

Hobby Electronics

MARCH '82

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65p

For A Down-To-Earth Approach To Electronics



Hobby Dice

A gadget for games of all kinds

By popular request:
Probing the Oscilloscope
The instrument and
how to use it

PLUS

Bike Siren and Stereo Bass Booster
projects, PCB feature and all our regular columns



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I.C. SOCKETS

A range of high quality, low cost, low profile DIL sockets ideally suited for both the OEM and hobbyist. All types feature double sided phosphor bronze contacts, tin-plated for low contact resistance.

8 x 0.3" 12p	22 x 0.3" 20p
14 x 0.3" 13p	22 x 0.4" 20p
16 x 0.3" 13p	24 x 0.6" 22p
18 x 0.3" 18p	28 x 0.6" 25p
20 x 0.3" 19p	40 x 0.6" 35p
20 x 0.4" 19p	42 x 0.6" 38p

DISCRETES

BC237 8p	BC556 12p	2SK168 35p
BC238 8p	BC560 12p	J310 69p
ZTX238 9p	BC639 22p	J176 65p
BC239 8p	BC640 23p	40823 65p
BC307 8p	2SC1775A 22p	3SK45 49p
BC308 8p	2SA872A 18p	3SK51 54p
BC309 8p	2SD666A 30p	3SK60 58p
BC413 10p	2SB646A 30p	3SK88 99p
BC414 11p	2SD668A 30p	MEM680 75p
BC415 10p	2SB648A 40p	BF960 99p
BC416 11p	BF256 38p	BF961 70p
BC546 12p	2SK55 28p	BF963 99p

VOLTAGE REGULATORS

78XX1A TO-220 pos	0.58
79XX1A TO-220 neg	0.60
78G 1A TO-220 adj pos	1.10
78G 1A TO-3 adj pos	3.95
78H5A TO-3 5v pos	4.25
78H5A TO-3 12v pos	5.45
78HG5A TO-3 adj pos	7.45
79HG5A TO-3 adj neg	7.45
LM317.5A adj pos	1.30
LM337.5A adj pos	1.75
78S401.5A adj pos sw reg	1.20

XTALS

1MHz	3.00
3.2768MHz	2.00
4MHz	1.70
4.194MHz	1.70
4.43MHz	1.25
5MHz	2.00
6.5536MHz	2.00
7MHz	2.00
8MHz	2.00
9MHz	2.00
10MHz	2.00
11MHz	2.00

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CMOS			74LSXX			Processors										
4000	0.11	4077	0.18	4705	4.24	7447N	0.62	74153N	0.55	74366N	0.85	74LS109N	0.20	74LS248N	1.35	8080 series 8080AFC/2 7.30 8212 2.30 8214 3.50 8216 1.85 8224 3.50 8251 8.21 8255 5.40
4001	0.11	4078	0.18	4706	4.50	7448N	0.56	74154N	0.55	74367N	0.85	74LS112N	0.20	74LS249N	1.35	
4002	0.12	4081	0.12	4720	4.00	7450	0.14	74155N	0.55	74368N	0.85	74LS113N	0.20	74LS251N	0.35	
4007	0.13	4082	0.18	4723	0.95	7451N	0.14	74156N	0.55	74390N	1.85	74LS114N	0.19	74LS253N	0.35	
4008	0.50	4093	0.30	4724	0.95	7453N	0.14	74157N	0.55	74393N	1.85	74LS122N	0.35	74LS257N	0.40	
4008AE	0.80	4099	0.80	4725	2.24	7454N	0.14	74159N	1.90	74490N	1.85	74LS123N	0.35	74LS258N	0.37	
4009	0.25	4175	0.80	40014	0.54	7460N	0.14	74160N	0.55			74LS124N	1.80	74LS259N	0.60	
4009	0.25	4502	0.60	40085	0.99	7470N	0.28	74161N	0.55			74LS125N	0.24	74LS260N	0.50	
4010	0.30	4503	0.50	40098	0.54	7472N	0.27	74162N	0.55	74LS00N	0.10	74LS126N	0.24	74LS266N	0.22	
4011AE	0.24	4506	0.70	40106	0.69	7473N	0.28	74163N	0.55	74LS01N	0.10	74LS132N	0.42	74LS273N	0.70	
4011	0.11	4507	0.37	40160	1.05	7474N	0.28	74164N	0.55	74LS02N	0.11	74LS133N	0.24	74LS275N	3.20	
4013	0.25	4508	1.50	40161	1.05	7475N	0.35	74165N	0.55	74LS03N	0.11	74LS136N	0.20	74LS279N	0.35	
4015	0.50	4510	0.55	40162	1.05	7476N	0.30	74166N	0.70	74LS04N	0.14	74LS138N	0.30	74LS280N	2.50	
4016	0.22	4511	0.45	40163	1.05	7480N	0.26	74167N	1.25	74LS05N	0.13	74LS139N	0.30	74LS283N	0.42	
4017	0.40	4512	0.55	40174	1.05	7481N	0.20	74170N	1.25	74LS06N	0.12	74LS145N	1.20	74LS287N	0.50	
4019	0.38	4514	1.25	40175	1.05	7482N	0.75	74173N	1.10	74LS09N	0.12	74LS151N	0.30	74LS293N	0.40	
4020	0.55	4515	1.25	40192	1.08	7485N	0.75	74174N	0.75	74LS10N	0.12	74LS153N	0.27	74LS295N	1.50	
4021	0.55	4516	0.60	40193	1.08	7486N	0.24	74175N	0.75	74LS11N	0.12	74LS154N	0.89	74LS298N	0.76	
4022	0.55	4518	0.35	40194	1.08	7489N	1.05	74176N	0.75	74LS12N	0.12	74LS155N	0.35	74LS305N	0.32	
4023	0.15	4520	0.60	40195	1.08	7490N	0.30	74177N	0.75	74LS13N	0.20	74LS156N	0.37	74LS306N	0.34	
4024	0.33	4521	1.30			7491N	0.55	74178N	0.90	74LS14N	0.30	74LS157N	0.30	74LS307N	0.32	
4025	0.15	4522	0.89			7492N	0.35	74179N	1.35	74LS15N	0.12	74LS158N	0.30	74LS308N	0.35	
4026	1.05	4527	0.80			7493N	0.35	74180N	0.75	74LS16N	0.12	74LS160N	0.37	74LS309N	0.37	
4027	0.26	4528	0.65			7494N	0.70	74181N	1.22	74LS17N	0.12	74LS161N	0.37	74LS310N	0.70	
4028	0.50	4529	0.70			7495N	0.60	74182N	0.70	74LS18N	0.12	74LS162N	0.37	74LS311N	0.70	
4029	0.55	4531	0.65			7496N	0.45	74184N	1.20	74LS19N	0.12	74LS163N	0.37	74LS312N	0.70	
4030	0.35	4532	0.80			7497N	1.40	74185N	1.20	74LS20N	0.12	74LS164N	0.40	74LS313N	0.70	
4035	0.67	4534	4.00			74100	1.10	74188N	3.00	74LS21N	0.12	74LS165N	0.60	74LS314N	0.70	
4040	0.50	4536	2.50			7406N	0.22	74104	0.62	74LS22N	0.12	74LS166N	0.80	74LS315N	0.70	
4042	0.50	4538	0.85			7407N	0.22	74105	0.62	74LS23N	0.12	74LS168N	0.70	74LS316N	0.70	
4043	0.50	4539	0.80			7408N	0.15	74107	0.26	74LS24N	0.12	74LS169N	0.85	74LS317N	0.70	
4043AE	0.93	4543	0.80			7409N	0.15	74109N	0.35	74LS25N	0.15	74LS170N	0.80	74LS318N	0.70	
4044	0.60	4549	3.50			7410N	0.12	74110N	0.54	74LS26N	0.15	74LS173N	0.80	74LS319N	0.70	
4046	0.60	4553	2.70			7411N	0.18	74111N	0.68	74LS27N	0.15	74LS174N	0.40	74LS320N	0.70	
4047	0.68	4554	1.20			7412N	0.19	74112N	1.70	74LS28N	0.14	74LS175N	0.40	74LS321N	0.70	
4049	0.24	4555	0.35			7413N	0.27	74116N	1.98	74LS29N	0.35	74LS181N	1.05	74LS322N	0.70	
4050	0.24	4556	0.40			7414N	0.51	74118N	0.85	74LS30N	0.15	74LS183N	1.75	74LS323N	0.70	
4051	0.55	4557	2.30			7416N	0.27	74119N	1.20	74LS31N	0.15	74LS189N	1.28	74LS324N	0.70	
4052	0.55	4558	0.80			7417N	0.27	74120N	0.95	74LS32N	0.15	74LS190N	0.45	74LS325N	0.70	
4053	0.55	4559	3.50			7420N	0.13	74121N	0.34	74LS33N	0.15	74LS191N	0.45	74LS326N	0.70	
4054	1.30	4560	2.50			7421N	0.28	74122N	0.34	74LS34N	0.15	74LS192N	0.45	74LS327N	0.70	
4055	1.30	4561	1.00			7423N	0.22	74123N	0.40	74LS35N	0.15	74LS193N	0.42	74LS328N	0.70	
4056	1.30	4562	2.50			7425N	0.22	74125N	0.40	74LS36N	0.15	74LS194N	0.35	74LS329N	0.70	
4059	5.75	4566	1.20			7426N	0.22	74126N	0.40	74LS37N	0.15	74LS195N	0.35	74LS330N	0.70	
4060	0.75	4568	1.45			7427N	0.22	74128N	0.65	74LS38N	0.15	74LS196N	0.55	74LS331N	0.70	
4063	1.15	4569	1.70			7430N	0.12	74132N	0.50	74LS39N	0.15	74LS197N	0.60	74LS332N	0.70	
4066	0.30	4572	0.22			7432N	0.23	74136N	0.65	74LS40N	0.15	74LS200N	3.40	74LS333N	0.70	
4067	4.30	4580	3.25			7437N	0.22	74141N	0.45	74LS41N	0.15	74LS202N	3.45	74LS334N	0.70	
4068	0.16	4581	1.40			7438N	0.22	74142N	1.85	74LS42N	0.15	74LS221N	0.50	74LS335N	0.70	
4069AE	0.14	4582	0.70			7440N	0.14	74143N	2.50	74LS43N	0.15	74LS240N	0.80	74LS336N	0.70	
4070	0.16	4583	0.80			7441N	0.54	74144N	2.50	74LS44N	0.15	74LS241N	0.80	74LS337N	0.70	
4071	0.16	4584	0.27			7442N	0.42	74145N	0.75	74LS45N	0.15	74LS242N	0.80	74LS338N	0.70	
4072	0.16	4585	0.45			7443N	0.62	74147N	1.50	74LS46N	0.15	74LS243N	0.80	74LS339N	0.70	
4073	0.16	4702	4.50			7444N	0.62	74148N	1.09	74LS47N	0.15	74LS244N	0.80	74LS340N	0.70	
4075	0.16	4703	4.48			7445N	0.62	74150N	0.79	74LS48N	0.15	74LS245N	0.80	74LS341N	0.70	
4076	0.55	4704	4.24			7446N	0.62	74151N	0.55	74LS49N	0.15	74LS246N	0.80	74LS342N	0.70	

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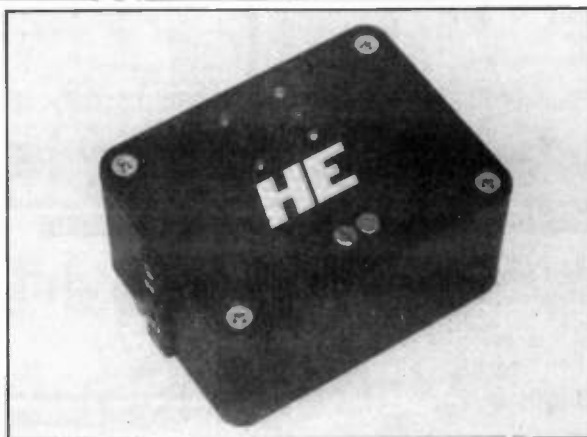
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OPTO		CONNECTORS	
★ 3mm red	8	DIN	Plug
★ 3mm green	12	2 pin	9p
★ 3mm yellow	12	3 pin	12p
Clips to suit 3p each		5 pin	13p
Rectangular	12	Phono	10p
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green	12	13p	13p
yellow	17	4mm	18p
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FND507 0.5"	95		
TIL312 0.3"	105		
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BI-PAK BARGAINS



5121 SCREWDRIVER SET
6 precision screwdrivers in hinged plastic case. Sizes — 0.8 1.4 2.2 2.4 2.9 and 3.8mm **£1.75**

5131 NUT DRIVER SET
5 precision nut drivers in hinged plastic case. With turning rod. Sizes — 3 3.5 4 4.5 and 5mm **£1.75**

5141 TOOL SET
5 precision instruments in hinged plastic case. Crosspoint (Phillips) screwdrivers — M 0 and M 1 Hex key wrenches — 1.5 2 and 2.5mm **£1.75**

5151 WRENCH SET
5 precision wrenches in hinged plastic case. Sizes — 4 4.5 5 5.5 and 6mm **£1.75**
BUY ALL FOUR SETS 5121-5151 and get HEX KEY SET FREE
HEX KEY SET ON RING
Sizes 1.5 2 2.5 3 4 5 5.5 and 6mm
Made of hardened steel
HX/1 **£1.25**



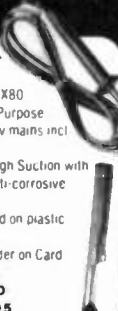
BI-PAK PCB ETCHANT AND DRILL KIT

Complete PCB Kit comprises
1 Expo Mini Drill 10 000RPM 12v DC incl 3 collets & 1 x 1mm Twist bit
1 Sheet PCB Transfers 210mm x 150mm
1 Etch Resist Pen
1 1/2lb pack FERRIC CHLORIDE crystals
3 sheets copper clad board
2 sheets Fibreglass copper clad board
Full instructions for making your own PCB boards
Retail Value over **£15.00**
OUR BI-PAK SPECIAL KIT PRICE **£9.75**
ORDER NO. SX81



BI-PAK SOLDER - DESOLDER KIT

Kit comprises ORDER NO. SX80
1 High Quality 40 watt General Purpose Lightweight Soldering Iron 240v mains incl 3/16" (4.7mm) bit
1 Quality Desoldering pump. High Suction with automatic ejection. Knurled, anti-corrosive casing and teflon nozzle
1 5 metres of De-soldering braid on plastic dispenser
2 yds (1.83m) Resin Cored Solder on Card
1 Heat Shunt tool Tweezer Type
Total Retail Value over **£12.00**
OUR SPECIAL KIT PRICE **£8.95**



BRAND NEW LCD DISPLAY MULTITESTER.

RE 188m
LCD 10 MEGOHM INPUT IMPEDANCE
"3 1/2" digit "16 ranges plus hFE test facility for PNP and NPN transistors "Auto zero" auto polarity "Single handed" pushbutton operation "Over range indication" 12.5mm (1/2-inch) large LCD readout "Diode check" "Fast circuit protection" "Test leads" battery and instructions included
Max indication 1999 or -1999
Polarity indication Negative only
Positive readings appear without + sign
Input impedance 10 Megohms
Zero adjust Automatic
Sampling time 250 milliseconds
Temperature range -5°C to 50°C
Power Supply 1 x PP3 or equivalent 9V battery
Consumption 20mW
Size 155 x 88 x 31mm
RANGES
DC Voltage 0-200mV
0-2-20-200-1000V Acc. 0.8%
AC Voltage 0-200-1000V
Acc. 1.2% DC Current 0-200uA
0-2-20-200mA 0-10 A Acc. 1.2%
Resistance 0-2-20-200K ohms
0-2 Megohms Acc. 1%
BI-PAK VERY LOWEST POSS. PRICE **£35.00** each

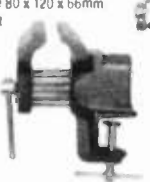


MINI VICE

This small cast iron quality made vice will clamp on to any bench or table having a max thickness of 1 1/4". The 2 1/2" jaws open to max. of 1 1/4". Approx size 80 x 120 x 66mm
Bi-Pak's Mini Vice at a Mini Price only

£2.

ORDER NO. SX82



The Third and Fourth Hand...

.... you always need but have never got 'until now'
This helpful unit with Rod mounted horizontally on Heavy Base. Crocodile clips attached to rod ends. Six ball & socket joints give infinite variation and positions through 360° also available attached to Rod a 2 1/2" diam magnifier giving 2.5 x magnification. Helping hand unit available with or without magnifier. Our Price with magnifier as illustrated ORDER NO. T402 **£5.80**
Without magnifier ORDER NO. T400 **£4.75**



EXPERIMENTOR BOXES - ALUMINIUM - PLASTIC ALUMINIUM BOXES

Made with Bright Aluminium folded construction with deep lid and screws

SIZE	L	W	H	Order No	Price
5 1/4"	2 1/4"	1 1/2"	1 1/2"	159	83p
4"	2 1/4"	1 1/2"	1 1/2"	161	83p
4"	2 1/4"	2"	1 1/2"	163	83p
3"	2"	1"	1 1/2"	164	87p
8"	6"	3"	1 1/2"	166	£1.08
6"	4"	2"	1 1/2"	167	£1.12

All measurements for boxes are shown in inches L = Length W = Width H = Height

Plastic Boxes

SIZE	L	W	H	Order No	Price
4"	2"	1"	1 1/2"	141	£1.00
4 1/4"	2 1/4"	1 1/2"	1 1/2"	143	£1.30
6"	3 1/4"	2"	1 1/2"	144	£1.50
Plastic as above but with aluminium top panel					
4"	2"	1"	1 1/2"	146	£1.40
Plastic sloping front					
4 1/4"	2 1/4"	1 1/2"	1 1/2"		
slope					
10"					
1 1/2"				148	£2.14

MW398 NI-CAD CHARGER

Universal Ni-Cad battery charger. All plastic case with lift up lid. Charger/Test switch. LED indicators at each of the live charging points



Charges	Power
PP3 (9V)	220-240V AC
U12 (1.5V penlite)	Dimms
U11 (1.5V C)	210 x 100 x 50mm
U2 (1.5V O)	£6.95

POWER SUPPLY OUR PRICE £3.25

Power supply fits directly into 13 amp socket. Fused for safety. Polarity reversing socket. Voltage switch. Lead with multi plug. Input — 240V AC 50HZ Output — 3 4.5 6 7.5 9 & 12V DC Rating — 300 ma MW88

"IRRESISTABLE RESISTOR BARGAINS"

Pak No.	Qty	Description	Price
SX10	400	Mixed All Type Resistors	£1
SX11	400	Pre-formed 1/4 watt Carbon Resistors	£1
SX12	200	1/4 watt Carbon Resistors	£1
SX13	200	1/4 watt Carbon Resistors	£1
SX14	150	1/2 watt Resistors 22 ohm	£1
SX15	100	2m2 Mixed 1 and 2 watt Resistors 22 ohm 2m2 Mixed	£1

Paks SX12-15 contain a range of Carbon Film Resistors of assorted values from 22 ohms to 2.2 meg. Save pounds on these resistor paks and have a full range to cover your projects.
Quantities approximate. count by weight

"CAPABLE CAPACITOR PAKS"

Pak No.	Qty	Description	Price
SX16	250	Capacitors Mixed Types	£1
SX17	200	Ceramic Capacitors 1ml	£1
SX18	100	Mixed Ceramics 1ml 5 pl	£1
SX19	100	Mixed Ceramics 580pl 0.5ml	£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 1000ml	£1
SX24	20	Tantalum Beads, mixed	£1

Quantities approximate. count by weight

AUDIO PLUGS, SOCKETS AND ACCESSORIES

25 pieces of Audio Plugs, Sockets and Connectors to include DIN 180 240 Inline 3.6 Pin Speakers, Phone Jack Stereo and Mono etc. etc. Valued at well over £3 normal. Order No. SX25. Our Price **£1.50** per pak. Guaranteed to save you money.
SX26 3 Pcs. of 6 pin 240 DIN Plugs and Chassis Sockets **50p**
SX28 100 Silicon NPN Transistors—all perfect. Coded mixed types with data and eqvt sheet. No rejects. Real value **£2.50**
SX29 100 Silicon PNP Transistors—all perfect. Coded mixed types with data and eqvt sheet. No rejects. Fantastic value **£2.50**

TRIACS - PLASTIC

4 AMP	400v	T0202	TAG 136G
1 OFF	10 OFF	50 OFF	100 OFF
40p	£3.75	£17.50	£30.00
8 AMP 400v	T0220	TAG 425	
60p	£5.75	£27.50	£50.00

Everyday Electronics

Teach in 81
Kit 1 **£15.65** (Kits 1 & 2 combined)
Kit 2 **£8.94** price **£23.00**

All prices include V.A.T. & postage.

IC SOCKETS

The lowest price ever.

Pin	10 off	50 off	100 off
8	75p	£3.00	£5
14	80p	£3.25	£5.50
16	80p	£3.25	£5.50



VOLTAGE REGULATORS

T0220	Positive +	Negative +	(please state voltage required)
	7805 - 50p	7905 - 55p	
	7812 - 50p	7912 - 55p	
	7815 - 50p	7915 - 55p	
	7824 - 50p	7924 - 55p	

Other types LM340K - 6 volt - 18 volt - 24 volt
103 - 40p UA723 - 14 pin DIL - 40p

Guarantee
Satisfaction or your money back has always been BI-PAK'S GUARANTEE and it still is. All these Sale Items are in stock in quantity and we will despatch the same day as your order is received.

MOTOROLA PIEZO ELECTRIC TWEETER

Maximum Ratings
25 volts rms which is equal to 200 watts across 4 ohms
100 watts across 8 ohms
50 watts across 16 ohms
BI-PAK SPECIAL OFFER PRICE **£4.65**
ORDER NO. 1907

DOME TWEETER

Dome tweeter for systems up to 50w
Impedance 8 ohms
Frequency Response 2000-20 000Hz
Dims 98mm diam x 31mm deep
Our Price **£2.85** DMT200



BI-PAK'S COMPLETELY NEW CATALOGUE

Completely re-designed. Full of the type of components you require plus some very interesting ones you will soon be using and of course the largest range of semiconductors for the Amateur and Professional you could hope to find.
There are no wasted pages of useless information so often included in Catalogues published nowadays. Just solid facts i.e. price description and individual features of what we have available. But remember BI-PAK's policy has always been to sell quality components at competitive prices and THAT WE STILL DO.
BI-PAK'S COMPLETELY NEW CATALOGUE is now available to you. You will be amazed how much you can save when you shop for Electronic Components with a BI-PAK Catalogue. Have one by you all the time—it pays to buy BI-PAK.

To receive your copy send **75p** plus 25p p&p

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Remember you must add VAT at 15% to your order.
Total Postage add 50p per Total order.

MONITOR

Portable Music Power

The somewhat curiously named Yacht Boy 80, from Grundig, is a four-band radio designed for maximum portability. It measures a mere 18 x 12 x 4 cm and will comfortably slip into a briefcase or handbag. The bands cover medium, longwave and short-wave plus FM, with a LED indicator to show optimum tuning on any frequency.

The Yacht Boy 80 is powered by either batteries or a separate mains adaptor and its output of 0.6 watts is adequate for comfortable listening without disturbing your neighbours on the beach!

Including carrying strap, the radio is available for about £24, including VAT, in a choice of either silver or brown finish.

For details, contact Grundig International Ltd., Newlands Park, London SE26 5NQ, 'phone 01 659 2468.

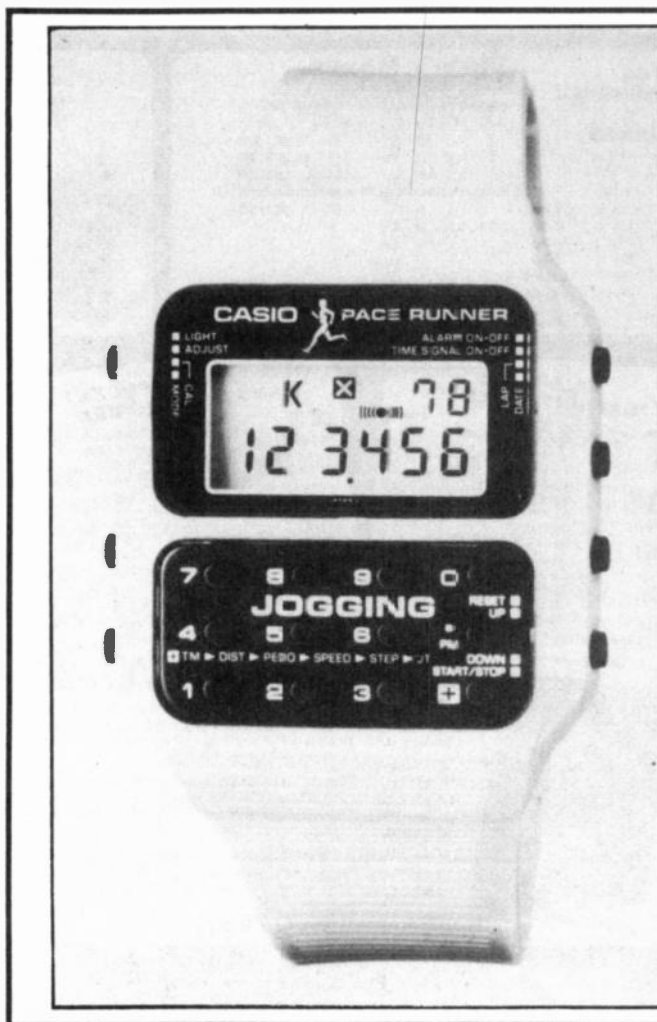


Master Crafted

The quest for the highest-fi is never ending. Connoisseurs have long been aware of the superb quality of records produced from a 'half-speed master'; this is a variation of the normal record-cutting process in which both the stereo master tape and the cutting lathe are run at half the usual speed. The result is a more faithful transfer of information from tape to vinyl. Original Master Recordings are produced in America by a small company called MFSL and marketed in the UK by Zerostat Components Ltd. Their half-speed mastered recording of popular titles are produced to 'the most exacting standards', with each title limited to a run of 200 000 copies. Each disc is pressed onto vinyl specially developed by JVC and is perfectly flat. To preserve this quality, the packaging is particularly robust.

The titles include some of the best pop music of the last 10 years — Pink Floyd's 'Dark Side Of The Moon', the Rolling Stones' 'Sticky Fingers', 'Parallel Lines' from Blondie and Bowie's 'Ziggy Stardust'. In addition there is a selection of classical titles, including Holst's 'The Planets' and Beethoven's famous Ninth.

Full details of Original Master Recordings and the address of your local stockist can be had from Zerostat Components Ltd., 14 Edison Road, St Ives, Huntingdon, Cambs PE17 4LE, 'phone (0480) 62225.



Calculate By Candle Power

Maintaining their position as one of the most inventive, innovative company in the consumer electronics market, Casio continue to astound and amaze us. This time, it's a candle-powered calculator; actually, it is powered by solar cells but they are so efficient that it really will run from the light emitted by a single candle. It works even better by daylight, of course, when it's less of a strain to read the eight-digit display.

Designated the model SL801, it offers all the facilities of a normal four-function calculator, including square root, percent and independent memory.

Recommended retail price, including a leatherette wallet, is £10.95. This price is the maximum anyone might expect to pay.

A similar calculator, the model SL701, is available in 'credit card' format, priced at £11.95.

Jogging Memories

Readers may recall an item in last month's Monitor about Casio's new Jogger's Watch. The picture, which we were unable to print last month, gives a more accurate idea of the facilities provided. About the only factor the model J-100 (as it is called) won't calculate is the number of blisters-per-mile!

Mail Order Madness

Ace Mailtronix Ltd ('Component supplies for electronic enthusiasts') have made a good start in 1982 with the early release of their new mail order catalogue.

New additions include low-leakage electrolytic capacitors, more cases and an expanded LED range, including rectangular and triangular types, indicators and bargraphs. The IC range has been considerably improved both for linear and logic devices and the keyboard range now includes keyboard switches and complete

keyboards.

Their development pack of resistors ought to be of interest to every electronic hobbyist; it consists of 600 resistors with values between 1R and 10M, in quantities of either 5, 10, 15 or 20, depending on popularity.

The Ace Mail Order Electronic Component Catalogue may be obtained by sending 30p to Ace Mailtronix Ltd, 3A, Commercial Street, Batley West Yorks WF17 5HJ.

As a special service to hobbyists, Ace is prepared to look for components which the constructor cannot obtain elsewhere, on receipt of a stamped addressed envelope.

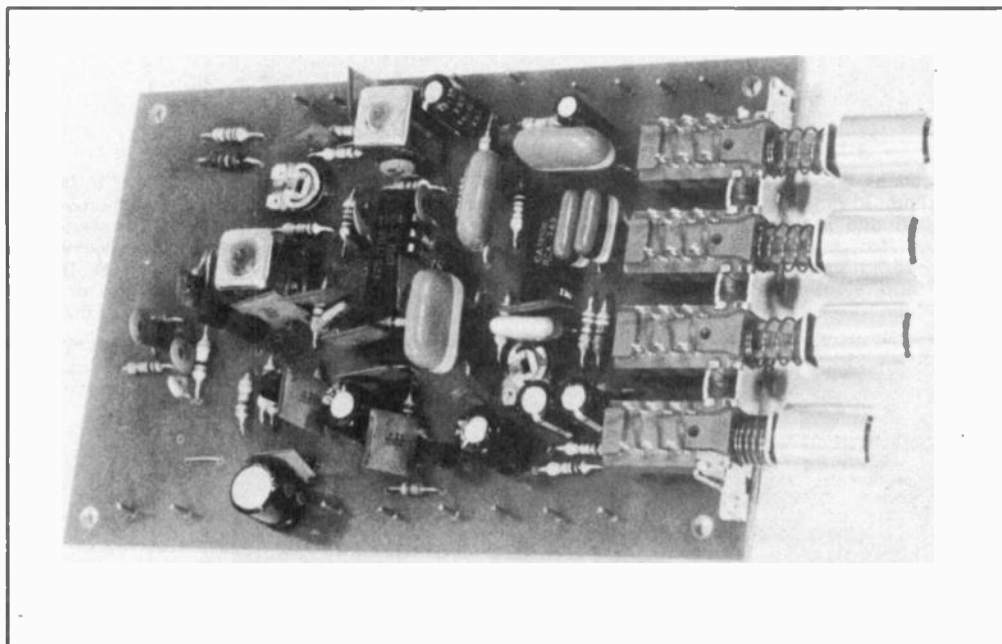
Velleman Discovers the UK

Velleman electronic kits, previously available only in other parts of Europe, have landed in the UK and are now available from Velleman UK Ltd.

The kits are designed to satisfy electronics enthusiasts, from the novice to the experienced kit-builder, with projects that range from a simple three-tone bell to a microprocessor-controlled EPROM programmer. Each kit is given a "degree of difficulty" grading to help prospective constructors choose

an appropriate project; prices range from £3 to £300.

At present, the kits are available only from Velleman UK, however, they will be more generally available later in 1982. Write for a free catalogue to Velleman UK, PO Box 30, St. Leonards-on-Sea, East Sussex TN37 7NL or 'phone Hastings (0424) 753246. The range of kits is expanding rapidly and already new lines are being added to meet popular demand. Recent additions include a stereo input selector with DC control, a stereo volume and tone control unit and a "very special" microprocessor controlled timer. The technical details are available free on request from the above address.



Bi-Kits

The new S.453 Stereo FM Tuner module from Bi-Pak Semiconductors offers push-button varicap tuning for four frequencies, phase-locked loop decoder for mono or stereo and provision for the addition of a LED stereo indicator, centre-zero tuning meter and a mono/stereo switch. The tuning range is from 88-108 MHz with a sensitivity of 4 μ V for 30 dB signal to noise ratio and the audio output is of the order of 200 mV; operating voltage is in the range 18-25 V.

The module is carefully designed for stability and may be used in a wide range of applications. The price is £21.85 including VAT, plus £0.50 p&p, from Bi-Pak Semiconductors, PO Box 6, Ware, Herts SG12 9AG.

Tooling Up

Meanwhile, the carpenters are hard at work repairing the damage to Monitor's Newsdesk caused by the arrival, with a resounding thump, of two Cooper Tools catalogues.

The Electronic Catalogue, 1981-82, covers the very extensive range of Weller soldering irons and Xcelite pliers and cutters, screwdrivers and nutdrivers and a variety of special tools (eg tweezers and clamps — very useful for fine work).

The general catalogue contains, in addition, the complete range of Nicholson files, Lufkin measuring tapes (for long jobs), Crescent adjustable wrenches and screwdrivers and, for those moments when it's all too much, the range of Plumb hammers and axes.

Mr. Jonathan Bird of Cooper Tools Ltd., Sedling Road, Washington, Tyne and Wear NE38 9BZ (phone Washington (0632) 466063) will be pleased to supply further information on the Cooper Tools range.

Electronics For Atari Games

A new company, Electronic Hobbies Ltd., has been formed with the specific aim of providing hobbyists, experimenters and small companies with small-quantity orders of high technology electronics and computer products.

The product range includes production equipment and tools such as PCB exposure boxes, hand tools, soldering irons etc; test equipment (low cost oscilloscopes) and microelectronic products (for example, microprocessors and support devices, control circuits etc).

Sample prices are attractive — 'scope prices range from £145 to 355, for example — and a full price list/catalogue is being prepared. The company is based at 17 Roxwell Road, Chelmsford, Essex.

Ingersoll Electronics, UK distributors of the Atari 400 and 800 personal computers, have released a new selection of entertainment packages developed by Thorn EMI Video Programmes. Titles include puzzles with nursery rhyme themes, jigsaws and board games, plane and submarine-attack simulators and a schematic cube problem with 300 variations. All programs make full use of the Atari facilities for full colour

graphics and animation, plus authentic sound effects (the darts game, which offers 300 variations for up to four players, even simulates the sound of a dart hitting a wire!).

The new titles are available nationwide through the network of Atari dealers or through the rental companies DER, Radio Rentals and MultiBroadcast. For a full list of titles and prices (which range from £14.95 to £29.95), contact your local dealer or write to Ingersoll Electronics Ltd., 202 New North Road, London N1 7BL, 'phone 01 359 0161.

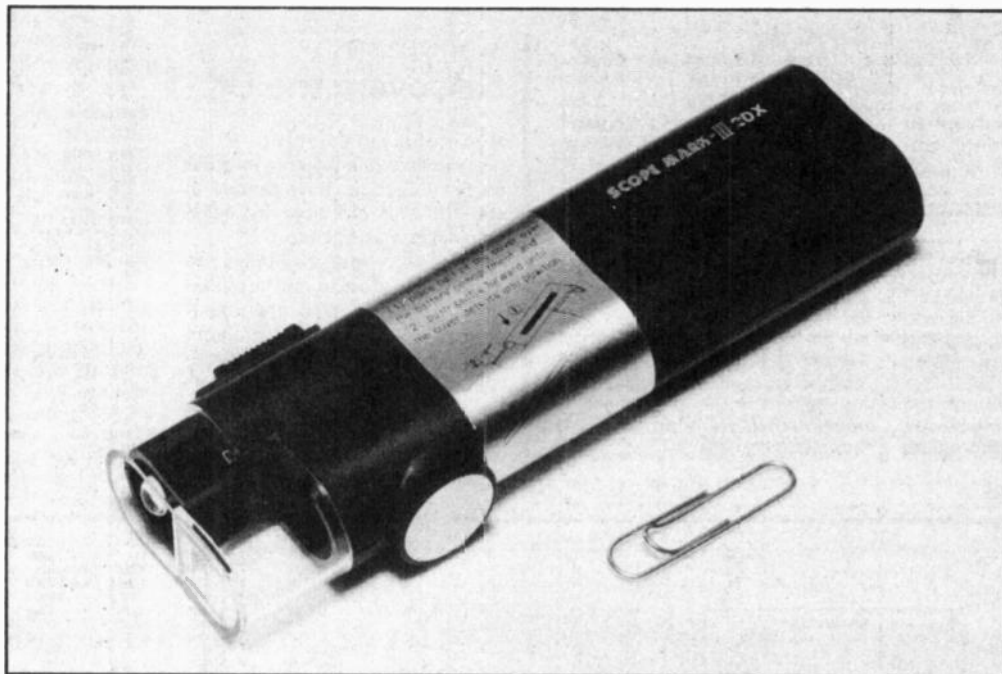
SCHOOLS PRIZE

DASH — Distress Alarm for the Severely Handicapped — is a project developed by Carlton Evans, from Brentwood, Essex. It monitors

skin response, indicating pain and stress, or relaxation.

