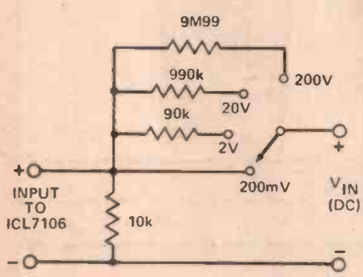
Maximum centre frequency = 10 kHz



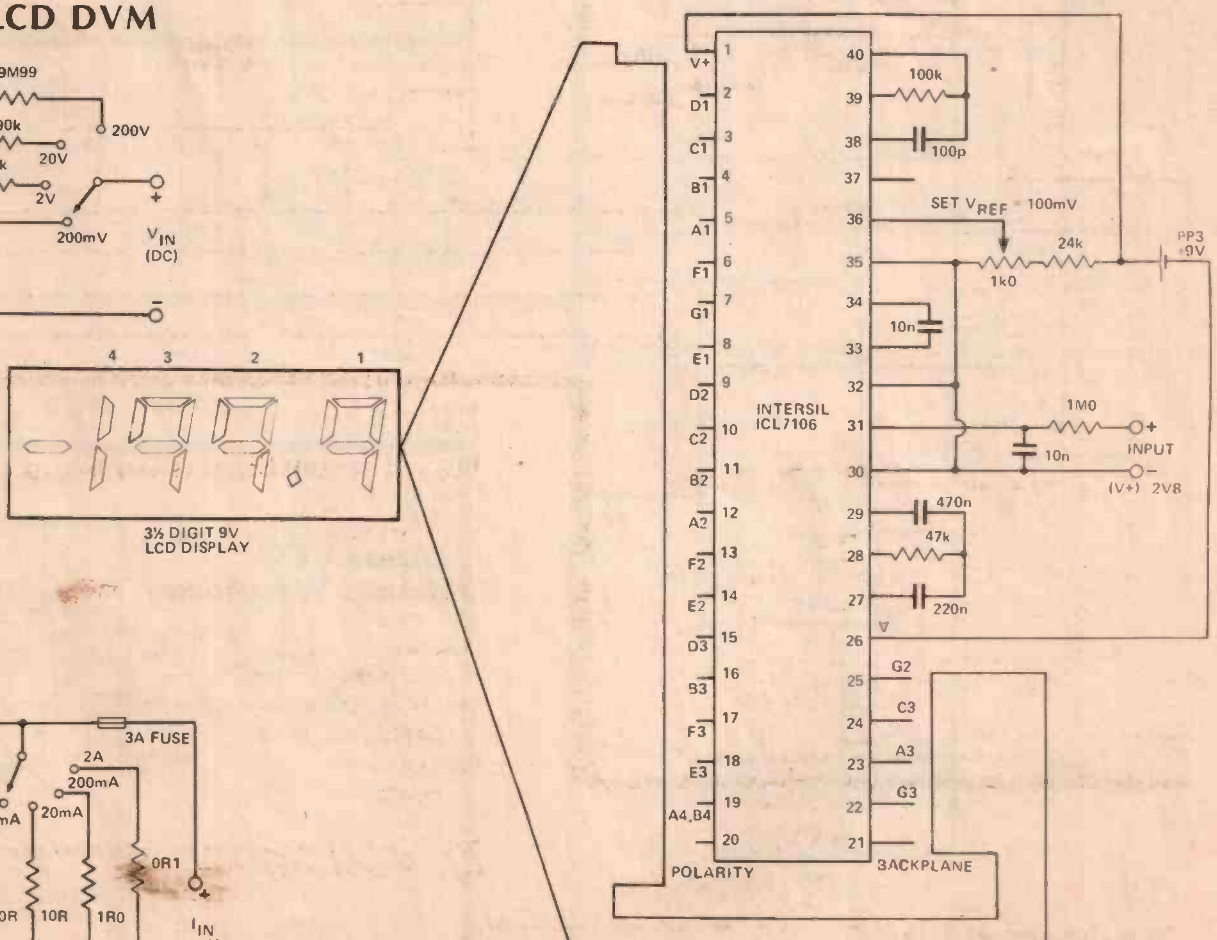
Frequency response of one device. To obtain lower octaves, merely divide input clock frequency by factors of 2.

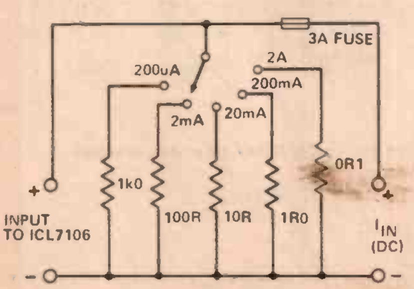


13
3½ Digit LCD DVM



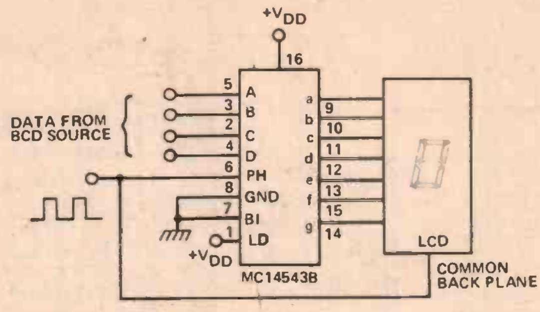
DC voltage inputs





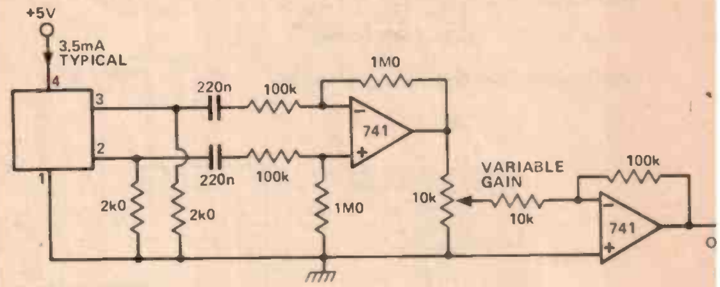
Input voltage range = ±200 mV
Quiescent current = 0.8 mA
Common mode input range = (V+) – 0V5 to (V–) + 1V
Decimal point must be driven externally by EXORing the decimal point data with the backplane strobe

DC current inputs

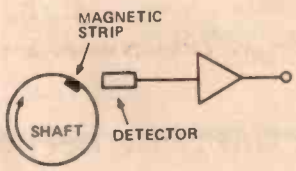


14
BCD-to-seven-segment Latch/Decoder/Driver for LCD Display

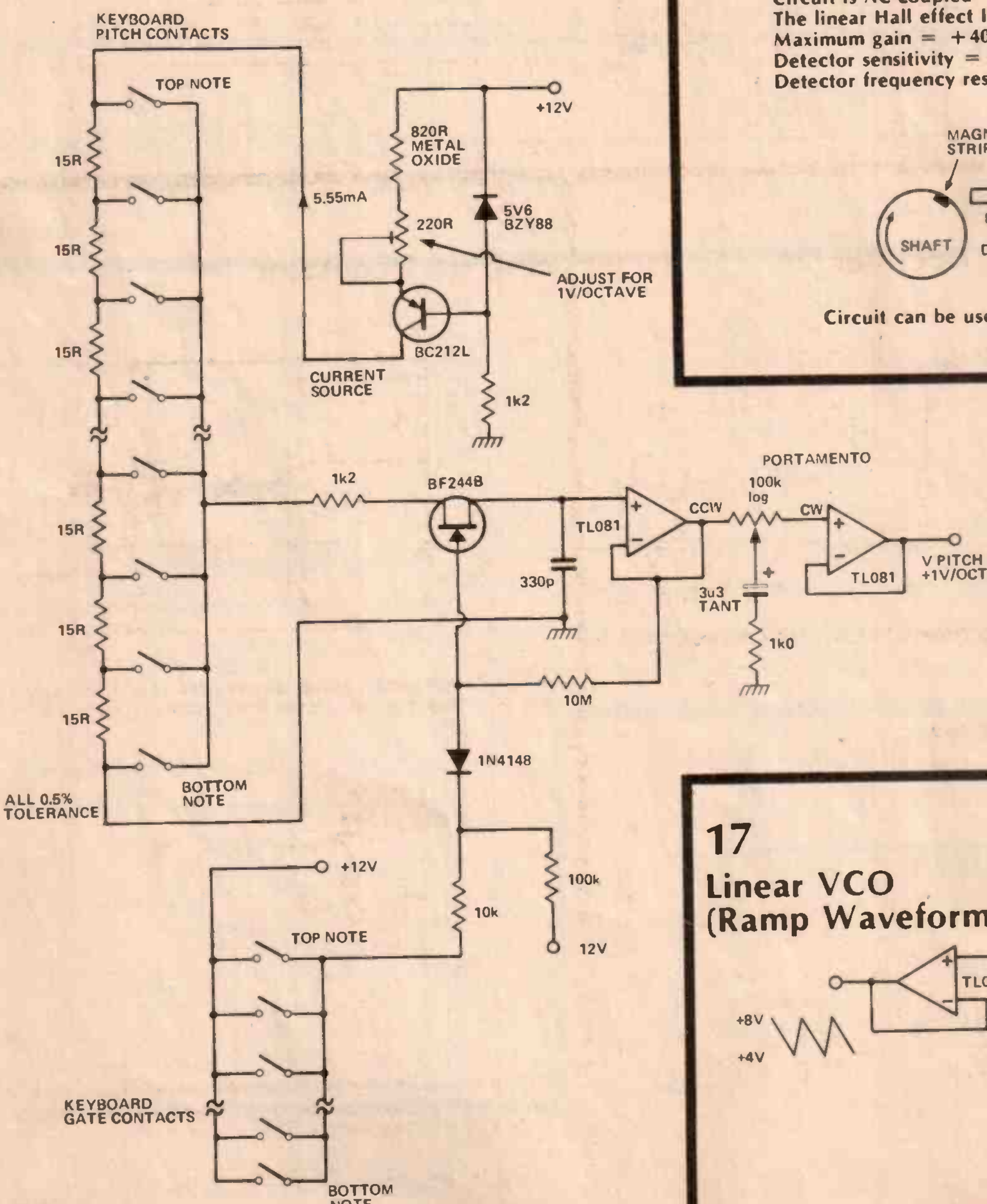
16
Magnetic Field Detector



Circuit is AC-coupled
The linear Hall effect IC is the 634SS2 (RS 304 267)
Maximum gain = +40 dB
Detector sensitivity = 7.5 mV to 10.6 mV/mT
Detector frequency response = DC to 100 kHz



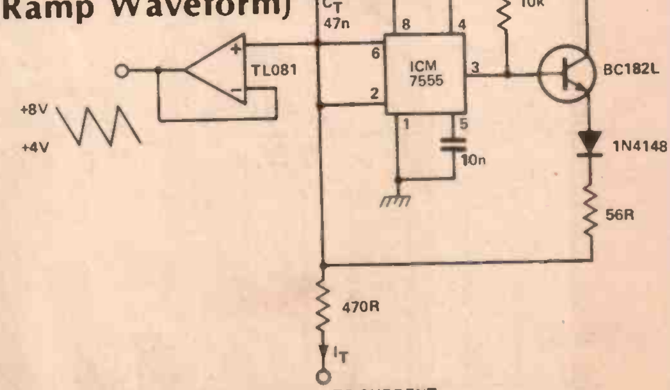
Circuit can be used as a tachometer



15
Keyboard Unit

Adjust the keyboard contacts so that the pitch contacts make before the gate contacts

17
Linear VCO (Ramp Waveform)



Output frequency $F = I_T/4\,C_T$

If I_T = 1mA, C_T = 47n, then F = 5.3 kHz

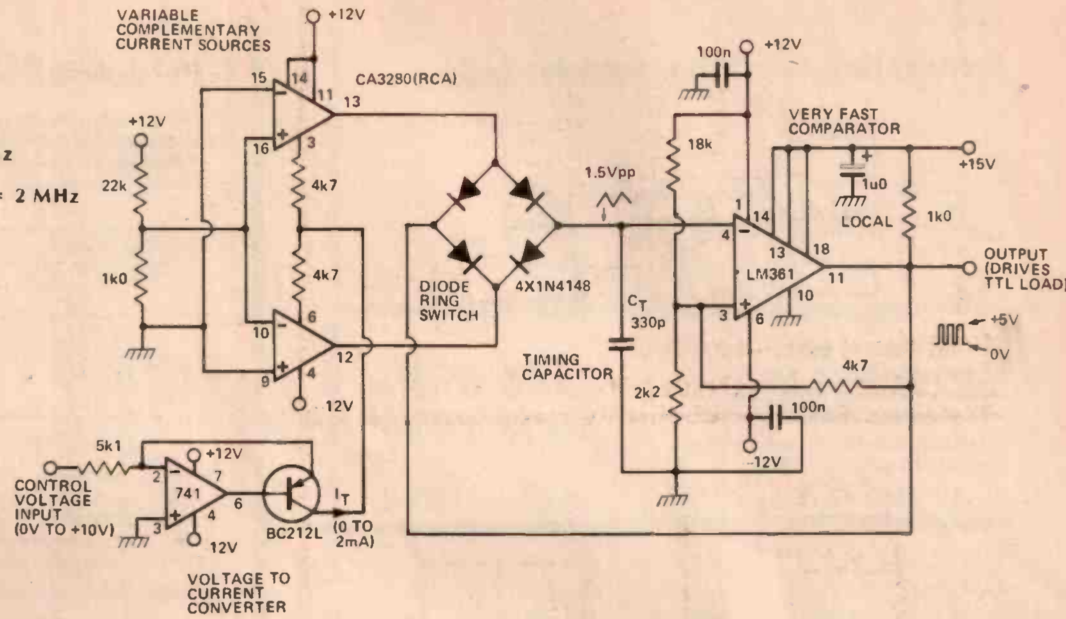
18
Fast VCO

Oscillation frequency $F = I_T/3C_T$ Hz

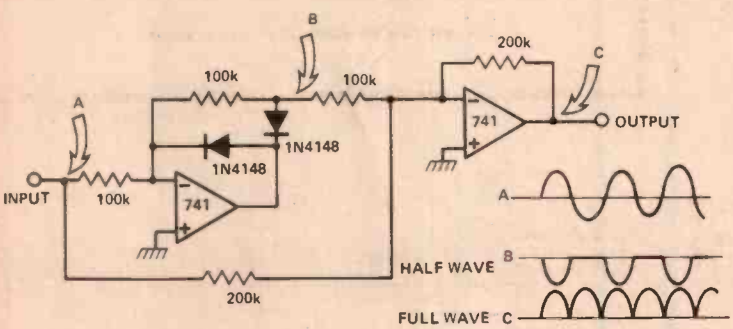
If I_T = 2 mA, C_T = 330p, then F = 2 MHz

Alter C_T to increase F

Maximum frequency = 10 MHz

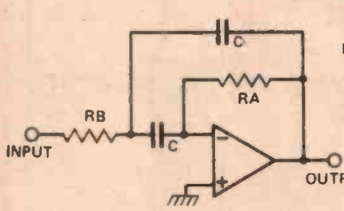


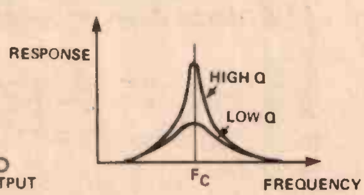
19
Precision Full Wave Rectifier



20
Band Pass Active Filter

$F_c = 1/2\pi C\sqrt{RA+RB}$
$Q = 1/2\sqrt{RA/RB}$
Gain $= 2Q^2$

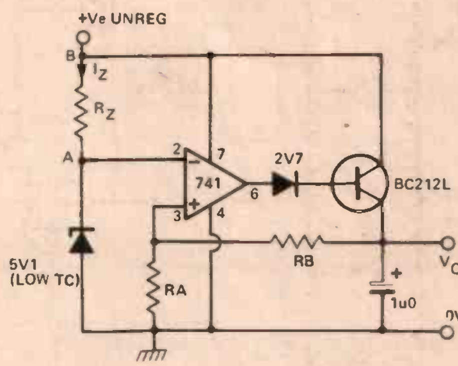




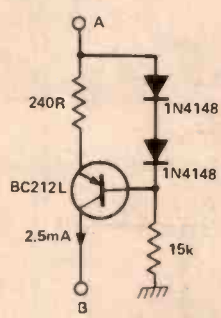
F_C = 1kHz, C = 15n

RA	RB	Q	GAIN
10k6	10k6	0.5	x 0.5
21k2	5k3	1.0	x 2.0
42k4	2k65	2.0	x 8.0
84k8	1k32	4.0	x 32.0

21
Battery Regulator



A very low dropout voltage can be obtained by allowing Q1 to saturate. This gives maximum lifetime on battery power.



Better regulation can be obtained by replacing RZ with this 2.5 mA current source. However, the unregulated supply rail must not drop below (5V1 + 1V2) = 6V3

Select R_Z for an I_Z of about 2.5 mA

V_{OUT} = 5V1 X (RA + RB)/RA

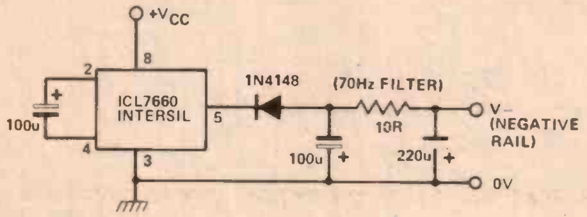
Minimum $V_{OUT} \sim 6V$

Dropout voltage = V_{CE}(Q1 saturated) $\sim$ 0V3

Keep I_{OUT} less than 50 mA

22

Generating Negative Supply Rails

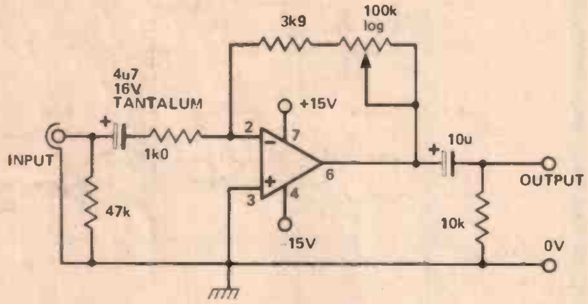


$V- = (+V_{CC} - 0V7)$
Typical efficiency = 98%
Quiescent current = 170 uA
$+V_{CC}$ range = 3 to 10 V
Maximum output current = 40 mA
Output resistance = 55R

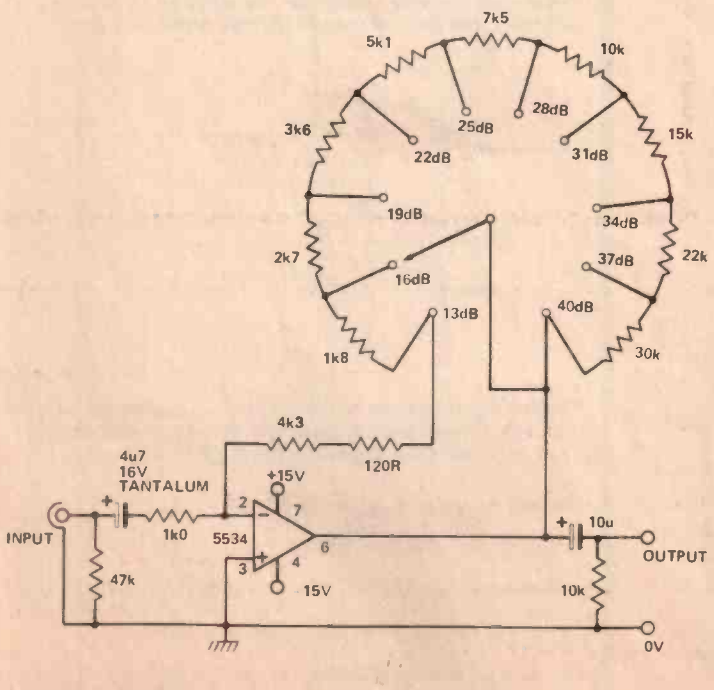
23

Low Impedance Source Preamp

Very low input noise
Input noise = 4 nV$\sqrt{Hz}$
Equivalent input noise voltage = 0.56 uV$_{RMS}$ (20 kHz bandwidth)
Input impedance = 1k0 (suitable for microphone)



Variable gain; x 3.9 to x 100 (12 dB to 40 dB)

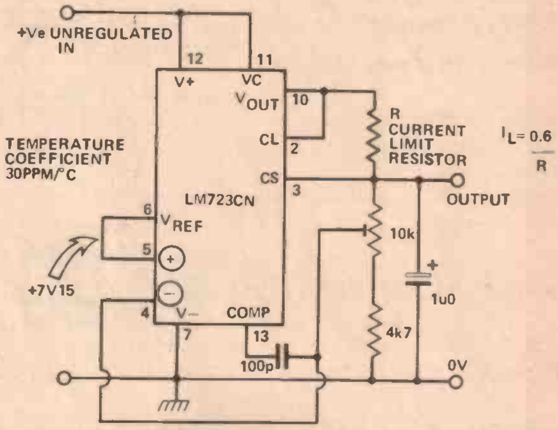


Switched gain; 3 dB steps

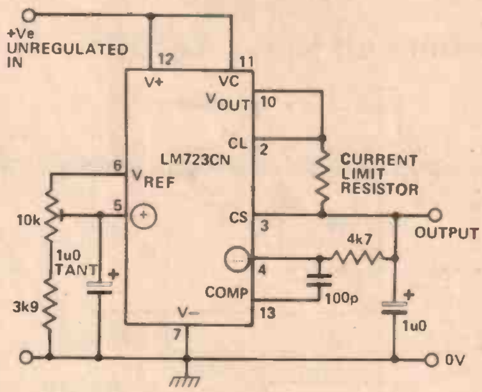
24

Precision Power Supplies

723 general specifications:
Maximum input voltage = 40 V
Maximum current output = 150 mA
Output voltage range = 2 to 37 V



Adjustable +7 V to +21 V

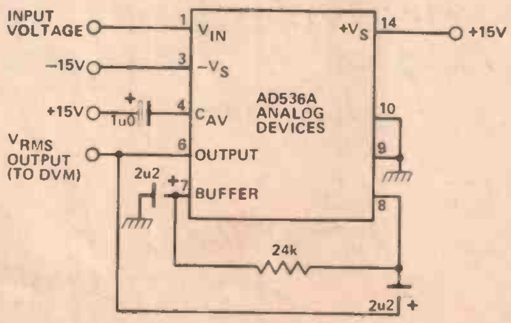


Adjustable +2 V to +7 V

25

True RMS Measurement

Input voltage 7 V$_{RMS}$ maximum
Bandwidth: 300 kHz, V$_{RMS}$ > 0V1
Error of 1% for a crest factor of 7
Quiescent current = 1mA
60 dB range



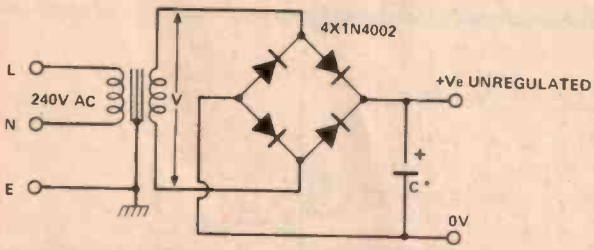
26
Unregulated Power Supplies

* Smoothing capacitor must have a voltage rating greater than the rail voltage.

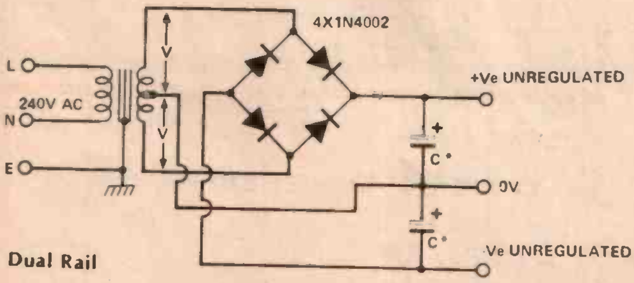
TRANSFORMER SECONDARY VOLTAGE (V_{RMS})	TYPICAL UNREGULATED DC VOLTAGE
4.5	6.3
6.0	8.4
9.0	12.6
12.0	16.8
15.0	21.0
20.0	28.0

APPROXIMATE RIPPLE VOLTAGES (V_{pp})

OUTPUT CURRENT	C = 470u	C = 1000u	C = 2200u
30 mA	0.42	0.21	0.10
100 mA	1.4	0.7	0.32
300 mA	4.2	2.1	0.96
1 A	14.0	7.0	3.20



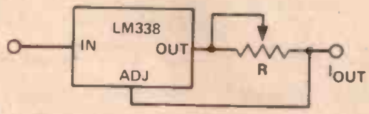
Single Rail



Dual Rail

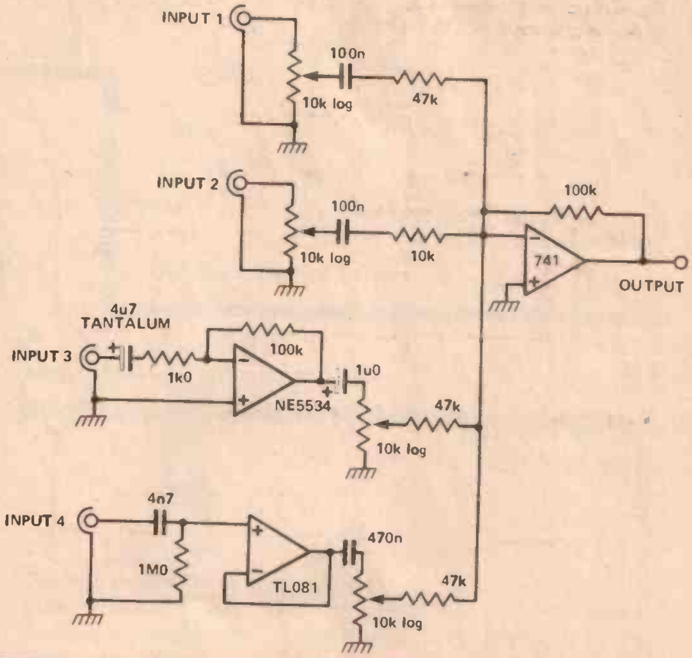
28
Current Limiter

0R4 < R < 120R

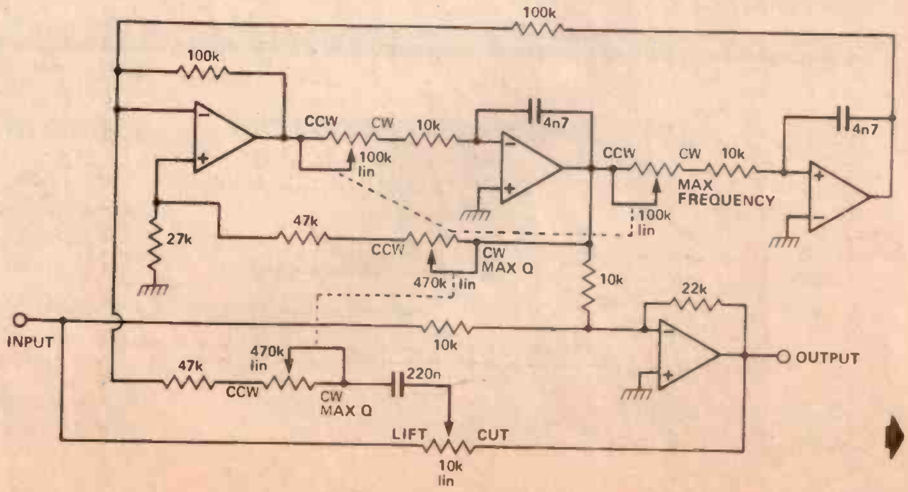


29
Simple Mixer

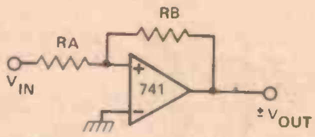
INPUT	MAX GAIN	INPUT IMPEDANCE	SOURCE
1	+6 dB	10k	line level
2	+20 dB	5 to 10k	line level
3	+46 dB	1k0	low impedance microphone
4	+6 dB	1M0	high impedance input



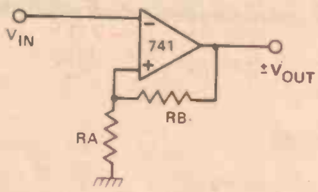
27
Parametric Equaliser



30
Schmitt Triggers

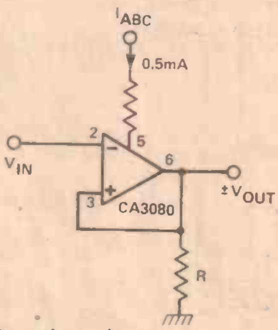


Non-inverting; input hysterysis levels = $\pm(RA/RB)) \times V_{OUT}$



Inverting; input hysterysis levels = $\pm(RA/(RA + RB)) \times V_{OUT}$

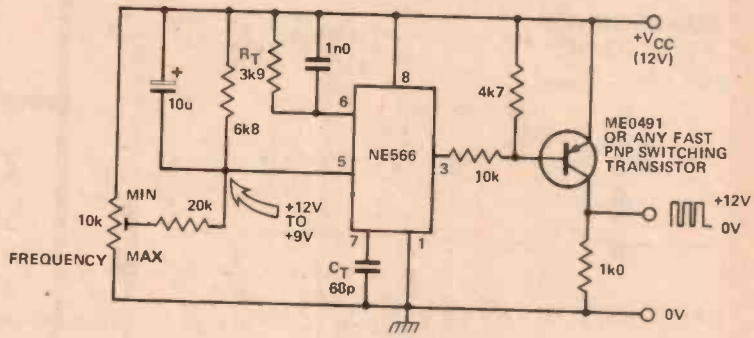
Note that V_{OUT} depends on the supply voltage and the individual op-amp



