EVERYDAY ELECTRONICS

DECEMBER 1991

INCORPORATING ELECTRONICS MONTHLY

£1.60

MIND MACHINE

AUDIO/VISUAL ENTRAINMENT UNIT

SIGNAL GENERATOR

0.1Hz TO 100kHz; SINE, SQUARE, TRIANGLE

FREE INSIDE

48 PAGE GREENWELD BARGAIN LIST

9 770262 361027 12

UNIDEN SATELLITE RECEIVER Brand new units (model 8008) £60.00 ref 60P4V also some 7007s also £60.00 ref 60P5V

SPECTRUM +2 COMPUTER Built in data recorder, 128K, psu and manuals £59.00 ref 59P4V

SPECTRUM +3 COMPUTER Built in disc drive, 128K, psu and manuals £79.00 ref 79P4V

AMSTRAD CPC464 COMPUTER No manuals but only £79.00 ref 79P5V

AMSTRAD CPC6128 COMPUTER Again no manuals but only £149.00 ref 149P4V

AMSTRAD GT65 Green screen monitor £49.00 ref 49P4V

AMSTRAD PORTABLE PC'S FROM £149 (PPC1512SD). £179 (PPC1512DD). £179 (PPC1640SD). £209 (PPC1640DD). MODEMS £30 EXTRA.NO MANUALS OR PSU.

AMSTRAD PC BARGAIN!!!!!!

PC 1512DD COMPLETE WITH CGA COLOUR MONITOR, 2 DISC DRIVES, MANUALS ETC ONLY £249.00 REF 249P4V

HIGH POWER CAR SPEAKERS. Stereo pair output 100w each 4ohm impedance and consisting of 6 1/2" woofer 2" mid range and 1" tweeter. Ideal to work with the amplifier described above. Price per pair £30.00 Order ref 30P7V

2KV 500 WATT TRANSFORMERS Suitable for high voltage experiments or as a spare for a microwave oven etc. 250v AC Input. £10.00 ref 10P93V

MICROWAVE CONTROL PANEL. Mains operated, with touch switches. Complete with 4 digit display, digital clock, and 2 relay outputs one for power and one for pulsed power (programmable). Ideal for all sorts of precision timer applications etc. £6.00 ref 6P18V

FIBRE OPTIC CABLE. Stranded optical fibres sheathed in black PVC. Five metre length £7.00 ref 7P29V

12V SOLAR CELL. 200mA output ideal for trickle charging etc. 300 mm square. Our price £15.00 ref 15P42V

PASSIVE INFRA-RED MOTION SENSOR. Complete with daylight sensor, adjustable lights on timer (8 secs -15 mins), 50' range with a 90 deg coverage. Manual overide facility. Complete with wall brackets, bulb holders etc. Brand new and guaranteed. £25.00 ref 25P24V

Pack of two PAR38 bulbs for above unit £12.00 ref 12P43V

VIDEO SENDER UNIT Transmit both audio and video signals from either a video camera, video recorder or computer to any standard TV set within a 100' range! (tune TV to a spare channel). 12v DC op. £15.00 ref 15P39V Suitable mains adaptor £5.00 ref 5P191V

FM TRANSMITTER housed in a standard working 13A adapter (bug is mains driven). £26.00 ref 26P2V

MINATURE RADIO TRANSCEIVERS A pair of walkie talkies with a range of up to 2 kilometres. Units measure 22x52x155mm. Complete with cases. £30.00 ref 30P12V

FM CORDLESS MICROPHONE. Small hand held unit with a 500' range! 2 transmit power levels reqs PP3 battery. Tuneable to any FM receiver. Our price £15 ref 15P42AV

10 BAND COMMUNICATIONS RECEIVER. 7 short bands, FM, AM and LW DX/local switch, tuning 'eye' mains or battery. Complete with shoulder strap and mains lead **NOW ONLY £19.00!! REF 19P14V.**

WHISPER 2000 LISTENING AID. Enables you to hear sounds that would otherwise be inaudible! Complete with headphones. Cased. £5.00 ref 5P179V

CAR STEREO AND FM RADIO Low cost stereo system giving 5 watts per channel. Signal to noise ratio better than 45db, wow and flutter less than 35% Neg earth. £25.00 ref 25P21V

LOW COST WALIKIE TALKIES. Pair of battery operated units with a range of about 150'. Our price £8.00 a pair ref 8P50V

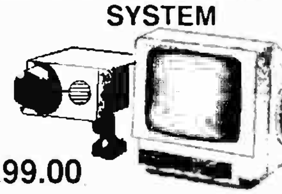
7 CHANNEL GRAPHIC EQUALIZER plus a 60 watt power amp! 20-21KHZ 4-8R 12-14v DC negative earth. Cased. £25 ref 25P14V

NICAD BATTERIES. Brand new top quality. 4 x AA's £4.00 ref 4P44V. 2 x C's £4.00 ref 4P73V, 4 x D's £9.00 ref 9P12V, 1 x PP3 £6.00 ref 6P35V

TOWERS INTERNATIONAL TRANSISTOR SELECTOR GUIDE. The ultimate equivalents book. Latest edition £20.00 ref 20P32V

CABLE TIES. 142mm x 3.2mm white nylon pack of 100 £3.00 ref 3P104V. Bumper pack of 1,000 ties £14.00 ref 14P6V

VIDEO AND AUDIO MONITORING SYSTEM



£99.00

Brand new units consisting of a camera, 14cm monitor, 70 metres of cable, AC adapter, mounting bracket and owners manual. 240v AC or 12v DC operation complete with built in 2 way intercom. **£99.00** ref 99P2v.

1991 CATALOGUE AVAILABLE NOW IF YOU DO NOT HAVE A COPY PLEASE REQUEST ONE WHEN ORDERING OR SEND US A 6"X9" SAE FOR A FREE COPY.

GEIGER COUNTER KIT. Complete with tube, PCB and all components to build a battery operated geiger counter. £39.00 ref 39P1v

FM BUG KIT. New design with PCB embedded coil. Transmits to any FM radio. 9v battery req'd. £5.00 ref 5P158V

FM BUG Built and tested superior 9v operation £14.00 ref 14P3V

COMPOSITE VIDEO KITS. These convert composite video into separate H sync, V sync and video. 12v DC. £8.00 ref 8P39V.

SINCLAIR C5 MOTORS 12v 29A (full load) 3300 rpm 6"x4" 1/4" O/P shaft. New. £20.00 ref 20P22V.

As above but with fitted 4 to 1 inline reduction box (800rpm) and toothed nylon belt drive cog £40.00 ref 40P8V.

SINCLAIR C5 WHEELS 13" or 16" dia including treaded tyre and inner tube. Wheels are black, spoked one piece poly carbonate. 13" wheel £6.00 ref 6P20, 16" wheel £6.00 ref 6P21V.

ELECTRONIC SPEED CONTROL KIT for c5 motor. PCB and all components to build a speed controller (0-95% of speed). Uses pulse width modulation. £17.00 ref 17P3V.

SOLAR POWERED NICAD CHARGER. Charges 4 AA nicads in 8 hours. Brand new and cased £6.00 ref 6P3V.

AT 286 MOTHER BOARD

640K RAM

UPGRADABLE TO 4 M

AT CASE

AT POWER SUPPLY

AT KEYBOARD

MANUAL

NO I/O CARDS

£139

ELECTRONIC TICKET MACHINES These units contain a magnetic card reader, two matrix printers, motors, sensors and loads of electronic components etc. (12"x12"x7") Good value at £12.00 ref 12P28V.

JOYSTICKS. Brand new with 2 fire buttons and suction feet these units can be modified for most computers by changing the connector etc. Price is 2 for £5.00 ref 5P174V

GAS POWERED SOLDERING IRON AND BLOW TORCH Top quality tool with interchangeable heads and metal body. Fully adjustable, runs on lighter gas.£10.00 ref 10P130V

ANSWER MACHINES BT approved remote message playback, intergral push button phone, power supply and tape. Exceptional value at £45.00 ref 45P2V

CAR IONIZER KIT Improve the air in your car! clears smoke and helps to reduce fatigue. Case required. £12.00 ref 12P8V

6V 10AH LEAD ACID sealed battery by yuasha ex equipment but in excellent condition now only 2 for £10.00 ref 10P95V.

12 TO 220V INVERTER KIT As supplied it will handle up to about 15w at 220v but with a larger transformer it will handle 80 watts. Basic kit £12.00 ref 12P17. Larger transformer £12.00 ref 12P41V.

VERO EASI WIRE PROTOTYPING SYSTEM Ideal for designing projects on etc. Complete with tools, wire and reusable board. Our price £6.00 ref 6P33V.

MICROWAVE TURNTABLE MOTORS. Ideal for window displays etc. £5.00 ref 5P165V.

STC SWITCHED MODE POWER SUPPLY 220v or 110v input giving 5v at 2A, +24v at 0.25A, +12v at 0.15A and +90v at 0.4A £6.00 ref 6P59V

HIGH RESOLUTION 12" AMBER MONITOR 12v 1.5A Hercules compatible (TTL input) new and cased £22.00 ref 22P2V

VGA PAPER WHITE MONO monitors new and cased 240v AC. £59.00 ref 59P4V

25 WATT STEREO AMPLIFIER c. STK043. With the addition of a handful of components you can build a 25 watt amplifier. £4.00 ref 4P69V (Circuit dia included).

LINEAR POWER SUPPLY Brand new 220v input +5 at 3A, +12 at 1A, -12 at 1A. Short circuit protected. £12.00 ref 12P21V.

MAINS FANS Snail type construction. Approx 4"x5" mounted on a metal plate for easy fixing. New £5.00 5P166V.

POWERFUL IONIZER KIT. Generates 10 times more ions than commercial units! Complete kit including case £18.00 ref 18P2V.

MINI RADIO MODULE Only 2" square with ferrite aerial and tuner. Superhet. Req's PP3 battery. £1.00 ref BD716V.

HIGH RESOLUTION MONITOR. 9" black and white Phillips tube in chassis made for OPD computer but may be suitable for others. £20.00 ref 20P26V.

BARGAIN NICADS AAA SIZE 200MAH 1.2V PACK OF 10 £4.00 REF 4P92V, PACK OF 100 £30.00 REF 30P16V

CB CONVERTORS. Converts a car radio into an AM CB receiver. Cased with circuit diagram. £4.00 ref 4P48V.

FLOPPY DISCS. Pack of 15 3 1/2" DSDD £10.00 ref 10P86V. Pack of 10 5 1/4" DSDD £5.00 ref 5P168V.

BULL ELECTRICAL

250 PORTLAND ROAD HOVE SUSSEX BN3 5QT TELEPHONE 0273 203500

MAIL ORDER TERMS: CASH PO OR CHEQUE WITH ORDER PLUS £2.50 POST PLUS VAT.

PLEASE ALLOW 10-14 DAYS FOR DELIVERY

NEXT DAY DELIVERY £8.00

FAX 0273 23077

SONIC CONTROLLED MOTOR One click to start, two click to reverse direction, 3 click to stop! £3.00 each ref 3P137V

FRESNEL MAGNIFYING LENS 83 x 52mm £1.00 ref BD827V

LCD DISPLAY. 4 1/2 digits supplied with connection data £3.00 ref 3P77V or 5 for £10.00 ref 10P78V

ALARM TRANSMITTERS. No data available but nicely made complex transmitters 9v operation. £4.00 each ref 4P81V

100M REEL OF WHITE BELL WIRE figure 8 pattern ideal for intercoms, door bells etc £3.00 a reel ref 3P107V

TRANSMITTER RECEIVER SYSTEM Originally made for nurse call systems they consist of a pendant style transmitter and a receiver with telescopic aerial 12v. 80 different channels. £12.00 ref 12P26V

CLAP LIGHT. This device turns on a lamp at a finger 'snap' etc. nicely cased with built in battery operated light. Ideal bedside light etc £4.00 each ref 4P82V

ELECTRONIC DIPSTICK KIT. Contains all you need to build an electronic device to give a 10 level liquid Indicator. £5.00 (ex case) ref 5P194V

UNIVERSAL BATTERY CHARGER. Takes AA's, C's, D's and PP3 nicads. Holds up to 5 batteries at once. New and cased, mains operated. £6.00 ref 6P36V

ONE THOUSAND CABLE TIES! 75mm x 2.4mm white nylon cable ties only £5.00 ref 5P181V

PC MODEMS 1200/75 baud modems designed to plug into a PC complete with manual but no software £18.00 ref 18P12V

ASTEC SWITCHED MODE POWER SUPPLY 80mm x 165mm (PCB size) gives +5 at 3.75A, +12 at 1.5A, -12 at 0.4A. Brand new £12.00 ref 12P39V

VENTILATED CASE FOR ABOVE PSU with IEC filtered socket and power switch. £5.00 ref 5P190V

IN CAR POWER SUPPLY. Plugs into cigar socket and gives 3,4,5,6,7.5,9, and 12v outputs at 800mA. Complete with universal spider plug. £5.00 ref 5P167V

CUSTOMER RETURNED switched mode power supplies. Mixed type, good for spares or repair. £2.00 each ref 2P292V

DRILL OPERATED PUMP. Fits any drill and is self priming £3.00 ref 3P140V

PERSONAL ATTACK ALARM. Complete with built in torch and vanity mirror. Pocket sized, req's 3 AA batteries. £3.00 ref 3P135V

POWERFUL SOLAR CELL 1AMP .45 VOLT only £5.00 ref 5P192V (other sizes avaliable in catalogue).

SOLAR PROJECT KIT. Consists of a solar cell, special DC motor, plastic fan and turntables etc plus a 20 page book on solar energy! Price is £8.00 ref 8P51V

RESISTOR PACK. 10 x 50 values (500 resistors) all 1/4 watt 2% metal film. £5.00 ref 5P170V

CAPACITOR PACK 1. 100 assorted non electrolytic capacitors £2.00 ref 2P286V

CAPACITOR PACK 2. 40 assorted electrolytic capacitors £2.00 ref 2P287V

QUICK CUPPA? 12v immersion heater with lead and cigar lighter plug £3.00 ref 3P92V

LED PACK. 50 red leds, 50 green leds and 50 yellow leds all 5mm £8.00 ref 8P52V

FERRARI TESTAROSSA. A true 2 channel radio controlled car with forward, reverse, 2 gears plus turbo. Working headlights. £22.00 ref 22P6V

ULTRASONIC WIRELESS ALARM SYSTEM Two units, one a sensor which plugs into a 13A socket in the area you wish to protect. The other, a central alarm unit plugs into any other socket elsewere in the building. When the sensor is triggered (by body movement etc) the alarm sounds. Adjustable sensitivity. Price per pair £20.00 ref 20P34V. Additional sensors (max 5 per alarm unit) £11.00 ref 11P6V

WASHING MACHINE PUMP. Mains operated new pump. Not self priming £5.00 ref 5P18V

IBM PRINTER LEAD. (D25 to centronics plug) 2 metre parallel. £5.00 ref 5P186V

COPPER CLAD STRIP BOARD 17" x 4" of .1" pitch "vero" board. £4.00 a sheet ref 4P62V or 2 sheets for £7.00 ref 7P22V

STRIP BOARD CUTTING TOOL. £2.00 ref 2P352V

3 1/2" disc drive. 720K capacity made by NEC £60.00 ref 60P2V

TV LOUDSPEAKERS. 5 watt magnetically screened 4 ohm 55 x 125mm. £3.00 a pair ref 3P109V

SPEAKER GRILLS set of 3 matching grills of different diameters 2 packs for £2.00 (6 grills) ref 2P364V

50 METRES OF MAINS CABLE £3.00 2 core black precut in convenient 2 m lengths. Ideal for repairs and projects. ref 3P91V

4 CORE SCREENED AUDIO CABLE 24 METRES £2.00 Precut into convenient 1.2 m lengths. Ref 2P365V

TWEETERS 2 1/4" DIA 8 ohm mounted on a smart metal plate for easy fixing £2.00 ref 2P366V

COMPUTER MICE Originally made for Future PC's but can be adapted for other machines. Swiss made £8.00 ref 8P57. Atari ST conversion kit £2.00 ref 2P362V

6 1/2" 20 WATT SPEAKER Built in tweeter 4 ohm £5.00 ref 5P205V

5" X 3" 16 OHM SPEAKER 3 for £1.00!! ref CD213V

ADJUSTABLE SPEAKER BRACKETS Ideal for mounting speakers on internal or external corners, uneven surfaces etc. 2 for £5.00 ref 5P207V

PIR LIGHT SWITCH Replaces a standard light switch in seconds light operates when anybody comes within detection range (4m) and stays on for an adjustable time (15 secs to 15 mins). Complete with daylight sensor. Unit also functions as a dimmer switch! 200 watt max. Not suitable for flourescents. £14.00 ref 14P10V

2 MEG DISC DRIVES 3 1/2" disc drives made by Sony housed in a 5 1/4" frame 1.2 meg formatted. £66.00 ref 66P1V.

CUSTOMER RETURNED 2 channel full function radio controlled cars only £8.00 ref 8P200V

WINDUP SOLAR POWERED RADIO! FM/AM radio takes NICAD batteries complete with hand charger and solar panel 14P200V

240 WATT RMS AMP KIT Stereo 30-0-30 psu required £40.00 ref 40P200V

300 WATT RMS MONO AMP KIT £55.00 Psu required ref 55P200V

ALARM PIR SENSORS Standard 12v alarm type sensor will interface to most alarm panels. £16.00 ref 16P200V

ALARM PANELS 2 zone cased keypad entry, entry exit time delay etc. £18.00 ref 18P200V

35MM CAMERAS Customer returned units with built in flash and 28mm lens 2 for £8.00 ref 8P200V

STEAM ENGINE Standard Mamod 1332 engine with boiler piston etc £30 ref 30P200V

SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK

VOL. 20 No. 12 DECEMBER 1991

EVERYDAY ELECTRONICS

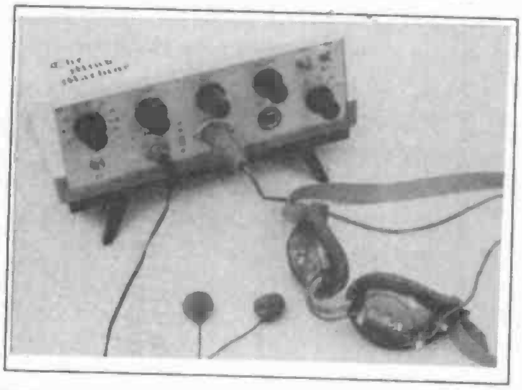
INCORPORATING ELECTRONICS MONTHLY

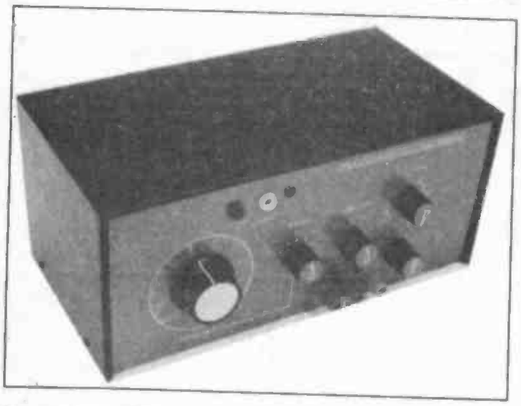
ABC

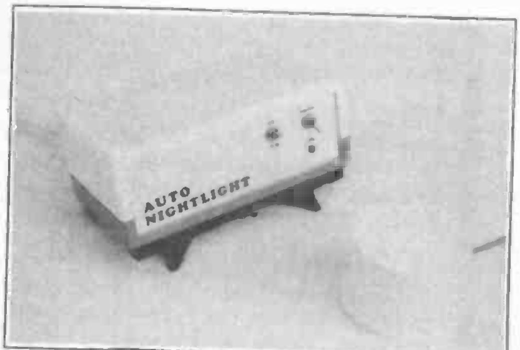
The No 1 Magazine for Electronic & Computer Projects

ISSN 0262 3617

PROJECTS . . . THEORY . . . NEWS . . .
COMMENT . . . POPULAR FEATURES . . .







Our January '92 issue will be published on Friday, 6 December 1991. See page 755 for details.

Projects

Series

Features

NEXT MONTH

FREE

CRICKLEWOOD ELECTRONICS

1992 CATALOGUE WORTH £2

MICRO-SENSE ALARM

Thanks to modern technology electronic goods keep becoming smaller and more portable, unfortunately this also makes life easier for the thief. This alarm was designed to protect computers and their peripherals from being removed while unattended.

Items are protected by fixing piezo transducers to them, with self adhesive foam pads. When an attempt is made to remove the sensor a voltage is produced by the piezo crystal as it is distorted, which will set off the alarm. If the security loop is cut or short circuited the alarm will also be set off, tilt switches (and other types of switches) may be connected in series and parallel with the loop and fixed to the back of the sensors for even more security.

STEPPING MOTOR DRIVER/INTERFACE

A single board stand-alone stepping motor driver with built-in oscillator for variable low speed, high speed and acceleration control. A computer connector is included on the p.c.b. The article also explains the basic operation of stepping motors.

CHRISTMAS FUN SPECIAL

An unusual wordsearch puzzle plus a crossword with an electronic theme. To keep you occupied over the festive season.

EVERYDAY ELECTRONICS

JANUARY ISSUE ON SALE FRIDAY DECEMBER 6

Part	Price
CA3140E	0.87
CA3141E	1.42
CA3146E	1.16
CA3160E	1.25
CA3161E	1.41
CA3162E	5.29
CA3183E	1.39
CA3189E	1.30
CA3240E	1.38
CA324E	0.44
CA3260E	1.68
CA3290E	0.91
CA3306CE	9.23
CA339E	0.33
CA3420E	1.57
CA358E	0.33
CA555CE	0.20
CA741CE	0.18
CD82C55A	8.65
CNX36	0.40
CS8205	0.98
DAC08EP	2.78
DAC08CP	2.60
DAC0800LCN	3.60
DAC0806LCN	3.10
DAC0830LCN	12.26
DAC0832LCN	7.13
DAC1000LCN	19.99
DAC1006LCN	19.99
DAC1008LCN	11.85
DAC1020LCN	18.87
DAC1201KPV	14.36
DG200CJ	4.16
DG201ABK	4.37
DG201ACJ	3.73
DG201CJ	5.70
DG211	2.05
DG212CJ	2.25
DG303ACJ	6.85
DG508CJ	4.45
DG509ACJ	6.30
DP8212N	2.56
DP8304BN	2.40
DS1221	6.44
DS1228	3.90
DS1231	4.44
DS1231-20	4.44
DS1232	3.78
DS1488N	0.30
DS1489AN	0.30
DS1489N	0.30
DS14C88M	1.60
DS14C88N	1.25
DS14C89AN	1.25
DS14C89N	1.56
DS3486N	1.92
DS3487N	1.92
DS34C86N	2.80
DS34C87N	2.80
DS75150N	1.21
DS75154N	1.21
DS75160AN	5.86
DS75161AN	6.14
DS75176BN	1.62
DS75361N	2.51
DS75451N	0.62
DS75452N	0.62
DS75453N	0.62
DS75491N	0.65
DS75492N	1.09
DS75494	2.38
DS8640N	0.96
DS8641N	2.06
DS8836N	1.05
DS8837N	2.10
DS8838N	2.10
DS88C20N	5.72
HA12017	1.44
HA13426	11.96
HCPL-2231	10.28
HCPL-2602	6.89
HCPL-2630	4.80
HCPL-2730	3.90
HCPL-2731	3.80
HCPL-4200	8.15
HCPL-2200	6.38
HEF4754VP	12.40
HI1-0201-5	3.30
HI1-0506-5	12.19
HI1-0507-5	12.19
HI1-0509-5	6.84
HI1-0509A-5	9.78
HI3-0201-5	3.40
HS574AK	19.80
ICL232CPE	4.93
ICL232CPE	4.93
ICL7106CPL	6.75
ICL7107CPL	6.95
ICL7109CPL	6.80
ICL7116CPL	5.25
ICL7126CPL	5.35
ICL7135CN	11.53
ICL7135CPI	6.32
ICL7606CJN	17.02
ICL7611DCBA	2.00
ICL7611DCPA	1.32
ICL7611SBCPA	3.05
ICL7612DCPA	1.71
ICL7621BCPA	5.79
ICL7621DCBA	2.58
ICL7621DCPA	1.98
ICL7642ECPD	3.24
ICL7650SCPD	4.48
ICL7652BCPD	5.82
ICL7652SCPD	7.29
ICL7660CBA	3.11
ICL7660CPA	1.40
ICL7660SCPA	2.74
ICL7662CPA	3.24
ICL7663BCJA	3.12
ICL7663BCPA	3.12
ICL7663SCPA	3.63
ICL7664CPA	3.95
ICL7665BCPA	4.42
ICL7665SACPA	4.73
ICL7667CPA	2.66
ICL766OCPA	2.74
ICL7673CPA	1.80
ICL8038CCPD	4.70
ICL8052ACPD	12.85
ICL8068ACJD	13.40
ICL8069CCSQ	2.59
ICL8069DCSQ	2.68
ICL8069DCZR	1.61
ICL8211CPA	2.28
ICL8212CPA	1.10
ICM7170IPG	7.66
ICM7207AIPD	6.80
ICM7207IPD	5.76
ICM7211AIPL	4.98
ICM7211AMIPL	4.98
ICM7212AMIPL	4.60
ICM7216AIJI	27.72
ICM7217AIPI	9.85
ICM7217BIJI	10.42
ICM7217IJI	10.42
ICM7218AIJI	8.41
ICM7218CIJI	8.41
ICM7218DIJI	8.41
ICM7218EIJL	16.88
ICM7224IPL	9.24
ICM7226BIPL	25.04
ICM7227AIPI	12.60
ICM7232CRIPL	7.72
ICM7242IPA	2.40
ICM7249IDM	14.62
ICM7555CBA	1.47
ICM7555IPA	0.64
ICM7556IPD	1.30
ICL7104-16CPL	20.08
ICL7106CPL	8.75
ICL7107CPL	6.95
ICL7109CPL	8.60
ICL7116CPL	5.25
ICL7126CPL	5.35
ICL7606CJN	17.02
ICL7611DCPA	1.32
ICL7621DCPA	1.98
ICL7652BCPD	5.82
ICL7660CPA	1.40
ICL7662CPA	3.24
ICL7673CPA	1.60
ICL8069CCSQ	2.59
ICL8069DCSQ	2.68
ICL8069DCZR	1.61
ICL8211CPA	2.28
ICL8212CPA	1.10
ICM7170IPG	7.66
ICM7207IPD	5.76
ICM7211AIPL	4.98
ICM7211AMIPL	4.98
ICM7212AMIPL	4.60
ICM7216AIJI	27.72
ICM7217AIPI	9.85
ICM7217IJI	10.42
ICM7218AIJI	8.85
ICM7218CIJI	8.85
ICM7218DIJI	8.85
ICM7218EIJL	15.90
ICM7224IPL	9.24
ICM7226BIPL	25.04
ICM7227AIPI	12.60
ICM7555IPA	0.64
ICM7556IPD	1.21
ILD74	0.99
INA101HP	9.85
INS8250N	13.38
ISO102	7.60
ISO74	0.99
L272	2.83
L293B	3.48
L293E	4.56
L297	5.31
L297A	4.69
L298N	8.31
L4805CV	2.20
L4810CN	2.40
L487	3.15
L4960	3.54
L702B	2.52
L723	0.79
L7808CV	0.50
LF13201N	7.80
LF13202N	7.80
LF13333N	7.80
LF13508D	18.20
LF155H	10.66
LF156H	9.82
LF157H	9.82
LF256H	7.21
LF311H	7.92
LF347BN	6.74
LF347N	0.88
LF351M	0.66
LF351N	0.43
LF353N	0.45
LF355H	3.05
LF355N	1.06
LF356BN	3.36
LF356H	3.05
LF356M	2.39
LF356N	7.32
LF357BN	0.90
LF357DP	1.75
LF357N	1.60
LF398D	3.71
LF398H	7.05
LF398N	2.75
LF411CN	1.20
LF412ACN	10.11
LF412CN	1.20
LF441ACN	6.93
LF441CN	0.90
LF442CN	1.40
LF444CN	2.80
LH0002CH	21.17
LH0002CN	10.80
LH0021CK	43.86
LH0022CH	10.20
LH0024CH	39.26
LH0032CG	42.25
LH0041CJ	31.17
LH0042CH	12.52
LH0062CH	37.57
LH2311D	21.17
LIU01FP	0.94
LM101AH	4.43
LM101AJ	5.84
LM105H	9.48
LM107H	4.43
LM108AH	22.49
LM108ALB	7.38
LM108H	12.30
LM10CH	11.09
LM10CLH	8.40
LM10CLN	6.75
LM10CN	9.24
LM110H	8.76
LM111H	8.74
LM117H	20.70
LM118H	20.28
LM119H	17.05
LM119J	22.93
LM124AJ	24.99
LM124J	3.83
LM12CLK	29.25
LM131H	20.14
LM134H	10.81
LM135H	12.03
LM13600N	2.44
LM13700N	2.32
LM139AJ	18.30
LM139J	3.31
LM1458H	2.89
LM1458M	1.05
LM1458N	0.45
LM148J	10.18
LM1496N	2.39
LM1558H	5.75
LM1558J	5.75
LM1578H	20.43
LM158AH	14.99
LM158H	6.88
LM161H	14.33
LM1801N	3.42
LM1877N-9	7.13
LM1881N	3.60
LM1886N	4.39
LM1894N	4.16
LM193AH	18.87
LM193H	11.51
LM1946N	3.35
LM201AH	4.81
LM207H	4.17
LM208AH	18.17
LM208H	8.75
LM211H	5.84
LM218H	15.75
LM224J	3.54
LM224N	2.01
LM231N	8.01
LM239J	4.23
LM239N	1.28
LM248J	7.72
LM2575T-12	6.26
LM2575T-15	6.26
LM2575T-5.0	6.26
LM2575T-ADJ	7.16
LM2577T-12	7.07
LM2577T-15	7.07
LM2577T-ADJ	7.76
LM2578H	8.28
LM2578N	3.97
LM2579T	12.91
LM2901N	1.16
LM2902N	0.60
LM2903N	0.60
LM2904N	0.60
LM2907N	5.41
LM2917N	5.20
LM2917N-8	3.65
LM2925T	4.33
LM2940CT-5.0	1.20
LM2941CT	3.40
LM2984CT	3.84
LM301AN	0.40
LM3046N	2.69
LM305AH	6.39
LM305H	2.39
LM307N	0.60
LM3080N	2.03
LM3086N	1.59
LM308A	2.03
LM308AH	7.54
LM308AN	2.50
LM308H	2.70
LM308N	1.01
LM310H	4.81
LM310N	2.39
LM311H	2.22
LM311J-8	3.78
LM311N	0.40
LM311N-14	2.15
LM311P	0.77
LM312H	4.90
LM317H	9.23
LM317KC	5.05
LM317LZ	1.16
LM317MP	1.75
LM317T	0.84
LM318H	3.84
LM318J-8	6.28
LM318N	1.25
LM318P	1.25
LM319H	6.28
LM319J	7.32
LM319N	1.45
LM324AN	2.82
LM324J	1.60
LM324N	0.35
LM325N	4.60
LM3302N	1.64
LM331AN	11.66
LM331N	7.56
LM334Z	1.46
LM335Z	2.16
LM3361AN	3.32
LM336Z-2.5	1.29
LM336Z-5.0	1.20
LM337J	3.28
LM338K	6.50
LM338K STEEL	7.96
LM339AN	1.00
LM339J	2.44
LM339N	0.36
LM340AT-12	1.68
LM343H	7.83
LM346N	3.10
LM348DP	0.48
LM348J	3.34
LM348N	0.48
LM34DZ	4.34
LM350K/STEEL	11.50
LM350T	2.68
LM3524N	1.71
LM3578N	3.06
LM358AN	2.93
LM358N	0.32
LM358P	0.77
LM359N	3.44
LM35CHN	10.58
LM35CZ	7.84
LM35DH	5.83
LM35DZ	4.34
LM360H	7.72
LM360N	9.83
LM361N	5.66
LM363H-100	4.65
LM376N	1.35
LM377N	3.53
LM380N	1.00
LM380N-14	2.12
LM380N-8	2.10
LM381AN	5.65
LM381N	4.53
LM383T	4.34
LM384N	4.17
LM385LP-1.2	2.06
LM385LP-2.5	2.06
LM385M-1.2	2.40
LM386M-1/SMD	1.65
LM386N	1.72
LM386N-1	1.63
LM386N-4	2.16
LM387AN	3.27
LM387N	3.15
LM388N-1	2.46
LM3900N	0.72
LM3909N	2.18
LM3911N	3.15
LM3914N	3.68
LM3915N	6.28
LM3916N	4.10
LM392N	1.56
LM393AN	1.42
LM393N	0.40
LM393P	0.70
LM394CH	6.47
LM394CN	4.96
LM394H	10.35
LM3999Z	2.77
LM399H	6.38
LM4250CN	2.22
LM4250J	6.35
LM431ACZ	0.90
LM555CM	0.40
LM555CN	0.29
LM556CN	1.18
LM556J	8.35
LM567CN	1.35
LM604CN	4.16
LM607CN	2.96
LM611CN	2.87
LM6125H	14.99
LM613N	2.66
LM614CN	4.03
LM6213N	6.95
LM6218N	10.04
LM621N	9.34
LM6221N	7.98
LM6225N	9.55
LM6264J	17.20
LM6265N	8.38
LM6361N	2.90
LM6364N	2.95
LM675T	7.67
LM709CH	2.70
LM709CN	1.85
LM710CH	1.68
LM710CN	1.64
LM710H	4.59
LM715CH	6.29
LM723CH	1.82
LM723CN	0.85
LM723H	6.90
LM725CH	12.52
LM725CN	9.39
LM733CH	2.93
LM733CN	1.93
LM741CH	1.58
LM741CN	0.28
LM741EN	2.29
LM741H	4.40
LM741J	3.98
LM747CN	0.56
LM747J	4.59
LM748CH	2.29
LM748CN	1.13
LM759CH	4.78
LM759CP	3.75
LM77000CP	2.90
LM776CN	2.51
LM78GCP	1.82
LM78L05ACZ	0.30
LM78MGCP	1.57
LM7912CT	0.38
LM7915CT	0.40
LM833N	2.10
LM837N	2.72
LMC555CN	1.04
LMC660CN	1.79
LMD18200T	20.29
LMD18201T	16.96
LMF40C1N-100	5.41
LMF40C1N-50	5.41
LMF60C1N-100	8.17
LMF60C1N-50	6.45
LP2951ACN	4.53
LP311N	1.38
LP324N	1.38
LP339N	1.23
LP365N	1.26
LPC6621N	2.29
LS204CB	1.34
LS285AB	3.55
LS288B	3.60
LS404CB	2.36
LT1004CLP-1.2	2.79
LT1004CLP-2.5	2.79
LT1006CN8	2.60
LT1007CP	4.07
LT1009CP	2.79
LT1014	9.80
LT1030CN	3.28
LT1032CN	4.20
LT1037CP	4.07
LT1052CPK	3.71
LT1054	6.86
LT1070CKV	13.06
LT1071CKV	10.54
LT1083CP	8.15
LT1084CKK	10.64
LTC485CN8	1.92
M5218P	0.44
M5220	0.70
M54547P	1.90
M706B1	1.42
MAX232CPE	3.90
MAX232EWE/SMD	8.86
MAX359CPE	8.80
MAX452CPA	5.38
MC10103P	1.24
MC1350P	3.10
MC1377P	4.93
MC1413P	0.74
MC14490P	3.40
MC145406P	2.63
MC1455P	0.40
MC1458P	0.32
MC1488L	1.46
MC1488P	0.58
MC1489A	0.80
MC1489P	0.46
MC1558L	2.80
MC3301P	0.68
MC3302P	0.68
MC3479P	7.92
MC3486N	2.45
MC3523U	2.94
MC4024P	6.64
MC4044P	8.35
MCT2	0.84
MCT61	1.18
MM53200N	2.98
MM58167AN	13.32
MM58174AN	14.52
MM58274BN	8.30
MM58274CN	8.30
MPOP07CP	2.02
MUX08-EP	8.52
MV601DP	3.31
N8264N	3.68
NE5020N	8.24
NE5532N	0.72
NE5534P	1.19
NE555N	0.20
NE556D	0.68
NE556N	0.40
NE565N	1.10
NE566N	1.14
NE567N	0.85
NE568N	3.85
NE570N	2.75
NE589N	3.25
NE592N14	0.92
NJM4556D	0.88
NJM4556S	0.88
NJM4558DX	0.86
NJM4558S	0.80
NS16450N	10.42
OP07-CP	2.35
OP11-GP	4.26
OP227-GY	10.04
OP27-GP	2.89
PBD352302	6.80
PBD352303	6.80
PBL3726/6	7.20
PCB80C39-11P	7.84
PCD3311P	4.82
PCD3312P	4.73
PCF8583P	7.96
QMV16BP5	7.80
QMV16CW1	7.80
QMV24C	8.74
QMV62AW1	8.10
RC4136N	0.90
RC4207GN	2.24
RC4558C	0.60
RC4558M/SMD	0.82
RC4558P	0.77
REF01CP	1.52
REF01HP	2.98
REF02CP	2.30
REF02GP	3.20
REF03GP	1.95
REF25Z	1.12
S202DS2	4.80
SAA1027	2.65
SAA1043P	7.98
SAA5025D	6.40
SAA6002A	10.80
SAS560S	3.40
SAS570S	1.60
SFC2741DC	0.18
SL1451DP	12.44
SL1452	6.21
SL1452DP	10.01
SL1454DP	11.10
SL1455DP	12.44
SL1612CDP	5.03
SL1613CDP	3.69
SL1640CDP	7.84
SL1641CDP	7.09
SL2363CCM	12.73
SL2364CDC	14.33
SL2364CDP	4.28
SL301LCM	13.19
SL3127CDP	2.76
SL3145CDP	3.78
SL3145CMP	4.01
SL360GCM	13.91
SL362CCM	10.06
SL486DP	2.98
SL490B	2.56
SL521CCM	12.52
SL532CCM	13.61
SL541BCM	23.42
SL541BDG	19.20
SL560CCM	6.83
SL560CDP	2.98
SL560CLC	10.14
SL561CDP	4.13
SL610CCM	9.60
SL611CCM	9.60
SL612CCM	9.60
SL621CCM	18.92
SL6270C	2.76
SL6270CCM	9.35
SL6270CDP	2.75
SL6270MP	3.01
SL6310CDG	4.07
SL6310CDP	2.34
SL6310CMP	2.57
SL641CCM	10.81
SL6443CDP	4.28
SL6601CDG	8.57
SL6639MP	18.33
SL6652DG	12.38
SL6655HP	20.43
SL6700CDP	5.47
SL952DP	7.26
SN75107AN	1.57
SN75107BN	1.57
SN75108BN	2.06
SN75109AN	2.46
SN75110AN	1.57
SN75112N	4.50
SN75113N	4.57
SN75114N	4.57
SN75115N	1.20
SN75116N	3.60
SN75124N	2.42
SN75136N	3.10
SN75138N	4.41
SN75140P	3.11
SN75150P	1.62
SN75151N	5.02
SN75152N	6.36
SN75154N	1.98
SN75155P	1.36
SN75157P	5.68
SN75158P	4.94
SN75159N	5.77
SN75160BN	7.35
SN75161AN	9.31
SN75162BN	11.76
SN75172N	4.56
SN75173N	4.56
SN75174N	3.25
SN75175N	5.28
SN75176AP	1.80
SN75176BP	2.28
SN75177BP	2.74
SN75179BP	2.46
SN75182N	2.90
SN75183N	2.90
SN75188N	0.40
SN75189AN	0.85
SN75189N	0.85
SN75437ANE	3.28
SN75451	0.28
SN75451BP	0.99
SN75452BP	0.49
SN75453BP	0.99
SN75454BP	0.99
SN75462P	1.52
SN75463P	1.52
SN75468	4.33
SN75469N	4.33
SN75472P	1.89
SN75477	2.10
SN75512BN	4.76
SN75C188N	1.43
SN75C189CN	1.43
SP8660DP	3.80
STK4141II	4.70
STK4152II	7.75
TA7215P	7.20
TA7256P	2.60
TA7526P	2.60
TA78005AP	1.64
TA6410K	4.20
TBA120S	0.80
TBA120SA	1.20
TBA540	1.84
TBA570	6.90
TBA800	0.84
TBA820M	1.11
TBA920	1.80
TBA990	1.84
TCM1520AP	1.29
TDA1083	2.80
TDA1085A	2.98
TDA1085C	3.80
TDA1151	1.10
TIL113	0.86
TIL117	0.86
TIL119	0.78
TIL311	11.20
TL026CP	1.22
TL064CDP	0.48
TL081CP	0.35
TL082CP	0.40
TL084CN	0.74
TL331CP	1.23
TLC272CP	1.30
TLC555CP	0.65
TLC556CN	1.14
TLP521	0.80
TSC7126CPL	3.60
TSC7135CPI	6.98
TSC7640CPA	1.20
U1096B	4.92
U2066B	2.84
UA2240PC	1.40
UA709CP	1.40
UA723CN	0.80
UA733CN	0.80
UA741	0.18
UA748CP	0.52
UA748TC	0.52
UA78M12UC	0.40
UA9636ACP	1.88
UA9637ATC	1.35
UA9638CP	1.88
UA9639CP	1.65
UDN6118A	1.66
ULA1RE029E1	4.98
ULN2001AN	0.93
ULN2002AN	1.40
ULN2003A	0.40
ULN2003AN	0.48
ULN2004AN	1.40
ULN2803A	1.10
ULN2804AN	2.20
UM5101	3.80
XR2206CP	3.95
ZN425E-8	5.98
ZN426E-8	3.63
ZN427E-8	10.65
ZN428E-8	6.20
ZN429E-8	2.58
ZN435E	7.44
ZN439E8	7.44
ZN447E	10.88
ZN448E	7.98
ZN449E	4.78
ZN459CP	4.07