DASH has met with a favourable response from the medical profession, who find it useful for showing the condition of patients otherwise unable to communicate.

MONITOR



Details Examined

Another new release from Stotron Ltd is a pocket micro-

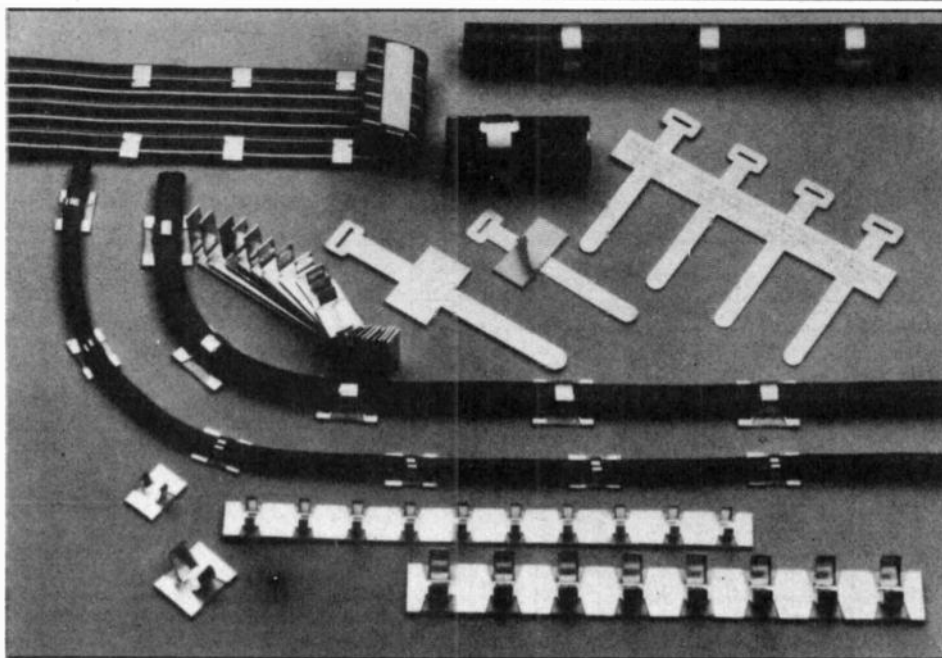
scope priced at under £20 including stand. It provides 20x magnification and would be a useful tool for laboratories, schools, workshops, service engineers and electronics enthusiasts.

It measures just 125 mm long, has a graticule for linear and angular measurements and is powered by standard 1V5 'penlight' batteries.

A micro-stand, with spring-clips for sample slides, is

available, allowing it to be used like a conventional microscope.

Stotron Ltd are located at Unit 1, Haywood Way, Ivyhouse Lane, Hastings, East Sussex; write for a catalogue or phone Hastings (0424) 442160.



Hey, Good Looking

The almost universal use of printed circuit board or Veroboard has made the "rats nest" syndrome (several yards of various-coloured wires snaking through the innards of a chassis) virtually obsolete. Nevertheless, most electronics projects require some off-board components which

must be wired to a PCB or Veroboard and if neatness is important to you, some way must be found to keep those wires from tangling potentiometer shafts or snarling-up in a finned heatsink.

If you like your finished works to look good on the inside as well as the outside, Brandauer adhesive cable clips from Stotron Ltd will keep internal wiring in its

proper place.

The range can handle single cables or bunches of wires, from a few millimetres diameter up to 19 mm (¾in) or even lengths of flat ribbon cable. The adhesive is instant and the polyethylene pads provide a high level of insulation from the mounting surface.

Apart from their usefulness to the electronics constructor, they would also be handy for DIY wir-

ing jobs around the house.

Brandauer cable clips are available through Stotron's mail order service: write for a catalogue to Stotron Ltd., Unit 1, Haywood Way, Ivyhouse Lane, Hastings, East Sussex or phone Hastings (0424) 442160.

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WATFORD ELECTRONICS

35 CARDIFF ROAD, WATFORD, HERTS., ENGLAND
MAIL ORDER, CALLERS WELCOME. Tel. Watford 40588

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

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We stock thousands of most items. It is not in this list. We are situated in Watford, Hertfordshire. Please contact us for a full list of our stock. Open Monday to Saturday, 10am to 5pm.

POLYESTER CAPACITORS: Axial Lead Type

400V: 1nF, 1.5n, 2n2, 3n3, 4n7, 6n8 11p; 10n, 15n, 18n, 22n 12p; 33n, 47n, 68n 16p; 100n, 150n 20p; 220n 30p; 330n 42p; 470n 52p; 680n 60p; 1uF 68p, 2u2 82p; 4u7 85p.
160V: 1nF, 1.5n, 2n2, 3n3, 4n7, 6n8 11p; 10n, 15n, 18n, 22n 12p; 33n, 47n, 68n 16p; 100n 20p; 150n 25p; 220n 30p; 330n 42p; 470n 52p; 680n 60p; 1uF 68p, 2u2 82p; 4u7 85p.

POLYESTER RADIAL LEAD CAPACITORS: 250V:

10nF, 15n, 22n, 27n 6p; 33n, 47n, 68n, 100n 7p; 150n, 220n 10p.
330n, 470n 13p; 680n 16p; 1uF 23p; 1u5 40p; 2u2 48p; 4u7 60p.

ULTRASONIC TRANSDUCERS

40kHz 395p/pr

ELECTROLYTIC CAPACITORS: (Values are in uF) 500V: 10 52p; 47 78p; 250V: 100 65p; 83V: 0.47, 1.0, 1.5, 2.2, 2.5, 3.3 3p; 4.7 5p; 6.8, 10 5p; 15, 22, 33 5p; 47, 100, 150, 220 5p; 330, 470, 1000, 2200 5p; 4.7, 15, 22, 33, 47, 100, 150, 220, 330, 470, 1000, 2200 5p; 100K-500K single gang 2p; 50K-200K Single Gang 2p; 50K-200K Single Gang D/P Switch 7p; 50K-200K Double Gang 8p.

TAG-END TYPE: 70V: 4700, 245p; 64V: 3300 18p; 2200 13p; 50V: 3300 15p; 2200 11p; 3300 17p; 4700 20p; 25V: 10,000 32p; 15,000 34p.

TANTALUM BEAD CAPACITORS:

35V: 0.1uF, 0.22, 0.33 15p; 0.47, 0.68, 1.0uF, 1.5 15p; 2.2, 3.3 18p; 4.7, 6.8 22p; 10uF 28p; 15V: 2.2, 3.3 16p; 4.7uF, 6.8 10 15p; 15, 36p; 22, 30p; 33, 47, 100, 100 75p; 220, 330p; 10V: 15, 22, 26p; 33, 47, 100 55p; 6V: 100, 42p.

MYLAR FILM CAPACITORS:

100V: 1nF, 2, 4, 4n7, 10 7p; 15nF, 22n, 30n, 40, 47, 77p; 56 100n, 200 90p; 470n/50V 12p.

MINIATURE TYPE TRIMMERS:

2-6pF, 2-10pF, 2-25pF, 5-56pF 30p.

COMPRESSION TRIMMERS:

3-40pF, 10-80pF 20p; 20-250pF 28p; 100-580pF 38p; 400-1250pF 48p.

POLYESTER CAPACITORS:

10pF to 1nF 6p; 1nF to 10nF 10p.

SILVER MICA (Values in pF): 2, 3, 3.3, 4.7, 6.8, 8.2, 10, 15, 18, 22, 27, 33, 47, 50, 56, 68, 75, 82, 85, 100, 120, 150, 180pF 15p each;

200, 220, 250, 270, 300, 330, 360, 390, 470, 500, 560, 680, 820 21p each.

1000, 1200, 1800, 2200 30p each

3300, 4700pF 60p each

CERAMIC CAPACITORS 50V: 0.5pF to 10nF 4p; 22n to 47n 5p; 100n 7p.

VOLTAGE REGULATORS

1A T03 +ve -ve 220p
5V 7805 145p 7905 220p
12V 7812 145p 7912 220p
15V 7815 145p
18V 7818 145p

1A T0220 Plastic Casing 7905 55p
5V 7805 45p 7905 55p
12V 7812 45p 7912 55p
15V 7815 50p 7915 55p
18V 7818 50p 7918 55p
24V 7824 50p 7924 55p

100mA T092 Plastic Casing 7905 60p
5V 7805 45p 7905 60p
6V 7862 30p
8V 7862 30p
12V 7812 30p 7912 60p
15V 7815 30p 7915 60p

CA3085 95p LM232K 240p TAA550 50p
LM300H 170p LM232N 240p TAA525H 50p
LM308H 140p LM232N 240p TAA512 150p
LM309K 135p LM227 270p 78H05 560p
LM317K 135p LM723 35p 78H05 560p

JACKSONS VARIABLE CAPACITORS

Dielectric 0.2 365pF with slow motion drive 495p
100/300pF 220p motion drive 495p
500pF 250p 00.208/176 435p
6:1 Ball Drive 4511/DAF 185p with slow motion drive 495p
Dial Drive 4103 775p C804-50F: 10: 15: 15p
6:1/36:1 775p 25: 50pF 278p
Drum 54mm 59p 100: 150pF 350p
0-1.365pF 350p L: 3x310pF 725p
00.2.365pF 435p 00.3x25pF 575p

DENCO COILS

DP VALVE TYPE RFC 5 cokes 140p
Range 1 to 5 BL RFC 7 (19mH) 160p
R-DT WHI 122p
6-7 B-Y-R 12p 13: 14: 15: 16: 15p
1.5 Green 150p 18: 16: 15p
T Type 1 to 5, BL 135p
Dr. Whi. YI 150p 18: 46: 15p
B9A Valve Holder 120C MW5FR 122p
RDT2 145p MW/LW SFR154p

VEROBOARD

0.1 Pitch clad plain 73p 52p
2 1/2 x 3 83p
3 1/2 x 3 83p
3 1/2 x 5 95p 79p
3 1/2 x 17 326p 211p
4 1/2 x 17 426p

COPPER CLAD BOARDS

0.1 Pitch 73p 52p
2 1/2 x 3 83p
3 1/2 x 3 83p
3 1/2 x 5 95p 79p
3 1/2 x 17 326p 211p
4 1/2 x 17 426p

Phi of 100pins 50p
Spot face cutter 118p
Pin insertion tool 162p

Gas and Smoke Detectors

TGS 812 and 813 575p

TOGGLE: 2A 250V:

SPST 33p
DPDT 44p
4 Pole on/off 54p

SUB-MIN TOGGLE

SP changeover 60p
SPST on/off 54p
DPDT 6 tags 75p
DPDT c/o 80p
DPDT 6 tag 145p

SLIDE 250V:

1A DPST 14p
1A DPST c/o 18p
1/2A DPST 13p

SWITCHES: Miniature Non Locking

Push to Make 15p Push Break 20p
ROCKER: SPST on/off 10A/250V 28p
ROCKER: Illuminated (back) chrome bezel, lights when on DPST 3A 240V 85p

ROTARY: (ADJUSTABLE STOP) 1 pole: 2-12

way, 2p/2.6 way, 3p/2.4 way, 4p/2.3 way 42p

ROTARY: Mains 250V AC, 4 Amp

DIL SOCKETS: 8-pin 8p; 14-pin 10p; 16-pin

10p; 18-pin 16p; 20-pin 22p; 24-pin 25p; 28-pin 28p; 40-pin 30p.

DIODES

BY126 12p
BY127 12p
CA303 250p
OA9 40p
OA7 12p
OA79 12p
OA85 15p
OA90 15p
OA91 8p
OA95 8p
OA200 8p
OA202 8p
IN914 4p
IN916 4p
IN4001/2 8p
IN4003/5 8p
IN4006/7 7p
IN4148 12p
IN5401/2 18p
IN5404 18p
IN5406 17p
IN5408 19p
IS44 8p
IS921 8p
6A/100V 95p
6A/400V 95p
6A/600V 125p
10A/200V 215p
10A/100V 360p
25A/200V 340p
25A/600V 340p
BY164 58p
VM18 50p

ZENERS

Range 2V7 to 39V 400mW 8p each
Range 3V3 to 33V 1.3W 15p each

NOISE

Diode 195p

BRIDGE RECTIFIERS

(plastic case) 20p
1A/50V 2p
1A/100V 22p
1A/400V 28p
2A/50V 35p
2A/200V 46p
2A/400V 48p
6A/100V 83p
6A/400V 83p
6A/600V 125p
10A/200V 215p
10A/100V 360p
25A/200V 340p
25A/600V 340p
BY164 58p
VM18 50p

TRIACS

3A100V 48p
3A200V 48p
3A400V 58p
6A100V 83p
6A400V 83p
6A600V 125p
10A200V 215p
10A100V 360p
25A200V 340p
25A600V 340p
BY164 58p
VM18 50p

DIAC

512 28p

7400 TTL

7400 11p
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TTLs	74367	55p	4014	60p	LINEAR ICs	MB3712	250p	
7400	11p	74368	55p	4015	AN103	200p	MC1310P	150p
7401	11p	74390	100p	4016	AY10212	600p	MC1458	40p
7402	12p	74393	100p	4017	AY11313	660p	MC1495L	350p
7403	12p	74490	120p	4018	AY11320	320p	MC1496	70p
7404	12p	74LS SERIES		4019	AY15050	140p	MC3340P	120p
7405	18p	74LS00	12p	4020	AY158910	600p	MC3403	120p
7406	25p	74LS01	14p	4021	AY158912	650p	MC50398	750p
7407	25p	74LS02	14p	4022	AYS-1224A	240p	ML820	800p
7408	14p	74LS03	14p	4023	AYS-1315	600p	MY52160	620p
7409	15p	74LS04	15p	4024	AY5-4037D	520p	MY6221A	16
7410	15p	74LS05	15p	4025	CA3028A	120p	NE531	20p
7411	20p	74LS08	16p	4026	CA3031	80p	NE555	20p
7412	20p	74LS09	15p	4027	CA3046	70p	NE556	20p
7413	22p	74LS10	15p	4028	CA3048	225p	NE564	420p
7414	22p	74LS11	15p	4029	CA3069	300p	NE565	130p
7415	22p	74LS12	15p	4030	CA3080E	72p	NE566	155p
7416	25p	74LS13	25p	4031	CA3086	48p	NE567	140p
7417	25p	74LS14	40p	4032	CA3088	225p	NE570	425p
7420	17p	74LS20	15p	4034	CA3090A	375p	NE571	425p
7421	30p	74LS21	15p	4035	CA3100C	90p	NE5534A	500p
7422	20p	74LS22	15p	4036	CA3130E	50p	PLL02A	500p
7423	22p	74LS26	16p	4037	CA3160E	100p	RC1326	500p
7425	28p	74LS27	16p	4040	CA3189E	450p	SM66	250p
7426	30p	74LS30	15p	4041	CA3240	120p	SLF96364	800p
7427	25p	74LS32	16p	4042	CA3280G	200p	SL90	75p
7428	30p	74LS37	16p	4043	DACT408-B	200p	SN76477	175p
7430	15p	74LS38	16p	4046	HA1366	300p	TA7120	250p
7432	25p	74LS42	36p	4047	HA1388	270p	TA7204	250p
7433	27p	74LS47	40p	4048	ICL7106	250p	TA7205	250p
7437	27p	74LS51	15p	4049	ICL8038	300p	TA7206	250p
7438	30p	74LS55	15p	4050	ICM7555	80p	TA7222	200p
7440	17p	74LS73	25p	4050	LC7120	400p	TA7230	200p
7441	36p	74LS74	16p	4051	LC7130	400p	TA7231	200p
7443	36p	74LS76	20p	4052	LF347	175p	TA7232	200p
7445	60p	74LS83	45p	4053	LF351	48p	TA7233	200p
7446A	93p	74LS85	65p	4055	LF352	48p	TA7234	200p
7448	45p	74LS86	20p	4056	LF353	48p	TA7235	200p
7450	17p	74LS90	28p	4059	LF354	48p	TA7236	200p
7451	17p	74LS92	40p	4063	LF355	120p	TA7237	200p
7453	17p	74LS93	40p	4063	LF356	120p	TA7238	200p
7454	17p	74LS96	45p	4066	LF357	120p	TA7239	200p
7460	17p	74LS96	100p	4067	LM10C	425p	TA7240	200p
7470	36p	74LS107	45p	4068	LM301A	27p	TA7241	200p
7472	30p	74LS109	30p	4069	LM310	120p	TA7242	200p
7473	30p	74LS112	34p	4071	LM318	200p	TA7243	200p
7474	20p	74LS113	30p	4071	LM319	225p	TA7244	200p
7475	30p	74LS114	30p	4072	LM324	45p	TA7245	200p
7476	30p	74LS122	42p	4073	LM324	45p	TA7246	200p
7480	50p	74LS123	50p	4075	LM335Z	140p	TA7247	200p
7481	100p	74LS124	120p	4076	LM339	65p	TA7248	200p
7482	70p	74LS125	30p	4081	LM348	75p	TA7249	200p
7483A	45p	74LS126	30p	4082	LM348	75p	TA7250	200p
7484	100p	74LS132	45p	4086	LM358P	175p	TA7251	200p
7485	90p	74LS133	30p	4089	LM380	150p	TA7252	200p
7486	20p	74LS136	30p	4093	LM381AN	180p	TA7253	200p
7489	210p	74LS138	34p	4094	LM382	120p	TA7254	200p
7490A	25p	74LS139	36p	4095	LM386	120p	TA7255	200p
7491	30p	74LS145	36p	4096	LM387	120p	TA7256	200p
7492A	30p	74LS147	36p	4097	LM388	95p	TA7257	200p
7493A	30p	74LS148	30p	4098	LM389	95p	TA7258	200p
7494	50p	74LS151	70p	4099	LM393	100p	TA7259	200p
7495A	50p	74LS153	60p	4098	LM394	350p	TA7260	200p
7496	45p	74LS154	90p	4097	LM709	35p	UDN618	320p
7497	120p	74LS155	40p	4098	LM710	50p	UDN6184	200p
7498	120p	74LS156	40p	4099	LM711	70p	UDN6184	200p
74100	22p	74LS157	35p	4103	LM733	100p	UPC755	400p
74109	40p	74LS158	36p	4106	LM741	18p	UPC759H	200p
74116	40p	74LS160	40p	4109	LM747	70p	UPC759H	200p
74118	75p	74LS161	40p	4113	LM747	70p	UPC759H	200p
74119	90p	74LS162	40p	4114	LM748	35p	UPC759H	200p
74120	70p	74LS163	40p	4117	LM748	35p	UPC759H	200p
74121	25p	74LS164	48p	4117	LM748	35p	UPC759H	200p
74122	45p	74LS165	100p	4119	LM748	35p	UPC759H	200p
74123	48p	74LS166	90p	4120	LM748	35p	UPC759H	200p
74125	40p	74LS170	120p	4120	LM748	35p	UPC759H	200p
74126	40p	74LS172	70p	4120	LM748	35p	UPC759H	200p
74128	40p	74LS174	70p	4120	LM748	35p	UPC759H	200p
74132	45p	74LS175	50p	4120	LM748	35p	UPC759H	200p
74136	32p	74LS180	140p	4120	LM748	35p	UPC759H	200p
74141	65p	74LS190	50p	4120	LM748	35p	UPC759H	200p
74142	200p	74LS192	50p	4120	LM748	35p	UPC759H	200p
74145	70p	74LS193	48p	4120	LM748	35p	UPC759H	200p
74147	100p	74LS193	48p	4120	LM748	35p	UPC759H	200p
74148	75p	74LS194	40p	4120	LM748	35p	UPC759H	200p
74150	80p	74LS195	48p	4120	LM748	35p	UPC759H	200p
74151A	45p	74LS196	60p	4120	LM748	35p	UPC759H	200p
74153	45p	74LS197	65p	4120	LM748	35p	UPC759H	200p
74154	45p	74LS221	40p	4120	LM748	35p	UPC759H	200p
74155	50p	74LS240	70p	4120	LM748	35p	UPC759H	200p
74156	50p	74LS241	70p	4120	LM748	35p	UPC759H	200p
74157	50p	74LS242	80p	4120	LM748	35p	UPC759H	200p
74159	100p	74LS243	80p	4120	LM748	35p	UPC759H	200p
74160	60p	74LS244	65p	4120	LM748	35p	UPC759H	200p
74161	60p	74LS245	65p	4120	LM748	35p	UPC759H	200p
74162	60p	74LS251	40p	4120	LM748	35p	UPC759H	200p
74163	60p	74LS252	40p	4120	LM748	35p	UPC759H	200p
74164	50p	74LS257	45p	4120	LM748	35p	UPC759H	200p
74165	55p	74LS258	45p	4120	LM748	35p	UPC759H	200p
74166	70p	74LS259	50p	4120	LM748	35p	UPC759H	200p
74170	140p	74LS260	100p	4120	LM748	35p	UPC759H	200p
74172	300p	74LS266	25p	4120	LM748	35p	UPC759H	200p
74173	65p	74LS273	75p	4120	LM748	35p	UPC759H	200p
74174	60p	74LS279	45p	4120	LM748	35p	UPC759H	200p
74175	60p	74LS283	45p	4120	LM748	35p	UPC759H	200p
74176	50p	74LS298	160p	4120	LM748	35p	UPC759H	200p
74177	70p	74LS323	250p	4120	LM748	35p	UPC759H	200p
74178	100p	74LS324	250p	4120	LM748	35p	UPC759H	200p
74180	50p	74LS348	150p	4120	LM748	35p	UPC759H	200p
74181	160p	74LS352	100p	4120	LM748	35p	UPC759H	200p
74182	50p	74LS353	100p	4120	LM748	35p	UPC759H	200p
74184A	90p	74LS363	160p	4120	LM748	35p	UPC759H	200p
74185	120p	74LS364	160p	4120	LM748	35p	UPC759H	200p
74186	500p	74LS365	36p	4120	LM748	35p	UPC759H	200p
74188	325p	74LS367	36p	4120	LM748	35p	UPC759H	200p
74190	50p	74LS378	36p	4120	LM748	35p	UPC759H	200p
74191	50p	74LS379	70p	4120	LM748	35p	UPC759H	200p
74192	50p	74LS374	70p	4120	LM748	35p	UPC759H	200p
74193	50p	74LS375	50p	4120	LM748	35p	UPC759H	200p
74194	12p	74LS377	90p	4120	LM748	35p	UPC759H	200p
74195	12p	74LS378	70p	4120	LM748	35p	UPC759H	200p
74196	14p	74LS390	55p	4120	LM748	35p	UPC759H	200p
74197	14p	74LS393	50p	4120	LM748	35p	UPC759H	200p
74198	14p	74LS399	200p	4120	LM748	35p	UPC759H	200p
74199	15p	74LS440	135p	4120	LM748	35p	UPC759H	200p
74221	14p	74LS451	135p	4120	LM748	35p	UPC759H	200p
74251	70p	74LS5670	170p	4120	LM748	35p	UPC759H	200p
74273	75p	4000 SERIES		4120	LM748	35p	UPC759H	200p
74278	150p	4000	12p	4120	LM748	35p	UPC759H	200p
74279	80p	4000	14p	4120	LM748	35p	UPC759H	200p
74283	75p	4002	15p	4120	LM748	35p	UPC759H	200p
74284	200p	4006	65p	4120	LM748	35p	UPC759H	200p
74285	200p	4007	16p	4120	LM748	35p	UPC759H	200p
74290	100p	4008	60p	4120	LM748	35p	UPC759H	200p
74293	100p	4009	35p	4120	LM748	35p	UPC759H	200p
74298	100p	4010	14p	4120	LM748	35p	UPC759H	200p
74365	55p	4011	14p	4120	LM748	35p	UPC759H	200p
74366	55p	4012	16p	4120	LM748	35p	UPC759H	200p

COMPUTER COMPONENTS

CPUs	1802CE	700p	6947	£10	INTERFACE ICs
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DIGITAL DICE

Roll Them, bowl them!

THE DIGITAL DICE project is, as its title suggests, an electronic replacement for those spotted cube-shaped things. However, instead of being thrown around, ours is operated by touching two screws mounted on the top. The resulting display of red dots show a number from one to six with an equal chance of any number 'turning up' — or, in this case, of turning on!

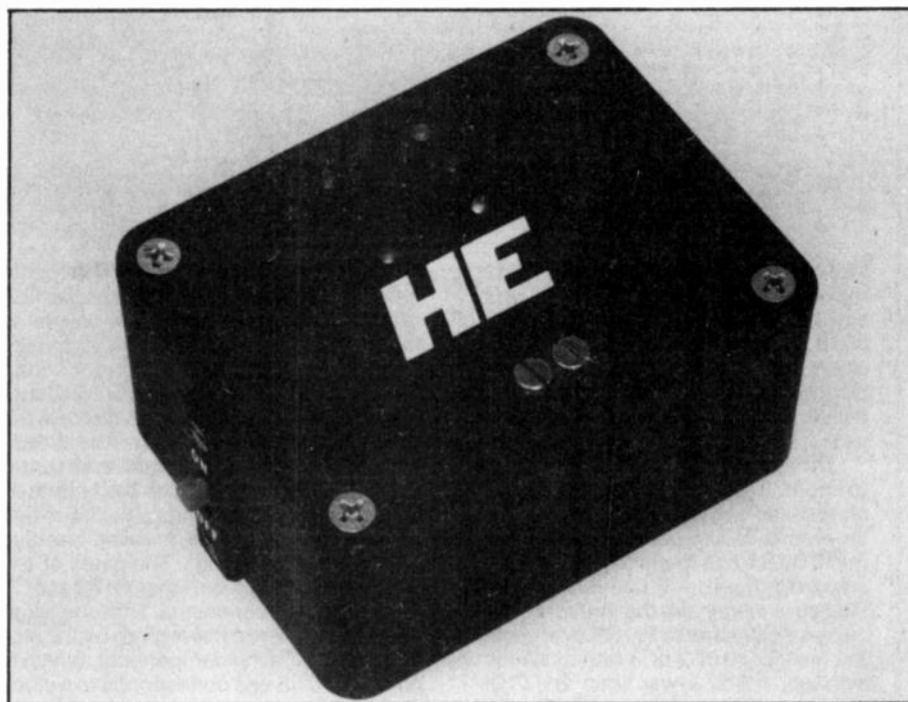
The unit is powered by a small nine volt battery, so there is no possibility of getting a shock — essential when there are children around. Also, the switch can be triggered by any area of skin, enabling the handicapped to use the dice.

Construction

The Dice is designed for ease of construction and reliability. The PCB contains only three ICs, all of which are CMOS and must be handled with care (if at all!). Use sockets and an insertion tool to mount them or, failing this, make sure you never touch the pins with our fingers.

All the off-board connections are made using PCB pins, following the overlay (Figure 2) very closely (note that IC2 is placed upside-down in relation to the others), and remember to check the polarity of the diodes. A nice touch is to mount the resistors with the tolerance band (gold, 5%; silver, 10%) at the bottom end; this looks neat and makes the values easier to read. The PCB slots neatly into the recommended box, eliminating the need for fixing bolts.

The box should be drilled and



assembled before soldering any wires to the board. Fit the LEDs to the lid first, following the layout in Figure 3. A tip for locating the holes is to use a piece of stripboard as a guide through which a pin is inserted to mark their positions. The holes can then be drilled using a 3 mm drill and the LEDs glued into place with epoxy resin (eg Araldite). The leads from the LEDs should be cropped to a reasonable length for soldering and wired up as shown

in Figure 3. Links on the PCB must be made using insulated wire, to avoid any chance of short circuits occurring. Our prototype used a special square switch, but any small slide switch may be substituted.

When all the wiring has been checked, the battery can be connected and the unit switched on . . . and you're ready for a tumble!

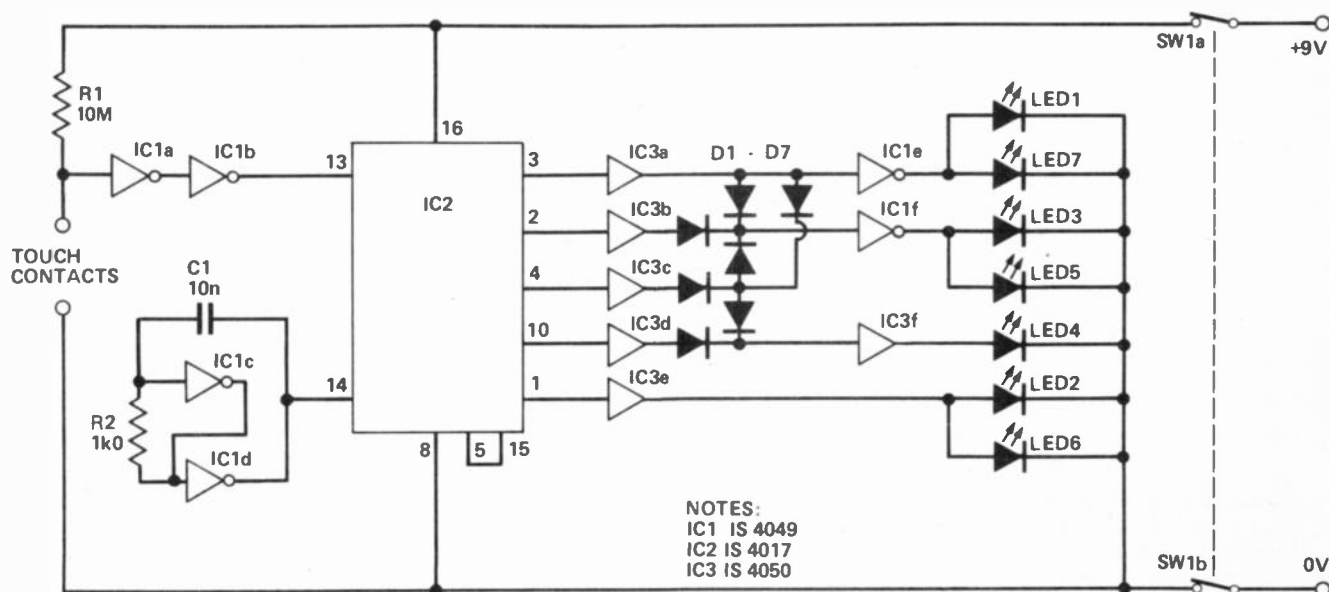
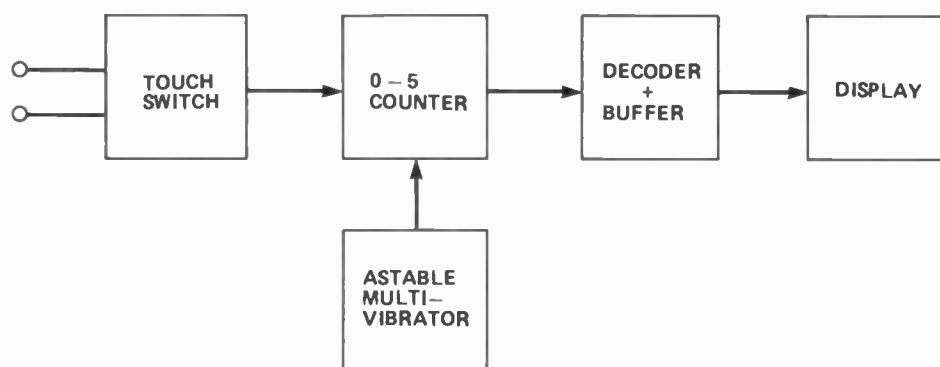


Figure 1. The circuit uses only three ICs.

How It Works



Like nearly all electronic circuits, this one may be understood if it is broken down into small blocks. This is called 'partitioning' and it is a technique used, for example, by engineers to test circuits bit by bit. From the block diagram it can be seen that there are five distinct blocks in the Digital Dice project.

The touch switch tells the counter when to count. It consists of only three parts; a resistor and two gates that are part of IC1, the inverter IC. One gate is kept at nine volts (high) by R1 and therefore its output is at zero volts (low) — it has been inverted. Placing a finger on the touch contacts causes the inverter to switch over because the resistance of 2 or 3 mm of skin is on average, much lower than R1 (10M).

Therefore, IC1a input is taken low and its output goes high. The second inverter flips the signal back over, to allow the counter to be switched on — it needs zero volts at its 'enable' input (pin 13) to begin counting.

The astable multivibrator, IC1c, d, supplies a very fast switching waveform to the counter via pin 14. Every time the astable goes from a low to a high state, the counter moves its output on to the next number. The process of changing on the transition from zero to nine volts, is called 'positive going edge triggering'. The gates of the astable are connected in series via R2 and C1 — the timing components. The time taken for one complete cycle is given by the product of the timing components, which is around 10 μ s and corresponds to a clock

frequency of about 100 kHz, ensuring the numbers change too quickly to be predictable.

IC2 has the job of counting sequentially from zero to five, which is the same as counting from one to six. At each positive going edge from the astable one of the counter outputs goes high. Once the fifth output has been triggered, the count instantly returns to zero due to output six (pin 5) being connected to the reset input, pin 15.

The decoder and buffer circuit, on the outputs of IC2, ensure the correct LED's are lit. Buffers precede each of the six outputs to prevent loading effects, on the counter, by the LEDs. The decoding circuit can be understood with the aid of a 'truth table' (Figure 5).

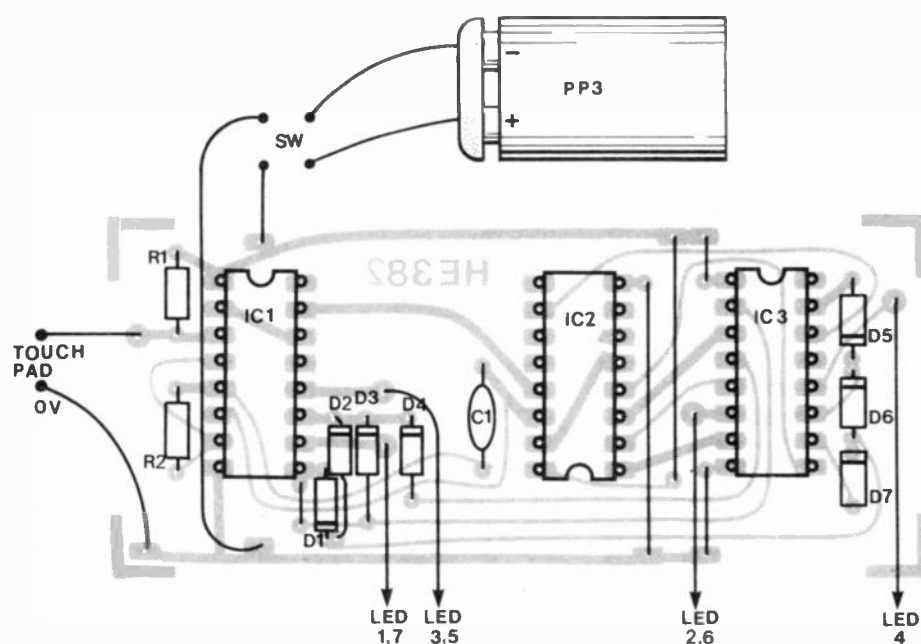


Figure 2. The component overlay; note that IC2 is reversed, relative to ICs 1 and 3.