Transconductance type; input hysterysis levels = $\pm V_{OUT}$; $V_{OUT} = R \times I_{ABC}$

R can be replaced by two 1N4148 diodes back-to-back

31
Fast Oscillator

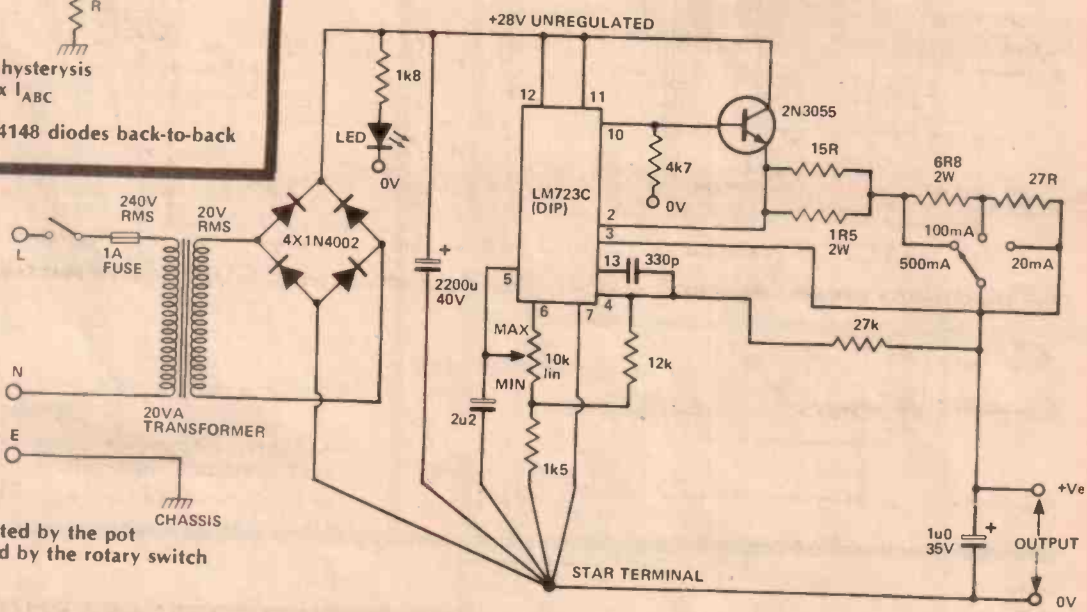


Bias voltage on pin 5, $V_B = \frac{3}{4} V_{CC}$ to V_{CC}

V_B gives a 10 to 1 control range

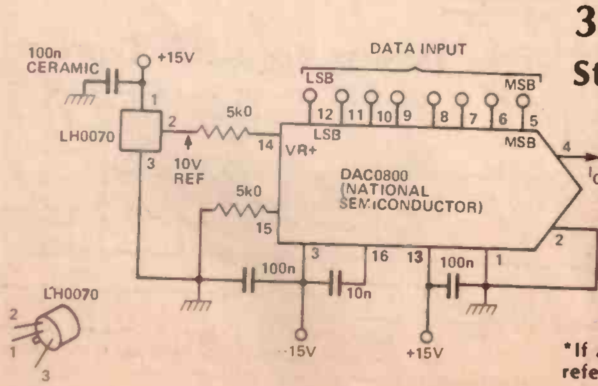
Typical frequency = 1 MHz

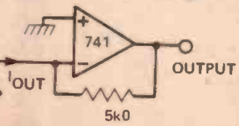
32
Mains Power Supply Unit



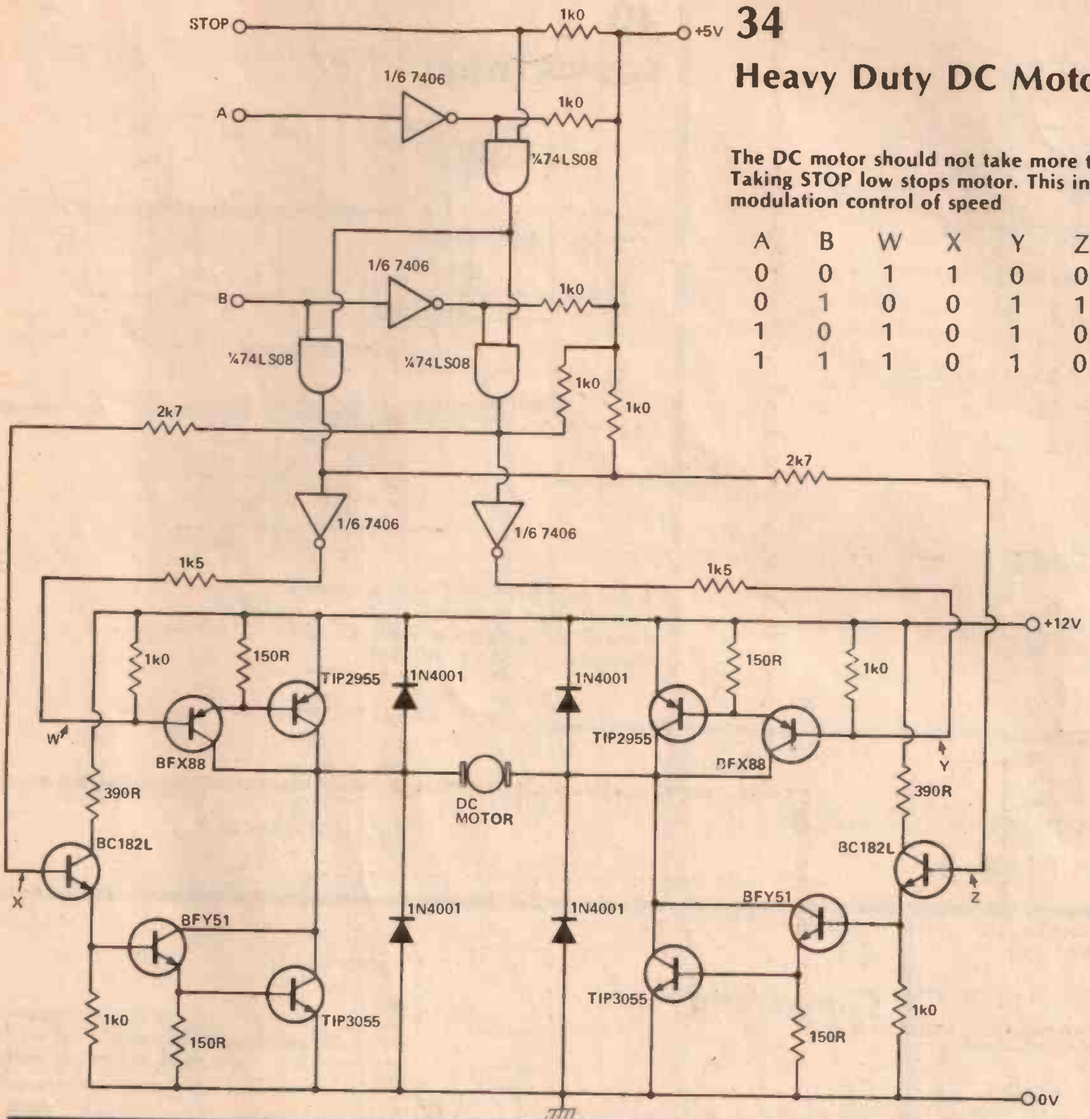
Variable output voltage is selected by the pot
Variable current limit is selected by the rotary switch
Output voltage is 0 to +20 V

33
Standard Eight-bit DAC





*If a precise absolute amplitude is not needed, then a zener diode reference can be used



34
Heavy Duty DC Motor Control

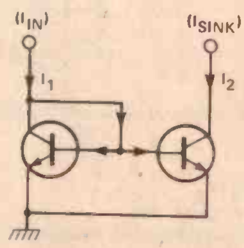
The DC motor should not take more than 3 to 4 A continuous current Taking STOP low stops motor. This input can be used for mark/space modulation control of speed

A	B	W	X	Y	Z	
0	0	1	1	0	0	REVERSE
0	1	0	0	1	1	FORWARD
1	0	1	0	1	0	OFF
1	1	1	0	1	0	OFF

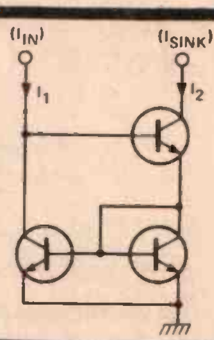
35
Current Mirrors

If ß = 100, I_2/I_1 = 0.98

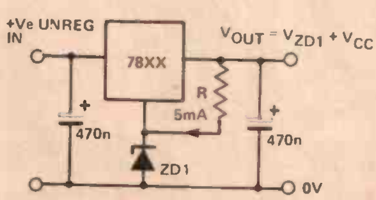
*Matched transistors with the same ß



This improved mirror gives a better I_2/I_1 performance with lower values of ß. Also the I_{SINK} current sink has a much higher output slope resistance.

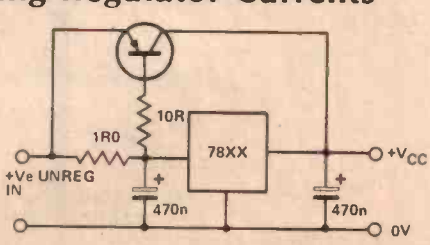


36
Increasing Regulator Voltages



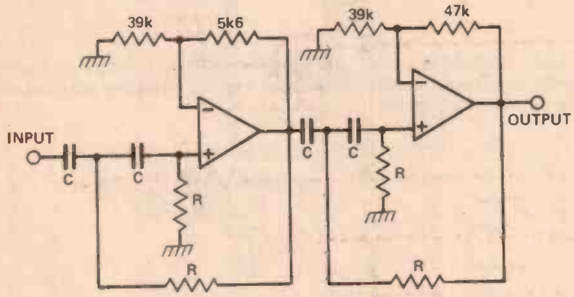
Increasing the output voltage using a zener diode.

37
Increasing Regulator Currents

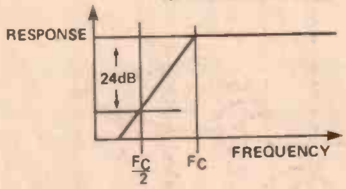


Using a bypass transistor to increase the output current drive. The first 600 mA flows through the regulator, the rest via the external transistor.

38
Rumble Filter



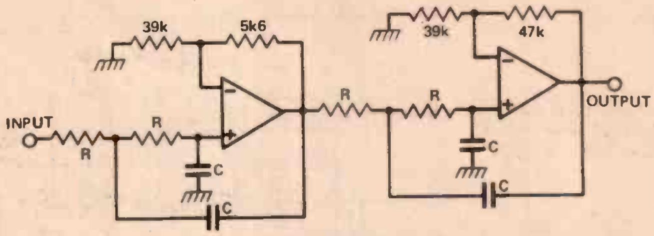
4th ORDER HIGH PASS



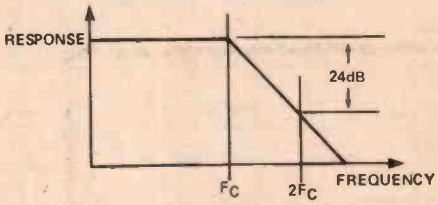
Roll-off slope = 24dB/octave
Overall voltage gain = x 2.6 (8.3 dB)
Op-amps are 741's or RC4558

F_c	C	R
25 Hz	100n	62k
50 Hz	100n	30k
100 Hz	100n	15k
200 Hz	100n	7k5
	(5% tolerance)	

40
Scratch Filter



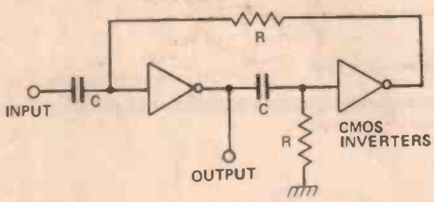
4th ORDER LOW PASS

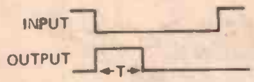


Input must have a DC path to ground
Roll-off slope = 24 dB/octave
Overall voltage gain = x 2.6 (8.3 dB)
Op-amps are 741's or RC4558

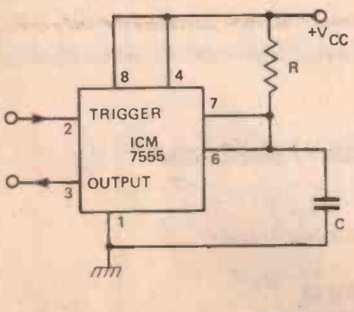
F_c	C	R
10 kHz	1n5	10k
7.5 kHz	1n5	14k
5 kHz	1n5	20k
	(5% tolerance)	

39
Monostables



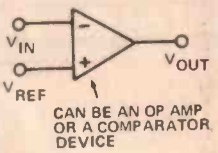


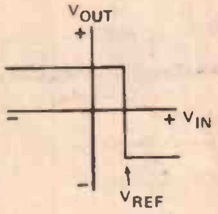
CMOS inverters
T = 1.38RC
Keep R greater than 47k



CMOS 555
T = 1.1RC

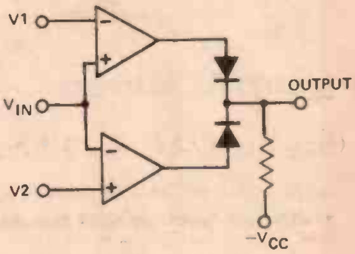
41
Comparators

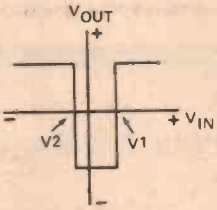


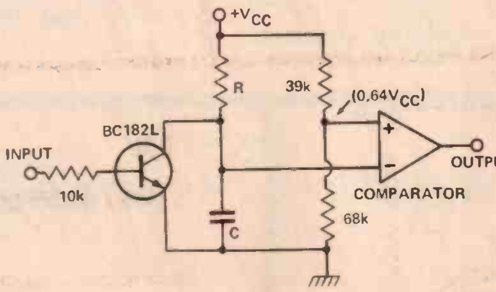


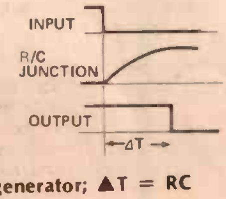
Response of a simple comparator

Window comparator
V1 and V2 can be defined by resistors
or can be set by any voltage
Note that V1 must be more positive
than V2







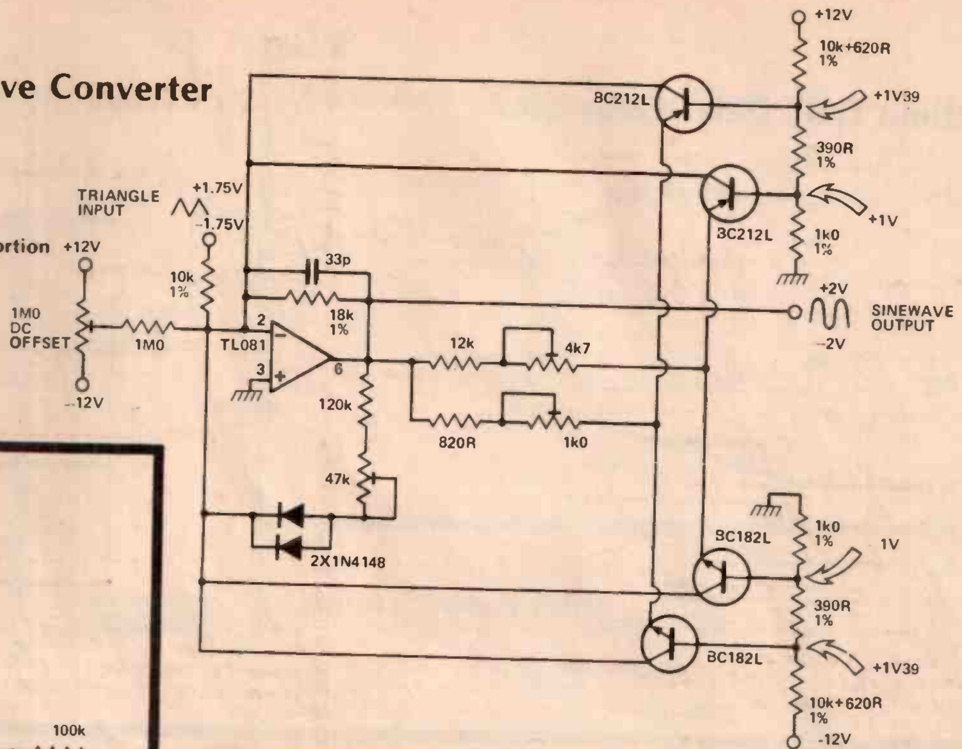


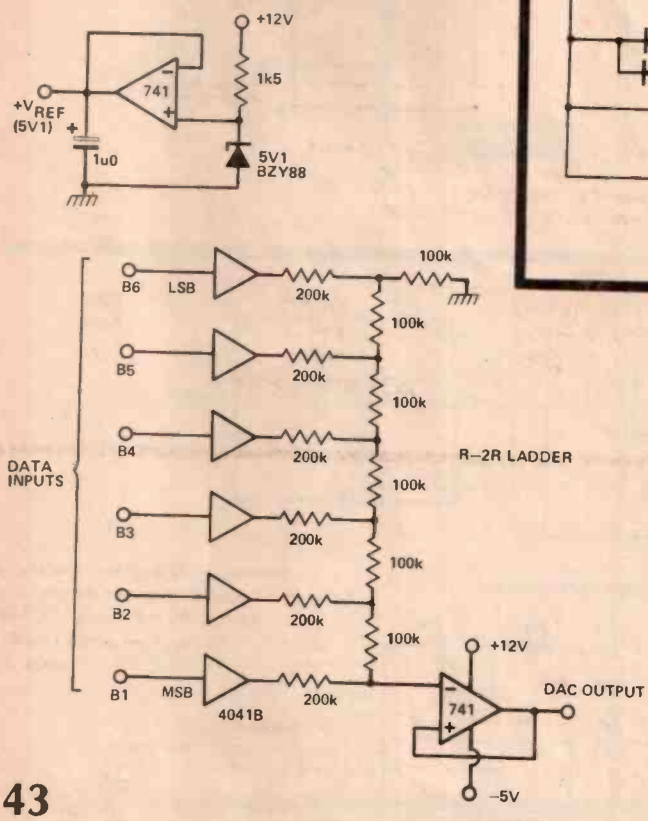
Time delay generator; ▲T = RC

Standard comparators
LM311 single
LM339 quad
LM361 very fast single
LM3914 linear 10-section
LM3915 log 10-section

42
Triangle To Sine Wave Converter

Adjust all presets for minimum distortion
Typical THD = 1%
Best THD = 0.5%

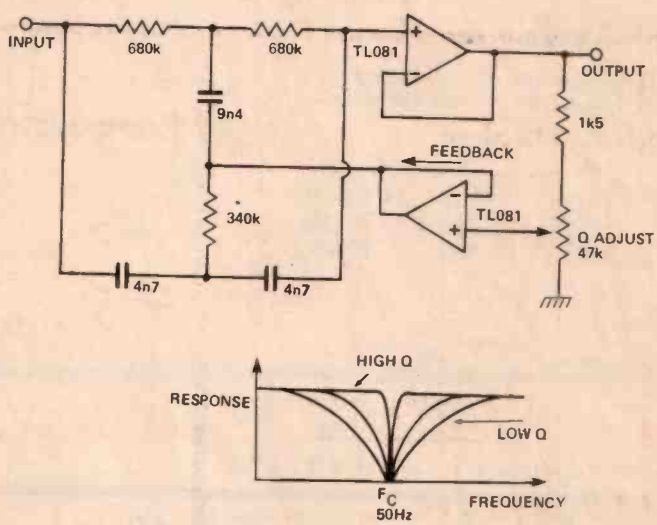


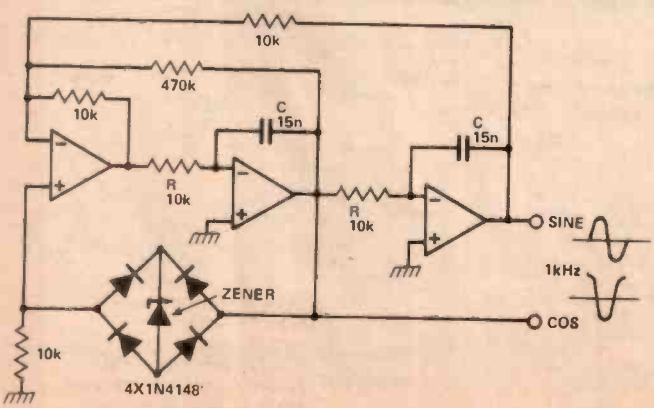


43
Six-bit DAC — 10-bit Precision

Buffers powered from 0 V and $+V_{REF}$
Resistors in ladder need 0.1% tolerance
DAC output has 64 steps

44
50 Hz Notch, Variable Q





45
Dual Integrator Oscillator

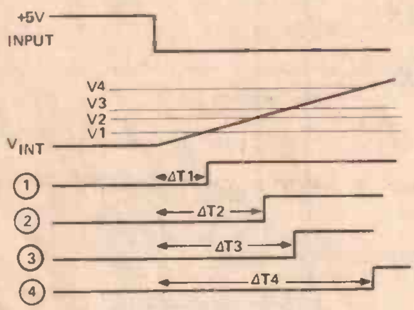
Quadrature outputs (ie sine and cosine)

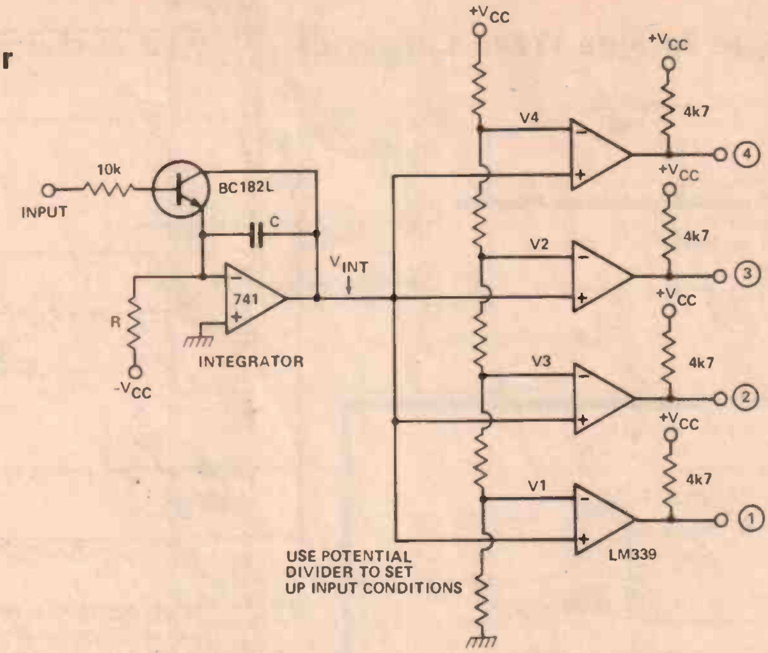
Output frequency $F = \frac{1}{2\pi RC}$ Hz

To change frequency, change both R's or both C's.
Maximum frequency ~ 20 kHz
Minimum frequency ~ 0.016 Hz using C = 1u0, R = 10M, and TL081 op-amps
Oscillation amplitude ≈ 2x(zener voltage + 1V2) V_{pp}

46
Multiple Time Delay Generator

Ramp rate = $-(-V_{cc}/CR)$ volts per second





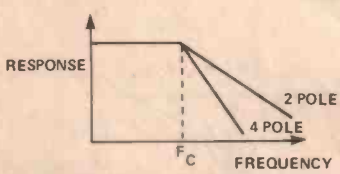
47
Low Pass Active Filters

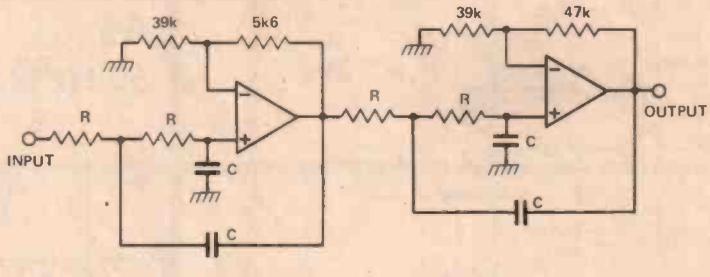
Inputs must have a DC path to ground

$$F_c = \frac{1}{2\pi RC}$$

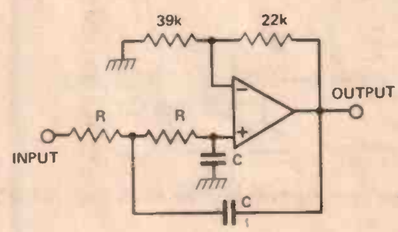
2 pole roll-off = −12 dB/octave
4 pole roll-off = −24 dB/octave

R	C	F_c
107k	15n	100 Hz
10k7	15n	1 kHz
10k7	1n5	10 kHz





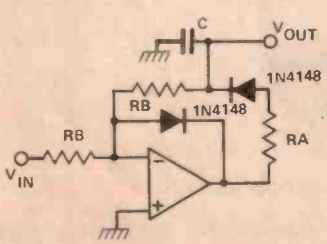
4 pole Butterworth



2 pole Butterworth

48
Inverting Peak Voltage Detector

Attack time constant = C.RA
Decay time constant = C.RB



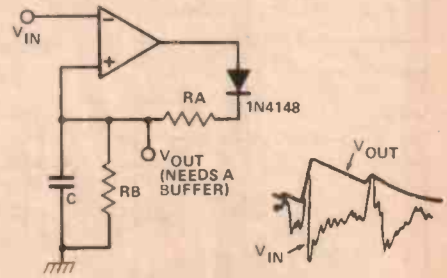
This circuit works well at high frequencies

49
Non-inverting Peak Voltage Detector

Input must have a DC path to ground

Keep RA grater than 1k0 to avoid dumping large currents to ground via C

Attack time constant = C.RA
Decay time constant = C.RB



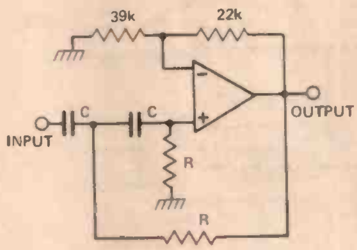
This circuit is not suited for high frequency operation

50
High Pass Active Filters

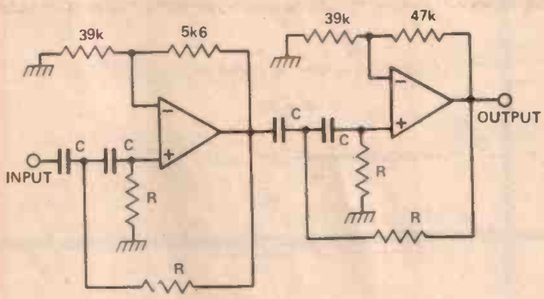
$$F_c = \frac{1}{2\pi RC}\ \text{Hz}$$

2 pole roll-off = +12 dB/octave
4 pole roll-off = +24 dB/octave

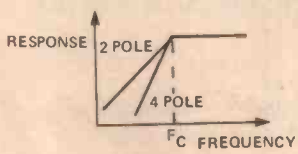
R	C	F_c
107k	15n	100 Hz
10k7	15n	1 kHz
10k7	1n5	10 kHz



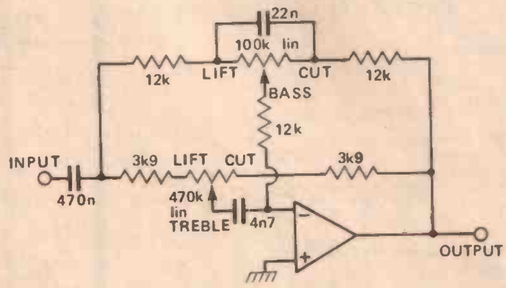
2 pole Butterworth



4 pole Butterworth

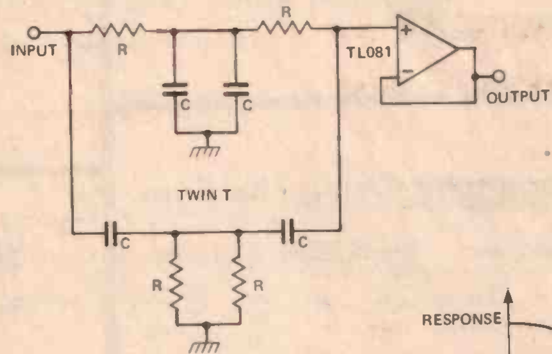


52
Bass And Treble Tone Control

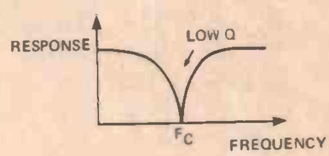


53
Active Notch Filter

The two R's in parallel represent R/2
The two C's in parallel represent 2C
For 50 Hz, R = 680k, C = 4n7 (a hum remover)

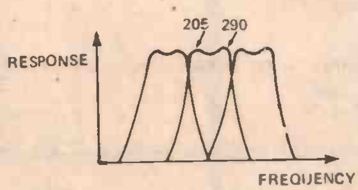


$$F_c = \frac{1}{2\pi RC}$$

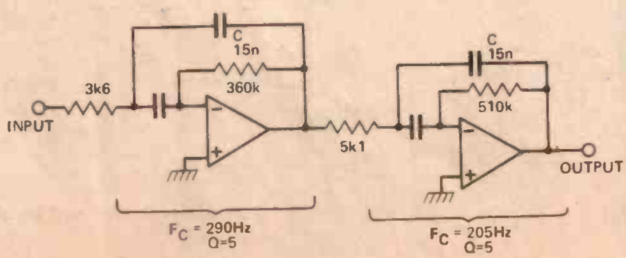


51
Double Tuned Band Pass

Filter section has been designed for one octave spacing. To alter the components for the other octaves, scale the resistors or the capacitors, ie changing C to 7n5 increases the filter frequency by one octave.