MICROPROCESSOR & SUPPORT ICs

Part	Price
6321P	4.20
63485CP32/SMD	32.50
63B03XP	11.95
6502	3.40
6502A	3.90
6502C	5.95
6520P	3.89
6522	3.60
6522A	7.95
6551	3.10
6551A	3.60
65C02P2	6.80
65C02P3	6.90
65C102P2	8.40
65C22P2	5.67
65C51E1	3.65
65C51E2	4.45
68000CP10	6.02
68000CP12	7.72
68000CP8	4.95
68008CP10	7.70
68008CP8	5.95
6802P	2.47
6803P	4.98
6805E2P	9.18
6810P	2.98
6821P	1.52
6840P	3.10
6844P	17.20
6845L	8.80
6845P	5.40
6845SP	6.92
68A00P	7.02
68A09P	7.63
68A21P	3.03
68A40P	4.83
68A50P	2.82
68B03P	15.25
68B09P	9.25
68B21P	4.29
68B21P	3.14
68B40P	5.22
68B45P	9.92
A80C286-12	48.60
AM9050CDC	4.95
AM9050CPC	4.60
C8253	2.85
CA80C85B	4.80
CD82C85	9.62
CD82C86H-5	9.74
CG80C286-12	46.60
CG80C286-16	54.70
D8254-2	6.42
D8282	4.20
D8284A	3.90
D8288	6.48
D82C288-8	9.36
D8748H	10.65
DP8311N	6.54
DS5000-32-12	62.98
EF6803P	4.98
F6821P	1.30
HD6321P	4.20
HD63485PS32	32.50
HD63B03XP	11.95
HD6845SP	6.92
HD68B21P	4.29
M5M82C54P-5	5.40
MAB8035HL-6P	3.50
MAB8035HP-6P	3.50
MAB8039HL-11P	5.09
MC146805E2P	9.18
MC6802P	2.47
MC6821P	1.60
MSM80C35RS	4.90
MSM80C85A	3.60
MSM80C85A-2	3.85
MSM80C86	7.60
MSM81C55	4.60
MSM82C51A	3.58
MSM82C53-2	3.98
MSM82C53-5	3.58
MSM82C54-2	4.20
MSM82C59A-2	3.98
MSM82C84A	3.30
MSM82C84A-2	3.60
MSM82C88	12.60
NS16550AFN	18.90
P8051AH	11.20
P8052AH/BASIC	23.45
P8080A	3.90
P8085A-2	3.00
P8085AH-2	3.30
P8088	4.00
P80C86AL-2	18.60
P8155H	3.50
P8185	18.10
P8205	2.00
P8212	2.40
P8226	2.40
P8228	3.86
P8251	2.45
P8251A	2.85
P8253	2.20
P8255A-5	2.40
P8259	2.60
P8259A	2.70
P8274	6.98
P8275	21.20
P8279-5	2.60
P8282	2.84
P8286	3.60
P8287	4.58
P82C54	4.10
P82C54-2	4.00
PCF8566T	4.08
PCF8573P	4.95
PCF8574P	4.15
PCF8591P	8.90
R6502AP	5.95
R6520P	3.89
R6522	3.20
R6522AP	7.95
R65C02P2	5.84
R65C02P3	6.80
R65C22P2	5.67
SCC2692BC1N40	7.88
SCN2641CC1N24	3.73
SCN2651CC1N28	9.08
SCN2652AC2N40	6.82
SCN2661AC1N28	3.74
SCN2661BC1N28	3.60
SCN2661CC1N28	3.60
SCN2672BC3N40	6.84
SCN2672BC4N40	6.42
SCN2673AC5N40	10.53
SCN2674BC3N40	10.24
SCN2674BC4N40	8.42
SCN2681AC1N24	6.52
SCN2681AC1N28	6.52
SCN2681AC1N40	5.85
SCN2691AC1A24	4.92
SCN2691AC1A28	6.65
SY6522	3.20
SY6522A	3.80
SY6551	3.90
TMP8085AP-2	3.60
TMS3477NL	12.10
TMS77C01NL	2.65
TMS9900NL	24.40
TMS9901NL	7.22
TMS9902ANL	7.98
TMS9902NL	7.34
TMS9914ANL	18.94
TMS9928ANL	4.70
TMS9995JDL	69.85
UM82C288-10	6.80
UM82C50A	5.60
UMC82C284-12	4.80
UMC82C288-12	4.80
UPB8282C	3.80
UPB8284AD	3.80
UPB8286C	3.80
UPD70108C-8	6.95
UPD70108C-10	9.10
UPD70116C-8	9.20
UPD70116C-10	12.90
UPD7201AC	6.80
UPD7201C	6.80
UPD765AC	5.42
UPD8085AC-2	4.98
UPD8085AHC-2	6.46
UPD80C39HC	6.42
UPD80C40HC	13.84
UPD8243HC	2.80
UPD8251AFC	5.78
UPD8253C-2	3.32
UPD8253C-5	3.32
UPD8255AC-2	3.20
UPD8255AC-5	3.20
UPD8259AC	3.34
UPD8259AC-2	3.60
UPD8279C-5	5.40
UPD8741AD	12.52
UPD8749HC	13.98
V20-8MHz	6.95
V20-10MHz	9.10
V30-8MHz	9.20
V30-10MHz	12.90
Z80-DMA	4.45
Z80-PIO	1.86
Z80A-CPU	1.25
Z80A-CTC	1.72
Z80A-DART	3.26
Z80A-PIO	1.81
Z80A-SIO/O	3.40
Z80B-CPU	1.80
Z80B-CTC	3.00
Z80B-DART	5.80
Z80B-PIO	2.20
Z80B-SIO	4.50
Z8001B-CPU	1.96
Z8018008VSC	6.25

MATHS CO PROCESSOR

Part	Price
AM9511-4DC	48.85
AM9511A-4DC	58.30
D80287-10/INT	127.00
D80287-8/INT	122.00
80287XL/INT	127.00
BOX287XL/INT	127.00

MEMORIES DYNAMIC RAM

Part	Price
4164-10	1.40
4164-12	1.00
41256-8	1.80
41256-10	1.50
41256-12	1.40
41464-12	2.50
41464-10	2.50
44C256AZ-10	6.95
44C256-8	5.00
511000-85	8.80
HM48416AP-15	4.60
HM48416AP-20	4.25
HYB511000-85	8.80
KM41256AP-12	1.68
KM44C256AZ10	6.95
MK4116N-54	2.78
MK4564N-15	1.45
NMC3764N-15	1.80
TMM4164AP-15	1.75
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Part	Price
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6264LP-10	2.40
6264LP-12	2.40
62256LP-12	4.95
62256LP-10	4.95
CDM6116AE3	5.30
CDM6117AE3	5.85
HM1-6116-5	2.50
HM3-6116-5	3.15
HM6116LP-2	2.60
HM6116LP-3	2.60
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HM6264ALP-12	4.20
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HM6267P-35	6.25
HM628128LP-80	25.50
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KM62256ALP-10	4.95
LH5164D-10L	2.40
M5M4464P-15	5.80
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MM2102AN-2L	2.80
MSM2114L-3RS	2.40
P2114AL-2	2.98
P2114AL-4	2.40
PCD5101P	3.60
TMM2016AP-10	3.80
UPD2114LC-5	2.80
UPD4016C-1	3.80
UPD4016C-5	3.80
UPD43256AGU10L	25.20
UPD43256C-12	5.60
UPD4364C-15	2.80

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Part	Price
27C128-25	2.95
27C64AD-15	2.74
27C256-15FA	3.95
D27256	4.35
HM27C101G-20	11.40
HN27C1024HC-10	37.50
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HN27C64G-20	3.80
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HN462532P	3.60
HN462716G	3.40
HN4827128G-25	4.55
HN482764G	3.80
HY53C256LS-80	3.20
HY6264LP-10	2.40
M2716-1F1	3.15
M5L27128K	5.60
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MBM27C128-25	5.80
MBM27C256-25	5.10
MBM27C256-30	5.10
NMC27C16Q-45	4.98
NMC27C256Q-25	3.95
NMC27C64Q-25	3.30
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TMS2516JL-45	4.58
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TMS27128NL-25	4.80
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UPD27256D/21V	4.80
UPD2732A/21V	4.40
UPD27C256AD-15	5.40
UPD27C512D-15	5.80
UPD27C64D-25	3.85

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AT28C64-25	9.80
AT28C64-15	10.95
KM28C256-20	28.45
KM28C256-15	47.60
KM28C64-25	9.80
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X2816AP-25	8.70
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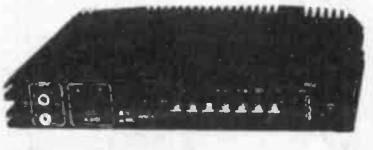

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- Output power .... 2 x 60W stereo 0.1% THD, 120W mono 0.1% THD
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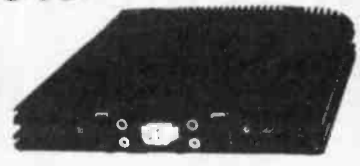
- Input sensitivity .... 100mV-3V adjustable
- Input impedance..Low level input 20kΩ
- Output impedance 4Ω
- Power .... 14.4V dc 15A
- Dims .... 240 x 120 x 50mm

£39.99



ORDER CODE: CAR/CPA504

4 x 120W CLASS "A" AMPLIFIER B005N (CPA 504)

High power 4-channel Class "A" amplifier, capable of delivering 4 x 120W or 2 x 240W in bridge mode. Inputs are direct from the speaker outputs of the car radio cassette, or low level phono inputs with left and right level controls. Full thermal overload protection.

- Output power .... 4 x 120W or 2 x 240W (bridged)
- Signal to noise ratio .... > 90dB
- Frequency response 10-50000Hz
- Input sensitivity .... 100mV-3V adjustable
- Input impedance .... High level input 100Ω, Low level input 20Ω
- Power .... 14.4V dc 60A
- Dims .... 400 x 240 x 50mm

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2-WAY Hand Held Crystal Control Tranceivers. Built-in Telescopic Aerial, call button, transmiter receive key, on air indicator. Each unit requires PP3 battery for operation (not supplied)

- Operating Frequency .... 49 MHz
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- Frequency Tolerance .... +or –0.005%
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- Oscillation .... Crystal Control
- Power Pack .... 9V DC (PP3 batttery. 1 pair in box)

£26.50

ORDER CODE CAR/CPA200

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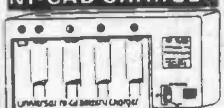
High power Class A amplifier capable of delivering 2 x 200W stereo or 400W mono in bridge mode. Inputs are direct from the speaker outputs of the car radio/cassette or low level phono inputs, with left and right level controls. Full thermal and overload protection.

- Output power .... 2 x 200W stereo 0.08% THD, 400W mono 0.2% THD
- Signal to noise ratio .... > 90dB
- Frequency response 10-50000Hz
- Input sensitivity .... 100mV-3V adjustable
- Input impedance .... High level input 100Ω, Low level input 20kΩ
- Output impedance 4Ω
- Damping factor .... > 180 into 4Ω
- Power .... 14.4V dc 43A nom
- Dims .... 240 x 130 x 50mm

£107

NI-CAD CHARGE



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Dims 93 x 198 x 50

Price: £17.50

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MW	530 to 1620kHz	SW5	13.40 to 14.15MHz
LW	150 to 270kHz	SW6	14.85 to 15.20MHz
SW1	5.85 to 6.23MHz	SW7	17.35 to 18.35KHz
SW2	6.95 to 7.42MHz	SW8	20.80 to 22.15MHz
SW3	9.45 to 9.95MHz	SW9	24.95 to 26.10MHz

Power: 6V dc (4 x AA batteries
Dims: 196 x 35 x 123mm

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ORDER CODE: MIC/G210

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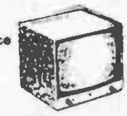

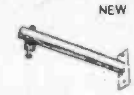

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Plus £10 carr

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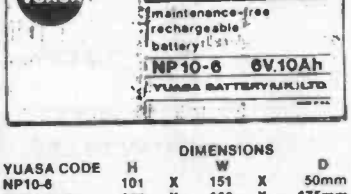

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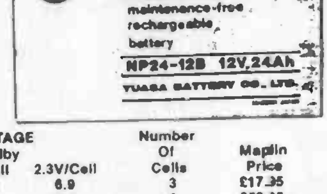

YUASA CODE	DIMENSIONS H		W		D	Max Initial Charge Current	CHARGE VOLTAGE Cyclic Standby 2.5V/Cell	2.3V/Cell	Number Of Cells	Maplin Price
NP10-6	101	X	151	X	50mm	2.5A	7.5	6.9	3	£17.95
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Weights: NP10-6 2.2Kg NP24-12B 22.7Kg NP24-12B has bolt style terminals NP10-6 is spade style

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Frequency 105-109MHz FM

ORDER CODE SEC/FMB1

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PRICE £7.50

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- ★ External Red Bell Box
- ★ 2 x 1 Internal Passive I.R.
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KIT REF 812

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KIT REF 841

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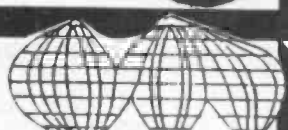
3 BAND SHORT WAVE RADIO



EE AUG 87

Covers 1.6–30 MHz in 3 bands using modern miniature coils. Audio output is via a built-in loudspeaker. Advanced design gives excellent stability, sensitivity and selectivity. Simple to build.

KIT REF 718

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EE MAR '91

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KIT REF 840

£19.86

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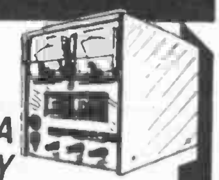

EE FEB 88

A superb design giving 0.25V and 0-2.5A. Twin panel meters indicate Voltage and Current. Voltage is variable from zero to 25V. A Toroidal transformer MOSFET power output device, and Quad op-amp IC design give excellent performance.

KIT REF 769

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EE Jan '90

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EE MAY '87

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KIT REF 707

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KIT REF 838

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EE OCT '88

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KIT REF 790

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EE OCT '86

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EE MAR '90

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KIT REF 835

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INCORPORATING ELECTRONICS MONTHLY

The No.1 Magazine for Electronic & Computer Projects

VOL. 20 No. 12 DECEMBER '91

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I doubt if *Everyday Electronics* has ever before appealed to such a wide range of readership in any single issue. Our *Information Technology* series is in its infancy and, at this stage, designed to provide information and ideas to those teaching in junior or first schools; although most of us will find some of the information refreshes the brain – or indeed fills in a few gaps.

On the other hand the *Mind Machine* project can be said to be at the forefront of its field and will interest many people outside of electronic engineering as well as those familiar with our general discipline. So within two articles we have an interest for engineers, those investigating the mind, the general hobbyist, teachers, parents, students in general and all school children now getting to grips with Information Technology, as it has to be taught in UK schools.

STEADY OUTPUT

It has been comforting through the year of recession in the UK to find that the interest in our hobby, and more particularly in *Everyday Electronics*, has not waned.

The dedicated team that produce EE each month, myself included, has a total of over 80 years of experience in the market place. Hopefully that does not mean we are a bunch of old fuddy-duddies (I certainly consider that I have a good few years left before I even think about considering myself to be "getting on a bit". If you know what I mean?). The point is that while we can bring a certain professionalism to the production of the magazine we also try to keep up to date and interest young new readers in our exciting and fascinating hobby.

As I have said before I am always interested in your views on the magazine and all your comments are read to assist me in forming the overall picture of your interests, likes and dislikes. Sometimes we change regular features – this month sees the last of the regular *Robot Roundup's*, mainly because the general interest in this subject has declined and most of the available product is expensive or aimed totally at teaching – in this way the magazine gradually changes to keep in step with the requirements of its readers.

So, next time you send for a back number, book, p.c.b., binder or subscription, if you want to add a one line comment to your letter please do. I assure you I will read it and – providing it's not too insulting – it will add to the mental picture of the ideal magazine forming in what's left of my grey matter.

Mike Kenward

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All reasonable precautions are taken to ensure that the advice and data given to readers is reliable. We cannot however guarantee it and we cannot accept legal responsibility for it.

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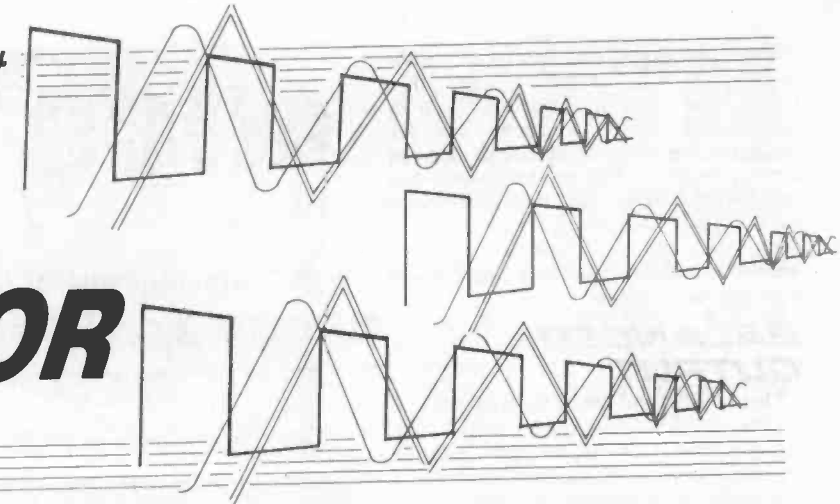
Constructional Project

SIGNAL GENERATOR



STEVE KNIGHT

An easy to build test instrument that does not compromise on accuracy. 0.1Hz to 100kHz, better than 2 per cent.

A NUMBER of low-frequency signal generator circuits using the 8038 function chip have appeared in electronics magazines over the years. An examination of these designs have shown that most of them have been nothing more than producers of sine, square and triangular waveforms without any particular regard being addressed to the accuracy either of frequency or output voltage levels. It is true that for most measurements over the audio range, precise frequency is not all that important, but for work on such systems as filters it is.

Since it is as easy to build an instrument with good accuracy as it is to build one in which the accuracy is indifferent, then it is not something to be neglected. The same is generally true of output levels; in many projects a control is provided to turn the wick up and down, but what the actual output level is for any particular setting is a matter of guesswork or estimation.

Well, since the 8038 still seems to be going strong in the integrated circuit world, here is a design for a Signal Generator which enables quantitative measurements to be made over the frequency range 0·1Hz to 100kHz with an accuracy better than 2 per cent and an output level range from a maximum of 10V peak-to-peak to 40dB down on this in four switched ranges and a continuously variable control. The output impedance is 50 ohms.

There is a separate TTL compatible square wave output, and provision is made for an external modulating signal to be imposed on the generated frequency, this facility enabling audio-range response curves of amplifiers, filters and the like to be readily displayed on an oscilloscope. The whole assembly (apart from the simple power supply) is arranged on a single printed circuit board (p.c.b.) and when mounted in its case forms an attractive and useful instrument.

THE 8038

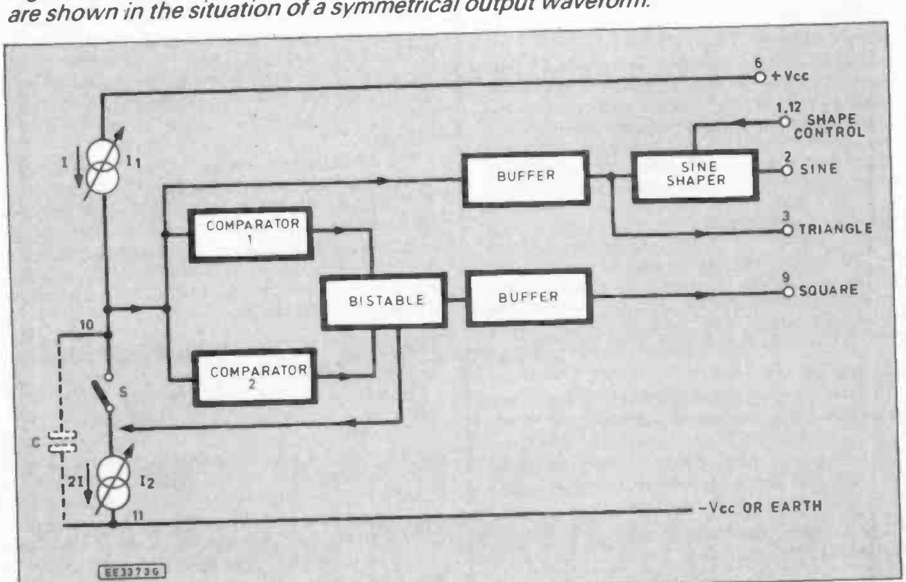
For those constructors who may not be familiar with the 8038 waveform generator chip (and there are newcomers arriving all the time these days), here are a few relevant details about what you get for your money.

The i.c. comes in 14-pin d.i.l. format and is fabricated with monolithic technology, using Schottky diodes and thin film resistors together with something like *fifty* transistors to provide signal outputs in sine, square and triangular waveshapes over a possible frequency range of 0.001Hz to something like 250kHz. A functional diagram is given in Fig. 1, where the system is seen to be made up from two comparators, two constant-current sources, two buffer amplifiers, a bistable switch and a triangular-to-sinewave approximation converter.

When an external capacitor C is connected, together with an appropriate power supply, V_{cc}, the comparators sense the charging and discharging voltage levels across C and respond to define a rising and falling ramp voltage held between two precise potential excursions. Comparator 1 responds to a voltage level of two-thirds V_{cc} while Comparator 2 responds to a level of one-third V_{cc}.

Suppose the capacitor C is to be charged by way of constant-current source I_1, current source I_2 being switched off at switch S. The voltage across C will rise linearly (since the current is constant) until it reaches a level equal to $\frac{2}{3}V_{cc}$; Comparator 1 will then trigger and cause the bistable to change state. This closes electronic switch S and the capacitor begins to discharge through current source I_2, but now decreasing linearly with time.

Fig. 1. Function diagram of the 8038 generator i.c. The constant current generators are shown in the situation of a symmetrical output waveform.



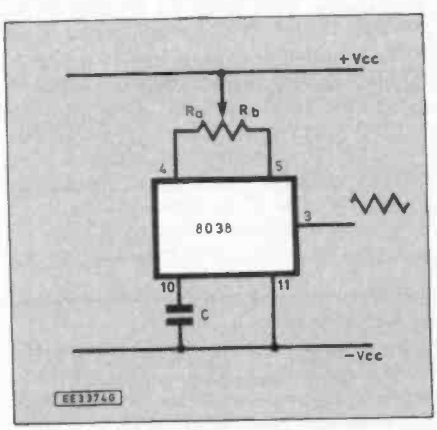
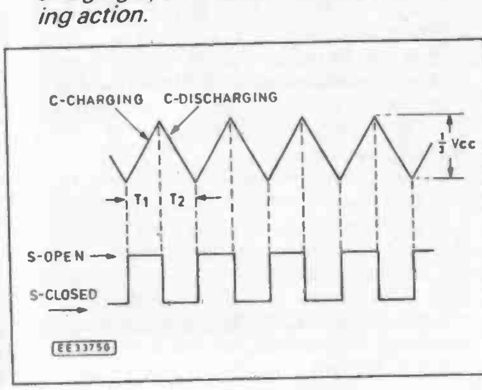


Fig. 2. Method of balancing the output triangular waveform.

Fig. 3. Relationships between the charging cycle and the bistable switching action.



When the capacitor voltage reaches the trigger level of Comparator 2, set at $\frac{1}{3}V_{cc}$, the bistable responds by reverting to its initial state, switch S opens, and the capacitor begins again to charge through current source I_1. This cycle of events then repeats indefinitely, with the amplitude of the triangular wave which appears across C being $\frac{1}{3}V_{cc}$ and of a frequency depending upon the value of C and the charge and discharge current levels.

BALANCED OUTPUT

These levels, and hence the frequency of the triangular wave, can be varied in a practical circuit by two external resistors connected between positive V_{cc} and pins 4 and 5 on the integrated circuit. Strictly, these resistors are best kept separate, but the arrangement shown in Fig. 2 simplifies the circuit and enables the effective resistance between the pins and the supply line to be adjusted over a sufficient range to make the charge and discharge gradients equal, that is, to achieve triangular symmetry.

Resistance R_a controls the rising portion of the charge on C and since the amplitude of the triangular wave is $\frac{1}{3}V_{cc}$ and as we have seen, the period of the rising portion is $T_1 = \frac{5}{3}CR_a$. See Fig. 3.

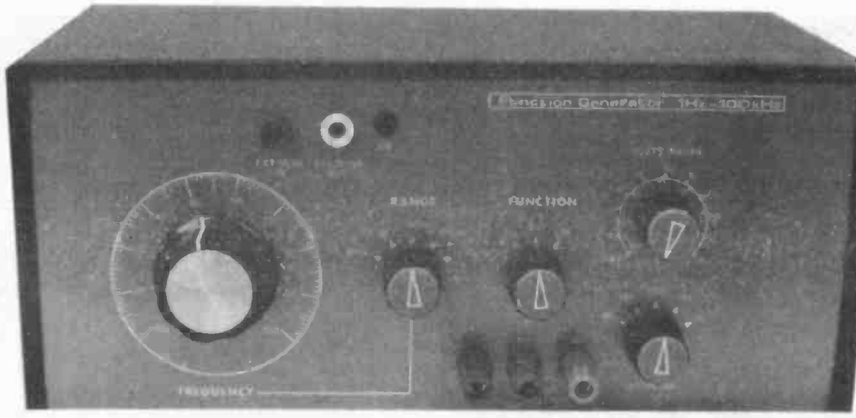
The falling portion of the wave is slightly more involved, its period is $T_2 = \frac{5}{3}(R_aR_bC)/(2R_a - R_b)$. From this we see that if $R_a = R_b$, T_1 will equal T_2 and the triangle will be symmetrical. This is the normal operating condition; the constant-current sources then have the relative levels shown in Fig. 1.

If R_a and R_b are not equal the charge time is not equal to the discharge time, and the triangular wave is asymmetrical, tending towards a sawtooth form as the resistors differ in value. It should be noticed that the supply voltage does not affect the switching actions; this is because both current sources and the comparators thresholds are direct linear functions of V_{cc}, hence the frequency is unaffected even though the supply voltage may vary.

The triangular waveform developed across capacitor C is passed through a buffer stage and is available at pin 3 of the package. The output of the bistable itself is, of course, a square wave, the change of state occurring in step with the changeover from charge to discharge of the capacitor, and conversely. Fig. 3 shows this relationship. After passing through a buffer stage, the square wave is available at pin 9.

The sinewave output is derived from the triangular wave and is shaped by a series of approximations within a non-linear circuit system made up from 16 transistors and graded resistors. A perfect sinewave cannot be produced by this method but by careful external adjustments which modify the characteristics of the shaping circuit, distortion can be reduced to less than 0.5 per cent at frequencies below 10kHz and within 2 per cent for frequencies up to 100kHz. The sinewave output appears at pin 2 of the integrated circuit.

As the sinewave is derived from the triangular wave, it will not be symmetrical unless the triangular wave is symmetrical; the same applies to the square wave. The mark-space ratio will only be 1 to 1 (or the duty cycle equal to 50 per cent) if the triangle is balanced. At the setting up stage, therefore, adjustment of the equivalent resistors R_a and R_b mentioned above must be made with extreme care.



COMPONENTS

Resistors

R1, R4, R18, R19	10k (4 off)	R15	100 1%
R2, R3, R5, R6	180k (4 off)	R16	33 1%
R7	1k	R17	10 1%
R8, R9	4k7 (2 off)	R20, R21, R22	10 (3 off)
R10, R12	5k1 (2 off)	R23, R27	3Ω9 (2 off)
R11	3k9	R24	51
R13	1k 1%	R25, R26	12k (2 off)
R14	300 1%	R28	3k3 1W
All ¼W 5% carbon, except where stated.		R29, R30	47 1W (2 off)

Potentiometers

VR1	4k7 multiturn preset
VR2	10k min. rotary Colvern CP1601, lin.
VR3, VR4	10k multiturn preset (2 off)
VR5, VR6	100k min. preset, horiz. (2 off)
VR7	2k2 min. preset, horiz.
VR8	10k min. preset, vert.
VR9	4k7 min. preset, horiz.
VR10	1k min. rotary carbon (type P20) lin., with d.p. switch

Capacitors

C1	100n polyester
C2	4700p polyester 1%
C3	100p silvered mica or polystyrene
C4	330p silvered mica or polystyrene
C5, C14	0μ22 polyester
C6	8200p polystyrene 1%
C7	39000p polystyrene 1%
C8	0μ47 5% or selected
C9	4μ7 (selected)
C10	10n polyester
C11, C12	100μ radial elec. 25V
C13	10p min. ceramic
C15, C16	1000μ axial elec. 25V

Minimum 5% except elects. and where stated

See SHOP TALK Page

Semiconductors

D1, D2, D7 to D10	1N4148 signal diode (6 off)
D3	0A90 germanium signal diode
D13	5mm red l.e.d.
D4	4V3, 400mW Zener diode
D5, D6	2V4, 400mW Zener (2 off)
D11, D12	13V, 1.3W Zener (2 off)
TR1, TR5	BC549 *npn* silicon transistor (2 off)
TR2, TR6	BC559 *pnp* silicon transistor (2 off)
TR3	BC107 *npn* a.f. driver transistor
TR4	BC177 *pnp* a.f. amp. transistor
IC1	741 op. amp
IC2	8038 waveform generator
IC3	741S op. amp
REC1	W005 1.5A 50V bridge rectifier

Miscellaneous

S1 to S3	2-pole 6-way rotary switch, with adjustable limit stop (Lorlin) (3 off)
S4	d.p.s.t. switch, part of VR10
T1	Min. mains transformer, 12V-0V-12V 250mA sec.
FS1	500mA 20mm fuse and holder

Aluminium, vinyl-covered, case, size 305mm x 130mm x 160mm; 8-pin d.i.l. low-profile socket (2 off); 14-pin d.i.l. low-profile socket; 4mm terminals, one each red, blue, green; 4mm socket, one each brown, white; control knobs 1mm dia. (4 off), 45mm dia. (1 off); solder pins; 3-core mains cable; rubber grommet, ¼in. inside dia. (2 off); connecting wire; solder etc.

Printed circuit boards available from the *EE PCB Service*, codes EE776 (Sig Gen) and EE777 (PSU)

Approx cost guidance only **£45**

CIRCUIT DESCRIPTION

The full circuit diagram of the Signal Generator is shown in Fig. 4, with a suitable power supply unit in Fig. 5. This last unit is a conventional dual voltage arrangement and both positive and negative rails are stabilized by 13V Zener diodes, D11 and D12 respectively, mounted on the main board.

The choice of 13V rails may seem an odd value (no pun intended) but the 8038, although designed to be used up to a 15V-0V-15V dual or a single 30V supply (some references say 36V), does tend to run, in my experience, rather hot when operated at these limits. As the frequency is temperature dependent, it seems best to avoid as much heating as possible, consistent with being able to generate an output to the design level of 10V peak-to-peak. The quoted frequency drift for the standard chip is typically 50ppm°C with an upper operating temperature of 70°C.

Using a 13V-0V-13V supply, any possibility of the device overheating seems to be avoided, particularly when the circuit may be switched on over an extended period. Nothing more elaborate than this simple Zener stabilization is necessary to achieve this.

FREQUENCY OUTPUT

The frequency output from the 8038 is determined by the capacitance connected between pin 10 and the negative rail and by the voltage on pin 8. The voltage across the resistance chain VR1, VR2, VR3 and R1 is 13V; taking the presets VR1 and VR3 to be approximately at the centre of their tracks when the required frequency range is covered by the main panel control VR2.

The potential excursion swept out by potentiometer VR2 is about 12.5V to 7.5V; in conjunction with the appropriate value of capacitor, this enables a 10:1 frequency sweep to be obtained. This enables the frequency ranges covered to go up in conventional decade steps by a choice of capacitors which go up in the same ratio. The capacitors, two of which are made up from parallelled arrangements, are selected by the front panel rotary switch S1.

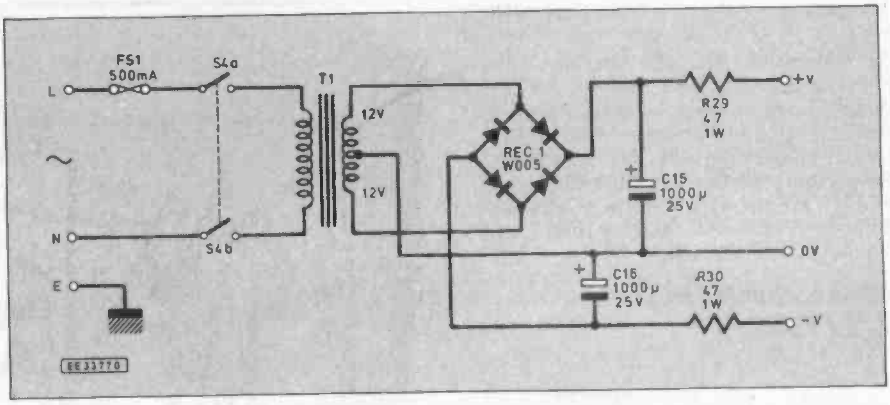


Fig. 5. Circuit diagram of the Power Supply Unit. Switch S4 is part of potentiometer control VR10.

In most designs, the slider of frequency control potentiometer VR2 is connected directly to pin 8. This is quite permissible, but by using a unity gain op.amp, IC1, between the control and the 8038, provision is made for frequency modulation from an external source (SK1). This will be considered later on in more detail.