Figure 3 (right). Truth table showing how the counter outputs are decoded. For example, if Pin 3, '0', is high (+9 V) then all other outputs will be low (0 V). Therefore: IC3a output is high, IC1a out is low and LEDs 1 and 7 are off; Pin 2 is low so IC3b output is low and its diode does not conduct — but the high on IC3a output is coupled via a diode to the input of IC1f, therefore IC1f out is low and LEDs 3,5 are off; Pin 4 is low so IC3c out is low and its diode is off (there is a high on the cathode of the diode but this only reinforces the high on IC1f input); Pin 10 is low, IC3d out is low and its diode is off, but there is a high on IC3f input coupled, via the diodes, from IC3a, therefore IC3f output is high and LED 4 is turned ON; finally, Pin 1 is low, IC3e is low, LEDs 2 and 6 are off. Any other count can be decoded in a similar fashion.

Parts List

RESISTORS (all $\frac{1}{4}$ W 10%)

R1 10 M

R2 1 k

CAPACITORS

C1 10 n C280 polyester

SEMICONDUCTORS

D1-D7 1N4148 or 1N914

IC1 CD4049B

IC2 CD4017B

IC3 CD4050B

LED1-LED7 0.12" sub-miniature red LED

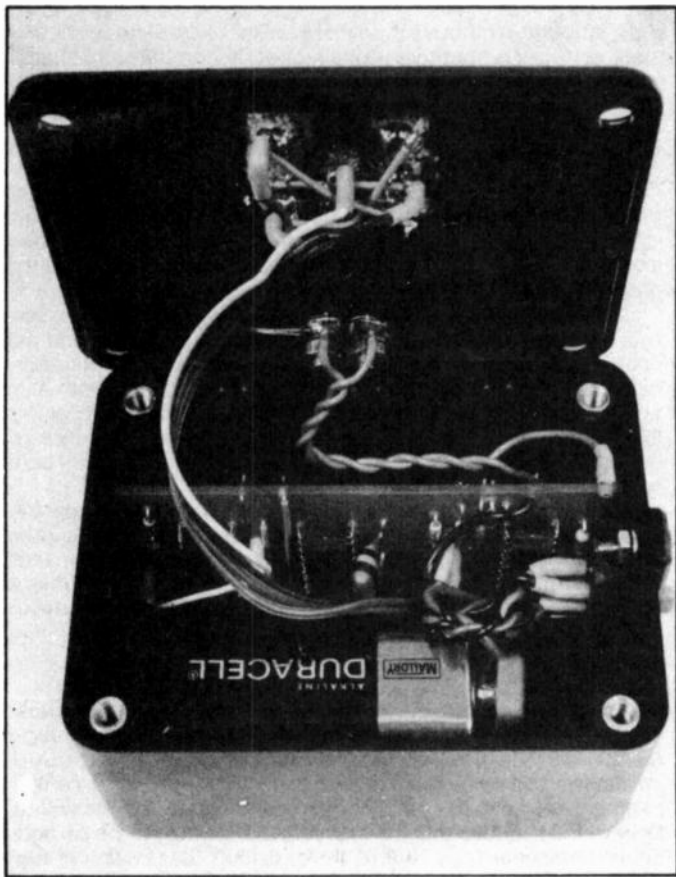
MISCELLANEOUS

SW1 DPDT slide switch

Case, PP3 battery and clips, nuts, bolts, etc.

Buylines

The components for the complete project including the case should cost less than £5. The case is available from: Frank Mozer Limited, 5 Angel Corner Parade, Edmonton., order code HB1.



COUNT	IC2 OUTPUTS					LEDs				DISPLAY
	PIN 3 "0"	PIN 2 "1"	PIN 4 "2"	PIN 10 "4"	PIN 1 "5"	1,7	2,6	3,5	4	
0	+9V	0	0	0	0	—	—	—	ON	•
1	0	+9V	0	0	0	ON	—	—	—	•
2	0	0	+9V	0	0	ON	—	—	ON	•
3	0	0	0	0	0	ON	—	ON	—	•
4	0	0	0	+9V	0	ON	—	ON	ON	•
5	0	0	0	0	+9V	ON	ON	ON	—	•

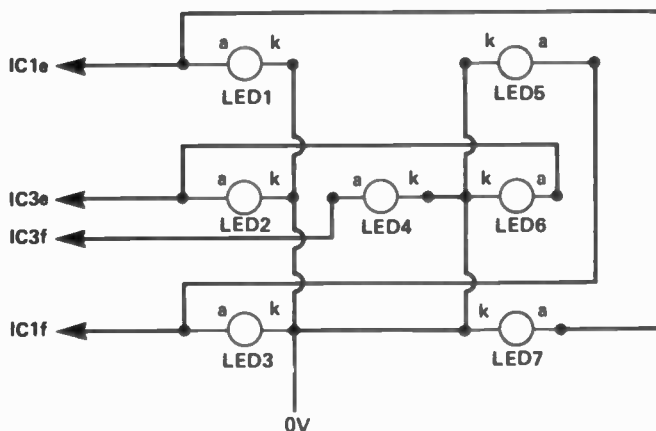


Figure 4. Connection diagram for the LED's.

HE

Beginners' luck

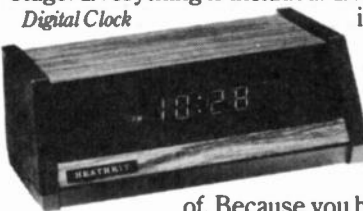
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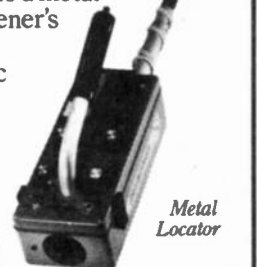
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SCALING the Hi-Fi HEIGHTS Part 3

In many ways, loudspeakers are the most important components of a hi-fi system. After all, "What you hear is what you get".

CHOOSING THE SPEAKER for your hi-fi system involves a fair number of preliminaries. For a start, how much room can you allocate to the enclosures? If you're serious about hi-fi, then go for the most you can, as "the bigger the better" is the rule with speakers. The more air they can move, the better will be the bass and, generally, big boxes move more air than little 'uns.

Look around and decide whether you're going to use shelf-mounted units or floor-standing enclosures (these will have to be allowed for in the budget don't forget). Either approach is a valid one. There are some excellent small speakers which lack nothing but that very bottom octave of gut-moving, window-rattling, bass extension. Does this matter to you? (Really?) Go through the kind of music you intend the boxes to play and make an *honest* judgement.

For the sake of peace, have the arguments before leaving home. You've no idea how silly it looks from the other side of the counter to see people — whatever relation to each other — squabbling over whether teak or walnut finish will match granies false teeth better, or if those huge Wharfedales will *really* go between the sideboard and the china leopard Aunt Jocasta sent from Kenya last year. . . salesmen are only human and patience is a virtue few of us have in abundance. You'll get better service if you appear organised and clear about your wants at the outset.

Two (or Three) into One

Most of the adverts you read for speakers make great play of the number of drive-units (ones) there are in the box, the tone controls on the back, the materials used, the lasers which dance across the design curves, the side of the forest the trees came from to make the veneer, how often the engineers clean their teeth, etc, etc, etc.

Well, that *might* be an exaggeration, but give the ad men a few years and you never know.

It is all quite pointless. Listen and forget the lot. If you begin by defining the physical requirements for the speakers as outlined above, then you can just settle back into the comfortable demo-room chairs and open up your ears.

At the risk of repetition, it's the sound you're interested in and not the manner by which the speaker achieves it. Use the 'blurb' as an indication to guide you to the area you're interested in — and no more.

Loudspeakers are the voice of the hi-fi system and yet remain the least technically refined. Every unit on the market has an individual character, which is clearly apparent if compared to another. Hence, extensive listening sessions are more vital than

ever. Anyone who buys a pair of loudspeakers without hearing three or four competitive models directly compared to them is gambling the cost of his entire system plus that of replacement speakers.

Elephants For Reviewers?

Comparisons *have* to be simultaneous, because a person's audio memory is very short — half an hour after you've heard a speaker is too late to listen to another and try to decide between them. Your mind will have 'enhanced' the earlier impressions, be they good or bad, and rendered the comparison pretty useless.

It takes training (ie a great deal of practice!) to be able to listen to a piece of hi-fi and retain objective criteria of its sound over even a short period of time. General impressions — poor bass, high distortion, etc, are easy, but fine detail such as depth of image, amount of detail in the sound, high frequency quality and the like cannot be accurately 'stored away' indefinitely. The more experienced a person becomes, the more reliable his memory banks will prove to be.

For this reason, have your demonstration of speakers set up in a comparator box which can switch from one set to another, while the music is playing. Also make sure the cartridge in use is the one you intend using at home. This is most important of all, but if you can arrange for the turntable and amplifier to match, so much the better.

Listening

What to listen *for*? Mainly those things in music which appeal to you! Some people consider it desperately important, for instance, that a hi-fi has an excellent stereo image, ie that all the instruments and singers are spread out from the speakers and appear to have an exact position, from which they do not wander. Others will sacrifice this, to a varying extent, to get the particular sound balance they want — excellent bass, sharp high-frequencies, etc, etc.

There are some guidelines, however, which are fairly universal. A good speaker should stand the sound away from its wooden sides, so that you are not aware that the box is the source of the music.

It must also be all things to all frequencies and not stress any particular band. Units which fail this criteria will quickly become tiring at home and lead to dissatisfaction. Look also for the 'ease' with which the speaker lets the music out and lets you listen through it, to what is happening earlier in the system.

As to the type of sound, none is more correct than any other — choose the one you prefer. Just make sure that the cartridge and speaker don't aggravate each other, exaggerating weaknesses in either, or both. Try to aim for a final result which gives you the impression that a spoken voice actually sounds like a *person*, not just a hi-fi playing a voice! Sounds simple does it not? If it were, there would be far fewer brands of stereo around!

One thing to be aware of is that lining up loudspeakers wall-to-wall in a showroom will invariably effect the performance of any and all of them. The bass cones of other speakers, in particular, will move in sympathy with the unit actually playing, modifying the sound you hear. Generally, the effect is to add warmth and remove detail. This can give a totally false impression of the system.

The cure is easy, fortunately. The better dealers will move the pair you select out of the stack, if you ask nicely. Position them as you would in your room and listen again. If the result is what you want, sign the cheque — the salesman's earned it!

A loudspeaker is a transducer — that is, it converts one form of energy into another. In this case electrical energy from the amplifier output is converted into mechanical movements of the air in the listening room, ie sound.

This is achieved by use of the laws of electromagnetic induction and is exactly the same principle which lies behind electric motors — that if you pass an electric current through a wire which is close to a magnet, a force is exerted on the wire proportional to the current flowing through it.

In a loudspeaker, the wire is coiled around the end of a cone and is extremely close to a very powerful magnet. The audio current from the amplifier is passed through the coil, which moves under the influence of the magnet, taking the cone with it. The movement of the cone in turn creates sound waves in the surrounding air and these will be a good representation of the audio signal from the amplifier. How good depends on the quality of the

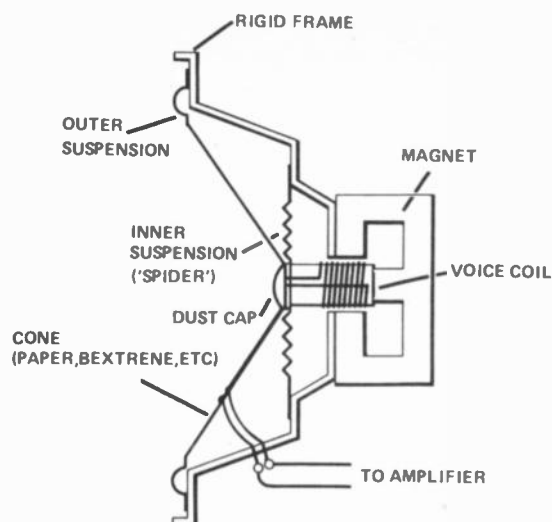


Figure 1a. Moving-coil drive unit. The voice coil (connected to the amplifier) sits centrally in the gap between the magnet poles and the longer the coil is made, the further it can move and still be controlled by the magnet, hence the unit can handle higher currents from the amp (higher power handling). This type of unit is used mainly for bass and mid-range frequencies, as there comes a point when the large cone will be unable to respond fast enough to replay the input accurately.

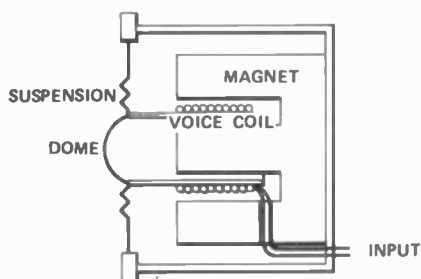


Figure 1b. Domed drive-unit for high frequencies. Here the cone is replaced with a curved 'dome' of material which is more rigid and much lighter, hence more able to respond quickly.

speaker! Figure 1 illustrates the basics of the moving-coil drive unit, as this type of speaker is termed.

Electro-Statics

There is only one other significant method of sound reproduction on the market and that is the electrostatic loudspeaker. Here the cone and coil are both replaced by the use of a very thin and light conductive plate. This is positioned between two grilles of metal connected to a very high voltage (— 700 V) in such a way that it can move without contacting the grilles. The audio signal, which is to be replayed, is imposed upon the high voltage supply.

Once more, the varying signal imposes a force upon the conductive plate, this time electrostatically, which moves in sympathy, thus creating the required sound-waves. Figure 2 illustrates this principle. Note that here a transformer is used between amplifier and speaker, both to even out the load and to set correct voltage levels.

Units For All Seasons

Returning to the moving coil loudspeaker — which accounts for 99.9% of all units sold — Figure 1 shows that, as not all frequencies can be played equally well by one drive unit, most enclosures will contain two or three to handle the entire audio spectrum. The sound is split-up by the crossover network in to the bands suited to each unit so that, for example, the high-energy bass signals do not reach the more fragile high frequency drive unit.

Rarely are drive-units referred to as 'low frequency drive' or 'high frequency-moving-coil-loudspeakers'. For no good reason (other than that someone somewhere thought it amusing no

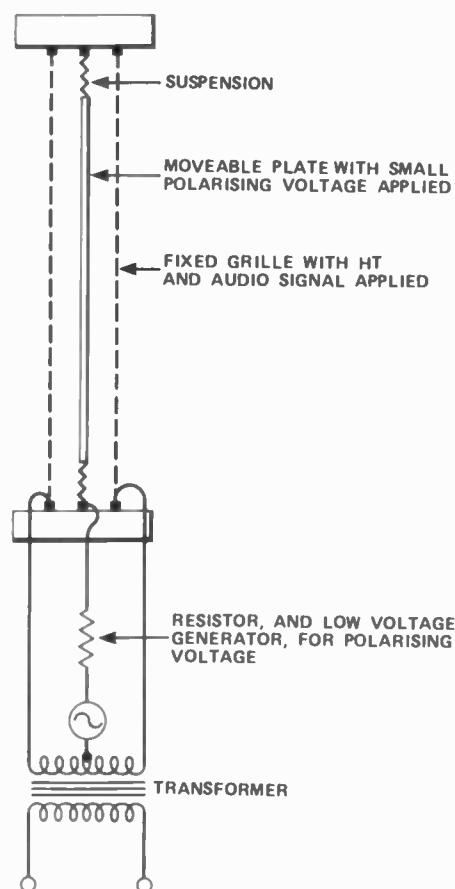


Figure 2. Electrostatic loudspeaker. The polarising voltage is to help maintain the position of the moveable plate, with a large input signal by 'offsetting' it. Note here that no magnets are used and that sound will be emitted in two directions (ie a dipole radiator).

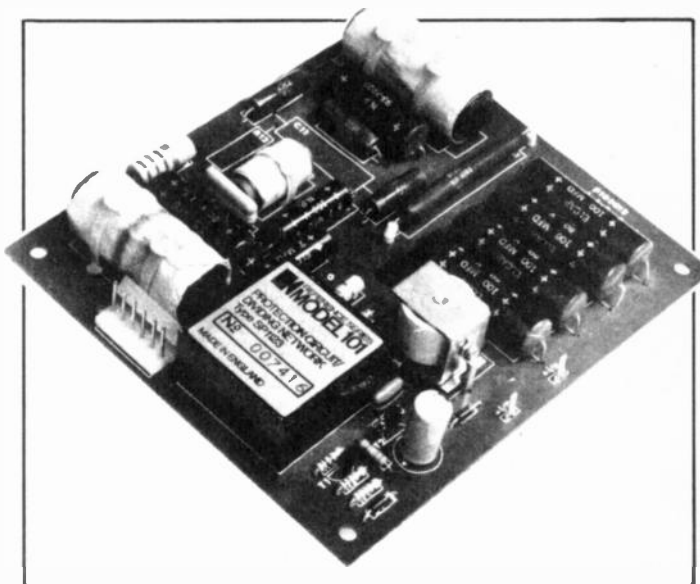


Figure 3. A typical crossover circuit. In this case the unit is the ETI V3 DIY loudspeaker which uses the three units (two of which are domed units) which provide a better spread, or dispersion of sound, than a normal cone.

doubt), bass speakers are termed 'woofers', mid-range 'sqawkers' and high-frequency 'tweeters'.

No comment.

There are also three kinds of box (enclosure) in use for hi-fi: (i) Infinite baffle or acoustic suspension. (ii) Bass Reflex. (iii) Transmission Line or acoustic labyrinth. Figure 4 illustrates

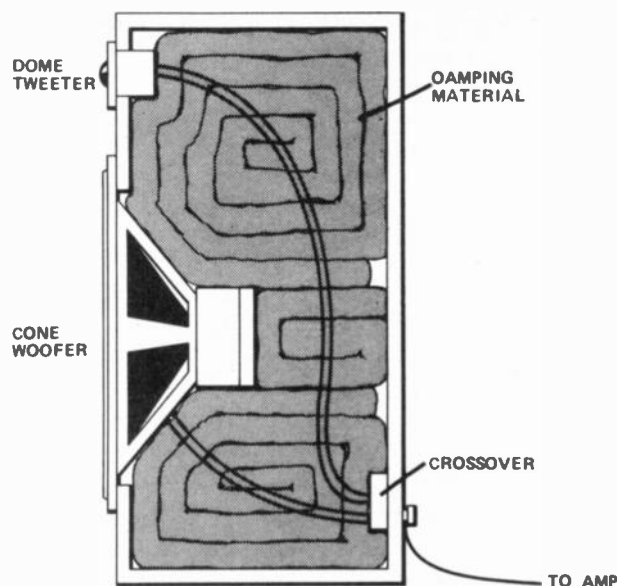
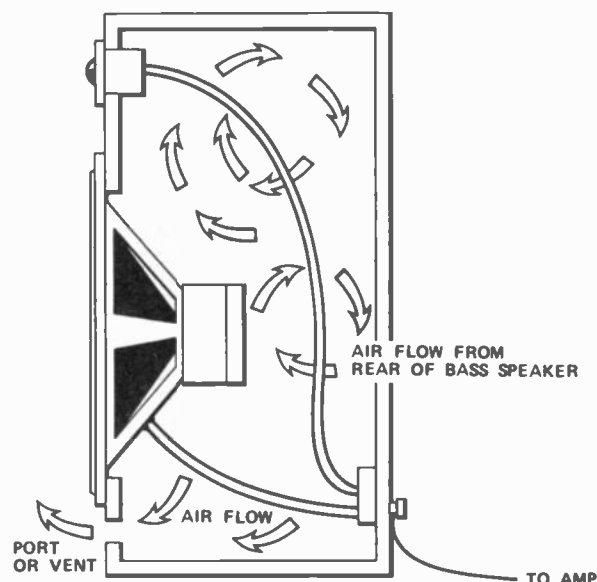


Figure 4. Enclosure types. (i) Infinite Baffle (ii) Bass Reflex (iii) Transmission Line
 (i) Infinite Baffle. Box is sealed tight and air trapped inside will act as 'suspension' for the woofer, increasing the unit's power handling.
 (ii) Bass Reflex. The vent or post in the front panel will, under the correct conditions, act as a supplementary speaker unit, thereby raising the overall efficiency of the enclosure.
 (iii) transmission line. Since the bass speaker is a long way from the port (and assuming the correct choice of damping materials in the 'line'), it can be considered, for all intents and purposes, to be in an infinitely long pipe! No energy is reflected back on to the unit and the enclosure has virtually *no effect* on the final sound — an ideal situation.



the principles, but as they are largely irrelevant to how a speaker sounds, we are not going to spend too much time on the differences here. Bass reflex enclosures are more efficient than the others, but at the cost of bass output. Transmission lines give the best bass response of the three, but at the cost of larger enclosures.

Take It On Spec

There are comparatively few specifications to cope with for loudspeakers buyers, which means that quite often a manufacturer or dealer will attempt to confuse the issue with the most

amazing irrelevancies. As before, let your ears decide. The list below includes all the relevant technical points to watch.

Power Handling: Simply how many watts a unit can handle before disaster sets in. There are many ways of specifying this, with good old fashioned RMS still the most honest. The better manufacturers now specify a range of recommended amplifier power outputs for their units, taking into account the peak output capabilities. Try to place your amp in the centre of the range for safety. If a unit is specified only in terms of 'music' or 'programme' power, halve the figure to get a useful RMS equivalent.

Efficiency/Sensitivity: The former means how well a unit translates input into output with minimal losses and the latter means how much output is obtained for a given input. In other words, the two mean the same thing to a purchaser! Efficiency is usually specified in terms of percentage, ie 20% efficient means that 80% of input is lost. Average loudspeakers — if such things exist — are around 0.3% efficient! So that 99.7% of input ends up as heat and electrical losses! Only horn loudspeakers, where a special method of coupling to the air is used, can exceed 1%. They manage 20% or so but cost the penalty of huge enclosures for bass. It is no exaggeration to say that to have a pair of full range horn speakers at home, you'd be living *in* them rather than *with* them. . . . Commercial units are a compromise. Sensitivity is nowadays quoted as the sound output (in dB) for 1 W of full-range input, such as pink-noise. Each *doubling* of power then adds 3 dB to the output. (As 2 dB is about the *smallest* perceptible change the ear can detect, high-power amps become easier to appreciate at this point). As a guideline, 90 dB is loud, 96 dB about the point where your body begins moving to the music (who's dancing?) and 100 dB around the onset of pain. Look for a sensitivity figure above 85 dB and take care with the amplifier output figure. For example: speaker A has 88 dB sensitivity, amplifier 60 W RMS output and amplifier C 200 W output. Amp B can obtain around 106 dB from the speaker and Amp B could reach 108 dB, ie an imperceptible increase. But as the speaker power handling is only 40 W, both blow it to pieces a long way short. . . . Point made?

Impedance: There is no right or wrong for this spec. Nearly all modern units quote 8 ohms anyway and there is little to choose between, on paper. A more important point to note is that impedance is a *nominal* figure and the actual value will vary widely with frequency. A plot of impedance against frequency is the most useful measure — the nearer a straight line the better!

Frequency Response: As with any other hi-fi unit, this is a measure of linearity, ie how evenly the enclosure treats the audio spectrum. Ideally the output should be at the same level for a given value of input, regardless of frequency. Loudspeakers, being partly mechanical in nature, are not as precise as amplifiers, for example. In addition, the room in which the unit is used will limit bass response (unless it's the Albert Hall — in which case you're a squatter and we don't talk to them. . . .) Look for 30 Hz — 20 kHz \pm 5 dB from a small enclosure and anything which boasts 100 Hz — 20 kHz \pm 2 dB is worth a second look!

Distortion: Regardless of type, modern enclosures have made great strides in recent years. Accept nought less than 3% total, preferably 2% if THD is all that is quoted! Electrostatics and the top-end moving-coil types can better 1% from 100 Hz upwards.

Bass Resonance: Often quoted as some sort of 'figure-of-merit' but is, in fact, totally irrelevant. It will be given in Hertz, around 20 Hz-30 Hz and denotes the frequency at which the bass speaker is most efficient or resonant. Below this, the response drops off rapidly into unusability. Once the speaker is fitted into an enclosure, however, this will be compensated for by the box and the crossover network will smooth out the response. In other words — ignore it!

Crossover Frequencies: Nearly always given in specs, but not as a good or bad figure — which is a pity as a deal of potentially useful information can be extracted from these seemingly innocuous numbers! A crossover frequency is that point at which the sound output is changing from one drive unit to another. At this point, in theory, it is being played by two units at an equal level. Beyond, it will be quickly 'filtered out' from one, allowing the other to dominate. As the human ear is most

sensitive between 1 kHz and 3 kHz, it is best if only one unit replays this band, as even small shifts will be detectable, probably as roughness or brightness. Thus any crossover point between 1 kHz and 3 kHz should be mistrusted. The importance of the mid-range speaker is thus emphasised and experience has shown that the best sounding units can cover something like 500 Hz - 5 kHz. With this in mind, look for a lower crossover above 100 Hz, but below 500 Hz and an upper changeover between 3 kHz and 7 kHz.

Phase Linear/Time Delay Compensated: In order for a loudspeaker to sound as 'real' as possible it must reproduce all the aspects of a live sound accurately. Some years ago it was realised that while a musical instrument produces a wide frequency range effectively at one point in space, a multi-unit loudspeaker does not. This is due to the huge difference in physical size between bass drivers and tweeters. The point from which sound appears to radiate is well inside the enclosure for a cone woofer, but will be at the outside edge of the h.f. dome — difference of some 5-12". This is many times the wavelength of frequencies in question and is thus significant. Since sound travels at a constant speed, regardless of frequency, the low frequencies will arrive at the listener after the HF even though they are supposedly from the same instrument. This is termed 'phase distortion' and is audible as a lack of sharpness or precision. The best phase-linear speakers, which 'stagger' the drivers (figure 5) to line-up the sound sources, can produce an uncannily believable stereo image and a beautifully clear and sharp sound overall. Units such as this are usually more expensive nowadays, as the fashion for lining up the units in this way has died out. Quite frankly this is probably because very few of the manufacturers ever got it right!

Next month our series concludes with a brief look at tape recorders and tuners — and instructions for installing your first hi-fi system.

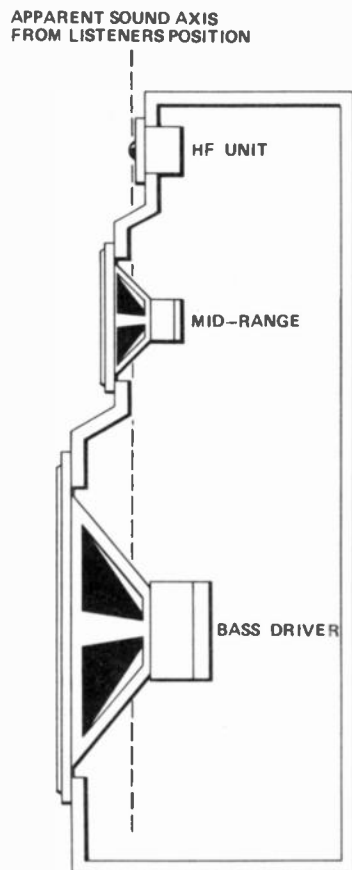


Figure 5. Lining up the sound sources to overcome phase distortion — otherwise known as time-delay compensation.



Figure 6. This revealing cutaway of the KEF 105 II loudspeaker shows the level of complexity that top-end designs can require. The bottom enclosure contains the bass-driver and crossover while the pivoted 'head' carries the (cone) midrange and the (dome) high frequency units. You can see the protection circuitry, which makes this speaker virtually invulnerable, behind the rear of the head. This is a design in which practically all the parameters concerned with an enclosure have been optimised. Even the edges of the top enclosure are rounded off, to prevent sharp corners interfering with sound dispersion. In addition, the bass-driver is 'developed' from the box in such a way that vibrations from the framework are prevented from reaching the enclosure itself, where they would colour the output.



Figure 7. One recurring question is that of what to listen for in loudspeaker auditions. Try this: A single vocalist, ie Stevie Nicks, and a single (complex harmonic) instrument, ie a tambourine. Listen to the voice closely; can you pick out the singer clearly, whether the instrument is playing or not? Is the sound of the voice modified in any way by the instrument? Listen for expression in the voice — not what is being sung but HOW. The instrument should be sharp and distinct at all times and you should be able to shift your attention from voice to instrument, and back again, equally well without either one dominating. An exacting test — but they're the best kind!

HE

WHAT'S ON NEXT?

POPULAR COMPUTING No. 1

Our new computing supplement for budding hardware engineers leads gently into the world of bits and bytes, CPUs and I/O Ports. Our first feature explains these terms and many more. Then there's the special feature that separates publicity from practicality; there are many good reasons for owning a computer, but there are also many traps for first-time buyers. Once you've decided, though, our buyer's guide — a survey of the most popular budget-price computers on the UK market — will help you choose the best machine for your purposes.

INTO RADIO

Beyond the CB-Barrier lies a fascinating hobby — Amateur Radio. Every day, thousands of people, of all ages, from all walks of life and from countries all around the world, talk to each other by radio. How can you get into Amateur Radio? Easy. Just follow us

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You don't have to be a rock superstar to get a recording contract — you can write your own and record yourself using one of the new multitrack recording systems developed in recent years. This new feature series untangles the recording chain, tells you what equipment you'll need and how to use it. The rest is up to you!

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DIGITAL CAPACITANCE METER

Our cousins at Electronics Today International have theirs — but take a look at ours before you decide. It's easy to build, fast and accurate. What more could you need?

BIKE ALARM

Following our Super-Hooter in this month's issue, we present an easy-to-build anti-theft alarm.

INSIDE COLOUR TV

Most of us spend a considerable amount of time looking at the outside of a colour TV — ever wondered what goes on inside? Hobby Electronics' April issue has the full story — inside out, you might say.

That's just part of what's on in the April issue of Hobby Electronics. On sale 12th March.

Although these articles are being prepared for the next issue, circumstances may alter the final content.

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HY 120	60w/4-8 Ω	0.01%	<0.006%	$\pm 35 \pm 40$	120 x 78 x 40	410	£20.10	£17.48
HY 200	120w/4-8 Ω	0.01%	<0.006%	$\pm 45 \pm 50$	120 x 78 x 50	515	£24.39	£21.21
HY 400	240w/4 Ω	0.01%	<0.006%	$\pm 45 \pm 50$	120 x 78 x 100	1025	£36.60	£31.83

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Model No	Output power Watts rms	DISTORTION T H D Typ at 1kHz	I M D 50Hz/7kHz 4:1	Supply voltage Typ/Max	Size mm	Wt gms	Price inc VAT	Price ex VAT
HY 120P	60w/4-8 Ω	0.01%	<0.006%	$\pm 35 \pm 40$	120 x 26 x 40	215	£17.83	£15.50
HY 200P	120w/4-8 Ω	0.01%	<0.006%	$\pm 45 \pm 50$	120 x 26 x 40	215	£21.23	£18.46
HY 400P	240w/4 Ω	0.01%	<0.006%	$\pm 45 \pm 50$	120 x 26 x 70	375	£32.58	£28.33

Protection: Load line, momentary short circuit (typically 10 sec) Slew rate 15V/ μ s Rise time 5 μ s S/N ratio 100db Frequency response (-3db) 15Hz-50kHz. Input sensitivity 500mV rms. Input impedance 100k Ω Damping factor (8 Ω /100Hz) >400

HEAVY DUTY with heatsinks

Model No	Output power Watts rms	DISTORTION T H D Typ at 1kHz	I M D 50Hz/7kHz 4:1	Supply voltage Typ/Max	Size mm	Wt gms	Price inc VAT	Price ex VAT
HD 120	60w/4-8 Ω	0.01%	<0.006%	$\pm 35 \pm 40$	120 x 78 x 50	515	£25.85	£22.48
HD 200	120w/4-8 Ω	0.01%	<0.006%	$\pm 45 \pm 50$	120 x 78 x 60	620	£31.49	£27.38
HD 400	240w/4 Ω	0.01%	<0.006%	$\pm 45 \pm 50$	120 x 78 x 100	1025	£44.42	£38.63

HEAVY DUTY without heatsinks

Model No	Output power Watts rms	DISTORTION T H D Typ at 1kHz	I M D 50Hz/7kHz 4:1	Supply voltage Typ/Max	Size mm	Wt gms	Price inc VAT	Price ex VAT
HD 120P	60w/4-8 Ω	0.01%	<0.006%	$\pm 35 \pm 40$	120 x 26 x 50	265	£22.82	£19.84
HD 200P	120w/4-8 Ω	0.01%	<0.006%	$\pm 45 \pm 50$	120 x 26 x 50	265	£27.17	£23.63
HD 400P	240w/4 Ω	0.01%	<0.006%	$\pm 45 \pm 50$	120 x 26 x 70	375	£39.42	£34.28



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Your Letters

This month, as promised, the Editor answers a selection of your letters querying projects from past issues.

The process of turning a designer's circuit diagram and component layout sketch into a work of art suitable for publication is one that is very sensitive. Errors can creep in at any one of the half-dozen or so stages involved.

Lately, however, it seems that the Gremlins (or 'bugs', if you prefer) have been having a field-day. The situation has been complicated by the fact that, due to the Christmas period, we have had to produce two issues in less time than we would normally take to do them. As a result, the collection of unanswered enquiries has grown to an alarming size.

We apologise to all those readers who have been anxiously awaiting a reply and assure you that, in future, all letters sent with an SAE will be answered by the publication date of the following issue.

Corrections, where necessary, will also be published in the very next issue — however, you can be sure that we will be doing our very best to ensure that the word "Errata" disappears from our Contents page!

Doorphone

Dear Sir,
With reference to your "Doorphone" project, featured in the October 1981 issue; I followed your instructions but, on completion, I am sorry to report great frustrations. Discovering a discrepancy between the diagrams on pages 10 and 12 greatly soothed my mind but, before altering anything, perhaps you could advise me which is correct?
I. Merwitzer,
Salford.

Regular readers will be aware that our original title for this project was a registered trademark, hence we have re-named it the "Doorphone". To further complicate matters, several errors slipped through.

1. On the circuit diagram RV1 should be drawn with an arrow through it, ie a potentiometer with one end 'floating'; the battery voltage should be 12V, not 9V.

2. R6 and LED1 should be interchanged.

3. On the component layout, the missing C5 should be inserted between points B10 (+) and B12.

4. There should be a wire from point D1 to the top right of SW1 and a break in the Veroboard at D4.

5. It is not clear from the diagram that LED1 anode is connected to SW2. Another query on this project was received from Mr. F. W. Andrew of Newbury, Berks; we hope these corrections answer your questions.

Stylish Organ

Dear Sir,
In your November 1981 issue you published a circuit for a Simple Stylus Organ. Being interested in electronics but by no means fully conversant with circuit diagrams such as your Figure 1, I followed the illustration of Figure 2. After connecting all the components as in the upper drawing and making the breaks as in the lower drawing, the organ did not seem to work.

I checked the connections and, as far as I can see, there appears to be discrepancies between the two. Could you please check and inform me which drawing is correct?

E.J. Butler,
Sheffield.

In fact there are several errors in this Quick Project — and not just on the component overlay. On the circuit diagram, RV2 should NOT be connected to pin 6 of IC1 — it should, in fact, be shown as connected to pin 3. On the layout (Figure 2), the lead from RV2 should be connected at F4, NOT F11. Back on the circuit, RV3 should have been drawn with an 'arrow' through it.

In addition, there should be a link from D23 to A23; the link from F15 to I15 should NOT also connect to H15; finally R5 (unlabelled) should connect to B14, not A14. On the underside of the Veroboard, connection points should have been shown at J14 and 16.

In Time, Out Of Place

Dear Sir,
Having just completed the Metronome project from the November (1981) issue, I have these points to make.

1. Veroboard track breaks — none are shown for IC1.
2. Battery, RV1/SW1 and battery leads are rather misleading in that the polarities appear to be reversed.
3. On the component layout, Q1 collector and emitter connections are reversed.
4. SW2 was supplied as a single-pole 12-way rotary.

This being the first project that I have attempted from your magazine (and also the first I have attempted with this IC) the ICs were the last items to be inserted (in sockets) before switching on. However, with SW2 at position 1, LEDs 1 and 2 flash and a tone is produced at every beat. With SW2 in position 2, 3, 4, or 5, LED 1 flashes with every beat, LED 2 flashes on every tenth beat and a tone is produced 4 or 5 times out of ten with a change in pitch when it coincides with LED 2.