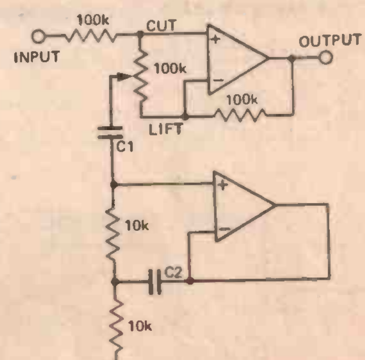


Typical filter bank response

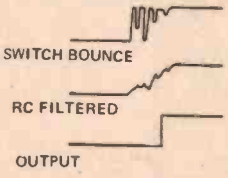


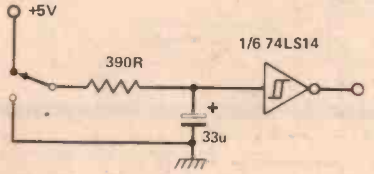
54
Middle Tone Control

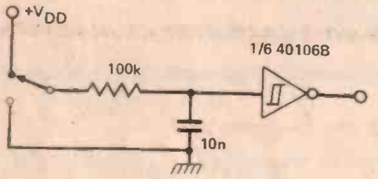
Input must have a DC path to ground



55
Switch Debouncing Using Schmitt Triggers







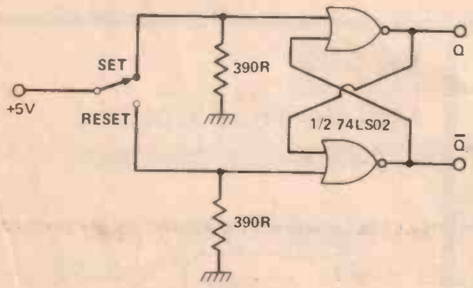
56
Switch Debouncing Using Flip-flops

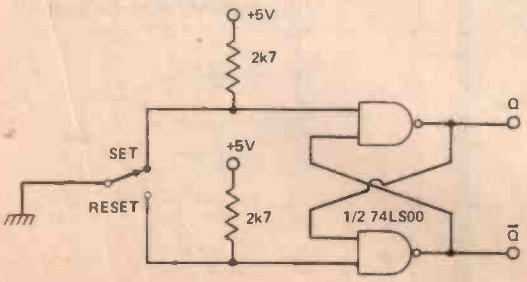
Flip-flop using NOR gates

S	R	Q	$\overline{Q}$
1	0	0	1
0	1	1	1

Flip-flop using NAND gates

S	R	Q	$\overline{Q}$
0	1	1	0
1	0	0	1

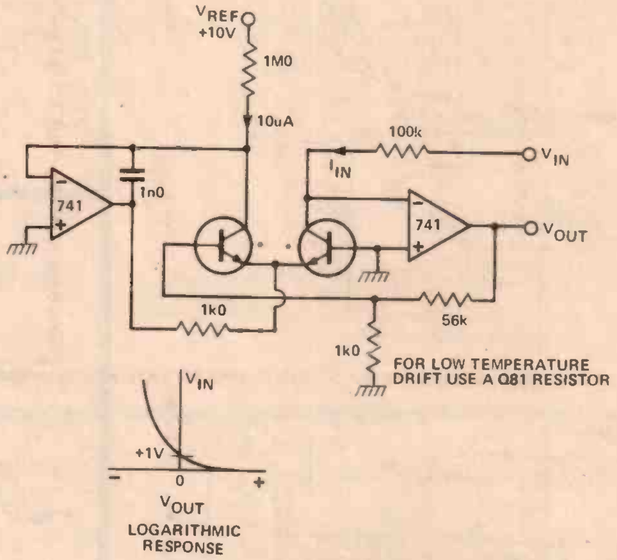




57
Log Converter

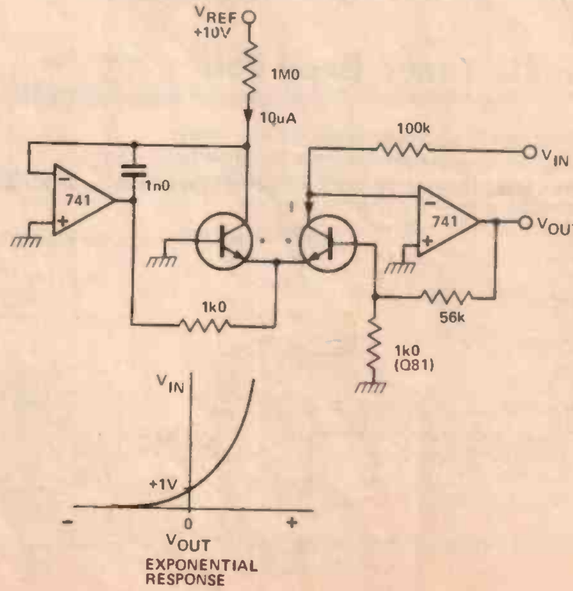
V_{OUT} changes by 1 V for every octave change of the I_{IN} current

*The matched transistors can be two BC212L in thermal contact, or a dual transistor (LM394), or pat of an array (CA3046)



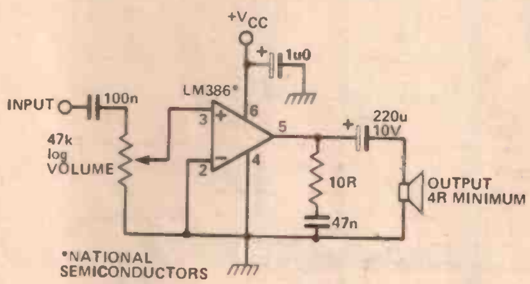
58
Antilog (Exponential) Converter

$V_{OUT} = I \times 100k$
The current I doubles for every 1 V increase of V_{IN}
When $V_{IN} = 0$ V, I = 10 uA



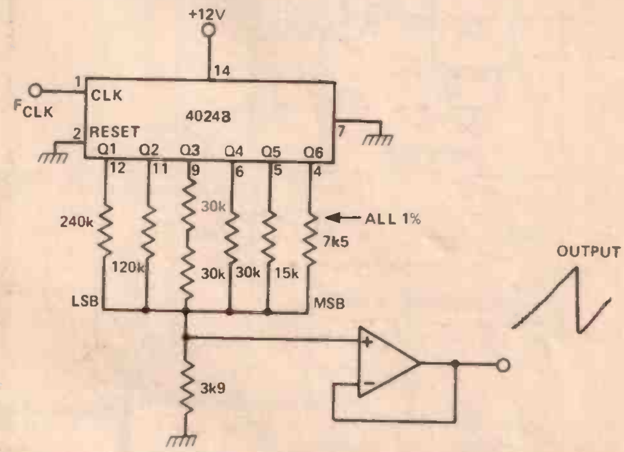
59
Low Voltage Power Amp

Voltage gain (fixed) = x 20 (26 dB)
$+V_{CC}$ range = +4 V to +12 V
Typical quiescent current = 4 mA (suitable to PP3 use)
Output power = 0W7 (if $+V_{CC}$ = 9V, speaker = 8R)
THD = 10%



61
Staircase Generator

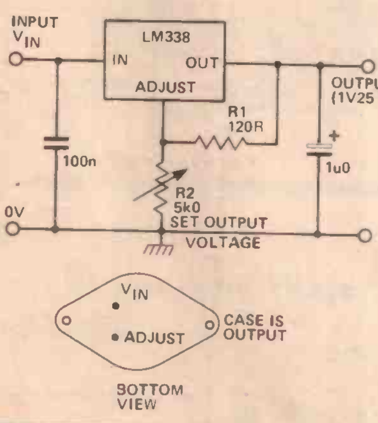
Output frequency F = $F_{CLK}/64$
Staircase is made up of 64 steps



60
5 A Regulator

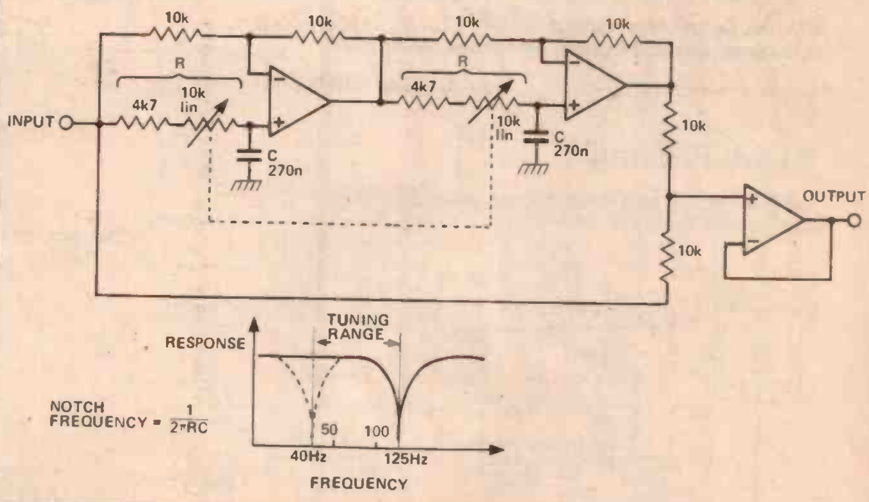
LM338 parameters:
Maximum input/output difference = 35 V
Maximum output current = 5 A
Ripple rejection = 85 dB
Thermal resistance, junction to case = 1°C/W

V_{OUT} = 1.25 (R1 + R2)/R1
P_{DISS} = $I_{OUT}(V_{IN} - V_{OUT})$. Use a heatsink.



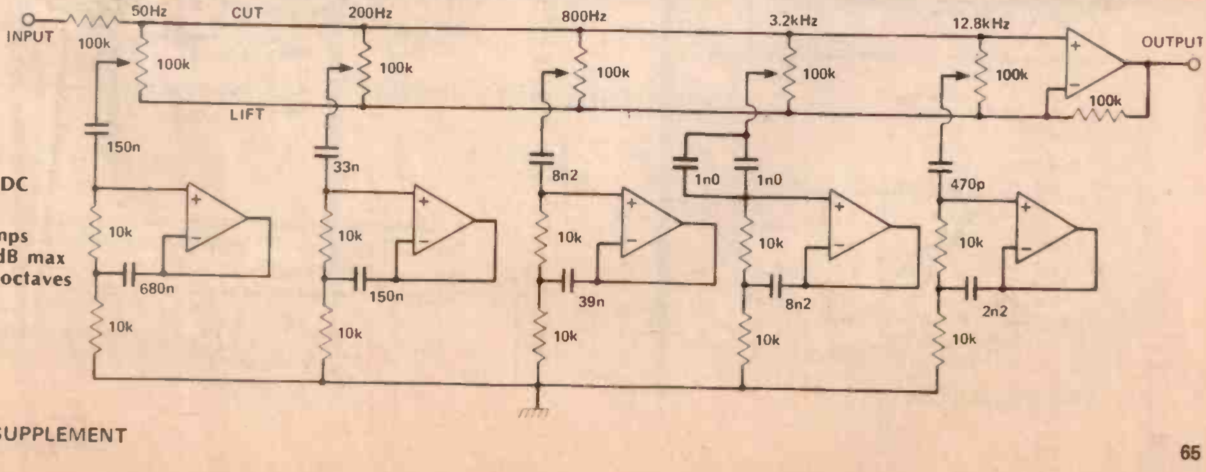
62
Notch Filter (Hum Remover)

Notch frequency = $1/2\pi RC$



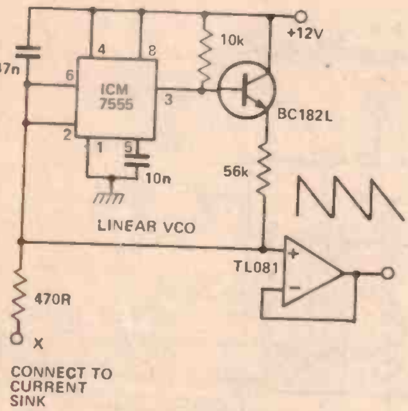
63
Graphic Equaliser

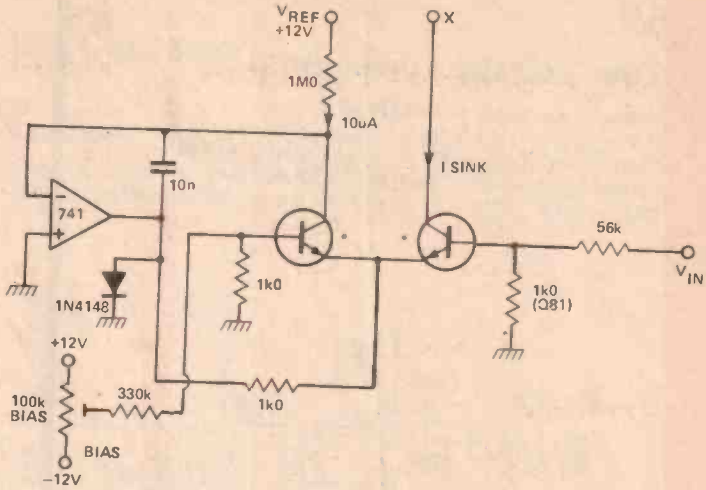
Input must have a DC path to ground
Use 741's for op-amps
Cut and lift = 13 dB max
Filter spacing = 2 octaves



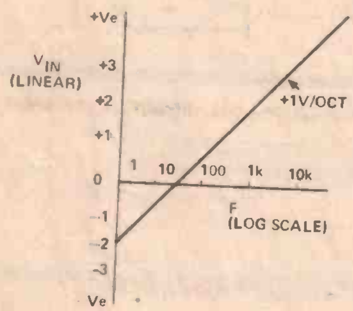
64

Exponential Current Sink





*Matched transistors in thermal contact

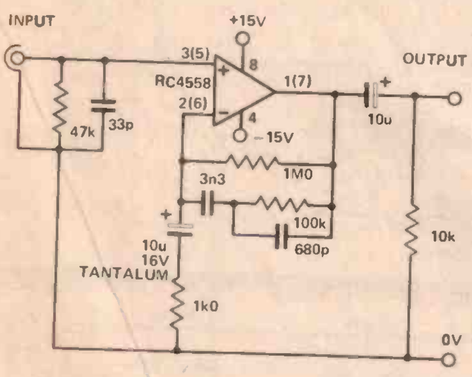


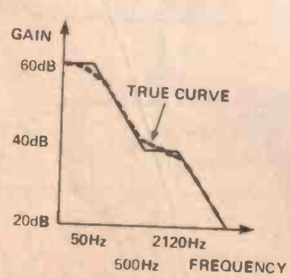
Frequency response of a linear VCO driven by an exponential current sink

65

RIAA Preamp

Suitable for use with magnetic cartridge
Use RC4558 for low noise

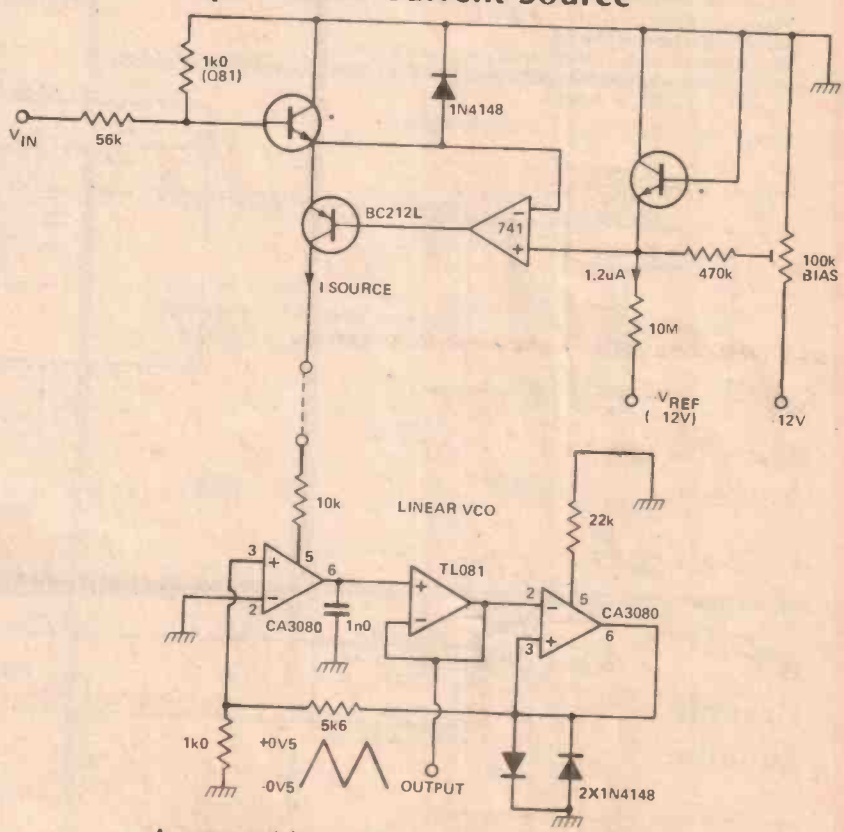




RIAA playback curve

66

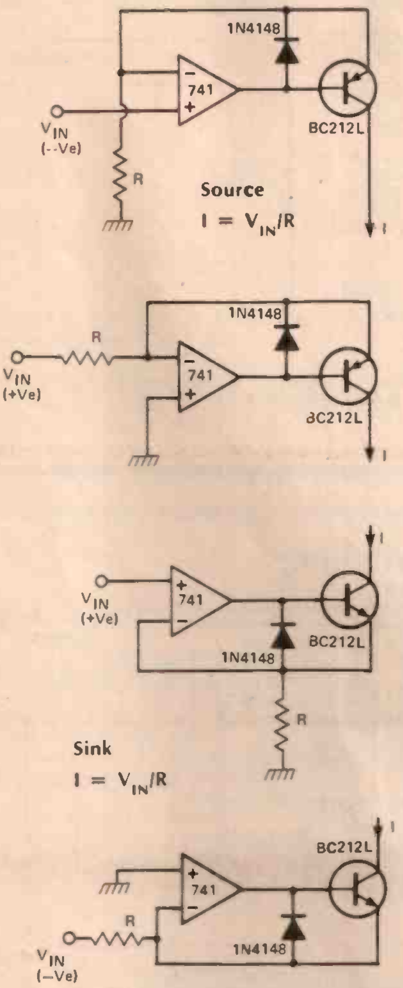
Exponential Current Source



An exponential current source can be used to drive a linear VCO. The VCO then has a 1 V/octave response

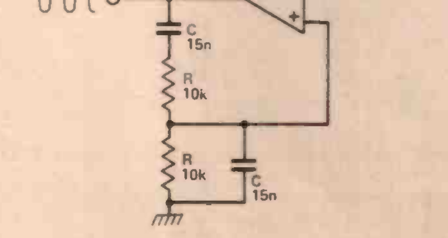
Devices all powered from ± 12 V
*Matched transistors in thermal contact

67
Voltage-to-current Converters



68
Wien Bridge Sine Wave Oscillator

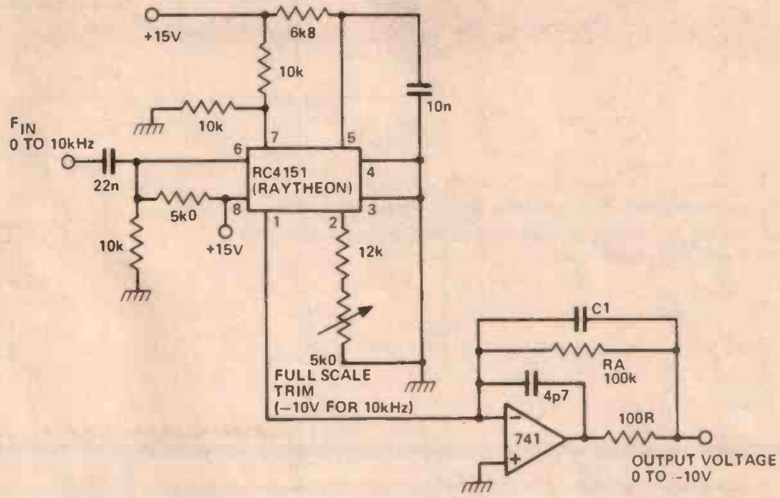
Output frequency $F = \frac{1}{2\pi RC}$ Hz



The RA53 is a negative temperature coefficient thermistor; it sets A_V to 3 for stable oscillation.

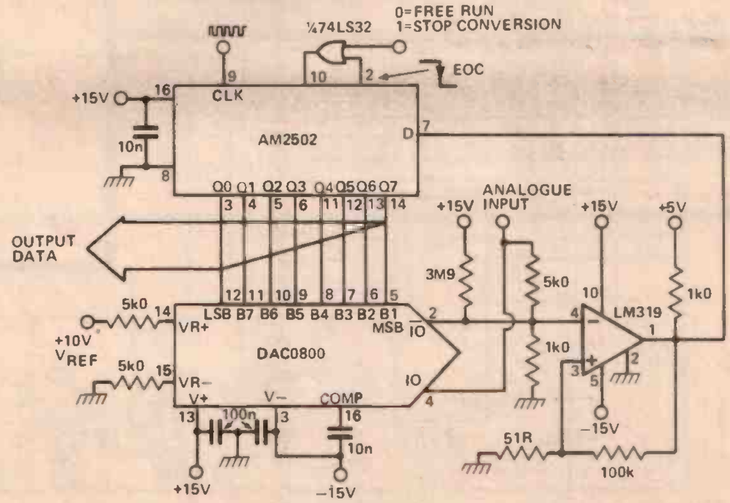
69
Frequency-to-voltage Converter

With C1 = 100n, ripple is 100 mV
Response time = RA.C1
If RA = 100k, C1 = 100n, response time = 10 ms

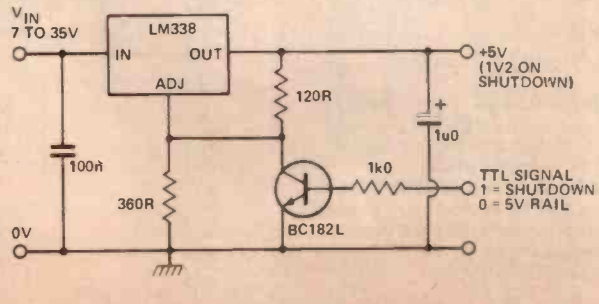


70
Eight-bit ADC

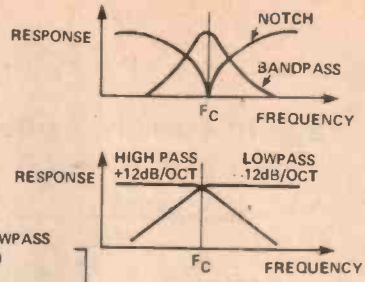
This circuit uses an eight-bit DAC plus a successive approximation register.
Conversion time 9 clock periods

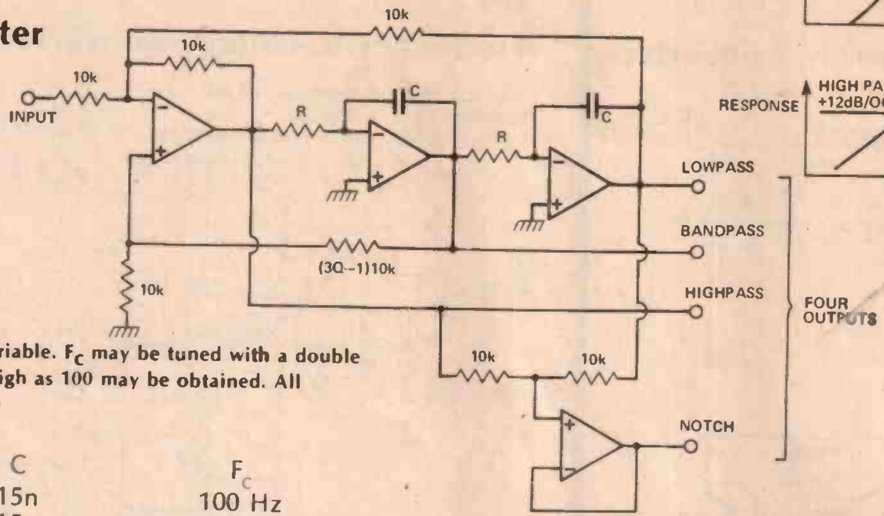


71
Electronic Shutdown



72
State Variable Filter



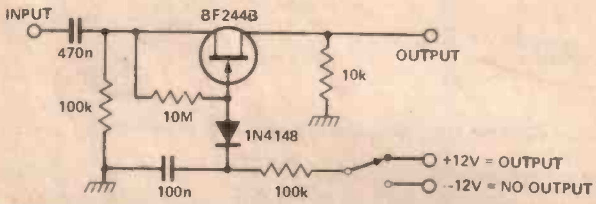


$$F_c = \frac{1}{2\pi RC}\ \text{Hz}$$

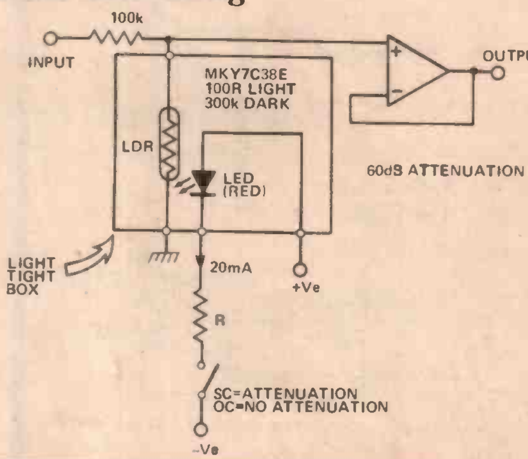
Gain = Q
Q and F_C are independently variable. F_C may be tuned with a double gang pot (for R). Q factors as high as 100 may be obtained. All responses track with frequency.