The output of IC1 (pin 6) follows the voltage present on its non-inverting input, hence pin 8 of the 8038 receives the voltage variation from VR2. The output frequency of IC2 produced at pins 2, 3 and 9 is directly proportional to the voltage on pin 8, hence potentiometer VR2 is selected with a linear track, so making the panel frequency scaling linear with rotation also.

Pin 8 of IC2 is susceptible to pick-up, so capacitor C1 bypasses any such unwanted transients to "ground". Diode D1 in the supply feed to the 8038 is included to prevent distortion which can occur when the slider of VR2 is close to the V_{cc} voltage.

WAVEFORMS

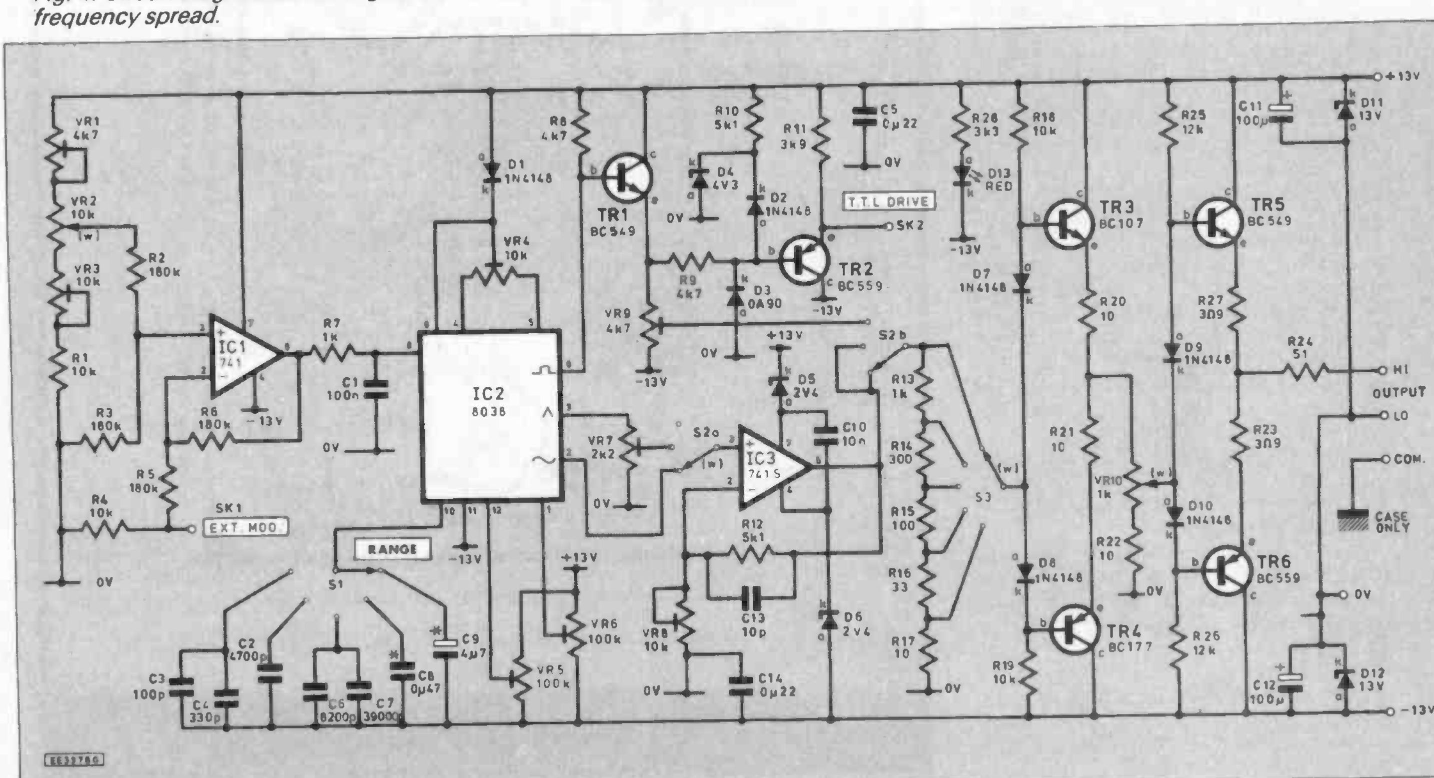
The three waveforms available at pins 2, 3 and 9 of IC2 could be used directly as outputs, but there are reasons why this is not a practical proposition. To begin with, the outputs are all at different amplitudes; the square wave on pin 9 has a peak-to-peak amplitude which is not far short of the supply voltage; the triangular wave has, as we have noted, an amplitude of one third V_{cc}, and the sinewave output has an amplitude of only about 0·22 of the supply voltage. So something has to be done to balance things up a bit.

Further, the 8038 can be damaged if the output pins are shorted out or if excessive current is drawn. There is no internal protection which will limit the output currents, so it is necessary to ensure that the generator outputs operate into circuits with high input impedances.

This can be accomplished best by feeding into an op.amp or an emitter-follower. In this circuit, both methods are employed.

The sinewave output (pin 2) of about $0{\cdot}22V_{cc}$ (about 6V peak-to-peak) feeds directly (via Function selector switch S2a) into the non-inverting input of IC3, as does the triangular wave output (pin 3), this

Fig. 4. Circuit diagram for the Signal Generator. It is important that potentiometer VR2 has a wide rotation angle (300°) for good frequency spread.



being suitably reduced by the preset potentiometer VR7 to equalize its amplitude with that of the sinewave. The gain of IC3 is then set by adjustment of the feedback preset resistor VR8 for the output to be precisely 10V peak-to-peak at switch S2b.

In the meanwhile, the square wave output at pin 9 on IC2 bypasses the op.amp and feeds instead into transistor TR1, an emitter-follower, the output at the emitter being adjusted by preset VR9 to match the 10V peak-to-peak amplitudes of the sine and triangular waves at switch S2b. In this way, switches S2a and S2b being ganged, all waveform levels are identical at the wiper (w) or pole contact of S2b, and the necessary high impedance loading on the generator outputs is achieved.

TTL OUTPUT

To provide a useful TTL compatible output of a 5V amplitude square wave independent of the other outputs selected by switch S2b, the square wave appearing at the emitter of TR1 is passed at full amplitude into the base of the second emitter-follower TR2, this time a *pnp* transistor. Zener diode D4, however, holds the potential at the junction of resistor R10 and diode D2 at 4.3V.

The positive excursion of the square wave cannot therefore exceed 5V, the drop across D2 being about 0.7V when it is driven into conduction; and the negative excursion is held at close to earth potential by the conduction of diode D3. A 5V amplitude square wave consequently appears at the emitter of TR2. This is taken to a separate terminal on the front panel of the instrument as a TTL Drive Output signal.

The switched attenuator made up from resistors R13 to R17 is a coarse control giving voltage ratios of 1, 0.3, 0.1, 0.03 and 0.01 very closely corresponding to attenuations of 0dB, −10dB, −20dB, −30dB and −40dB respectively below 10V peak-to-peak. The output voltage ranges on potentiometer VR10 which is the fine attenuator control, are therefore 0-10V, 0-3.16V, 0-1V, 0-31mV and 0-100mV. The use of a peak-to-peak calibration provides easy correlation between sine and the other output waveforms.

The output and intermediate driver amplifiers are quite conventional complementary stages, having an overall unity gain. TR3 is a BC107 and TR4 its complement, the BC177. TR5 and TR6 are complementary pairs BC549 and BC559 respectively. The output is taken via resistor R24 and has a nominal impedance of 50 ohms.

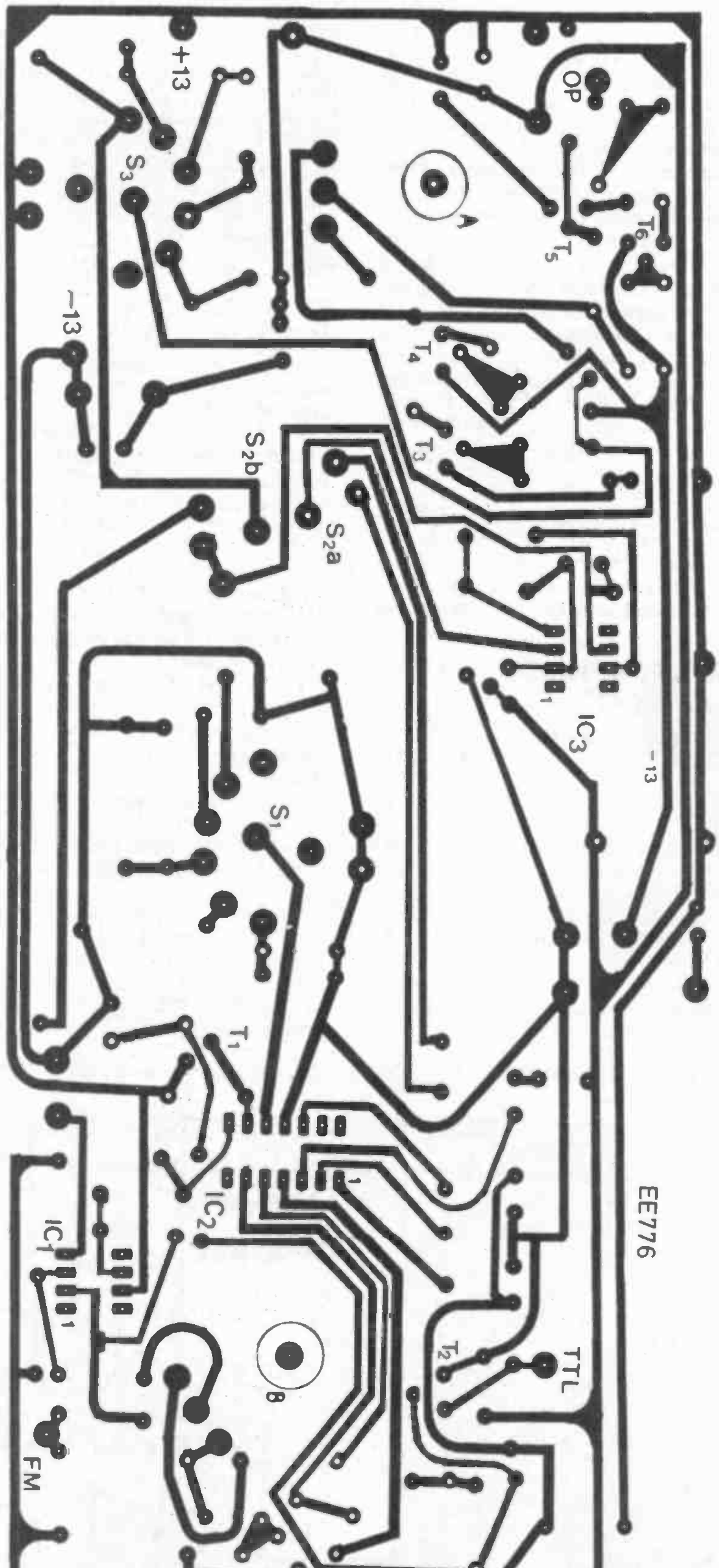
A l.e.d. indicator is provided, D13, which is fed from the full dual supply rails by way of limiting resistor R28.

Little need be said about the power unit, Fig. 5, which is assembled on a small separate p.c.b. A 12V-0V-12V, 250mA miniature mains transformer feeds into a bridge rectifier, REC1, which provides both positive and negative outputs of about 18V (unloaded) about the 0V line taken from the transformer secondary centre-tap.

Smoothing is carried out by 1000µ 25V working capacitors C15 and C16. Two 47 ohm one watt resistors R29, R30 act as safety limiters for the 13V Zener stabilizers D11, D12 on the main board.

CONSTRUCTION

Construction of this project is basically very easy as all components are mounted



Full size underside copper foil master pattern. The connecting pads for potentiometers VR2 and VR10 are not drilled.

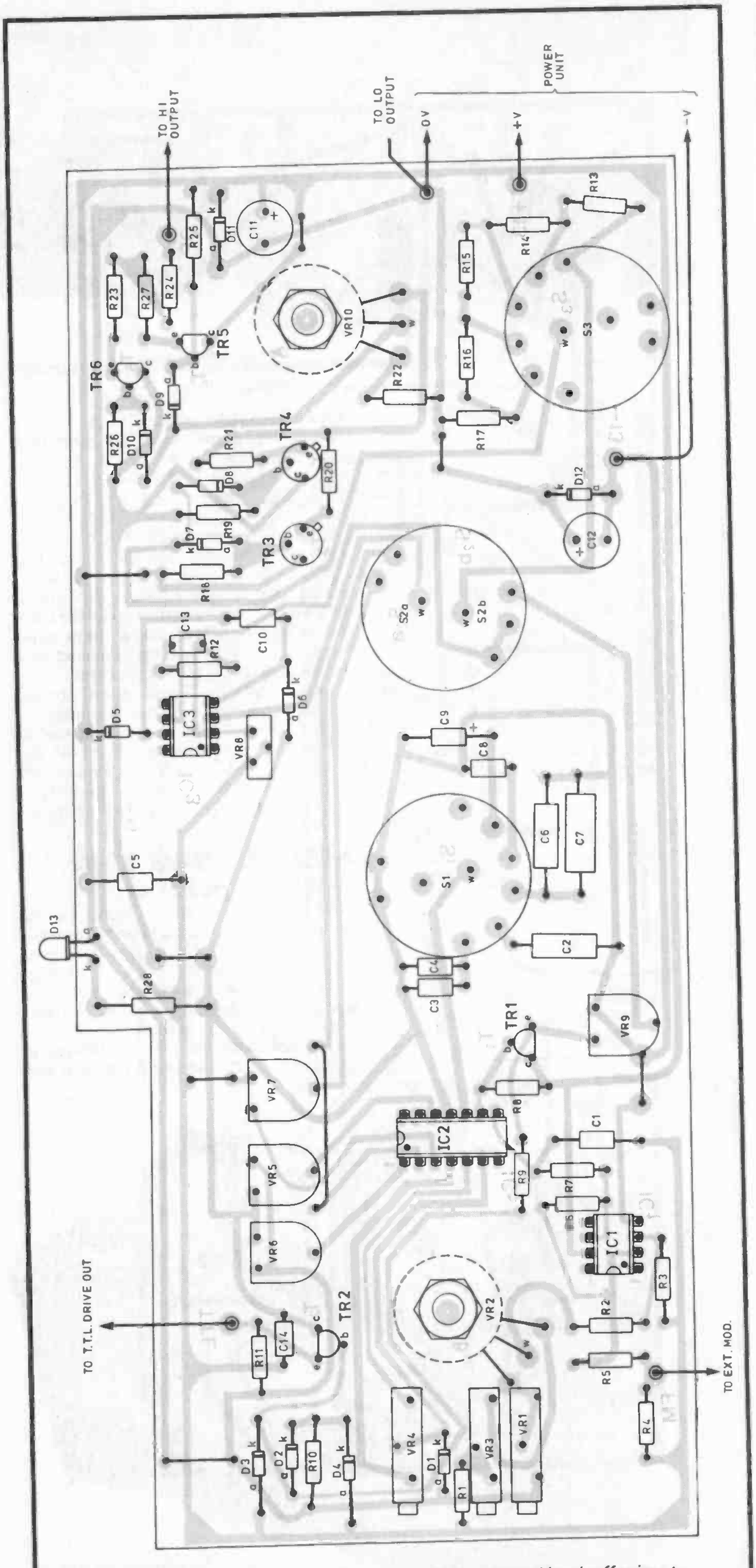


Fig. 6. Printed circuit board component layout and lead-off wires to front panel sockets and power supply board. Indicator l.e.d. D13 is fitted after assembly to the panel.

on two p.c.b's. The component layouts are shown in Fig. 6 and Fig. 10. These boards are available from the *EE PCB Service* codes, EE776 (Sig. Gen.) and EE777 (PSU).

The only separate wiring runs to external parts are those to the various output terminals (four wires), those between the power unit and the main board (three wires), and the mains supply input which goes via fuse FS1 and on-off switch S4 (on the fine attenuation control VR10) to the transformer primary.

The main board fits directly on to the front panel, the three switches bush nuts being the means by which attachment is made. It is necessary then for the panel drilling to match *exactly* to the control component spindles and bushes on the board and we will return to this later on.

CIRCUIT BOARD

The component layout and full size printed circuit copper foil master pattern of the main signal generator board is given in Fig. 6. If you make your own, it is essential that the hole positions for the Frequency control potentiometer VR2 and the fine

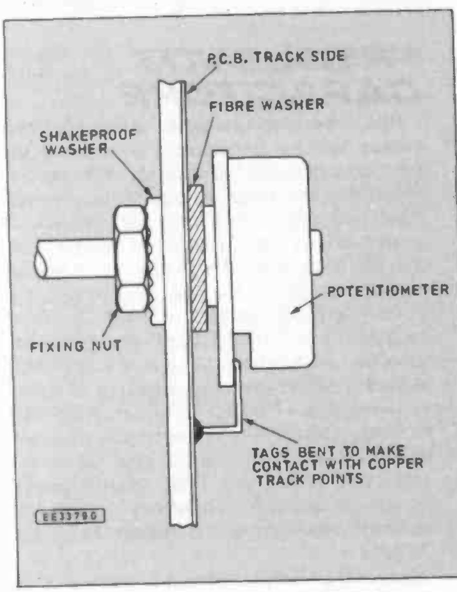


Fig. 7. How the attenuator potentiometer VR10 is fitted to the p.c.b.

output attenuator VR10 (shown at points *B* and *A* respectively) are precisely drilled in the positions indicated.

These pots are mounted on the track side of the board and the tags of VR10 are bent forward through 90 degrees to make solderable contact with the three copper pads provided for each of them, see Fig. 7. Potentiometer VR2 has a wide electrical rotation angle and must be the type specified if an adequate sweep is to be obtained for each frequency range. This pot is wired with short length of wire from its tags down to the pads on the printed board. It is also necessary to ensure that the switch contact connecting pads on the board are drilled accurately as the switch positions must also coincide with the panel drilling holes.

A 1mm drill is suitable for all the component mounting holes except those which are for the miniature preset potentiometers VR5, VR6, VR7 and VR9. These require a 1.2mm drill.

The switches S1, S2 and S3 are mounted directly onto the board and their connecting pads need to be drilled 1.6mm (1/16 inch), through a hole up to 2mm is acceptable. The preset VR1, VR3 and VR4 are multi-turn types requiring only a 1mm drilling.

The order of assembling components on the board is not particularly important; it is perhaps best to begin with the various jumper links (there are eight of these), then all the diodes (taking care with the polarities), then the resistors and capacitors, presets and transistors. Make sure with the transistors that you don't muddle the *npn's* with the *pnp's*.

It is probably advisable to use low-profile i.c. holders for the three integrated circuits just in case you get a dud (not unheard of), but if you are an optimist they may be soldered directly to the board. IC3 *must* be a 741S, not a plain 741, though this latter type is suitable for IC1.

The control potentiometers and the three switches are best left to last as their projecting shafts can prove a hinderance if they are mounted sooner. The two potentiometers VR2 and VR10 which go on the track side of the board must have a *thin* fibre or other type of insulating washer between the case and the board as Fig. 7 illustrates; this ensures that there is no possibility of the metal case touching onto the board tracks.

FREQUENCY CAPACITORS

Just a word at this point about the frequency selector capacitor associated with the rotary switch S1. Capacitors C3 and C4 are 330pF and 100pF one per cent silvered mica (or polystyrene will do) connected in *parallel* to give a total of 430pF for the 100kHz range. In theory a 470pF is needed but there are sufficient strays to make 430pF adequate.

Capacitor C2 is a 4700pF one per cent capacitor, and C6 and C7 are 39000pF and 8200pF one per cent capacitors in parallel to give a close 47000pF. It is necessary for the capacitors to be as accurate as possible, and by using one per cent precision types and combining them where necessary, very accurate frequency scaling is obtained throughout the ranges 1kHz to 100kHz.

It is not so easy to obtain a one per cent capacitor of the value required for C8, but nothing worse than five per cent should be selected. The 4.7µF electrolytic, C9, is just that, though you may be able to get a five per cent polycarbonate type (rather pricey though!) or make up a combination from, say two 2.2µF plus a 330nF. If you have access to a capacitance meter or bridge use it as I did, to select these larger value capacitors.

SWITCHES

The three Lorlin rotary switches need a bit of work done on them preparatory to mounting on the board. Not all of the pins are used and certain of them have to be snipped off. Also, the position of the locating stop-ring has to be adjusted. Fig. 8 shows how this is done.

First, turn each switch fully *anticlockwise*. For S1 and S3 the stop-ring should then be moved back one place to position 5; this makes the switches 5-way types. For S2 put the stop back to position 3; this then makes this a 3-way type. Replace the washer and nut and *check* that the switches all move the appropriate number of places from the anticlockwise position.

The following table indicates which of the switch tags have to be snipped off completely. Snip them off close to the body of the switch to leave stumps not more than about 1mm high. Fig. 9 shows the method.

Switch S1: remove tags 6, 7, 10, 11
Switch S2: remove tags 4, 5, 6, 7, 10, 11, 12
Switch S3: remove tags 1, 4, 5, 12

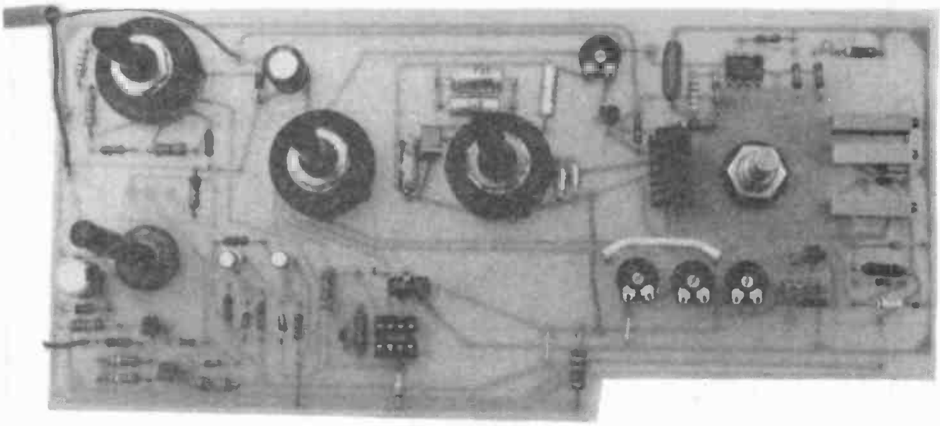
All the remaining tags then have their eyelets *only* removed as Fig. 9 indicates, leaving as much of the tag as possible on these so that they will protrude on the track side of the board by about 1mm when fitted. This enables a sound soldered connection to be made to the copper foil.

Using your snips "upside down" for this job is advantageous in that it enable the eyelet to be removed without biting into the stump itself. The orientation of the flat on the switch shafts will be automatically correct for the fitting of a grub-screwed knob (if you prefer these) when finally assembled.

MOUNTING THE SWITCHES

When mounting the switches on the board, made sure the tag stumps are not bent out of vertical and that their tops haven't been "sprayed" out by your snipping action. Push them into their respective hole positions carefully, making sure that the board is not bent or strained.

It is best, once the pins are located in their holes, to lay the board flat on a soft



The completed printed circuit board showing component layout. Note that potentiometers VR2 and VR10 are mounted on the track side.

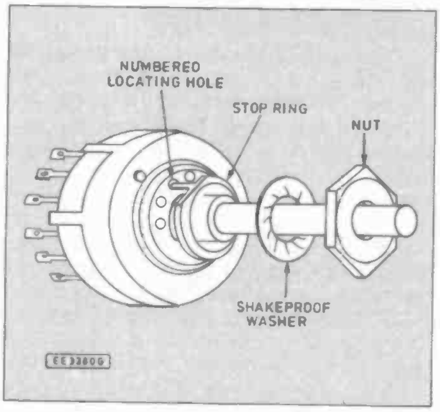


Fig. 8. How to adjust the number of "ways" on the rotary switches.

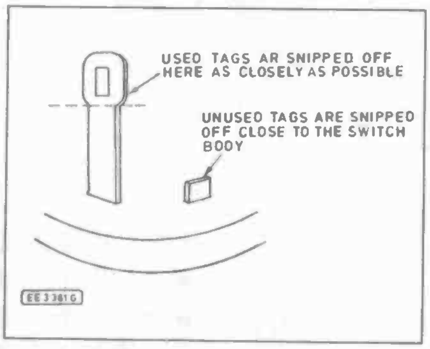
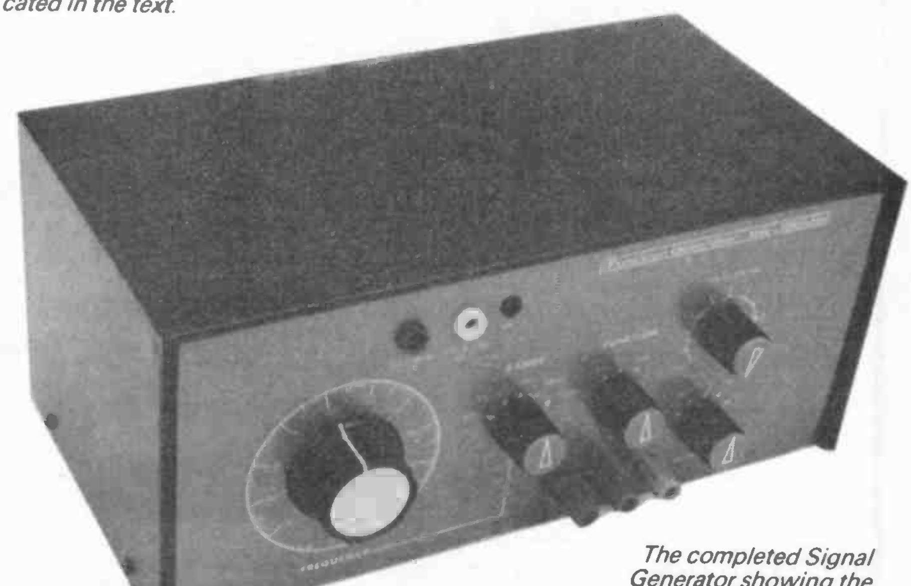


Fig. 9. Preparing the rotary switches for the p.c.b. by snipping the tags as indicated in the text.



The completed Signal Generator showing the frequency scale and front panel controls.

but firm surface and press the switch home by applying firm pressure to the body of the switch. This will ensure that the switch sits squarely on the board *before* soldering; unless you check this point the shaft may not be at right-angles to the plane of the board and it will not locate through the appropriate panel hole later on.

Also, on the front face of the switches there is a small locating boss formed in the plastic; this should be snipped off as well as this is not required for locating purposes. Do not fit the l.e.d. D13 indicator at this stage.

POWER SUPPLY

The printed circuit board component layout and full size copper foil master pattern for the Power Supply Unit (PSU) is given in Fig. 10. The two separate secondary windings of the mains transformer are connected together at the two centre tags and this centre-tap point together with the outer connections are wired through to the board foil with short lengths of bare wire.

Take particular care when fitting the bridge rectifier; this can go in any one of four ways since the lead spacing is symmetrical, and only one is correct! Also, make sure the electrolytics are correctly polarized.

Later on, the fitting of the supply board to the instrument case is accomplished by screws and spacers through the two transformer fixing points marked *F* (so use temporary screws to secure the transformer at this stage) and the hole marked *G* between the + and − output points. Solder three solder pins to the three output points so that a convenient connection can be made to the main board during preliminary testing. The rest of the circuit and its assembly needs no further comment.

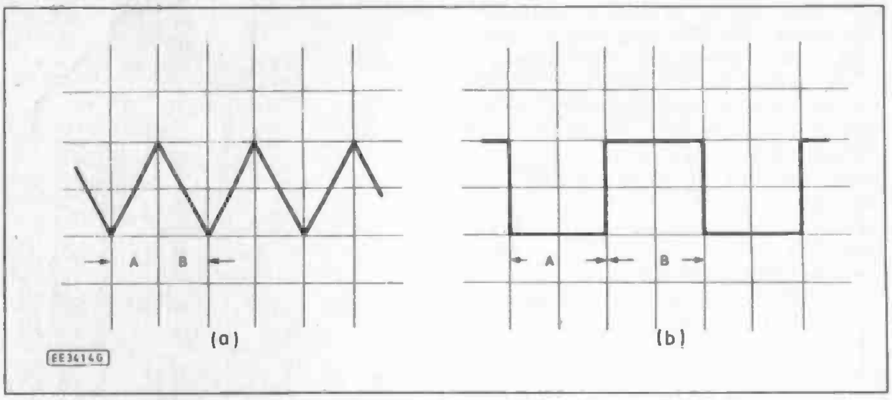


Fig. 11. Balancing the output signal by making the periods A and B equal. Either triangular or square waves may be used.

TEST AND ALIGNMENT

Nearly all of the testing and setting up of voltage levels can be done with the boards on the bench; all that remains once the boards are fitted into the case is the alignment of the main frequency scale. An oscilloscope is necessary for setting waveforms; the other requirements are an a.c. voltmeter and some means of measuring frequency. The oscilloscope does not need to be a particularly good one provided its Y-amplifier is distortion free up to 100kHz and its time-base is linear.

Using about 305mm (12 in.) lengths of wire for the time being, connect the main board to the power unit; also connect a short length of wire to the signal output point (from resistor R24) on the main board so that the output is available. Two insulated mains rated wires are also needed from the transformer primary terminals to the mains supply. It is wise to protect these terminals with a piece of insulating tape while setting up to avoid accidental contact.

Before applying power, turn all the preset potentiometers including the multiturns, to about their mid-positions. Turn the mains Frequency control pot VR2 to about its mid-position also, set the Range switch (S1) to the 1kHz mode (its middle position), the Function switch (S2) to Sine (fully clockwise), the Coarse Attenuator (S3) to 0dB (fully clockwise) and the Fine Attenuator pot (VR10) to maximum.

WAVEFORMS

Connect the oscilloscope input between the output point from R24 and earth (the Common connection). Switch on; a sinewave, probably distorted somewhat, should appear on the screen. Check briefly, using the Function switch, that a triangle and square wave are also present.

Turn the main Frequency control and verify that the frequency of the sinewave varies. Don't worry at this stage about either their actual shapes or their different amplitudes. Set the scope controls so that you get about three full cycles on the screen.

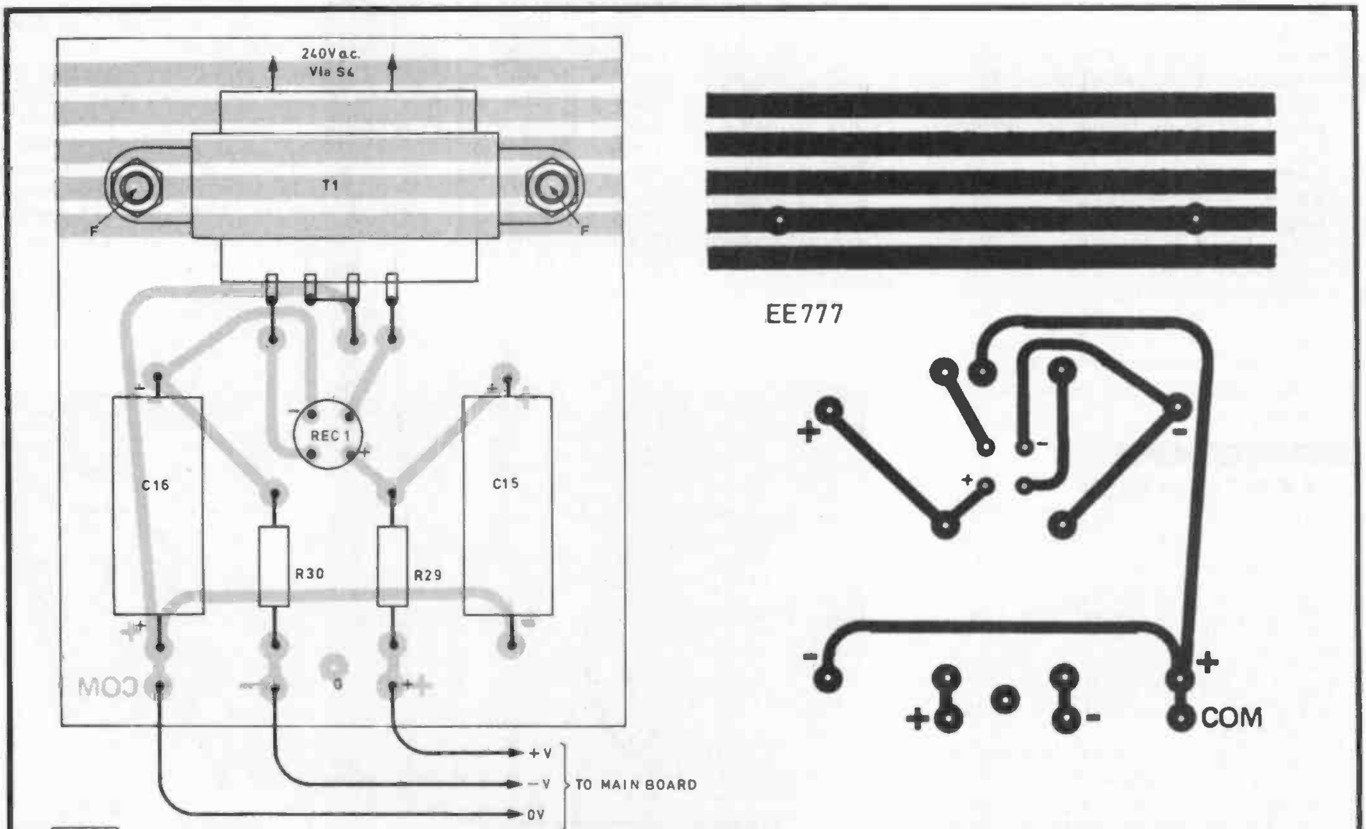


Fig. 10. Printed circuit board component layout and full size copper foil master pattern. Fixing holes at F and G are 6BA clearance, transformer T1 is temporarily fitted during assembly by two 6BA screws.

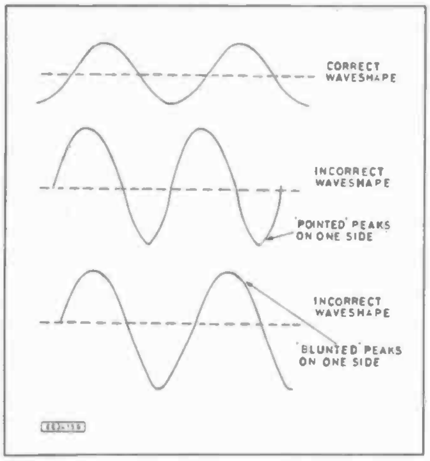
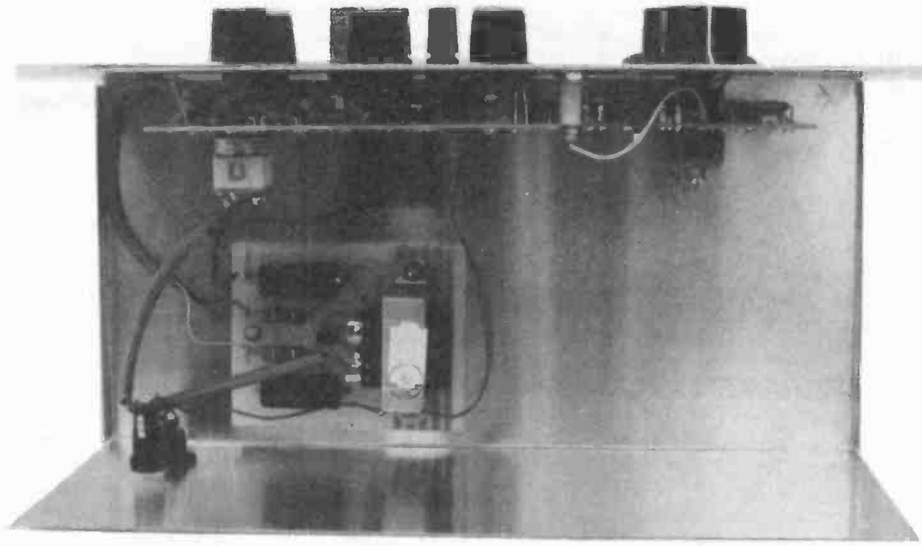


Fig. 12. using VR5 and VR6 adjust for best possible sinewave shape.



Position and wiring of the two circuit boards inside the metal case.

We now need to set the balance control VR4 to give us a symmetrical triangular wave. Set the Function switch to Triangle (fully anticlockwise) and adjust VR4 until the triangle on the scope screen is symmetrical, see Fig. 11a. It is sometimes easier to use the square wave for this adjustment; if you choose this, adjust VR4 until the square wave has a 1:1 mark-space ratio, see Fig. 11.

When you have got this right, switch back to Sine, and making sure that the Fine output attenuator pot is fully clockwise, adjust the gain preset VR8 (close to IC3) so that the output level is 10V peak-to-peak sinewave.

Now adjust VR5 and VR6 alternately to give the best sinewave shape you can get. This is a subjective matter and the thing to aim for is to get a sinewave that is equally "rounded" at the maximum and minimum points of each cycle, the rights and wrongs being illustrated in Fig. 12.

Ideally, a distortion meter should be used for the best possible waveform, but with care a very accurate sinewave can be obtained. Recheck now on the output level, as this may have changed slightly with the sinewave shaping adjustment.

For the correct amplitudes of the other two waveforms, the scope can again be used but if its accuracy is suspect, use the a.c. voltmeter again across the output points. Set the triangular amplitude using VR7 so that the meter reads 2.9V, this will be close enough, and for the square wave (where r.m.s. and peak vales are identical), adjust VR9 to give a reading of 5V. These measurements are best made at a relatively low frequency, say, somewhere on the 1kHz range or lower as an a.c. meter is strictly scaled for 50Hz, though most meters will be O.K. up to several kilohertz without error.