Long distance diagnostics of the above symptoms will be quite difficult but I would welcome any suggestions. My assumption is that IC2, the 4017, is unserviceable. I would also welcome your comments on the faults I have found.

J.F. Seaman,
Cornwall.

Long distance diagnostics are always difficult — we can but try! In this case, there are one or two other errors which, when corrected, may solve the problem. For the benefit of other readers who have been troubled by the Metronome, we'll list all the corrections, starting with the ones mentioned in Mr. Seaman's letter.

1. The missing track breaks are at U27, T27, S27 and R27.
2. RV1/SW1 (our artist's impression of a pot-switch); the battery leads should be reversed.
3. Q1 — 'e' and 'c' should be interchanged.
4. This should not make any difference.
5. Swap the leads at J2 and L2.
6. C3 should be connected between M33 and I33.
7. C1 should be between R24 and S24.
8. Remove the link between T29 and V29.
9. Resistor R1 should be R2 and connected between V33 and T33; resistor R2 should be re-labelled R1.
10. The wiper of RV1 should go to point S36.

Special caution is needed with this project because of the small size of the component layout; every connection on the Veroboard should be checked against the circuit diagram — which IS correct.

Understanding Diana

Dear Sir,
I have built the 'Diana' pulse induction metal detector (September, 1981), but it does not work!

Using an oscilloscope, I can get square pulses from IC2 and IC3 but IC4 seems quite "dead" — even a new one made no difference. Also, RV1 and RV2 do not alter the voltages as described.

R12 is not on the Parts List — is it 1MΩ? I have built other metal detectors, but this one has me puzzled. Perhaps you can let me know where I have gone wrong?

H.J. Fisk,
Suffolk.

We published an Errata on the "Diana" in the November 1981 issue, which you may have missed: R11 should be 2k2, not 2M2, and R12 is 1MΩ as you have correctly assumed. The correct

value of R11 will probably "revive" IC4.

Telephone Bell Repetition

Dear Sir,
I am very interested in the Telephone Bell Repeater described in the October 1981 issue of HE. However, after checking the design and building instructions I discovered three faults.

First, I failed to find R9 on the component overlay drawing, which leaves the emitter of Q3 open circuit. Second, the connection point of the loudspeaker is not shown. Third, the solder points on the Veroboard strip do not agree with the component overlay.

I look forward to seeing your comments on these points.
P. Smith,
Leics.

Dear Sir,
With reference to the Telephone Bell Repeater project, there are several errors:

1. R1 is shown as 47k in the circuit and as 47R in the Parts List. Which is correct, please?
2. R9 is omitted from the component layout on page 58.
3. Pin 11 of IC1 is not shown as soldered on the underside of the Veroboard on page 58.

May I suggest that, when you do have corrections to publish, they be given prominence and not left to be found in reader's letters?
C.R. Munro.

No doubt H.J. Holland of Salisbury, Wilts., and A.B. Ely of Kirkcudbright are also looking forward to seeing our comments on this project! Our apologies for the delay; here they are (at last):

Figure 1, page 57: R1 should be 47R, as shown in the parts list.

There should not be a connection between C1 and R1.

Figure 2, page 58: Insert R9 between points L18 and S18.

C1 should be between points V3 and T3.

The loudspeaker, LS1, connects between V2 and W2.

The socket for IC1 should have all its pins soldered.

Finally, concerning Mr. Munro's last point: We receive a large number of letters every month, many of them straight-forward technical enquiries but also a considerable number of queries on possible errors in projects. Where else can we reply, except in the Letters pages?

In future, however, we will draw your attention to corrections by an entry in the Contents referring to the page (or pages) on which Errata are to be found — as we have done in this and the previous issue.

Baby's Alarming

Dear Sir,
On page 39 of the October '81 issue of HE you published a project for a Baby

Alarm. Under the component layout diagram, you mention that six breaks are needed in the Veroboard tracks but you fail to indicate where they should be.

Could you please tell me which track positions are to be broken?
P. Newstead,
Oxford.

We had many letters from readers concerned about these missing track breaks; at first we thought the error was in the text because the layout is such that the project should work without any track cuts at all! The solution was provided in a letter from Mr. Ko Yenlie of Singapore who very cleverly suggested that track breaks will be needed adjacent to the two mounting holes at the end of the board. Accordingly, if you are using or wish to use mounting screws, track breaks should be made at locations A22, B22, C22 and at H22, I22 and J22. The mounting screws should come after the breaks, at the end of the board. Our collective thanks to Mr. Ko!

R.P.M. Meter

Dear Sir,
I have made up the above item, but I am surprised no correction or reader's letter has been published.

The overlay, which is very faintly printed and almost impossible to work from, is shown the same as the printed circuit pattern (on page 62), ie the parts would be mounted on the copper track side. Presumably the circuit foil pattern should have been a mirror image of the overlay outline.

Fortunately, by mounting the IC sockets on the foil face and other components as normal, all is well. Wish I'd spotted the error before I had etched the board, as I might have done had the overlay been clearer.

I.M. Tasker
Grantham, Lincs.

Murphy's Law strikes twice. Mr. Tasker is perfectly correct; the PCB pattern on page 62 is shown from the top, that is, the component side. A solution to the problem is to trace the pattern on to clear paper, then flip it over to present the correct orientation for transfer to a blank PCB.

The track outline on page 54 is very faint indeed, but at least it is possible to refer to page 62 for a clearer picture!

Hobby Organ

Dear Sir,
Having made, and played, the HE Organ (which, I might add, sounds pretty good to me), I am rather surprised by one of the items in the Errata box in the August 1981 issue. Referring to C3 in Figures 2 and 3, has it really been turned around?

Also your (Oops) in the June issue re. points 1, 2 and 3; 0 volts does not go to R2 — is this not the amplifier input?

E.G. Elliott,
Taunton, Somerset.

Quite obviously, the Gremlin-fixer has been fixed and the Errata printed in the August issue is itself — in error. The correct corrections are as follows: In Figure 2, C9 should be 220u, not 220n (the Parts List is correct). However, C12 can be 22n and C13 can be 10n as neither is critical.

In Figure 2, C32 (not C3, as we said in August) should be turned around; that is, its positive plate should be at the bottom.

In Figure 3, the positive plate of C34 (not C3) should be at the right-hand side and capacitors C28 and C32 should both be turned around.

Regarding "points 1, 2, and 3", we are unable to make out what 'oops' they are in reference to. Could you be a bit more specific?

Kitchen Timer

Dear Sir,
A few months ago I made up the Kitchen Timer described in the October 1980 issue of HE. However, I have never managed to get it to work. I have changed a number of components, checked connections and polarities and also checked resistors and joints with a multimeter. Are there any other checks I could make?

Hoping you can help,
A. Webb,
Glasgow.

Firstly, R17 should be 3k9, NOT 82k, as shown on the circuit and in the Parts List. The incorrect value may well be the source of your troubles. If, after changing R17, the Kitchen Timer still fails to "do its thing", you can isolate the fault to either the timing section or the multivibrator by metering pin 3 of the 555; it should go high (+9V) when the timing period is started and go low (0V) when the IC "times out". Then, at least, you will have narrowed the possibilities.

Mast-Head Amplifier

Dear Sir,
Would you please let me know where I can purchase the IC, OM355, for your Mast-Head Amplifier project? Also, am I right in saying that pin 1 goes towards the output socket and the aerial cable goes to the input socket of the amplifier?

H. Joyce,
Bembridge, I.W.

We made an error — there are other words for it — in giving RS Components as a supplier for this IC. However, it is available from Magenta Electronics.

The last point is correct, but the data sheet for the OM355 clearly shows that pin 1 is the input, NOT the output, as suggested. Due to production problems last month (we'll spare you the horrifying details), the component overlay is somewhat difficult to read; pin 1 is to the right of the IC, ie the one that stands alone.

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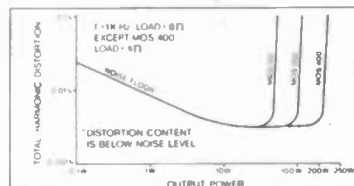
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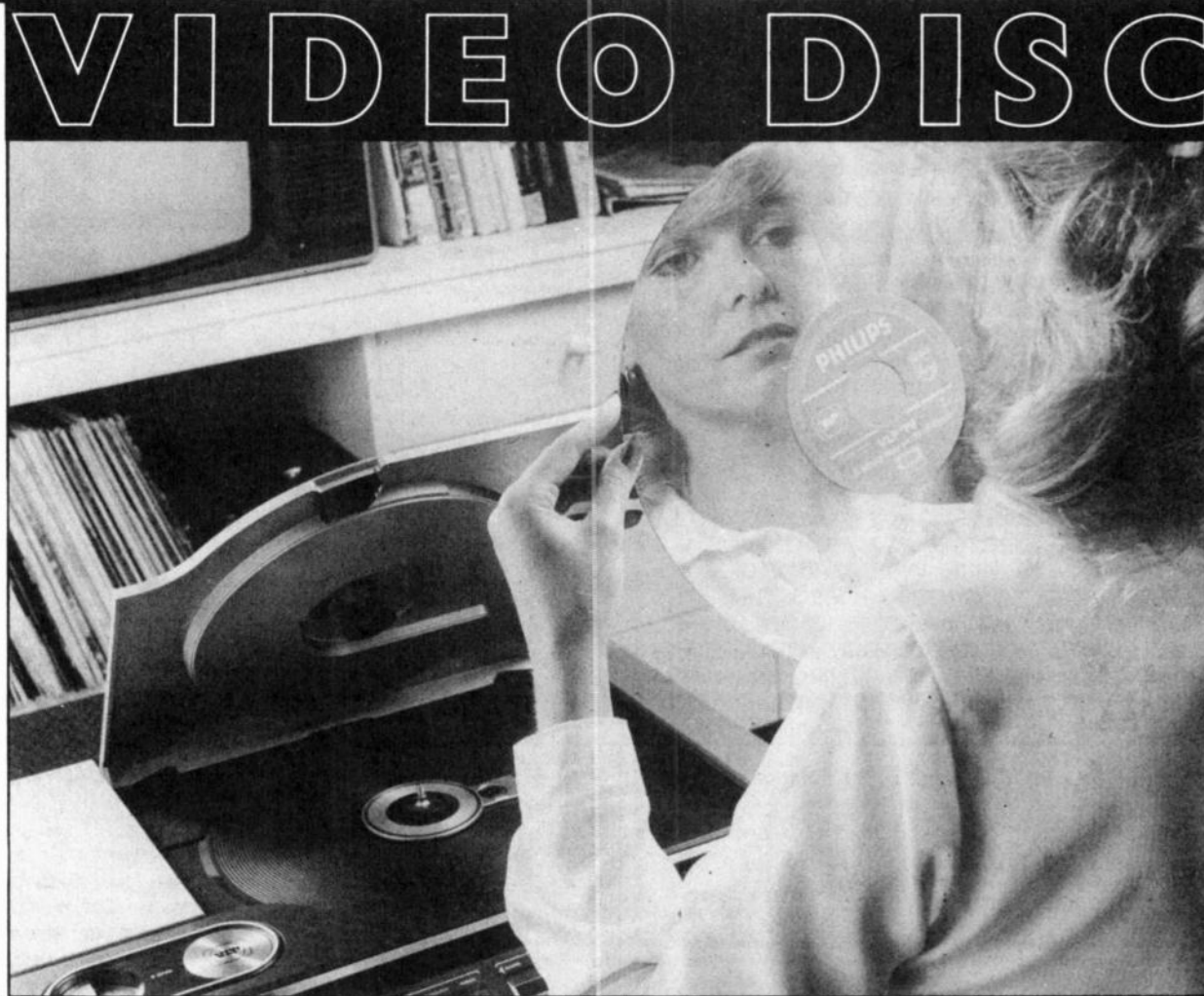
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Reflections on a Philips Videodisc.

The battle lines have been drawn and World War III (for the domestic videodisc market) is about to commence.

DISCS WERE WIDELY USED for audio recording long before magnetic tape recorders became widely available. The pattern has been completely reversed in video recording with video tapes and cassettes available whilst we still await the first commercially available videodiscs! However, the battle for the videodisc market is rapidly heating up.

The videodisc market is believed to be extremely attractive and more and more manufacturers are deciding to take part in its development. Indeed, US consultants forecast that, within three years, videodisc machine production should exceed that of video cassette recorders.

They expect that over half of American homes will have a video disc player by this time.

Laser Optics System

The Philips/MCA system has a price tag of US \$750. The surface of the (12") disc is covered with a reflective coating into which tiny pits are burned by a laser. A small helium-neon laser is used to read information from the spiral tracks of the disc on playback. Each disc has 54 000 tracks and each track contains the information for a single picture frame. The disc rotates at 1800 rpm to provide a playing time of up to 30 minutes. However, it is possible to extend the playing time to one hour per side of the disc by adjusting the speed of rotation in proportion to the decreasing circumference, so that the laser tracks the disc at a constant velocity.

The Philips playback system requires precise tracking of the laser spot beam together with servo control and time base correction to account for any warping of the disc. It is

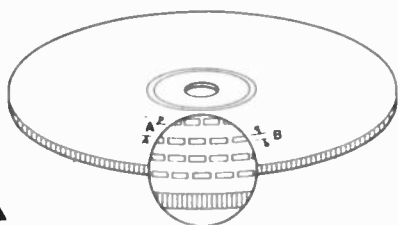
claimed that the laser modulated discs provide excellent picture resolution together with a long life, while the pits provide very high information storage density. The video bandwidth can exceed 8 MHz, and it seems likely that this system may offer sharper images than capacitive tracking systems.

RCA System

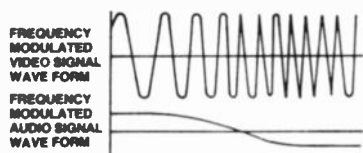
The RCA Selectavision system employs a metal electrode attached to the back of a diamond stylus. This stylus follows the track of a groove, cut in a vinyl disc, which is electrically conductive and uses the capacitance variations arising from small depressions (known as 'pits') at the bottom of the groove. These changes in capacitance modulate the amplitude of a carrier which is subsequently decoded and fed into the aerial terminals of a television receiver.

It is claimed that this capacitive stylus system offers the principal advantages of low cost and ease of manufacture. The selling price of the RCA type players has been forecast to be less than US \$500 in the world markets. This may make it the cheapest videodisc system to become available in the fairly near future.

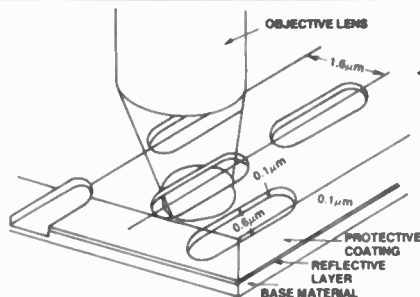
The RCA system employs a 300 mm disc rotating at 450 rpm will provide up to an hour's playing time per side. No tracking control mechanism is required in this system. The main disadvantages are stylus wear, which is understood to limit the life of the capacitive pick-up to some 500 hours of playing time, and the relatively limited video and audio bandwidths.



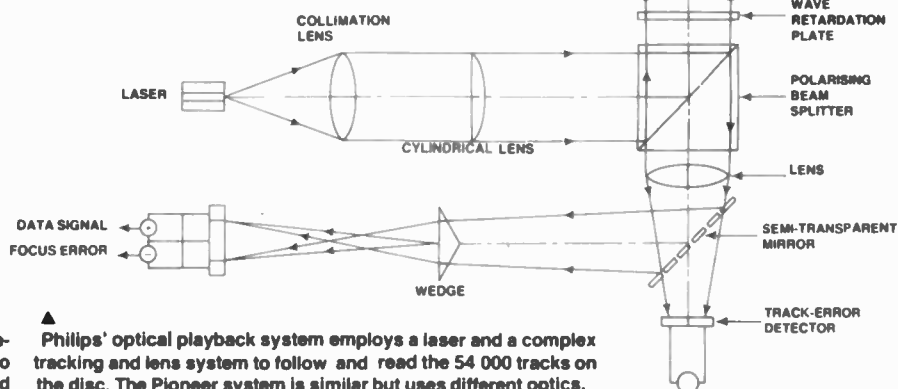
▲ Information is encoded on Philips' Discovision disc as tiny pits only $0.6\text{ }\mu\text{m}$ wide (dimension B) by $0.1\text{ }\mu\text{m}$ deep, spaced $1.6\text{ }\mu\text{m}$ apart (dimension A).



▲ The optical pulses from the micropits are demodulated to produce both video and audio carrier signals, which are subsequently converted into picture and sound.



▲ A laser reads the length of the microscopic pits, which contains the encoded information.



▲ Philips' optical playback system employs a laser and a complex tracking and lens system to follow and read the 54 000 tracks on the disc. The Pioneer system is similar but uses different optics.

JVC System

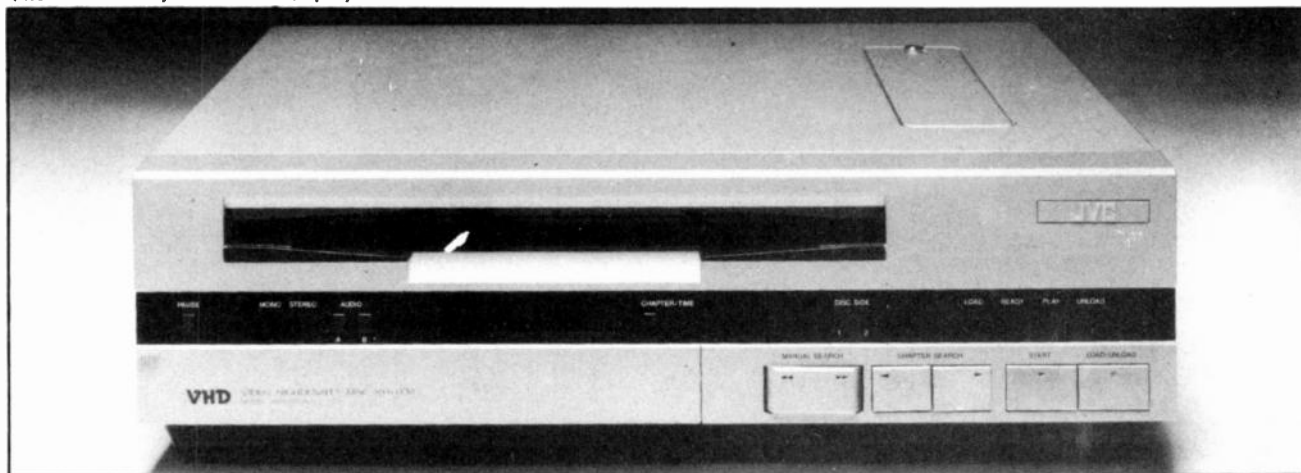
The Video High Density (VHD) system is also a capacitive pick-up type, but does not depend on grooves in the disc for guiding the movement of the stylus across the disc. Encoded tracking information is included on the disc alongside the video information. The stylus does not move in a groove, but sits on the smooth surface of the disc. Minute indentations or pits provide capacitive variations to the pick-up which translates them into electrical signals. Movement of the stylus is controlled by a servo-mechanism which uses the tracking information on the disc.

The VHD capacitive system provides audio bandwidth to 20 kHz with a signal-to-noise ratio of 60 dB.

The life of the stylus is of the order of 2000 hours (four times that of the RCA system), but the servo mechanism required raises the cost of both the discs and of the equipment.

The discs are somewhat smaller than used in the Philips and RCA systems (260 mm dia.) and revolve at 900 rpm. This system has been developed by the Japanese Victor Company (JVC) and will be manufactured in the USA by General Electric Company and by Thorn-EMI in Europe. Players for these videodiscs can also replay suitable digital audio discs.

The JVC VHD system videodisc player.



The VHD system provides access to any point randomly chosen on a disc more quickly than those systems in which the stylus must follow some form of groove. It can provide special effects such as a still picture, fast or slow motion replay, etc. It is rather remarkable that the discs can be manufactured using existing audio disc pressing equipment.

In the recording process for the production of the master disc, a single laser beam is split into two parts, one half being used for recording the information and the other half being used to record the tracking signal. The master disc is made of glass coated with a photosensitive material and the recording must be carried out in a dust-free room. The laser beams are moved along a radius of the disc at constant speed, whilst the disc rotates at 900 rpm. Fine pits are thus recorded spirally on the glass disc which is then used to make a metallic master disc by the conventional process used for audio recordings.

The VHD discs sold to consumers are of conductive polyvinyl chloride (PVC) and have a life of some 10 000 playings. A sapphire stylus is employed, mounted at the end of a cantilever arm with a magnet on the opposite end. Fixed coils are mounted near the magnet and a single coil is wound around (but not in contact with) the magnet. In addition, a pair of vertical coils are mounted on either side of the single coil in opposition to one another. This arrangement

enables the stylus to be moved as the current flowing in the coils varies. The coil currents are controlled by the tracking error signals and timebase error signals. However, a command to move the stylus to a particular track can also be used to control the coil current.

JVC claim that their use of a relatively conventional disc production technique is a great advantage of their system over optically based videodisc systems.

Matsushita (who market Technics and Panasonic products) have decided to abandon their own videodisc system in favour of the JVC system and have now made an agreement with JVC. The original Matsushita system employed a direct contact stylus and a rigid disc.

Conclusions

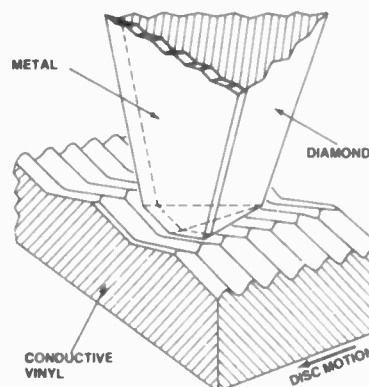
It seems probable that the three incompatible videodisc systems will exist side by side at least in the early 1980s, so this could mean that people who want to be able to play any videodisc will be involved in expensive investments.

In spite of the current interest in videodiscs, one must remember that people may not want to replay their favourite videodisc as often as they play their favourite audio discs and this may well affect the chances of videodiscs attaining the widespread use essential for their success. However, if a wide range of material is available on disc at reasonable prices, it seems certain that there is a pretty good market for high quality systems.

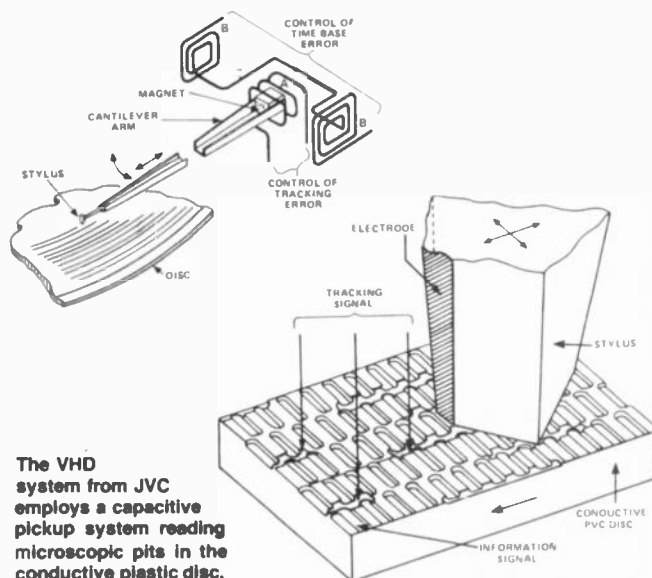
The picture quality provided by videodiscs is certainly superior to that from domestic video cassette recorders. The most expensive videodisc system (Philips) will be cheaper than videotape systems (apart from its better quality pictures) and will be one of the most flexible disc systems. The JVC system offers the highest storage density of any of the videodisc systems.

It is interesting to note that videodiscs are no longer limited to the domestic consumer market. Videodiscs are very suitable for the storage of computer type information and it could well be that this application will help enormously to spur manufacturers to invest more heavily in videodiscs generally, since there is also an enormous potential market in the business and other data storage computer fields.

RCA's SelectaVision videodisc player.



RCA's SelectaVision system uses a metal diamond composite stylus running in modulated grooves on the disc. The stylus tip is only $5\text{ }\mu\text{m}$ by $2\text{ }\mu\text{m}$ and the groove pitch is $2.6\text{ }\mu\text{m}$. Wear is said to be its biggest problem.



The VHD system from JVC employs a capacitive pickup system reading microscopic pits in the conductive plastic disc, tracking signals encoded on the disc providing information to a servo system that drives the stylus across the disc. Stylus life is said to be around four times that of the RCA system.

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"Isabel necessary on a bike, when you have the HE Push-bike Siren?"

IT'S TRUE, you know — never again will you have to slam on the anchors or swerve to avoid jaywalkers who step from the pavement into the road ahead — but only if you build this project. All you'll need to do then is give a brief warning blast of the siren as you ride along and everyone will know you're coming!

The HE Push-Bike Siren makes a realistic sounding imitation of a wailing police-car siren — 'Starsky 'n 'Hutch' style. Its piercing — nay, irritating — sound will make all but the doziest of 'peds' (ie, pedestrians) jump out of your path.

The siren sound is created by a combination of clever, but simple, electronic circuitry and a special solid-state audible warning device; the complete project is battery-powered — a couple of PP3-sized batteries will last for many months, depending on usage.

Construction

Following the Veroboard layout shown in Figure 2, make all required track breaks. This should be done with either

the correct cutting-tool or, simply, a hand-held, small (about 1/8") drill bit. Press the cutting edge of the tool/bit against the hole in question and turn it back and forth until the copper is cut into a clean circular break. Make sure there is no loose copper swarf which can form electrical bridges between tracks.

Insert and solder all components individually into the board, starting with links, followed by resistors, capacitors and finally semiconductors. Links should be formed out of single-strand, tinned-copper wire.

Use an IC socket to hold IC1 — this prevents the need to solder-in the clip, which is a CMOS type. Mark and drill the box to fit the push-button and the holes required to mount the solid-state warning device (ie, one for the mounting-bolt, one for the connecting leads). Solder two leads (about 6" long) to the solid-state warning-device. Use a different colour for each lead, say red and black, because the device is polarised and must not be connected the wrong way round. Push the free ends of the two connecting leads

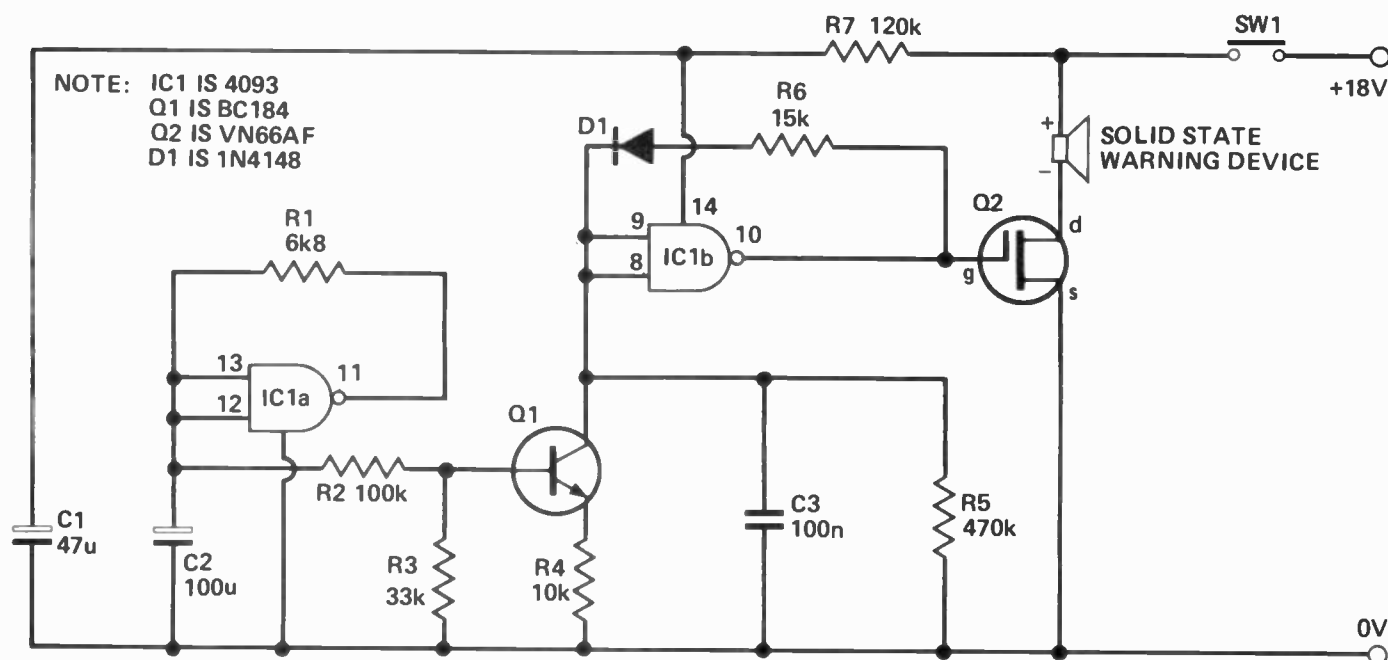
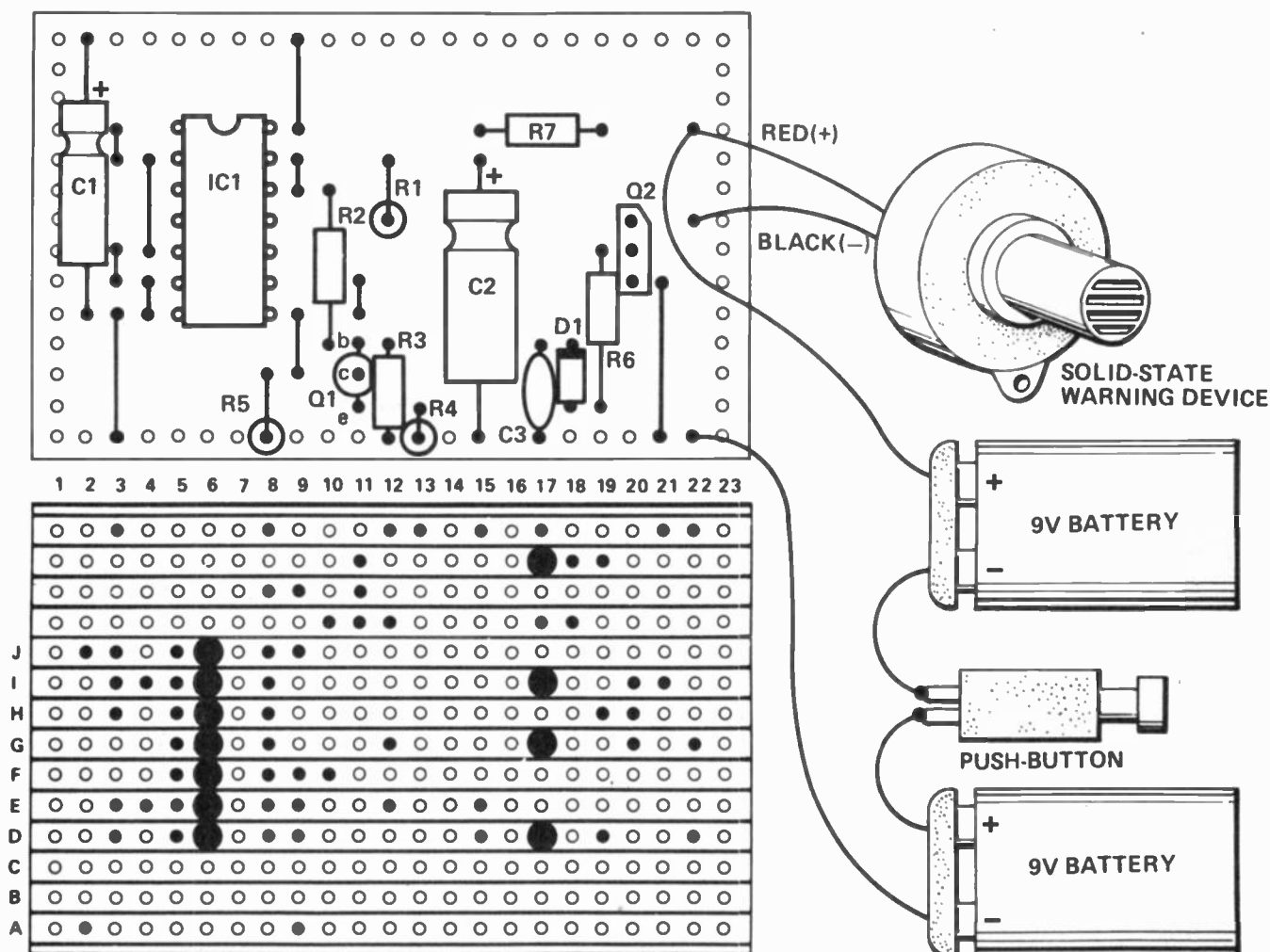


Figure 1. Circuit of the HE Push-bike Siren



▲ Figure 2. Veroboard layout, showing underside track breaks and component locations, with connection details of the project.

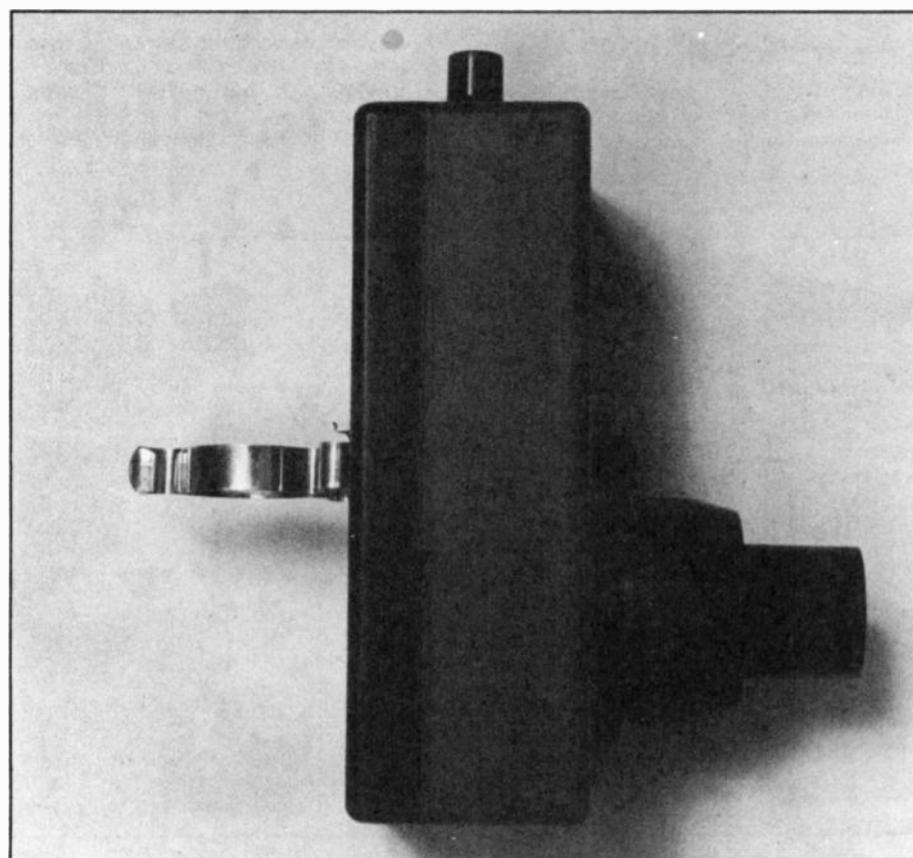
through their holes and fasten the warning device to the box, using glue as well as the mounting bolt, to make the join between device and box lid as rainproof as possible.

Fasten the push-button to the box. Now, wire-up your project as shown diagrammatically in Figure 2. Fasten the batteries and the circuit board to the bottom of the box using self-adhesive pads. Finally, bolt-on a suitably-sized Terry clip to the box base and fasten the whole project on the handlebars of your bike.