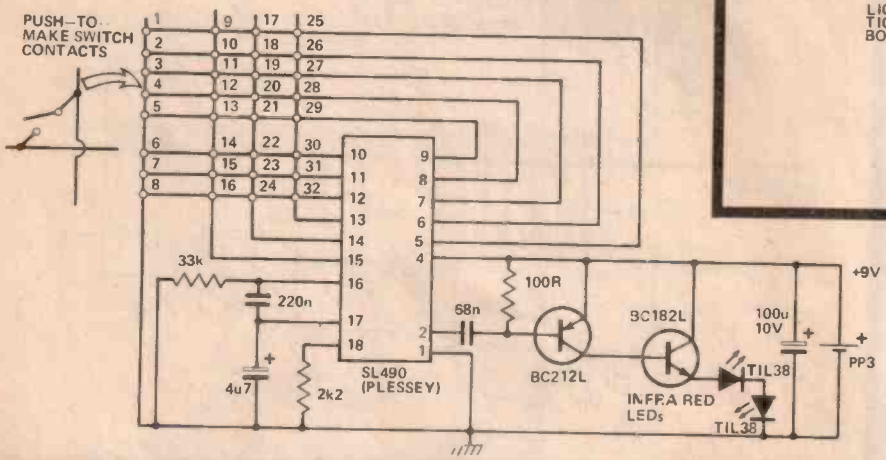
R	C	F_c
107k	15n	100 Hz
10k7	15n	1 kHz
10k7	1n5	10kHz

73
FET Audio Switching



74
LDR Audio Switching





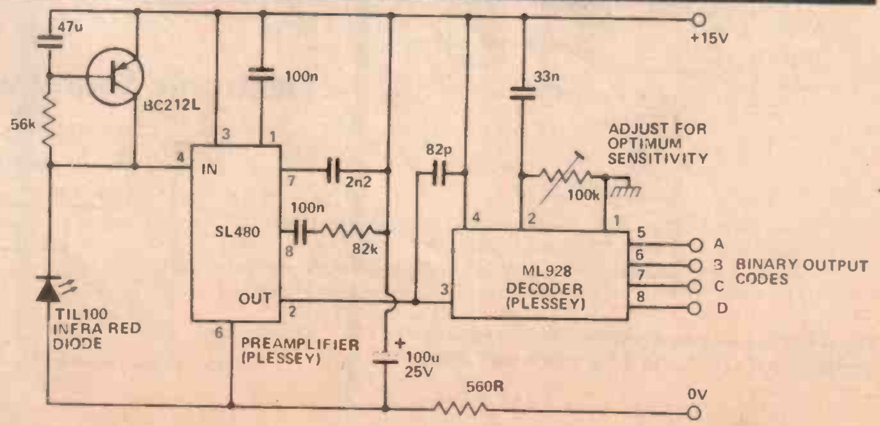
75
Infra-red Transmitter

Standby current = 6 uA
Operating current = 8 mA
32 commands (five-bit code)

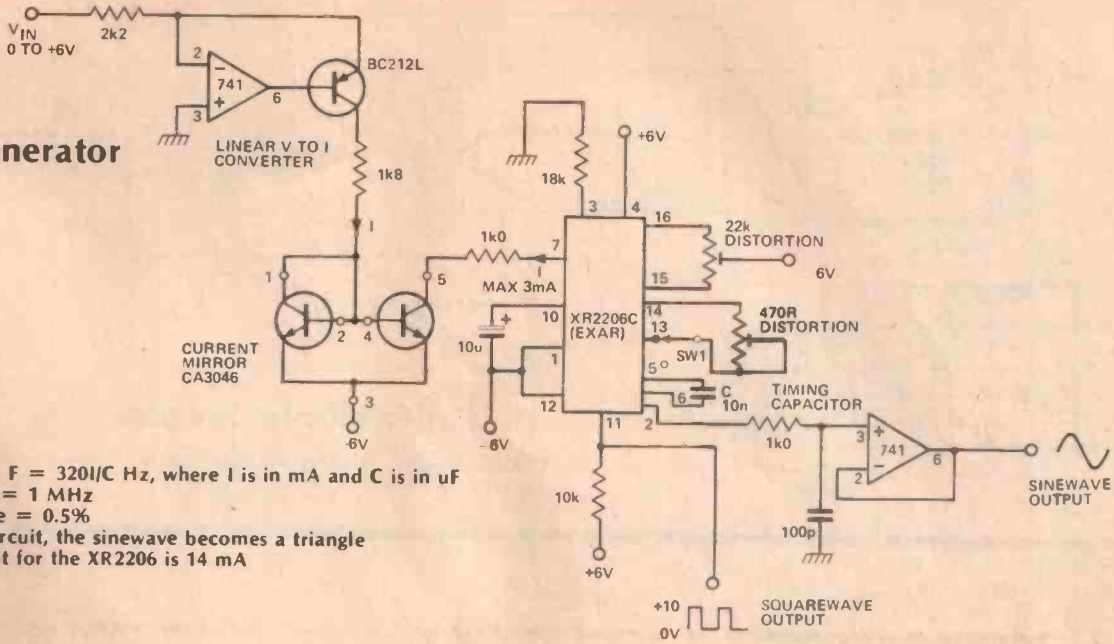
76
Infra-red Receiver

Plessey receiver chip range

ML928 codes 1 to 16 latched
ML929 codes 17 to 32 latched
ML926 codes 1 to 16 momentary
ML927 codes 17 to 32 momentary
ML920 20 outputs and three analogue channels
ML922 10 outputs and three analogue channels
ML923 16 outputs and one analogue channel
ML924 five bit code output
ML925 multifunction for toys



77
Function Generator

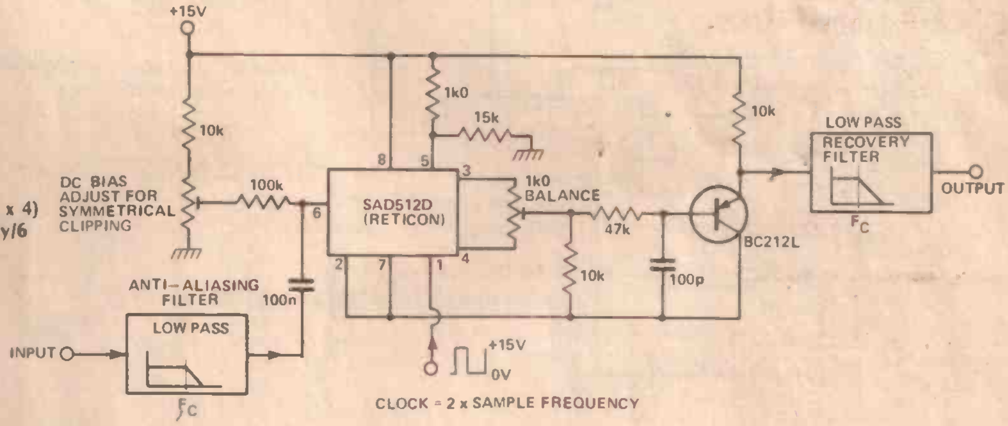


Oscillation frequency F = 320I/C Hz, where I is in mA and C is in uF
Maximum frequency = 1 MHz
Best THD of sinewave = 0.5%
When SW1 is open-circuit, the sinewave becomes a triangle
Typical supply current for the XR2206 is 14 mA

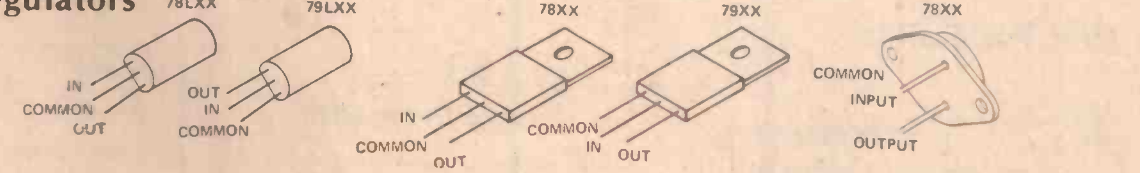
78
Analogue Delay Line

Delay time ▲T = 512/(clock frequency x 4)
Signal bandwidth (F_C) ≤ clock frequency/6

If clock frequency = 60 kHz
▲T = 512/(60,000 x 4) = 2.13 ms
Bandwidth = 10 kHz



79
Voltage Regulators



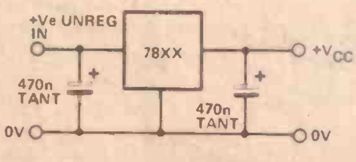
LOW POWER TYPES
TO92 CASE
100mA MAXIMUM

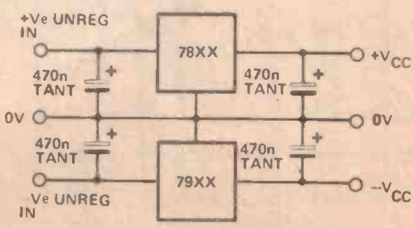
1A TYPES
TO220 CASE

TO3 CASE

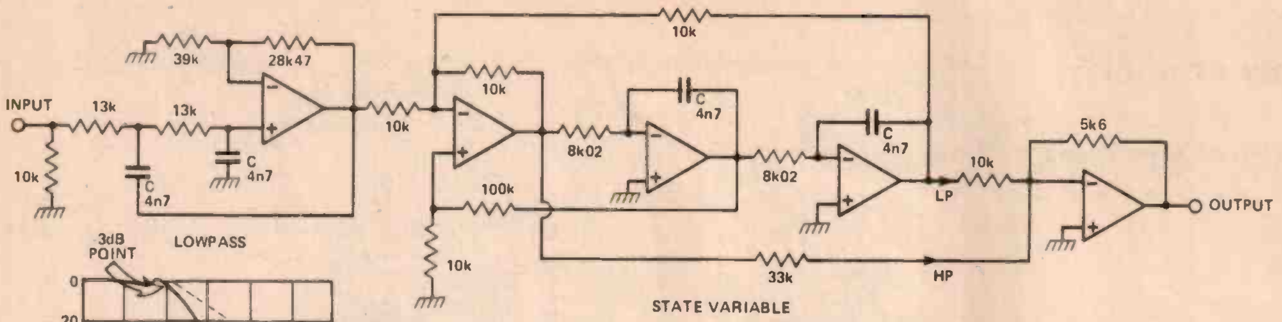
Generally Available Output Voltages

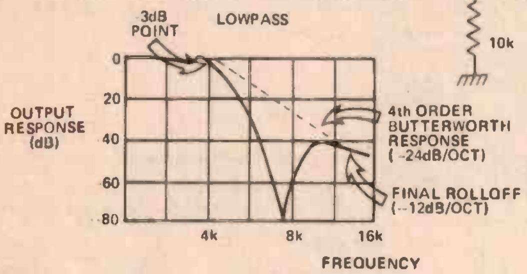
78XX series	79XX series
+5V	−5V
+12V	−12V
+15V	−15V
+18V	−18V
+24V	−24V





Refer to manufacturer's information for maximum input voltage. Typically this is 25 V for 5 V devices and 35 V for all others. Regulators need about 2 V difference between the unregulated rail and the output rail. Less than this, and the output rail will collapse. Note that the power dissipated in the regulator
$= I_{OUT}(V_{UNREG} - V_{CC})$.
This can be several watts, and so sufficient heatsinking must be used.



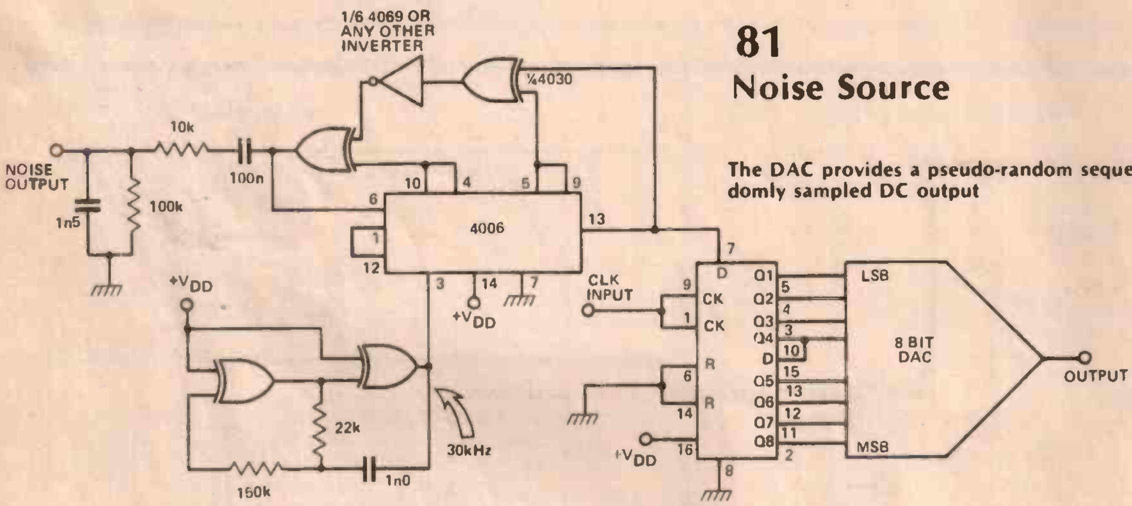


80
4th Order Elliptic lowpass

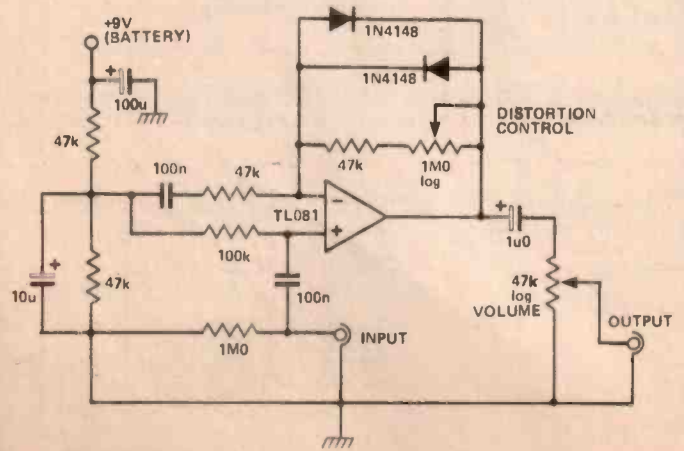
Cutoff frequency is 4 kHz. To change cutoff frequency, scale capacitor C (four off)

81
Noise Source

The DAC provides a pseudo-random sequence generator, with a randomly sampled DC output

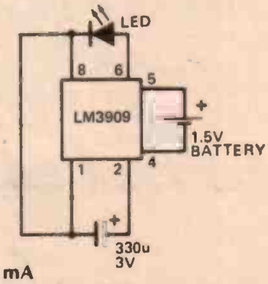


82
Fuzz Unit For Guitar

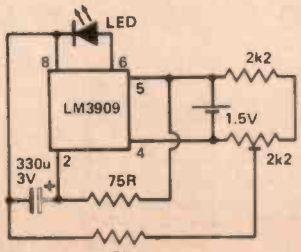


The battery can be switched on via the jack socket (a stereo jack can be used).

83
LED Flasher



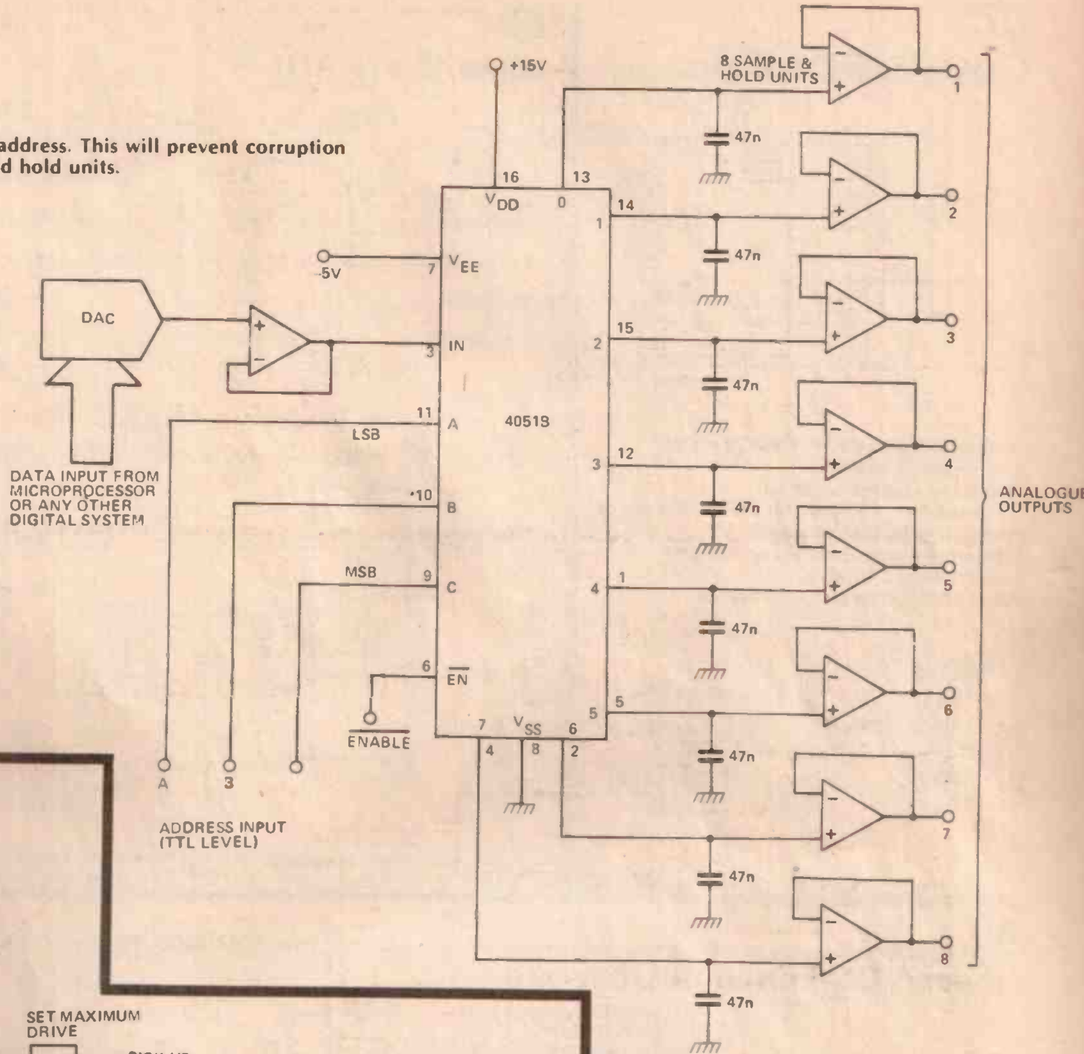
1 Hz flash rate
Average current drain = 0.32 mA
Circuit uses the timing capacitor to boost the output voltage

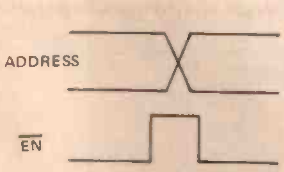


Variable flash rate 0 to 20 Hz

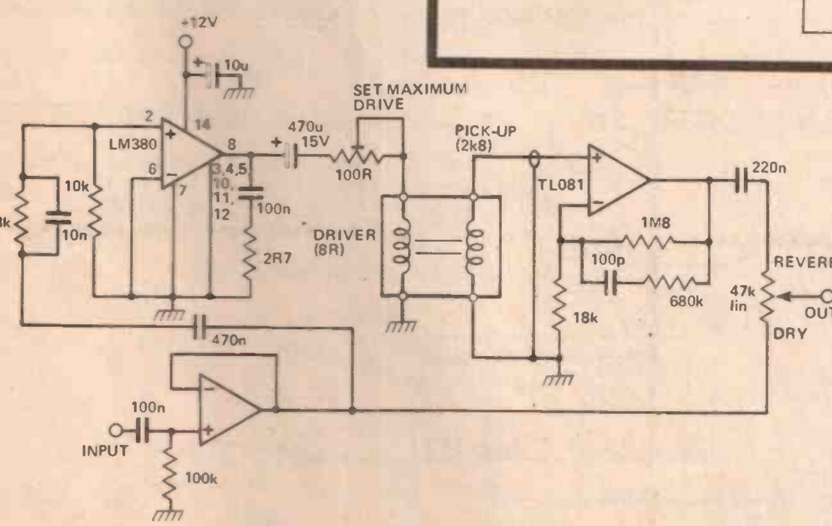
84
Data Multiplexer

Take $\overline{EN}$ high when changing the address. This will prevent corruption of the data held on the sample and hold units.
All TL081 powered from ± 12 V

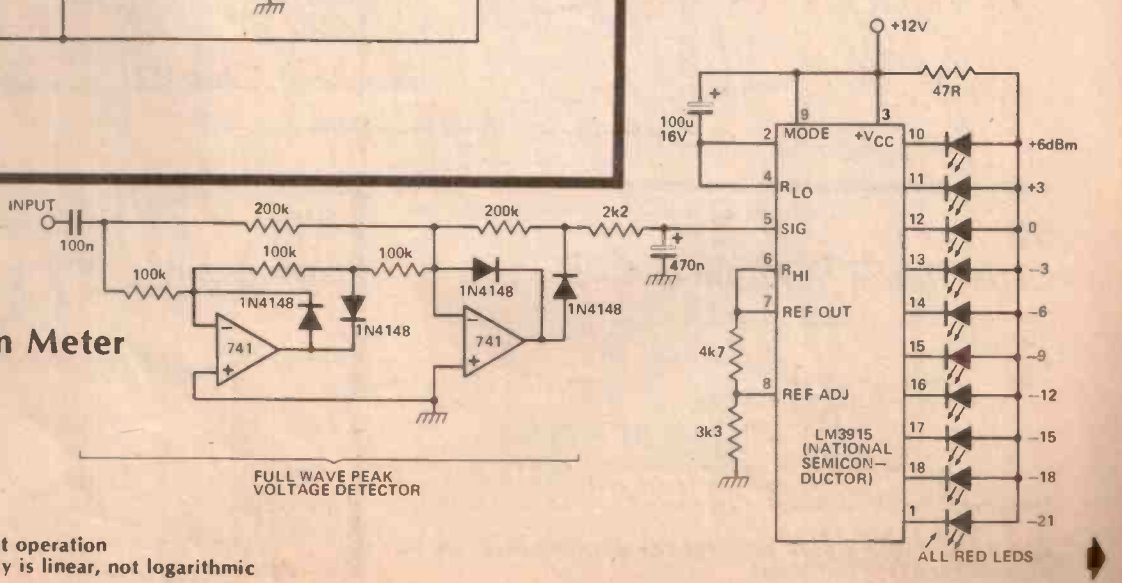




85
Reverberation Unit

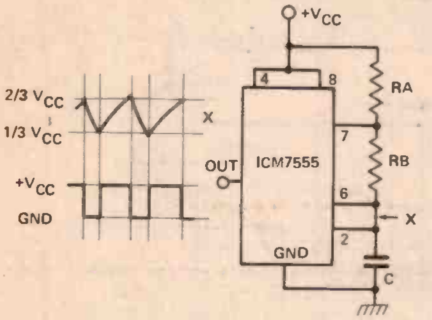


86
LED Peak Program Meter



Leave pin 9 open circuit for dot operation
If an LM3914 is used the display is linear, not logarithmic

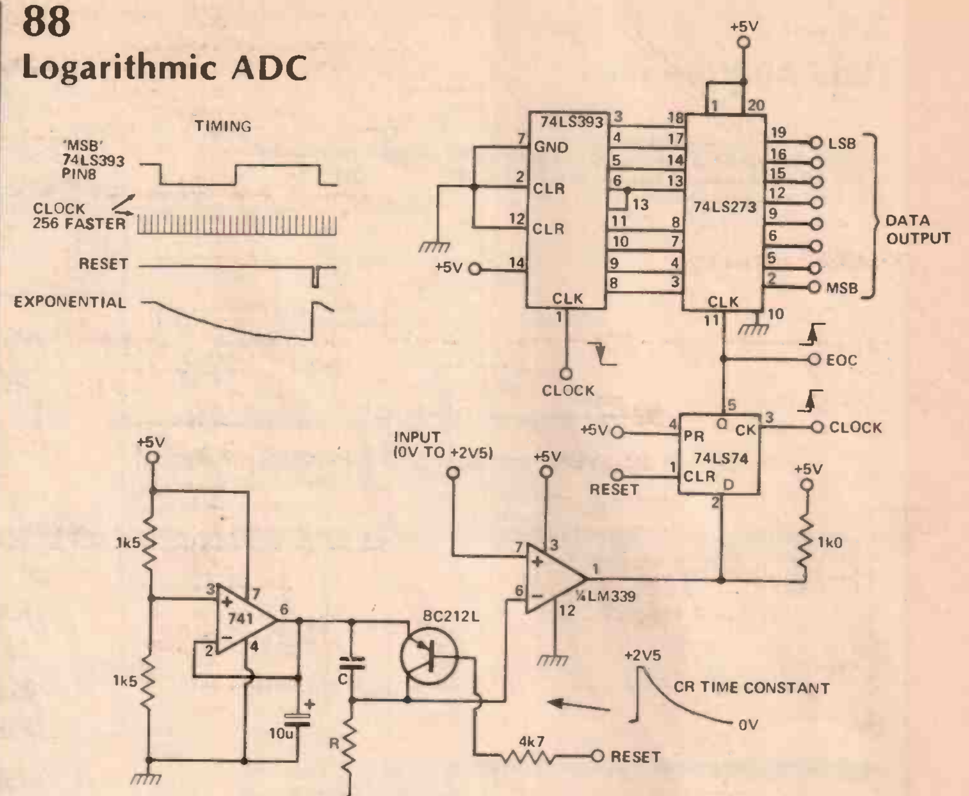
87
CMOS 555 Oscillator



Output frequency F = 1.46/C(RA + RB)
C in farads, R in ohms
Quiescent current ∼ 120 uA
Input current ∼ 50 pA (this allows the use of resistors up to 10M in value)
Frequency range 0.001 Hz to 500 kHz
Supply range 2 to 18 V
Rise and fall time (pin 3) = 40 ns

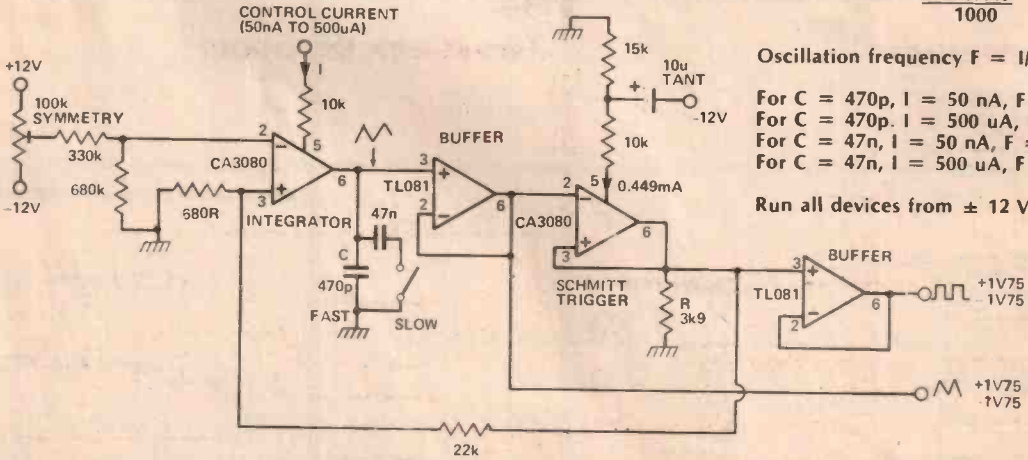
RA,RB	C	F
10M	10u TANT	7.3 mHz
1M0	1u0	0.73 Hz
100k	100n	73 Hz
10k	10n	7.3 kHz
10k	1n0	73 kHz

88
Logarithmic ADC



Adjust C-R-PR time constant for suitable range

89
Linear VCO/Function Generator



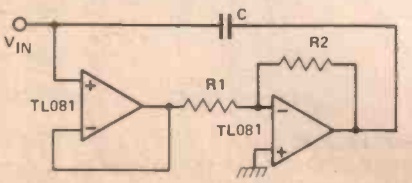
Schmitt levels = $\frac{R \times 0.449}{1000}$ = 3.9 x 0.449 = ± 1V75

Oscillation frequency F = I/(C x 4 x 1.75) = I/7C Hz

For C = 470p, I = 50 nA, F = 15 Hz
For C = 470p, I = 500 uA, F = 150 kHz
For C = 47n, I = 50 nA, F = 0.015 Hz
For C = 47n, I = 500 uA, F = 150 Hz

Run all devices from ± 12 V

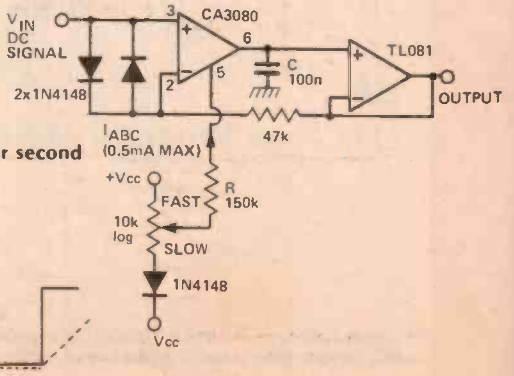
90
Capacitance Multiplier



The input looks like a capacitor C_{IN} where C_{IN} = C (R1 + R2)/R1

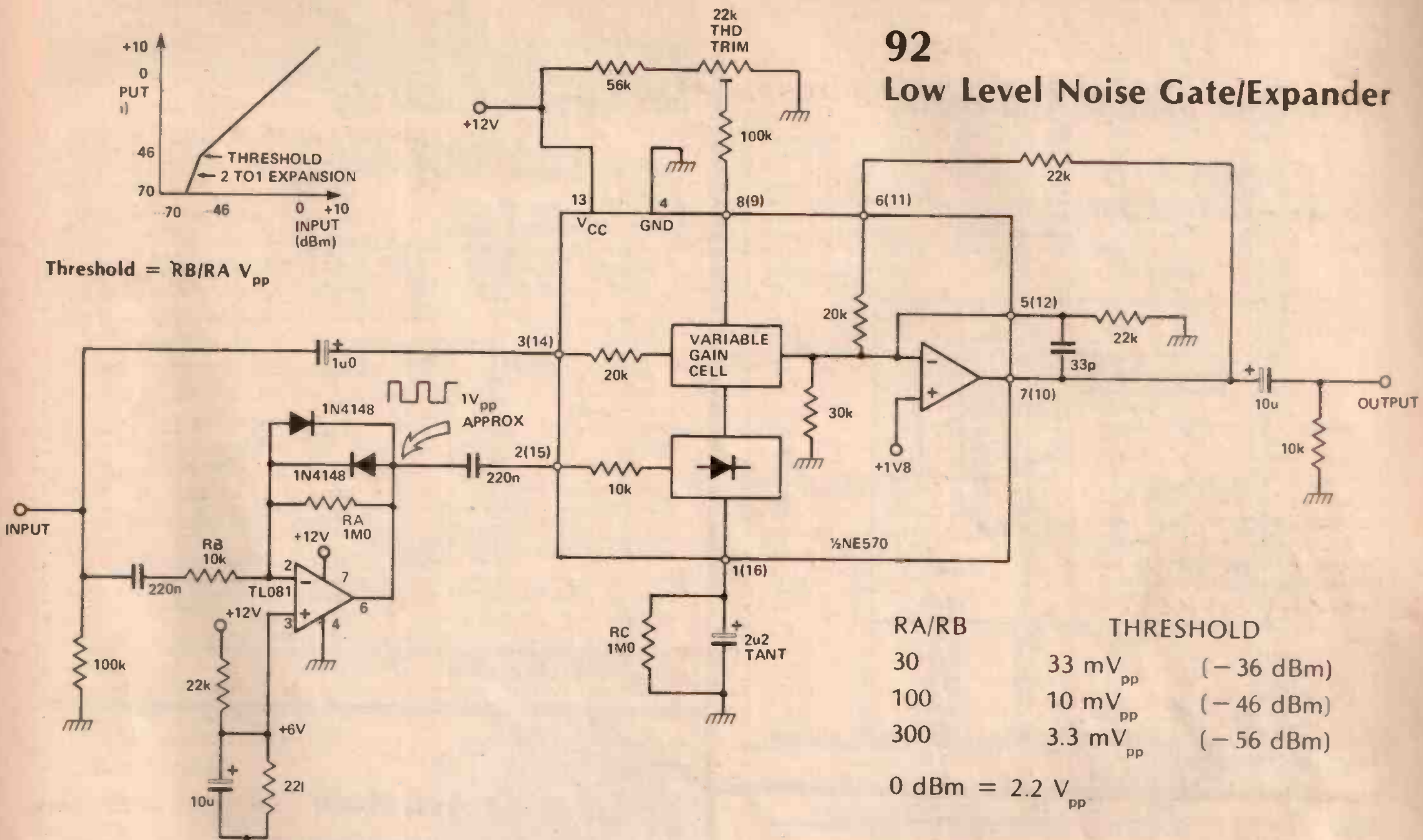
Circuit can be used to synthesise large capacitors (NB equivalent in impedance, not energy storage)