PREPARING THE CASE

The specified case measures 305 mm by 130mm high by 160mm deep and is a relatively inexpensive box having a vinyl covering over a plain aluminium lower part. For a reasonable finish, this lower part should be sprayed with a colour of your fancy, though the front panel itself will depend upon what you do about adding on a legended overlay. But more of this in a little while.

Apart from two holes to be drilled in the rear for the mains input lead and the fuse fitting, the positions of which are not critical, the front panel *must* have its holes drilled exactly suited to the positions indicated on the panel layout given in Fig. 13. Unless this is done, the board will not fit the panel drillings. You can achieve good results by marking through the holes on the unpopulated p.c.b.

If you are a dab hand with rub-down lettering, you can use Fig. 13 has a guide to make a good copy onto a piece of card or very thin aluminium. Alternately, you can get a twice up photocopy made on to a sheet of good quality paper of a colour of your choice, and stick this onto a piece of aluminium sheet. A full size frequency scale is shown in Fig. 14.

DRILLING

Whatever you decide, position the panel over the front of the case and mark through the hole centres onto the aluminium with a punch or scriber. Preferably drill small guide holes, say one-eighth inch, through the points you have marked and *recheck* their positions *before* going on to the full size drilling.

Now drill or punch out the positions to the following sizes: (a) the main frequency scale and the fine attenuator scale, 3/8 in. dia.; (b) the three switch positions, 3/8 in. dia., though it eases any slight inaccuracies if you make these 7/16 in. dia.; (c) the three lower level output terminals, 9/32 in. dia.; (d) the Ext Mod and TTL Drive positions, 5/16 in. dia.; (e) the l.e.d. "ON" position, 1/4 in. dia. If you use a drill, de-burr all the holes carefully.

You will need to file a very small V-shape at the base of each of the three output terminal holes to accommodate the locating lug on each of these terminals. The drillings mentioned under (c) and (d) above assume you use the specified terminals; if you do not, you must make these holes to suit your terminal choice.

ASSEMBLY

The front panel print can be either glued to the panel, if it is a paper photocopy, or held in position by the three switch locking nuts and the various terminals if a printed card is used. Put grommets with a 1/4 in. centre hole into the Frequency and Fine Attenuator holes so that the shafts of these two controls can pass through them when the board is offered up to the panel, using the grommets as soft bearings.

It makes things easier to push the shafts through the grommets if you smear a trace of caster oil inside the grommet holes. Check that the board control shafts pass correctly through the panel holes but do not fasten anything yet.

The power supply board is screwed to the base of the case by three fixing screws (6BA or 3mm metric will do) and held off the case floor by 1/4 in. spacers. Its position is not critical but it should be mounted about 1/4 in. from the rear of the case towards the end where the three power input leads come from the main board. The mains input point and fuse can then also be positioned at this end.

Before fitting the main (Sig. Gen.) board,

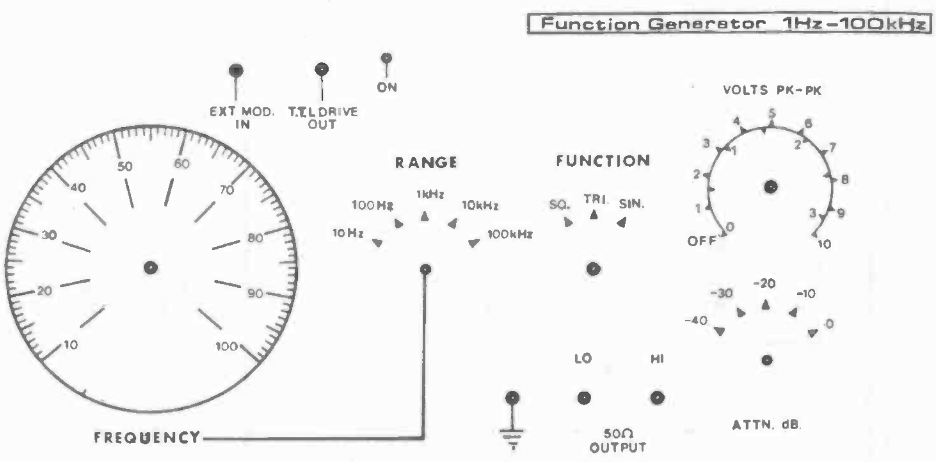


Fig. 13. Half-size details of front panel layout and frequency scale.

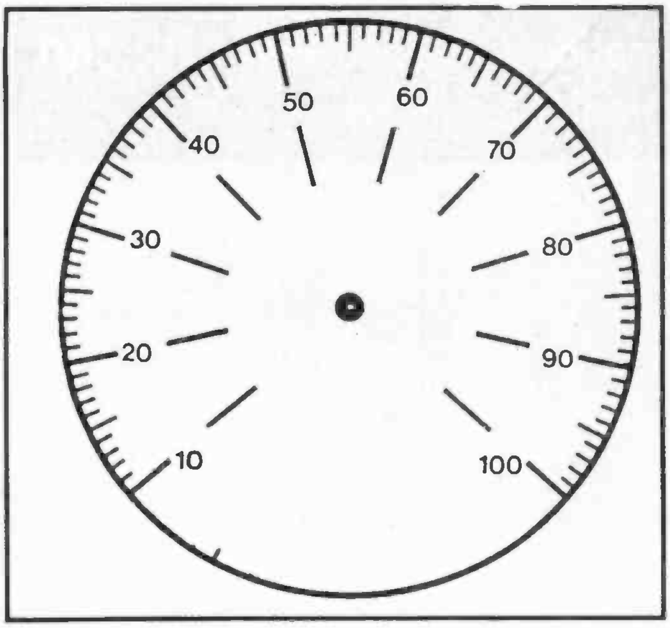


Fig. 14. Full size frequency scale.

solder lengths of flexible wire to the Ext Mod point (152mm), the TTL Drive point (76mm), and position these wires so that they can be connected to the two upper socket outlets *after* the board is mounted. Also, cut the three wires which will go to the power unit to about 7 in. in length.

It eases things if you solder the output wires (from R24) to the HI terminals, and 152mm lengths of wire to the other two terminals before fitting the board to the front panel. The "earth" one of these wires then goes to the case itself via a tag under one of the transformer fixing screws. The LO output does *NOT* go to the case but to the 0V connection pin on the power board where it also joins to the 0V lead from the main board.

To mount the main board, remove the three locking nuts from the three switches, taking care that the locating rings and the shakeproof washers do not fall out of position as you manoeuvre the board up to the panel and get the shafts into their respective holes. Push the board into position, letting the threaded bushes of the three switches fit snugly through their holes before putting their nuts back onto them. The shakeproofs are left *behind* the panel.

Tighten the nuts (but not overtight) and ensure that the board is straight and parallel to the panel and that nothing has been forced into position against its will. If there are slight inaccuracies in the bush positions, a touch with a file should remedy things, but this won't help if there are gross misalignments.

Once everything is shipshape, cut off the shafts to suit the knobs you are using. One-inch diameter collet knobs with marker caps are best; grub-screwed knobs must have their indicating marks opposite the screw positions. The main frequency control knob is a 45mm diameter component and should be fitted so that it moves over its rotation range equally beyond the extremities of the panel scale when turned fully in either direction.

The l.e.d. indicator D13 can now be fitted. bend its leads slightly so that they will pass through the two holes in the board, then bring the l.e.d. forwards so that it will slide into either a standard mounting clip of a ¼ in. inside-hole grommet mounted in the panel hole.

To complete things, the wiring from the mains input leads (three-core) and the fuse can now be taken via the double-pole switch on VR10 to the primary terminals of the transformer. If you have a split primary, don't forget to link the two inner tags.

FREQUENCY CALIBRATION

To set up the Signal Generator it is only necessary to align the frequency scale on one of the frequency ranges as the others will then be correct, if the capacitors selected by switch S1 are accurate. This is best done on the middle position of the Range switch, i.e. the 100Hz to 1kHz range.

Switch to this position, set the frequency knob to indicate 20 on its scale and adjust VR1 until the output, as measured on a suitable frequency meter, reads 200Hz. Turn the Frequency knob to indicate 90 on the scale and adjust VR3 to give an output of 900Hz. Repeat this procedure a few times until no change is observed when turning from one position to the other.

This completes the calibration. The other ranges will be correct within the tolerance of their capacitors. □

ACTUALLY DOING IT!

by Robert Penfold

FOR anyone just starting out on the hobby of electronics construction I could not really recommend making your own printed circuit boards. There will be plenty of skills to master without adding a few more to the list by making your own circuit boards. Initially it is much better to use stripboard, or better still, a ready-made custom printed circuit board. This keeps the task as simple as possible, and optimises your chances of success.

You will probably want to try your hand at printed circuit making before too long though, and I suppose that it is something which every electronics hobbyist should try at some stage or other. To be honest, it is a pastime that is not everyone's "cup of tea". It involves the use of some messy chemicals, one of which is practically guaranteed to permanently stain any clothing, carpets, etc. that it comes into contact with.

I suppose that messing around with chemicals is one of those things you either love or hate, with few people being indifferent about it. Provided you are not put off by this aspect of making printed circuit boards, it is an interesting and rewarding part of the hobby.

SIMPLE METHODS

Making printed circuit boards can be as simple or complicated as you care to make it. At one extreme you can use simple equipment such as pens and hand-drills, while at the other you can use photographic methods, special "bubble" etching tanks, and all sorts of paraphernalia. In this Actually Doing It article we will take a look at the more simple methods, which are the best starting point. These will give you a "taste" of printed circuit board construction without involving you in great expenditure.

If you decide that this aspect of the hobby is one that does not really interest you, then you will not have wasted much money. If you do decide to pursue this aspect of things, then you may find that the simple techniques are all that you will need. However, if you are going to get involved in a lot of printed circuit construction, it would probably be advisable to progress to more advanced methods. These will be discussed in the next Actually Doing It article.

The basic printed circuit board material consists of a piece of board made from an insulating material, and covered with a thin layer of copper on one or both sides. Some designs for the home constructor are based on double-sided boards, but the vast majority use single-sided types. Making double-sided boards is not an easy task, and is certainly not a good starting point. Initially you should content yourself with fairly simple single-sided designs.

LAMINATE

Two types of copper laminate board are readily available, and these are the s.r.b.p. and fibreglass varieties. These are simply the materials from which the boards are made. Fibreglass consists of fibres of glass plus polyester resin (a type of plastic), as used in boat building etc. This is the tougher type of board, and is the one preferred by many users. Be warned though, that the fibres of glass tend to rapidly blunt saws and drills. Special super-hard drills are available for drilling this material, but they are very expensive and break easily.

For most purposes s.r.b.p. (sheet resin bonded paper) is adequate, and this is the type I mainly use these days. This is much cheaper than fibreglass board, but is still quite tough. It is probably only worthwhile using the fibreglass type when a very large board is being made, or if it will have to accommodate a heavy component such as a mains transformer.

BASIC PROCESSES

In order to turn the raw board into a working printed circuit board there are two basic processes that must be undertaken. First the unwanted areas of copper must be removed, so as to leave a pattern of copper tracks that will connect all the components together in the appropriate manner. This is achieved using a simple etching process. Then holes for the component leads must be drilled. The components are mounted on the non-copper (top) side of the board, and their leadout wires are soldered to the copper tracks on the underside of the board.

This is very much like stripboard, but there are some important differences. With stripboard the tracks are of uniform width, even at the points where there are holes for leadout wires. With custom printed circuits the tracks are often of several widths, are generally quite narrow, and widen out to form pads at the points where there are holes for leadout wires. Obviously there are only holes where they are needed, and the tracks can go in any direction.

On many boards the track shapes are quite intricate. This enables more compact layouts to be achieved, and usually enables fewer link wires to be used. In fact there may be no need for link wires at all, which is not usually possible when using stripboard.

TRACING

Once a board of the correct size has been cut out, the copper track pattern must be marked on the copper side of the board using etch resist. The board is then immersed in etchant, which removes the exposed areas of copper, but leaves the areas covered by the resist.

Before the track pattern is drawn onto the board it is essential that the copper side of the board is cleaned to produce a bright and shiny finish. This ensures that the board will etch efficiently. A dirty board may etch very slowly, giving poor results. It is even possible that some areas of the board will fail to etch at all.

Cleaning the board is very simple, and there are special abrasive blocks for this purpose. Alternatively, wire-wool gives good results, as do "Brillo-Pads" and scouring powders. The difficult part is keeping the cleaned board in good condition. Touching the copper surface will leave finger marks that might prove reluctant to etch. Try to only hold the board by the edges once it has been cleaned.

Next the track pattern must be traced from the diagram in the magazine or book onto the copper side of the board. There are various ways of doing this, and you may have your own "pet" method of doing this type of thing. The method I have always found most satisfactory is to first make a photocopy of the design. There is a potential problem here in that many photocopiers produce a copy that is slightly smaller than the original. In most cases the slight shrinkage will not be enough to cause any problems, and the more modern photocopiers seem to be largely free from this trait anyway.

The copy is fixed on the copper side of the board using double-sided tape. If you are prepared to cut up the book or magazine, you can use the original diagram (which should guarantee accurate results). You can now mark the positions of the holes in the board, using a sharp instrument such as a bradawl to make small indentations in the board at the appropriate points. Do this as accurately as possible. Later these indentations will act as guides when drilling the holes in the board.

With a complex board it might be advisable to gently scratch further navigation points onto the boards, such as the corners of intricate tracks. With the drawing and tape removed you can then use your selected method to add the etch resist.

ETCH RESIST

The resist can be a water resistant paint or ink applied by brush. However, the complexity of most modern boards is such that this method is not very practical these days. Rather than a brush, it is more normal for a fibre-tipped pen having a spirit based ink to be used. These enable quite fine designs to be produced with good neatness.

Many of the larger component retailers sell pens for this purpose, but just about any pen having a fine tip and a spirit based ink seems to be suitable. You may well already have something suitable. If in doubt, you can always do a test run on a small scrap of copper clad board to see if the ink will resist the etchant properly.

A popular alternative to a pen is to use etch resist transfers. These are rub-on transfers, and there are various types available (pads, tracks, d.i.l. clusters for integrated circuits, edge connectors, etc.). With these it is possible to produce really professional looking results, but they are much more time consuming to use. They are also more expensive. Most people find they provide a more satisfactory method of laying down the resist pattern, and I would have no hesitation in recommending this method.

You need to be careful when ordering etch resist transfers, as they are sometimes mixed in with drafting materials in the component catalogues. These drafting materials are for drawing up printed circuit boards on translucent film so that they can be produced using photographic methods. These are mostly of no use in the current context. Therefore, be careful that the items you order are described as "etch resistant", or something similar.

When drawing the copper pattern onto the board it is best to start with the pads. Then add the tracks, starting with the simple ones and finishing with the most complex tracks. If the copper pattern is produced using a pen, make sure that a generous thickness of resist is applied at every point on the pattern.

If you are using rub-on transfers the tracks must be cut to length before they can be rubbed into place. Simply position the transfer sheet on the board with a length of "track" in place, but have the sheet up-side-down. You can then carefully cut the "track" to length using a scalpel or sharp modelling knife, making sure it is fractionally over-length. Turn the sheet over, and rub the track into place on the board, making sure that both ends slightly overlap their respective pads. Also be sure to have a reasonable overlap at any corners of convoluted track runs.

ETCHING

If you use an etch resist pen, make sure that the resist has dried properly before etching the board. Most etch resist pens have a very quick drying ink, so it should not be necessary to wait more than a few minutes for the resist to dry thoroughly.

The standard etchant for do-it-yourself printed circuit making is ferric chloride. Of the various chemicals that are suitable for the job this is about the least dangerous, but it still needs to be treated with due respect. In minute quantities it is apparently used for water purification, but the strong solutions used for etching are decidedly poisonous. It should not be stored in lemonade bottles etc. It attacks many metals, and it must therefore be stored in containers which are entirely metal-free. The bottles that are sold for use with photographic chemicals are probably the best choice.

Ferric chloride can be washed from formica worktops etc. without any difficulty, but it will probably put a permanent yellow-brown stain into any clothing, carpets, towels, etc. that it touches. It will not etch your skin, but it is an irritant. If any of this chemical is spilled, always clean it up immediately. If any should get it on your skin, wash it off at once with plenty of soap and water. Always try to avoid getting ferric chloride anywhere that it should not be.

Ferric chloride is available as a solution ready for use, or in some cases requiring one-to-one dilution with water before use. This is the most convenient form in which to buy it, but it is not the cheapest. Usually solid forms of the chemical are significantly cheaper, and these days it only seems to be pellets that are available. These will dissolve quite easily in warm water with occasional stirring or agitation.

Opinion seems to vary as to the optimum dilution for etching purposes. Some advocate a saturated solution, which means using equal weights of water and ferric chloride (i.e. add a 250gm pack of ferric chloride to 250ml of water). I prefer to use a half strength solution, and to make up one litre or so at a time. I therefore add two 250gm packs of the chemical to 1 litre of water.

Photographic dishes and plastic tongues are well suited to making printed circuit boards. Place the board copper side uppermost in a dish and add sufficient ferric chloride to thoroughly cover the board. Etching is quickest if the board and solution are constantly agitated.

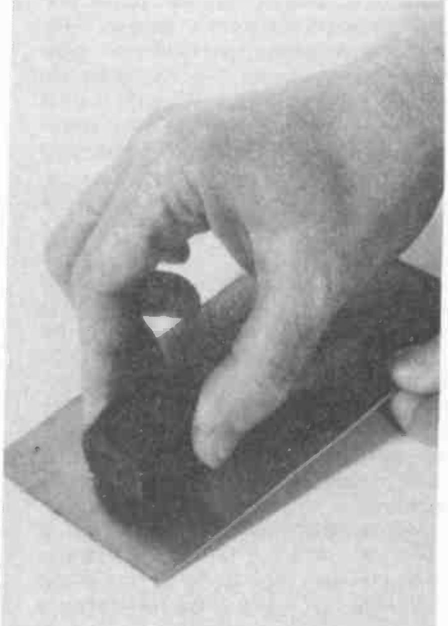
The need for agitation can be avoided if the board is suspended up-side-down in the solution, or if it is positioned vertically in the solution. This generally requires some form of etching tank, or a very large jar. If you can improvise something suitable it will make the etching process much easier, and will probably be well worth the effort involved.

Inspect the board frequently to see how etching is progressing. The time taken depends on factors such as the strength of the solution, how much it has been used, the size of the board, and the temperature of the solution. It can take as little as ten minutes, but with a large board and well used etchant it can take over an hour. It is important not to leave the board in the etchant for any longer than is really necessary as this could cause severe undercutting of the tracks and pads.

Once the board has completely etched, remove it from the etchant and rinse it thoroughly. The resist must then be removed, and this can be done using the same methods that were originally used to polish the board. The board is then ready for drilling.

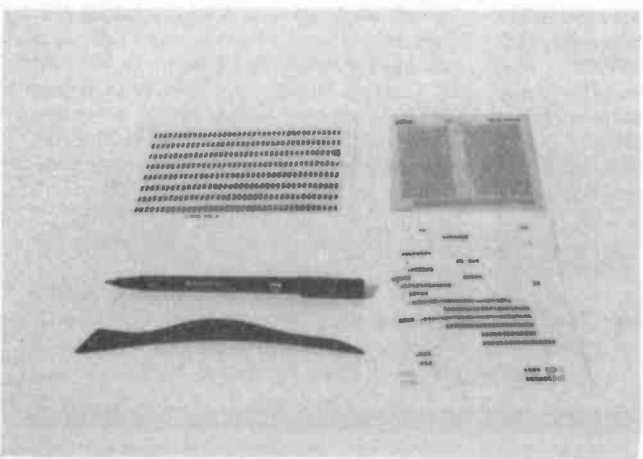
Most components require 1 millimetre diameter holes, but for most semiconductors 0.8 millimetres is a better size. A few components, such as preset resistors, require larger holes of about 1.6 millimetres in diameter. The holes can be drilled using a small hand-drill, but this is a slow way of doing things. Also, the drills will tend to snap quite frequently, and the harder miniature drill bits are strictly for use in power drills.

A full-size power drill mounted in a stand is usable, but it is probably worth investing in one of the inexpensive miniature electric drills that are available from some component retailers. With one of these plus a matching stand it is possible to drill the holes at a fair rate, and with good accuracy. Provided you proceed with reasonable care, snapped drill bits should then be a rarity.

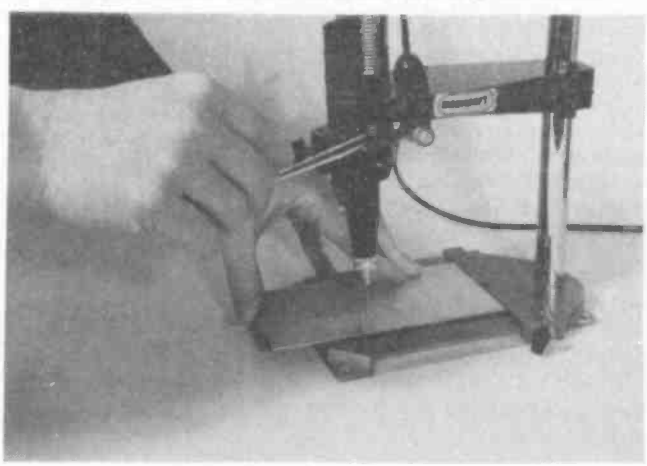


Cleaning the board with an abrasive block.

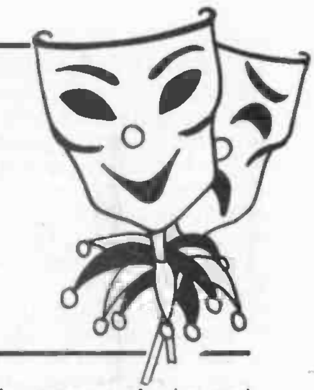
Etch resist transfers and pen, with rubbing down tool.



Drilling the board with a miniature drill and drill stand.



FOR YOUR ENTERTAINMENT



by Barry Fox

Old Idea – New Batteries

Nice to see the *Mail on Sunday* pick up on one of Everyday Electronics' constructional projects (September 1991) with a story about the "schoolboy project which is causing fury in Britain's £250 million pound battery industry".

Alan Tong had described how to build a Dry Cell Re-charger from components costing only around £8.50. He poo-poohed the warnings printed on dry cell labels which threaten danger of leakage or explosion if people try and recharge dry cells. But Tong emphasised that there is no point in even trying to recharge dry cells in NiCad chargers.

NiCad chargers simply push d.c. back through the cell in reverse. This neatly recomposes the chemistry of a NiCad cell because it is designed for recomposition. But if straight d.c. is pushed through a dry cell, recomposition produces a disorderly chemical mass which takes up too much space. This pops the safety vent to make the cell leak. And the cell holds virtually no charge anyway.

Predictably the battery manufacturers mouthed all the usual warnings. It suits them very nicely if people go on throwing cells away instead of recharging them. And my experience of salesmen in the battery business is that they know very little about the curious mix of electrochemistry, cookery and black magic on which their livelyhoods depend.

Also, all this rang bells in the back of my brain and I dug out a file from exactly ten years ago. Sorry to say it, but recharging dry cells is by no means a new idea. *(We understand that it was done in the second world war – Ed.).*

At the May 1981 electronics industry trade shows in London, British company Fidelity Radio of North London launched the Battery Saver. This was a portable mains/battery radio with a special feature; it incorporated a dry battery charger.

While the radio was plugged into the mains, but not in use, the charger fed a mixture of a.c. and d.c. power back into the batteries. The a.c. was superimposed on the d.c. to prevent the zinc from reforming as dendrites which take up too much space and flake off the electrode. The mixed a.c./d.c. charge was fed as a variable trickle, over a long period of time. The charge rate in the Fidelity radio started at around 24 milliamps and fell away to zero as the 9 volt battery pack returned to a nominal voltage of 8.7 volts.

At the time Fidelity described this as "a British technology breakthrough which could revolutionize the design of many battery powered home electronic products". The Battery Saver sank without trace, Fidelity ran into financial problems and the name was bought by Amstrad.

Environmental thinking makes the time right for a radio which recycles cells. Alan Sugar of Amstrad is not the kind of man to worry about offending the battery industry.

New Idea – Old Batteries!

There is something very interesting buried in the small print of a new brochure from Aiwa, subsidiary of Sony, and purveyor of high tech and stylish portable stereos of the Walkman type.

"Personal stereo users are discovering the economy of rechargeable batteries", says Aiwa, "yet often find long recharge time inconvenient".

Too true.

And nicad rechargeable cells never seem to work as well as the adverts or spec sheet claims. There is good reason for this.

The text books tell that nicad cells should be completely discharged before recharging, not continually topped up. Some chargers used to discharge the cells before starting to charge them. But this increases both cost and charging time. The feature now seems to have been dropped, for reasons of price and overall charging time.

Some portable telephones, which use nicad cells, now have circuitry built in which control complete discharge. Users are advised to trigger the circuit once a month. But there is no way this kind of circuitry can be built into budget domestic equipment, especially if it is designed to take either expendable or rechargeable cells.

Not surprisingly, people top up the nicads for a portable stereo or computer to be sure of having a full charge before leaving home. This topping up creates a memory effect, whereby the cell is only able to hold a part charge.

Aiwa is now going back to the good old lead acid battery, as used in cars, albeit with the electrolyte in a sticky gel, rather than acid water. New Aiwa portable stereos have lead acid gel batteries. These can take a far heavier charge current than nicads, making it possible to recharge a portable stereo in just ten minutes. Before that Sony had used lead acid batteries for portable CD players.

There is another advantage. Lead acid cells like to be continually topped up, which is of course what happens in a car. So they are ideal for real world use of portable stereos and computers.

But be warned. If you run a lead acid cell flat, do not leave it flat. Irreversible chemical changes will then take place which prevent it ever again holding a charge.

Will Rabbit run for Hutch?

Earlier this year I wrote about the insanity of the CT2 (second generation digital cordless phone) market, and referred to the fourth incompatible service, called Rabbit from BYPS. This is the consortium of Philips, Shell and Barclays. Or rather it was. Hong Kong communications company Hutchison, has bought BYPS.

Hutchison is very successful in Hong Kong, as a cellular radio phone operator. If anyone can make Rabbit run, it will be Hutchison. Witness what happened over the crazy publicity stunt adopted by BYPS, which broke the cardinal rule of advertising – don't encourage the public to buy something until it is actually on sale.

BYPS has been paying for "Try Rabbit" signs round the edge of rugby and cricket pitches. As Rabit CT2 phones were not on sale, anyone who watched sport on TV and saw a "Try Rabbit" sign could only wonder what on earth it meant. Apparently anyone going to a rugby match learned all about it from a full page advert in the printed programme. The exhortation to "try" is a word play on rugger "tries".

I asked Philips why they were letting BYPS squander a fortune on perimeter advertising which encouraged millions of people without the printed programme explanation to try something that wasn't available. Why not save the money on perimeter advertising and just rely on the printed programme page inside?

Before I got an answer the Chinese had bought the company. The daft adverts have now disappeared. I suspect some of the BYPS staff will disappear too.

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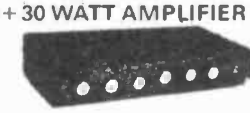

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(Featured project in *Everyday Electronics*, April 1989 issue). Reprint Free with kit.

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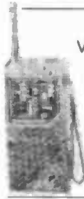

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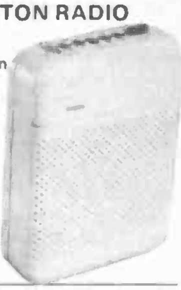

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Transmitters listed on this page are not licensable in the UK.

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DOWN TO EARTH

George Hylton

ADDING WITH AMPLIFIERS

CIRCUITS tend to get associated with particular applications. So much so that it's easy to overlook the possibility of using a "standard" circuit for some non-standard task.

MICROPHONE MIXER

A case in point is the circuit commonly used in audio systems for mixing inputs from several sources – microphones, for

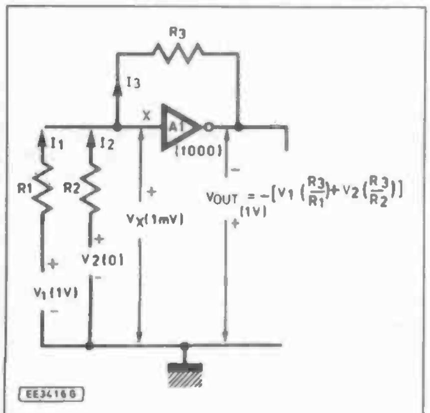


Fig. 1. Adding voltages with the aid of a feedback amplifier.

example. Reduced to its essentials (omitting irrelevant details such as coupling capacitors) this boils down to Fig. 1. Here V_1 and V_2 are inputs (from two microphones or whatever).

If $R1=R2=R3$, the output voltage (V_{out}) is the sum of the input voltages (V_1 and V_2), but with polarity inversion. Or, rather it's very nearly the sum. In practice, it is very slightly less, because exact summing is obtained only if the amplifier's gain is infinite.

NEGATIVE FEEDBACK

Infinite gain seems to imply infinite amplification, but the gain is reduced (to 1 in the present case) by negative feedback. With the signal polarities shown, signal current flows as the arrows indicate (I_1 and I_2). These input currents flow into point X. Now, if currents flow into something there is a build up of electric charge, producing a build-up of voltage. However, in the present case feedback from the (inverted) output causes a current I_3 to flow *out of* point X. This removes charge and so tends to counteract the build-up of voltage.

If the counterraction were totally effective there would be nothing left at point X, and since point X is the true input to A1 there would be no input voltage and so no output. What happens in practice is that the feed-back cancels as much of the input as it can. What's left is amplified to give a reduced output.

If the true (inner) amplification of A1 is 1000 and V_{out} is 1V then V_x (the voltage at X) must be 1mV. So the voltage at X may be very much less than V_1 or V_2. Suppose V_1 is 1V and V_2 is zero. Then the whole of V_{out} must be the result of V1. If $V_1 = 1V$ the signal voltage across R1 is the difference between V_1 (1V) and V_X (1mV). This is 999mV, which is so close to V_1 that the signal current driven by V_1 is almost identical to $V_1/R1$. By the same token, the feedback current driven by V_{out} through R3 is very nearly $V_{out}/R3$.

SCALING FACTOR

The upshot of all this is that the input current can be said (with very small error) to be $V_1/R1$ and feed-back current to be $V_{out}/R3$. These currents have opposite effect on the charge at point X and very nearly cancel it. It is therefore almost true to say that they are equal.

If we do say so, as a reasonable approximation, then the feed-back current equals the input current. The voltage at X being (nearly) zero, we can say (with very good approximation) that $V_{out}/R3 = V_1/R1$. If $R3=R1$ then V_{out} must be the same as V_1 (except for a voltage inversion, positive to negative). If R3 is different from R1 then V_{out} is different from V_1. A bit of fiddling with numbers tells us that $V_{out}/V_1 = R3/R1$.

Since V_{out}/V_1 is the voltage gain to V_1, this means that if we want to amplify V_1 by 5 all we need do is make $R3=5R1$, and so on. Better still, since the voltage at X is always going to be small compared with the input voltage, the current driven by V_2 through R2 isn't going to be affected much by V_1.

If V_2 is not zero but 100mV then the 1mV at point X caused by V_1 can only change the voltage across R2 by 1mV, so it can't ever be far from 99mV. Once again, this is virtually the input voltage (V_2 in this case) so I_2 is always close to $V_2/R2$ and is scarcely affected by V_1. This is just what's wanted from a microphone mixer, where the signal from one microphone ought not to alter the signal from another.

The output (V_{out}) is the sum of the inputs, each changed by a "scaling factor" R3/R1, or R3/R2. Different gains for different inputs can be set by placing appropriate resistors between input and X.

FINITE GAIN

Earlier on I glibly assumed that the gain is 1000 and the signal voltage at X is 1mV. But what if the gain is other than 1000? All that happens is that V_x adapts itself to suit the new gain. For an internal amplifier gain of 100, V_x is $V_{out}/100$, which for our input of 1V means that V_x is 10mV. If the internal gain of A, is 10,000 then V_x is 0.1mV.

In all these cases V_x is sufficiently low to make our approximations reasonably accurate. If A1 rises they become even more accurate. Only if A1 falls to less than about 10 are they likely to lead to errors of more than a couple of decibels.

The mixer amplifier is not restricted to two inputs. Given a high gain A1, virtually any number of signals can be applied, each through an appropriate series resistance.

This kind of circuit is often called a virtual earth amplifier because the voltage at X is close to "earth" (zero) voltage. It's widely used in sound systems where its only major snag is noise. For good results when used as an input circuit A1 must be a low-noise amplifier. In practice designers may opt for a low-noise op.amp, with signals and feedback applied to the inverting input.

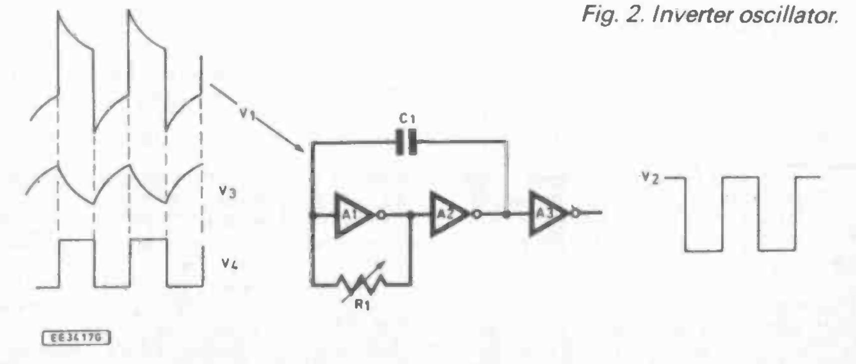
WAVEFORM ADDITION

This ability to add together input voltages has applications far beyond audio mixing. Recently I had need of a test oscillator capable of delivering sine waves and square waves. Its job was to provide test signals for an audio amplifier. Being far from home and friendly component suppliers I needed to make do with what was available. My stocks in fact amounted to a fair selection of passive components, some transistors and a few simple CMOS chips.

Getting square waves was easy. A simple free-running relaxation oscillator (Fig. 2) made from two inverters (A1, A2) gave a squarish output which could be tidied up by a third inverter (A3) to give reasonable square waves. But what about sine waves? If triangular waves could be obtained (Fig. 3a) their peaks might be crushed by making them overload an amplifier to give an approximation to sine waves (Fig. 3b).

It is quite possible to convert square waves to isoscles triangles by passing them through an integrator circuit. However, as the frequency rises the amplitude falls. What I wanted was waves of constant amplitude.

Fig. 2. Inverter oscillator.



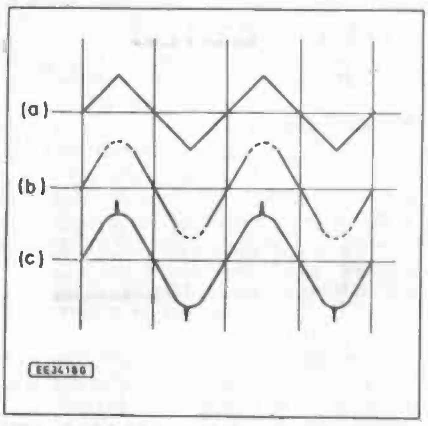


Fig. 3. Making a "sine wave" from a triangular wave.

SUBTRACTION

After fiddling around and getting nowhere it dawned on me that the answer had been staring at me all along from the face of my 'scope. The waveform (V_1) at the input to A1 can be read as the sum of a distorted triangular wave (V_3) and a square wave (V_4). To separate the triangular wave all that is needed is to subtract the square wave from V_1. Subtraction can be turned into addition by first inverting what you want to subtract.

I had plenty of inverters (six on a 4069, of which I'd only used three for the oscillator). In fact, A3 was already performing the necessary inversion. All I had to do was apply V_1 and V_2 to a virtual earth mixer, through suitable scaling resistances, to obtain V_3, then crush it.

SERENDIPITY

In fact, what I got after a bit more fiddling was waveform (3c). This is fairly like a sine wave except for pips at the peaks, caused by stray coupling of energy from the edges of the square waves. In theory the pips, being made up of high harmonics could be attenuated with a low-pass filter. After thinking how to arrange it I decided not to bother. Fortunately!

After passing through the amplifier under test, waveform (3c) emerged with pips which had become enlarged into hefty spikes. This indicated a fault; the response of the amplifier was peaking at high frequencies, causing distortion of transients. Which all goes to justify the lazy person's proverb: If a thing's worth doing it's worth doing badly!

SHOP TALK

with David Barrington

Audio Trends

Claiming a price breakthrough for a true sub-woofer loudspeaker line-up, **B.K. Electronics** have just marketed the Sub-Woofer Satellite System from Studio Power.

Targeted towards the customer who would normally choose a small pair of traditional loudspeakers, the Studio Power system consists of two "satellite" units and one bass "bin" and costs just £129 complete. All three units are finished in grey metallic.

The bass bin contains two bass units in a push/pull arrangement, which, it is claimed, gives a non-directional sub-bass sound and may be hidden behind the sofa, curtains or under the coffee table.

The two main enclosures or satellites each contain a 1in. tweeter and a 3in. mid-range speaker. The system's power handling is 60W r.m.s. (90W peak music power).

The Sub-Woofer Satellite System is priced at £129 (including VAT) plus £6 postage and is available from **B.K. Electronics, Dept EE, Unit 1/5, Comet Way, Southend-on-Sea, Essex SS2 6TR.** (☎ ***0702 527572***).

Christmas Decoration – Simple Model Series

The melody i.c. UM66 is available in four versions with differing melodies, ranging from Christmas Carols to Elvis. The one used in the *Christmas Decoration*, this month's *Simple Model Series* project, is of course the Carols version and is designated Type 1 (UM66-1).