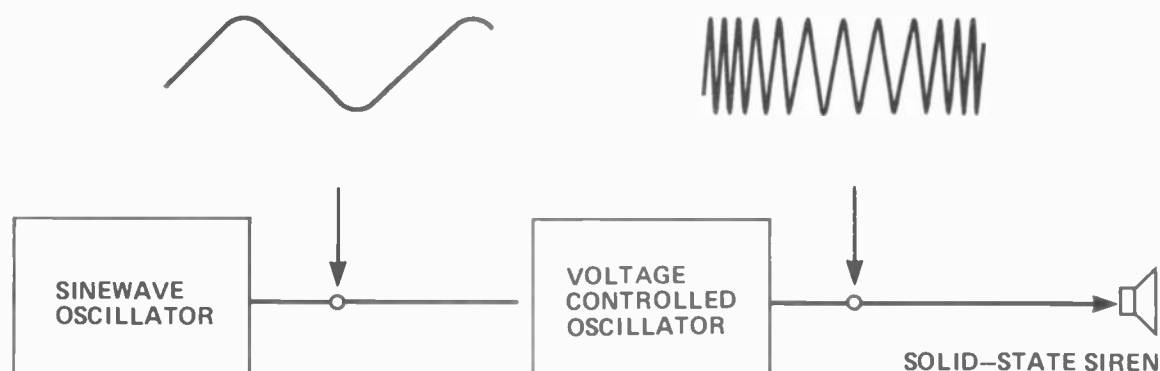
Buylines

The solid-state audible warning device is available from Magenta Electronics Ltd for £3.07. Please add 40p to cover p&tp. The box is type BOC430R from West Hyde Development Ltd.

All other components should be easily obtained. Approximate price of parts for the project (excluding box and batteries) will be £6.



How It Works



A low frequency (about 2 Hz) oscillator provides a sinewave control voltage, for a voltage controlled oscillator (VCO). Thus the VCO output frequency varies, up and down, at a rate of 2 Hz (ie, twice a second). The resultant output is used to switch on and off a solid-state audible warning device to produce a sound effect similar to American police car sirens.

Schmitt trigger NAND-gate, IC1a, is configured as an astable multivibrator. Resistor R1 and capacitor C2 define the overall frequency of this multivibrator: reducing the value of either of these components will increase the frequency; in-

creasing their value will reduce the frequency. With the values shown, the multivibrator frequency is about 2 Hz.

An astable multivibrator produces a squarewave output, but a sinewave is needed so, instead of using the voltage at the output of the multivibrator, the voltage across the capacitor C2 is used. This resembles a sinewave closely enough for our purposes.

NAND-gate IC1b, with associated components, form another astable multivibrator oscillator. Transistor Q1 is connected across C3, the multivibrator timing capacitor. The resistance of the transistor defines the charging rate of the capacitor and thus controls the overall

frequency of the multivibrator. Varying the voltage at the base of the transistor varies the transistor's resistance so, by applying the voltage obtained from the low frequency multivibrator to the transistor base, the second multivibrator frequency is controlled by the first.

Transistor Q2, a VFET, is switched on and off by the output of the voltage controlled multivibrator and powers the solid-state warning device to create a loud sound output. By setting the centre frequency of the voltage controlled multivibrator to the resonant frequency of the warning device, the sound output becomes particularly irritating!

Parts List

RESISTORS (All 1/4 W, 5%)

R1	6k8
R2	100k
R3	33k
R4	10k
R5	470k
R6	15k
R7	120R

CAPACITORS

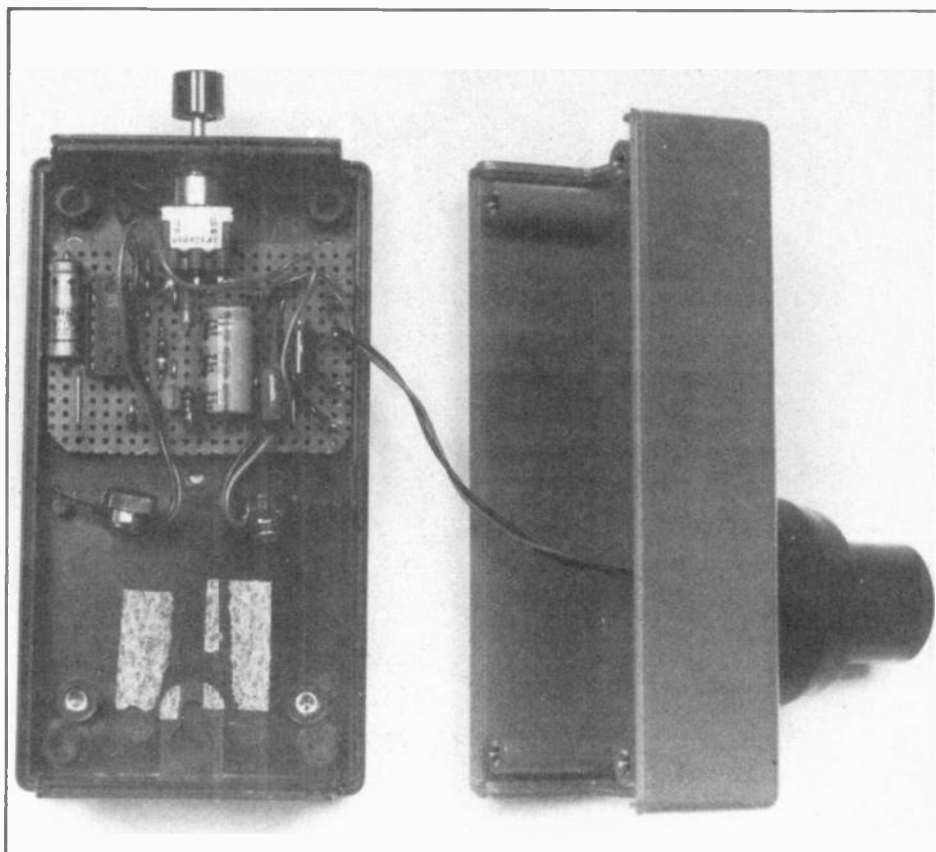
C1	47u, 25 V electrolytic
C2	100u, 16 V electrolytic
C3	100n polyester

SEMICONDUCTORS

IC1	4093 quad, Schmitt trigger NAND-gate
Q1	BC184 NPN transistor
Q2	VN66AF VFET transistor
D1	1N4148 diode

MISCELLANEOUS

SW1	single-pole push-button
Solid-state audible warning device, 12V 2 x PP3 sized batteries + clips	
Box to suit	
Terry clip	

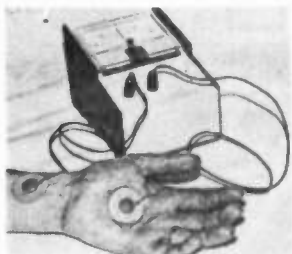


HE

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LIE DETECTOR

Not a toy, this precision instrument was originally part of an "Open University" course, used to measure a change in emotional balance, or as a lie detector. Full details of how to use it are given, and a circuit diagram. Supplied complete with probes, leads and conductive jelly. Needs 2 4k batts. Overall size 155 x 100 x 100mm. Only £7.95 — worth that for the case and meter alone!

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A bulk purchase of PCBs from several well-known computer games including Battleships, Simon and Starbird enable us to offer these at incredible low prices.

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Probably one of the most popular electronic games on the market. Unfortunately the design makes it impractical to test the PCB as a working model, although it may well function perfectly. Instead we have tested the sound chip, and sell the board for its component value: SN76477 sound IC; TMS1000 u-processor; batt clips, R's, C's etc. Size 160 x 140mm. Only £1.50. Instruction book and circuit 30p extra

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Gives realistic engine sounds and flashing laser blasts — accelerating engine noise when module is pointed up, decelerating noise when pointed down. Press contact to see flash and hear blast of lasers shooting. PCB tested and working complete with speaker and batt clip. (Needs PP3). PCB size 130 x 80mm. Only £2.95

MICROVISION CARTRIDGES

These are a small PCB with a micro-processor chip, designed to plug in to the microvision console. Only snag is, we don't have any consoles! However, they can be used as an oscillator with 4 different freq. outputs simply by connecting a battery and speaker. Tested and working (as an osc) with pin out data. PCB size 72 x 60mm. ONLY 25p each!!

'SIMON'

The object of this game is to repeat correctly a longer and longer sequence of signals in 3 different games. (Instructions included) PCB contains chips, lampholders and lamps, and is tested working, complete with speaker. Tested and working (as an osc) with pin out data. PCB size 130 x 80mm. Only £3.95

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Tested Logic 5 now sold out — but we have some PCB's with 10 LEDs and chip on, but no keyboard. Not tested. 50p

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FNA5220 2 digit 1/2 7-seg display on PCB. CC With data. £1.50. 7-seg displays: FND0360, 367, 501, all 50p; 530, 847, 850, all £1.50. Regs: T03 case: 7924 120p, 7885 100p, 7808 100p, 7912 100p, 78CB 230p. Others on B/L 13. Op Amps: uA4136 130p; uA776 145p; uA777 300p; uA318 245p. Isolators: FC0831, IL15, TIL118, all 60p. TIL311 Hexadecimal display with decoder, 0-9 and A-F. With data. £3.50.

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Z521 Panel with 16236 (2N3442) on small heatsink, 2N2223 dual transistor, 2 BC108 diodes, caps, resistors, etc. 60p. Z482 Ported Oscillator Module works from 1-20V, can be used as LEO flasher (3V min). Supplied with connection data, suitable R, C & LEO. £1. Z527 Reed relay panel — contains 2 x 6V reeds, 6 x 25030 or 25230, 6 x 400V reeds. Rs. 50p. Z529 Pack of ex-computer panels containing 74 series ICs. Lots of different gates and complex logic. All ICs are marked with type no. or code for which an identification sheet is supplied. 20 ICs £1; 100 ICs £4. A504 Black case 50 x 50 x 78mm with octal base. PCB inside has 24V reed relay, 200V 7A SCR, 4 x 5A 200V reeds, etc. 60p.

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Z537 PCB 100 x 75mm containing a wealth of components: 2 x 12V DPCD min. relays, 2 x 47uF 16V tanis, SC146E 10A 500V triac, C112d 8A 400V SCR, 566 timer, 10 x IN4001 diodes, 2N5061, 2 x 3mm leds 3 x 2N3704, also R's and C's. Amazing value!! — if bought separately parts would cost around £8!! — Price for the panel just £2.00.

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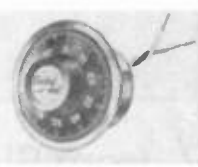
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K001 50V ceramic plate capacitors, 5%, 10 of each value 22pF to 1,000pF, total 210. £4.80. K002 Extended range 22pF to 0.1. Values over 1000pF are of a greater tolerance, 10 of each value 22 27 33 39 47 56 68 82 100 120 150 180 220 270 330 390 470 560 680 820 1000 1500 2200 3300 4700 6800 0.015 0.022 0.033 0.047 1. 10. 15. 22. 33 and 47uF. PRICE: £7.66.

K003 C280 or similar Polyester capacitors, 10 each of the following: .01, .015, .022, .033, .047, .068, 1, 15, 22, 33 and 47uF. PRICE: £3.40.

K004 Mylar capacitors. Small size, vertical mounting 100V, 10 each of the following: .001, .0012, .0015, .0018, .0022, .0027, .0033, .0039, .0047, .0056, .0068, .0082, .01. Total 130 capacitors. PRICE: £4.70.

K007 Electrolytic capacitors 25V working small physical size axial or radial leads, 10 each of the following: 1, 2.2, 4.7, 10, 22, 47, 100uF. Total 70 capacitors. PRICE: £3.59.

K008 Extended range, as above, also including 220, 470 and 1000uF all at 25V. Total of 100 capacitors. PRICE: £8.35.

K021 CR25 resistors or similar, miniature 1/4 watt carbon film 5%, as used in nearly all projects, 10 of each value from 10 ohms to 1M, E12 series. Total 610 resistors. PRICE: £5.95.

K041 Zener diodes 400mW 5%, 10 of each of all the values from 2V7 to 36V. Total 280 zeners. PRICE: £15.95.

K051 LEDs — pack of 60, comprising 10 each red, green and yellow 3mm and 5mm, together with clips. PRICE: £8.95.

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HY 68	Stereo mixer	Two channels, each mixing ten signals into one.	20 mA	£9.14	£7.95
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HY 76	Stereo switch matrix	Provides two channels, each switching one of four signals into one.	20 mA	To be announced	
HY 77	Stereo VU meter driver	Programmable gain/LED overload driver	20 mA	£10.64	£9.25

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POCKET TV



The prototype Microvision pocket TV.

The new Microvision flat-screen TV, from Sinclair Research Ltd, will be going into production late in 1982.

THE pocket-sized computer system is now very close to being realised with the development of a new visual display unit which consumes little power and is roughly the size of a pocket calculator. It is now possible to construct a pocket computer with printer, central processor unit, visual display and printout on to photo-sensitive paper.

"The slim-line pocket TV is here and is going into production", says Clive Sinclair, founder and director of Sinclair Research Ltd. The company has been responsible for developing pocket calculators, small TVs, etc, and has now overcome the formidable problems of designing and producing a miniature (20 mm thick) cathode ray tube (CRT).

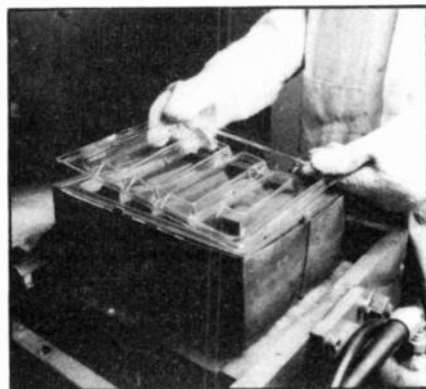
A manufacturing plant is being set up to produce a pocket TV/radio with a 75 mm diameter black and white screen. Mr. Sinclair expects this to be available late in 1982 and he predicts that a colour version will be produced shortly afterwards. Owing to the radical design of the flat CRT, the brightness of the screen is three times that of the conventional CRT. This makes it ideal for use in projection TVs with up to 1250 mm diameter wall-mounted screens.

A great deal of energy and money has been spent over the last decade to produce a miniature VDU which consumes low power. The announcement by Sinclair of a flat CRT, where the electron gun is mounted to the side of the screen, is a breakthrough because the development of a low cost solid state device still seems years away. It is certainly possible to construct a complete screen from individual LEDs or liquid crystal elements, but the cost of manufacturing and the complex circuitry needed to control it is prohibitive at the

moment. In addition, such a system would inevitably give poor visual definition and, if liquid crystal displays were used, the contrast would be unsatisfactory.

The Sinclair CRT is shown in Figure 1. It measures 100 x 50 x 20 mm and is half the volume, three times as bright and consumes one quarter to one tenth the power of a conventional CRT of the same screen size. The device is constructed from a fairly conventional electron gun, collimator, and vertical and horizontal electrostatic deflection plates mounted at the side with the axis parallel to the phosphor screen. A positive electrode behind the screen, and a negative electrode inside the front face cause electrons to be deflected towards the screen. The negative electrode at the front is made of a tin oxide coating which is transparent to light. The vacuum enclosure is made of glass and a plastic Fresnel lens is mounted outside the front surface.

Although the design concept is very simple, the fact that the electron beam does not strike the screen at right angles means that one or two tricks are needed to produce images which are well-defined and undistorted. First of all, good definition of a picture requires that the electron beam spot should be circular and as small as possible. The situation without the electrostatic field is shown in Figure 2a. It can be seen that at point A the angle of incidence is greater than at point B, so that the beam spot is much less elliptical here. Figure 2b shows the situation when an electrostatic field is applied. The angle of incidence is constant across the screen and the spot is therefore of constant size.



Top: The man himself, Clive Sinclair, holding the prototype of the Microvision 2700.

Middle: Machinery for making flat CRTs — it's a vacuum metaliser, used to deposit an aluminium backing surface for the tube screen.

Bottom: The flat CRT can easily be mass produced. This particular machine, at the company's pilot production plant at St Ives, Cambs., was designed by Sinclair engineers and produces 14 glass covers every 2 minutes.

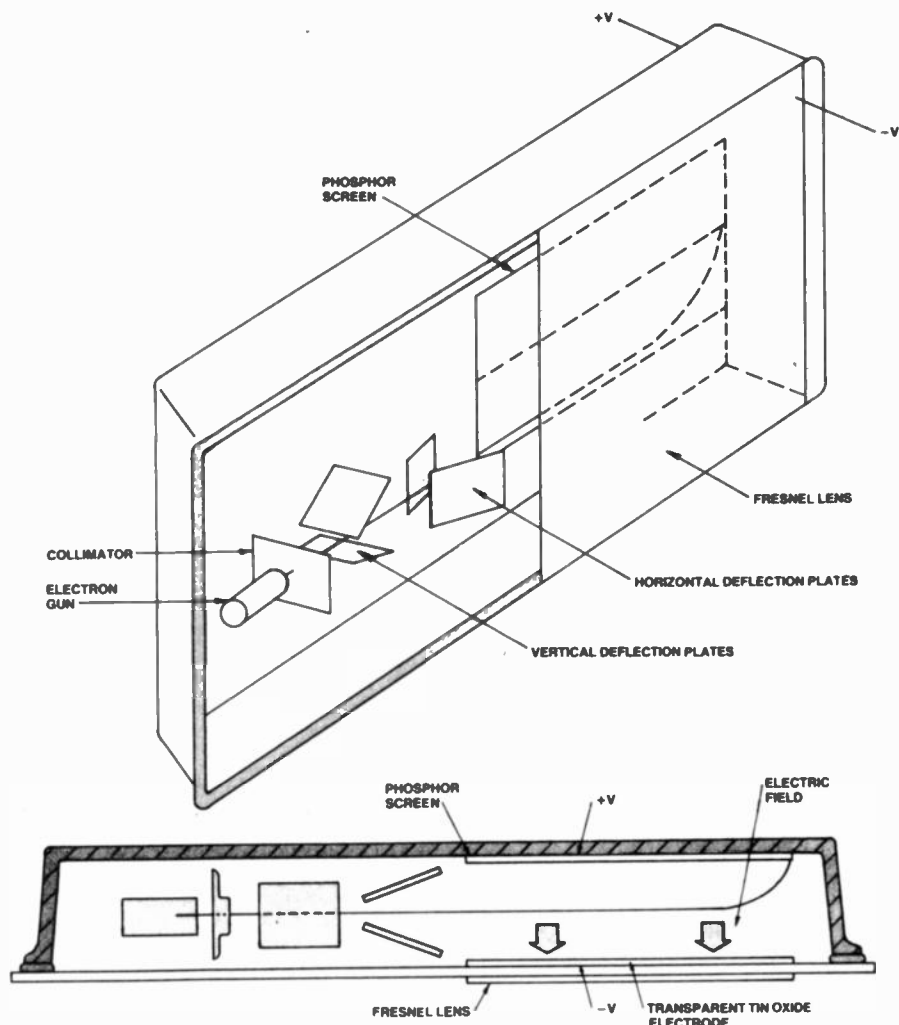
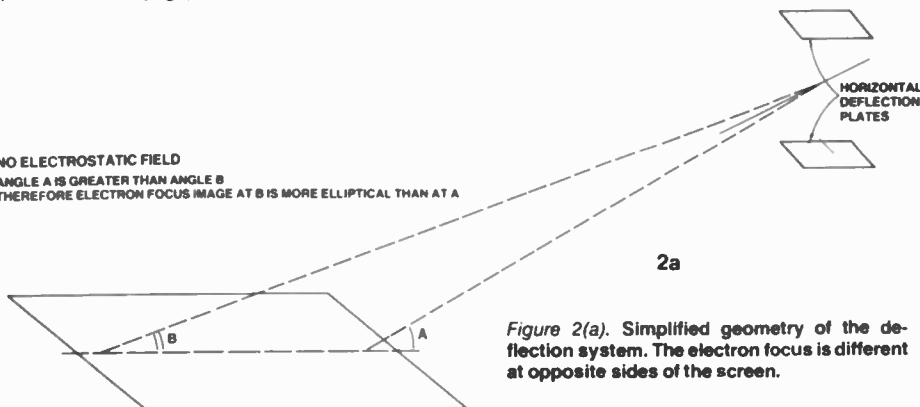


Figure 1. General construction (simplified) of the Sinclair miniature flat screen picture tube (see also picture over the page).

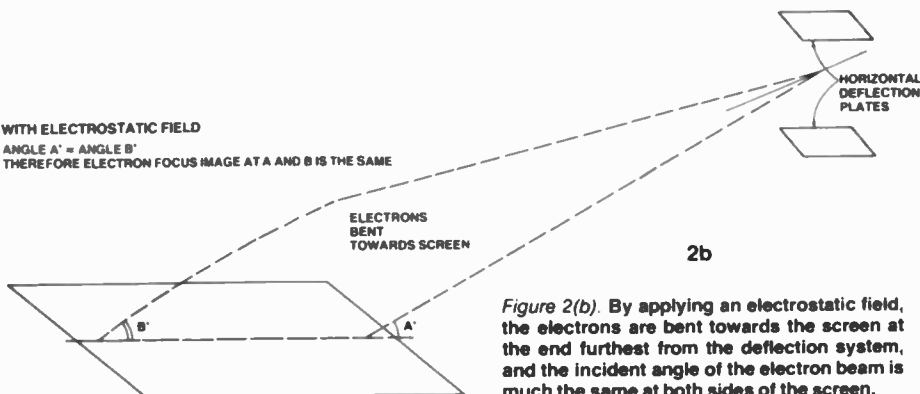
NO ELECTROSTATIC FIELD
ANGLE A IS GREATER THAN ANGLE B
THEREFORE ELECTRON FOCUS IMAGE AT B IS MORE ELLIPTICAL THAN AT A



2a

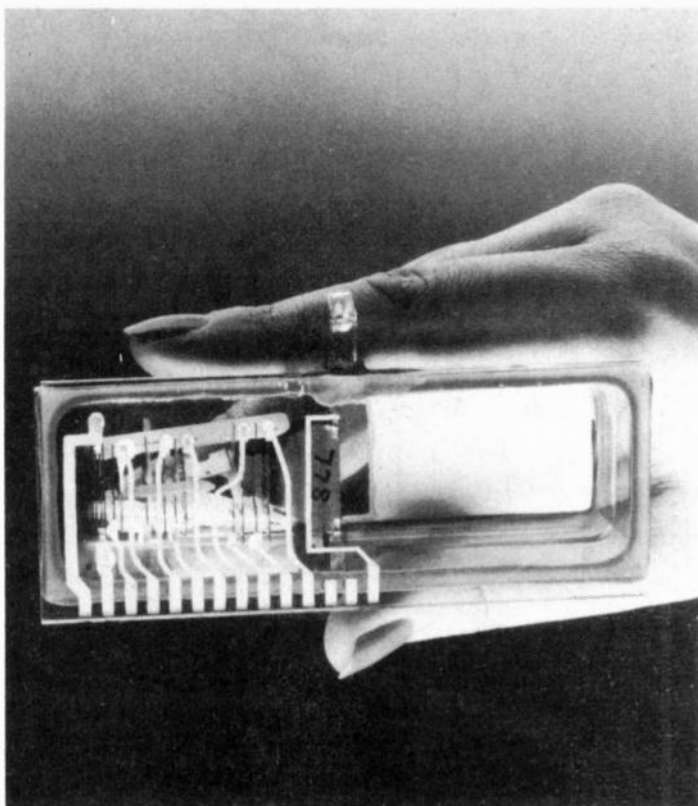
Figure 2(a). Simplified geometry of the deflection system. The electron focus is different at opposite sides of the screen.

WITH ELECTROSTATIC FIELD
ANGLE A' = ANGLE B'
THEREFORE ELECTRON FOCUS IMAGE AT A AND B IS THE SAME



2b

Figure 2(b). By applying an electrostatic field, the electrons are bent towards the screen at the end furthest from the deflection system, and the incident angle of the electron beam is much the same at both sides of the screen.



The flat CRT — a triumph of British ingenuity. They are now being mass-produced at the Timex factory, at Dundee, ready for assembly into complete units later this year.

Achieving an undistorted image is difficult because the distance from the collimator to the screen is comparable to the screen dimensions. Without correction the shape of the scan would be as shown in Figure 3a. A combination of optical and electronic methods is used to rectify this shape as much as possible.

The verticle deflection angle of the beam is reduced to make the resulting image more nearly rectangular and the vertical dimension is then magnified optically by the Fresnel lens in front of the screen. The horizontal dimension is unchanged.

A modulation voltage is applied to the vertical deflection plates during each frame to change the image as shown in Figure 3b. Image MNOP changes to M' N' O' P', which is more nearly rectangular and distortions are therefore reduced to a minimum.

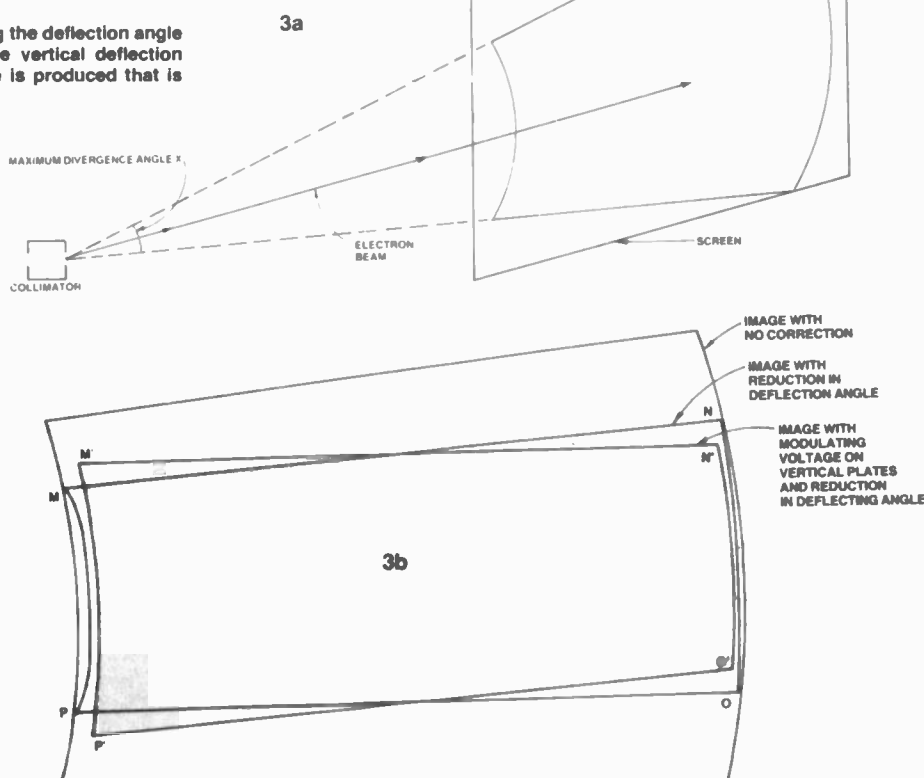
Sinclair point out that the construction of the CRT lends itself to mass production technology in that, for example, connections to the electron gun and deflection assembly are screen-printed on the inside of the faceplate and the assembly is attached in a single operation.

The feature that makes the CRT ideal for projection TV is that the image is viewed from the side of the phosphor that the electrons strike. This results in a much brighter image in comparison to the conventional CRT where the image is observed through the phosphor layer. It can be seen that a heatsink placed directly on the backing plate of the screen allows the phosphor to be driven much harder by the electron beam without thermal damage.

In the future the miniature CRT could well be used in pocket oscilloscopes and other test equipment once the techniques of obtaining perfectly distortion-free images are mastered.

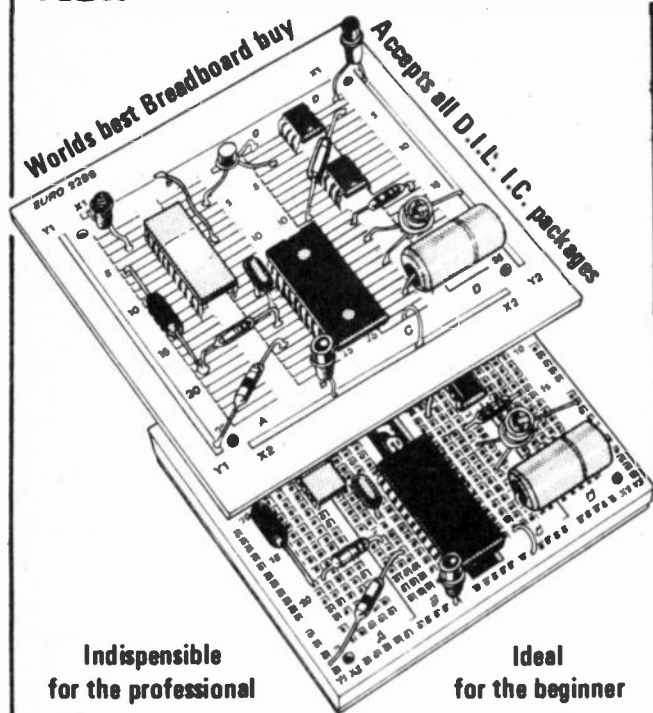
Figure 3(a). If no image correction system were applied the normally rectangular image would be distorted as shown on the top diagram, the side nearest the vertical deflection being shorter than that furthest from the vertical deflection.

Figure 3(b). By both reducing the deflection angle and suitably modulating the vertical deflection voltage waveform an image is produced that is more nearly rectangular.



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HE 6/3
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FEEDBACK

THEY KEEP USING THIS WORD feedback, don't they? The amplifier you've just built sounds a bit loud and fuzzy and you're told it needs feedback. Another one just howls all the time, and you're told it's caused by feedback. OK, then, let's unwrap the mystery.

First of all, sort out what we mean by an amplifier. Whatever its made from, you can put a signal into it and you get a signal at the output which is a good copy of the input signal's shape but of much greater amplitude. When the input signal is a sine wave, its voltage amplitude (peak-to-peak) is the voltage difference between the opposite peaks. For example, a signal with its positive peak at 2 V and its negative peak at -2 V is a signal of 4 V peak-to-peak amplitude. It's this that an amplifier amplifies; a few types (called current amplifiers) are intended to amplify not the voltage but the current amplitude. The point is, though, that the amplifier doesn't miraculously cause amplitude to become greater; it actually creates a new waveform whose amplitude is greater than the signal input, and which is controlled by the signal input, so that it ought to be a good copy. If it isn't, we say that the output signal is distorted.

Now the signal at the output of an amplifier can be connected to other circuits and, if we're reasonably careful about it, these connections won't make much difference to the amplitude of the signal. The care we need to take is not to connect the signal onto a circuit with resistance much lower than that of the output of the amplifier. An amplifier that is designed to feed a loudspeaker can, for example, happily feed its signal into the low resistance of a loudspeaker but voltage amplifiers, which are *not* intended to feed loudspeakers, can't cope with low resistances. If we stick to fairly high resistance circuits, though, we can make connections to the output of a voltage amplifier without reducing the signal.

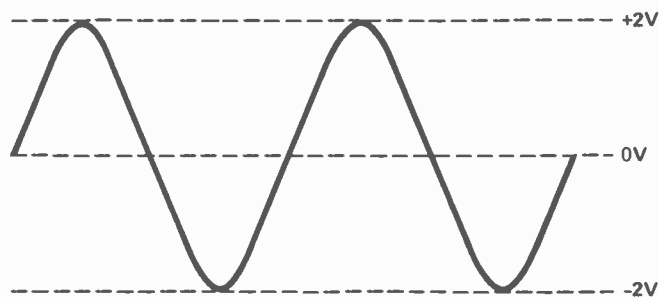


Figure 1. Voltage amplitude. This wave has a voltage amplitude of 4 V peak-to-peak.

Feedback Loops

Now this is where feedback comes in. Feedback is a connection made through a resistor, or through a set of resistors and capacitors called a network, which connects the signal at the output of an amplifier back to the input of the amplifier. This connection is called the feedback loop and, when a feedback loop is connected, the behaviour of the amplifier is considerably changed. The reason is that the amplifier is no longer making a copy just of the input signal, but of a mixture of signals — the input signal and the feedback signal. What happens now depends on how the mix is arranged.

One way of arranging it is to have the feedback signal in phase with the output. 'In phase' means that the signals are exactly alike (except for amplitude) with the peaks happening at exactly the same time. When the mixing of signals is done this way, the

feedback is said to be positive — the signal coming back through the feedback network or resistor looks just like the input signal and when we mix this with the genuine input signal the two add together to make a higher amplitude input for the amplifier. This in turn produces a greater amplitude of output which will result in more feedback signal and so on.

If we use an attenuating network in the feedback loop (remembering that an attenuator network reduces the amplitude of a signal) and we make sure that the attenuation of the feedback loop is more than the gain of the amplifier, the whole thing comes to balance; the amplifier behaves as if it had much more gain because the feedback is providing some of the input signal. At the same time, any distortion that the amplifier produces is greatly increased because the distorted signal is being fed back to be amplified again.

Earthy Problems

If, however, the gain of the amplifier portion is greater than the attenuation of the feedback network, then the output signal will provide enough feedback to the input to produce the output signal all by itself, with no other input needed. This arrangement makes an oscillator — it continually generates an output signal with no input. If an amplifier oscillates, it's because of positive feedback somewhere, perhaps from signals passed along the power supply line if the oscillation is at a low frequency. Even a careless arrangement of earth connections can cause oscillations, if the amplifier has a large amount of gain.

Positive feedback is used, therefore, to make oscillator circuits and to boost amplifier gain but, because it's difficult to control, high quality audio amplifiers avoid using positive feedback. Oscillator circuits control the positive feedback carefully so that it operates only at one frequency, the frequency of oscillation.

Negative Feedback

Negative feedback is the other option. Negative feedback is what we get if the feedback network is connected to an amplifier whose output signal is in antiphase with the input signal. An-

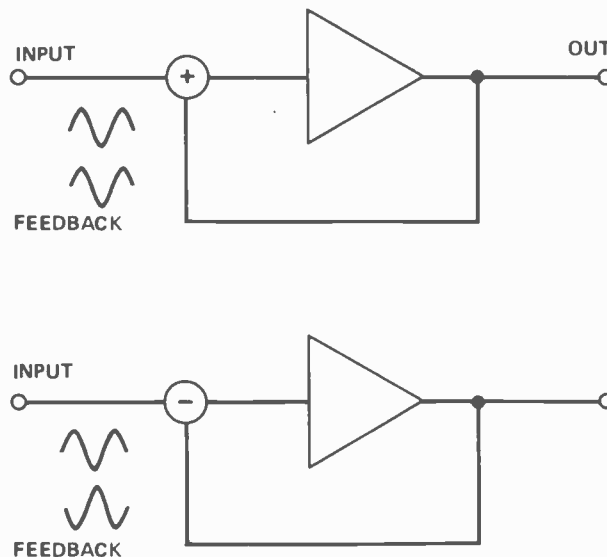


Figure 2. Feedback; (a) in phase, adding to the signal at the input (positive feedback); (b) in antiphase, subtracting from the signal at the input (negative feedback).

tipphase means that the signals (apart from the differences in amplitude) look like mirror images of each other. When we add signals in antiphase, the effect is of subtracting one signal voltage from the other. The result of negative feedback, then, is to make the signal into the amplifier less than the genuine input signal. The amplifier is still doing its stuff, but there is less signal for it to work on so that it looks as if the gain of the whole arrangement is less than it was before the feedback was connected.

At first sight this doesn't look like a very good bargain. Gain, after all, is what we want from an amplifier and it doesn't seem to make sense to do anything that reduces gain. The advantages of negative feedback, however, greatly outweigh the small disadvantage of a loss of gain. Gain, after all, is easily obtained; if you want more gain you can use more transistors. What negative feedback does is to stabilise gain — a much more valuable feature. Think of it this way. Suppose you built twenty samples of two stage voltage amplifiers. There's precious little chance that all of them would have the same gain figure; because of the differences between transistors, we might find gain figures ranging from 500 to 8,000. Now if these were all negative feedback amplifiers, we could design for a gain of 250 — and find values ranging from 230 to 260.