91
Slew Limiter



Slewrate = $\frac{I_{ABC}}{C}$ volts per second

92
Low Level Noise Gate/Expander

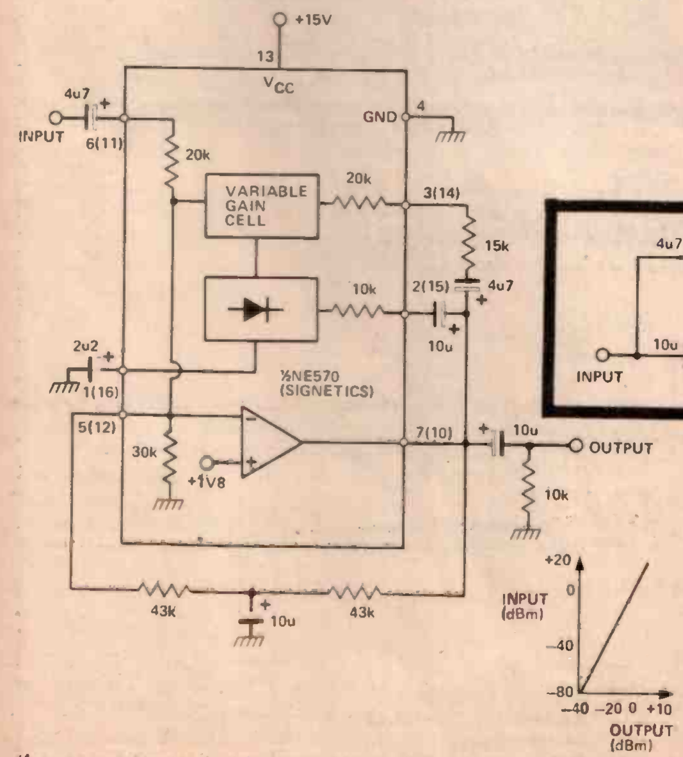


RA/RB	THRESHOLD	
30	33 mV_{pp}	(−36 dBm)
100	10 mV_{pp}	(−46 dBm)
300	3.3 mV_{pp}	(−56 dBm)

0 dBm = 2.2 V_{pp}

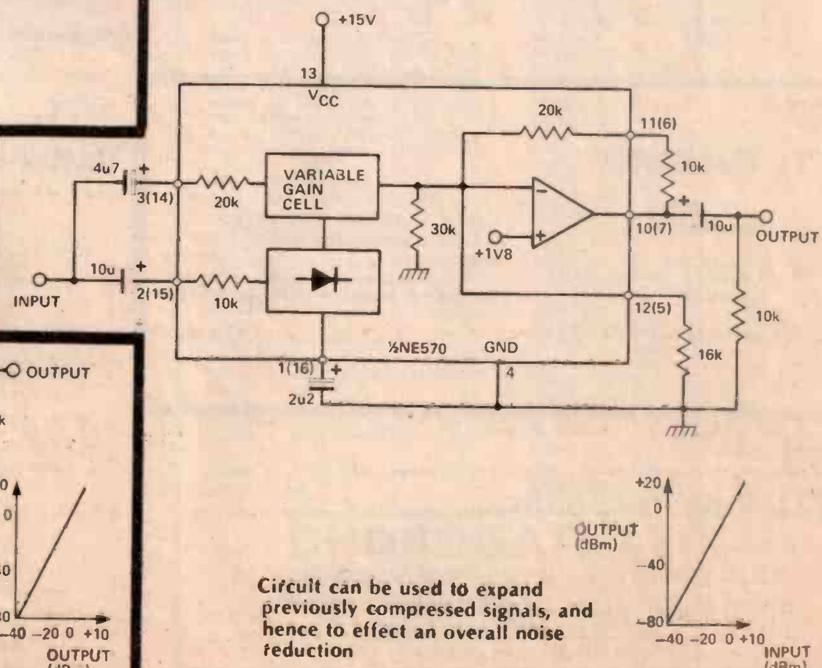
RC increases the expansion rate, turning the unit into a noise gate.
With RC = 100k the effect is very abrupt; withRC = 10M the effect is very subtle.

93
Two-to-one Compressor



The pin numbers in brackets refer to the second circuit in the IC.
Circuit can be used as a preconditioner in a noise reduction system.

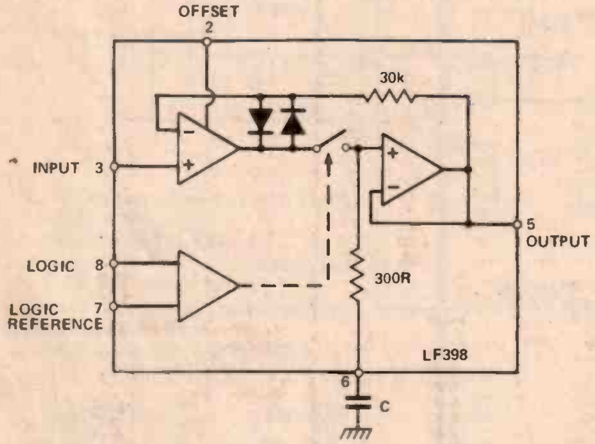
94
Two-to-one Expander



Circuit can be used to expand previously compressed signals, and hence to effect an overall noise reduction

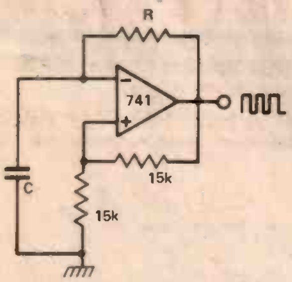
95
Monolithic Sample And Hold

Logic high = sample
Logic low = hold
Logic reference = TTL or CMOS



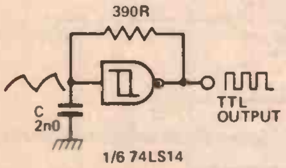
Use a printed circuit guard ring (connected to the output voltage) around the hold capacitor

96
Op-amp Oscillator



$F \sim \frac{1}{RC}$ (rule of thumb)

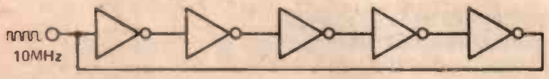
97
TTL Oscillator



Vary C to change frequency
Do not increase the size of the 390R resistor

Frequency range = 1 Hz to 1 MHz

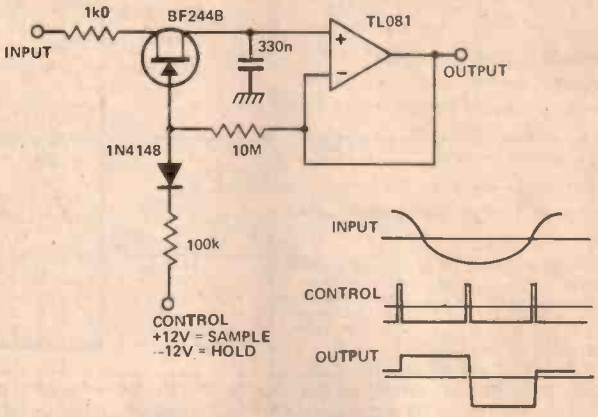
98
TTL Ring Oscillator



F = 1/(5 x propagation delay)
For TTL inverters (74LS04) total propagation delay = 20 ns

99
FET Sample And Hold

Control = +12 V; sample
Control = −12 V; hold

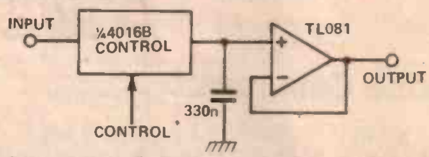


Use a printed circuit guard ring (connected to the output voltage) around the hold capacitor

100
4016 Sample And Hold

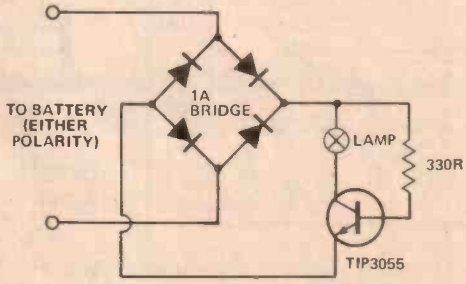
Control = $+V_{CC}$; sample
Control = $-V_{CC}$; hold
$-V_{CC}$ < signal voltage < $+V_{CC}$

$+V_{CC} - (-V_{CC}) \leq 15$ V



Use a printed circuit guard ring (connected to the output voltage) around the hold capacitor

101
Battery Eliminator



A free bonus!
Lamp glows to show circuit is in operation
Lamp goes out when battery has been eliminated
Patent applied for

ETI

ETI PCB SERVICE

NEW

Up until now PCBs were always the hardest component to obtain for a project. Of course you *could* make your own, but why bother anymore?

Now you can buy your boards straight from the designers — us! As of this issue all (non-copyright) PCBs will be available automatically from the ETI PCB service. Each board is produced from the same master used to build our prototypes, so you can be *sure* it's accurate, and will be finished to the high standard you would expect from ETI.

In addition to the PCBs for this month's projects, we are making available some of the more popular designs from our recent past. See the list below for details. Please note that NO OTHER BOARDS ARE AVAILABLE. If it's not listed, we don't have it!

APRIL 79	
Guitar Effects Unit	£1.98
Click Eliminator	£4.98
JUNE 79	
Accentuated Beat Metronome	£2.70
FEB 80	
Tuning Fork	£1.98
MARCH 80	
Signal Tracer	£1.70
AUGUST 80	
CMOS Logic Tester	£1.98
Capacitance Meter	£2.20
Ultrasonic Burglar Alarm	£2.15
OCTOBER 80	
Cassette Interface	£2.20
Fuzz/Sustain Box	£2.45
NOVEMBER 80	
Touch Buzzer	£1.45
Light Switch	£1.45
Metronome	£1.45
2W Power Amp	£1.45
RIAA Preamplifier	£1.45
Audio Test Oscillator	£2.35
DECEMBER 80	
Musical Doorbell	£2.10
Bench Amplifier	£1.90
Four Input Mixer	£1.98
JANUARY 81	
LED Tacho	£3.10
Multi-Option Siren	£2.40
Universal Timer	£2.48
FEBRUARY 81	
Infra-red Alarm (four boards)	£4.98
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MARCH 81	
Engineer's Stethoscope	£1.99
APRIL 81	
Musical Box	£1.98
Drum Machine (two boards)	£4.20
Guitar Note Expander	£2.40
JUNE 81	
Mini-drill Speed Controller	£2.20
Antenna Extender	£2.40
Alien Attack	£1.98
LED Jewellery: Cross	£1.10
Spiral (two boards)	£1.98
Star (two boards)	£1.99
Waa-phase	£1.15
JULY 81	
System A A-MM/A-MC	£1.99
System A A-PR	£3.88
Superdice (two boards)	£5.95
Smart Battery Charger	£1.48
AUGUST 81	
System A Power Amp (A-PA)	£3.58
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Hand-clap Synthesiser	£2.98
Heartbeat Monitor	£1.37
Watchdog Home Security (two boards)	£3.98
SEPTEMBER 81	
Mains Audio Link (three boards)	£5.51
Laboratory PSU	£3.40
OCTOBER 81	
Enlarger Timer	£2.25
Sound Bender	£1.99
Thermal Alarm	£1.97
Micropower Pendulum	£1.66
Remote Control (three boards)	£9.74

Order using the form below, or a piece of plain paper if you prefer not to cut the magazine, then sit back and wait for your PCBs to come dropping in through your letterbox, encased in a Jiffy bag. What could be easier?

Send to: ETI PCB SERVICE, ARGUS SPECIALIST PUBLICATIONS LTD, 145 CHARING CROSS ROAD, LONDON WC2H 0EE.

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Address ....

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BARCLAYCARD VISA

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Please debit my account

Signature: ....

BOARDS REQUIRED	PRICE
ADD 40p p & p	0.40
TOTAL ENCLOSED £	

Please allow 14 days for delivery

NEW PRACTICAL ELECTRONICS - STEREO TUNER KIT

This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July issue). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System.

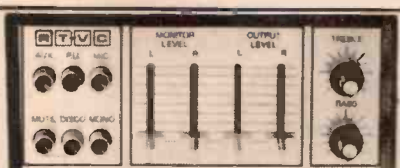
FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod, FM - 75 or 300 ohms. Stabilised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification. Front scale size 10¼"x 2½" approx. Complete with diagrams and instructions

ONLY **£17.95** plus £2.50 p&p.

SPECIAL OFFER! TUNER KIT PLUS:

- Matching I.C. 10+10 Stereo Power amplifier kit (usually £3.95 + £1.15 p&p)
- Mullard LP1183 built preamp. suitable for magnetic/ceramic and auxiliary inputs (usually £1.95 + 70p p&p)
- Matching power supply kit with transformer (usually £3.00 + £1.95 p&p)
- Matching set of 4 slider controls complete with knobs for bass, treble and volumes (usually £1.70 + 80p p&p)

£21.95 plus £3.80 p&p.



STEREO AMPLIFIER KIT

- Featuring latest SGS/ATES TDA 2006 10 watt output IC's with in-built thermal and short circuit protection.
- Mullard Stereo Preamplifier Module.
- Attractive black vinyl finish cabinet, 9"x 8¾"x 3¾" (approx)
- 10+10 Stereo converts to a 20 watt Disco amplifier.

To complete you just supply connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs - tape, speakers and headphones. By the press of a button it transforms into a 20 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus power amp assembly kit and mains power supply. Also features 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia with matching knobs and contrasting cabinet. Instructions available, price 50p. Supplied FREE with the kit.

£14.95 Plus £2.90 p&p.

SPECIFICATIONS: Suitable for 4 to 8 ohm speakers.

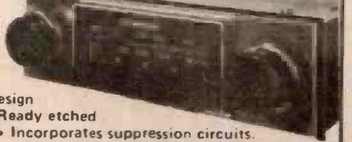
Frequency response	40Hz - 20KHz.
Input sensitivity	P.U. 150mV. Aux. 200mV. Mic. 1.5mV.
Tone controls	Bass + 12db @ 60Hz Treble + 12db @ 10KHz
Distortion	0.1% typically @ 8 watts
Mains supply	220 - 250 volts 50Hz

STEREO MAGNETIC PRE-AMP CONVERSION KIT
Includes FREE Magnetic cartridge with diamond styli.
All components including p.c.b. to convert your ceramic input on the 10+10 to magnetic.
Only available with 10+10 amp. £2.00 includes p&p.

8" SPEAKER KIT Two 8" twin cone domestic speakers. £4.75 per stereo pair plus £1.70 p&p. when purchased with amplifier. Available separately £6.75 plus £1.70 p&p.

PRACTICAL ELECTRONICS CAR RADIO KIT SERIES II

2 WAVE BAND MW - LW



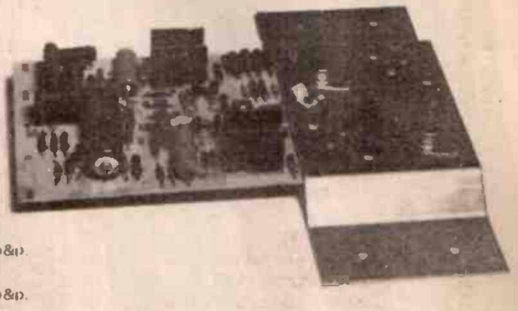
- Easy to build
- 5 push button tuning
- Modern design
- 6 watt output
- Ready etched and punched PCB
- Incorporates suppression circuits.

All the electronic components to build the radio, you supply only the wire and the solder, featured in Practical Electronics March issue. Features: pre-set tuning with 5 push button options, black illuminated tuning scale. The P.E. Traveller has a 6 watt output neg. ground and incorporates an integrated circuit output stage, a Mullard IF Module LP1181 ceramic filter type pre-aligned and assembled, and a Bird pre-aligned push button tuning unit.

£10.50 Plus £2.00 p&p.

Suitable stainless steel fully retractable aerial (locking) and speaker (6"x 4" app.) available as a kit complete. £1.95/pack. Plus £1.15 p&p.

HIGH POWER AMPLIFIER MODULES



READY BUILT OR IN KIT FORM

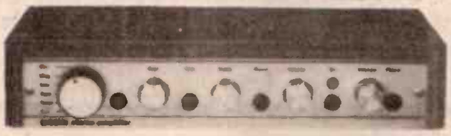
	KIT	BUILT
125 WATT MODEL	£10.50 Plus £1.15 p&p	£14.25 Plus £1.15 p&p
200 WATT MODEL	£14.95 Plus £1.15 p&p	£18.95 Plus £1.15 p&p.

SPECIFICATIONS:	125 W Model	200 W Model
Max. output power (RMS)	125 watts	200 watts
Operating voltage (DC)	50 - 80 max.	70 - 95 max.
Loads	4 - 16 ohms	4 - 16 ohms
Frequency response measured @ 100 watts	25Hz - 20KHz	25Hz - 20KHz
Sensitivity for 100 watts	400mV @ 47K	40mV @ 47K
Typical T.H.D. @ 50 watts, 4 ohms	0.1%	0.1%
Dimensions (both models)	205 x 90 and 190 x 36mm.	

The P.E. power amp kit is a module for high power applications - disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, result, a high powered rugged unit. The PC Board is back printed, etched and ready to drill for ease of construction and the aluminium chassis is preformed and ready to use. Supplied with all parts, circuit diagrams and instructions.

ACCESSORIES:

Suitable LS coupling electrolytic for 125W model	£1.00 plus 25p p&p.
Suitable LS coupling electrolytic for 200W model	£1.25 plus 25p p&p.
Suitable mains power supply unit for 125W model	£7.50 plus £3.15 p&p.
Suitable Twin transformer power supply for 200W model	£13.95 plus £4.00 p&p.



30+30 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet, silver finished rotary controls and pushbuttons with matching fascia, mains indicator and stereo jack socket. Functions switch for mic magnetic and crystal pickups, tape and auxiliary. Rear panel features fuse holder. DIN speaker and input socket 30+30 watts RMS. 60+60 watts peak. For use with 4 to 8 ohm speakers.
Size 14½"x 10" approx.
BUILT AND TESTED.

£32.90 Plus £3.80 p&p.

PHILIPS BELT DRIVE RECORD PLAYER - DECK GC037 (Size: 15¾"x 12¼" approx.)

HiFi record player deck, 2 speed, damped cueing, auto shut off, belt drive with floating sub chassis to minimise acoustic feedback. Complete with GP401 stereo magnetic cartridge

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UNBEATABLE OFFER AT
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COMPLETE
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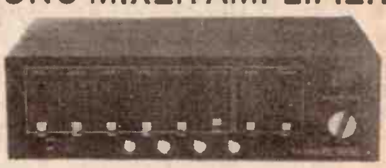
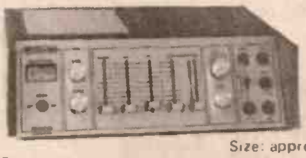
MONO MIXER AMPLIFIERS



50 WATT Six individually mixed inputs for two pick ups (Cer. or Mag.), two moving coil microphones and two auxiliary for tape, tuner, organs, etc. Eight slider controls - six for level and two for master bass and treble, four extra treble controls for mic and aux inputs. Size. 13¼"x 6½"x 3¾" app. Power output 50 watts R.M.S. (continuous) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.

£39.95 Plus £3.70 p&p.



100 WATT

Brushed Aluminium fascia and rotary controls.
Size: approx. 14"x4"x10¼".

Five vertical slider controls, master volume, tape level, mic level, deck level, PLUS INTERDECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PFL) lets YOU hear the next disc before fading it in.
VU meter monitors output.
100w RMS output (200w peak).

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PHONE BELL SHIFTER

If you want to customise your phone without incurring a visit from the British Telecom heavies clutching their wirecutters, then this is the project for you. Design by Ray Marston. Development by Steve Ramsahadeo.

A major problem with the present-day British telephone system is that all bell-type phones generate virtually identical ringing sounds, thereby creating all sorts of problems. In the home, for example, while watching TV you'll often hear a phone ring and instantly leap to your feet to answer the call, only to find that the ringing sound comes from a phone in the TV programme. Similarly, when you are relaxing in the garden on a summer's day, or when you have wandered into a neighbouring office at work, you'll often hear a distant phone ring and will not know if the call is intended for you or a neighbour.

The ETI Phone Bell Shifter project is designed to overcome these identification problems by giving your phone its own distinctive sound. The project consists of a sophisticated five IC circuit; its input is provided by an inexpensive transducer, acoustically coupled to the phone body to detect the ringing of the phone bells, and its output is taken to an external 15R speaker from a built-in alarm-tone generator. A distinctive pulsed-tone alarm sound is generated which is synchronous with the detected phone bell signal. The speaker is connected to the output of the unit using twin flex, and can either be placed near the phone (so that the unit acts as a phone identifier) or can be placed at a remote location (so that the unit acts as a phone bell extender).

A unique feature of our Phone Bell Shifter project is that it uses a micropower signal-sampling technique (as described in last month's Designer's Notebook) to detect the presence of a ringing signal and then automatically switch the unit into the full-power mode. Because of this technique, the unit draws a quiescent current of a mere 7 uA, thus giving up to two years of continuous operation from a single PP9 supply battery.

The Phone Bell Shifter project is provided with two preset pots plus a normal volume control, and is simple to set up and use. The acoustic pickup transducer (which forms the input of the unit) is simply placed underneath the telephone body (below the bells) and the sensitivity of the unit is then initially adjusted by one preset to give the desired trigger action when the phone rings: once this pot has been initially set, it requires no subsequent adjustment.

Construction

All of the major electronics of this project (except the input transducer and the output speaker) are built into a single Verobox, which also houses the PP9 supply battery, and construction should present very few problems. A number of high value resistors are used in the circuit, so extra care should be taken to ensure that moisture and contaminated grease are not allowed to shunt down the effective values of these components; when PCB construction is complete and the circuit has been tested, the board should be given a coating of varnish to prevent the ingress of moisture.

When the PCB construction is complete, fit the PCB and the PP9 battery into the recommended Verobox and complete the interwiring to RV1, SW1 and the input and output sockets. Fit the specified speaker in a second Verobox and then connect it to the input of the main unit.

To set the unit up initially, simply adjust sensitivity control PR1 so that the unit's alarm activates when the phone bells ring, and then adjust PR2 so that the alarm volume does not fall to zero when the main volume control is turned fully down.

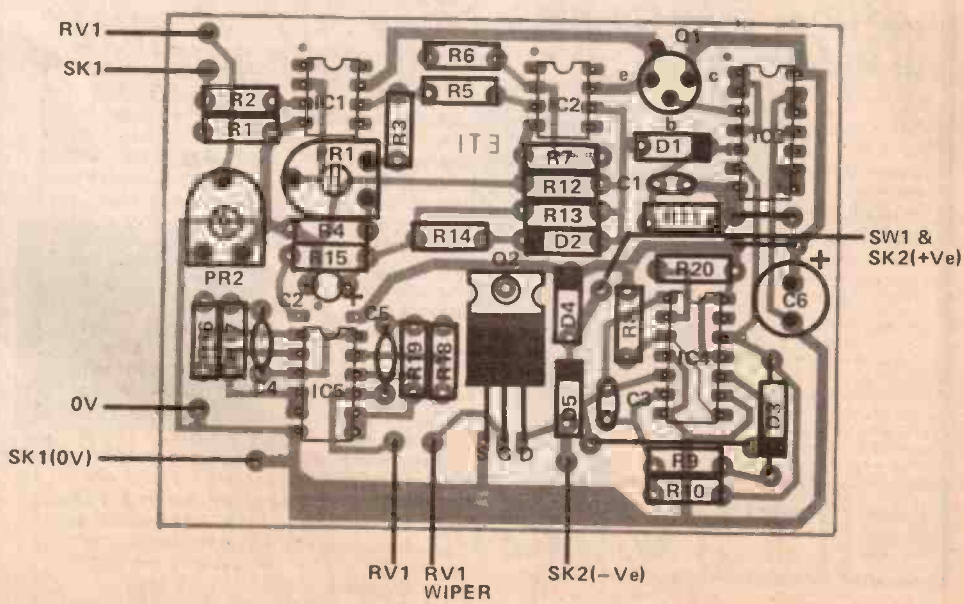

Fig. 1 Component overlay.

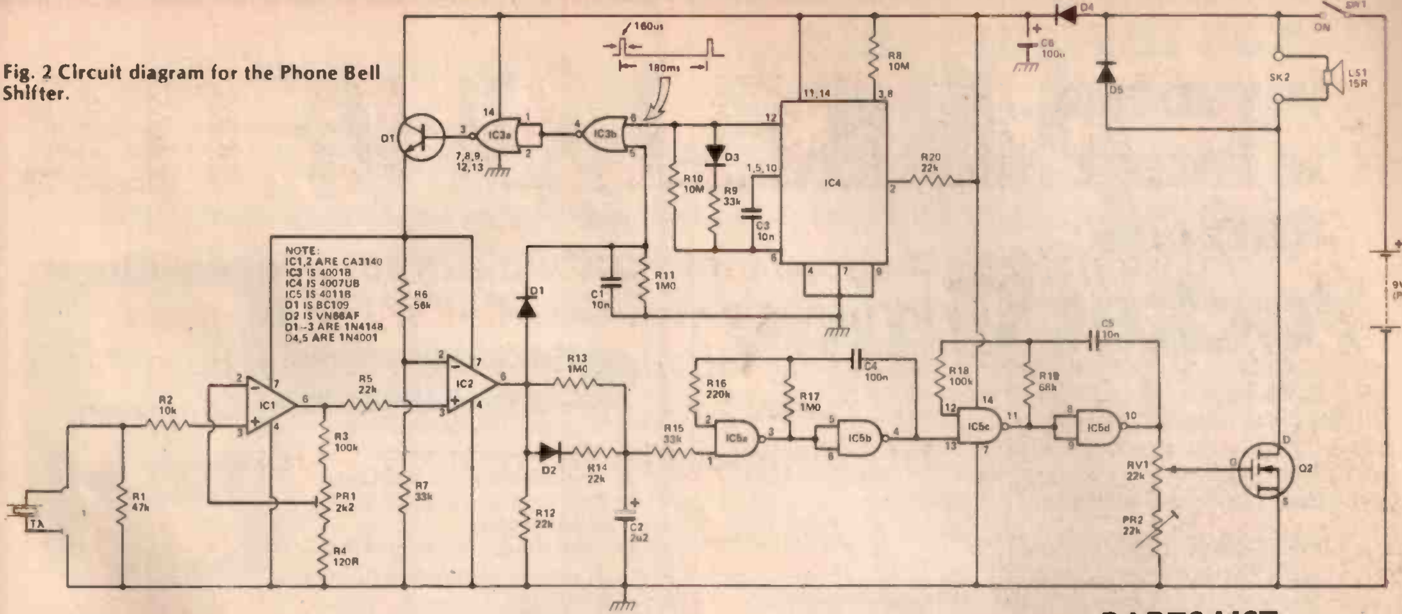

Fig. 2 Circuit diagram for the Phone Bell Shifter.

HOW IT WORKS

First ignore the effects of the signal-sampling circuitry and assume that Q1 is replaced by a short-circuit, so that supply power is continuously applied to IC1 and IC2.

The acoustic pickup device used in the circuit is a PB-2720 transducer, which is placed under the phone body, below the bells. This transducer has a poor low frequency response, but is quite sensitive to the high frequency (3 to 5 kHz) overtones of the phone bell. The output of the transducer is applied directly to the input of non-inverting variable-gain amplifier IC1.

Although the input of IC1 is DC-grounded by R1-R2, the CA3140 op-amp used in this position is able to respond to input signals all the way down to 0 V: consequently, the output of this op-amp (pin 6) corresponds to an amplified but positively half-wave rectified version of the input signal. This signal is fed to the input of non-inverting voltage comparator IC2, which is reference-biased at about 3 V by R6-R7.

Thus, the overall action of the IC1-IC2 circuit is such that the output of IC2 is normally low, but changes into a series of 3-5 kHz square waves in the presence of bell-ring input signals. These square wave signals are processed by the R13-D2-R14-C2 dual-time-constant integrating network, so that a high DC voltage (6 V) is developed across C2 in the presence of a true ring signal, and this voltage is used to activate the IC5 alarm-tone generator circuitry. Note that, because of the integrating action of D2-R14-C2, the input signal must be sustained for greater than 50 ms to initiate a high switching action in IC5, so the circuit has excellent immunity to transient signals caused by physically banging the telephone body or PB-2720 transducer. Similarly, because of the actions of R13-C2, the IC5 alarm circuit does not turn off until several hundred milliseconds after the bell-ring input has been removed, and thus gives a single continuous action from a double (ring-ring) input signal.