The circuit "board", Santa, sleigh and reindeer is built up on printed white card, which can be obtained from the EE Editorial Offices for the sum of £1.50 (including postage). The wiring up of the circuit card is accomplished by the use of the Vero Easiwire "no soldering" wire-wrapping system.

To help with assembly special arrangements have been made with **Bull Electrical** (☎ ***0273 203500***) and **Greenweld Electronic Components** (☎ ***0703 236363***) to supply a complete kit, including cards, for the sum of £4.95 plus £1 postage fee. – See *Special Offer* page 790.

Auto Nightlight

The only item required for the *Auto Nightlight* that requires special comment is the mains transformer. As this has to sit directly on the printed circuit board (p.c.b.) the spacing and "circuit" configuration of the transformer's pins is critical.

The 0-9V, 0-9V 6VA transformer used in the prototype was purchased from **Maplin** code YJ53H. This has a metric pitch although the rest of the p.c.b. is designed around a 0.1in pitch.

The plastic case is the Verobox 212 and is currently listed, money with order, by **Verospeed** (☎ ***0703 644555***), code 75-1238D and **Maplin**, code LL09K. Other cases can be used, but, as mains is present on the circuit board, it is essential that the two halves of any chosen case can be secured together so that it is impossible to gain access to the interior without the use of a suitable tool.

The printed circuit board for the Auto Nightlight is obtainable from the *EE PCB Service*, code EE779. For added safety, it would be wise to cover the mains carrying copper tracks with insulation tape.

Signal Generator

To obtain the best performance from the *Signal Generator* its a case of purchasing the best quality components you can afford, for instance use one per cent tolerance wherever possible. However the best you can hope to achieve with electrolytic capacitors is about ±20 per cent.

This throws up one particular problem in that the frequency sweep control VR2 must have a large electrical rotation to give a reasonable spread at each end of the front panel scale. The one used in the model has a claimed electrical rotation of 340 degrees.

This control is from the Colvern one watt conductive plastic range and carries the code CP16/001/22. The figure 22 designates the length of spindle. The potentiometer was purchased from **Farnell Electronic Components** (☎ ***0532 636311***), order code CP1601/22-10k.

It is important that the 741S op. amp be used in this circuit. The S-designated 741 has an improved slew rate and full-power bandwidth. To date, the only listing we have been able to find is from **Electromail**, coded 305-995. It is about eight times as expensive as the standard 741.

The 6VA mains transformer is the **Electromail** (☎ ***0536 204555***) type 196-303. The two printed circuit boards are available from the *EE PCB Service*, codes EE776 (Main board) and EE777 (PSU) respectively.

Knockerbox

One or two problems have come to light when sourcing components for the *Knockerbox* project. Most of them are only minor and are not likely to cause too much concern.

Having said that suitably powerful 12V solenoids seem to be few and far between and will, as mentioned, be mostly governed by the amount of power/force required to activate your door knocker. The one used in the model is an RS type (code 349-709) and has a claimed coil power of 10W.

The solenoid can be ordered through any *bona fide* RS stockist or obtained direct from **Electromail** (☎ ***0536 204555***), their mail order operation. Other types can be used and it might be worth checking through the new season of catalogues, particularly in the "Bargain" listings section.

The metal frame of this solenoid has M4 tapped fixing holes which allows the metal tab of the power transistor to be bolted to it. The frame then acts as a heatsink.

The 2046 opto-isolator (code 307-979) was also purchased from the same company, but will only be available while stocks last. This is not a problem as it is a general purpose device and most of our advertisers will be able to supply a suitable transistor opto-isolator.

The isolator is a 6-pin d.i.l. device and sits in an 8-pin i.c. socket on the board. Two things to note here is that only six mounting holes have been provided for the i.c. socket and the opto device must sit in the bottom pins of the holder. Pins one and eight of the *holder* should be snipped off or splayed out clear of the board.

Because of the power requirements of this circuit, particularly the solenoid, it is important to use a 30VA mains transformer. The 500k preset potentiometer specified for VR2 seems to be in very short supply and may prove difficult to locate. However, the more common value of 470k should work quite comfortably in this circuit.

Due to the presence of mains voltages, it is essential that a metal case be used and that it is Earthed as indicated. The printed circuit board is available from the *EE PCB Service*, code EE775 (see page 824).

Mind Machine

Looking down the components list for the *Mind Machine*, only two components stand out as devices that will cause local sourcing problems. These are the 5V voltage regulators and the programmable CMOS crystal clock oscillator.

These are both RS components and are available through **Electromail**. The LP2950CZ micropower regulator is coded 648-567 and the EXO-3C programmable crystal cock oscillator is coded 647-075, this is the required 12MHz version.

The printed circuit board for the Mind Machine is available from the *EE PCB Service*, code EE778. See page 824. Finally, please pay special attention to the warning note at the start of the article.

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MIND MACHINE

ANDY FLIND

Learn to relax with this sophisticated programmable Entrainment unit.

IN THE *Brainwave* project (Sept '91), the design of a simple mind "entrainment" project was given, and the principles of this relaxation technique were described. Although an effective first project for newcomers to this field, the unit was very simple, and a far more sophisticated instrument can be built.

The next two articles in this series will cover the construction of an advanced version of the *Brainwave* unit. The Mind Machine combines "photic stimulation" and "binaural" sound, and has the optional facility of a programmer so that users can experiment with various sequences.

Photic stimulation, the flashing of lights in the user's eyes at the desired brainwave frequency, is the most effective entrainment method. Sound is the next most popular, various types of noise being available from instruments sold in the States.

White or pink noise is common, modulated in time with the lights, but the designer tried this and found it irritating! Plain synthesized "surf" sound is better.

HEMI-SYNC

The most effective sound is undoubtedly that termed "Hemi-sync" or "Binaural". This consists of two audio tones, nominally about 400Hz, but differing by the entrainment frequency in use. For instance, for "Alpha", the lights might flash at 11Hz with one tone at 400Hz, whilst the other would be 11Hz lower at 389Hz.

Played together through loudspeakers these tones would produce the familiar "beat note" but, played one to each ear with headphones, the effect is different. It is perceived as a sort of bell-like tone, not at all unpleasant or monotonous as might be expected.

Meanwhile, the theory is that, in synthesizing the "beat note" internally, the brain rapidly settles into it's own internal rhythms at the same frequency. It has also been suggested that this technique encourages synchronisation between the brain's two hemispheres.

The author's personal experience is that, whilst not as powerful as light stimulation, such sound has a useful enhancing effect when synchronised and combined with it.

CLOCK OSCILLATOR/ DIVIDER

At first sight, it seems all that is necessary to create the tones is a pair of audio oscillators. In practice this isn't so, because at such close frequencies they tend to "pull" together, becoming unstable, and precise and repeatable control of the frequency difference is very difficult.

After some fruitless attempts with phase-locked loops, a simple and effective circuit was devised however. A single high frequency "clock" oscillator drives two dividers. One simply provides a fixed audio frequency, but the other blocks it's own input briefly each time the output changes state, so the end frequency is a fraction lower.

This technique avoids the "pulling" and instability inherent in the use of two oscillators. The only snag is that a high clock frequency is necessary for reasonably smooth output control. For example, if the output is 400Hz and the clock is blocked once per cycle, for adjustment steps of 1Hz the clock must be 160kHz.

In practice better resolution than this is desirable and a clock in excess of a megahertz is needed. This caused difficulties as this part of the circuit operates from a five volt supply and most simple oscillator circuits proved unreliable at this frequency and voltage.

The solution came in the form of a CMOS crystal oscillator-divider type EXO-3C. Intended for five volt supplies, this can produce a precise 1.5MHz signal. Supplied in an 8-pin d.i.l. package, it needs no external components other than a 100n decoupling capacitor.

CIRCUIT DESCRIPTION

In the complete circuit diagram of the Mind Machine, Fig. 1, IC1 is the clock oscillator. IC2 divides it by 4096 to give an output of 366Hz, close to the desired 400Hz. The clock output also goes to the second divider IC4 through resistor R5, and so can be gated by pulling low.

Voltage control of the gating period was needed for later use with a programmer. This is achieved with dual comparator IC3, which operates as follows.

The output of each comparator in IC3 is an open-collector transistor, not a bi-directional source like an op-amp. When an inverting input of one of these is *higher* than the non-inverting, the output can sink a current to ground, pulling any voltage present low. When the inverting input is *lower*, the output is effectively open-circuit. A signal for this part of the circuit is taken from pin 15 of divider IC4, one stage before the output pin 1.

WARNING NOTICE

Photic stimulation at Alpha frequencies can cause seizures in persons suffering from Epilepsy. For this reason such people MUST NOT try this project.

A user who is not a known epileptic, but when using the "Mind Machine" begins to experience an odd smell, sound or other unexplained effect, should turn it off immediately and seek professional medical advice.

Because of the above possibility the Mind Machine should not be used while on your own.

YOU MUST TREAT THIS UNIT WITH DUE RESPECT.

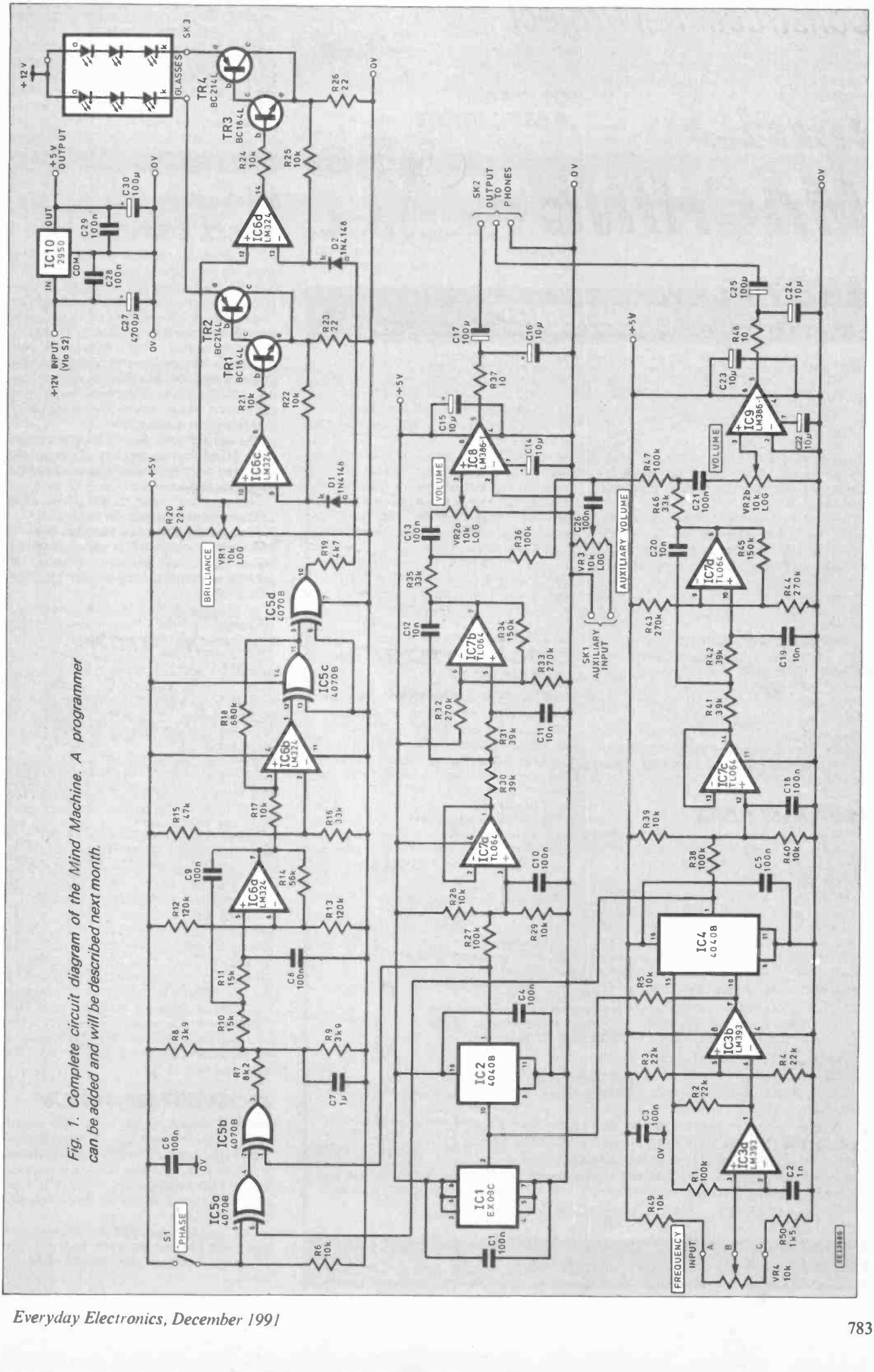


Fig. 1. Complete circuit diagram of the Mind Machine. A programmer can be added and will be described next month.

The non-inverting input to IC3b is held at half the supply voltage. Whilst the inverting input is low, the output will be open circuit so the divider will be clocked. When the signal from IC4 pin 15 goes high, IC3b's output will block the clock by pulling it low.

At the same time, the high signal from IC4 charges capacitor C2. When the voltage across this exceeds the control voltage applied to the input at "B", IC3a's output will pull the input to IC3b low again and the clock will continue. Thus, the higher the control voltage, the longer each break in the clock, so the higher the difference between the output frequencies from IC2 and IC4.

Most readers will know that a square-wave signal sounds horrible! As the project is intended to promote relaxation, the divider outputs are shaped into almost pure sine-waves by two third-order filters constructed around IC7.

OUTPUT AMPLIFIER

The choice of output amplifier was unusually critical with this project. A pure sinewave of fairly low frequency sounds relatively quiet, so reasonable output power is needed.

However, the least bit of distortion or noise is far more obtrusive and annoying than with music or speech. This means that excellent quality is needed in these stages, and several apparently suitable stereo amplifier chips failed to satisfy. They just did not sound "clean" enough.

The LM386 gave the best results, the only problem being that two separate amplifiers, each with a number of electrolytics, are needed. Even these needed a measure of output damping to remove the last traces of noise.

An auxiliary input is included for users who wish to experiment with the mixing injection of other sounds such as surf, pink noise, soft music or possibly even a self-hypnotic tape!

L.E.D. DRIVER

The signal for the l.e.d. drivers is derived from the two divider outputs. Although it would appear possible to extract it digitally, in practice this causes unacceptable "jitter", so an EX-OR gate, IC5b, followed by a third-order filter stage IC6a, is used.

During testing, some headphones used proved to be connected in anti-phase! Because of this, and to allow for experimenting with the phase of the lamps relative to the sound, Phase switch S1 was included. Closing it inverts the phase.

The output from filter IC6a is a triangle wave of reasonable linearity. As explained in September's *Brainwave* article, the l.e.d.s should be driven with a duty cycle of about 25 per cent "on" time, as this allows them to be overdriven to increase brilliance.

In this circuit the required duty cycle is obtained by switching at the appropriate points of the triangle wave. In fact, the positive section of the input signal turns the l.e.d.s "off".

As with the *Brainwave* circuit, the l.e.d.s are normally "on", their brilliance being set by the "log" law potentiometer VR1. The signal from IC5d passes through diodes D1 and D2 to force the IC6c and IC6d inverting inputs high, causing their outputs to go low and turn off the lights. A small amount of positive feedback is provided through resistor R18 to ensure clean switching.

There is one difference in the output stages from those of the previous design, this being the inclusion of an extra transistor in each. If the glasses are unplugged from the *Brainwave*, the op-amps will see an error in the sensed output current, and will force base current into the output transistors in an effort to correct the situation. The only limit to this current is the op-amp output current limiting circuitry.

Whilst not a serious problem, it was decided to eliminate it in this design. If the glasses are unplugged with this circuit, the op-amps will still try to correct or compensate, but the base currents will be limited by the 10k resistors R21 and R24. The current that can be supplied through these two resistors will not be enough to operate the l.e.d. driving transistors directly though, so the inclusion of transistors TR2 and TR4 overcome this.

POWER SUPPLY

A 12V battery supply allows the use of three l.e.d.s for each eye. A large decoupling capacitor, C27, reduces the likelihood of heavy l.e.d. currents causing unwanted noises in the audio output, whilst IC10 supplies a 5V regulated rail for everything except the l.e.d.s.

The regulator specified is a micropower type with greater accuracy and a lower "drop-out" voltage than the standard 78 series.

COMPONENTS

See SHOP TALK Page

Resistors

R1, R27, R36, R38, R47	100k (5 off)
R2, R3, R4, R20	22k (4 off)
R5, R6, R17, R21, R22, R24, R25, R28, R29, R39, R40, R49	10k (12 off)
R7	8k2
R8, R9	3k9 (2 off)
R10, R11	15k (2 off)
R12, R13	120k (2 off)
R14	56k
R15	47k
R16, R35, R46	33k (3 off)
R18	680k
R19	4k7
R23, R26	22 (2 off)
R30, R31, R41, R42	39k (4 off)
R32, R33, R43, R44	270k (4 off)
R34, R45	150k (2 off)
R37, R48	10 (2 off)
R50	1k5

All 0.6W 1% metal film

Potentiometers

VR1, VR3	10k rotary carbon, log.
VR2	10k dual (stereo)-ganged rotary carbon, log.
VR4	10k rotary carbon, lin.

Capacitors

C1, C3, C4, C5, C6, C8, C9, C10, C13, C18, C21, C26, C28, C29	100n polyester (14 off)
C2	1n polystyrene
C7	1µ polyester
C11, C12, C19, C20	10n polyester (4 off)
C14, C15, C16, C22, C23, C24	10µ radial elect., 50V (6 off)
C17, C25, C30	100µ radial elect., 10V (3 off)
C27	4700µ radial elect., 16V

Semiconductors

D1, D2	1N4148 signal diode (2 off)
TR1, TR3	BC184L *npn* silicon transistor (2 off)
TR2, TR4	BC214L *pnp* silicon transistor (2 off)
IC1	EXO-3C programmable CMOS crystal clock oscillator (12.0MHz)
IC2, IC4	4040B CMOS 12-stage divider (2 off)
IC3	LM393 dual comparator
IC5	4070B CMOS quad "Exclusive-OR" gate
IC6	LM324 quad op-amp
IC7	TL064 quad low-power op-amp
IC8, IC9	LM386-1 audio amplifier (2 off)
IC10	LP2950CZ 5V regulator

Miscellaneous

S1	Miniature s.p.s.t. slide switch
S2	Miniature s.p.s.t. On/Off toggle switch
SK1	Mono ¼ in. jack socket and plug (Aux)
SK2	Stereo ¼ in. jack socket and plug (Headphone)

Plastic case with aluminium front and rear panels, Vero 202-21035F, size 205mm x 140mm x 75mm; 8-pin d.i.l. socket (4 off); 14-pin d.i.l. socket (3 off); 16-pin d.i.l. socket (2 off); 3-pin DIN plug and chassis mounting socket; 5mm ultrabright (500 mcd) l.e.d. (6 off); swimming goggles for "glasses"; control knobs (4 off); 8-cell battery holder and batteries; "Walkman" type miniature headphones, without headband; connecting wire; solder etc.

Printed circuit board available from the *EE PCB Service*, code EE778.

Approx cost guidance only **£32** *plus case*

CONSTRUCTION

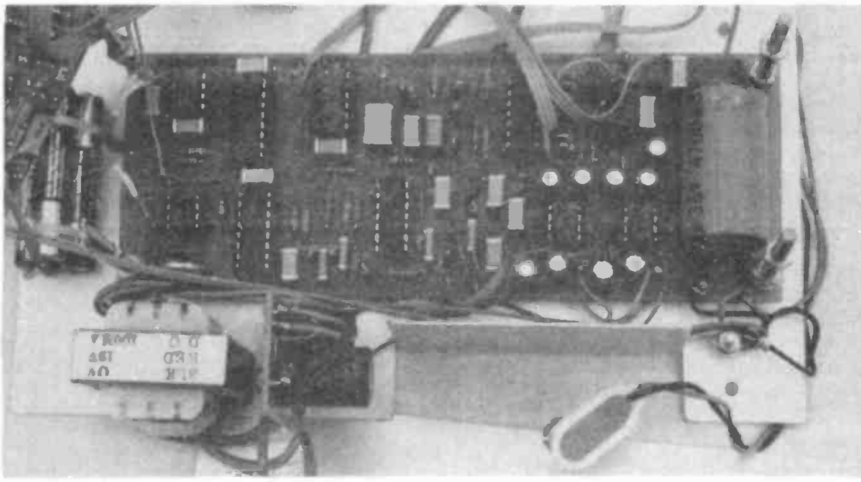
Most of the components of this project are mounted on a single printed circuit board, construction of which should present no special problems. This board is available from the *EE PCB Service*, code EE778.

The component layout and full size copper foil master pattern is shown in Fig. 2. There is a single wire link to fit, after which the components should be fitted in order of physical height.

With the exception of IC10, d.i.l. sockets are strongly recommended for all i.c.s, the insertion of which should be left until testing is carried out. IC10 should be the last soldered component to be fitted, as it is a CMOS device and this will keep the risk of static damage to a minimum.

The polyester capacitors should all be of the silver-coloured miniature layer type, which should fit correctly onto the board. Take care with the polarity of the electrolytics and diodes, and with transistor types since two are *npn* and two *pnp*.

Most of the resistors are mounted horizontally, but a few are vertical to suit the layout and keep the board size to a minimum. Solder pins are recommended for external connections as these make testing and wiring easier.



The Mind Machine p.c.b.

TESTING

A board of this complexity should be tested in logical steps. Fortunately, this project's circuit design makes this quite simple. An oscilloscope is useful for some tests, but constructors without access to one need not be deterred as a most sections can be effectively verified as operating correctly using just a meter.

Hopefully, sockets will have been used for IC1 to IC9, so the initial test is to power the board without any of the i.c.s fitted, and check the 5V regulated supply. A good place to find this is on the top of capacitor C29. There will be an initial surge of current as the capacitors charge, in particular C27, after which the supply current should settle to a very low value, no more than a milliamp or two.

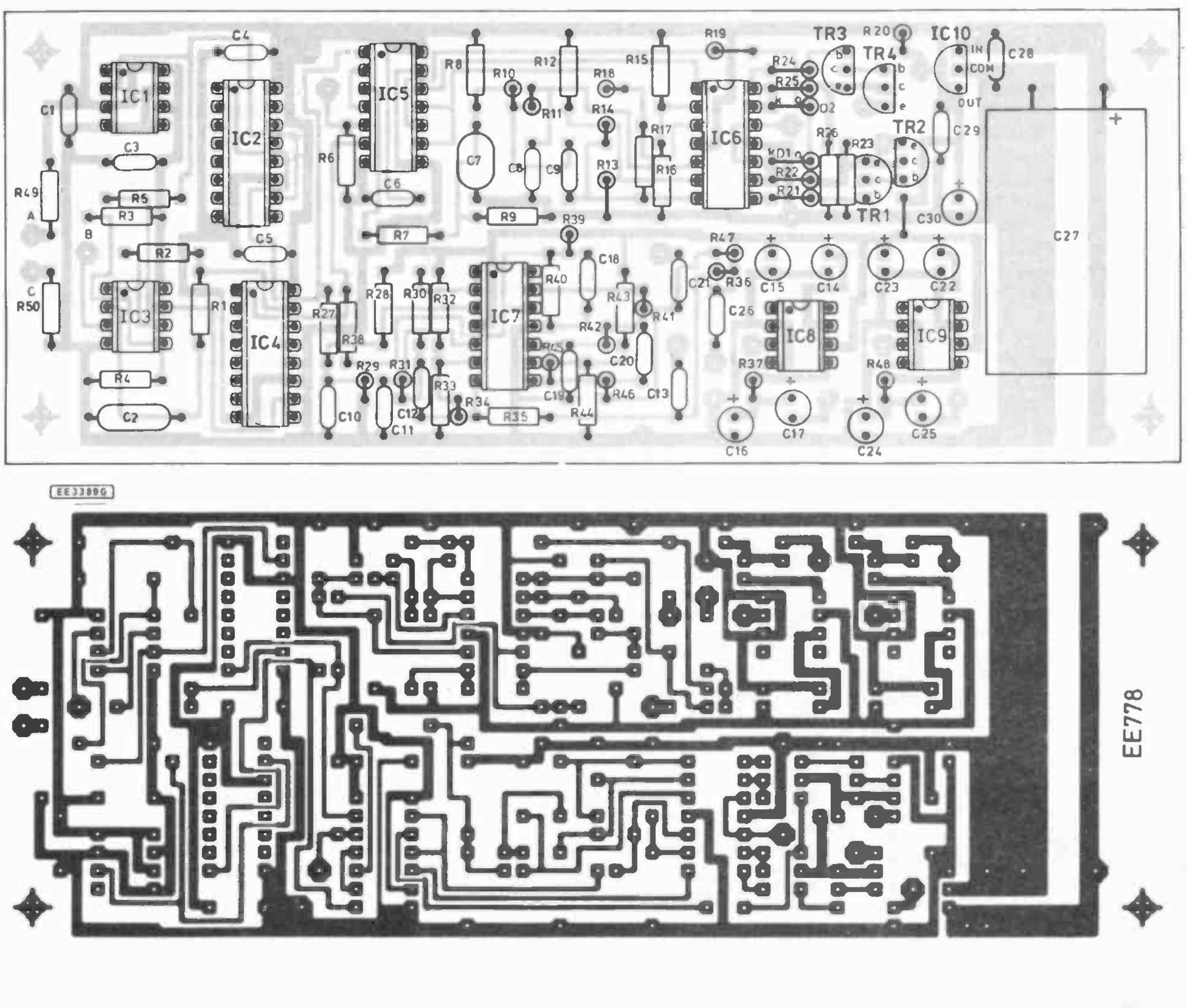


Fig. 2. P.C.B. layout and wiring for the Mind Machine.

The negative supply rail is used as the reference for all tests. The power should always be turned off when fitting i.c.s or making connections other than test gear.

If the regulated supply is working, the oscillator IC1 should be inserted on the board, and it's output, at pin 2, checked. A 'scope should show a 1.5MHz squarewave, but if this is not available a meter should show the average d.c. value of the output as 2.5V. If this is present, it's a virtual certainty that the oscillator is operating.

The two dividers IC2 and IC4 can be fitted next. Without IC3, IC4 has an uninterrupted clock signal. Again, a scope should show their 366Hz squarewave outputs, or a meter should show the average value of 2.5V. The output of each will be found at pin 1.

Assuming this is OK, IC7 is next, to complete the two filters. These should have sinewave outputs at pins 7 and 8. Peak-to-peak values seen on a scope are around 0.5V, or a DVM (Digital Volt Meter) on an a.c. range should show the r.m.s. value of about 0.2V. Again, the d.c. level should be about 2.5V, though this time it doesn't indicate presence of the signal. The supply current up until this point should be very low, no more than 5mA.

The volume control VR2 can now be temporarily connected and IC8 and IC9 plugged in, one at a time. These too should have about 2.5V d.c. at their outputs, pin 5, whilst the signal, as seen at each headphone output with VR2 at maximum, should be about 2.5V peak-to-peak on a scope or about 0.8V r.m.s. on a meter.

If all is fine so far, the headphone socket should be hooked up and the 'phones plugged in. At this point the frequencies will be identical, so the sound will be apparently "mono". It should, however, be very smooth and pure. Depending on the surroundings of the board on test, there may be some induced hum, but this will not be a problem after final assembly.

If VR4 is now connected to the board and IC3 fitted, the "binaural" sound effect should be audible on the phones, with the frequency of the "beat" adjustable from about two to twenty hertz. The supply current will now depend upon the volume setting. To some extent this is the case even if the headphones are not plugged in, as when the control is turned well up current flow through capacitors C16 and C24 will be apparent.

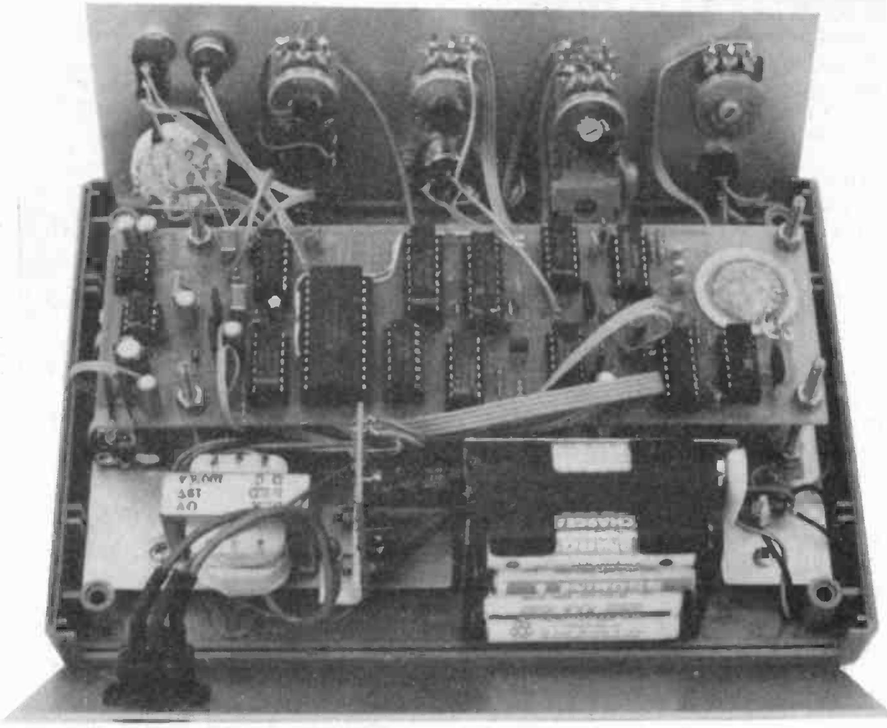
LIGHTING UP TIME

With the oscillators and sound processing working, attention can be turned to the "lights" part of the circuit. IC5 and IC6 can now be fitted.

With VR4 set to minimum frequency, if the output at IC5 pin 10 appears mostly positive, pulsing low at about two hertz, this part of the circuit is probably satisfactory. At a higher frequency setting the apparent average d.c. voltage at this point should be around 3.8V.

If there are problems in this area, it may help to know that there should be average d.c. levels of 2.5V at IC5 pin 4 and pin 3, and at IC6 pin 7. At low frequencies a flicker should be visible at IC5 pin 3 and IC6 pin 7. A scope should show a triangle wave of about two volts peak-to-peak at IC6 pin 7, but don't bother trying this at IC5 pin 3 where the signal consists of 5V peak-to-peak pulses of constantly varying width!

Finally, VR1 can be hooked up, an l.e.d. placed across each l.e.d. output point, and



The complete unit with programmer p.c.b. and charger – see text.

VR1 checked for controlling their brilliance correctly. The frequency control VR4 should adjust their flicker rate from about two to twenty hertz.

The total supply current will now depend on volume and brilliance of the outputs. With both at a minimum, it will be about 20mA-25mA. At full power on both, it will be in the order of 80mA-90mA.

CASE

It was felt that this project deserved a smarter case than the grey boxes that have graced many of the author's designs so a smart grey and white Verobox, size 205mm x 140mm x 75mm, was purchased. A "tilt leg assembly" added a nice finishing touch, but is not essential.

An aluminium "screening chassis" was made and fitted to the moulded bosses in the base of the box with the self-tapping screws provided. The other components of the project are mounted on this.

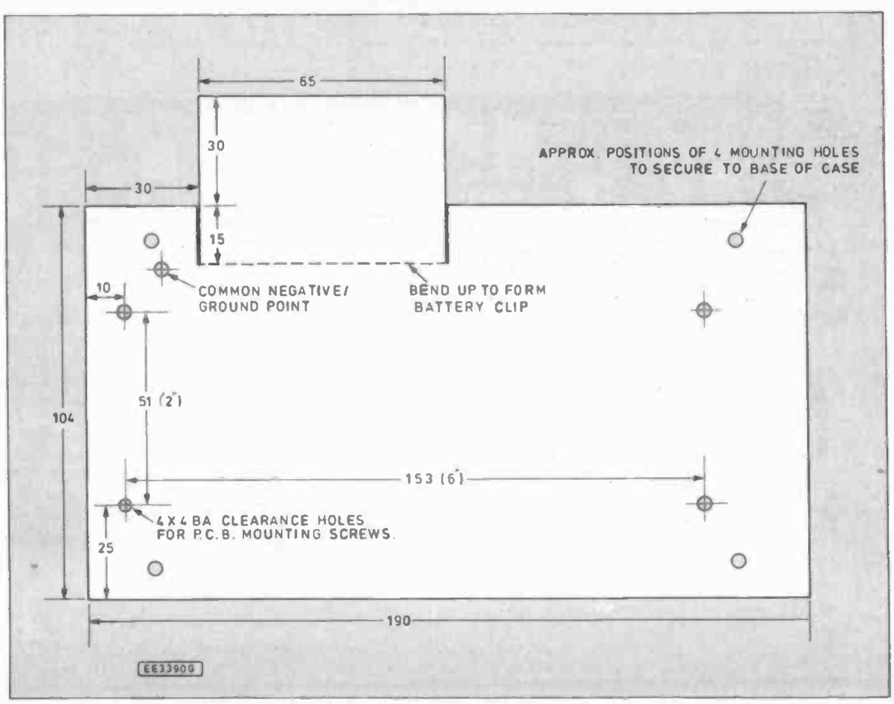
At the back of the plate a section is cut and bent up to secure the battery pack by pressing it against the aluminium back of the case. A drawing of this plate appears in Fig. 3, and the general layout of the various parts inside the case is shown in the photographs and Fig. 4.

The batteries are housed in an eight-cell plastic holder, connecting to the circuit through a PP3-style clip. Some masking tape prevents the metal parts of the holder touching the metal plate.

BOARD MOUNTING

The circuit board is mounted on four 50mm (2 in.) brass 4BA screws projecting

Fig. 3. Metal screening chassis details.



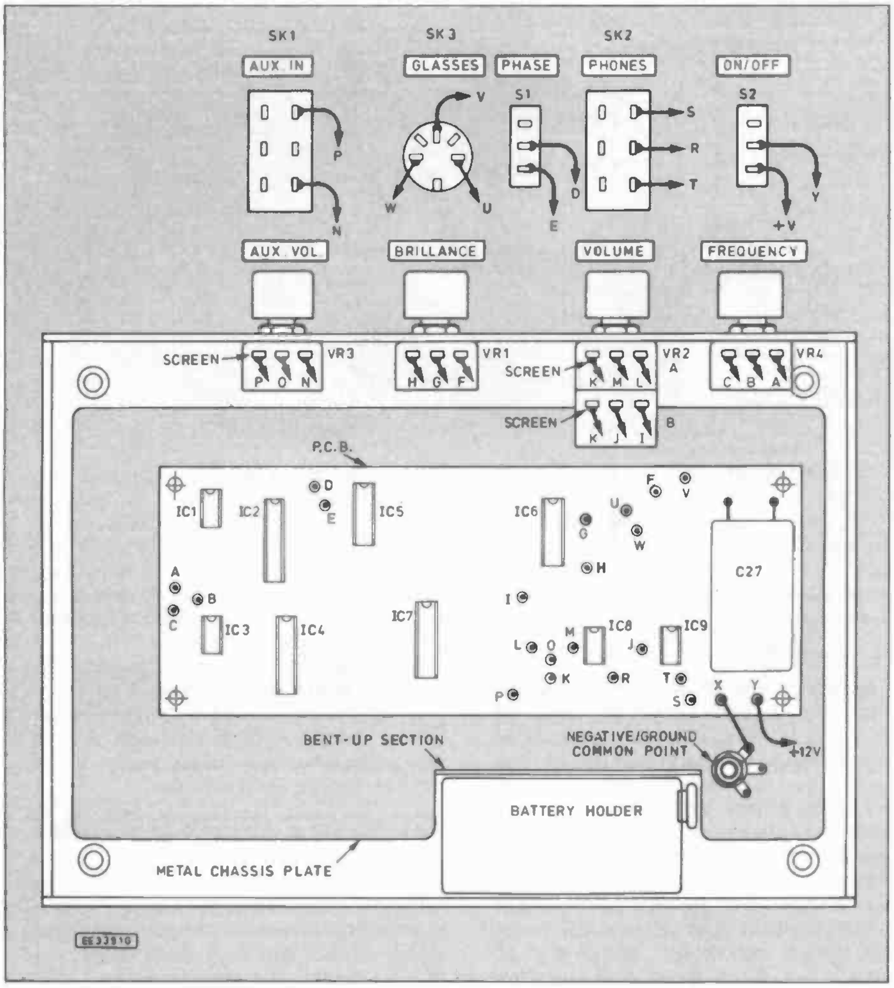


Fig. 4. Interwiring of the front panel mounted components and the p.c.b. Only those sockets and controls that relate to this part are shown.

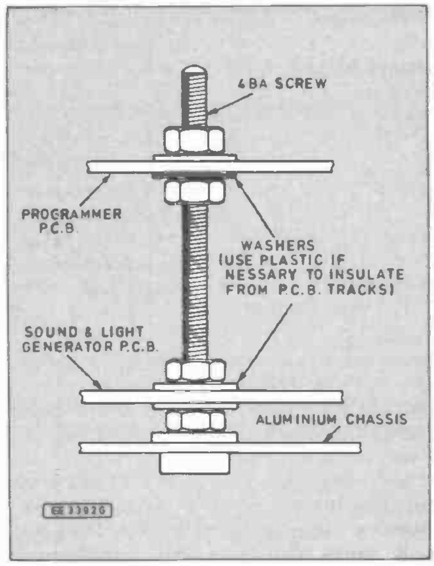


Fig. 5. Mounting the two p.c.b.s (programmer p.c.b. will be described next month).

up from the chassis, detail of one of these is shown in Fig. 5. Some plastic washers are needed to ensure the fixing nuts are insulated from the copper tracks of the board, these being cut from a redundant credit card!