This is a much smaller spread of gain values and illustrates the value of negative feedback for the designer. It's possible, using negative feedback, to design an amplifier whose gain can be exactly calculated, whatever the tolerances of the transistors. The use of integrated circuit amplifiers makes negative feedback even more important because the gain of an IC amplifier simply cannot be closely controlled when the IC is manufactured.

How much gain can we expect from an amplifier fitted with negative feedback? If the amplifier has a large amount of gain before the feedback is added, the answer is fairly simple. Find the attenuation of the feedback network — this amount is then equal to the gain of the complete amplifier when feedback is added. For example, if the feedback network causes the output signal amplitude to be divided by 50 then the gain of the complete amplifier will be 50 times, provided that the original gain of the

amplifier, before the feedback was added, was much more than 50 (perhaps 500 or more). This figure should remain fixed throughout the life of the amplifier, even if transistors are replaced.

Noise and Distortion

Being able to design for a definite gain figure, then, is one good reason for using negative feedback but it's certainly not the only one. Another compelling reason is the reduction of some types of distortion. Remember that what an amplifier does is to create a larger-scale copy of an input signal. Any difference, apart from the difference of amplitude, between output and input is distortion. One kind of distortion in this sense is noise — unwanted signals which are generated inside resistors, transistors and all other conductors by the movement of electrons. Because the noise generated inside an amplifier is not present as a signal at the input of the amplifier, the use of negative feedback reduces the noise by cancelling it with an antiphase signal at the input. Hum signals picked up from a poorly-smoothed supply line can be reduced in the same way.

Another type of distortion is frequency distortion. An amplifier may not treat signals of different frequencies in the same way; very often, the gain of the amplifier for signals of low frequencies (below 50 Hz) or high frequencies (above 10 kHz) is less than for 'mid-band' frequencies in the range 400 Hz — 1 kHz. A negative feedback connection will reduce the gain but also make the lower value of gain one which holds true for a much greater range of frequencies. The effect is shown on the graph of Figure 3; the amplifier can cope with low and high frequencies at low values of gain and applying negative feedback brings the gain of the amplifier for the middle range of frequencies down to the same value.

Cure All?

Negative feedback is so useful that we fall into the habit of assuming that it can cure all sorts of nasty complaints which amplifiers are prone to. What we have to remember, though, is that negative feedback works according to the book only when

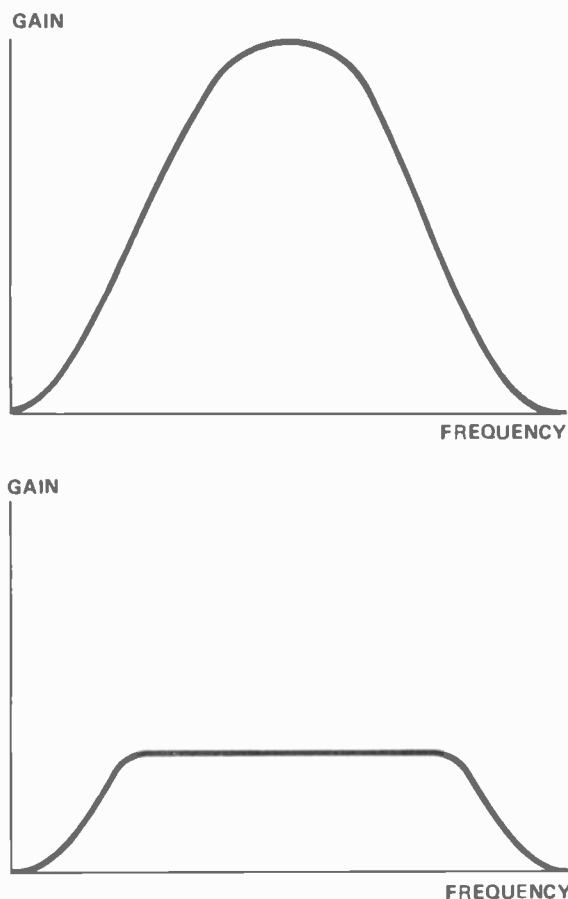


Figure 3. Reducing frequency distortion by negative feedback; (a) Graph of gain plotted against frequency for an amplifier without feedback; (b) the effect of negative feedback is to reduce the gain, creating a flat portion of graph.

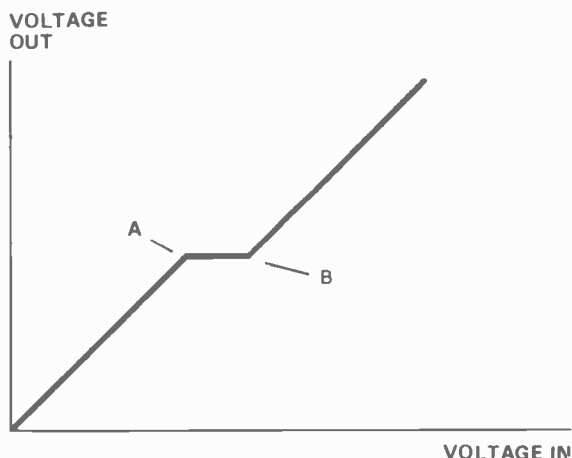


Figure 4. Effect of bias faults. The graphs shows a region A-B in which there is no gain, so that negative feedback cannot operate.

the gain of the amplifier is very high in the first place. If the amplifier gain without feedback is low, then feedback has little or no effect. Would we use negative feedback on such an amplifier? In the normal course of events we wouldn't, but we sometimes forget that an amplifier can have low gain in patches. For example, Figure 4 shows the graph of signal-out plotted against signal-in for an amplifier output stage which is not correctly biased. Most of the graph is fine, showing a healthy gain, but the small section marked AB at the centre is not so good. In this section there is no output for a small range of input, so there is no gain and this means that negative feedback will not correct the distortion which this sort of shape also causes; and yet we often assume that this 'cross-over' distortion, as it's called, is removed by negative feedback. A good general rule is that negative feedback can make a good amplifier a bit better; but it can never make a lousy amplifier into a good one!

HE

**Ready made
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For Readers!!**

Apart from the PCBs for this month's projects, we are making available some of the popular designs from earlier issues. See below for details. *Please note that only boards for projects listed below are available*; if it isn't listed we can't supply it.

March 82
Digital Dice £1.46

THE OSCILLOSCOPE REVISITED

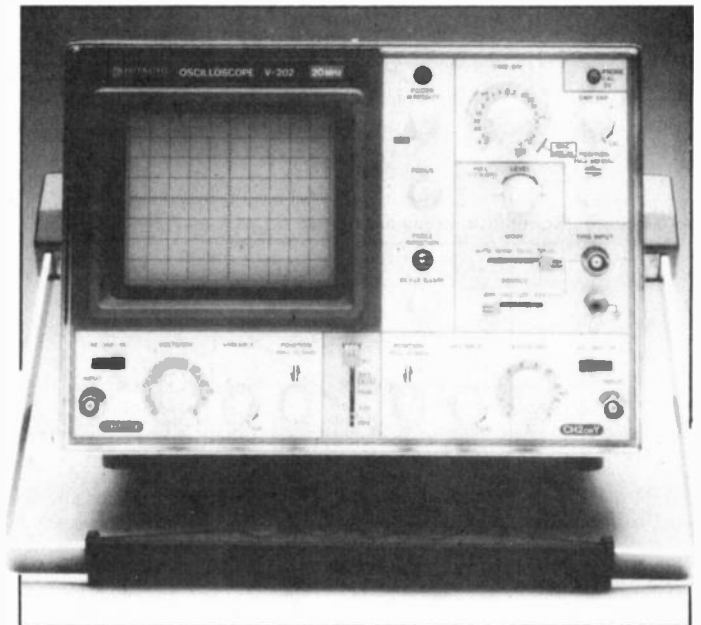
Since our articles on the subject in February and June last year — and the Special Offer which many readers found too good to refuse — we've had many requests for a follow-up describing, in greater detail, how to use this most useful tool of the electronics trade. Ready then? Here we go.

THE OSCILLOSCOPE is one of the most versatile and useful electronic test instruments ever invented (Allen B. Du Mont — the 'inventor' of the oscilloscope — is the subject of this month's Famous Names). It's true that they are not cheap (though second-hand bargains are available) and that you can do a lot of trouble-shooting without one, but it's equally true that some faults are virtually impossible to pinpoint without using a 'scope and that any sort of circuit design or modification work is just not on. Pulse circuits, in particular, are extremely difficult to trouble-shoot without a 'scope because steady voltage readings are meaningless in pulse circuits — all you can check is whether an IC has a voltage supply or not. Let's take another look, then, at this remarkable instrument and how it's used.

The heart of a 'scope is, of course, a cathode-ray tube (CRT). The CRT has already been described in detail (HE, February 1981), but to refresh memories, the principle of the CRT (whether it's in oscilloscope or in a TV receiver) is that a beam of electrons can be generated by a heated cathode, focused in to a thin beam and made to travel towards a positively charged anode — the cathode and focusing mechanism together make up an 'electron gun'. The anode is a glass screen, coated with a material (phosphor) which gives off light when struck by the beam, making a spot of light on the screen. The brightness of the spot can be controlled but, more importantly, so can its position. The spot can be guided (deflected) to any part of the screen, or even pushed right off the edge, by applying a varying electric or magnetic field; oscilloscope tubes invariably use electrostatic deflection, while TV tubes use the magnetic method because it allows greater deflection to be obtained from a reasonably short tube. In a 'scope tube, guidance is achieved by the deflection plates — four of them altogether arranged in pairs called the X plates and the Y plates. As you look at the screen the Y plates deflect the spot vertically, up or down, while the X plates move it from side to side. The beam swings over towards the more positive deflection plate so that, by changing the voltages on the four plates, the beam can be positioned anywhere you like on the face of the screen. Unlike the needle of a meter, though, a beam of electrons has no mass to speak of, so it can be pushed around with incredible acceleration and made to trace out complicated patterns at very high speeds; that's the key to the oscilloscope.

Sweeping Up

Every oscilloscope contains a built-in oscillator, the timebase or horizontal sweep circuit. This circuitry generates a voltage waveform with a sawtooth shape and this is amplified and fed to the X plates. The result is that the spot on the tube face moves at a steady speed, from left to right as we look at the screen. The speed can be controlled and, even more important, measured; its value, in time per centimetre of movement across the tube face, can be read off the TIME/CM (sometimes labelled TIME/DIV) control on the front panel. During the time the spot is moving across the screen, a voltage fed to the Y plates will cause the spot to move vertically. If this voltage is a sinewave then the vertical movement of the spot, combined with its steady horizontal speed, will trace out the shape of the wave, in light, on the screen



the instrument and how to use it

(Figure 2). Adjusting the controls labelled SYNC or TRIG will produce a steady pattern on the screen, showing the waveshape of the voltage which is being fed to the Y-plates. An amplifier (the Y amplifier) is provided and its gain control is calibrated in volts per centimetre of (vertical) movement so that the peak-to-peak voltage of the waveform can be calculated easily. From such a display, then, you can see the waveshape, measure its frequency and also its peak-to-peak amplitude in volts, so that every measurement that can be carried out on a waveform is possible. Very useful — but how do we go about it?

Screen Test

Suppose you're sitting there in front of an oscilloscope, ready to switch on for the first time. Be patient; keep that main-switch finger away for the moment. Start with nothing — not even the mains plug — connected and take a look at the controls on the front panel. They might not look exactly like the examples we've shown here but the same controls have to be there somewhere. There has to be a BRILLIANCE (or INTENSITY) control and a FOCUS control, and there must also be X and Y POSITION (or DEFLECTION) controls. Find these and you're well on the way to knowing your way about — but there's one more. It may be labelled TRIG, SYNC or LEVEL. Whatever it's called, turn it fully clockwise (that's full on); if there is a STABILITY control with an AUTO position, set it to auto. Now make sure that the brilliance/intensity control is turned fully off (anticlockwise). Next step is to plug in and switch on. There may be a separate toggle switch for on/off or the mains switch may be combined with the brilliance/intensity control; if this control has to be turned (clockwise) to switch on, turn it only as far as is needed to click the switch — then leave the 'scope, for a minute so that the CRT heaters can warm up. Older oscilloscopes (which use valves) will also need this minute for the valve heaters to warm.

While the 'scope is warming up, set the volts/cm to the highest value of the range and the time/cm to 1 ms/cm, or the nearest value to this. Adjust the vertical and horizontal position (deflection) controls to midway round their travel and, when warming-up is complete, gradually advance (clockwise) the setting of the brilliance/intensity control. If all is well, you should eventually see the horizontal line of the trace on the screen.

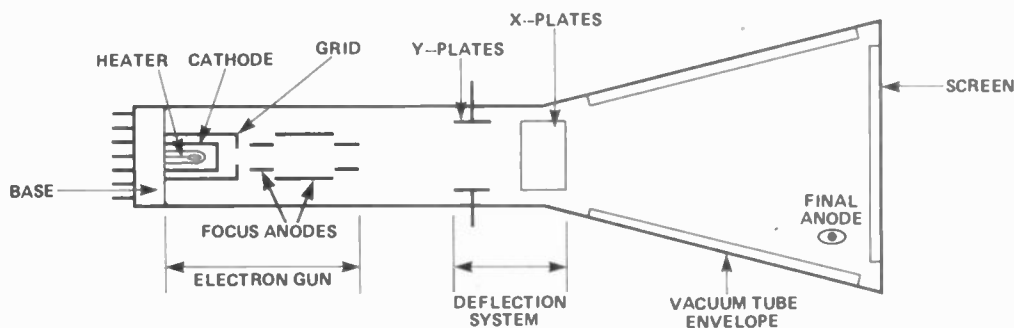


Figure 1. Schematic cross-section of a Cathode-Ray Tube (CRT).

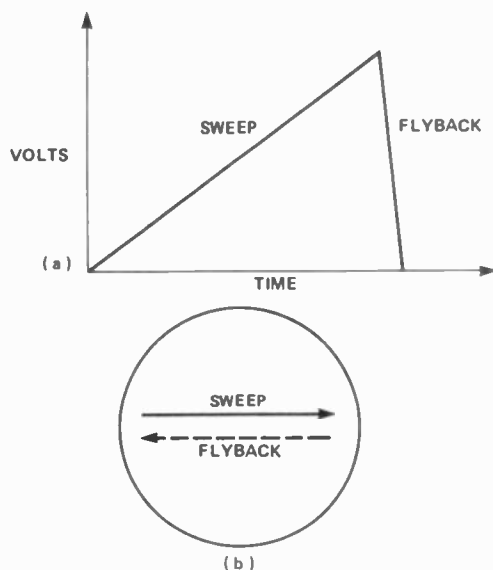


Figure 2. (a) The timebase (sweep) waveform is a sawtooth wave. The voltage rises at a steady rate, then returns rapidly to its starting value: (b) The spot moves steadily from left to right, then rapidly returns with the 'flyback'.

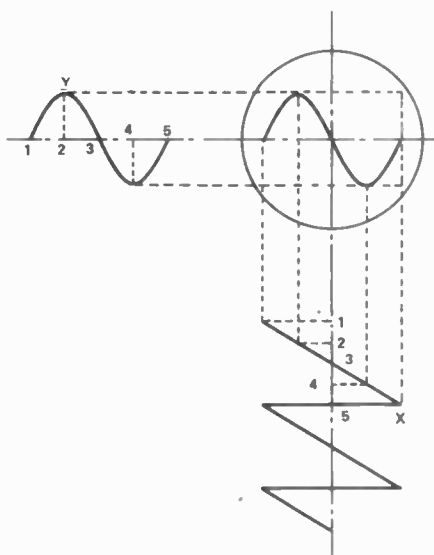


Figure 3. The deflection waveforms, applied to the X and Y plates, cause the electron beam to sweep out a faithful replica of the Y-input waveform.

No trace of the trace? Don't panic just yet — it's surprising how difficult it can be to find the trace, even for an experienced operator! Modern oscilloscopes have a TRACE LOCATE push-button; pressing this useful 'twit-switch' produces a spot at the centre of the screen and, as the switch is released, the spot slowly moves off to wherever it was before. This way, you can recover a trace which was lost because the position/deflection

controls were badly set. If your oscilloscope doesn't have this humanitarian device, sort it out as follows:

1. Turn the brilliance/intensity right up and the timebase (time/cm) control to its slowest speed (but not off). You should now see some light appearing on the screen, moving slowly.
2. If there is still nothing to be seen, advance (clockwise) the trig/level control; a low setting can prevent the timebase from starting.
3. With something happening inside, twiddle the vertical position control until the trace appears; some adjustment of the horizontal position control may be needed as well.

If that lot doesn't produce some sort of trace then you have every right to start wondering if the thing is working — but unplug the mains and check the fuses before you do anything drastic!

Assuming that these actions have produced some sort of trace on the screen, we can start to lick it into shape for useful measurements. The first step is to centre the trace — with the time/cm control reset to 1ms/cm — using the vertical and horizontal position controls, so that the horizontal line starts just at the left-hand side of the screen and is along the centre-line. If there is a control marked TRACE EXPANSION or X-GAIN, it should be set so that the width of the trace is just enough to stretch across the screen, but no more.

Now reduce the brilliance/intensity setting to a comfortable level and adjust the focus control (sometimes labelled spot size) so that the line is as thin as possible. It's usually impossible to obtain a fine, focussed line if the brilliance/intensity control is set too high. If necessary, use the oscilloscope in a corner where there are no lights shining directly on the screen.

Now, sitting there with a working oscilloscope in front of you, how about looking at a waveform? You don't need a signal generator just yet because there's a waveform available literally at your fingertips — it's the mains waveform which your body picks up from the wiring all around you. Set the time/cm control to 20 ms/cm and the volts/cm to 1 V/cm, or to a lower value if this is available. Now connect a probe or a lead to the Y input and hold the other end; you should see a 50 Hz mains waveform, a sine wave, probably with some distortion, on the screen. If the whole wave is moving, adjust the control labelled SYNC (on older 'scopes) or TRIG LEVEL (on more up-to-date models); this control is used to start the timebase at the same part of the waveform on each sweep, so that the trace appears stationary. If you simply can't get the trace to stay still ('locked'), check if there is a switch labelled TRIG INT-EXT (or SYNC INT-EXT). If there is, make sure that it is on the INT (for internal) setting. In this position the timebase is locked to the signal into the Y-input (TRIG, EXT or, on older models, the X-input). On a few oscilloscopes, a FINE TIME/CM control may have to be adjusted, to obtain perfect lock.

With the waveform locked on the screen, its vertical size can be changed by altering the volts/cm switch. Changing this to a more sensitive setting, such as 0.2 V/cm will make the display look larger while changing to a less sensitive setting, such as 5 V/cm, will make the display look smaller. If the sensitivity is reduced too much, so that the vertical size of the pattern is less than 1 cm overall, the timebase lock will be affected and the pattern will start to shift horizontally. The best setting for the volts/cm switch depends to some extent on the size of the screen, but 4-5 cm overall is usually convenient.

All oscilloscopes worthy of the name allow measurements to be made on the displayed waveform. The usual method is to have an engraved plastic sheet, called the graticule, which fits snugly over the screen. The graticule is engraved with parallel lines, 1 cm

apart, with small divisions on the centre lines to indicate 0.2 cm; both horizontal and vertical lines are engraved, so that both time and voltage measurements are possible. On modern 'scopes, the graticule may be generated as a display.

For voltage measurements the method is to count the number of centimetres on the vertical scale from the negative peak to the positive peak, then to multiply this number by the setting of the volts/cm switch. For example, if the volts/cm switch is set to 5 V/cm and the waveform measures 3.2 cm from peak-to-peak, the waveform voltage is $3.2 \times 5 = 16$ V peak-to-peak. The time measurement we most often have to make is that of the time (period) of one complete cycle, so that we have to measure the horizontal distance between two identical points on neighbouring waves. This distance is then multiplied by the setting of the time/cm switch to calculate the period of one cycle. The inverse of this time (that is $1/\text{time}$) is the frequency of the wave. For example, if the peaks of the waveform are 2.5 cm apart and the time/cm switch is set to 100 $\mu\text{s}/\text{cm}$, the time of one wave is $2.5 \times 100 = 250 \mu\text{s}$ and the frequency is $1/250 \mu\text{s} = 4 \text{ kHz}$.

It's usual, on modern 'scopes, to find a choice of AC or DC coupling, by means of an AC/DC switch at the Y-input. In the AC position, the signal on the Y-input is passed via a coupling capacitor and, therefore, any DC voltage also present in the signal is blocked. With the switch in the DC position, however, the Y amplifier is completely DC coupled from the input all the way to the plates; this is very useful. Connecting a 1V5 dry cell to the input will, for example, cause the whole trace to shift vertically. If the volts/cm switch is set to 1 V/cm then the trace will shift by 1.5 cm for 1V5. If the negative terminal of the cell is connected to the oscilloscope's earth and the positive terminal of the cell to the Y-input, the trace will shift upwards. If the connections are reversed, the trace will shift downwards; that is, positive voltages are represented by upward movements and negative voltages by downward movements. Now if you disconnect all signals from the front panel of the 'scope and short the Y-input to earth, the Y position/deflection control can be set so that the trace lies along one of the horizontal graticule lines — and this line will now represent earth voltage. Attach a signal now and you can measure the DC level of the signal relative to earth — a measurement you can't possibly make with a multimeter. With the input switched to AC, set some convenient part of the trace, such as a peak, to lie on one of the horizontal lines. Now switch to DC, and see how far up or down the peak shifts; the amount shifted represents the average DC level of the wave. The shift, in centimetres, is multiplied by the setting of the volts/cm switch as

usual.

For comparing waveforms, a double beam 'scope is essential. In a double beam 'scope two traces appear on the tube face, each using the same time-base and X deflection, but with separate Y-input controls. The two traces are separate and different waveforms can be displayed, but with the same timebase setting so that time/frequency differences between them can be measured.

Several different methods are used to obtain double beam displays and these include:

- (a) beam splitting, in which the beam from an electron gun is split in two after it has passed the X plates but before reaching the Y plates.
- (b) separate guns, in which two separate electron guns, mounted vertically one above the other are used, with the X-plates connected together but with separate Y plates.
- (c) by beam-switching, using a single gun CRT.

The beam-splitting method was used in old double beam 'scopes and served well, providing you remembered that upwards meant positive on one beam and, negative on the other. Double guns made it easier to relate the waves to each other, but it was difficult to ensure that both beams were perfectly focused and equally deflected by the timebase. Most modern double-beam scopes use beam switching and, since it's purely a circuit technique, a double-beam switch can be added to any normal single-beam tube.

Beam-switching makes use of DC coupling into the 'scopes Y-amplifier. At the start of a timebase sweep, one of the two input signals is applied to the Y-input of the amplifier, with some DC level decided by a Y-shift control. On the next sweep, the other signal is applied to the Y-input but at a different DC level, so that the traces are at a different vertical positions.

When this is done rapidly enough, it looks as if two traces are there simultaneously. The method doesn't work at low timebase speeds (a slow sweep speed means you see first one trace, then the other — but never both at once!), so a 'chopping' method of switching is used instead. In this switching system, input A is displayed for a short time, then the trace is shifted up (or down) so that input B can be displayed. If the beam and the inputs are switched at a frequency many times that of the timebase sweep, each trace appears continuous. At high sweep speeds (approaching the 'chopping' frequency), however, the traces will appear as dashed lines!

Double beam arrangements are very useful when looking at circuits which make use of pulse triggering, synchronisation,

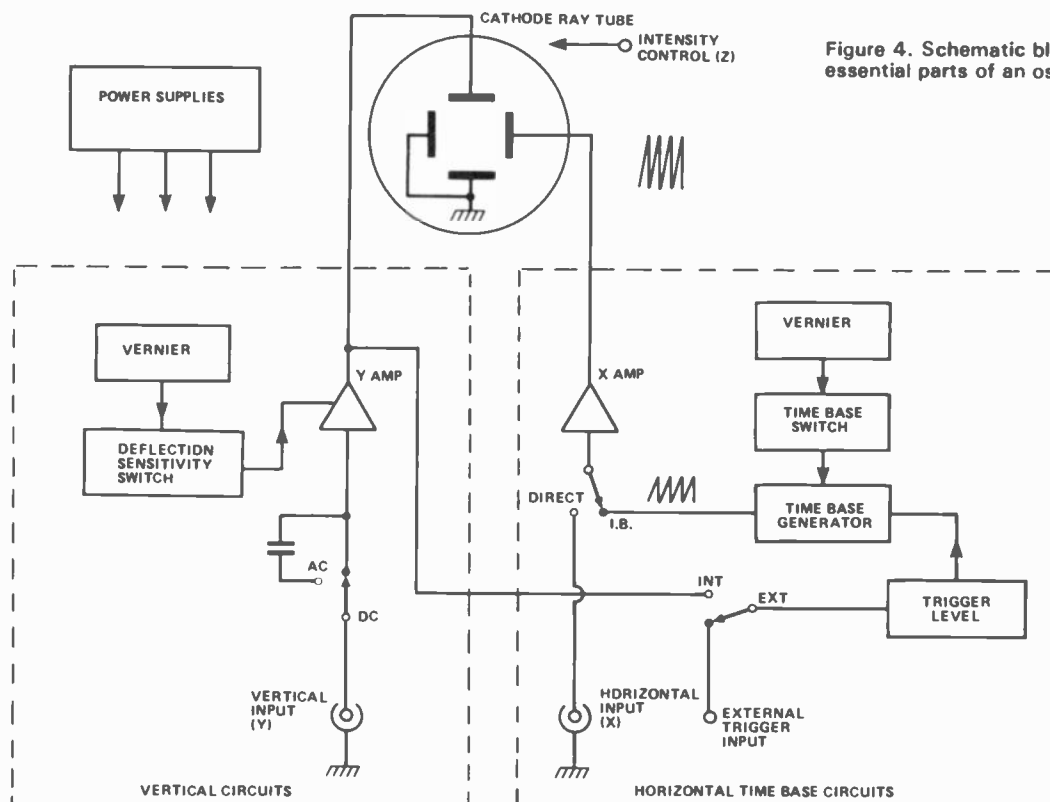


Figure 4. Schematic block diagram of the essential parts of an oscilloscope.

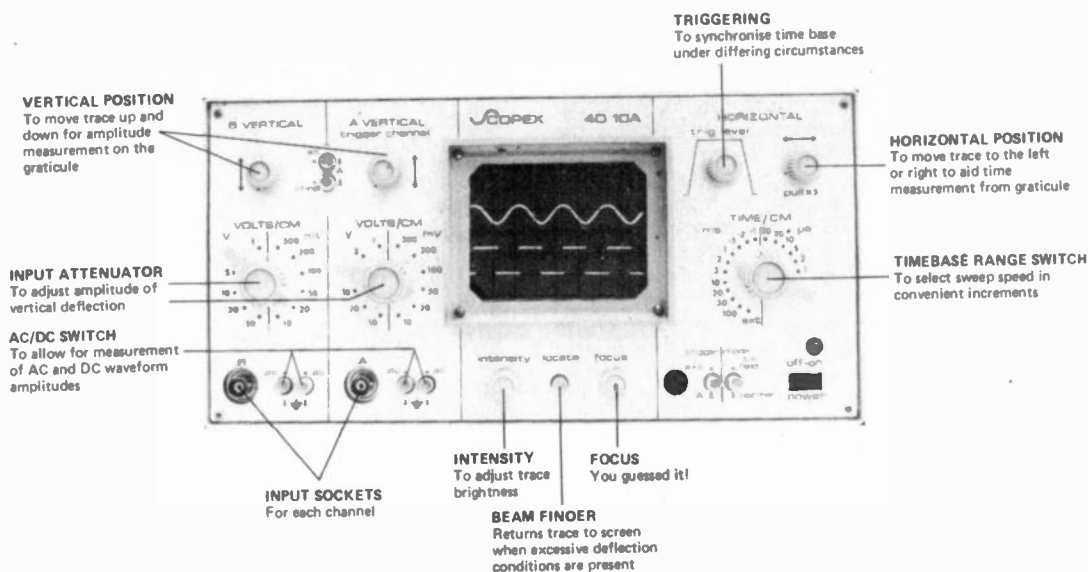


Figure 5. Front panel layout of a SCOPEX 4D 10A, a modern double-beam 'scope.

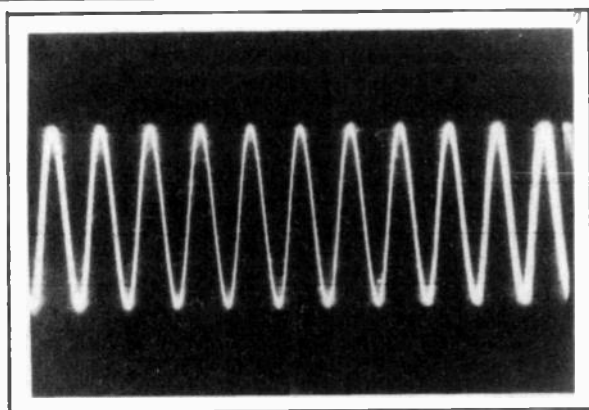


Figure 6. A 50 Hz waveform produced by touching the input of a 'scope.

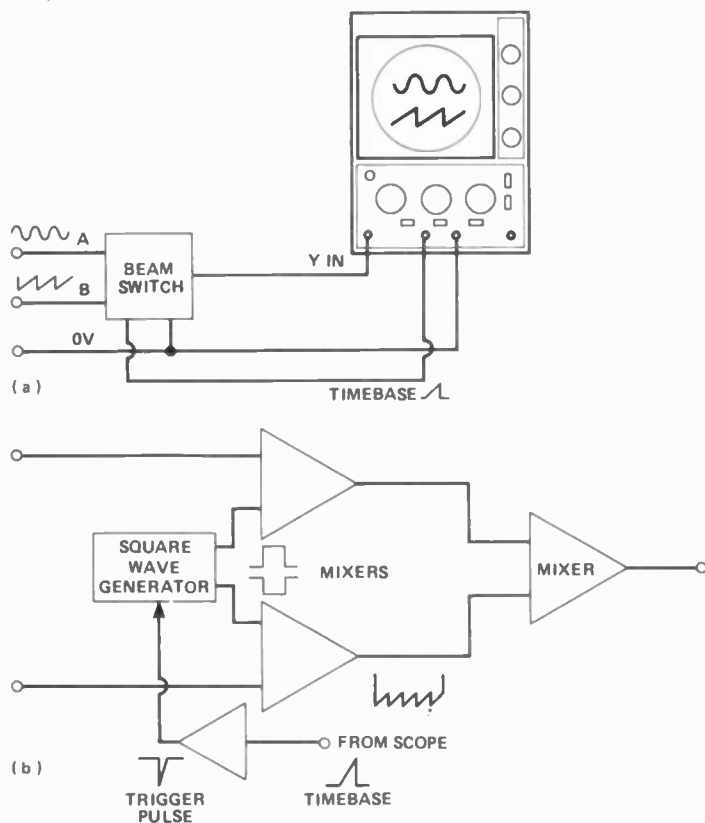


Figure 7. Beam switching techniques produce a dual-beam oscilloscope: (a) Connecting the beam-switch to a 'scope: (b) The waveforms are added to the level parts of a squarewave and the DC voltage difference between the positive and negative levels produces the separation of the traces. The squarewave generator is triggered by the flyback of the timebase: (c) At high sweep speeds, the beam is switched on alternate traces: (d) At low sweep speeds, the beam is 'chopped' at a high frequency so that each waveform is traced out, alternately, in sections.

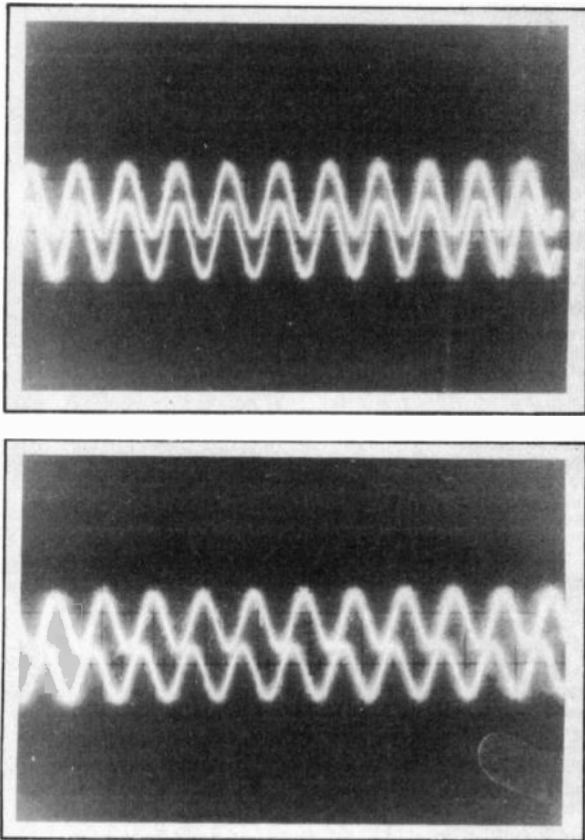


Figure 8. Comparing waveforms on a double-beam 'scope: (a) Sinewaves in phase: (b) Sinewaves out of phase.

phase sensitive detection or similar techniques. Remember, however, that unless the two sets of waveforms have the same frequency or are at related frequencies, it will be difficult (if not impossible) to get both traces 'locked' on screen. This is usually not a problem with pulse circuits or when phase-locked loops are used to synchronise sinewaves.

Another use for the oscilloscope is to compare frequencies and the method is particularly useful for comparing frequencies which are to be adjusted so as to be equal or in some simple relation. The method is an old one called 'Lissajou Figures'; the connections needed are shown in Figure 9. The method depends on being able to switch off the timebase and make a direct connec-

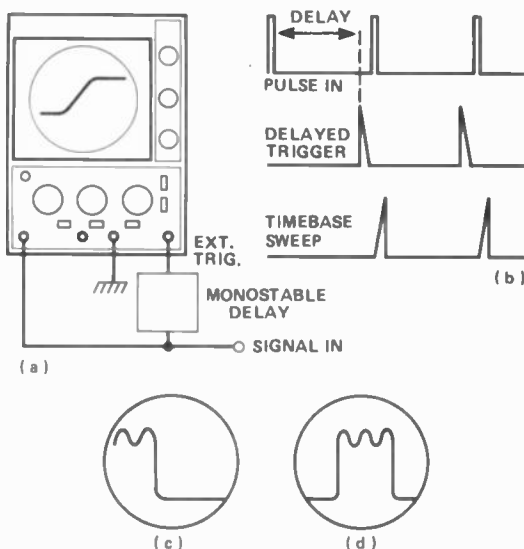


Figure 9. Lissajou figures: (a) Arrangement required for comparing frequencies: (b) Trace with frequencies equal and in phase (or 180° out of phase): (c) 90° out of phase: (d) Phase shift between 0° and 90° . If the pattern moves then the frequencies are not exactly equal.

tion to the X-amplifier.

If the two signals are sinewaves and are synchronised, the pattern produced by this arrangement will be stationary. For equal frequency sinewaves, the pattern can vary from a diagonal line to a circle. Why the difference? The reason is the *phase* difference between the waves — a difference of 90° produces the circle whereas 0° (or 180°) produces a straight line. If the frequencies are not quite identical, then the pattern will change and the number of complete cycles of change per second is equal to the difference in frequency of the two signals. Suppose for example, that two signals are supposed to be equal at 1.075 MHz but the pattern 'rolls' at a rate of one complete changeover per second. This makes the frequency difference 1 Hz! Using this method, we can detect frequency differences of less than one cycle per minute, so that an accuracy of 0.01 Hz is easily attainable. It is, for example, an excellent way of testing the frequency stability of one crystal, in an oscillator, as compared to another and it is also an excellent method of testing how well a phase-locked loop does its stuff. Another trick is to compare signal generator outputs with 50 Hz mains, or with the crystal-controlled frequency picked up (by a search coil) from a digital watch.