The IC5 oscillator circuitry is quite simple. IC5a-IC5b is a low-frequency gated astable (about 6 Hz), with its output fed to the input of 1 kHz gated astable IC5c-IC5d. The output of the 1 kHz astable is fed to the input of VFET Q2 via volume control pot RV1, and Q2 uses the external 15R speaker as its drain load. In the absence of an input signal (from C2) the two astables and Q2 are cut off and the circuit consumes virtually zero standby current: in the presence of a high signal from C2 the low frequency astable activates and pulses the 1 kHz astable on and off at a 6 Hz rate, thereby producing a pulsed tone in the 15R speaker.

Note that the supply to the major sections of the Phone Bell Shifter circuitry is decoupled from speaker/Q2 transients by D4 and C6.

In this circuit, IC5 and Q2 consume virtually zero quiescent current, but the IC1-IC2 ring detector stages would, if continuously powered from a 9 V supply, consume a quiescent current of about 4 mA and would thus flatten a PP9 battery in less than two days of continuous running. To overcome this problem and vastly extend the battery life, we use a signal-sampling technique in which a micropower oscillator network (IC4-IC3-Q1) is used to feed pulses of supply power to the IC1-IC2 ring detector circuit and simultaneously check the output of the detector for signs of such a signal; if a signal is detected, the circuitry then applies full power to IC1-IC2, so that the signal can be fully processed. The sampling pulses are only 160 us wide and are repeated every 180 ms; consequently the mean power consumption of the detector circuit is reduced by a factor of 1125, to a mere 3.5 uA. The micropower oscillator network also consumes a running current of 3.5 uA so the total quiescent current of the entire Phone Bell Shifter circuit works out at 7 uA, thus giving up to two years of continuous running from a single PP9 supply battery.

IC4 is a special-purpose micropower oscillator circuit, designed around a 4007UB dual complementary pair plus inverter CMOS chip: a full description of this oscillator was given in the October edition of Designer's Notebook. The output pulses of IC4 are fed to one input of the IC3a-IC3b OR gate and then passed on to emitter follower Q1, which consequently connects supply power to the IC1-IC2 ring detector circuitry for 160 us once every 180 ms. Simultaneously, the output of IC2 is peak-detected (inspected) during the sampling period and the resulting signals (if any) are stored in C1 and fed to the second input of the IC3 OR gate. Consequently, if a bell-ring signal is absent during the sampling period, the output of IC2 will be low and zero voltage will appear across C1, so another sample pulse will be applied 180 ms later. If, on the other hand, a bell-ring signal is present during the sampling period, the output of IC2 will switch high and store a high voltage on C1, thereby taking the second input of the IC3 OR gate high. This causes Q1 to turn fully on, so that the supply is semi-permanently connected to IC1-IC2 and the input signals may be fully processed.

PARTS LIST

Resistors (all ¼ W, 5%)

R1	47k
R2	10k
R3,18	100k
R4	120R
R5,12,14,20	22k
R6	56k
R7,9,15	33k
R8,10	10M
R11,13,17	1M0
R16	220k
R19	68k

Potentiometers

RV1	22k logarithmic
PR1	2k2 miniature horizontal preset
PR2	22k miniature horizontal preset

Capacitors

C1,3,5	10n ceramic
C2	2u2 16 V tantalum
C4	100n ceramic
C6	100u 16 V PCB electrolytic

Semiconductors

IC1,2	CA3140
IC3	4001B
IC4	4007B
IC5	4011B
Q1	BC109
Q2	VN66AF
D1,2,3	1N4148
D4,5	1N4001

Miscellaneous

SW1	SPST miniature toggle
LS1	15R 2 W, 5" x 3" elliptical speaker
SK1,2	phono socket
TX1	PB-2720

Case for electronics (Verobox order no. 202-21391A; case for speaker (order no. 202-21030K).

BUYLINES

LS1 might prove a little difficult to obtain from your local component emporium, but Watford Electronics have agreed to supply the speaker on request. The VMOS transistor (Q2) is available from Electrovalue, and Ambit International are stockists for the PB-2720. The PCB can be obtained from our PCB Service — see page 76 for details.

AUDIOPHILE

A first look at a new name to the tape market and a mention for a useful gadget to keep it clean! Ron Harris reports on the Alpage AL-300.

I hate summer. All that lousy sunshine and hot weather. The main problem is that people expect you to get outdoors and *enjoy* being roasted to death slowly. Sounds very lemming-like, if you ask me, all this rushing off to the sea every time the sun shines.

Hi-fi tends to become an anti-social undertaking too — even if, like me, you resolutely refuse to burn to death with a smile and prefer to remain enthroned in your lounge with Tchaikovsky caressing the speakers. But they won't leave you alone, not even then. Hot weather means open windows and open windows mean 100 dB of music escaping into the wide world outside — and *that* means neighbours banging on doors because you woke them from their sun-drenched stupor on the back lawn.

Oh for the joys of winter, with icy rain sleeting against the windows (closed), a warm glow in the hearth (the cat got too close to the electric fire and burst into flames), a glass of brandy in the hand and the sweet sounds of music gently filling the room . . . until the roof leaks, water pours in and short circuits the amp which explodes violently, taking out the speakers and impaling you in the armchair with pieces of flying speaker cone.

Is there nought to life save adversity in the face of perfection?

Record Time

Avoiding the sunshine this month paid some dividends, in that I came accross two superb new LPs which can be totally recommended for content *and* recorded quality. The old 'Rickie Lee Jones' album has long been a demonstration standard and now the new LP, called 'Pirates', could well go the same way. The guitars and vocals are outstandingly reproduced and will get better as your system improves. The content is much more jazz orientated than the earlier offering, which undoubtedly puts off as many people as it endears.

The better of the two, however, has to be the new Stevie Nicks album, 'Belladonna'. To start with the woman has an amazing voice and is devastatingly attractive. The kind of beauty for which men would kill, merely to earn a smile and a softness in the eye. Nothing to do with the music, I know, but . . .

The record has a truly excellent vocal recording and is very well detailed. The balance is slightly bright, which will show up any hardness inherent in the system, as the LP itself is never hard-sounding. If you want a system test for detail and clarity then this is it. I suspect that if you frequent hi-fi shops as a hobby (plastic mac optional) you'll be hearing more of this particular album in future.

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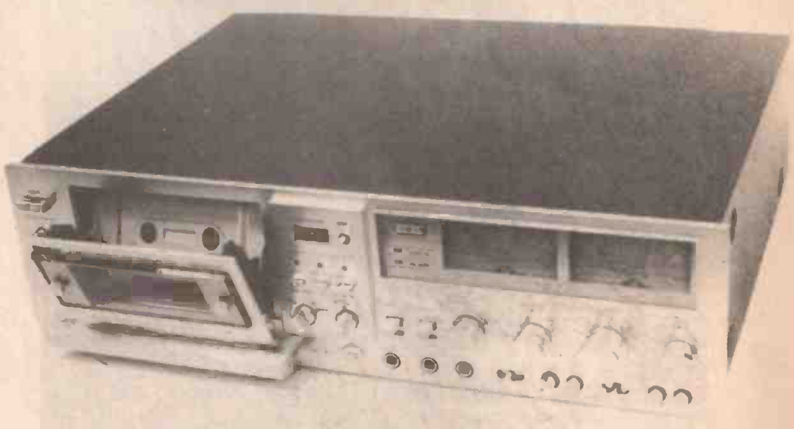
Alpage AL-300

Couple of issues ago now I mentioned the new range of



Above: The Alpage AL-300 in all its glory, the top line machine in Shure's range of three.

Below: The front panel block on the Alpage AL-300 detaches to form a corded remote control.

Left: The stunning and sensuous Stevie Nicks, as she appears on the cover of her new album.

tape decks from Shure Electronics, entitled Alpage, promising more details to follow. When, they've arrived! Herein one review of the AL-300 cassette deck, the top-line machine in the present range of three.

Among its many attributes it boasts variable bias and Dolby, which work in conjunction with the metering. This itself is switchable from peak reading to average. More common facilities include metal-tape capability, off-tape monitoring and auto play/rewind. Record mute is there, for those who can suss out how to use it.

Transport control is solenoid operated and the front panel block detaches to form a (corded) remote control. There is also a pitch control for altering replay speed slightly — useful if you're slow of hearing or wish to make sure that your 46 minute LP will fit onto a 45 minute side. With a small variation in pitch it is most unlikely that anyone would ever notice that the music is playing slightly fast . . .

Variable Everything

Dolby B has been so widely accepted that hardly anyone bothers to question it any more. With the new surge of interest in noise reduction systems — Dolby C, HX, dbx, etc etc some points are now being raised.

Variable Dolby (allowing optimisation of level) *can* bring audible benefits. With Dolby B the signal passing through the record circuits has to have identical response to, and be at the same level as, the signal in the replay deprocessors.

Failure to achieve this will mean that tapes replaying at a higher level will sound bright and edgy, and less sensitive tapes dull and lacking in treble.

The Alpage AL-300 has a built-in test oscillator, operable at 400 Hz and 10 kHz. The former frequency is used to align the Dolby processors, by recording the calibration tone and setting up the replay level on the meters. Worthwhile if you're searching for the 'nth' degree of audible quality.

As to the benefits of variable bias these can be clearly heard if you're mad enough to deliberately set up a tape wrongly and record the same piece of music again, only this time correctly.

Insufficient bias will cause LF and MF distortion and make the tape prone to 'dropouts' as the signal is not securely imprinted upon the tape.

Too much bias and the HF end of the spectrum disappears at great speed whereupon severe compression becomes apparent. All *very* nasty overall.

Since brands of tape vary so much in quality, manufacturers of tape decks thought it worthwhile to include 'fine-tuning' of bias-level to offset the usual 'type-select' switch found adorning front panels the world over.

The Alpage facility is thus a justifiable and useful addition.

The unfamiliar controls in the bottom right-hand corner operate the built-in test oscillator for those of you who like to squeeze the last drop of perfection out of your system.

Head Of The Class

One possible problem with the newer tape formulations, metal and ferrichrome, is their requirement for much higher levels of bias than had hitherto been required. Earlier designs of deck used record heads that had a small gap and were prone to 'saturate' under the level of bias required for these tapes.

It is thus reassuring (to me anyway — if I hadn't told *you* about it you wouldn't have worried, would you?) to note that the Alpage has a reasonable margin of safety in the design and that no trace of head problems was encountered. This is a sound design all round.

The bias levels seemed to have been well selected and were as 'right' as they could be for the overall settings. The 'chrome' option gave very good results, for example, with Maxell XLIIS and TDK SA, even without optimisation.

A useful table is provided in the pigeon-Japanese-English manual listing out a wide range of tape types and the recommended settings. Apart from this, though, the book is down to the usual standards of these productions — ie pretty dire. Alpage are no worse than most others, but with section headings like "A 4-step switch applicable to a metal tape being now talked about", they sure as hell ain't any better!

Tested Results

The outcome of the bench tests proved most satisfactory with the AL-300 giving a creditable account of itself. The metal tape response proved particularly extended, running from 22 Hz to 21,000 Hz ± 3 dB, beyond which it dived into the bottom of the graph paper.

Signal to noise (with Dolby in) on UDXLIIS proved to be a respectable 65 dB, good but not quite up to spec. Still, God alone knows how the inscrutable East derive some of their figures — and He probably works for Matsishuta Electronics nowadays anyway.

Without Dolby, S/N fell to a wholly irrelevant 54 dB.

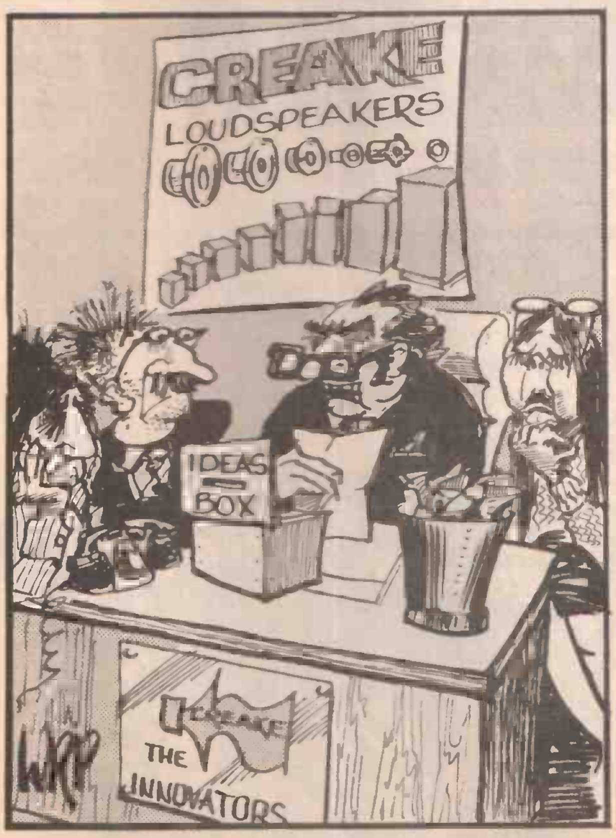
Rest of the figures (taken with Maxell XLIIS and TDK metal tapes):

THD (record to replay):	0.75% at 1 kHz, Dolby level		
FREQUENCY RESPONSE (± 3 dB):	22-21000 Hz	Metal	After optimising bias and Dolby levels
	30-18500 Hz	FeCr	
	25-18000 Hz	CrO_2	
	40-15000 Hz	Normal	
WOW AND FLUTTER (WRMS):	0.03%		
INPUTS:	0.25 mV/500R	(Microphone)	
	120 mV/47k	(Line)	
	0.15 mV/ k	(DIN)	
OUTPUTS:	1 V/47k	(Line)	
	2 mW/8R	(Headphone)	
SIZE:	435 (W) x 120 (H) x 300 (D) mm		
PRICE:	around £290 - £300		

A very good set of figures, these, and for the price asked in return, very good value for money. I have had my hands on machines costing a great deal more, from better known names, that have not performed to this standard. There is little to pick up on here, save maybe that the response is decidedly restricted on the cheaper tape types, regardless of how much the user may play with the tuning.

Metal and 'high-bias' types, however, gave better than expected results.

Last minute news, hot from the postman, is of Wharfedale's new DIY Speakercraft range, including treble, mid-range and bass drivers and crossover networks.



IT'S THAT YOUNG DEVIL JENKINS ON ABOUT LOWERING THE MODULUS OF ELASTICITY OF AIR . . .
. . . IS HE SENDING ME UP AGAIN STAN?!!

In Use

As you must expect by now, the Alpage AL-300 did not disgrace itself under listening tests any more than it did sat sitting in the middle of a test bench. Despite the optimisation system — which produced audible improvements in most brands of tape, at least at the top end — the AL-300 did seem to favour some manufacturers' wares. Maxell XLIIS gave consistently superior results to any other similar mixture and TDK metal outperformed all rivals. These two were thus employed for the listening tests.

In both cases the sound was clearer and sharper with these tapes, than with competitive productions and a smoother high frequency was evident. This would tend to suggest bias requirements were well met — but with 'adjustable' bias how could this be?

Anyway the AL-300 is a top class cassette deck, regardless of the vagaries of tape types. It gave consistently good results with a nicely 'open' sound, free of any of the dreaded 'cassette compression' which occurs with some designs. The bass response is very good, if a little on the full side of neutral. Treble is well extended and clean.

About the only real complaint is that it is damned difficult no, let's not be polite — impossible is a better word — to get at the heads and rollers to clean them. To do so one must first heave off the door — a procedure which is studiously ignored throughout the manual. Tsk tsk.

Summary

A well-designed cassette machine with a particularly versatile recording facility that offers audible improvements with most tape types. The head circuitry is especially well done and should guarantee good results from the AL-300 in a wide range of applications.

All in all, the Alpage offers excellent return for the asking price.

Clean-up Campaign?

While rambling on about tape and associated machinery, it seems like a good time to mention a clever little gadget which drifted across my desk recently. It is endearingly entitled 'Clean and Check'. Not a bad title in light of the fact that this describes its function in life perfectly.

After all, you can't fit 'A-device-for-checking-drive-belt-tensions-and-motor-operation-and-cleaning-both-the-heads-and-rollers-which-comes-complete-in-one-neat-little-box-which-opens-in-two-directions-just-to-confuse-you' all onto a cassette case now, can you? Sensible marketing, that.

One half of the package is a cassette body which contains a belt connecting the two hubs together. Once it is placed in the machine and the machine is started, the belt comes under tension moving a pointer across a scale to indicate the state of health of the drive system. Clever and effective.

The other half is a clean-up set, consisting of two bottles of cleaning fluid: one for the heads and another to take care of the rubber rollers etc. Cotton swabs are provided for applying the magic liquids to those important little places in the machinery.

Trying It Out

The cleaning mixtures proved most efficient in de-filming rollers on the aging machines we tried it on. The head cleaner too did its job without complaint and seemed as good as any other chemical brew I've wiped across bits of metal in the past.

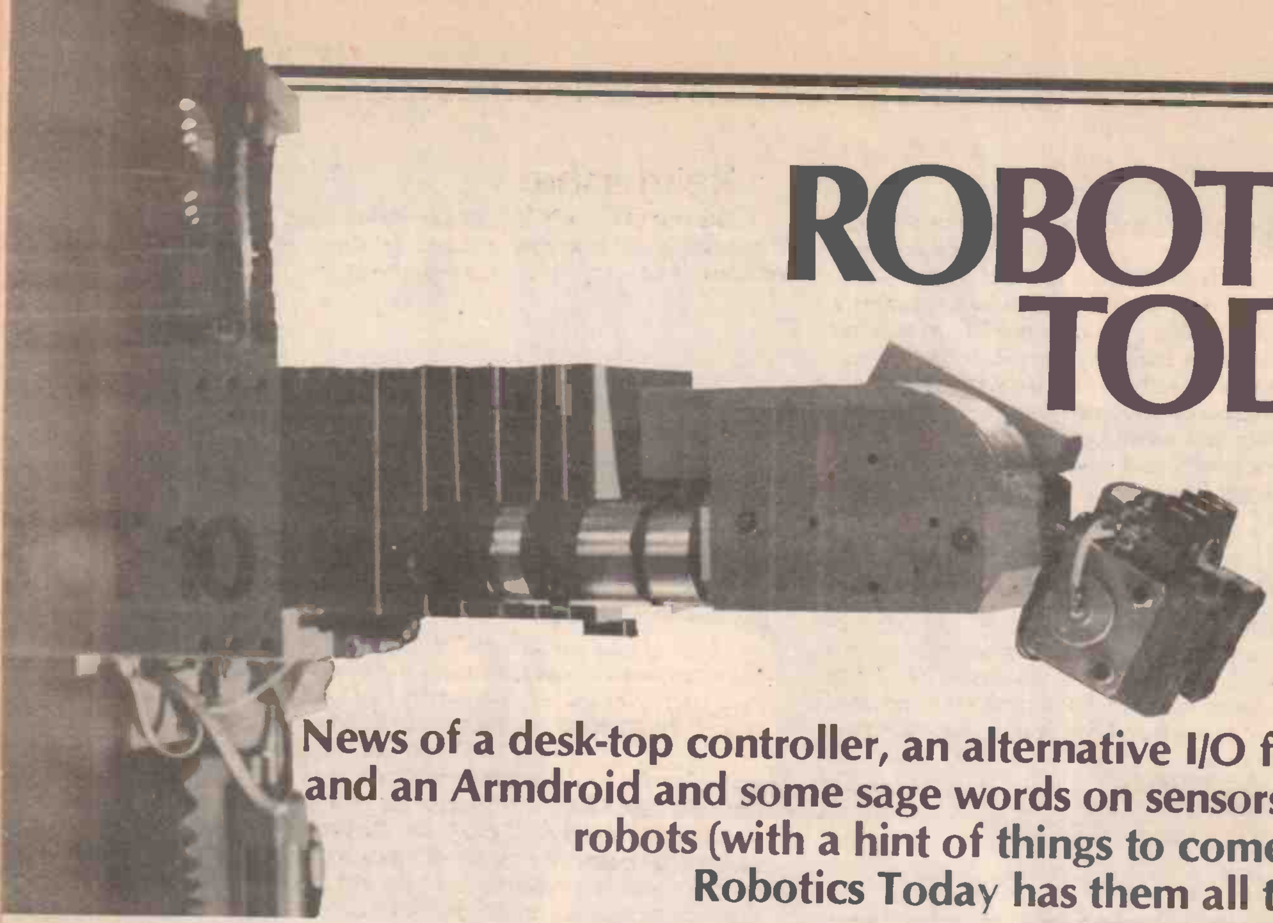
The drive checker, I can only say, seems a great idea — I didn't have any dying drive systems to prove it on, but the belt responds to change in tension quite well. The idea is so obv.ous once someone tells you about it, you wonder why no-one l.as thought of it before.

A neat little package. Good value at £4.50 all inclusive. Every home should have one.

Available from Technology Resources Ltd, Dept 654, Hendon Road, Sunderland SR9 9XZ.

ETI

See our adverts, also on pages 30 & 31



ROBOTICS TODAY

News of a desk-top controller, an alternative I/O for a Tandy and an Armdroid and some sage words on sensors in mobile robots (with a hint of things to come in ETI) — Robotics Today has them all this month.

The greatest single problem still to be solved for home roboticists is that of position sensing. It is fairly straightforward to produce an 'intelligent' mobile unit, which will have control over its own drive system and be able to operate an arm or gripper. Stored away in the memory can be routines which tell the unit how to handle common situations, such as running into a wall or chair etc, and command routines instructing it how to pick up items at the right time.

All this power is, of course, totally useless if the robot never knows where it is! The only thing home-built robots seem to have been able to do up to now is bounce off obstacles, trying different directions until they succeed in passing the barrier. Very crude and limiting on size.

After all, it is reasonable for something the size of a toy tank to bounce around the skirting boards at low velocity, but would you allow a 4 ft steel box on tracks moving at 5 mph to navigate your home in the same manner? Not unless you're round the loop you wouldn't.

Answers On A Postcard Please . . .

What is required is a reliable form of detection and avoidance initiation such that the mobile is capable of reacting to an obstacle, before it grinds it into the carpet.

There are many available techniques for this:

- Line or wire following
- Ultrasonic
- Infra-red
- Mapping
- Vision sensing or image recognition.

Line Following This involves running a white line or signal-carrying wire around the required path of the mobile. In the first case, photo-diodes can be used to ensure the machine travels the line without deviation. Humans then have to keep clear of the robot!

This technique is widely used in factory environments with low personnel counts, such that a machine doggedly trotting down the line does not disrupt too many working days.

Wire following is more sophisticated, in that different signals can be passed through different 'paths' and the robot set to detect the changes at various points, thus giving a more flexible routing capability.

Ultrasonic And Infra-red Both involve the reception and/or transmission of signals from the robot such that the received signals can be interpreted under program control to give the machine a 'picture' of its environment.

Ultrasonics are the most suitable for home or office machines and can be employed in two ways, either as a form of 'song', pinging out pulses of sounds and translating the received 'echoes' into a map of the surrounding world, or by use of location beacons placed around the workspace which send out recognisable signals which the robot then relates to its own position.

Mapping Simply, this is just reading into the robot, by whatever means, a complete and detailed map of the area it is supposed to operate in. This works perfectly as long as no-one moves a chair, or a filing cabinet — or a palette full of car parts! Not really suitable for all but the rare occasion where things do not change over a decent period, say a day.

If used in conjunction with some other sensors — say ultrasonic — which update the map continually and allow for people wandering around from time to time, then mapping can be a powerful technique.

Image Recognition Universally accepted as the ultimate end for robot sensors. 'Eventually all robots will be made this way', etc. Having a machine which can recognise objects as something more than a block to bend the chassis around is an obvious advantage.

Much work is being done, mainly with line-scan camera techniques, but we are a long way off the 'Star Wars' approach to mechanical creatures yet. Processing power and defining the image fast enough are the problems which are presently holding things up.

This is the only method that would not require collision sensing built in as well. If it can see it — it can avoid it. All the other techniques require the failsafe facility to stop if they hit something, or someone, undetected until impact.

And So?

It would thus appear that none of the available *practical* sensing techniques solves the problem fully. The only answer is to combine them to form the necessary facility.

As far as ETI is concerned, there is little point presenting a robot project to our readership if its only use lies in running down the expensive batteries used to power it. A mobile that runs around looking pretty is pretty pointless too in our opinion. Our investigations into sensors have been from the point of view of producing a machine that could be put to use in both the home and work environments, and developed into a powerful intelligent mobile in logical steps.

Coming Attraction

We reckon we've found a way of doing it, too. Coming very soon — as soon as we arrange the metalwork side to our satisfaction — will be a ETI mobile robot, which will be a **TRUE** robot, not an animal approximation, not a program-controlled toy, but a device to put to work and develop an understanding of robotics in the real sense.

Watch these pages for details.

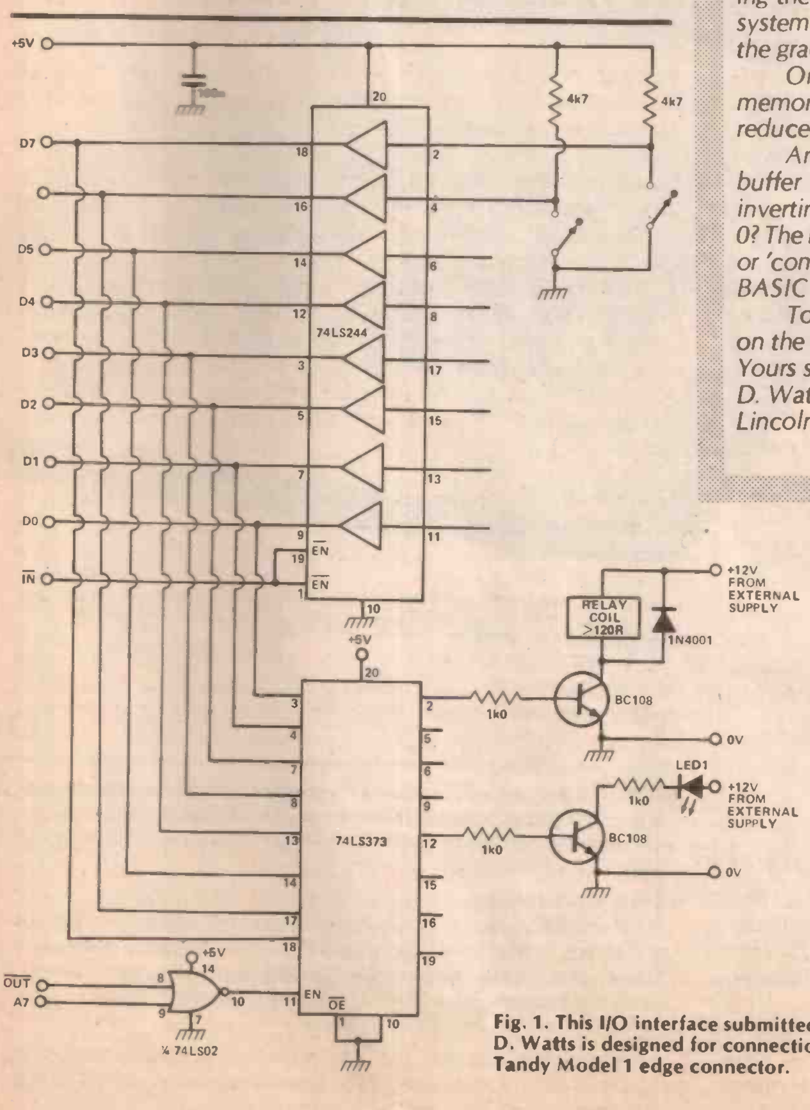


Fig. 1. This I/O interface submitted by D. Watts is designed for connection to a Tandy Model 1 edge connector.

Readership

The first of our readers to take up last month's offer to use these pages for publicity is a Mr. D. Watts of Lincoln, who reckons he can improve upon our arm I/O.

Dear Sir,

Would you please send the Robot machine code program listing, for the Tandy Model 1.

Some comments on the article, just for interest: I am delighted to see that all the hardware mechanics have been made available as a complete kit, since mechanical parts are not nearly so universal as standard silicon chips. It would be useful if a single stepping motor and gearbox could be purchased separately for control systems other than the robot arm. Also, we are not all sufficiently well heeled to throw £200 at one go.

Having just constructed a similar type of interface for a paper tape reader, may I say that I am not too happy about having the input buffer strobed out of its tri-state by data line 1. No doubt the software program will make sure that there is no conflict with internal data on the bus, but if there is corruption, or no program at all, then I would guess there will be trouble amongst the hardware. Perhaps I have overlooked something and it is fail-safe?

The straightforward $\overline{OUT}$ and $\overline{IN}$ strobes available on the Tandy edge connector are the obvious and safe way of controlling the tri-states. I assume you have not used these so that the system is more easily adapted to other micros, which do not have the grace to supply strobe lines.

On second thoughts, your design does avoid the need for memory decoding to port number, but this can be neglected, or reduced to a single line if necessary.