The board is placed low on the screws, to obtain the screening effect of the chassis plate below the audio amplifiers. The reason for the extra length of the screws is that the programming board, to be described next month, is fitted above the present one.

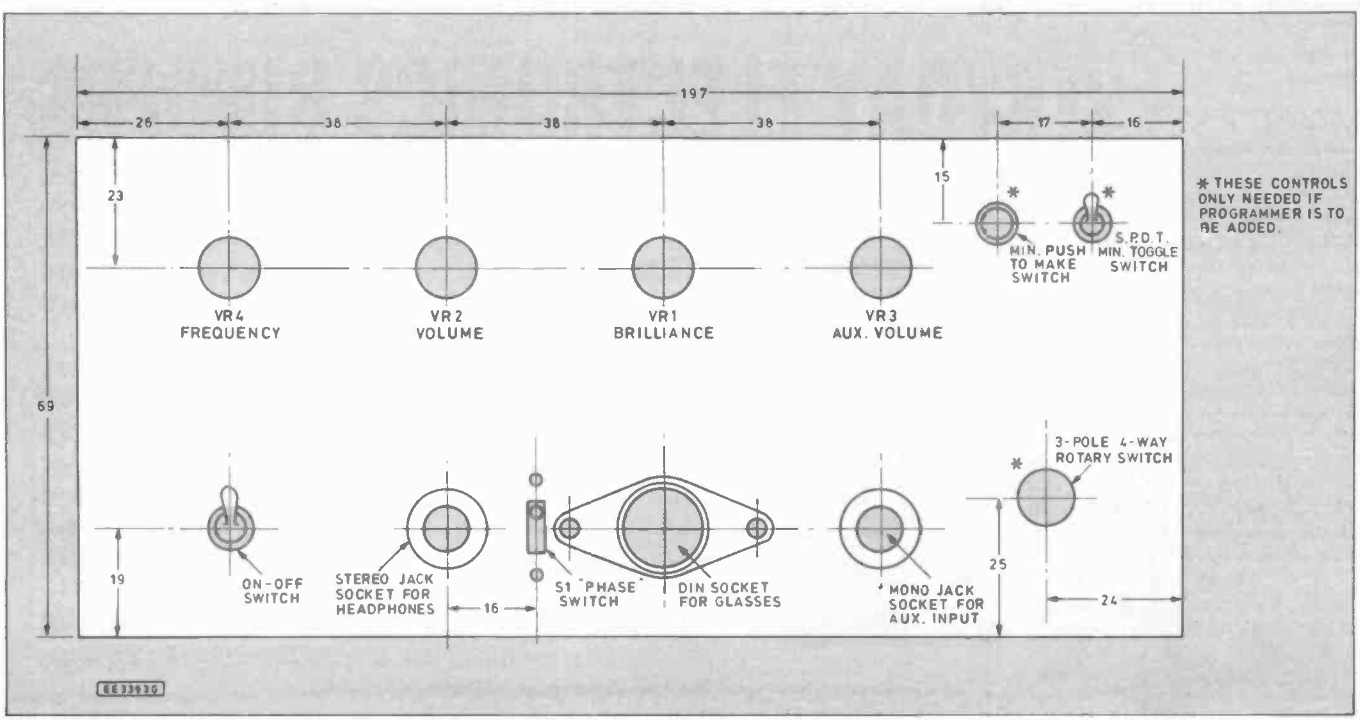
The front panel layout is shown in detail, Fig. 6, as the components fit onto this with little space to spare. Some holes shown will not be needed unless the programmer is added. It should be borne in mind that some of the clearances in the box are on the tight side, so it might be wise to check that the components you have will actually fit before cutting and drilling either this panel or the chassis plate.

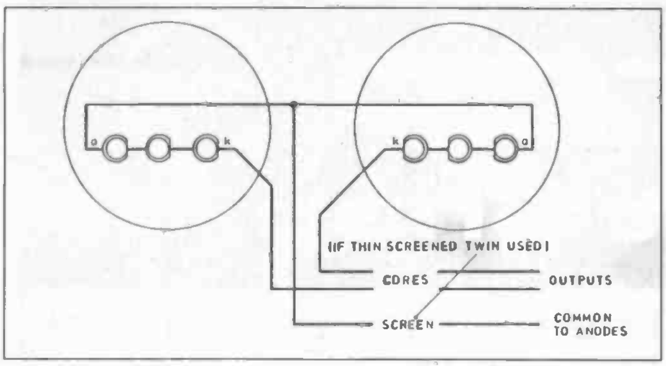
As the front panel is aluminium and earthed to the negative rail, the controls, sockets and so forth must NOT make contact with it. The headphone and auxiliary input sockets are standard ¼ in. types, as these are easier to obtain in plastic insulated form. The miniature headphones recommended are used with an adaptor. A 5-pin DIN socket provides the outlet for the l.e.d. lead.

External connections to the circuit board are shown in Fig. 4. Not shown is the "grounding" arrangement of the metalwork. The battery negative is connected to the point marked on the chassis plate drawing in Fig. 3, then all other negative supply connections are taken from this. Also, a wire is taken from here to the aluminium front plate, using a solder tag placed under one of the DIN socket mounting screws.

This arrangement reduces the possibility

Fig. 6. Front panel drilling details.





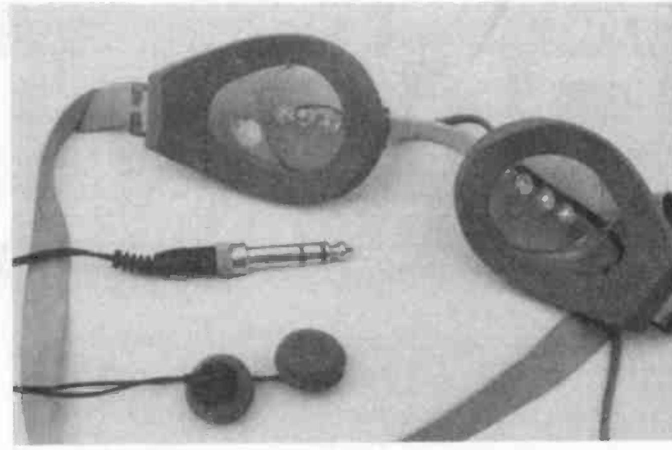


Fig. 7. Wiring of the l.e.d.s mounted in swimming goggles. The photograph shows the finished goggles.

of annoying clicks and pops on the audio due to currents flowing around "earth loops" in the circuit, and provides adequate screening to prevent hum pickup by the amplifiers. Hookup wire or, for greater neatness, ribbon cable, is fine for most connections, but those to the volume controls VR2 and VR3 should be made using *screened* lead.

Standard "AA" cells can be used, but the prototype is fitted with rechargeables and a built-in charger, details of which will be given next month. This avoids the need to dismantle the case from time to time to replace the batteries.

Three "AAA" cells may be visible in the photographs. As will be explained next month, these retain program memory when the instrument is switched off. They should not need replacing more than every couple of years or so.

GLASSES

The glasses are similar in construction to those used with the *Brainwave* project, using three ultrabright l.e.d.s in each lens. They are constructed from swimming goggles with the lenses drilled to take the l.e.d.s, connections for which are shown in Fig. 7.

The goggles are good quality types, with soft foam edging for comfort. Their lead is thin screened twin, with one core each to the l.e.d. cathodes and the screen acting as common for the anodes. This provides a neat, thin and flexible connection.

The headphones can be the cheapest available, as they are required only to play a single tone of medium frequency. "Walkman" phones, the sort that fit right inside the ear without a headband, are recommended as these will not tangle with the glasses as other types tend to.

IN USE

The use of this project is not going to be covered in depth as the principles of "entrainment" were described in detail in the September '91 Brainwave article. The warning for anyone who even remotely suspects they may be epileptic is just as important for this project of course, see the caution notice!

The unit should be used with the eyes **shut**. The light intensity should be set to a comfortable level, and the frequency adjusted until it feels "right". It can then be gradually lowered to produce a sensation of deep relaxation.

The controls are fairly self-evident, save for the phase reversal switch S1. If the frequency is turned right down the two headphones held close to one ear, the sound will be heard as the familiar "beat" note. It will be loudest when the two tones are in phase, and this is when the lights should flash.

If your phones are wired out of phase, as happened to the designer, this switch (S1) will correct matters. You may also like to experiment with reversed phase – it might prove more effective for you.

As a brief recap, the brainwave frequencies this machine can be used to stimulate range from : ***Delta***, 2Hz to 4Hz, the rhythm of deep sleep; ***Theta***, 4Hz to 7Hz, for vivid imagery and creativity; ***Alpha***, 7Hz to 14Hz, relaxed awareness; up to ***Beta***, 14Hz upwards, which is the normal "wide-awake" pattern.

Before the Programmer was fitted the designer would start at high Alpha, and gradually reduce it almost to Delta before slowly bringing it back up again. A brief burst of Beta was occasionally useful before rejoining the real world!

SHORT SESSIONS

It will be found that the effect of this project, with the addition of sound, is far more powerful than lights alone. If you're new to entrainment, it is suggested that initial sessions are kept fairly short, say fifteen minutes, and the Volume and Brilliance are not turned up too far.

The auxiliary input can be used to inject anything desired, pink noise, surf sounds, soft music, or a hypnotic "self-improvement" tape, if you're into that sort of thing. It might even prove to be the most effective tool for giving up smoking ever devised!

Seriously, the author, and most other people who have tried the prototype, found it very relaxing, just the thing for this stressful age.

Next Month: A Programmer Board.

SIMPLE MODEL SERIES SPECIAL EASIWIRE OFFER

FREE EASIWIRE IF YOU BUY ANY FOUR MODEL KITS OR EASIWIRE FOR £5 WHEN YOU PURCHASE A PROJECT KIT.

The two companies mentioned below have large stocks of Easiwire solderless wire wrapping systems, as used to build all our *Simple Model Series* projects. They have agreed to make these available to EE readers who purchase complete kits of components for the projects, **INCLUDING** printed cards to cut out and assemble for each model. If you are prepared to buy *any four* of the six model kits then you can get your Easiwire **FREE**.

If you buy *any one* model kit you can purchase an Easiwire kit for just **£5**. (These kits were previously advertised by BICC-Vero at £15, including p&p). To get your kit and Easiwire simply fill in the appropriate coupon and send it with your cheque (or credit card details) to *either of the companies*.

The six projects are: Police Car (July 91); Musical Roundabout (Aug 91); Micro Micro - a dolls house microcomputer (Sept 91); Centurion Tank (Oct 91); Mini Microwave - dolls house microwave oven (Nov 91); Christmas Novelty Decoration (Dec 91). These models all play tunes or make noises or flash lights etc. They will each cost about £8 or less to build, *the prices charged will be as given by EE in the "approximate cost box."*

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Please supply an Easiwire at £5 with the above kit ☐

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Simple Model Series

FLASH! BLEEP!! WHIRR!!!

CHRISTMAS DECORATION

OWEN BISHOP

PROJECT 6

A novel series which combines two hobbies in one – electronics and model-making. Simple electronic circuits combined with easy-to-assemble models that cover a wide range of interests.

WE continue this series of electronically enhanced models with a seasonal offering to amuse all members of the family. This decorative model can be hung on the Christmas tree, or placed on the sideboard among the Christmas cards. It is a model of Santa and his sleigh embellished with flashing lamps and a medley of Christmas tunes.

The lamps flash continuously. The medley consists of snatches of *Jingle Bells, Santa Claus is Coming to Town* and *We Wish You a Merry Christmas – and a Happy New Year*. It takes about 25 seconds to play and is repeated every one and a half minutes. Although we present the design for one particular model, the electronics can be applied equally easily to any similar model or decoration. There is also plenty of scope for ingenuity in adapting the model to suit your taste.

MEDLEY CHIP

The notes and timing for the medley are contained in a small memory included on the chip of the i.c. The i.c., which is inexpensive and is contained in a package no bigger than that of a single transistor, is one of a series intended for use in musical greetings cards.

The version specified for this project has Christmas tunes but there are three other versions available, appropriate to weddings, birthdays and Valentines. This circuit, when used with a suitable model is therefore apt for other festive occasions.

BUILDING THE MODEL

The model is in semi-relief and is built up in layers on a base-board. Cut out the baseboard from thick (2mm) card or laminations of thinner card (a). Use a steel ruler and craft knife for this operation. Also cut a sheet of matt black paper of the same size and shape as the base and glue this to the base.

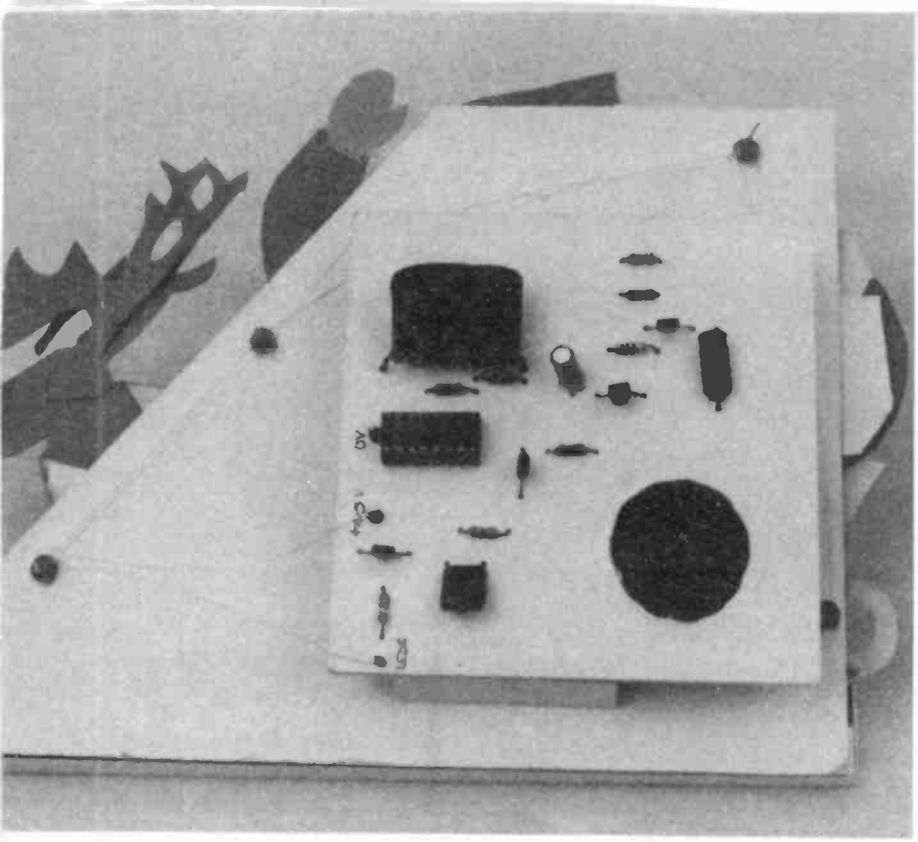
Santa is made of thin coloured card; we used bright red for his body and hat, and a light brown for his face and hands, alternatively white card can be coloured as required.

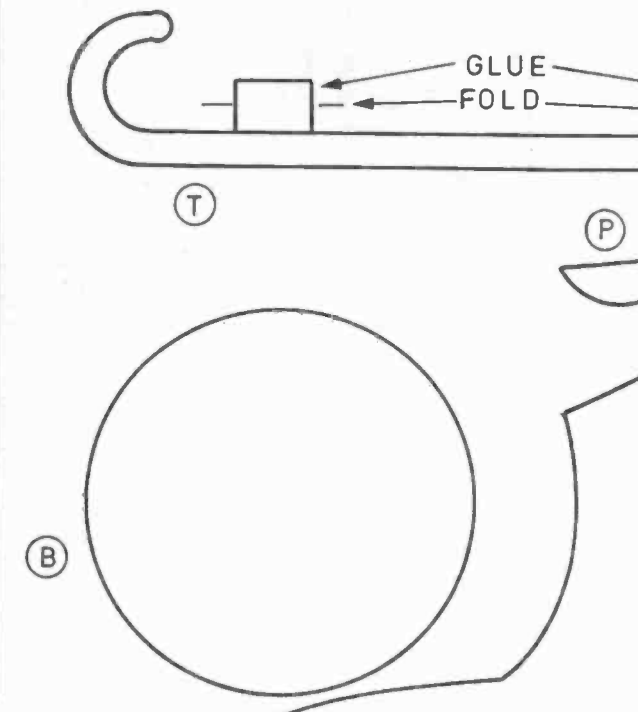
Cut out Santa's face and body and glue these to the base, on the black-papered side, leaving his right arm (left as seen from the front) free so that he can later rest it on the sleigh. Note that his left (raised) arm projects beyond the edge of the base. Cut out his hat (d), and hands (e, f) and glue these in position.

We chose a slightly darker rusty-brown card for the reindeer. Cut out the body (u) and glue the legs (h, i) to it, making sure that the bottoms of the feet are in a straight line. The body cut-out has only one antler, so cut out a second antler, with a small tab at the base for sticking behind the head. The antlers are more-or-less mirror-images of one another.

Prepare a rectangle of the thick card about 50mm x 200mm and glue this behind the body. This is for raising the reindeer away from the base to give the 3D effect. Glue the other side of the thick card rectangle and position the reindeer on the base. The bottoms of its feet are 20mm from the lower edge of the base.

The sleigh can be made in any colours that take your fancy. We have a bright green sleigh (g) with a red stripe along its side, and yellow runner (t). Cut out the sleigh body and mount it on *two* rectangles of thick card glued on top of one another. This brings the sleigh 4mm above the baseboard. As you slide the sleigh body into place, lift Santa's right arm so that his elbow rests comfortably on the upper edge of the sleigh.





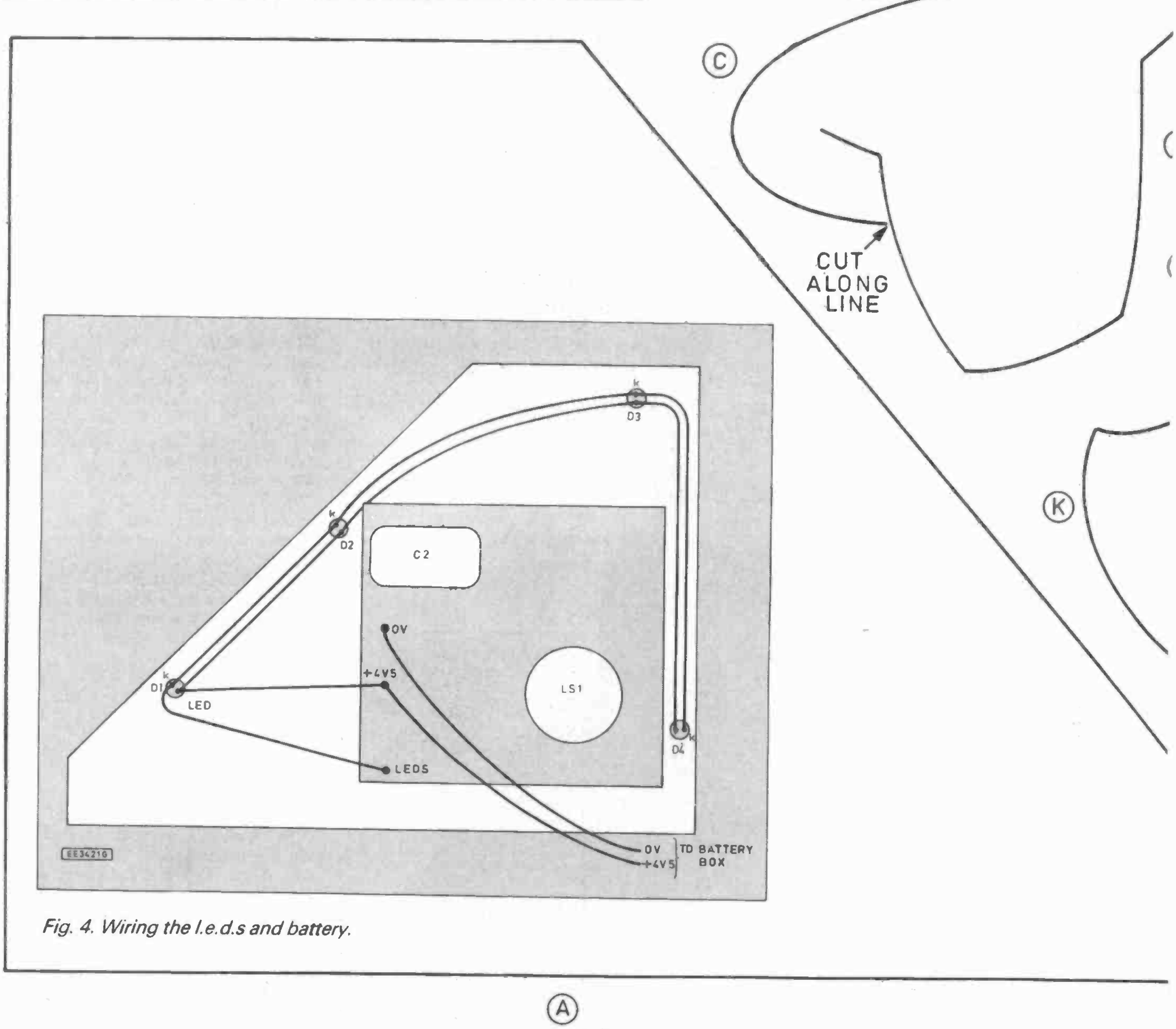
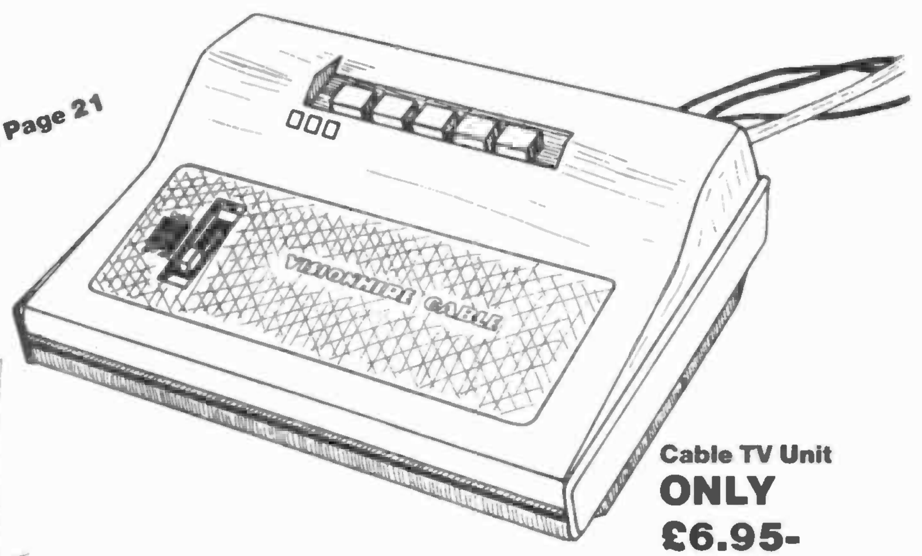


Fig. 4. Wiring the l.e.d.s and battery.

GREENWELD

BARGAIN LIST 75 ● NEW SURPLUS ELECTRONIC COMPONENTS & EQUIPMENT

LCD Module - **ONLY £8** - See Page 21



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ONLY £6.95-
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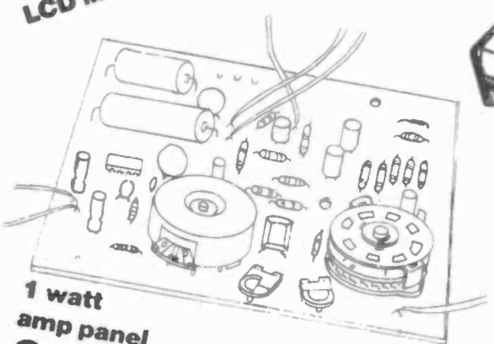

1 watt amp panel
Only £1.50
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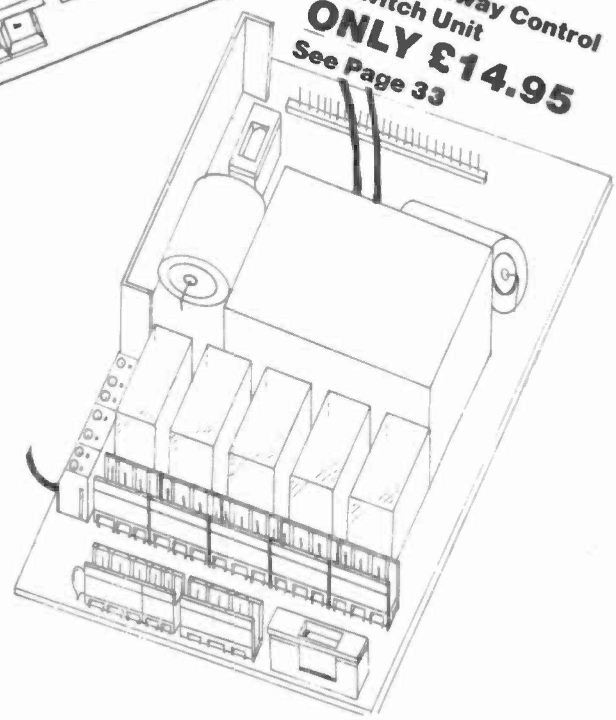
Keyboard - **ONLY £10** - See Page 34



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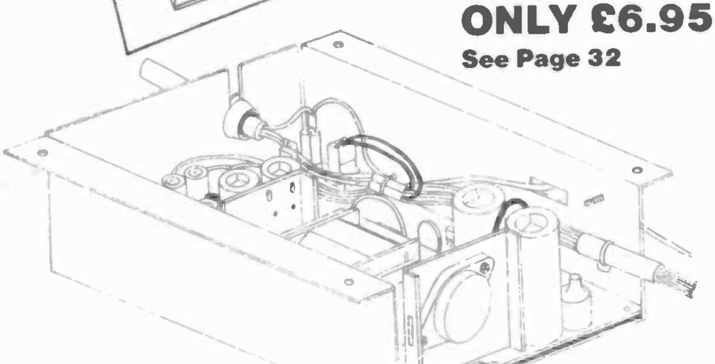

Welcome to the World of Surplus . . .

If you think 'surplus electronic components and equipment' means ancient junk left over from World War II, and auctioned off by the Government; or used components removed from panels, then you're in for a bit of a shock! Most surplus sold today has been manufactured in the last 5 years - some is literally only months old! So where does it all come from?

There are many sources: components left at the end of production runs; finished goods that were either over-produced or not purchased by the intended customer; companies going into liquidation with large stock inventories; discontinued franchises by distributors etc. In all cases, the person responsible for disposal is eager to turn his surplus stocks into cash - so he comes to someone like us. We normally only buy new, full spec parts which are often of a far higher quality than those commercially available to sell at a realistic price to retail customers. We make a fair offer (most are accepted) and collect or have delivered the goods. They are then sorted and appear on our next Bargain List. Because of the vast range of items offered, many odd and interesting devices unavailable elsewhere are included - but please do remember, once sold they are rarely available again!! So don't turn the page when you see 'surplus' mentioned - you're probably being offered exceptional value for money!!

ORDERING INFORMATION

If ordering by post please use the Order Form on Page 45 of this supplement, remembering to write your name, address and postcode in the space provided and giving all the information requested. Payment may be by cheque, PO, cash inc foreign currency banknotes, book tokens, Access, Visa or Connect. If ordering by phone, or fax we'll need details of goods required (order code and price), your name and address (including your postcode), your credit card no. and expiry date.

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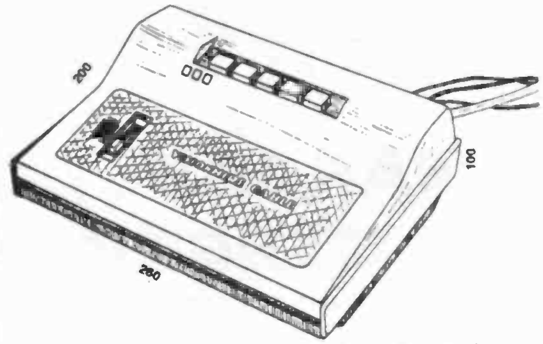
★ STAR BARGAINS ★

CABLEVISION CALAMITY!!!

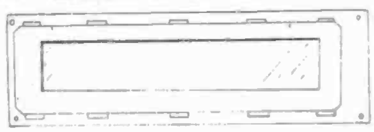


Seems like Visionhire became a bit overstocked on their cablevision consoles - we've just purchased a quantity of these superb brand new units which contain some great electronics and as ever can offer them at an absolute Bargain Price!! Two tone brown case (dimensions as shown) contains PCB 192 × 195mm with easily removed UHF modulator made by Labgear (Sound and Vision); video pre-amp; stabilised power supply and all the decoding circuitry (9 transistors and TBA673 chip).

On the front of the case is a cable/ off air switch and 5 push buttons (4 channels and on/ off mains switch). There are 4 cables coming from the rear (these alone are worth what we are asking for the whole thing!) - 2m mains lead, 1.5m 8 core screened cable with 9 pin plug, 2m video in lead with coax plug and 2m video out lead with coax socket. As you would expect from a company like Visionhire, everything is top quality. The case can easily be utilised for other purposes - the dark brown inserts on the front are both easily removable, if required. Please note the low price we are asking in no way reflects their true worth - they're taking up a lot of space, so we need to shift them quickly!! Supplied with circuit diagram.

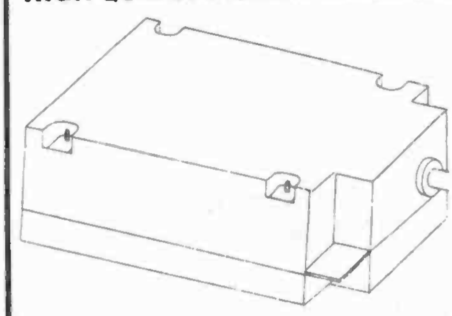
Z8939 .... **£6.95** 100+ 3.50 1k+ 2.50

24 × 2 LCD DISPLAY



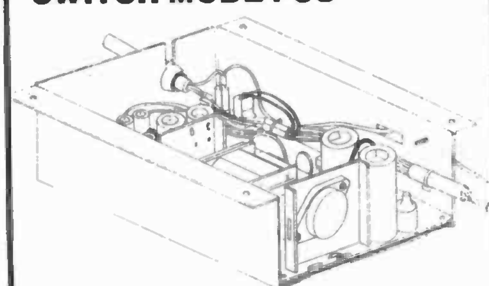
Z2171 24 character × 2 lines LCD by Optrex. High quality display with 192 character ROM; other characters can be displayed by generation in RAM. Other features include: EL type back light (details of high voltage generator supplied); cursor with control, blink character, scroll display, read and write display data, +5V and -7V supply with 150V AC required for backlight, data and power inputs by solder contacts on board, pin outs standard and compatible with other Optrex displays, extended temperature range (253 to 343°K), easily interfaced with either 4 or 8 bit uP's. Supplied complete with data.
Characters are 5 × 7 dot arrays with separate cursor
1 Character measures 3.2 × 6.0 mm
Display size 93 × 16mm Module size 118 × 35mm
DP around £30.00. **Our Price** **£10.00**

HIGH QUALITY NICAD CHARGER



Z5136 Nicad switched mode battery charger for charging 6 × AA, C or D cells. 70mA 16 hour rate, 700mA 1.5 hour rate, 25mA float charge automatically switched in when battery reaches correct charge level. Outputs for fast and slow charging simultaneously if necessary; both on timers to prevent over charging. Fast charge set at 700mA, but internally adjustable. Slow charge set to 70mA. Both outputs switch to 25mA trickle charging after their respective periods of 1.5 hours and 16 hours. Supplied new with instructions and circuit diagram. Was originally supplied for charging cellphone batteries.
Price **£12.95**

SWITCH MODE PSU

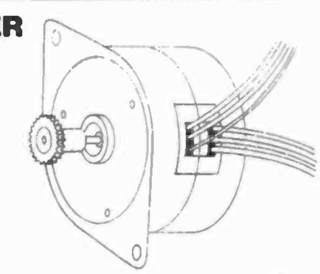


AA12531 This fine switch mode power supply made by Astec comes as a partially cased unit 160 × 104 × 45mm containing a Eurocard PCB 160 × 100mm. Input & Outputs are on colour coded flying leads. There is an additional IEC socket to extend mains to another unit.
Input 115/ 230V 50/ 60Hz
Outputs .... +5V@5A; +12V@0.15A
Total wattage 50W
Prices .... **£6.95** 25+ 5.43 100+ 4.53

Conversion Kit

K725 This kit converts the AA12531 PSU into a much more versatile supply, giving +5V@2.5A; +12V@2A; -12V@0.1A; -5V@0.55A.
Complete kit of parts and full instructions.
Price **£3.50**

STEPPER MOTOR



Z5054 Superb little 12V motor by Airpax. 35mm dia × 21mm deep with a 16 tooth 9.5mm dia gear wheel mounted on the 2mm dia spindle. Fixing centres 42mm 7½°, 48 step. 100+ price is £9.04. Supplied with data sheet.
Prices .... **£3 each** 100+ 2.00

NICAD BATTERY PACK

Z2349 Brand new, intended for use in Zonephones, comprising 4 × ½A size cells each rated 1.2V 0.45Ah, size 16.1mm dia × 28mm. DP £9.92.
Our Price .... **£2.00** 100+ 1.00 1k+ 0.70

Sealed Lead Acid Batteries

YUASA NP6-12. 12V 6Ah sealed lead acid battery. These have been regularly trickle charged whilst in store. Size 150 × 95 × 65mm. List price £28.00

Order Code **Z8918**

Prices .... **£14.95** 10+ 11.20

Nicad Batteries

Z4150 Ex mobile radio battery. 56 × 63 × 33mm case (sometimes damaged) contains 8 × AA size rechargeable Nicads. These can be removed by breaking the case open. Each cell rated 1.25V 600mA

Price **£3.00**

Z4149 As above but 84 × 66 × 33mm. There are again 8 cells but they are longer than AA size, being 73mm long. Each cell rated 1.25V 900mA.

Price **£4.50**

AAA Nicads by Sanyo

SUPERDEAL PRICE!! These superb quality batteries are rated 1.2V 200mAh, and may be charged at 20mA or quick-charged at 60mA. Normally costing around £1.50 each, we can offer these at the SUPERDEAL prices below:

Z2117 AAA Nicad **£1.00**

25+ 0.75 100+ 0.60

D size Nicads

Z5058 D-size Nicad 4Ah rating. Removed from battery packs.

Price **£2.50**

Please Note:

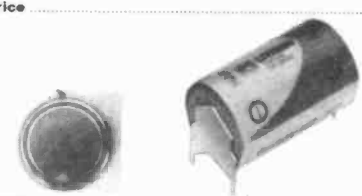
The Free Gifts offered in the Main Catalogue are not available with goods from Bargain Lists.

Z1830 Saft 40 RF310 back up Nicad battery PC mounting on 70 × 22.5mm centres. Rated 3.6V. 10mAH (20mA). Overall size 76 × 28 × 8mm.

Price **£2.00**

Z1951 Varta 'Memopac' PCB Nicad 8.4V 100mAh. Although new, these batteries are not in pristine condition, so are offered at way below normal costs. Size 41 × 26 × 14mm.

Price **£1.50**



Z1720 Lithium Manganese coin cell. Extremely thin, just 1.6mm × 20mm dia. model 2016. Normally £1.67.

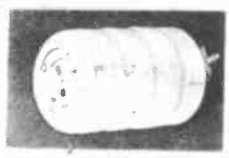
Price 70p

Z2307 Lithium battery ½ AA size, PC mounting 3.7V, 0.85Ah. Individually boxed with instructions. DP £4.57.

Our price £2.50

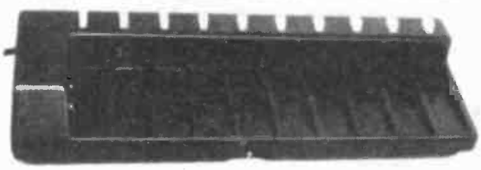
Z2308 Lithium battery Varta CR2430, horizontal mounting. 3V 0.20Ah. DP £1.58.

Our price £1.00



Z4216 Much sought after 4.8V 150mA batteries with PCB mounting tags on 25mm pitch. Battery size 25 × 16 dia. Ideal for paralleling. Some corrosion.

Prices reduced to .... **50p each** 25+ 0.35 100+ 0.25



Z8802 Battery charger unit. 2 part vacuum formed black plastic case 570 × 210 × 85mm with room for 10 × 2.6AH 6V sealed lead acid batteries. Inside is a neat PSU torroidal transformer. 120/240V primary 0-9, 0-9 secondary, each at 10VA. There is a bridge rectifier and smoothing cap. The output is taken to a PCB 510 × 45mm containing 10 identical charging circuits. Each has a TIP31A, 741, IN4002 and couple of Rs. and a 3 pin connector.

Clearing at .... **£8.00 each**

We are always looking for new lines to add to our lists. Send details/ samples of goods available to:

The Managing Director
Greenweld Electronics Ltd
27 Park Road
Southampton
SO1 3TB

If you like what you see in this supplement make sure you don't miss future bargains - only £2 (UK/ BFPO; £4 O'seas) for the next 6 issues - see order form for details.

The 1992 GREENWELD Catalogue is out now! 132 pages of electronic and modellers supplies.

Only £2 (UK/ BFPO; £4 O'seas)

ORDER NOW!

See order form for details

BOOKS

Sensing and Control Projects for the BBC by T. Nunns

The designers of the BBC microcomputer included a number of sockets to allow the computer to recieve signals from and send signals to the outside world. Yet the majority of owners of the BBC micro have only used the cassette and TV/RGB sockets at the back of the computer and the printer and disc drive plugs underneath.