For anyone working with fast repetitive pulses (TTL or CMOS) a very useful addition to a simple 'scope (often built-in to more expensive models) is a pulse delay. This consists of a mono-stable circuit which, when triggered by an input wave, delivers a sharp output pulse a short time later — the time delay can be adjusted, usually, in a range up to several milliseconds. How do we use it? The set-up is shown in Figure 10. The input signal is also used to trigger the delay and the delayed pulse in turn operates the EXT TRIG circuits of the 'scope. The delay and timebase controls are adjusted until the edge of the pulse can be seen, which lets you estimate the rise or fall time. The delay is needed because a triggered timebase cannot be started instantaneously; by the time a normal triggered timebase has started, the pulse you want to see is just about finished so that all you ever see even with a fast timebase is the end of the pulse. The delay prevents the timebase from starting until just before the *next pulse* is due, so that the timebase starts just before the next pulse. Obviously, this scheme cannot work with single pulses, but it is a very satisfactory method of looking at the leading or trailing edge of repetitive pulses, such as clock pulses.

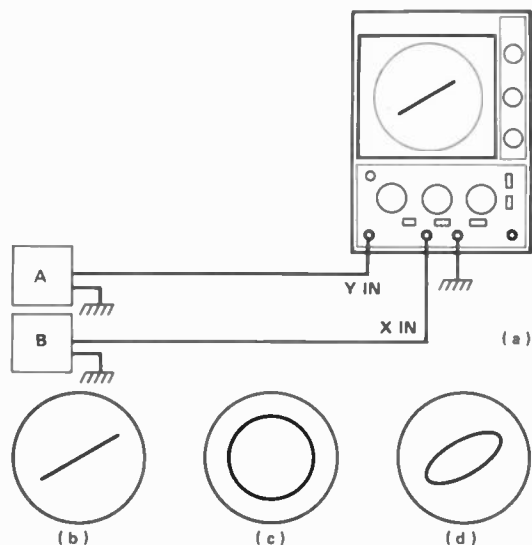


Figure 10. (a) Using a delayed timebase: (b) The monostable is adjusted to produce a trigger pulse (which fires the 'scopes timebase generator) just before the next input pulse: (c) With no trigger delay, the pulse would appear as shown: (d) Adjusting the delay as described enables the leading edge to be seen.

If you want to read more about the 'scope, then the ETI book service can help you, but nothing quite beats the satisfaction of using an oscilloscope for yourself. Once you appreciate what this remarkable instrument can do, you'll never want to return to simple fault-finding routines again and you may very well feel confident enough to tackle design and modification work so have another look at the piggy-bank, and think of the gentle art of oscilloscopy!

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To 'spin' the electronic 'coin' you press a button — when you release the button the 'coin' falls on one 'side' and the initial letter of that side is displayed.

No prizes for design complexity with this circuit. As you'll see in the diagram shown (Figure 1) it's so simple it's almost untrue!

NOR gates IC1a & b are coupled together, along with capacitor C1 and resistor R1, as an astable multivibrator, oscillating at about 700 Hz. The frequency of oscillation of the astable is controlled by the values of components C1 and R1. If either component is increased in value, the frequency of oscillation decreases: if either component value is decreased, the frequency increases. Chosen frequency (ie 700 Hz) is not critical, incidentally, so don't be afraid to insert other values if you don't have the exact values specified.

The squarewave output of the astable is applied, via push-button PB1, to a bistable multivibrator formed by NOR gates IC1c & d. The two bistable outputs are in antiphase ie one is on when the other is off, and they control LED segments c and d of the seven-segment display.

LED segments e, f and g are coupled together, through a 680R resistor to 0V and are permanently on forming the letter 'b'; the seven-segment display will show the letters 't' or 'h' only when the push-button is operated.

Construction is simple. The project is built-up on a 10 strip by 24 hole piece of Veroboard (as shown in Figure 2) and is powered by a PP3-sized 9V battery. It shouldn't take more than a couple of hours to build.

Once you've finished it, all you'll have to do, when faced with a seemingly impossible choice, is to pull it out of your pocket, press and release the push-button — and there's your answer: heads you accept that drink you've been offered; tails you don't refuse it!

Now, if you could only make up your mind whether you should build it or not

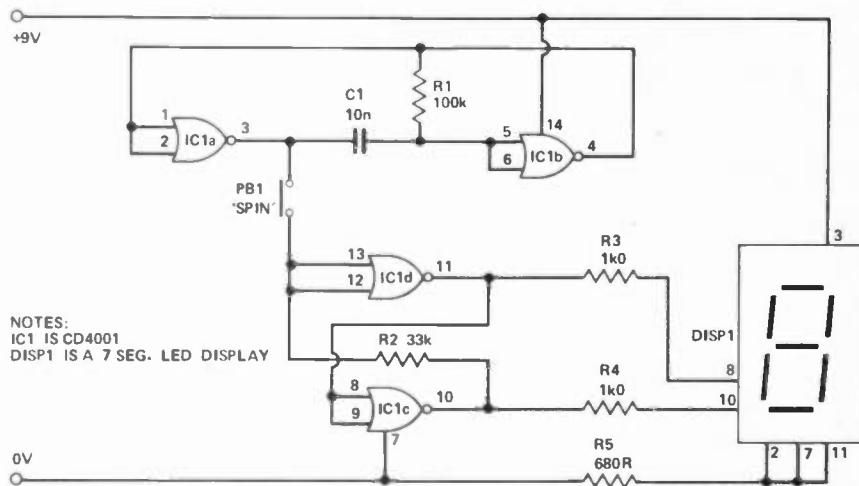


Figure 1. Circuit of the HE Heads and Tails Game

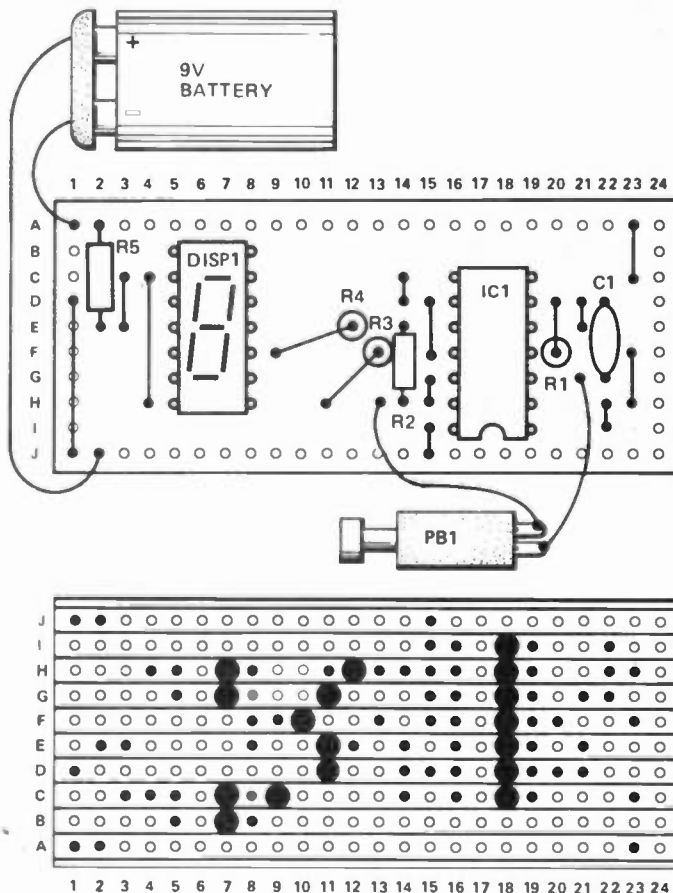


Figure 2. Veroboard layout of the project, showing component locations and track breaks underneath the board

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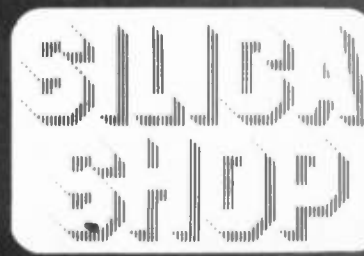
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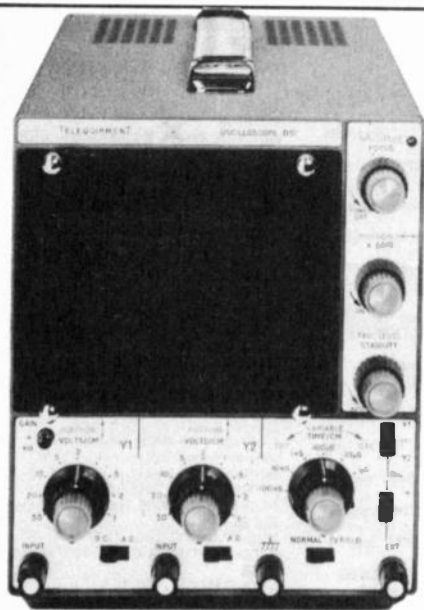
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FAMOUS NAMES

Allen B. Du Mont — an American engineer who developed the first commercially available oscilloscopes.



A modern oscilloscope, such as this Telequipment D51, offers the kind of facilities Allen B. Du Mont must have dreamed of. The operation and use of 'scopes of this type is described in this month's feature article on page 39

Allen Balcon Du Mont was born in 1901, which makes him one of the first of our Famous Names to be wholly a product of the 20th Century. His engineering career started in 1924 when, as a freshly appointed graduate, he joined the Westinghouse Lamp Corporation in Bloomfield, New Jersey, as an engineer in the development laboratory. Since the invention of the triode valve (Audion) by Lee De Forest, many of the large electrical firms who had interests in both communications and in electric light had used their technical knowledge of lamp construction (particularly the use of tungsten filaments sealed into glass) to manufacture valves. The Westinghouse plant was one which had been partly converted to valve manufacture and in 1924, the great radio boom started when RCA pioneered the use of radio as an entertainment medium. Du Mont, like so many engineers in the field at that time, found himself in at the start of something big. He transferred to the radio valve division at Bloomfield and started to apply mass production techniques to valve manufacture. Mass production was only just beginning to make a mark on car production (thanks to the work of Henry Ford) and its use on articles which were thought of as delicate scientific instruments was unheard of. In parallel with this effort, he also started to develop the first large-scale test equipment for radio valves, the forerunners of our modern test rigs.

The results of this truly *engineering*, as distinct from *scientific* effort was felt all over the USA. An engineer, it is sometimes said, is one who can make for a penny what any fool could make for a pound. Du Mont's work raised the production of the Bloomfield works to a staggering 50 thousand valves of all types per day. This remarkable achievement established the young Du Mont as a production engineer of the first calibre and in 1928 he became Chief Engineer of the De Forest Radio Co. in Passmore, NJ, where his task was to modernise the plant and improve its productivity. This was no small job, because the Passmore plant was the 'oldest' radio valve manufacturing plant in the world; having been set up by Lee De Forest to manufacture the first ever triode radio valves — it was full of relatively old equipment.

Du Mont gave the De Forest plant the same thorough attention he had devoted to the Westinghouse factory but then turned his mind back to research, since he was convinced that the key to success in radio was continual research and development. He had been fascinated by the patents of Charles Jenkins, one of the US pioneers of TV in the '20s. Jenkins, like Nipkow in the 1870's and Baird in the '20s, used electro-

mechanical methods (involving rotating mirror drums) which produced very low-definition pictures. Du Mont set up a sound and vision system in 1930 but came to the conclusion that such a system could not possibly provide pictures comparable to film movies. Unlike others at the time, he was convinced that nothing else but comparability with the movies would be good enough for public use and that only a fully-electronic system could provide the quality of picture needed. This remarkably logical conclusion led him to the most important step of his life.

In 1931, on his 30th birthday, Allen Du Mont set up his own business. It's never been difficult to set up business in the USA in boom years, because it tends to be a country more interested in starting things and seeing them through; compare this with our obsession with stopping things — for every Society for starting something, we have a hundred devoted to stopping something! The Allen B. Du Mont Laboratories existed to pursue a new technology — that of the Cathode-ray Tube — as far as was possible.

At the time, the cathode-ray tube was a fragile piece of experimental glassware, a curiosity with few applications. Its design, in fact, had hardly changed since it was invented by Braun at the turn of the century. It would be hard to imagine anyone better suited to convert this primitive piece of glass plumbing into a piece of modern mass-produced scientific equipment and Allen Du Mont flung himself into his self-appointed task with relish. He re-thought the design and construction of the cathode-ray tube with the same energy and thoroughness as he had shown in the Westinghouse plant. He not only improved the primitive design of the tube, he also devised methods of production which were still in use for making experimental storage tubes in 1956. Seeing that no-one else in the States was better equipped to make use of the new tubes, he went on to design his own oscilloscope, and built another production line for that.

The Du Mont oscilloscope was a landmark in the history of electronic instruments. It was the first truly commercially-available oscilloscope and was snapped up by laboratories all over the world. It had a good stable timebase, a Y-amplifier with a previously unheard of bandwidth of nearly 1 MHz and it was rugged and dependable. It was to prove, in fact, to be the most significant product of the Du Mont Laboratories, far outshining anything else, and in World War II the Du Mont oscilloscope was chosen by all three military services.

Meanwhile, however, Du Mont's work on the oscilloscope was financing TV receiver techniques. He was following closely the work of Zworykin at RCA, convinced that this line was going to result in the all-electronic TV system he had dreamed of. Zworykin, in the USA, and Schoenberg's team at EMI in England, both came up with the same answer — identical systems — in 1936 and Du Mont was able to manufacture TV receivers and offer them for sale to the public in 1937.

The glory was short-lived, however, because TV development was frozen by the outbreak of war. The Du Mont laboratories were turned over to the manufacture of radar tubes and other electronic equipment, while the production of oscilloscopes was trebled. The pioneering work on TV receivers was never resumed to any extent, despite Allen Du Mont's presence on the NTSC — the National Television Standards Committee — the body which, in the late '40s, came up with the famous specification for a colour TV system. By the time the Committee saw its recommendations emerging in the shape of the first RCA colour receiver, Du Mont was a sick man. He died in 1956.

Allen Du Mont never attained the fame and glamour of some of our other subjects, but he was one of the engineers whose work laid the foundations for much that we take for granted today. For two generations of enthusiasts in the USA, the Du Mont oscilloscope was one of the attainable dreams, an instrument which made an amateur into a near-professional. For that alone, his name will be remembered.

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NICARD CHARGER Jan 81 £7.87
CHUFFER Jan 81, less case £7.04
MODEL TRAIN CONTROLLER Dec 80 £18.54
BATTERY CHARGE MONITOR Dec 80 £5.40
STEREO POWER METER Dec 80 £20.87
MEMORY BANK — MINI SYNTHESISER Nov 80 Dec 80 £26.81
PARTY GRENADE Nov 81 £8.77
TRANSISTOR TESTER Nov 81 £8.12 inc test leads
DOUBLE DICE Nov 80 £15.18
GUITAR PRE-AMP Nov 80 £5.65 case (diecast) extra £2.95
NOBEL DOORBELL Oct 80 £11.98
INTRUDER ALARM Oct 80 £19.81
FREEZER ALARM Oct 80 with probe £10.36
TUG O'WAR Oct 80 £17.57
KITCHEN TIMER Oct 80 (2% resistors) £7.98
MICROMIX Sept 80 £8.60
AUTO PROBE Sept 80 £3.99 less case
TOUCH SWITCH Sept 80 £2.67 less case & contacts
GUITAR PHASER Sept 80 £15.22
BENCH PSU Sept 80 £31.35
OP AMP CHECKER Aug 80 £4.99
MOVEMENT ALARM Aug 80 £8.24
PASS THE LOOP GAME Aug 80 £15.37
SOUND OPERATED FLASH TRIGGER July 80 no sht £4.88
FOG HORN June 80 £8.21
SPEED CONTROLLER FOR R/C April 80 £16.41 (less case)
DIGITAL FREQUENCY METER April 80 £39.35
ELECTRONIC IGNITION (CD) April 80 £22.95
DIGI-DICE Jan 80 £10.97
BARGRAPH CAR VOLTMETER Dec 79 £7.98 less case
RING MODULATOR Dec 79 £14.24
GUITAR TUNER Nov 79 £11.99
ANALOGUE FREQUENCY METER Oct 79 £16.98
MULTI-OPTION SIREN Oct 79 £17.57
HOME SECURITY UNIT Aug 79 £31.41 less siren
SIREN £5.59 less case
LED TACHOMETER Aug 79 £19.77
INJECTOR TRACER Aug 79 £4.77
LINEAR SCALE OHMMETER July 79 £17.57
GSR MONITOR June 79 £10.59
WHITE NOISE EFFECTS UNIT May 79 £19.51
CAR ALARM Feb 79 £12.07
PUSH-BUTTON DICE Dec 78 £7.67

GUITAR TUNER — SUPERB PROJECT

Featured by us in E.T.I., Jan 82. Highly stable internal reference. Microprocessor generates fundamental frequencies. Special synchronous rectifier circuit compares input frequency from guitar pick up or microphone with internally generated pitch. Beat frequency is displayed on a large moving coil panel meter. Also operates with bass guitar, or acoustic instruments via a high impedance microphone.

Complete kit includes smart case, pcbs, panel meter etc. £28.98. Reprint extra 45p. Available separately 45p + 40p p&p.

TRAIN SET ACCESSORIES MODEL RAILWAY SPEED CONTROLLER

From E.E. Sept. Features fully variable speed control — from zero to full speed. Forward/reverse switch. Auto start and stop for realism. Brake and speed boost. Emergency stop. Use with the simple controller supplied with most train sets. Housed in an attractive 2 tone sloping front case. Built on a printed circuit board. All parts included. Kt £13.44. Reprint/instructions extra 45p.

TRAIN SOUNDS — from H.E.

STEAM LOCO WHISTLE Mar 81 £12.28 inc case
TWO TONE TRAIN HORN Feb 81 £5.24 less case
CHUFFER Jan 81 £7.64 less case

All 3 can be built into the whistle project case — or built as separate units.

BOOK — MODEL RAILWAY PROJECTS

by Penfold £1.95. Published Sept. 1981.

C106D	58p	2N5457	58p	BFY31	24p	CMOS						
TC46	48p	2N5474	63p	BFY52	23p	4001	20p	LM386N	92p			
Q147	11p	40E73	98p	BFX88	32p	4001	20p	LM389N	£1.10			
Q490	9p	AC118	29p	BRV39	38p	4013	32p	LM390N	£1.10			
QA202	16p	AC141	38p	MPSA65	39p	4017	62p	LM1830	£1.98			
WV005	33p	AC142	39p	RPV35A	£1.16	4020	65p	LM3909	82p			
W06	47p	AC176	37p	TIP31A	38p	4024	20p	LM3914	£2.99			
Z5J	£2.92	BC182	11p	TIP32A	83p	4089	20p	MC3343	£3.95			
IN4001	54p	BC182L	11p	TIP33A	94p	4081	20p	MC3343	£2.16			
IN4005	6p	BC183	11p	TIP34A	99p	4093	38p	NE570N	£4.98			
IN1418	5p	BC184	11p	TIP121	£1.12	40174	£1.20	NE571N	£4.84			
IN5404	18p	BC134L	11p	TIP2955	69p	4522	£1.25	OM335	£8.98			
IN5408	19p	BC212	11p	TIP3055	69p	555	26p	SN76477	£2.69			
BF244	47p	BC212L	11p	TIP3055	69p	566	79p	TL064	£1.64			
MPF102	69p	BC213	11p	TPSA13	35p	741	£2.20	TL071	47p			
TS188A	57p	BC214	11p	SN3053	25p	CA3130E	98p	TL082	74p			
VN647	£1.21	BC214L	11p	2N3055	59p	CA3140E	52p	TL083	£1.52			
2N3819	28p	BD131	48p	48p	2N3072	11p	HA1388	£3.20	TL084	£1.54		
2N3820	78p	BFY50	25p	2N3074	11p	ICL7611	88p	TL430	95p			
1W CARBON FILM RESISTORS												
E12 SERIES, 1R-10M				1p each								
MIN. HORIZ. PRESETS, 100R-4M7.				12p each								
MIDGET POTS, LINEAR, 470R-4M7.				37p each								
LOG, 4K7-2M3				38p each								
SWITCHED POTS, 4K7-1M, LIN, 75p, LOG 76p												
POLYESTER (C280) CAPACITORS, 25V0												
10nF; 15nF; 22nF; 33nF; 47nF 1p each, 58nF;												
100nF 8p, 150nF; 220nF 12p, 330nF 15p, 470nF 20p,												
680nF 28p, 1uF 33p, 1.5uF 49p, 2.2uF 67p.												
SUB MINIATURE PLATE CERAMICS, 63V												
Values in pF; 2, 3, 3.3, 4.7, 5, 6, 6.8, 8, 10, 15;												
22, 33, 47, 560pF 7p each, 68pF; 100pF 10pF												
150pF; 220pF; 330pF 11p each, 470pF, 4700pF												
1000pF 5p each, 2200pF 8p each, 3300pF, 4700pF												
7p each, 10nF 13p, 100nF 22p, 47nF 14p.												
ELECTROLYTIC CAPACITORS												
AXIAL Leads: 1uF/63V 11p; 1uF/63V, 1uF/100V												
22p; 2uF/63V, 3.3uF/63V, 1uF/63V 12p; 10uF/												
16V 11p, 10uF/25V, 10uF/63V 12p; 22uF/10V, 22uF/												
25V 12p; 22uF/63V 15p, 33uF/40V, 47uF/25V 12p;												
47uF/40V 15p; 47uF/63V 18p, 100uF/63V 29p;												
100uF/25V 15p; 220uF/25V 19p; 470uF/16V 29p;												
470uF/25V 38p; 470uF/40V 35p; 680uF/16V 32p;												
1000uF/10V 30p; 1000uF/63V 32p; 1000uF/25V 48p;												
1000uF/40V 55p; 1000uF/63V 77p; 2200uF/10V 39p;												
2200uF/25V 64p; 2200uF/63V £1.10.												
SWITCHES												
MIN. TOGGLE spst 59p; spdt 69p; dpdt 79p.												
MIN. PUSH ON 13p, PUSH OFF 22p.												
FOOTSWITCH & ALT. ACTION spco £1.39;												
dpco £1.88												
ROTARY SWITCHES, 1p 12 way, 2p 6w, 3p 4w,												
4p 3w												
12V 155R OPCD RELAY									£2.98			
SPEAKERS. Miniature, 8 ohm										87p	MIN. BUZZERS, 6V, 50p, 9V, £1 10.	
675 ohm										87p	12V, 65p.	
CRYSTAL EARPICEE										£2.96	MAGNETIC EARPHONES	15p
MONO HEADPHONES										£2.96	STEREO HEADPHONES	£4.95
TELEPHONE PICK-UP COIL										72p	F.M. AERIAL	49p
PP3 CLIPS										10p	PP9 CLIPS	11p
PANEL METERS, 60 x 45mm.										50uA, 100uA, 1mA, 1A, 25V		£4.99 each
VEROBORD 0 1 COPPER, 10 strips, 24 holes.												£1.20 per 5
24S 374TAL 24S 50H. 89p.										36S 37H. 89p.	36S 50H. 99p.	
TERMINAL PINS												48p/100
PIN INSERTION TOOL										£1.69	SPOT PACE CUTTER	£1.23
PCB ETCHING KIT										£4.98		
PLASTIC TWEEZERS										69p	DENTISTS INSPECTION MIRROR	£2.85
UROBREADBOARD										£6.20	JEWELLERS EYEGLASS	£1.50
IMBOARD 1										£6.48	HAND MAGNIFIER, 3"	£2.99
VEROBLOC										£3.98	ILLUMINATED MAGNIFIER, 1 1/2"	£1.14, 3"
										£3.98		£3.19
MULTIMETER TYPE 1, 1,000 opv with probes												£8.66
MULTIMETER TYPE 2, 20,000 opv with transistor tester												£14.75
24S 374TAL TEST LEAD SET, 10 leads with 20 clips.												99p
CONNECTING WIRE, 500' 24S 50H.												65p
RESISTOR COLOUR CODE CALCULATOR												21p
AM, FM aircraft band portable radio												£8.98
2 station desk intercom										£7.48	3 station	£8.98
Plug-in power supply, 4.5V, 6V, 9V, 300mW												£3.89
Dimmer switch												£3.98
PVC Tapes - 3 reels												34p

SOLDERING

ANTEX X5 SOLDERING IRON
25W £5 18
SOLDERING IRON STAND £2 40
SPARE BITS. Small standard,
large. 65p each. For X5+X25.
SOLDER. Handy size 99p.
HOW TO SOLDER PLEAFLET

DESOLDER BRAID 69p
HEAT SINK TWEEZERS 29p
DESOLDER PUMP £6.48
SOLDER CARTON £1.84
LOW COST CUTTERS £1.69
LOW COST LONG NOSE
PLIERS £1.68
WIRE STRIPPERS & CUTTERS
£2.69

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**CONTAINS LOTS MORE
KITS, PCBs &
COMPONENTS**

1982 ELECTRONICS CATALOGUE

Illustrations, product descriptions, circuits all included. Up-to-date price list enclosed. All products are stock lines for fast delivery.
Send 70p in stamps or add 70p to order.

**MORE H.E. KITS PLUS E.E. and E.T.I. PROJECT.
KITS IN THE PRICE LIST.**

DRUM SYNTHESIZER

From ETI Axl 81 this superb instrument has two independent percussion channels — each with its own pitch, noise, decay and level controls. The synthesiser contains a versatile in-built sequencer which enables different beat sequences to be programmed using 8 way DIL switches. Beats from either channel may be individually programmed, or combined in any mixture. Once programmed the sequence can be replayed automatically or manually as required. Manual and automatic operation are possible together so that you can play a programmed rhythm with an occasional free bar of automatically sequenced rhythm. A very versatile instrument. Drum Synthesiser Kit less case **£39.98**, with case **£53.56**. See also H.E. Projects Dec 81 — another Drum Synthesiser.

GUITAR NOTE EXPANDER

EXPANDER
From ETI April 81. Not just any other Fuzz/Sustain Unit. This versatile project can produce overload effects which closely approach the sound of an overdriven valve amp.
Switch selection for:—
1. Overall overdrive
2. Overall compression (sustain)
3. H.F. compression for bass overdrive
4. Overall expansion for sustained overdrive
5. Mid frequency expansion
6. H.F. expansion for H.F. accentuation.
All (except overall overdrive) have variable effects control. Guitar Note Expander Kit £10.47, less case £11.25.

SOUND BENDER

From ETI Oct 81. A very effective 'Ring Modulator' sound effects unit. This design incorporates its own variable frequency oscillator with sine or triangular waveform, and a 4 quadrant multiplier circuit. A mix control allows the modulated signal to be mixed with the straight through signal. Ideal for outer space, voice and music effects. Just connect a signal source and a power amplifier and speaker.

Sound Bender Kit £20.76 less case £16.76.

HAND CLAP SYNTHESISER

Adds a new interesting effect to your music. 6 controls enable wide variation of the clap sound to accompany different types of music. The 'clap' may be initiated by a push button switch or any external push-to-make switch e.g. a footswitch. Alternatively triggering may be via a microphone input to the unit so that a signal from a mic placed near to a snare drum will initiate the clap.

Hand Clap Synthesiser Kit £29.98, less case £23.58

Reprints of the Above 45p each

BOOKS . BOOKS . BOOKS

SEMICONDUCTOR DATA BOOK – Newnes	£5.90
MICROPROCESSORS FOR HOBBYISTS – R. Coles	£5.95
PRACTICAL ELECTRONIC PROJECT BUILDING Ainslie & Cowell	£3.35
CONSTRUCTOR'S PROJECT BOOKS	
ELECTRONIC GAME PROJECTS Rayer	£3.35
ELECTRONIC PROJECTS FOR HOME SECURITY Bishop	£3.35
ELECTRONIC PROJECTS IN AUDIO Penfold	£3.35
ELECTRONIC PROJECTS IN MUSIC Flind	£3.35
ELECTRONIC PROJECTS IN PHOTOGRAPHY Penfold	£3.35
ELECTRONIC PROJECTS IN THE CAR George	£3.35
PROJECTS IN AMATEUR RADIO & SHORT WAVE LISTENING Rayer	£3.35
PROJECTS IN RADIO AND ELECTRONICS Sinclair	£3.35
ELECTRONIC PROJECTS IN HOBBIES Rayer	£3.35
ELECTRONIC PROJECTS I THE HOME Bishop	£3.35
ELECTRONIC PROJECTS IN THE WORKSHOP Penfold	£3.35
ELECTRONIC TEST EQUIPMENT PROJECTS Ainslie	£3.35
MORE ELECTRONIC PROJECTS IN THE HOME Flind	£3.35
110 ELECTRONIC ALARM PROJECTS FOR THE HOME CONSTRUCTOR Marston	£5.35
ELECTRONIC PROJECTS – PAPERMAKERS	
COST EFFECTIVE PROJECTS AROUND THE HOME Watson	£4.50
PROJECTS FOR THE CAR AND GARAGE Bishop	£4.25
AUDIO CIRCUITS AND PROJECTS Bishop	£4.50
TEST GEAR PROJECTS Oixon	£4.35
ELECTRONIC PROJECTS FOR MODEL RAILWAYS Penfold	£1.95
SOLID STATE SHORTWAVE RECEIVERS FOR BEGINNERS Penfold	£1.30
BEGINNERS GUIDE TO BUILDING ELECTRONIC PROJECTS Penfold	£1.50
ELECTRONIC MUSIC AND CREATIVE TAPE RECORDING Berry	£1.35
IC 556 PROJECTS Parr	£1.90

BASIC ELECTRONICS — BOOKS 1-5 £1.90
Super set of books covering theory and practice. Educational. Suit age 14 upwards. Lots of useful projects — circuits built on an 5—Dec breadboard.
Sold as a set of 5 books £11.99

ADVENTURES WITH MICROELECTRONICS

by Tom
Duncan

An easy to follow book suitable for all ages. Ideal for beginners. No soldering. Uses a Bimboard 1 breadboard, gives clear instructions with lots of pictures. 11 projects based on integrated circuits —includes dice, two-tone doorbell, electronic organ, MW/LW radio, reaction timer, etc. Component pack includes a Bimboard 1 breadboard and all the components for the projects. Adventures with Microelectronics £2 55. Component pack £29 64 less battery.

ADVENTURES WITH ELECTRONICS

by Tom
Duncan

An easy to follow book suitable for all ages. Ideal for beginners. No soldering, uses an S-Dec breadboard. Gives clear instructions with lots of pictures. 16 projects—including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-Dec breadboard and all the components for the projects. **Adventures with Electronics £2.40. Component pack £17.98 less battery.**

MAGENTA gives you FAST DELIVERY OF QUALITY COMPONENTS & KITS.
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THIS MONTH'S NEW KITS

For the musically inclined	
Drum Synthesiser	£29.50
Mixer/Pre Amp	£16.00
Stylus Organ	£4.95
For the Service Engineer	
Micro Volt Multiplier	£3.95
Sign Wave Generator	£5.75
Linear Power Output Meter	£11.50
For the Ham or CB Enthusiast	
Aerial Rotator	£24.50
Aerial Direction Indicator	£5.90
For the Motorist	
Electronic Ignition Kit	£19.50
For all of you	
Electric Jigsaw Puzzle	£5.30
Blow Heater Kit	£6.45
And if you are having TV Interference Problems	
High-Pass Filter	£1.95
Low-Pass Filter	£3.45

UNIVAC KEYBOARD BARGAIN

Ideal for use with ZX80/81. Has 50 keys and many other parts for your spare box. Probably cost in excess of £100. In very good used condition - £13.50 + £2.00 post. Diagram showing how to connect to ZX80/81 - £2.00 extra.

COMPUTER DESK

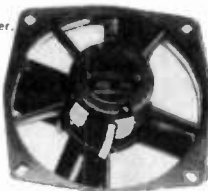


Size approx. 4' x 2' x 2'6" high. These were made for hard work, the top being formica covered. Suitable for housing instruments or for use as office desks. Beautifully made, these cost over £100 each, our price only £11.50 each, however, you must arrange to collect.

EXTRACTOR FANS

Mains operated - ex. Computer.

5" Woods extractor	£5.75 Post £1.00
6" Woods extractor	£6.90 Post £1.25
6" Plannair extractor	£7.50 Post £1.00
4" x 4" Muffin 115v.	£4.50 Post 50p.
4" x 4" Muffin 230v.	£5.75 Post 50p.



INTERRUPTED BEAM

This kit enables you to make a switch that will trigger when a steady beam of infra red or ordinary light is broken. Main components - relay, photo transistor, resistors and caps, etc. Circuit diagram but no case. Price £2.30

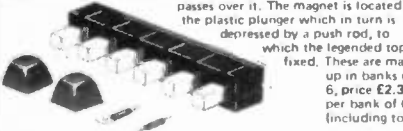
INSTRUMENT BOX WITH KEY

Very strongly made (ply-wood sides with hard board top and bottom). This is black grained effect, vinyl covered, very pleasing appearance. Internal dimensions 12" x 10" x 4" wide, 6" deep. Ideal for carrying your multi range meter and small tools and for keeping them in a safe place. £2.30. Post paid if ordered with other goods, otherwise £1.00.

ROPE LIGHT

4 sets of coloured lamps in translucent plastic tube arranged to give the appearance of a running or travelling light. With variable speed control box, ideal for disco or shop window display. Complete, made up, ready to plug into mains. £36.00 + £2 post.

COMPUTER KEY SWITCHES (make your own keyboard)
These are for making up on a p.c.b. and consist of a vertical mounting computer type reed switch, which makes circuit when a magnet passes over it. The magnet is located in the plastic plunger which in turn is depressed by a push rod, to which the legended top is fixed. These are made up in banks of 6, price £2.30 per bank of 6 (including tops)



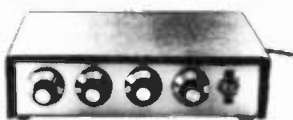
OUR CAR STARTER AND CHARGER KIT has no doubt saved many motorists from embarrassment in an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250w mains transformer, two 10 amp bridge rectifiers, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. Price £11.50 + £2.50 post.

GPO HIGH GAIN AMP/SIGNAL TRACER. In case measuring only 5 1/2" x 3 1/2" x 1 1/2" is an extremely high gain (70dB) solid state amplifier designed for use as a signal tracer on GPO cables, etc. With a radio it functions very well as a signal tracer. By connecting a simple coil to the input socket a useful mains cable tracer can be made. Runs on standard 4 1/2v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp, curing amp, etc. An absolute bargain at only £1.85. Suitable 800hm earpiece 69p.

FREE OUR CURRENT BARGAIN LIST WILL BE ENCLOSED WITH ALL ORDERS.

3 CHANNEL SOUND TO LIGHT KIT

Complete kit of parts for a three-channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by 1/4" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special snip price is £14.95 in kit form or £25.00 assembled and tested.



MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone. In easy to assemble modular form this should sell at about £30 - but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £16.75 including VAT and post. **FREE GIFT** - buy this month and you will receive a pair of Goodman's elliptical 8" x 5" speakers to match this amplifier.



THIS MONTH'S SNIP POCKET AUDIO COMPONENT TESTER



With it you can quickly test diodes, rectifiers, transistors, capacitors, check wiring and p.c. boards for open circuits, find the anode and cathode of a diode or rectifier and whether a transistor is PNP or NPN, which are the base collector and emitter connections. Condensers, if bad, give a continuous signal, but if good, give intermittent signals of varying length depending on their value. The test current is very low (2uA) and the voltage only 1.4v, so it is also possible to check MOS devices, as well as sensitive transistors without fear of damaging them. The unit is supplied complete with internal battery, which should last many months. Price £3.45p

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc., or when fitted say in front of the element of a blow heater, the heat would trip the stat if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0 - 100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats could cost around £15.00 however, you can have the parcel for £2.50.

6 WAVEBAND SHORTWAVE RADIO KIT

Bandspread covering 13.5 to 32 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit includes case materials, six transistors and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy if you have an amplifier to connect it to or a pair of high resistance headphones. Price £11.95.