Another point in the circuit design is the use of an inverting buffer for reading the microswitches. Why not use a non-inverting type, so that for all normal purposes, a 1 is a 1 and a 0 is a 0? The inversion can be provided by one line in the software, CPL, or 'complement the bits in the accumulator'. The same thing in BASIC is X = 255 − INP(1).

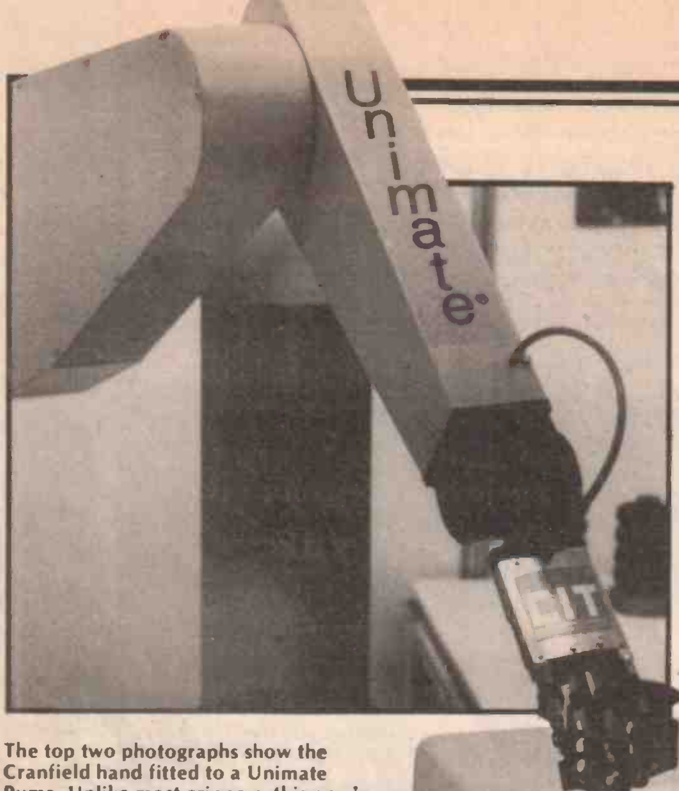
To finish off, I have included my own input/output design on the next sheet.

Yours sincerely,
D. Watts.
Lincoln.

HOW IT WORKS

The three 74LS chips may be powered from the Tandy +5 V on the edge connector. Any other devices must have a separate supply, with only the negative line in common with the Tandy negative. The BC108s act as voltage level shifters, allowing the 5 V TTL logic to switch 12 V relays, for example.

The interface may be used with BASIC or machine code. One reason for the NOR gate is to avoid a spurious $\overline{OUT}$ strobe which occurs every time a CLS is operated, or a READY> prompt occurs. This gives the equivalent of an unwanted OUT 255, 0 in the middle of a BASIC program. The interface will respond to any port number between 0 and 127.



The top two photographs show the Cranfield hand fitted to a Unimate Puma. Unlike most grippers, this one is designed to simulate the human hand — both Japan and the USA are trying to buy it.

This little box could solve a few big problems for anyone with a robot to control. A desk-top intelligent terminal, it's one of a range of products from FELTEC.

A BASIC test program is as follows:

```
 10  CLS
 20  X = INP(1)
 30  PRINT X;
 40  OUT 1, 255
 50  FOR Z = 1 TO 100
 60  NEXT Z
 70  OUT 1,0
 80  FOR Z = 1 TO 100
 90  NEXT Z
100  GOTO 20
```

It will read the switches and pulse all the outputs. To obtain the inverse of the switches use

```
20  X = 255 − INP(1)
```

and to mask off any unwanted bits, one may use the AND function, eg

```
25  X = XAND128
```

will only respond to bit 8, with all other bits set to zero internally.

•

Computer Controller For Robots

Called the 'Snipe Engineer', this little desk-top machine is designed as an intelligent terminal, or controller for stand-alone applications.

It has 32K of memory on-board and can be lined to any existing computer installation. As you can see, a novel LCD display format has been adopted, presumably to bring down costs.

There exists a range of SNIPE products, including terminals and peripherals, all of which are produced by FELTEC, Queensway, New Milton, Hants (telephone 0425 617477).

ETI

This new series will provide a stage upon which our readers may display their robotics achievements. It is intended to cover the practical application of robots in Britain today, be it at hobbyist level or in industry.

Readers in either category are invited to write to the editor of ETI, detailing their experiments, projects, application or usage of robotics. Any articles published will be paid for at commercial rates. It is also hoped to run an 'Ideas Forum' wherein readers can exchange views and ideas but that depends upon the response of our readers — you!

Write to: THE EDITOR, ETI MAGAZINE, 145 CHARING CROSS ROAD, LONDON WC2H 0EE and mark your envelope "Robotics Today".

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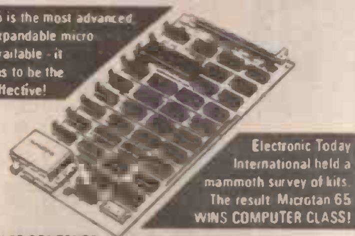

Electronic Today International held a mammoth survey of kits. The result: Microtan 65 WINS COMPUTER CLASS!

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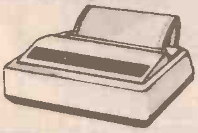

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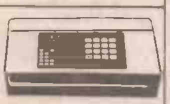

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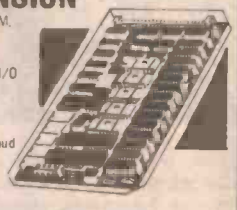

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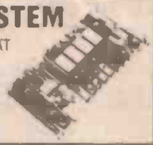

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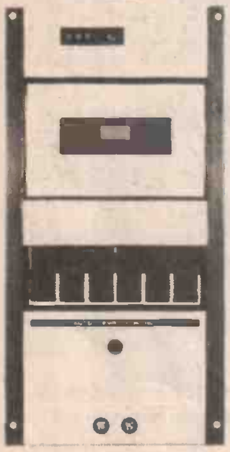

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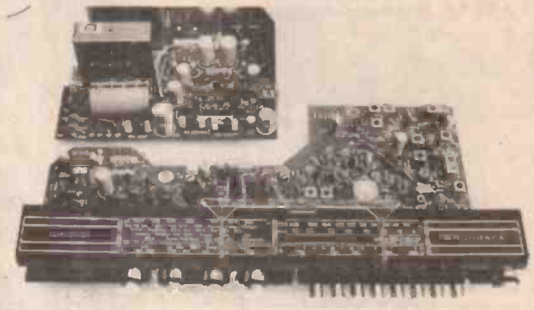

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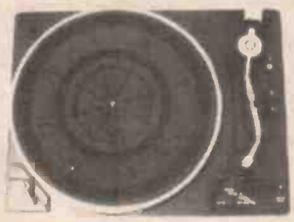

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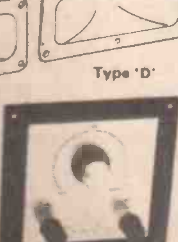

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CAR ALARM

This cunning car alarm uses the battery earth strap as a sensor to detect when a courtesy light or other electrical load occurs if a thief enters the vehicle. Design and development by Phil Wait.

A significant proportion of cars are stolen at least once in their lifetime. The thieves are generally 'joyriders' who use them for a few hours and then abandon them after vandalising such items as wheels, seats, stereo/radios and so on. If you fit a good, reliable alarm you're bound to deter all but the most determined of criminals — who are usually professionals out to 'redo' the car or strip it completely for parts. There's almost nothing that will stop the latter type of thief — alarms, steering locks or any other deterrents notwithstanding.

Early car alarms were electromechanical by nature. They generally had a balanced cantilever or a pendulum with a switch contact attached. Any movement of the vehicle would close the contact and latch on a relay sounding the horn. Simple and effective — but prone to false triggering. They've all but disappeared. Others operated from a series of hood and door switches, but installation often proved a major undertaking.

Drop Detectors

Later alarms became more sophisticated — one type sensed the slight voltage-drop pulse that appears across the vehicle battery's terminals when a load is connected — such as a 'courtesy' light being operated when a door is opened. Reliability often proved a problem with these alarms as they depended on the internal resistance of the battery, which causes the voltage-drop pulse following the connection of a load (the battery terminal voltage drops momentarily and then rises again). Any variation in the terminal clamp resistance produces the same effect — giving rise to false triggering problems.

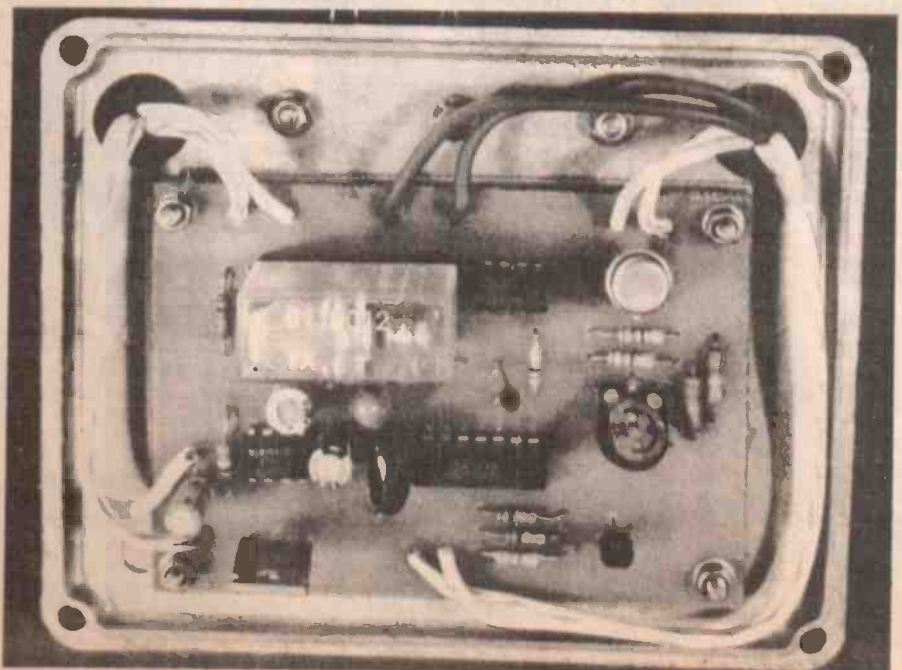
A cunning variation on this is to detect a voltage drop anywhere in the vehicle's electrical system. The battery 'earth' strap has a small, but finite, resistance. Any load on the battery will cause a current to flow through the earth strap (since the vehicle's chassis is used as the return circuit). The current causes a small voltage drop across the earth strap resistance. This is detected and used to trip the alarm circuit that sounds the car's horn. A thief entering the vehicle will inevitably operate a 'courtesy' light or something that draws current, thus tripping the alarm. As the 'sensing' input is essentially a very low impedance input, false triggering from magnetic induction or other sources is avoided. Other voltage drop sensing schemes essentially have a medium to high input impedance, hence their susceptibility to false triggering.

Pulsed Protection

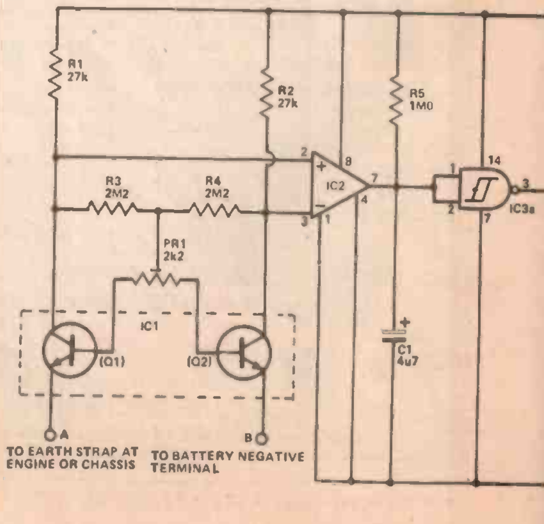
The sense and trigger circuit detects when the voltage drop across the battery earth strap rises above a predetermined amount. When triggered, this then arms the entry/exit delay. If the alarm does not remain triggered after the delay period nothing further will happen. If it does remain triggered, the delay circuit will trip the latch and start the alarm period timer. The alarm trip indicator will also light. When the alarm period timer is activated the relay driver is also activated. The relay pulser will then turn the relay on and off at one-second intervals, pulsing the horn on and off too.

The relay pulser circuit operates continuously and flashes a dashmounted LED to indicate that the alarm unit is 'armed'.

After the alarm period timer completes its period, the relay driver is turned off and the horn will cease pulsing on and off. If someone attempts to steal your car, trips the alarm and then abandons the attempt, the alarm trip indicator LED will remain on, telling you that the alarm was tripped in your absence.



(Left) The completed unit was mounted on the lid of a diecast box with a scrap of blank PCB substrate underneath as an insulating spacer. The external leads are passed through two grommetted holes to a terminal block on the outside.



Construction

Our prototype was constructed on a PCB; while this is not absolutely necessary — the project could be constructed on matrix board — a PCB does reduce the possibility of wiring errors which have to be sorted out when you first power up the project.

There is no particular order for assembling the components but it is usually easier to solder the resistors and capacitors in place first. Take care with the orientation of the tantalum and electrolytic capacitors. Follow with the semiconductors. Again, watch orientation of these components. The relay should be mounted last of all.

The completed board can be mounted in any convenient case — we housed ours in a diecast box measuring 120 x 40 x 95 mm. A diecast box was chosen because it can be effectively sealed against the ingress of dirt, moisture and other undesirable substances.

We mounted the PCB on the underside of the diecast box's lid and fitted a 10-way terminal block on the outside of the lid for all the external connections. Leads from the PCB to the 10-way terminal block are passed through grommetted holes.

Installation

First, mount the two LEDs on the dash in convenient positions where they can be seen from outside the vehicle. The alarm is switched on by a concealed switch which may be located under the dash or under the driver's seat. Alternatively, an externally mounted keyswitch may be used. If you install the latter, entry and exit delay may be reduced to about half a second by changing the value of C1 to 1uF.

We used a two-pole switch for SW1, one pole to switch the supply to the alarm, the other to short out the points when the alarm is switched on.

Thus, if somebody does gain entry to the car and ignores the alarm or disconnects the horn, they will not be able to start the car even if they hot-wire the ignition!

Connection to the earth strap is quite straightforward. Take a wire from terminal A and solder it to the end of the earth strap. A wire from terminal B is soldered to the battery terminal connection. It's a good idea to keep these leads fairly short to reduce noise pick-up. Ours were about 1 m long.

The positive supply, via the alarm

HOW IT WORKS

The current in the earth strap is sensed by a pair of transistors connected in a common base configuration. These two transistors, Q1 and Q2, are encapsulated in an integrated circuit package (IC1) and are on a single chip of silicon, ensuring that they have very closely matched characteristics. The base-emitter voltages of each transistor will track within 50 uV of each other, a characteristic which is exploited here.

When no current is being drawn from the battery there will be no potential drop across the resistance of the battery earth strap (ignoring the miniscule current drawn by this alarm). Thus, the emitters of each transistor in IC1 will be at the same potential. As the base-emitter voltage of each is virtually identical the collector currents will be identical. Thus initially, the collector-emitter voltage of each transistor will be the same.

When current is drawn from the battery (when a courtesy lamp is operated, for example), a small voltage drop will appear across the battery earth strap. Thus, point A (emitter of Q1) will be raised to a *higher* potential than point B (emitter of Q2). That is, point A will be more positive than point B. The voltage on the collector of Q1 will thus rise (a common base amplifier is a *non-inverting* amplifier).

The voltage on the collector of each transistor in IC1 (Q1 and Q2) is initially set by a preset, which varies the current fed to each base. This compensates for any slight mismatch between Q1 and Q2 (the DC gain of this circuit is very high) and also acts as a 'sensitivity threshold' control by introducing an offset which must be overcome by a certain level of current through the battery earth strap before the alarm will trigger.

The voltage difference between the collectors of Q1 and Q2 is monitored by a differential input comparator (IC2). When the voltage on its non-inverting input exceeds the voltage on its inverting input the comparator's output switches high. IC2 has an open collector output requiring an external load resistor (R5). When the output of IC2 is low the timing capacitor, C1, is held discharged by IC2's output circuitry. When the alarm is tripped and the output of IC2 goes high C1 starts to charge through R5. After a time determined by the time constant of R5 and C1 the Schmitt gate IC3a toggles over and its output, pin 3, goes low.

The Schmitt gates IC3b and IC3c form a latch circuit. On power up, the latch is automatically reset by R6 and C2 placing a momentary low on pin 8. The output of IC3c is high and the output of IC3b is low, Q3 is turned off and LED1 is not lit.

When the output of IC3a goes low the latch toggles over. The output of IC3b goes high, turning on Q3 and lighting LED1. The output of IC3c goes low at the same time. The latch remains in this state until it is reset when the power is turned off and then on again.

Before the alarm is triggered the output of IC3c is high and the input of IC3d is held high by R9. As IC3d is wired as an inverter its output is low and Q4 is turned off. When the alarm is triggered the output of IC3c goes low, and since C3 is discharged, the input of IC3d is pulled low, its output goes high and Q4 is switched on, allowing the relay to operate.

The timing capacitor, C3, slowly charges through R9 and, after a period determined by the time constant of C3/R9, IC3d switches over, turning Q4 off again and stopping the horn.

The relay RLA, and therefore the horn, is pulsed on and off about once per second during the horn timing period. IC5 is a 555 timer wired as a free-running oscillator. The frequency of oscillation is determined by the time constant of R12 and C5. As the 555 is capable of driving quite high currents it is connected directly to the relay, which is then switched by Q4. In other words, the 555 pulses the supply to the relay.

The output from the 555 is also used to pulse LED2 (mounted on the dash) as a warning to would-be car thieves and as an indication that the alarm is on.

A three-terminal regulator, IC4, drops the battery voltage down to 5 V to supply the sense and timing circuits. This protects against false triggering from battery voltage variations and also helps to remove noise from the supply.

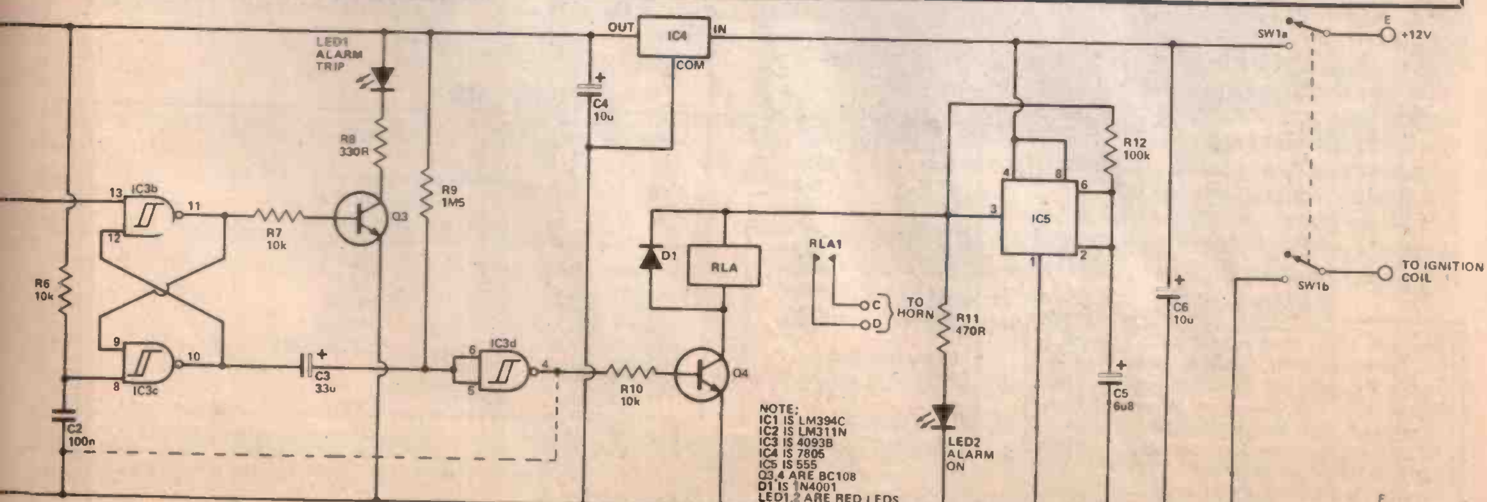


Fig. 1 Circuit diagram of the ETI Car Alarm.

See Fig. 2 for details on connecting the project to the car's electrics.

switch, should be taken through an in-line fuse holder, directly from the battery positive terminal.

The output from the alarm is a pair of switched contacts, which operate the horn by bypassing the horn switch or, on some cars, the horn relay. We have shown two common horn circuits. In the first circuit the horn switch is bypassed by the relay contacts. The second circuit is a little more complex and requires an extra pole on the alarm switch. If you want to short out the points as well you will need a three-pole double-throw switch. Make sure you break the connection from the ignition switch to the horn as shown, or when you switch the alarm on you will also switch on the ignition!

Try to make all wiring as neat as possible and try to blend it in with the car's wiring so it is not obvious to a thief what wire he has to pull out to stop the alarm.

Setting Up

When all the wiring is complete, all that remains is to set the sensitivity preset. Disable the entry and exit delay by removing C1, or alternatively connect a high impedance voltmeter across C1. With no current being drawn from the battery, adjust PR1 until the alarm just fails to trip or C1 fails to start to charge. Note the position on the preset. Turn on the interior light and the alarm should trip. If it does not, check your first adjustment; if it is correct, you probably have the leads to the earth strap and the battery negative terminal swapped.

Turn the preset until the alarm just won't trip or C1 doesn't charge when the interior light is turned on. Note this position. The correct position for PR1 is midway between these limits, for reliable operation.

Next check that the alarm doesn't trip on the car radio or the electric clock. Some mechanical clocks are rewound by a motor every few hours, or even days, and these are often a cause of false triggering. If false triggering occurs from the radio or the clock, reduce the sensitivity. In some extreme cases it may be necessary to use a higher wattage interior light, though we found operation to be extremely reliable with a 5 W light, and there was sensitivity to spare!

BUYLINES

The only tricky components are IC1 and IC2 — these are both available from Technomatic. The relay is type RL111 from Watford Electronics. The case can be any diecast aluminium box about 120 mm x 95 mm x 40 mm; suitable ones are available from West Hyde Developments (order as EDD40) and Watford (DCB8). The PCB is available from our PCB Service (see page 76).

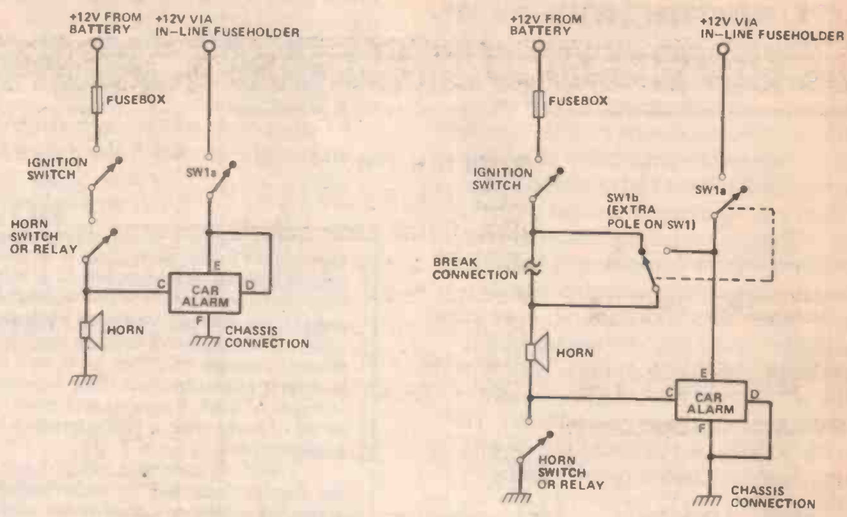


Fig. 2 Common horn circuits and how to connect the alarm to them. The circuit on the left will have only one wire from the horn. The one on the right is found in cars such as the Leyland Mini LS and is rather more complex.

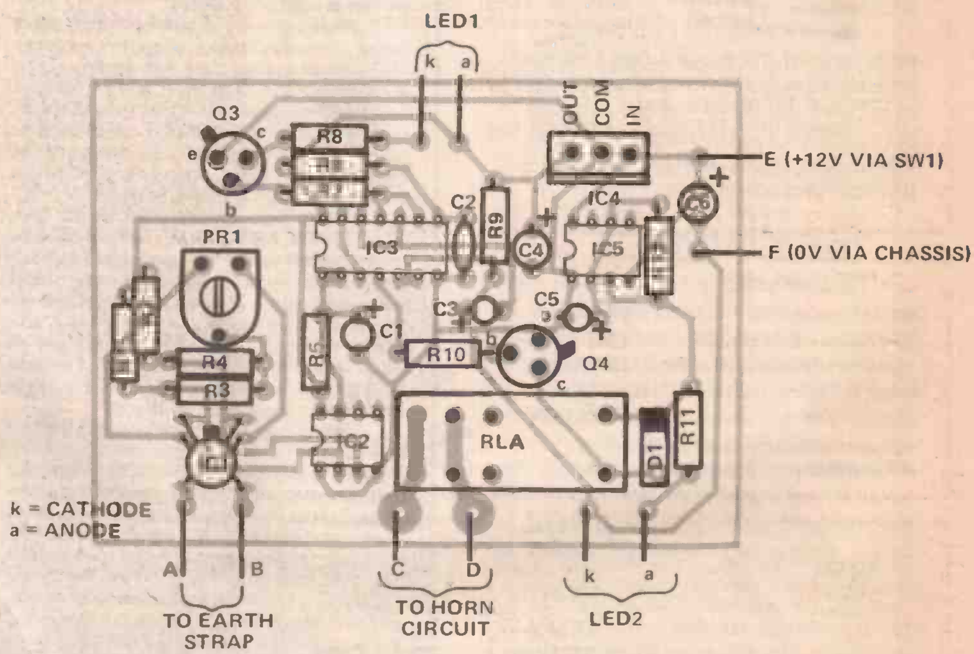


Fig. 3 Component overlay for the Car Alarm. There are a lot of polarised capacitors so make sure you get them all the right way round.

ETI

PARTS LIST

Resistors (all ¼ W, 5%)	
R1,2	27k
R3,4	2M2
R5	1M0
R6,7,10	10k
R8	330R
R9	1M5
R11	470R
R12	100k
Potentiometer	
PR1	2k2 miniature horizontal preset
Capacitors	
C1	4u7 16 V tantalum
C2	100n polyester
C3	33u 16 V tantalum
C4,6	10u 16 V PCB electrolytic
C5	6u8 16 V tantalum
Semiconductors	
IC1 (=Q1,2)	LM394C
IC2	LM311N
IC3	4093B
IC4	7805
IC5	555
Q3,4	BC108
D1	1N4001
LED1,2	0.2" red LED
Miscellaneous	
RLA	12 V DPCO PCB-mounting relay
SW1	DPST or 3PST toggle switch

PCB (see Buylines); case (see Buylines); 10-way terminal strip.