This book introduces ways of using the ANALOGUE IN socket and the USER PORT to interface the computer with its environment. The projects are fully explained in non-technical language at every stage and ideas are given for additional experiments.

No experience of electronics is needed – not even a soldering iron. But that does not mean the projects are trivial – they have been carefully designed around components which can be fitted together without soldering.

If you have never used the computer as a link to the outside world then you wil not have realised how versatile the BBC micro can be. This book will show you the way to many exciting hours of experimenting.

82pp 241×182 .... £2.00

'Go Forth' by Paul Kail

An introduction to Forth Language. It's as easy to use as BASIC, but is much faster. This book is a complete foundation course in Forth programming, and contains a number of complete programs. Originally published at £8.95.

Our Price **£2.00**

CABLE, LEADS

High Quality Audio/ Video Leads

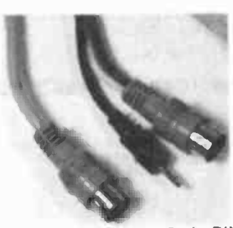
Packed in poly bags with header cards, these 'Nu-Way' leads are offered at a surprisingly low price. 16 types available, all 2m long except * which are 1.5m long. All connectors on all leads are screened - none of your cheapo plastic plugs here!!

Code	Type	Description	1+	25+
Z5033	677	PL259 +5 pin DIN 180° plug to phono plug +5 pin DIN 180° plug	**£1.64**	0.82
Z5034	686	PL259 + 2 phono plugs to phono plug +5 pin 180° plug.	**£1.96**	0.98
Z5035	687	Phono plug +5 pin 180° plug both ends.	**£1.24**	0.62
Z5037	680	PL259 +phono plug to BNC plug + 3.5mm plug.	**£2.46**	1.23
Z5038	685	PL259 +phono plug both ends.	**£2.12**	1.06
Z5039	683	PL259 + 2 × phono plug to BNC plug + 5 pin DIN 180° plug.	**£2.62**	1.31
Z5040	VTV015*	BNC plug + 3.5mm plug to 6 pin DIN plug.	**£1.77**	0.88
Z5050	682/ 764	BNC plug + 5 pin DIN 180° plug both ends.	**£2.56**	1.28
Z5051	VTV025*	PL259 + phono plug to 6 pin DIN plug.	**£1.43**	0.71
Z5052	691	6 pin DIN plug to 5 pin DIN 180° plug + phono plug.	**£1.04**	0.52
Z5053	669	PL259 + phono plug to 2 phono plugs.	**£1.72**	0.86
Z5054	672	PL259 + 5 pin DIN 180° plug to 3 phono plugs.	**£1.96**	0.98
Z5055	675	PL259 + 5 pin DIN 180° plug to PL259 + 2 phono plugs.	**£2.36**	1.18
Z5056	689	6 pin DIN plug to 2 BNC plugs + 2 phono plugs.	**£2.96**	1.48
Z5057	VTV065*	8 pin DIN plug to BNC plug + 3.5mm plug.	**£1.90**	0.95

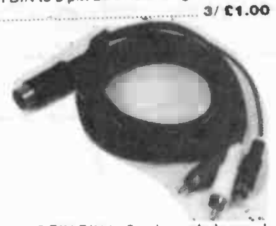
Quantity prices apply to any mix. (Don't forget to add VAT!)

Z4375 Scart plug to scart plug. All pins present, but only video and audio circuits connected. Length ½m. **£2.50**
Z4376 Scart plug to 15W mini 'D'. All circuits connected. Length ½m. **£2.50**

DIN Leads

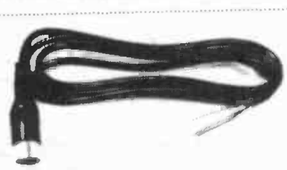


Z4146 Computer lead 7 pin DIN to 3 pin DIN + 2.5mm jack. Originally £1.95
Price .... Only 50p
Z487 3 pin DIN to 3 pin DIN 1.8m long.
Price **3/ £1.00** 100/ 21.75



Z5087 Lead - 6 PIN DIN to 3 coloured phono plugs (video + L and R audio) using flat splittable screened lead. Nice and long-2M. Cheap enough to cut the DIN plug off and reterminate with phonos!
Price .... **2/£1.00** 10+ 0.35 100+ 0.25
Z5134 1.5m long lead with 5pin DIN Domino plug one end, 6pin DIN the other. **Price 60p**

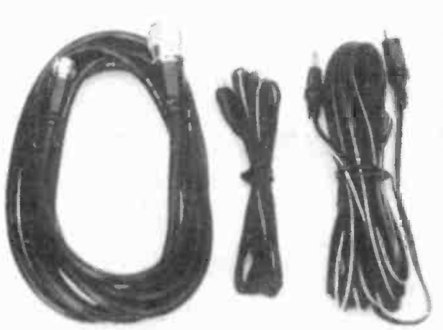
Z612 5 pin DIN 180° plug one end, with 200mm twin cable.
Price **85p**



Z4363 6 way DIN lead; 1.5m lead terminated one end with a 6 pin DIN plug. Bare wires the other end.
Prices..... Pack of 4/£1.00; 100/£12.00; 1000/£90.00

Telephone Leads

Z4169 Telephone lead 3m long with 4 way plug terminated both ends.
Price **£1.50**
Z4309 BT 'breakout' lead. One end has moulded housing with 6 pin BT plug and socket. Other end has 6 pin FCC68 plug (as used on some computers). Overall length 3m
Price **£2.20**



PL616 DC adaptor lead for Walkman. 1.8m long.
Price .... **30p** 100+ 0.15
PL528 2 pin DIN line socket to phono plug 0.2m long.
Price .... **20p** 100+ 0.10
PL708 Video lead. PL259 plug to F type plug. 3m low loss coax.
Price .... **85p** 100+ 0.45
PL508 5 pin DIN - 3 pin DIN audio lead 1.2m long.
Price .... **40p** 100+ 0.20
PL541 Intercom extension lead 3.5m line socket to 3.5m plug. 6m long.
Price .... **40p** 100+ 0.20

Computer Cables

Z2303 Computer printer lead - 36 way centronics plug to 20 way IDC socket, 1m long. **£2.00**
Z2304 Lead 1m long 20 way IDC - 20 way IDC **£1.00**

Z4339 **BBC Printer Lead.** 1m long with 34 way card edge connector one end and 34 way IDC socket the other.
Price £1.95

Z4186 3m multicore lead terminated both ends with 50 way centronics (IEEE-488) socket. Ideal for stripping down for flex — total 150m of multicoloured 7/0.2. Connectors alone worth £12.80
Price .... Only £9.95

Z03779 10 metre long ext'n computer or printer cable. 25 way D plug one end 25 D socket the other.
Price **£10.00**

Computer cables by Mitsubishi. 25 way 'D' socket both ends, connected 1-1, 2-3, 3-2, 4-5, 5-4 6-20, 7-7, 13-19, 14-16 & 25-25. (RS232 Asynchronous Cable for Data transfer Null modem.)
Z5017 10 metres long.
Price **£8.00**
Z5018 5 metres long.
Price **£5.00**

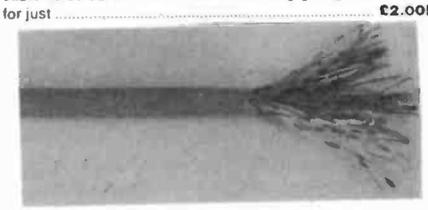
Z5161 Ribbon cable 330mm long terminated one end with 25 way IDC 'D' type and other end with 26 way IDC plug.
Price **£1.00**

RIBBON CABLE BONANZA!!

14 & 16 way Grey 100ft reels.
Z30176 14 way **£6.00**
Z30197 16 way **£8.00**

Z8851 Screened and jacketed 50 way ribbon cable. Found a few more reels of this popular item. DP £200+.
Our price for 100ft reel £45.00, or £2.50/ m

Z2161 14 way ribbon cable 500mm long terminated both ends with 14 pin DIL header plugs.
Price **£1.00**
Z2133 Ribbon cable, 16 way 550mm long terminated both ends with 16 way IDC sockets.
Price **2/ £1.00**
Z2169 Grey ribbon cable in 3m lengths. Now even cheaper to clear! 10 way.
Price **60p**
Z5106 Double screened (braid and foil) PVC insulated cable 40 coloured 7/0.2 cores. 2.5m long giving 100m of flex for just .... **£2.00!!**



Z542 Data transmission cable. 32 core 1/ 0.4 conductors. Overall dia 8mm.
Prices **5m £4.50 20m £13.00**

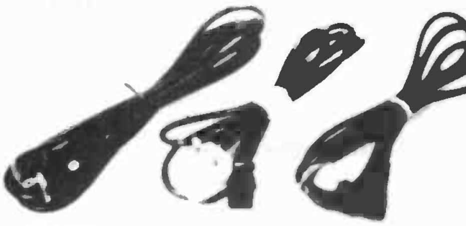
Z480 2m red and black power lead fitted with 2.5mm power plug.
Price **25p**

Z002 Curly 6 core flat lead which extends to 2.5m with socket one end.
Price **60p**
Z5023 Very springy coiled short lead 12 core, each 7/0.1. Coiled bit 6.5mm long. Overall length extended about ¾m.
Price **£1.00**
Z5024 Heavy duty coiled lead. 6 core - very fine flex (80/ 0.1?) Overall dia 8mm. Coiled bit 300mm. Overall length extended 2m.
Price **£1.20**
Z1430 Resistance wire - T2 alloy, 95.4% Ni, 1.8% Mn, 1.6% Si, 1.2% Al. 2.521Ω/ m. 0.0148" dia. Sold in 5m lengths.
Price **£1.00**

Enamelled Copper Wire

Very thin, on reels varying between 0.4 and 1.06lb nett. As every reel has a different weight, the best way to sell it is by the lb. Send enough for an exact no. of lbs (min 1lb) and we'll credit you with the difference. (or charge the correct amount on Access or open cheque).
Z4091 46SWG .0024" red solder thru' enamel
Z4092 44SWG .0032" brown enamel (few red)
All the same price £2.50 per lb

MAINS LEADS



Z4358 Mains lead - 13A plug one end, 3 pin IEC socket the other. Overall length 2m.
Price **£2.30**

Z4249 Mains lead - shrouded IEC plug to open end. Overall length 2m.
Price **£1.30**

Z03561 Mains cable 5m long fitted with right angle CEE22 plug. DP £4.99
Price **£2.50**

Z03068 2 metre mains lead CEE22 socket one end, 3 pin US style plug the other.
Price **£2.30**

Z03209 4 metre mains lead CEE22 socket one end, open the other.
Price **£2.50**

Z4338 3 core black mains lead 2m long. One end is fitted with a 2 pin continental plug, the other with a 6A 3pin IEC socket. Both are moulded on.
Price £1.20

MAINS CABLE ON REELS

Z30210 1.0mm^2 32/0.2 10A 3 core mains screened. Black sheath. 50m coils. List price £35.57
Our price **£20.00**

SCREENED CABLE ON REELS

Z30246 Screened 16 core 7/0.2. Grey sheath. 100ft reels.
Our price **£15.00**

EQUIPMENT WIRE

Z5041 Some more equipment wire has come our way. Made by BICC, 7/0.127 in 3 colours Grey, Brown and White (state 2nd/ 3rd choice).
Price/ 100m reel **£1.50**

Z30239 Woven 7/0.2 blue and orange (20 of each) ribbon cable. 40 way. Just pulling a thread separates all cores. 10m length giving 200m of flex.
Price **£4.00**

Z30239-02 As Z30239 (Page 16 of Spring Supplement) but 16 way. 10m length.
Our price **£2.00**

Z30244-03 As above, but 40 way in 11 colours. In 7.5m coils, giving a total of 300m of multicoloured flex.
Price **£4.00**

Z5019 As above but only 3m long.
Price **£2.00**

Z30171 Insulated earthing braid
Price **25p/m**

Z30244 Woven twisted ribbon cable red/orange 7/0.2 10 core.
Price **25p/m**

BULK CABLE BUY!!!

Some 500m reels of 1/ 0.6 equipment wire have just arrived - not many, so be quick and give second choice please. DP £13.75.
Z8942 Purple 1/ 0.6mm **£6.50**
Z8943 Green 1/ 0.6mm **£6.50**

Wire Links

Useful when breadboarding.
Z597 200mm long, black **200/ £1.50**
Z1704 30mm pitch, green **1000/ £2.00**

Z4395 Interboard jumper cable. Short piece of transparent ribbon cable. 10 way 0.1" pitch with ends prestripped and tinned ready for use. 50mm long. DP 30p each.
Pack of 100 .... **£3.00**

Z2094 Bandoliered wire links. 0.6mm dia with solder-thru insulation, 60mm long.
Price for pack of 200 .... **£1.00**

Z1806 We also have bandoliered wire links. 60mm long 24SWG.
Price ...... **200/ £1.00** 1k/ £2.60 reel of 15,000 £21.75

Sleeving

A number of reels of PVC sleeving have just become available:
Z9015 20mm dia Black 100m roll.
Price **£10.00**
Z9016 10mm dia Black 50m roll.
Price **£4.00**
Z9017 8mm dia Black 50m roll.
Price **£4.00**
Z9018 6mm dia Green 100m roll.
Price **£6.00**
Z9019 6mm dia Blue 100m roll.
Price **£6.00**
Z27273 Black PVC sleeving 2mm bore. 50m coil.
Price **£2.50**
Z29016 4mm black PVC sleeving. 30m reels. DP £3.61.
Our price **£1.50**
Z4396 Clear PVC tubing. 3mm bore 0.5mm wall.
Price **15p/metre**
100 metre roll £8.00

Z757 Numbered white sleeving. 25 each 0-9.
Price £1.50

Z1633 Clear layflat heatshrink tubing 10mm dia, shrinks to about 5mm when heated.
Price .... 40p/ metre 10m coil 2.20 25m coil 4.35

Z821 Heatshrink sleeving. Layflat effective dia 42mm. As listed in Cat (Y087). But we've a large amount to clear. Rolls of 100m at 90% off catalogue price.
Price £17.50

BUSHES/ GROMMETS

Strain relief bushes for anchoring cable through panels. For cables up to about 5mm dia.
Price .... **Pack of 25 £1.00**
100+ 0.025 1k+ 0.016
Z5003 Black
Z5004 White

Z07007 long sleeved grommet 45mm long. Hole dia 4mm.
Price .... **Pack of 40 £1.00**
1k+ 0.01

Z07059 Cable tie mounting base. Natural nylon colour. Self adhesive with holes for screw fixing if required. 28.5mm sq. List Price £5+
Our price/pack of 100 .... **£2.00**

PC KEYBOARDS

After the Russian keyboards featured in Bargain List 74, we've now purchased some French (sacre bleu!) and German (Donner und Blitzen!) varieties. Slightly different character set to UK models.

Brand new in original packaging. High quality, made by Intelligent, switchable AT/ XT offered at a knockout price:
Z8954 French **£20.00**
Z8955 German **£20.00**

Extraordinary Easiwire Offer!!!

The easy to use no-soldering wiring tool which makes construction of small electronic projects so simple!

All included in the kit are: Wiring pen, Utility tool, Punched wiring board, Self adhesive sheet, Spring loaded terminals and jacks, Spare spool of wire, Excellent instruction book. Catalogue price £15.00

PRICE **£5.00**

CAPACITORS

POWER SUPPLY CAPACITORS

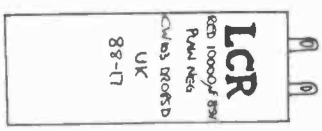
These high value, high ripple current cans are made by BHC/ LCR and are of excellent quality and value.

Code	Value	Voltage	Ripple	Mn f'r	l×d	Mfr's price
Z4343	2200µF	40V	2.7A	LCR	45×26	2.12
Z4345	10,000µF	40V	4.9A	BHC	56×41	3.89
Z4346	15,000µF	25V	5.5A	BHC	56×41	3.96

Prices:

Z4343	60p	25+ 0.45	100+ 0.30
Z4345	£2.50	25+ 1.80	100+ 1.50
Z4346	£2.50	25+ 1.80	100+ 1.50

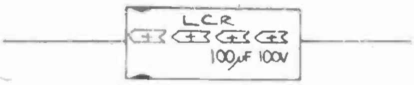
Z02122 51,000µF 40V 145mm × 65mm dia by Sprague.
Price **£5.00**



All these have screw terminals except those marked* which have tags.

Code	Value	Volts	Mnf'r	Size	1+	100+
Z4404	100	350	Novea	48×30*	**£1.00**	0.60
Z4408	2200	160	Novea	84×51	**£2.00**	1.20
Z4409	2200	250	LCR	116×64	**£3.00**	2.00
Z4410	3300	16	LCR	45×26*	**30p**	0.15
Z4419	3300	25	LCR	50×26	**40p**	0.25
Z4411	3300	80	LCR	55×35*	**£1.00**	0.60
Z4412	3900	63	Novea	115×35	**£1.20**	0.75
Z4413	5600	50	Novea	84×35	**£1.50**	0.90
Z4414	10000	6.3	Novea	50×35	**£1.00**	0.60
Z4415	10000	25	Novea	84×35	**£2.00**	1.20

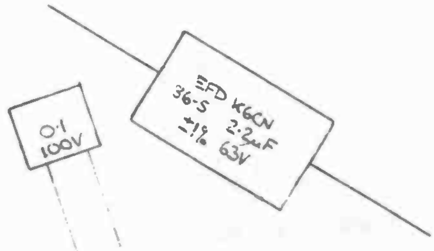
Screw-top electrolytic cans, B41455 +50 -10%; -40°C ... +85°C. DIN41250. Available in 2 values:
Z5146 10,000µF 100V 105 × 64 dia.
Price .... **£4.00 each; Box of 20 £60.00**
100+ 2.00 1k+ 1.70
Z5147 4,700µF 100V 105 × 51 dia.
Price .... **£3.00 each; Box of 35 £70.00**
100+ 1.50 1k+ 1.20



(b) Capacitors, electrolytic axial leads

Code	Value	Volts	Mnf'r	Size	1+	100+
Z4420	100	100	LCR	26×13	**70p**	0.40
Z4421	220	250	Noyea	75×26	**£2.00**	1.20
Z4422	1000	63	Novea	40×21	**£1.00**	0.60

Z2319 Phillips bandollered caps, 47µ 25V Radial. 12 × 6.5 dia.
Price .... **Pack of 20 £1.00** 100+ 0.025 1k+ 0.015
Z2320 Phillips MKT-P × 2 rated polyester axial lead caps. 0.1µF 250V AC.
Price .... **Pack of 6 £1.00** 100+ 0.10

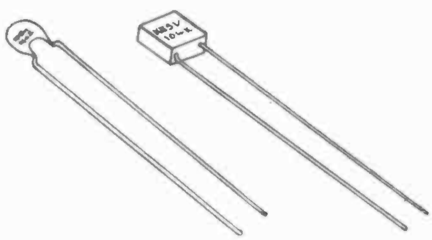


(c) Capacitors, non-electolytic axial leads
(*Radial 10mm pitch) inc close tolerance

Code	Value	Volts	Mnf'r	Size	1+	100+
Z4423	0.1	100		13×11×5*	**4p**	0.02
Z4425	1	63	EFD	18×7×7	**24p**	0.12
Z4426	1	63	EFD	18×7×7	**10p**	0.06
Z4427	1	630	EFD	31×27×19	**20p**	0.12
Z4428	2.2	63	EFD	32×18×7	**40p**	0.20

Z02284 DIL multilayer ceramic caps - 2 pin, so can be packed closely together on PCB using standard DIL spacing. Only one value - 0.22µ. List price on these is 98p each.
Our price .... **Pack of 8/£1**
100+ 0.09 1k+ 0.06

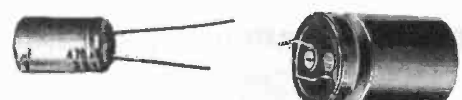
MULTILAYER CAPS



Z2152 Dipped ceramic 100n (0.1µF) 4 × 3.2mm.
Price .... **Pack of 25/ £1.00** 1k+ 0.02
Z2153 Moulded ceramic 100n (0.1µF) 5 × 5 × 2.5mm.
Price .... **Pack of 25/ £1.00**

Ceramic Disc Capacitors
1200pF 50V 4mm dia. 5mm pitch. Boxes of 2000 on tapes.
Price £12.00
Z781 Min ceramic plate cap .02µF 50V 5mm square. 3mm pitch. 30mm leads.
Prices .... 100/ £1.50 Box of 500/ 4.35
Z1709 0.01mF 50V bead ceramic.
Price (sample free) 30/ £1.00 1000/ 17.40
Z1541 Ceramic disc 2200pF 7mm dia. 5mm pitch.
Price 20/ £1.00
Z1769 High voltage ceramic capacitor - 680pF 2kV 6mm dia body.
Price 15/ £1.00
Z768 Feedthrough cap. Believed to be 1000pF and 10pF. Overall length 25mm.
Price for pack of 25 .... £1.20

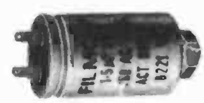
Z1428 33pF 5% polystyrene cap 100/ £2.00
Polyester Capacitors
0.68µF 250V 22.5mm pitch. Boxes of 200.
Price £3.00
Z1766 X2 class polyester capacitor 17 × 14 × 8mm, 15mm pitch 0.1mF 250Vac.
Price 4/ £1.00



Electrolytic Capacitors
33µF 25V radial leads. Reels of 1000.
Price **£12.00**
We have large quantities of the electrolytics listed below that we now wish to clear at substantially discounted prices:
Z741 Tubular tant cap. 15µF 35V. List price on these is really silly - £2.59 each!
Our price 6/ £1.00 25/ 2.60
Z427 Can 50 × 25mm dia. Sprague 2200µF 40V, tag ended.
Price 30p 10/ 1.90 100/ 13.00
Z428 Can 37 × 25mm dia. Lorlin 1500µF 40V. PC mounting.
Price 25p 10/ 1.75 100/ 10.40
Z429 Axial 30 × 16mm dia. Lorlin 750µF 16V, wire ended.
Price 10p 10/ 0.70 100/ 4.35
Z1708 0.47mF 40V solid axial tant.
Price **10/ £1.00**
Z788 Sprague 8µ 25V elec axial caps.
Price **25/ £1.00**
Z822 800µF 250V can 76 × 38 .... **£1.00** 10/ 5.20

Paper Block

High capacity for use in motor starter circuits, etc.



Value	Tol%	AC volts	Size	Make	Price
2uF	5	250	48x360	RIC	480p
2uF	10	440	52x350	RIC	670p
9uF	10	440	94x500	Advance	1160p
10uF	10	280	52x400	Gould	930p
13uF	10	250	85x68x40	Hunts	840p
25uF	10	280	90x450	Erie	1220p

Z4277 25mF ±10% 450V 50Hz capacitor, 110mm long × 70mm dia.
Price **£5.00**
Z5073 Capacitor pack - 4 × 1µF 250V ac (600V dc) WIMA MKS4- R caps connected in series with flying leads. Useful for motor starter caps.
Price **£2.00**

Please Note:

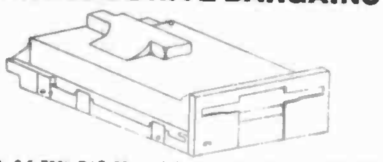
The Free Gifts offered in the Main Catalogue are not available with goods from Bargain Lists.

Bipolar capacitors - these are useful in crossover networks, and were probably used with Z1760 choke.
Z1756 8µF 50V 31mm long × 12mm dia.
Price **8/ £1.00**
Z1757 40µF 50V 39mm long × 12mm dia.
Price **6/ £1.00**
Z1758 80µF 50V 41mm long × 16mm dia.
Price **5/ £1.00**
Z1759 100mmF 50V 41mm long × 16mm dia.
Price **4/ £1.00**

Trimmers

Z1400 Miniature trimmer, 3.5-13pF, PC mounting, 8mm dia.
Price 10/ £1.00 100/ 6.10
K236 Miniature PCB mounting trimmer, 3-15pF.
Price 10/ £1.00

MORE DISK DRIVE BARGAINS

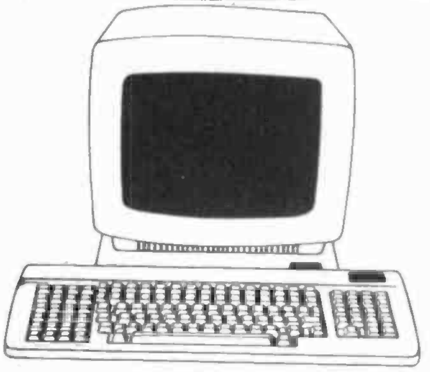


Z8934 3.5 720k D/S 80 track half height drive by YEDATA. Ex-equip, but guaranteed perfect.
Price **£29.95**

3" Disk Drive + PSU

Amazing deal allows us to offer these Amstrad units at this incredibly low price! Please note these are returns and are offered without guarantee. They are however complete with some info.

Z8949 DD1 for Amstrad CPC464 (First drive, low density). Cased unit 280 × 105 × 70mm with integral PSU. **£15.00**
Z8950 FD1 for Amstrad CPC464 (second drive, high density). Cased unit 280 × 105 × 70mm with integral PSU. **£20.00**
Z8951 FD2 PCW8256 second drive, high density chassis unit 155 × 95 × 45mm. **£10.00**
Z8952 FD4 PCW9512 second drive high density with special mounting frame. Chassis unit 155 × 95 × 45mm. **£10.00**



Z8946 Micronet 12 text terminals. Top quality kit by Sidereal Corporation of USA consists of 12" mono white screen monitor in cream case, and 117 key keyboard. Monitor is supplied with Z5123 modem (needs fitting) and has brightness and volume controls. On rear panel is mains inlet and power on/ off switch, batt on/ off switch, keyboard socket, parallel printer port and 2 RS232 ports. PCB inside has 68B09 processor and 16k of memory. Brand new units, originally selling for several hundred pounds.
Our special price to you is **£50.00**
page 39

BBC 'B' SOFTWARE - FINAL CLEARANCE

This has been cluttering up our stores for far too long - (SAE for more information, colour leaflets).

Micro Maestro - Comprises 5¼" disk + computer tape; 16 page handbook; C60 stereo cassette with backing tune of popular tracks like 'Ghostbusters', 'Chariots of Fire', and 'Superman'. **Original Price £17.95.**

Z4333 Concert Pitch **£4.95**
Z4334 B^b **£4.95**

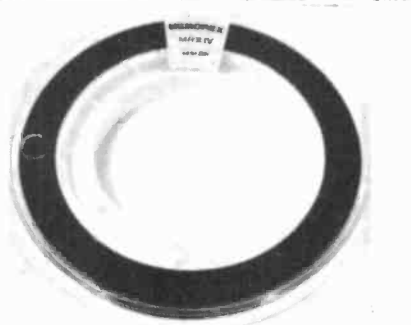
Music Master - Comprises microphone to attach to recorder + processing device; 5¼" disk; 12 page handbook. **Original Price £52.78.**
Z4326 40 track disk **£14.95**
Z4327 80 track disk **£14.95**

Mupados Recorder Tutor - Comprises 5¼" disk; 38 page large format spiral bound handbook; C90 stereo cassette with 52 tunes. **Original Price £30.94**
Z4328 40 track disk **£7.95**
Z4329 Ensemble Pack **£2.95**
Z4330 Duet Pack **£2.95**
Z4239 Recorder tutor Classroom Ensemble Network pack, for use when several micros are being utilised. Includes 2 disks, a cassette and book.
Price **£4.95**

Z22454 Emulex Intelligent Host Adaptor. MSCP Compatible. Panel with lots of expensive chips, plus a very comprehensive 208 page handbook. Must have cost a fortune originally.
Our price **£30.00**
(Handbook only on approval if required; £10 refundable deposit + £2 post).
Z22455 Similar to above: Emulex MT03 Controller. For interfacing SC51 hosts and controllers to a model TDC3309 0.25" streaming cartridge tape drive. Handbook available as above.
Price **£30.00**
Z9010 Tape streamer. Tandberg TDC3319. Internal fitting (same size as 5¼" disk drive). Takes DC600 tapes. Unsure of capacity - possibly 60Mb. Does anyone know?
Price **£250.00**
Z2044 Q-PAK cartridge insert. SQ100.
Price **£20.00**

Magnetic card reader head

- used for detecting when credit card or similar is swiped. Made by DRH. Type no 01.635. No other info (but our technical expert is working on it).
Order Code **Z2121**
Prices .... **£2.00** 100 + £1.00



Z9012 Memorex MRX IV ½" computer tape. 600 ft on 175mm dia spool. 6250BPI. In case, in sealed poly bag. List £7.49.
Our price .... **£3.50** 50 + 2.00
Z22297 Disk pack CDC1204 16MB CMD cartridge.
Price **£20.00**
Z8909 GNT3606 Tape/Punch station. Brand new in original packaging. This is a self contained punch station for data registration on 8 channel paper tape. 19" rack mounting. Punching speed 75c/s; TTL parallel input. RS232. Can be programmed from 50-1200 baud. Takes up to 8" roll. List price is £1,997.55.
Our special price **£500.00**

COMPUTER TAPES

Z8940 2400 ft of superb quality used 0.5" tape on 10" reels. 6250 CPI. Various manufacturers. Supplied in carrier. New, they cost £12.00. Could probably be used as video tape - we're checking this out. Meanwhile, why not buy a few reels - useful as cheap 'twine' for tying up garden plants etc!!
Price .... **Only £2 a reel**
- or come and collect .... **100 for £50 + VAT**

MODEMS

Z8936 Buzzbox DSL 21 CCITT V21 modem (300 baud) made by DaCom Systems.
Complete, new and boxed modem suitable for use with micro computers with RS232C or RS423 interface. Comes complete with external PSU, 5 pin DIN plug, and instructions. Very simple to use, only 4 wires employed V24 103 (Tx data), 102 (Ground), 104 (Rx data), 109 (Carrier Detect).
Note no auto dial therefore a telephone is required to be used with this modem. Originate and answer mode selectable. **£24.95**
Z8937 One to One 21/23 IAD CCITT V21/23 auto answer modem 300, 1200/75, 75/1200 baud full duplex, 1200 baud half duplex Tx or Rx. Made by Master Systems Ltd.
Complete, new and boxed modem suitable for use with micro computers with RS232C interfaces. Professional quality modem featuring full auto dial, last number redial, selectable baud rates, speed conversion to allow DTE/DCE communications to proceed at an apparent 1200/1200 baud (all functions operated by control characters sent from DTE), auto answer, internal bell or CCITT standards switch, and many other useful facilities. Comes with comprehensive 76 page manual, external power supply and 25 pin Din standard DCE connector. **£75.00**

Z5123 Modem. Fully functional brand new and boxed. Standard 160 × 100mm Eurocard with DIN41612 connector. Only 300 baud, but at the price we're asking represents superb value for money!! Supplied complete with wiring details - needs ± 12V.
Price .... **Only £14.95**

Miracom Technology, renowned manufacturers of modems have discontinued one or two models, and we've purchased their remaining stocks and their component inventory for these units.

Dataspectrum

Z5138 Modem serial interface and software package. Plugs directly into spectrum edge connector. Baud rates 1200/ 75, 75/ 1200, 300/ 300. Allows use of Prestel, Viewtext user-user comms with suitable modem. Includes Prestel telesoftware downloader. Main menu options include: Transmission Format selection, Prestel ID storage, Viewdata mode entry, Teletype mode entry, Frame processor, Mailbox editor, Save. Complete and new with cassette and user guide in plastic case. **Only £7.00**

Databeeb

Z5139 Intelligent comms ROM. Complete comms firmware allowing Prestel, Viewtext, Bulletin Board, Telex, Database, user-user comms with a suitable modem on BBC computer. Allows baud rates of 1200/ 1200, 1200/ 75, 75/ 1200, 300/ 300, 600/ 600. Full fitting instructions and user guide supplied in plastic case. **Only £7.00**

Maximiser

Z8953 Complete unit with power supply and comprehensive instructions. Designed to add the facilities of error correction, speed buffering, encryption (optional) and a battery backed data store with a printer port to existing modems capable of speeds up to 2400 baud. Easy to use. (Send £5 returnable deposit for user manual for further information). **£20.00**
Z2302 Encrypter unit for above. Supplied free with maximiser, otherwise (no data). **£2.00**

Apple Card

Z5140 Interface to modem, but no info. Card 140 × 70mm has 25 way edge plug. PCB fitted with lead + 25 way D plug.
Price **£5.00**

If you like what you see in this supplement make sure you don't miss future bargains - only £2 (UK/ BFPO; £4 O'seas) for the next 6 issues - see order form for details.

SPECIAL OFFERS

SPECIAL OFFER ON LARGE ELECTROLYTICS !

High ripple ALT20A cans by BHC at less than a quarter distributor prices!

Z4345 10,000µF 40V **£2.00**
Z4346 15,000µF 25V **£2.50**

Qty Prices (+ Vat):
Z4345/6 100+ 1.50 1k+ .75

SPECIAL OFFER ON 1A RECTIFIERS !

	1k	5k
IN4001	9.85	9.25
IN4004	10.85	10.25
IN4007	12.25	11.50

All +VAT, price per 1000

SPECIAL OFFER ON 1.5A BRIDGES !

	100+	1k
W005	0.075	0.068
W04	0.095	0.088
W06	0.10	0.090

All +VAT

SPECIAL OFFER ON DARLINGTON TRANSISTORS !

40V 80W 12A with h_{Fe} of 750 @ 5A!!

	1+	100+	1k+
BDW93	**40p**	.20	.15
BDW94	**40p**	.20	.15

(Qty prices exclude VAT)

SPECIAL OFFER ON SWITCH MODE PSU !

Astec Model AA12531. 115/230V 50/60Hz input. Size 160 × 104 × 45mm. Panel partially enclosed in steel case. Outputs: 5V@5A; 12V@150mA.

AA12531 **£6.95**
100+ 3.50+VAT
1k+ 2.80+VAT

SPECIAL OFFER ON 25W D SOCKETS !

PC right angle mounting by Souriau.

	100+	1k
DB255RA	0.25	.20

All +VAT

SPECIAL OFFER ON 2.5W W/W RESISTORS !

	1k	10k
IR2	0.02	0.015
IR5	0.02	0.015

All +VAT

SPECIAL OFFER ON 14 WATT HI-FI AMP !

5 lead TO220 package by STC normally retailing at over £2.00!!

	1+	100+
TDA2030	**£1.00**	.50

(Qty price excludes VAT)

SPECIAL OFFER ON SWITCH MODE PSU !

Astec 65 watt model BM41012 115/230V 50/60Hz input via suppressed, switched and fused IEC inlet. Fully enclosed in steel case 175 × 135 × 65mm. Outputs on socket: +5V 3.75A, +12V 1.5A, -12V 0.4A

BM41012 **£14.95**
100+ £11.00+VAT
1k+ £8.00+VAT

SPECIAL OFFER ON 40V 2A TRANSISTORS !

TO92 case by TI. Distributor price on 100+ is .21.

	100+	1k+	10k+
TIPP31 NPN	.07	.04	.03
TIPP32 PNP	.07	.04	.03

(Qty prices exclude VAT)
Pack of 4 of each type £1.00

SPECIAL OFFER ON 25A RECTIFIERS !

Tag ended 200V bridge rectifiers by IR normally costing £4 each.

Our low prices:
26MB20A 25A 200V £1.50
100+ 0.75+VAT
1k+ 0.55+VAT

SPECIAL OFFER ON MAGNETS !

High quality ceramic magnets in 2 sizes at a very special price:

Z1889 20mm dia × 5mm thick **10/£1.60**
100+ 0.09+VAT 1k+ 0.06+VAT

Z1890 26 × 11 × 9mm **10/£2.00**
100+ 0.12+VAT 1k+ 0.08+VAT

SPECIAL OFFER ON RESISTORS !

Huge parcel of resistors - mostly bandoliered in boxes of 1000, 2000 or 4000 or on reels of 5000. In order to get a good selection, you need to buy a lot! **Ref K529.**

25,000	**£25**
100,000	£74+VAT
250,000	£170+VAT
1,000,000	£500+VAT

GREENWELD ELECTRONIC COMPONENTS

SPECIAL OFFER ON 5A REGULATORS !

These high current devices normally sell for around £10 each.

Our low prices:
LAS1905 5V £3.00
LAS1912 12V £3.00
100+ 2.00+VAT

SPECIAL OFFER ON 2k × 8 SRAM's !

Low power version of this popular RAM by Hitachi, normally about £2.50 each.

Our low prices:
HM6116LP-4 £1.00
100+ 0.60+VAT
1k+ 0.40+VAT

SPECIAL OFFER ON TANT BEADS !

Top quality tantalum bead capacitors by AUX, bandoliered.

2.2µF 25V 5mm pitch **10/£1**
100+ .04+VAT
1k+ .025+VAT

SPECIAL OFFER ON VOLTAGE REGULATOR !

TO3 Variable voltage regulator, 1.2-37V at 1.5A.

LM317K £1.50
100+ £0.75+VAT

SPECIAL OFFER ON Z80A CPUs !

This popular 4MHz CPU by Zilag normally cost £2 each.

Our low prices:
Z80 4MHz CPU 75p
100+ 0.35+VAT
1k+ 0.25+VAT

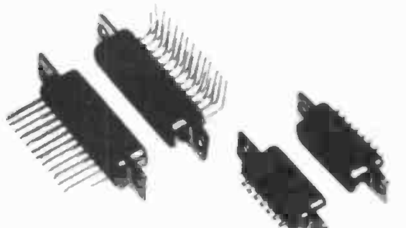
SPECIAL OFFER ON DC-DC CONVERTERS !