MEDIUM & 2 SHORT WAVE CRYSTAL RADIO
All the parts to make up the beginner's model. Price £2.30. Crystal earpiece 65p. High resistance headphones (gives best results) £3.75. Kit includes chassis and front but not case.

TRANSMITTER SURVEILLANCE

Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox - all electronic parts and circuit. £2.30. (Not licenceable in the U.K.).

RADIO MIKE

Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. £6.90 comp. kit. (Not licenceable in the U.K.).

RADIO STETHOSCOPE

Easy to fault find - start at the aerial and work towards the speaker - when signal stops you have found the fault. Complete kit £4.95.

MUGGER DETERRENT

A high-note bleep - push latching switch, plastic case and battery connector. Will scare away any villain and bring help. £2.50 complete kit.

POPULAR SNIP - STILL AVAILABLE

And it still carries a free gift of a desoldering pump, which we are currently selling at £6.35p. The snip is perhaps the most useful breakdown parcel we have ever offered. It is a parcel of 50 nearly all different computer panels containing parts which must have cost at least £500. On these boards you will find over 300 IC's. Over 300 diodes, over 200 transistors and several thousand other parts, resistors, condensers, multi-turn pots, rectifiers, SCR, etc. etc. If you act promptly, you can have this parcel for only £8.50, which when you deduct the value of the desoldering pump, works out to just a little over 4p per panel. Surely this is a bargain you should not miss! When ordering please add £2.50 post and £1.27 VAT.

BURGLAR ALARM CONTROL PANEL

Contains labelled connection block, latching relay, test switch and removable key control switch. Simplifies the whole installation, all you have to do is to take wires to pressure pads and to alarm bell. Price £7.95, with complete diagram.

MINI MONO AMP

on p.c.b., size 4" x 2" approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of £1.15 each, or 10 for £10.00.



DELAY SWITCH

Mains operated - delay can be accurately set with pointers knob for periods of up to 2 1/2 hrs. 2 contacts suitable to switch 10 amps - second contact opens a few minutes after 1st contact. £1.95.



TIME SWITCH BARGAIN

Large clear mains frequency controlled clock, which will always show you the correct time + start and stop switches with dials. Complete with knobs. £2.50.

LEVEL METER

Size approximately 3" square, scaled signal and power but cover easily removable for rescaling. Sensitivity 200 uA. 75p.



WATERPROOF HEATING WIRE

60 ohms per yard, this is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses - around water pipes, under grow boxes in gloves and socks.

TANGENTIAL BLOW HEATER

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STEREO BASS BOOSTER

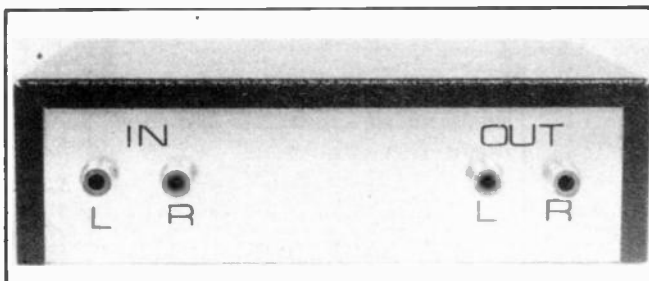
Explore the depths of your Hi-Fi system!

ONE OF the major drawbacks with budget speakers, compared to the higher priced systems, is their relatively poor performance at low frequencies.

This region of the audio spectrum is covered by the bass driver, which can be of inferior quality in cheaper designs. Also, the cabinet is usually constructed with a small internal volume that is sealed and filled with acoustically absorbent wadding — an infinite baffle enclosure. These factors raise the low frequency roll-off point which is the point at which the output level begins to fall as frequency is gradually decreased (see Figure 1).

Also, amplifiers within a similar price range tend to lack any form of equalisation apart from bass and treble controls; typically, these allow a boost/cut of around 10 dB at 100 Hz and 10 kHz but frequencies at a certain point below 100 Hz will be unaffected by the bass control and are therefore reproduced at a lower level. To compensate for this, some form of low frequency amplification is required — which is where the HE Stereo Bass Booster comes into play. It provides an increased output for signals at the bottom end of the bass range.

The boost is applied to signals within a frequency band that is variable between limits of 50-150 Hz. The amount of boost may also be varied (though not independently of frequency) up to a maximum of about 6 dB. These changes are achieved through the use of two special potentiometers that vary four resistance each, in a single control. These pots are shown on the circuit diagram of Figure 2 as RV1a, RV1b,



RV1c and RV1d.

Our prototype was enclosed in a small aluminium case with a black PVC covering. However, since nearly all of the components are built onto the PCB, any metal case of suitable dimensions may be used. Plastic boxes, though easier to adapt, are not desirable because the booster will be processing low level signals and screening is therefore necessary. Power for the unit is obtained from a PP3 battery supplying around 10 milliamps.

Construction

As mentioned earlier, the single PCB for this project takes most of the components, leaving only the on/off switch and phono sockets to be externally wired. This makes construction a fairly simple task, though special attention should be being given to the two ICs, which are mounted in 8-pin DIL sockets. Ensure all the polarised capacitors (eg electrolytic) are inserted the right way round and the link wires correctly positioned — just follow the overlay diagram of Figure 3.

The case may now be drilled to accept the switch, phono sockets and pot shafts. Also, four small holes are drilled in the base for the PCB fixing bolts

(see Figure 4). The main board is then bolted into the case (after being checked for errors).

The remaining hardware is fitted and wired up to the board as shown in Figure 3, and the internal view of the prototype (Figure 5).

Finally, the top of the case is screwed into place and the booster is ready for use.

In Use

The Bass Booster is best placed between the pre- and power amp sections of the amplifier, if your amplifier has pre-out power in terminals. Alternatively, the tape monitor facilities provided on most hi-fi amplifiers can be used; the input for the Booster is taken from the 'Tape Out' ('Rec') socket and the Booster output is taken back to the 'Tape In' socket. The source — record player or tuner — is connected as usual; the Monitor/Source switch should be set to 'Monitor'.

Amplifiers without these facilities are less satisfactory since the booster will have to be placed in between the signal source the pre-amplifier. This will result in a decreased signal-to-noise ratio and some loss of treble — but the effect may not be too noticeable.

Setting the controls is quite straightforward but takes a bit of time. The booster is switched on and both boost controls advanced until the amount of bass appears to balance the other frequencies present. This is made easier if a familiar source (a favourite record or tape) is used. If you are using the tape monitor set-up you can perform an 'A-B Test' by switching between 'Source' and 'Monitor'. In any case the controls should never be set so that 'booming' or distortion is produced.

How It Works

The design of this circuit is fairly simple to understand since the two FET op-amps are wired in cascade (one follows the other), with identical shaping (tonal response) and feedback circuitry (effecting the gain). Each amplifier is arranged to produce a non-inverted output. This output is determined by the feedback loop from pin 1 to pin 2 (for IC1a) and the series RC circuit of C3, R5 and RV1b. Varying RV1a and b alters the gain whilst simultaneously sweeping the roll-off frequency across a 100 Hz band, from 50 up to about 150 Hz. This results in a smooth transition from no boost to the full 6 dB increase in output at the lower end of the sweep range.

Bias for both halves of the circuit is set by R1, R2, and C1; these hold pin 3 of ICs 1 and 101 (not shown in the circuit) at half the supply voltage. R3 is included to minimise interference between channels (crosstalk). Supply decoupling is achieved by C7, across each op-amps supply pins. Each input is coupled to pin 3 by a large capacitor.

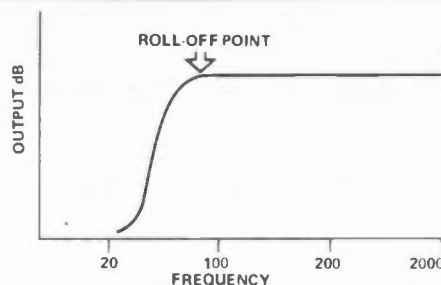
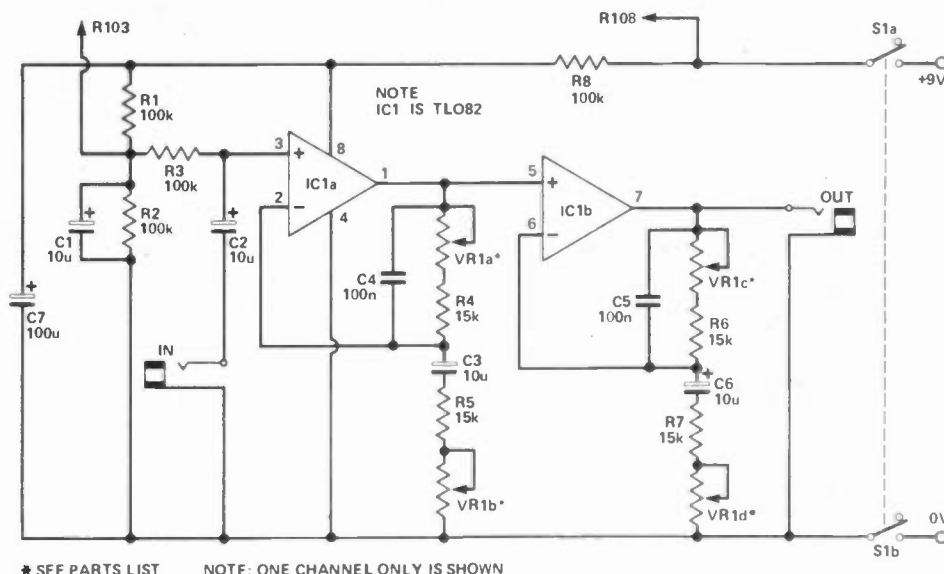


Figure 1. Typical bass response of a speaker system.

Buylines

A complete kit of parts for this project may be obtained from Bewbush Audio, 26 Hastings Road, Pound Hill, Crawley, Sussex. The cost, including postage, is £18.95. The pots may be ordered separately for £1.80 the pair and the PCB is available separately for £1.85. Suitable cases can be had from West Hyde and other suppliers.



* SEE PARTS LIST NOTE: ONE CHANNEL ONLY IS SHOWN

Figure 2. Circuit diagram of one-half of the Stereo Bass Booster.

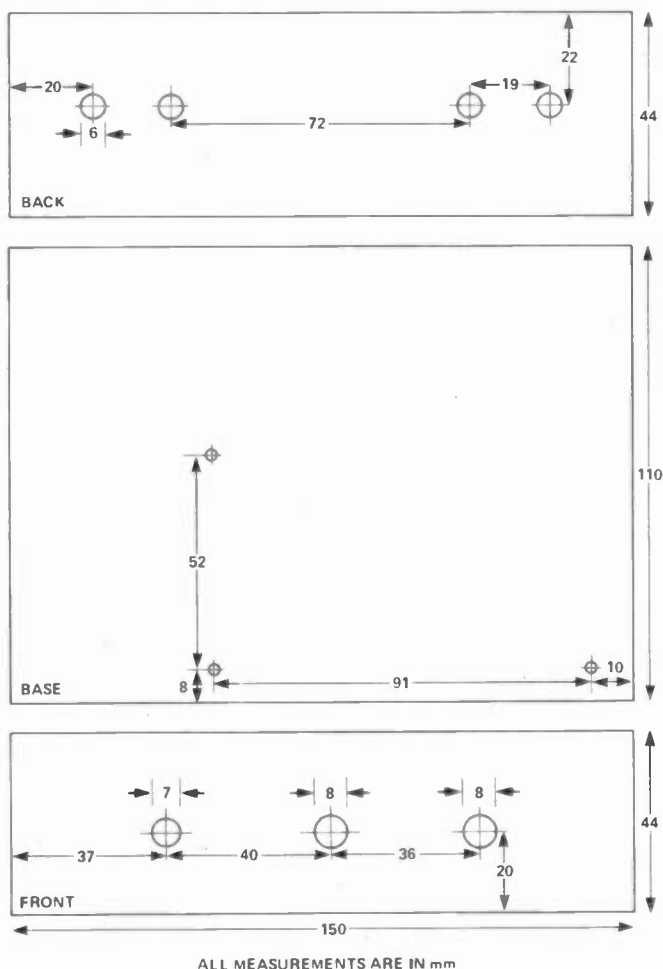


Figure 4. Layout dimensions for the case.

Parts List

RESISTORS (all 1/4 W, 5%)

R1, R2, R3, R103 100 k
R4, R5, R6, R7, R104, R105, R106, R107 15 k
R8, R108 100 R

CAPACITORS

C1, C2, C3, C6, C102, C103, C106 10 uF 16 V radial electrolytic
C4, C5, C104, C105 100 nF C280 polyester
C7, C107 100 uF 16 V radial electrolytic

PONTENTIOMETERS

RV1, RV101 50 k linear quad ganged

SEMICONDUCTORS

IC1, IC101 TLO82 BIFET dual op-amp

MISCELLANEOUS

SK1, SK2, SK3, SK4 chassis mount phono socket
S1 sub-miniature on/off switch
PCB, PP3 battery, PP3 clips, knobs, case, nuts, bolts etc.

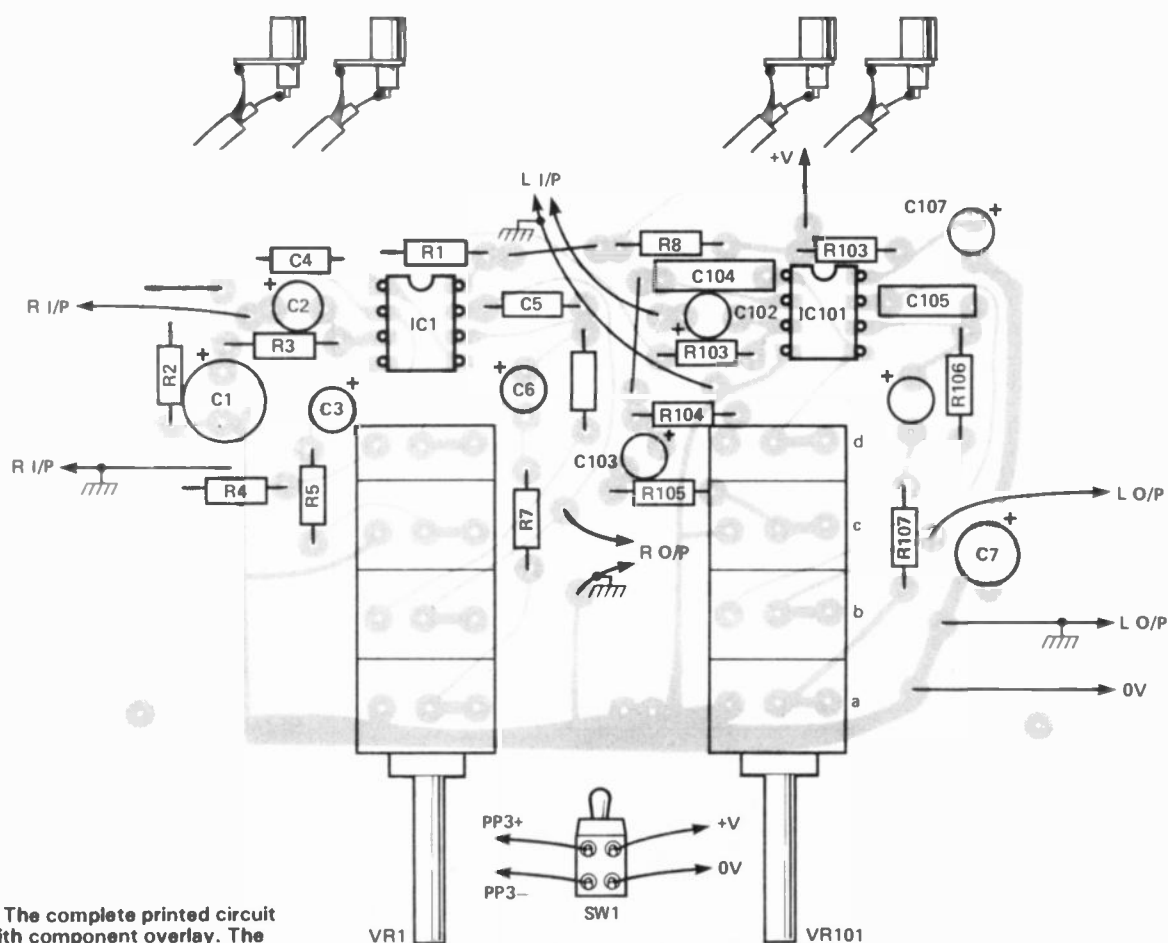
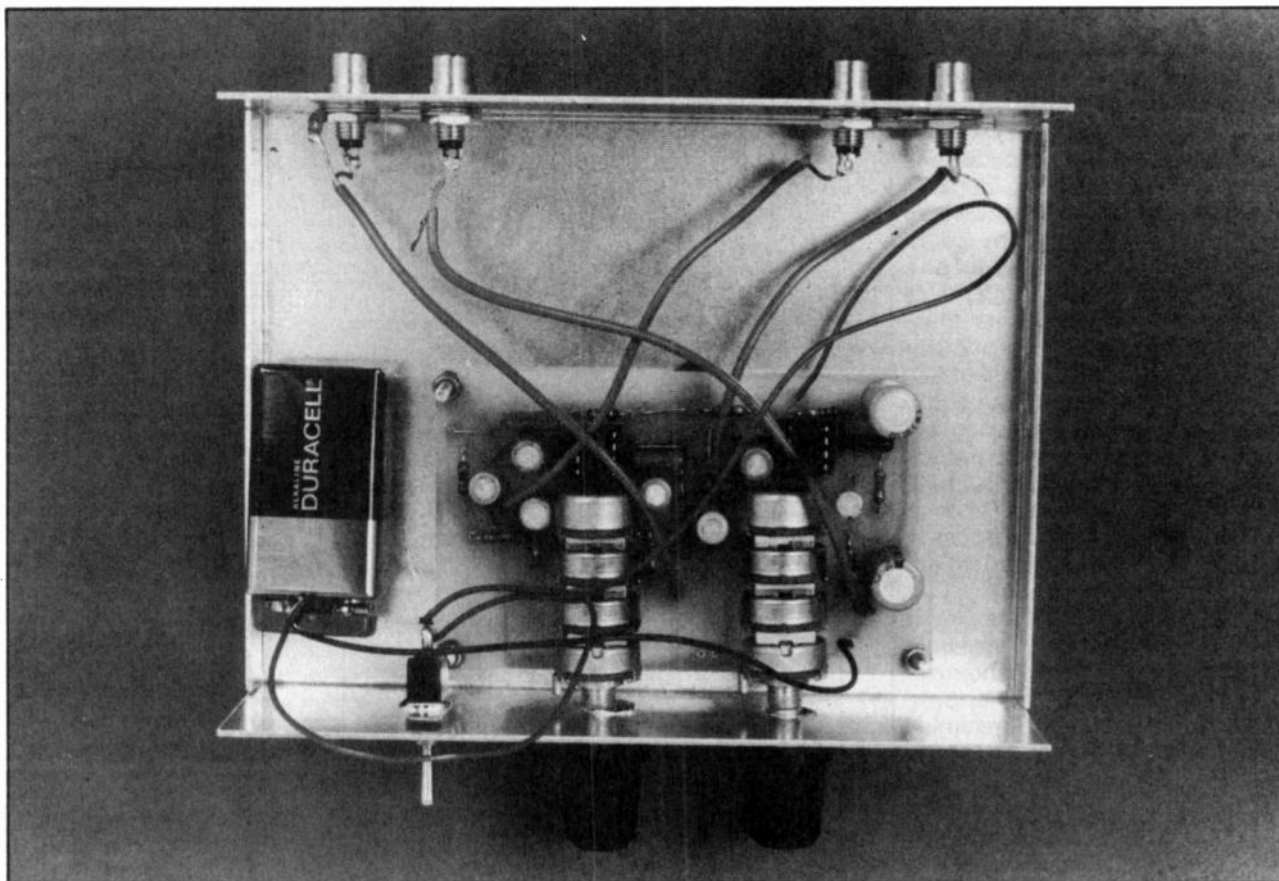
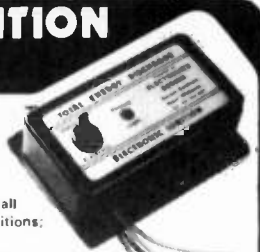


Figure 3. The complete printed circuit board, with component overlay. The full-sized PCB foil pattern is reproduced on page 65.

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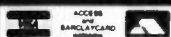
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Clever Dick

This month's collection includes a variety of clever puns, pithy comment and witty sayings — plus, of course, the usual grovelling and boot-licking.

This is "Corrections Month", in which Our Esteemed Editor has asked me to reply to the backlog of enquiries concerning projects which, for many curious reasons, have failed to work as they should. Here's a typical example.

*Dear CD,
I have just built the Quick Project "Simple Stylus Organ" from the November issue. I built it carefully and checked the circuit several times but when I connected it to the battery, nothing came out of the speaker. I found (if the circuit diagram is right) three mistakes in the Veroboard layout. I made some corrections but — still nothing. I would be most grateful if you could tell me what is wrong.
J.E. Hunt,
Bury, Lancs.*

What were you expecting — bug-eyed monsters? As sometimes happens, there were errors in both the circuit diagram and the component layout for this project. You can find them listed, in a reply to another enquiry in "Your Letters".
Did someone mention puns?

*Dear CD (Circuit Designer),
I have come up against some snags relating to the Metronome in HE, November '81. After having fitted all the links and most of the resistors I was prompted, for some reason, to check the circuit. Judging from the number of errors, I think someone has been LED astray. Please come to my rescue! I wish to finish this project in "time" and fit it into a conventional case which I am making in walnut. This in itself presents enough problems without mistakes in the component diagram. I have already angled-off two corners of the Veroboard to make it fit — I'll have a fit myself if it doesn't!*

Just one other thing; in the illustration of the case I would appreciate it if the young lady would remove her left thumb and forefinger from the control knob, so that I can see the notation.

In spite of a rum do, I trust you will take this in good spirit.

*R.P. Dawe
Bedford.*

*PS If I don't finish this project I'll have to face the music with my wife.
PPS I see that the lady's pretty little hand is clear of the illustration on page 3, but I prefer to see her looking on the SUNNY side of things.*

They say that a good pun has to hurt — well, you can believe that I'm in pain. I understand the Editor has already covered this project so, Mr. Dawe, if you'd like to refer to "Your Letters" you should find the solution to your problems with the Metronome. You'll have to see a doctor about your puns, though perhaps with the advances in medical science, you can have them surgically removed?

Ray Penn of Enfield and W.A. Burnell of St. Austell, down in Cornwall, will also find their answers in the Letter pages. The next letter is quite alarming (that's one of the worst things about puns — they're infectious).

*Dear CD,
While I was flicking through the October '81 HE I noticed that no track breaks were shown in the Baby Alarm project. As I've only been doing electronics for a year, could you please tell me where the track breaks go?*

Also, all my HEs, all four of them, are grotty and creased. GROVEL GROVEL. Please can I have a binder?

Yours binderly,

*D. Belfield,
Cheadle, Cheshire.*

PS Where do you get the SAB0600 and how much?

*PPS My sister likes chocolate digestives.
PPS Binder. . .*

This one comes under the heading "cryptic comment". What (or who) is an SAB0600? I will happily award next month's binder to anyone (excluding Mr. Belfield, naturally) who can explain, politely and in one sentence, what his sister or chocolate digestives have to do with me?

As to the track breaks, they are only needed if the board is mounted using screws or bolts; in that case the track should be cut at A22, B22, C22 and at H22, I22 and J22.

It's amazing the lengths some people will go to just to get their greasy paws on one of my sparkling new binders. . .

*Dear Intelligent "Superbrain '81"
Richard (the most intelligent electronics expert ever known to we inferior human life-forms),*

Wishing to construct the Fire Detector project from the November 1981 issue Supplement, I have found difficulty in obtaining the VA1056S Thermistors. Please, please can you help?

*A.J. Hilton,
Guildford, Surrey.*

PS How about a project for an infra-red beam burglar alarm?

PPS Keep up the super mag and read my comments on the survey!

PPPS A BINDER would be useful!!!!?

All true, of course — but naturally I'm too modest to say so myself. You'll also be happy to learn that type VA1056S Thermistors are listed in the Maplin catalogue and that a circuit for an Infra-Red Intruder Alarm appeared in the latest issue of Electronics Digest, which should still be available from your local newsagent. I've read your comments, thank you very much, and I quite agree. There's far too much of it going on.

I realise that not everyone out there has a typewriter (or could use one) but please, at least try to write clearly!

*Dear CD,
I wonder if you could tell me where I could obtain a 2SA715 transistor or an equivalent. I've tried my local stockist and all the companies advertising in HE but none of them stock it.*

I enjoy the features in the mag but I wondered whether there might possibly be more variation in the projects?

*Yours Desperately,
F. Smieja,
Cheltenham*

This letter presented a second-class puzzle — a guessing game with no prizes. After some considerable time spent checking all the catalogues, I came to the conclusion that there was no such animal as a "2SA715". There is, however, a transistor designated 2SA715, made by Hitachi, and the European equivalent is a BD436. Another hour spent checking the catalogues failed to turn up a supplier for the device, though, so the puzzle is back in your hands, Mr Smieja (I think that's the name). Finally, the word "variation" took a while to de-code; the answer to the question (if that's what it was) is that you'll find plenty of variation in the months to come. If Mr Smieja's(?) writing was somewhat less than legible, the following, was, at least, plain enough.

*Dear CD,
I have never owned a copy of HE nor ever will.
Can I have a binder please?
Yours Sarcastically,
C. Bicky,
Walthamstow.*

That's sarcasm? Sorry, I missed it. I would have thought an old salt like you could have done better than that. He certainly doesn't get a binder, either. My complaint in the January pages about nobody writing just to say "hello" prompted a flood of letters (well, two or three) from kind readers . . .

Dear Clever Dick,
HELLO.
P.A. Langley,
Stafford

Dear Clever Dick,
Hello.
N. Churchill,
Romford, Essex.

Some, however, couldn't resist a good grovel.

Dear clever, Clever Dick,
I'd like to say "hello". Well, you did ask, in the January issue — now isn't that obedient of me (grovel, grovel, lick, lick).

Please can you tell me how you mount your speakers (I see you don't use any ugly nuts and bolts).

Also, can you please tell me when you are going to publish the article on large scale model aircraft, mentioned in the December '81 edition?

Lastly, where do I get transfers for HE projects?

L. Arden,
Bracknell, Berks.

PS You must be fed up with grovellers so why don't you give in?

PPS Your mag is brilliant . . . great . . . fabulous (crawl, crawl).

PPS You have probably guessed by now . . . can I have one? Yes, yes a binder that's it. PLEASE. I can't buy one because I have spent all my money on Hobby Electronics Projects. (Here follows more abject grovelling)

No, I never get fed up with grovelling and crawling. I like to see how far you can go. I assume the reference to speakers is in connection with a Monitor item from the January '82 issue. Actually, my speakers are "mounted" on the floor! I am informed by our Esteemed Editor (EE, for short) that, regrettable as it might seem to some, John Greenfield's article will not be appearing. Hobby Transfers have also been discontinued but the PCBs for most projects are available from our PCB service — see page 38.

The Clever Dick Fan Club continues to grow — they even like me in Yugoslavia.

Dear CD,
I am in a very unpleasant position. I've lost my copy of HE with the Touch Switch project in it. Now that I want to make that project for my new stereo system, I'm "blind" 'cause I don't have the article.

Please, can you help me? I enclose a postal note and SAE for a photocopy. I'm sure you can help, 'cause you're clever! I need that project urgently!
A. Karakasevic,
Zemun, Yugoslavia.



Apparently we published not one but two Touch Switches, back in March and September, 1980 — variations on a theme — so, the Back Number Department have been instructed to send both to far off Yugoslavia, with our best wishes.

Some errors are more embarrassing than others.

Dear Sirs,
In the February issue of Hobby Electronics you recommend the fitting of a radio/cassette to a positive-earth motor vehicle using a piece of wood.

This is a potential fire hazard as the aerial is connected to the radio chassis, which is negative, and the car chassis, which is positive.

A. Bell,
London.

PS Now that I've saved all them cars, do I get a binder?

Who does he think I am? Twins?

Our resident expert on these matters has had his wrists slapped and been demoted to Part-Time Handyman. I'm not feeling too well myself, either.

The method recommended is perfectly satisfactory for car stereo cassette players, of course, but could have nasty results if used with a car RADIO, which has an aerial earth-braid connected to the car chassis.

A safe method was suggested by Mr. L.E. Thomas, who works for Halfords, the High Street automotive experts.

Dear Clever Dick,
I write with reference to your reply to A.M. Lawrence in February's issue. Should he fit anything like a decent aerial he will immediately short his chassis to 12V positive and, if lucky, only blow his fuse; if unlucky — goodbye car stereo.

There is only one safe way out of A.M. Lawrence's problem and the attached information is supplied for your future reference.

Yours Sincerely,
L.E. Thomas,
Plymouth, Devon.

The information kindly supplied by Mr. Thomas is too long to reprint here, but a copy has been sent to Mr. Lawrence, with our apologies. Briefly, though, the method applies to cars fitted with a dynamo and involves re-magnetising the pole-pieces. It cannot be used on cars fitted with an alternator or where existing electrical accessories such as a clock, tachometer, radio or tape player are already fitted. I will be happy to supply a copy of the method to anyone who cares to send in a stamped SAE.

Alternatively, there is a somewhat simpler method; connect a 1000 picofarad capacitor between the aerial earth braid and the car chassis. The drawback of this is that it may result in slightly increased interference on the radio.

One thing is certain about CB'ers — they're not only dedicated, they're one-eyed.

Dear CD,
Note my disgust when I noticed a mistake in the January issue. The CB rig is a Fidelity 2000, not a 1000 as stated (tut tut!). The price is even wrong — £89 instead of £69.

After putting you right, let me congratulate you on a great mag. 10-10
R. Neil,
Kent.

PS Keep up the good work.

PPS

For those who missed it, this complaint is yet another referring to a news item in January's Monitor which featured two rather stunning girls holding a CB rig. When informed, The Person Who Writes Monitor was, indeed, suitably disgusted. "These CB nuts", he said (I have censored some of his more colourful expressions). "Who else would look at the rig!"

And for those not familiar with Morse Code, the PPS reads: "Can I Have a Binder".

Right, that's it for this month. Clever Dick will now return to his cage. If you're all very good and write lots of letters, the EE will let me out again next month.

What's that? Who gets this month's binder? Oh.

No-one, that's who. Grovelling isn't everything you know.

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Vol. 2 No. 3

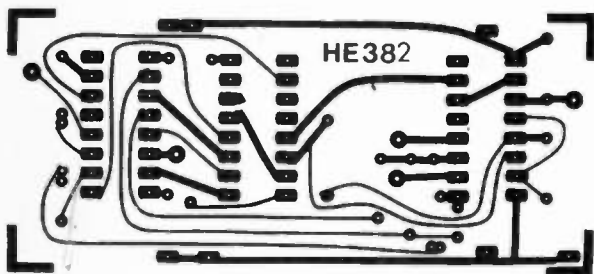
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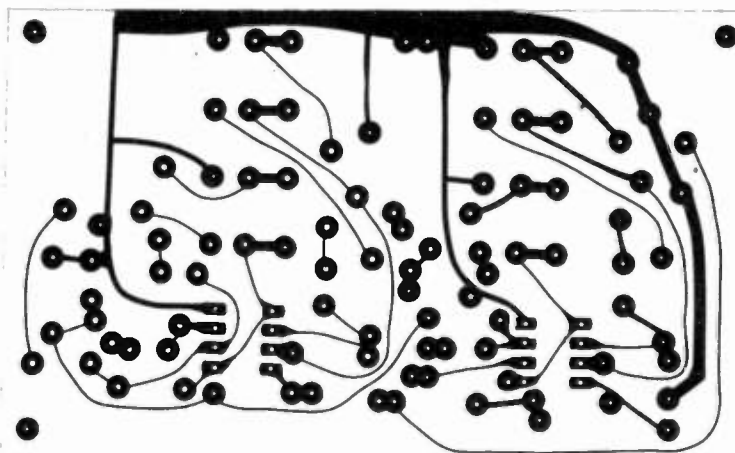
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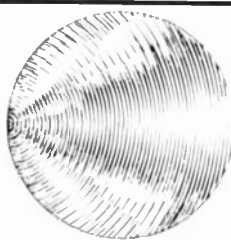
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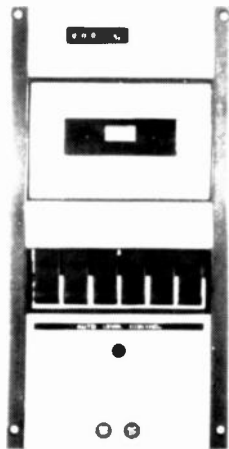
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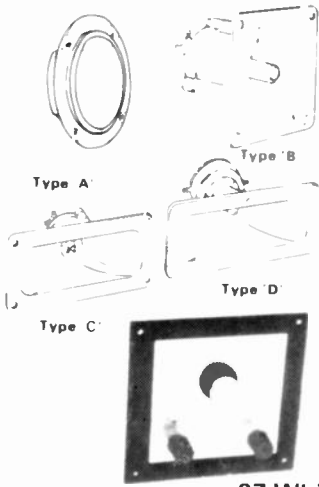
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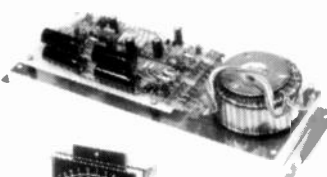
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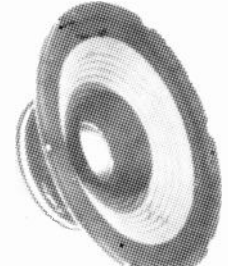
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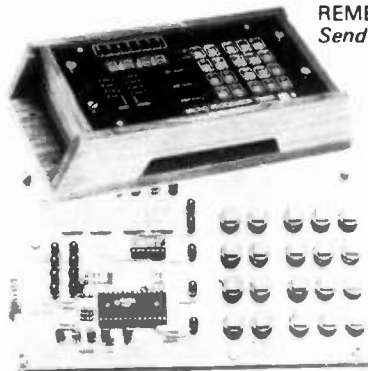
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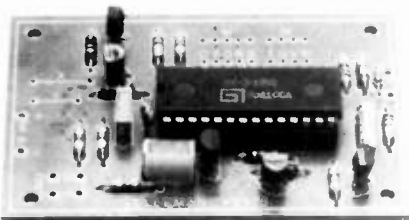


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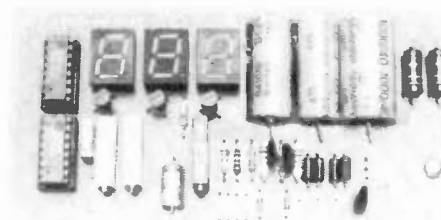
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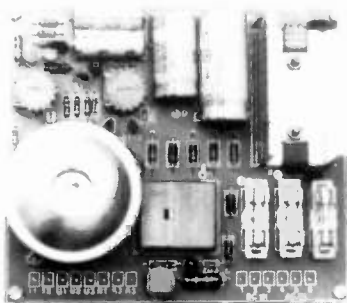
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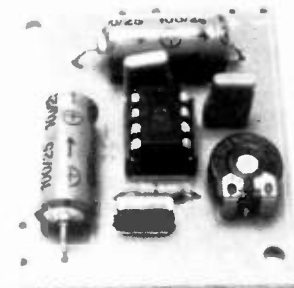
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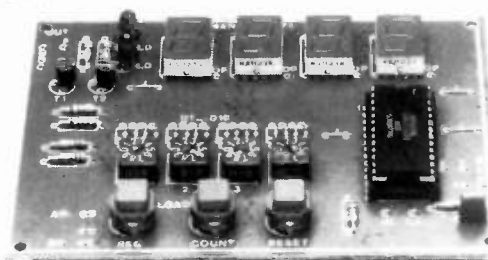
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