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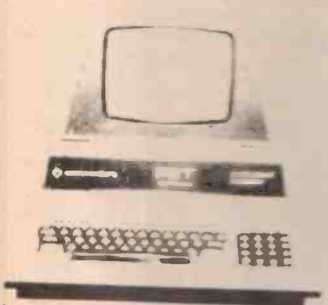

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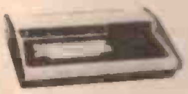

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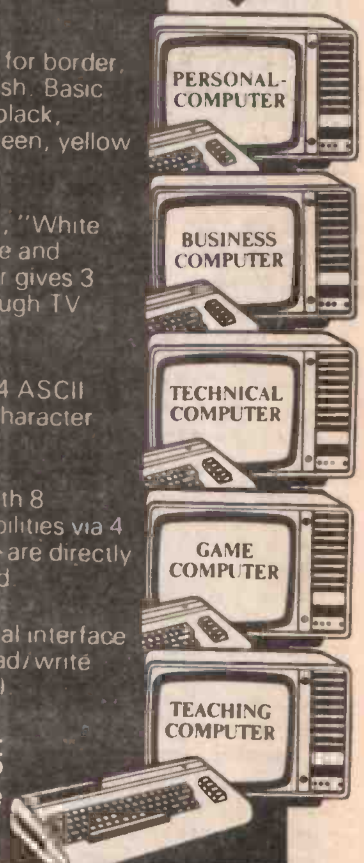

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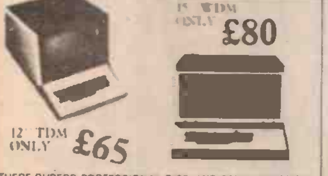

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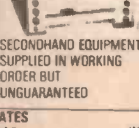

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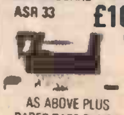

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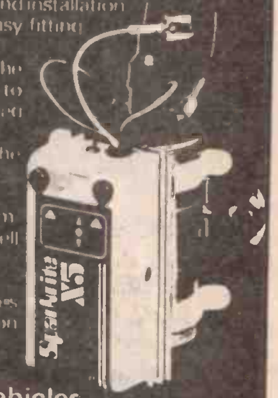

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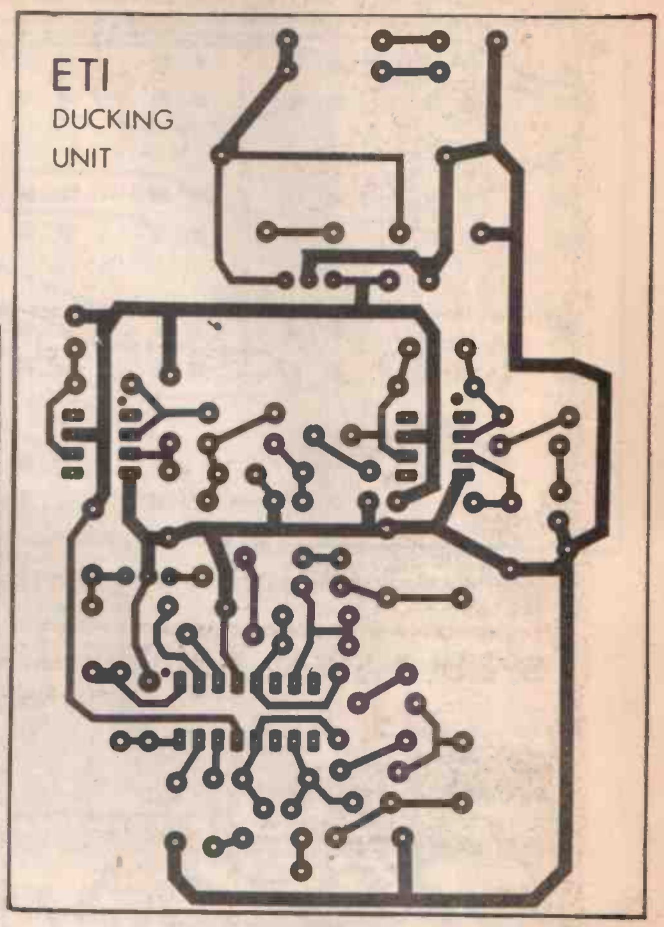
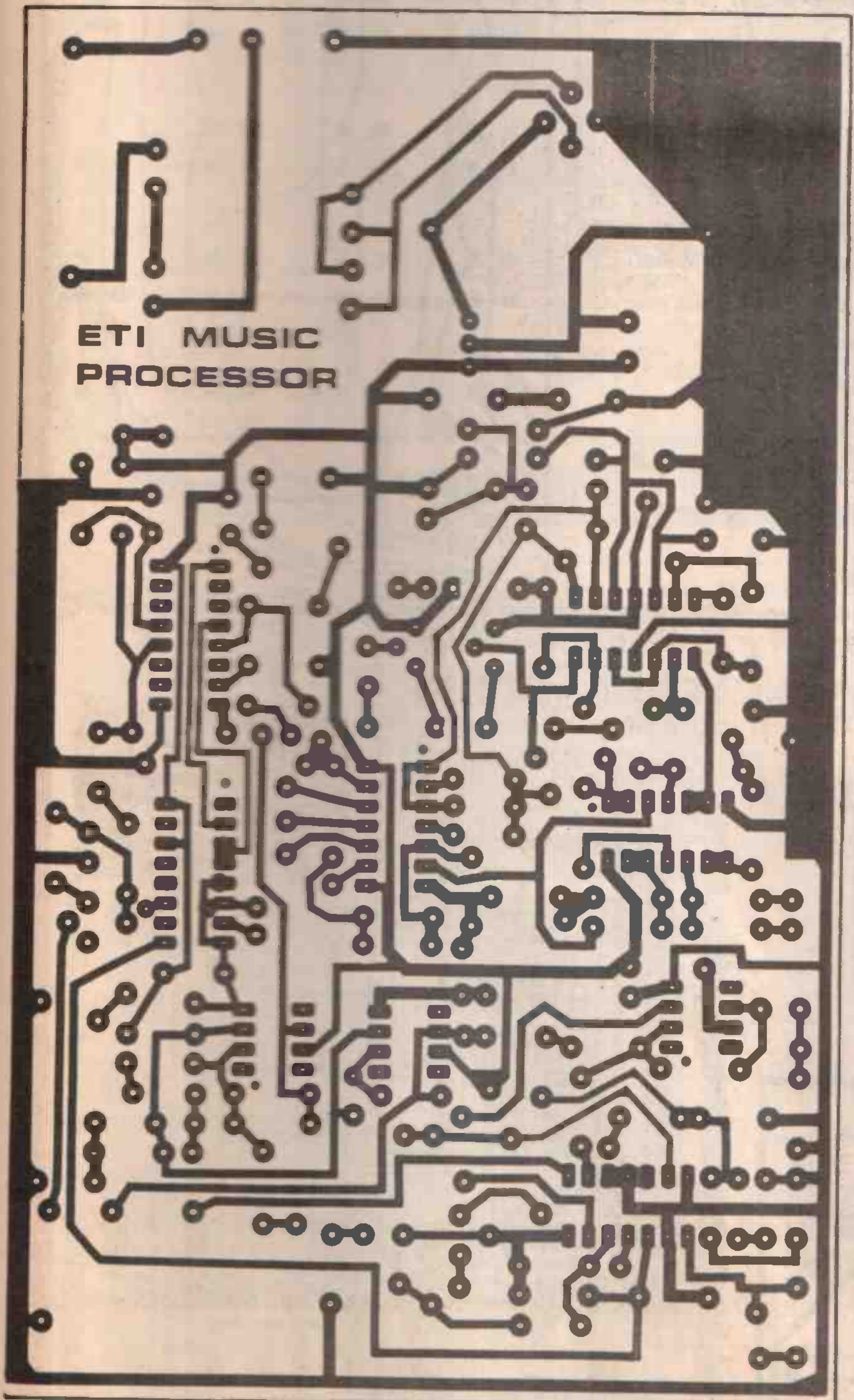
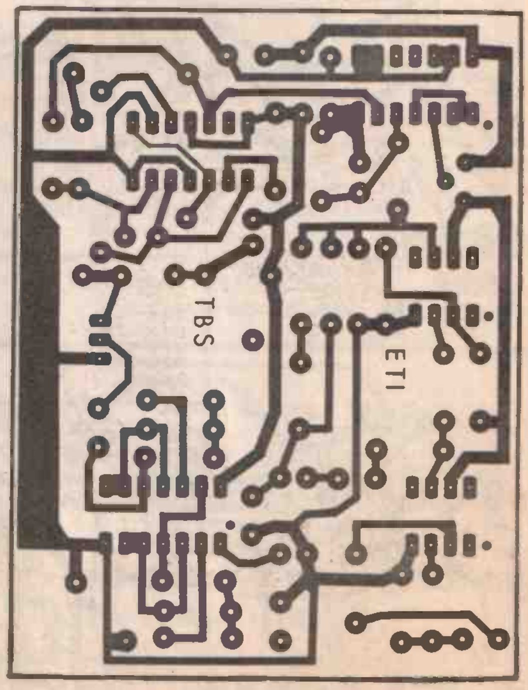


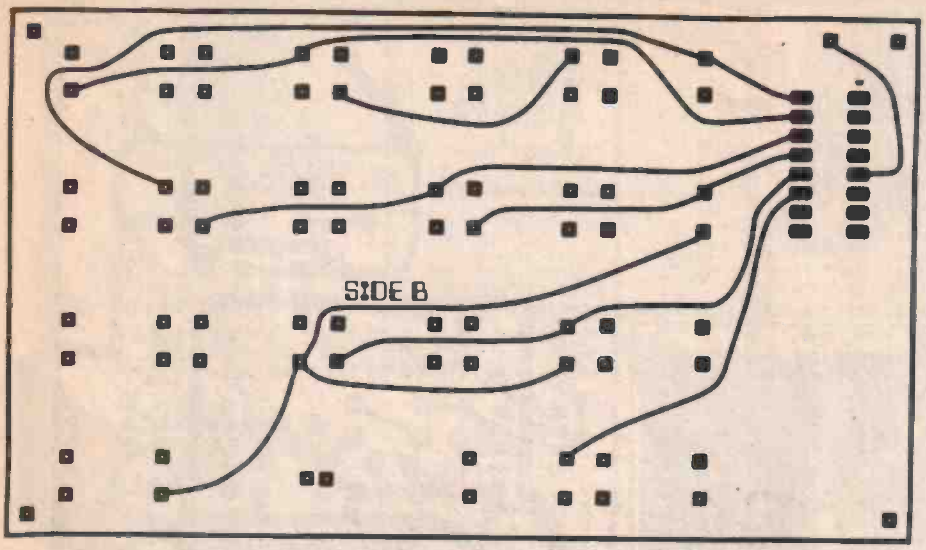
The Voice-over PCB.



foil pattern for the Music Processor.

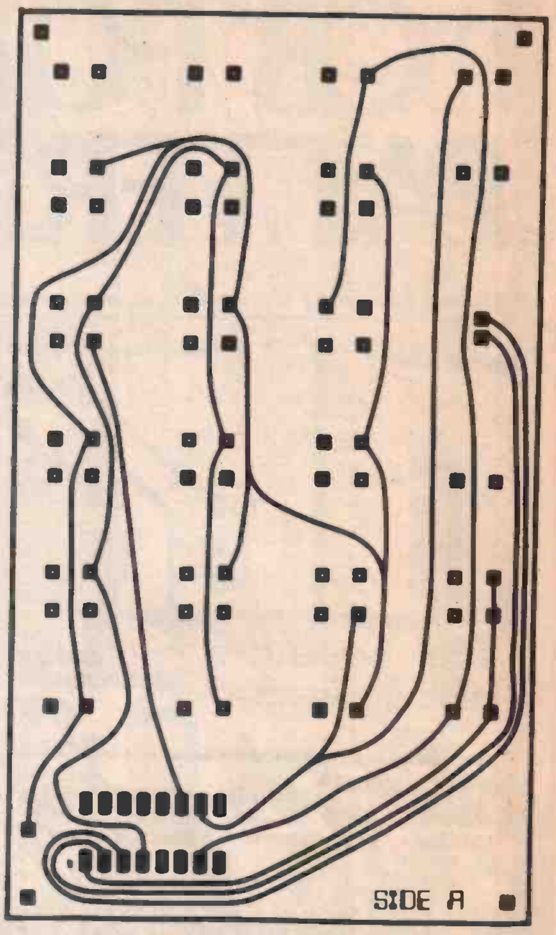


The board for the Phone Bell Shifter.

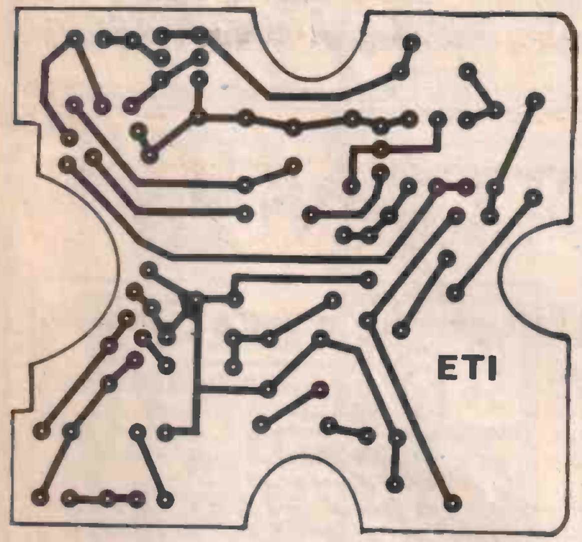


Above: The underside of the keypad PCB for last month's FM Mains Remote Control system.

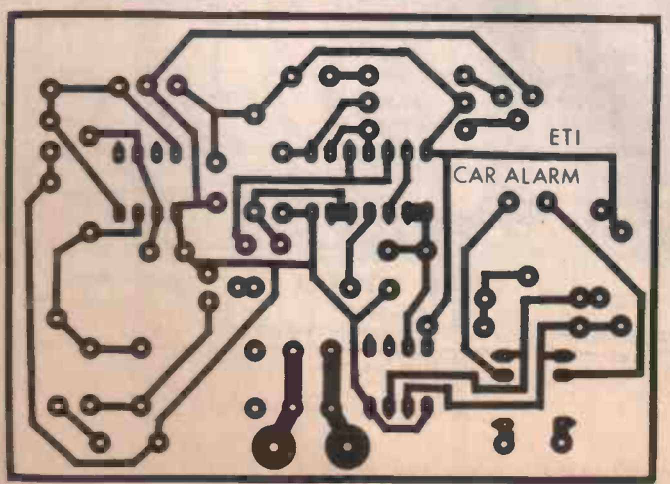
Right: The component side foil pattern of the double-sided keypad.

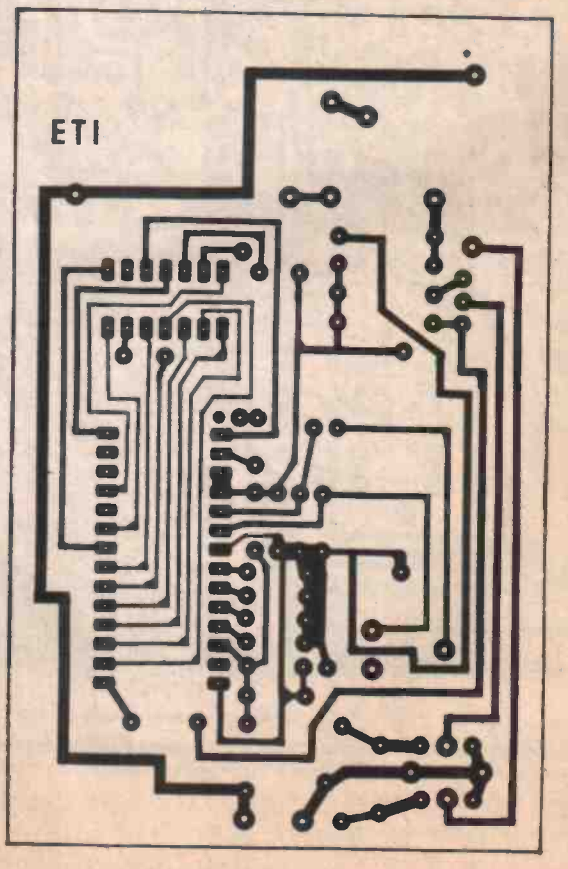


Below: FM Mains Remote Control receiver board.



Below: Foil pattern of the ETI Car Alarm.





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NE564N	4.29	CA3240	1.27	MSM5527	9.75
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uA741CN	0.27	KB4420B	1.09	MC145156	8.75
uA747CN	0.70	KB4422	2.85		
uA748CN	0.36	KB4423	2.30	**MISC**	
uA753	2.44	KB4424	1.65	ICM7106CP	9.55
uA758	2.35	KB4431	1.95	ICM7107CP	9.55
TBA820M	0.78	KB4432	1.95	ICM7216BP	19.50
TCA940E	1.80	KB4433	1.52	ICM7555	0.94
TDA1028	2.11	KB4436	2.53	**CRYSTALS**	
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TDA1054	1.45	KB4438	2.22	32 768kHz	2.70
TDA1062	1.95	KB4441	1.35	100kHz	3.85
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TDA1090	3.05	NE5044N	2.26	4.000	2.00
HA1137	1.20	NE5532N	1.85	4.1934	2.00
HA1196	2.00	SD6000	3.75	4.096	2.00
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LM1303	0.99	SL6600	3.75	4.800	2.00
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4011	0.15	4072	0.22	4703	4.48
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4013	0.35	4075	0.18	4705	4.24
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4019	0.38	4082	0.25	4724	0.95
4020	0.68	4093	0.45	4725	2.24
4021	0.75	4099	0.99	40014	0.54
4022	0.88	4175	1.15	40085	0.99
4023	0.19	4502	0.90	40098	0.54
4024	0.45	4503	0.55	40106	0.54
4025	0.18	4506	0.75	40160	0.69
4026	1.05	4507	0.45	40161	0.69
4028	0.60	4508	1.98	40162	0.69
4029	0.75	4510	0.70	40163	0.69
4030	0.35	4511	0.85	40174	0.69
4035	0.75	4512	0.70	40175	0.69
4040	0.68	4514	2.20	40192	0.75
4042	0.65	4515	2.50	40193	0.75
4043	0.68	4516	0.75	40194	0.69
4043	0.93	4518	0.75	40195	0.69
4044	0.68	4520	0.80	**TTL 'N'**	
4946	0.69	4521	2.36	7400	0.10
4047	0.69	4522	1.49	7401	0.10
4049	0.30	4527	0.95	7402	0.10
4050	0.30	4528	0.95	7403	0.11
4051	0.65	4529	1.40	7404	0.12
4052	0.69	4539	1.10	7405	0.12
4053	0.69	4549	3.50	7406	0.22
4054	1.30	4554	1.73	7407	0.22
4055	1.30	4555	0.72	7408	0.15
4056	1.35	4556	0.58		
		4560	2.18		

TTL

7448	0.56	74125	0.40	74190	0.55
7450	0.14	74126	0.40	74191	0.55
7451	0.14	74128	0.65	74192	0.55
7453	0.14	74132	0.50	74193	0.55
7454	0.14	74136	0.65	74194	0.55
7460	0.14	74141	0.45	74195	0.55
7470	0.28	74142	1.85	74196	0.55
7472	0.27	74143	2.50	74197	0.55
7473	0.28	74144	2.50	74198	0.85
7474	0.28	74145	0.75	74199	1.00
7475	0.35	74147	1.50	74221	1.00
7476	0.30	74148	1.09	74246	1.50
7480	0.26	74150	0.79	74247	1.51
7481	0.20	74151	0.55	74248	1.89
7482	0.75	74153	0.55	74249	1.89
7483	0.60	74154	0.55	74251	1.05
7485	0.75	74155	0.55	74265	0.66
7486	0.24	74156	0.55	74273	2.67
7489	1.05	74157	0.55	74278	2.49
7490	0.30	74159	1.90	74279	0.89
7491	0.55	74160	0.55	74283	1.30
7492	0.35	74161	0.55	74284	3.50
7493	0.35	74162	0.55	47285	3.50
7494	0.70	74163	0.55	74290	1.00
7495	0.60	74164	0.55	74293	1.06
7496	0.45	74165	0.65	74297	2.36
7497	1.40	74166	0.70	74298	1.85
74100	1.10	74167	1.25	74365	0.85
74104	0.62	74170	1.25	74366	0.85
74105	0.62	74173	1.10	74367	0.85
74107	0.26	74174	0.75	74368	0.85
74109	0.35	74175	0.75	74390	1.86
74110	0.54	74176	0.75	74393	1.86
74111	0.68	74177	0.75	74400	1.86
74112	1.70	74178	0.90	**'LPSN'**	
74116	1.98	74179	1.35		
74118	0.85	74180	0.75	7400	0.11
74119	1.20	74181	1.22	7401	0.11
74120	0.95	74182	0.70	7402	0.12
74121	0.35	74184	1.20	7403	0.12
74122	0.34	74185	1.20	7404	0.13
74123	0.40	74188	1.00		

LS

7405	0.14	7496	1.20	74190	0.60
7408	0.14	74107	0.25	74191	0.60
7409	0.14	74109	0.25	74192	0.68
7410	0.13	74112	0.25	74193	0.68
7411	0.14	74113	0.25	74194	0.42
7412	0.15	74114	0.25	74195	0.42
7413	0.28	74122	0.40	74196	0.65
7414	0.49	74123	0.55	74197	0.65
7415	0.14	74124	1.80	74200	3.45
7420	0.13	74125	0.29	74202	3.46
7421	0.15	74126	0.29	74221	0.60
7422	0.15	74132	0.45	74240	0.99
7426	0.18	74133	0.30	74241	0.99
7427	0.14	74136	0.28	74242	1.65
7428	0.35	74138	0.40	74243	1.65
7430	0.13	74139	0.40	74244	0.83
7432	0.14	74145	1.20	74245	1.50
7433	0.16	74147	2.10	74247	1.35
7437	0.17	74148	1.60	74248	1.35
7438	0.16	74151	0.35	74249	1.35
7440	0.13	74153	0.35	74251	0.46
7442	0.40	74154	0.99	74253	0.46
7447	0.42	74155	0.50	74257	0.56
7448	0.66	74156	0.50	74258	0.30
7449	0.81	74157	0.36	74259	0.39
7451	0.14	74158	0.40	74260	0.70
7454	0.15	74160	0.40	74266	0.24
7455	0.15	74161	0.40	74273	0.90
7463	1.50	74162	0.40	74275	3.20
7473	0.21	74163	0.40	74279	0.35
7474	0.18	74164	0.50	74280	2.50
7475	0.28	74165	1.20	74283	0.44
7476	0.22	74166	1.76	74290	0.58
7478	0.24	74168	0.85	74293	1.30
7483	0.50	74169	0.85	74295	1.50
7485	0.70	74170	1.85	74298	1.50
7486	0.18	74173	0.75	74365	0.35
7490	0.32	74174	0.55	74366	0.35
7491	1.25	74175	0.55	74367	0.36
7492	0.39	74181	1.35	74368	0.36
7493	0.38	74183	2.96	74373	0.78
7495	0.48	74189	1.28	74374	0.78
				74375	1.15
				74377	1.99
				74378	1.40
				74379	2.16
				74384	2.50
				74385	4.20
				74386	0.29
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				74395	2.10
				74396	1.99
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74926	4.32	2SA1085	20p
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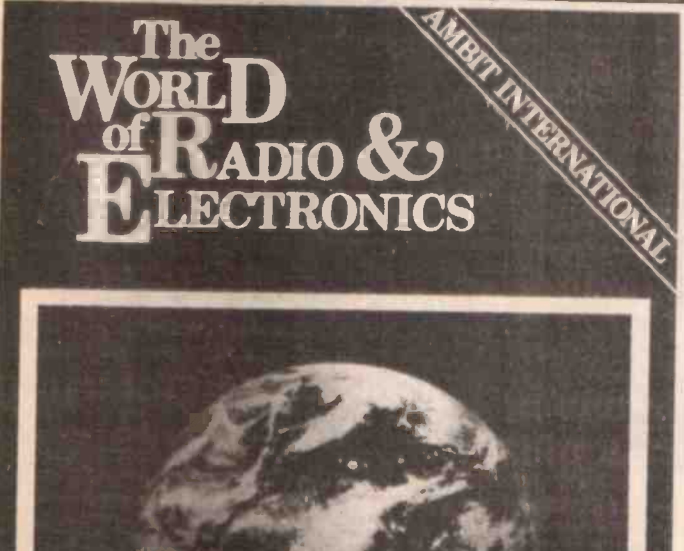

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and if that's not enough a fully floating 5v output @ 50 ma DC which may be seriesed to give a host of other voltages. All outputs are brought out to the front panel via miniature jack sockets and are also duplicated at the rear on short flying leads. Units accept standard 340v AC mains input. They are ex GPO and may have minor scratches on the front panels, they are sold untested but in good internal condition. **£16.50** each + **£2.50** p+p complete with circuit and component list. Transformer guaranteed. **HURRY WHILE STOCKS LAST!!**

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A superb piece of engineering made by SE Labs Ltd. to a "no cost spared" spec for the GPO, the Modem 12 is a synchronous Modem for use on DATEL 2412 services, or other data links. Many features include switchable V26 modulation, 2400 baud full duplex 600/1200 standby, auto answer, 4 wire or 2 wire operation. Self test, LED status indication, CMOS technology, modular construction, original cost over **£700** each. Believed brand new, supplied complete with PSU etc.
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*Permission may be required for connection to PO lines.

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PERTEC TAPE DRIVES
7 track 6840 — 75-25 £175.00 + VAT
9 track 6840 — 9-25 £295.00 + VAT
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ONLY **£9.95** + 1.85 pp

Superb professional fully enclosed, made for the G.P.O. to the highest standard, offered at a fraction of their original cost they feature aluminium sides, hinged removable front panel, which can be secured by 2 screws to prevent prying fingers. All are finished in two tone G.P.O. grey and although believed brand new may have minor scuff marks/scratches due to bad storage.
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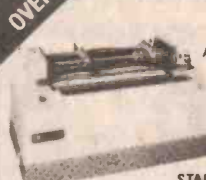
THE LOGABAX Z80 MICROPROCESSOR CONTROLLED LX180L MATRIX PRINTER

SAVE OVER £1400



A massive bulk purchase enables us to offer you this superb professional printer at a fraction of its recent cost of over **£2000**. Utilising the very latest in microprocessor technology, it features a host of facilities with all electronics on one plug in P.C.B. Just study the specification and you will instantly realise it meets all the requirements of the most exacting professional or hobbyist user.

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Ex-equipment 9" Motorola Video Monitors 75 Ω composite input, tested but unguaranteed.
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★ ALARM
★ 50/60 HZ

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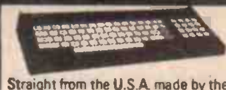

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7912 12V +	.58
7915 15V –	.58
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7401	.12
7404	.13

7408	.13
7414	.29
7420	.12
7442	.33
7448	.38
7474	.20
7486	.20
7490	.21
74107	.20
74151	.26
74159	.58
74167	1.15
74172	2.75
74178	.43
74179	.43
74184	.90
74185	.90
74198	.55
74199	.56
74273	.80
74278	.88
74284	1.44
74351	.87
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4001	.11
4011	.12
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4016	.25
4020	.64
4024	.36
4047	.76
4060	.85
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4099	1.20
4508	2.22
4514	1.50
4516	.70
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4522	1.20

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32	.12
33	.16
37	.15
38	.15
40	.12
42	.35
47	.40
48	.65
49	.60
51	.12
54	.14
55	.12
73	.21
74	.16
75	.25
76	.20
78	.20
83	.45
85	.70
86	.15
90	.30
91	.78

92	.35
93	.35
95	.44
109	.22
112	.22
113	.22
114	.22
122	.40
123	.42
124	.99
125	.26
126	.26
132	.48
136	.25
138	.36
145	.76
148	1.08
151	.30
153	.30
155	.45
154	.90
156	.38
157	.32
158	.32
160	.40
161	.40
162	.40
133	.40
164	.48
166	.32
173	.70
174	.48
175	.58
181	1.45
190	.57
191	.57
192	.65
193	.47
194	.40
195	.40
196	.65
197	.65

221	.55
240	.98
241	1.10
242	.80
244	.68
245	1.10
247	.37
248	.68
249	.68
257	.52
259	1.00
261	3.00
273	.78
290	.55
373	.75
374	.75
377	.90
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32.768kHz	.98
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2,562MHz	3.25
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4,194MHz	1.85
4,433MHz	.85
4,000MHz	1.85
5,120MHz	1.08
6,000MHz	1.95

6,144MHz	1.25
6,400MHz	1.50
10,000MHz	1.50
18,000MHz	1.50
20,000MHz	1.50
I.C. SOCKETS	
8 PIN	.08
14 PIN	.09
16 PIN	.10
18 PIN	.14
20 PIN	.15
22 PIN	.18
24 PIN	.20
28 PIN	.26
40 PIN	.30
TRANSISTORS	
BC141/10	.18
BC161/10	.18
BD139/10	.18
BD140/10	.18
BD441	.25
BD442	.25
BD679	.45
BD680	.45
BD245	.48
BD249	.80
BD250	.80
BD346	.55
BD378	.22
BF679	.40
BF926	.28
BF979	.60
BFW92	.28
BSW45	.09
BSY51	.09
BU100A	1.00
BU111	.90
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BU205	.90
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VN46AF	1.20
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2N1525	.28
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2N2219	.15
2N2258	.09
2N2483	.13
2N3054	.43
2N3325	.15
2N3415	.09
2N3771	1.20
2N3773	1.70
2N3819	.30
2N3829	1.70
2N4060	.09
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2N5248	.30
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2N5378	.12
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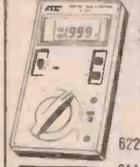


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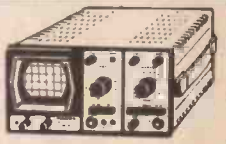
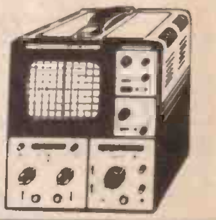

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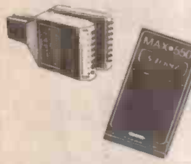

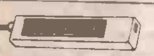

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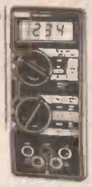

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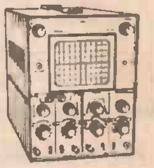

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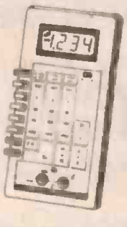


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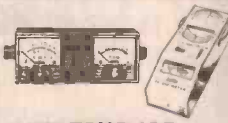

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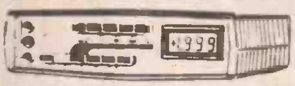

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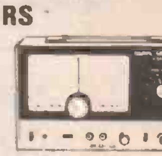
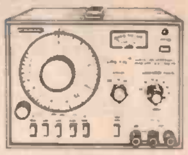

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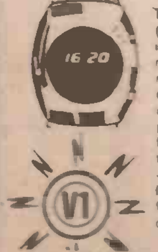

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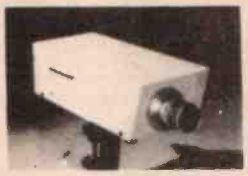

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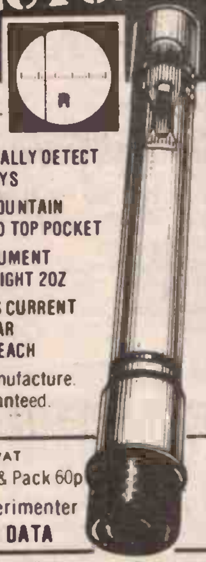

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