Heayberd PC mounting 51 × 51mm. 48V DC input. List price £50+.

Z1893 5V 1A output **£2.00**
Z1894 12V 420mA output **£2.00**
100+ .80+VAT
1k+ .50+VAT

Please note these are ex-equip but fully operational.

'D' Connectors



Angled solder pins PCB mounting plugs
Z1501 15 way **40p**
Z1502 25 way **50p**
Z1503 37 way **60p**

Angled solder pins PCB mntg sockets
Z1504 15 way **50p**
Z1505 25 way **60p**
Z1506 37 way **70p**

Wire wrap plugs
Z1508 25 way **50p**
Z1509 37 way **60p**

Wire wrap sockets
Z1510 15 way **50p**
Z1511 25 way **60p**
Z1512 37 way **70p**

Solder bucket plugs
Z2354 9 way **40p**
Z1514 37 way **50p**

Solder bucket sockets
Z1515 15 way **50p**

Solder pin Plugs
Z1516 15 way **40p**
Z1517 25 way **50p**
Z1518 37 way **60p**

Solder pin sockets
Z1519 15 way **50p**
Z1520 25 way **60p**
Z1512 37 way **70p**

Z2001 50 way 'D' IDC plug
Price **£4.00**
Z2002 50 way 'D' IDC socket
Price **£4.50**
Z2003 37 way 'D' cover, plastic
Price **80p**

Z2005 25 way 'D' PC right angle mounting plug.
Price **50p**
Z2006 25 way 'D' PC right angle mounting socket.
Price **50p**

Z03340 IDC 15 way D socket.
Price .... **70p each**
25 + 0.42 100 + 0.32
Z03341 IDC 15 way D plug. Special low price on quantities: Our catalogue price is £2.72, but we've rather a lot at the moment!
Clearing at .... **2 for £1.00**
25 + 0.35 100 + 0.25

Z2055 9 pin 'D' plug. Right angle PC mounting.
Price **30p**
Z2057 9 pin 'D' socket as above, but with captive nuts
Price **40p**

Z1970 9 pin D plug, right angle PCB mounting by Sourlau. Gold plated pins.
Price .... **3/£1.00** 100 0.20

D TYPE 25 WAY PLUGS

Z5080 Right angle PCB mounting in plastic housing by Amp, HDP-20. Gold plated contacts.
Price .... **Pack of 24 £5.00** 100 + .10, 1000 + .06.
Z5081 Right angle PCB mounting metal by Eurosab, EDA25PC Gold plated pins and contacts.
Price .... **Box of 25 £5.00** 100 + 0.10 1k + 0.60

Z5144 Pack of 10 25 way 'D' hoods with clamps & screws **£1.50**

PROFESSIONAL CONNECTORS

High quality plugs and sockets as used on military equipment, at a fraction of normal prices.

(a) McMurdo Red Range.
These are red nylon connectors with a low insertion/withdrawal force. Current rating 5A. Op voltage 800V. Pitch 4.7mm. Sockets have floating bushes, 90mm fixing centres. DP in brackets.
Z5077 8 way socket (5.00) **£2.00**
Z5078 16 way socket (7.92) **£3.00**
Z5079 32 way socket (17.48) **£5.00**

(b) McMurdo Micronector.
Z2145 41 way socket arranged in 2 rows of 14 and 1 row of 13 sockets. Type MS141.
Price **£2.00**

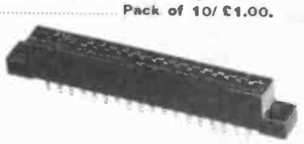
(c) Amphenol Round Multipin connector.
Z2140 126-215 4 way socket, cable mounting with cover.
Price **£1.00**
Z2141 126-216 5 way plug, cable mounting (no cover).
Price **£1.00**
Z2142 165-11 11 way plug, chassis mounting.
Price **£1.50**
Z2143 165-12 12 way socket, chassis mounting.
Price **£1.50**
Z2144 165-25 24 way plug, cable mounting.
Price **£2.00**
Z2146 165-31 14 way plug, chassis mounting.
Price **£1.50**

(d) Amphenol IDC PCB mounting plugs. Gold plated with ears.
Z2149 straight 60 way **£1.00**
Z2150 right angle 60 way **£1.00**

Edge Connectors

Z5084 43 way double sided edge connector, 0.156 (4mm) pitch. PC mounting. Gold plated contacts.
Price .... **Box of 11 £4.00** 100 + 0.15
Z5083 40 way IDC ribbon cable terminating card edge connector. Gold plated.
Price .... **Pack of 10 £2.00** 100 + 0.10 1k + 0.06
Z5085 11 way single sided PCB mounting edge connector, 0.1 pitch. Sample free.
Price .... **Pack of 250 £5.00** 1k + 0.015 10k + 0.01

Z2154 29 way Double sided 0.1 pitch gold plated edge connector (pin 5 missing) for right angle PCB mounting clipped onto plastic bracket.
Price .... **£1.00** 25 + 0.60 100 + 0.35
Z2155 Back to back 0.1 pitch card edge connector. The plastic moulding has room for 12 double sided contacts, but only numbers 3, 4, 5, 6, 7, 8, 9 and 10 are fitted. Gold plated.
Price .... **Pack of 10/ £1.00** 100 + 0.05
Z2156 PCB right angle mounting, card edge connector, 15 way double sided with pin 6 missing.
Price .... **Pack of 10/ £1.00.** 100 + 0.05

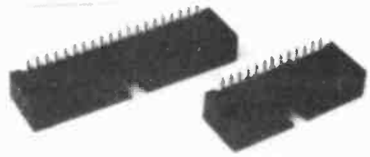


Z2050 Edge connector, 0.1 DS 31 way. PC mounting.
Price **£1.70**
Z2051 Edge connector, 0.1 DS 25 way. Right angle PC mounting.
Price **£1.50**
Z2013 0.156" double sided 18 way edge connector, DP £2.20.
Our price **£1.00**
Z1895 Edge connector by Souriau 40 way double sided 0.1 pitch with solder tags. Gold plated for extra reliability. List price of these is over £7.00!
Our low prices .... **£2.20; 10 + £1.30; 100 + £0.70**
Z2313 12 way DS edge connector for C64 computers (0.156"). **£1.00**
Z2160 PCB mounting gold plated edge connector with centre fixing hole giving 2 lots of 18 way DS contacts. Pitch 0.15.
Price **£1.00**

Z2344 High quality 2 pin + earth socket, cable mounting. Made in Germany, type no STAK20, rated 250V 6ADC, 16AAC.
Price **£1.00**
Z5169 Above socket with 2m 3 core 6A mains lead fitted.
Price **£2.00**
Z2345 As Z2344 but chassis mounting **£1.00**
Z2346 2 pins + earth cable mounting plug to fit Z2344/5.
Price **£1.50**

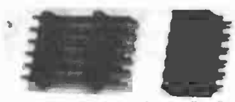
Z769 BNP plug (it says on the packet 101/ BNP/ PTFE/ 7C) so if you're desperate for one of these, we've got them!
Price **50p**
Z762 Transistor socket, 4 pin TO5 PTFE with gold plated pins. Extremely high quality.
Price .... **6/£1.00**

Z759 IDC plugs, 40 way with lugs for mounting once cable has been connected.
Price 70p

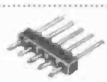


5342-26 26 pin boxed header plug ..... **3/ £1.00** 100 + 0.15
5342-40 40 pin boxed header plug ..... **3/ £1.00** 100 + 0.15

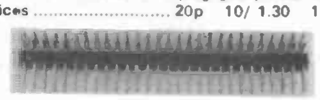
Z411 Terminal housing 0.1" pitch, 2 way.
Price 10/ 30p 100/ 1.75 1000/ 13.00
Z410 Shorting link 0.1" pitch.
Price 10/ 30p 100/ 2.60 1000/ 17.40



Z1551 12 way PC mounting socket, 2 rows of 6, 0.1" pitch both ways.
Prices .... 10/ £1.00 25 + 0.07 100 + 0.05
Z1552 12 way DIL header plug 0.1 pitch, with stand off. Used for connecting 2 layers of PCB. Length between spacers (ie gap between boards) 50mm. Or just use Z1551/2 as an ultra low cost 12 way plug and socket!
Prices 10/ £1.00 25/ 1.75 100/ 5.20
Z1381 10 way PCB mounting single sided low cost edge connector. 0.1" pitch.
Prices 10/ £1.00 100/ 6.10
Z1382 10 way commoning block, 2 × 5 way 0.1" pitch by Amp.
Prices 10/ £1.00 100/ 6.10



Molex headers 0.1" pitch. Ideal for Veroboard etc. at amazingly low prices.
4030-03 3 pins.
Price 10/ 60p 100/ 3.50 1000/ 26.00
Z1651 36 way right angle header plug, single 0.1 pitch, gold plated. List £1.20
Prices 40p 10/ 2.60
Z1652 31 way 0.15 pitch, single header plug, gold plated.
Prices 6/ £1.00
Z1548 32 way turned pin header plug, gold plated. List £2.40 each.
Our prices 80p 10/ 5.20 100/ 39.15
Z1571 10 way, 0.1 pitch header plug, gold plated. List 51p.
Our prices 20p 10/ 1.30 100/8.70



Z703 28 way double row right angle pin header (fits Z702).
Price .... **3 for £1**
Z1863 As above but 33 way .... **2 for £1** 100 + 0.35
Z702 28 way edge plug, fits Spectrum edge connector.
Price 60p

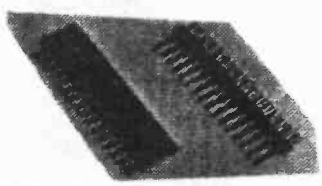
Z2018 Pin header 36 way right angle single row. Notched to allow easy subdivision.
Pack of 2 .... **£1.00** 100 + 0.25
Z4359 90° PCB socket connector 10 way 0.1 pitch. DP 60p. Made by Molex.
Price .... **Pack of 10/£2.00** 100 + 0.14 1k + 0.09

CONNECTORS

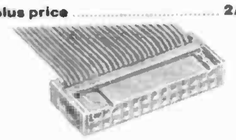
Molex Connectors

These are 36 way (9 × 4) sockets 38.5 × 22 × 20mm intended for PCB mounting, but could be used as a cheap form of breadboarding. The sockets are 1.8mm dia on an 0.166" pitch (6 to the inch) and if component leads are doubled over they are a tight fit. Available in 3 colours, blue, yellow and white. Also 5 × 3 way green socket on 3.5mm pitch.

Z4387 Blue 36 way; pack of 8 giving 288 points.
Price **£1.00**
Z4388 Yellow 36 way; as above.
Price **£1.00**
Z4389 White 36 way; as above.
Price **£1.00**
Z4390 Jumbo pack - 50 each Blue, Yellow and White.
Price **£12.00**
Z4391 Green 15 way; pack of 20 giving 300 points.
Price **£1.50**
We have about 8,000 altogether and would clear the lot for **£200.00** + VAT.



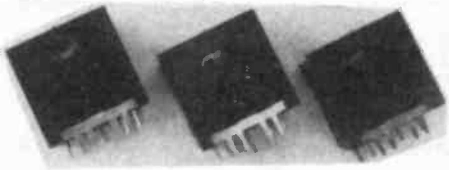
Z1722 16 pin SIL socket.
Price 5/ £1.00
Z1723 16 pin SIL header plug.
Price 10/ £1.00
Z2159 Turned pin SIL socket, 7 way notched so can be easily broken into any number of ways. Gold plated.
Price .... **Pack of 25/ £1.00**
Pack of 250 £4.00 Box of 3200 £25.00
Z5088 14 way 0.1 locking socket. Insert flexible wiring and push on clamp to lock into position. Sample free.
Price .... **Pack of 10 85p** 100+ 0.04 1k+ 0.02
Z2004 24 way centronics style (IEEE 488) socket by 3M. IDC. List £5.81.
Price **£2.00**
Z2058 6 way telecom type socket, PC mounting (as used with some computers).
Pack of 3 .... **£1.00**
Z1999 9 pin plug, circular. 8 pins around the edge, the 9th is a thicker centre pin. Made by Contact. Very solid housing.
Price .... **3 for £1.00**
Z767 26 way transition connector, IDC type.
Price 10/ £1.00
Z2114 34 way IDC card edge socket. Normal catalogue price £3.60.
Special surplus price .... **2/£1** 100+0.25



A couple of cheap IDC sockets:
Z2317 10 way .... **8 for £1**
Z2318 16 way .... **6 for £1**

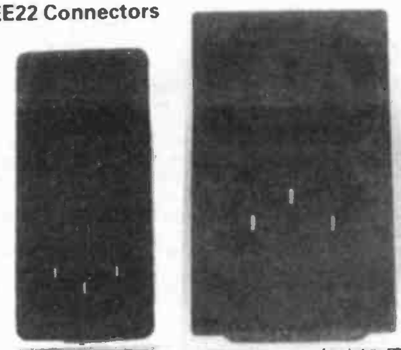
PC MOUNTING DIN SOCKETS

Z042 PC mounting 2 pin DIN socket made by Cliff.
Price .... 25/ £1.20 Box of 200/ 5.20

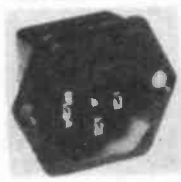


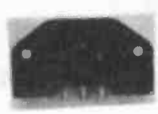
Z1714 5 pin 240°.
Price 100/ £5.00 1000/ 26.10
Z1715 6 pin 100/ £10.00
Z1716 7 pin 100/ £10.00
Pack of any 10 £1.55; any 25 £3.50; any 100 £10.45
Z1868 5 pin DIN 180° socket. Panel mounted by means of a press on clip at the back.
Price 10/ £1.00
Z2056 8 pin DIN socket, PC mounting.
Price .... **6 for £1.00**
Z2025 14 way DIN type line sockets with locking sleeve.
Price **£1.00**

CEE22 Connectors



Z1799 Belling, Lee L2723 fused switched mains inlet (DP on/ off rated 6A). Needs cut out 60 × 28mm. Clip fix. Their price £3.75.
Our Price £1.00
Z692 Fused mains inlet/ outlet. Extremely useful for equipment - allows 'linking' between units, thus avoiding numerous mains leads. Normally costs around £2.50.
Our Price £1.00





Appliance Inlet with Single Pole Fuse
J059 .... 47p
Z598 PCB mntg 6A IEC power plug by Switchcraft. British made 50p
Z1867 Shuttered IEC socket, 6 amp, 3 pin, clip fix. Needs hole 28.5 × 25mm.
Price 3/ £1.00

Horizontal appliance inlet
J055 Horizontal 6.3mm Faston tabs 23p
Z1843 As J055 (page of cat) but vertical mounting appliance inlet. 6.3mm tabs.
Price 4/ £1.00
Z1844 Vertical chassis mounting IEC plug, solder tags.
Price .... **3/£1.00**
J056 6.3mm Faston tabs — clip on 31p
RFI Suppressed Mains Inlets
J057 6.3mm Faston tabs £3.50
Z4189 Belling Lee L2136C/L mains inlet filter plug with ¼" tabs. 1A rating £2.00
Z2027 Suppressed CEE22 inlet by Shaffner. This is a high current version, rated 10A. Connection by 0.25" tabs at right angles to body. Screw fixing.
Price **£4.00**

Z2029 US style mains 3 pin plug. **Price** **£1.50**
Z2030 Matching 3 pin socket. **Price** **£1.00**
Z2031 Continental style 3 pin plug. **Price** **£1.00**

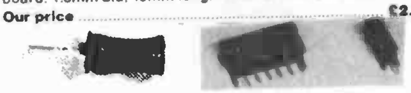
Z2173 Mains plug and socket. Bulgin P429 3pin 1.5A chassis plug and 3 pin right angle cable mounting socket. Current price of these two is around £2.50. **Our special low price (per pair):** **£1.00** 25+ 0.65 100+ 0.50

Electrical Accessories

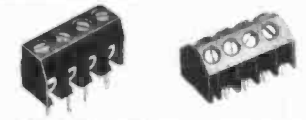
MK parts available as follows:
Z5010 Single gang unswitched 13A socket with 9mm face plate.
Price .... **£1.50** 10+ 1.00
Z5011 5215 45A DP control switch with lamp List £8.45.
Our price **£5.00**
Z5012 5045 Termination unit - will take 2 × 10mm² conductor. List £4.04
Our price **£2.50**

Terminal Pins

Z1869 PC mounted header pin requires 2.4mm hole. Pin dia 2.25 × 12mm above board. Slightly corroded.
Price 50/ £1.00
Z1870 Crimp sockets for above pins.
Price 25/ £1.00
Z522 AMP Terminal Pins on carrier strip 0.2" pitch. Bit small for Vero, but OK if you're making your own PCBs. Sample free.
Price .... 200/ £1.00 1000/ 3.00 reel of 10,000/ 26.10
Z2026 Cambion PCB pins. High quality double sided. Needs 1.8mm hole.
Packs of 1000 .... **£8.50**
(sample free)
Z2170 PCB pins - double sided for 0.15 pitch perforated board. 1.3mm dia, 19mm long. Packs of 1000 DP £6.62.
Our price **£2.50**

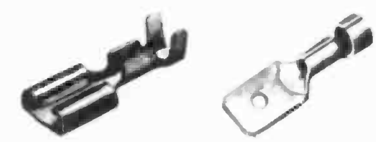


Z1897 1mm plugs. Belling & Lee L1944 type in Red, Black, White, Blue, Green and Yellow. 25 of each colour, total 150.
Price for 150 .... **£7.50**
Z2157 Single terminal post for 1mm plug.
Price .... **Pack of 100/ £1.00.** 1k+ 0.05
Z2158 6 way terminal socket for 1mm plug.
Price .... **Pack of 25/ £1.00.** 250+ 0.01
Z4070 3 way socket 4mm pitch by amp.
Price 10/ £1.00



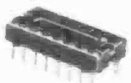
PCB Terminal Blocks similar to our range on Page 35. All 5mm pitch.
Z1993 10 way 90° .... **2/£1;** 100+0.25
Z1956 10 way 45° .... **2/£1;** 100+0.25

Crimp Connectors



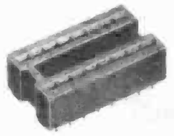
Supplied to us on reels, we have the following types:
Z1988 3.2mm receptacle, brass. **Pack of 50** **£1.00**
Z1989 5.0mm receptacle, brass. **Pack of 50** **£1.00**
Z1990 ¼" receptacle, tinned.
Pack of 50 .... **£1.50**
Z1991 ¼" locking receptacle, tinned.
Pack of 50 .... **£1.50**
Z1992 ¼" blade, copper (for use with above).
Pack of 50 .... **£1.80**
Z1546 Crimp terminal, box type for use on header described below. Gold plated.
Prices 100/ £3.00 1000/ 19.15
Z404 Push on crimp connectors - in line receptable type 100 - 0.11", for use with general purpose speakers.
Price 100/ £1.00 1000/ 4.35 10,000/ 26.10

IC SOCKETS



We have accumulated a large amount of low profile DIL sockets and now offer those surplus to our requirements at an especially attractive price.

Code	Pins	10	100	1000
Z1881	8	40p	2.60	17.40
Z1882	14	68p	4.40	29.50
Z1883	16	72p	4.70	33.00
Z1884	18	76p	4.95	31.30
Z1885	20	80p	5.20	34.80
Z1886	22	84p	5.50	36.50
Z1887	24	88p	5.75	38.20
Z1888	28	92p	6.00	40.00
Z1889	40	96p	6.25	41.75



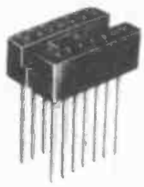
Standard profile, high quality by Vero, Amphenol, etc. Available as listed in the following table, all at remarkably low prices:

All gold plated:

Z1681	16pin	**10/90p**
Z1685	24pin	**10/£1.55**
Z1688	40pin	**10/£2.20**

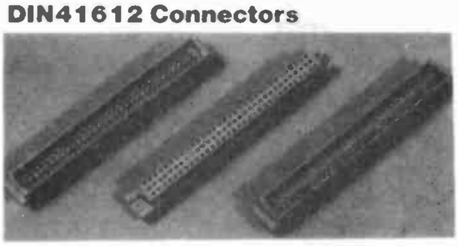
Pins	Tinned		
16	Z1680	60p	All are priced per pack of 10
24	Z1684	£1.00	

Wirewrap DIL Sockets

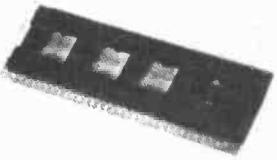


Top quality at give away prices.
Z1891 14 way tinned **15p**
Z1892 14 way gold plated **20p**
Less 25% for 25 off: less 50% for 100 off.
Z2116 40 pin wirewrap socket. Usually 126p Special price on surplus stock ..... **2/£1.00** 100+ 0.25

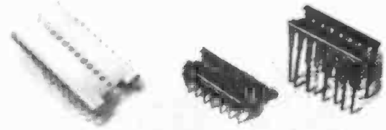
DIN41612 Connectors



Z2015 96 way right angle PC mounting plug.
Our price **£1.00**
Z2016 96 way socket (matches above).
Our price **£1.50**
Z2017 64 way right angle (AC) PC mounting plug.
Our price **90p**
Z1982 DIN41612 mini ⅓ B socket, 32 (2 × 16) way. DP £2.97.
Our price ..... **£1** 100+ 0.35
Z5082 DIN 41612 right angle plug 64W (A and B) Gold plated contacts.
Price ..... **Box of 50 £10.00** 250+ 0.10 1k+ 0.06



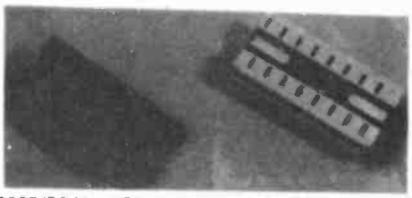
Z1717 'QIKEJECT' low extraction force IC sockets designed by Vero. 64 way.
Price 50p



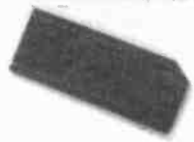
Z1554 Turned pin 28 pin DIL socket. This is a Jermyn device allowing IC's to be in close contact with PCB. Rows of pins are held on a carrier which is removed after soldering in place. This means that pins could be used individually if required. Jermyn's price £1.02
Our price ..... **30p**; 10/£2.50; 100/£18.00

Z2087 14 pin turned pin sockets, like Z1554 in Spring Supplement (p14).
Price ..... **5 for £1.00** 100+ 0.10

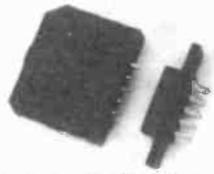
Z2088 16 pin wirewrap socket, like Z1554.
Price ..... **4 for £1.00** 100+ 0.12



Z2007 IDC 14 way DIL plug. Normally £1.00.
Price ..... **3/£1.00** 100+ 0.17
Z2008 IDC 16 way DIL plug. Normally £1.10.
Price ..... **3/£1.00** 100+ 0.18



Z2086 40 pin DIL header plug, gold plated. Normally £1.80
Price ..... **Pack of 2 for £1.00** 100+ 0.30
Z2355 Extremely high quality 14 pin DIL header plug, gold plated, turned pins.
Price ..... **3 for £1.00**



Z1741 High quality 10 pin chassis socket and cable mounted plug, gold plated contacts. Made by SATO, 30mm FC. Plug 41 × 30 × 13mm.
Price £1.50

PC Mounting Sockets

Z586 Phono socket, PCB mounting.
Prices 10/ £1.00 25/ 1.75 100/ 6.10
Z576 2.1 power socket, chassis mounting.
Prices 10/ £1.00 25/ 1.75 100/ 6.10 1k/ 43.50
Z1748 2.5mm power connector line plug. Fits PO64.
Price 3/ £1.00

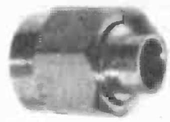
Z2059 3.5mm plastic socket, chassis mounting, 3 terminals. 8mm nut is missing.
Pack of 20 ..... **£1.00**

Z1495 Line socket for old style P.O. 4 pole plug.
Price £1.00

Z1361 Right angle DIL socket for mounting 7 seg displays (takes our MAN6740 dual digit). Extremely high quality.
Prices ..... 40p 10+ 0.26 100+ 0.17
Z1402 11 pin relay socket, solder pins. Normally 58p
Prices 10/ £3.00 100/ 17.40 1000/ 130.50
Z1405 Flush mounting coax socket with plastic surround. Normally 32p.
Prices 10/ £1.50 100/ 8.70 1000/ 60.90
Z1555 CRT socket. 10 way moulded green plastic.
Price 4/ £1.00

Z1657 11 pin relay holder, screw base as
Their price £3.10
Our price **£2.00**

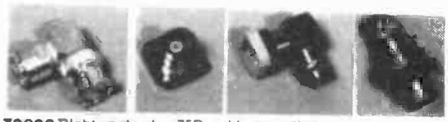
Z350 Amp 50 way panel mntg skt, IEEE488 type **£1.00**



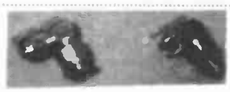
Z1557 'F' socket, single hole make low cost RF connector.
Price 4/ £1.00

BNC Connectors

Z1399 BNC socket. Single hole chassis mounting by Greenpar. Very high quality in sealed packets.
Price 2/ £1.00
Z1836 BNC 75R Crimp plugs by Greenpar. Normally around £1.50 each.
Our Price 3/ £1.00



Z2020 Right angle plug 75R, cable mounting.
Price **£2.50**
Z2021 Right angle PCB mounting socket.
Price **£2.50**
Z2022 PCB mounting socket, 50R by Belling Lee.
Price **£1.00**
Z2040 BNC Bulkhead Socket 50R. DP £4.44.
Our price **£2.00**



Z2023 SMC screw coupling elbow plug by Greenpar.
Price **£2.00**
Z2024 SMA screw coupling PC mounting right angle PCB socket. List price £6.66.
Price **£2.00**
Z1987 75R Sealectro miniature RF connector type 50-107-0000. List price £3+
Our price **£1.00**
Z2113 BNC free plug. DP £1.66.
Our price **75p**

PC connectors for 0.1 pitch. (DP shown in brackets).
Z2009 6 way plug (1.02) **40p**
Z2010 6 way socket (1.59) **60p**
Z2011 12 way plug (1.84) **80p**
Z2012 12 way socket (2.82) **£1.20**
Z743 24 way socket, connections on 5mm centres. Their price £4.74.
Our price £1.00

CASES, FINISHED ITEMS

Plastic Boxes

These are fine quality ABS black boxes:

Z5068 Individually packed. 112 × 62 × 31mm. Fixing by 4 screws (supplied) into threaded inserts. Also 2 lengths of PCB spacer included.
Only .... **£1.00** 100+ 0.50

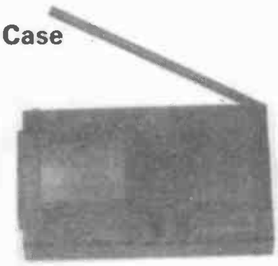
Z5126 Conductive plastic storage box 230 × 128 × 20mm, complete with antistatic foam. Same as Farnell 175-838. Their price £5.98.
Our low price **£2.00**

Z5127 Small version of above, 91 × 65 × 20mm like Farnell 175-840. Their price £1.40.
Our price .... **2 for £1.00**

Z5125 Potting box PB105B 75 × 50 × 35mm. List price 48p.
Our Price .... **4 for £1.00** 25+ 0.14 100+ 0.09

Z5142 Vacuum moulded case 225 × 175mm. Ideal for storing software/ audio cassettes, etc. **3/ £1.00** 100+ 0.22

Microvision Case

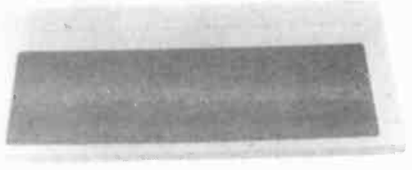


Z557 Sinclair microvision case. Complete case with lens and aerial for all inclusive price of **£2.00**
(These cases are brand new, and do not contain any electronics)

METER CASE

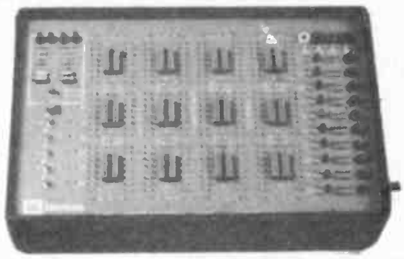
Z4224 Meter case 135 × 120 × 45mm, suitable for our smaller models.
Price **£1.00**

Keyboard Enclosure



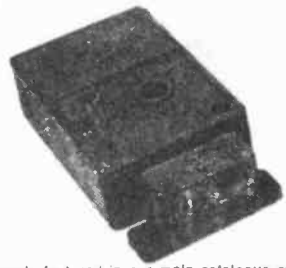
J063 High quality keyboard enclosure 550 × 225 × 70mm with black aluminium mask. Top professional quality - made by Data Packaging. Normally £38.69.
Our price **£11.00**

We've just purchased a parcel from a training centre that's closed down. There was a quantity of test equipment and components, including the following:



Z8932 Limrose Compukit 2 IC patchboard, model CK2 0020/1. This is a mains powered test and development unit 290 × 185 × 85mm for educational use. It has 12 16 DIL sockets with all contacts accessed via terminal pins; 10 5mm red LED's driven by a transistor circuit; 2 clocks; 5 switches and a 5V power supply. These are currently listed at £184 each.
Our special price to you is **£40.00**

Burglar Alarm

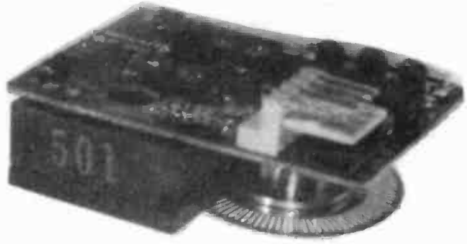


SB17 Previously featured in our main catalogue at £2.50 we've bought up all our supplier's remaining stock. One half houses 2 × AA batteries and loud buzzer operated by reed switch and is screwed to the door. The other part contains a powerful magnet and is screwed to the frame. Alarm sounds when door is opened.
Price **£1.50**

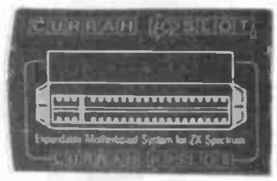
Please Note:

The Free Gifts offered in the Main Catalogue are not available with goods from Bargain Lists.

Optical Shaft Encoder

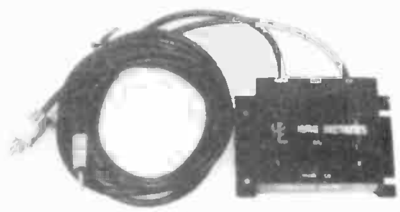


Z345 Optical Shaft Encoder. Made by sharp. Ideal wherever the position or speed of a rotating shaft needs to be know - ie machine tool control, robotics etc. Supplied with comprehensive data sheet. Size of module 46 × 33.5 × 20mm; size of disc 28mm dia. Bush with grub screw will take a 4mm dia shaft. Disc has 96 slots. DP £48.18.
Our Price **£8.50**
Data sheet available separately **30p**

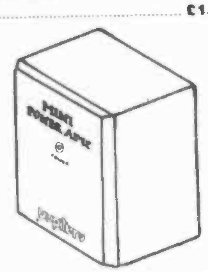


Z4138 μSlot. 'T' connector (1 female, 2 male) for the Spectrum enabling 2 peripherals to be connected at one time. Further μ slots can be added allowing more peripherals to be added. New and boxed.
Price **£2.00**

Z4139 As above but skeleton version - no plastic case.
Price **£1.00**

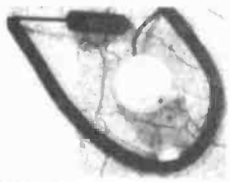


Z4081 CB Aerial Eliminator, enables ordinary car radio aerial to be used with CB set. Black metal case 75 × 70 × 30mm contains 2 × 500pF trimmers 2 switches, coil, R's etc. 2 × 10.5m leads from unit connect to CB rig and car radio. Socket on unit takes car radio plug, thus enabling either car radio or CB to be used at the flick of switch. These were originally selling (during the CB boom) for around £7.95. We've got 3000 to clear.
Prices **£1.00ea** 100/ 0.52

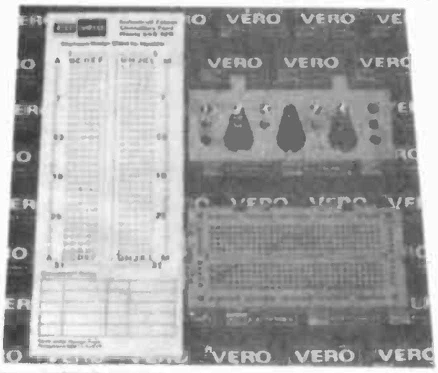


Z5155 Mini Power Stereo using 2 × LA4140 chips and 6 transistors giving 600mW output Amp. Neat silver cased unit. 88 × 58 × 68mm with LED on front for use with personal stereo. Input lead supplied. Just add 4 × AA batteries (supplied) or 6V PSU and connect speakers!
Special low price **£2.95**

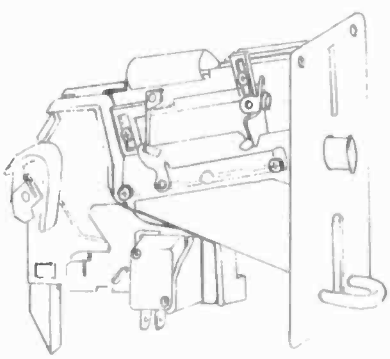
Z4284 Converter S5/8-RS232 box 88 × 62 × 24mm with small panel inside contains socketed ICL 232 chip (replaces 1488/89) and 74HC14. Coming from box are 2 leads: one is 0.5m long with a 25W socket, the other is 1.2m long with 8 pin DIN plug. Chips alone cost £9.00!
Price **£6.00**



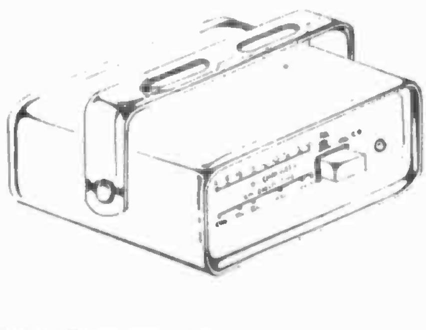
Z4071 MAP LIGHT. Magnetic map light with magnifier. This useful accessory is fitted with a cigar plug and has a curly cord extending to 3m. The white plastic housing for the lamp has an integral magnet and a swing-out powerful magnifying lens.
Price .... **£1.95** 100+ 0.75



SB15 VEROBLOC KIT
This discontinued kit give excellent value for money - verobloc, aluminium front panel and design pad.
Price **£5.95**



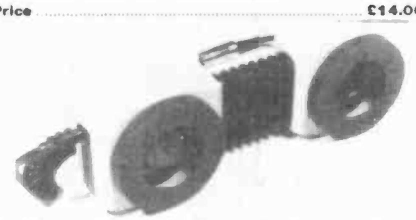
Z652 We've found a couple of hundred more coin mechs - these units were installed in the cream dispensers we had a year or two ago and were extremely popular. Made by Coin Controls, this unit will accept various size coins by simple adjustment of 4 screws. Incorporates various security features - magnet, bent coin rejector etc. Microswitch rated 5A 240V. Front panel 115 × 64mm. Depth 130mm. Normally £12.
Our price **£4.50**



Z4347 CB Converter. We had some of these a year or two ago and they went like hot cakes! It's in a neat case 108 × 68 × 44mm with a drilled mounting bracket for installation. By simply connecting the power leads, plugging your aerial into the converter and feeding output to your AM radio, you have the facility to tune through channels 1-40. A switch is fitted to the front panel so the unit can be by passed. Comes complete with box with instructions.
Price **£3.00**

SB5 CAR SPEAKERS. 4" air suspension unit with centre coaxial tweeter and crossover. All black plastic cabinet. Shelf or door mounting.

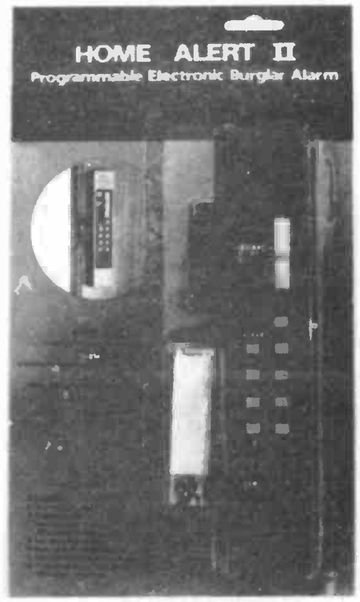
Power nom	7W
Power max	20W
Impedance	4Ω
Size of speaker	4" coaxial
Magnet weight	10oz
Dims	120 × 120 × 90mm
Price	**£14.00**



Z8884 Acoustic coupler for use with Liberator. Made by Sendata, 700F series. One end has PCB with lots of chips plus 4 × AA Nicads to power. Other end has socket to take mains power supply (supplied). Also included is a communications cartridge and a comprehensive 46 page manual. New.
Now only **£14.00**
Z8944 As above but without PSU **£10.00**

SB3 VIDEO HEAD CARE KIT: Double ended head tool. Snap-in inspection mirror. Three applicator arms.
Price **£1.00**

Have you missed the Bargain of a lifetime because you weren't a Bargain List Subscriber? Don't miss out next time, subscribe now! It's only £2 for the next 6 issues, all sent with a reply paid envelope at approximately monthly intervals.



Z4275 'Home Alert II' Programmable Electronic Burglar Alarm. Fitted to any door, it will sound an alarm when opened if the correct code has not been punched in. Easy and reliable to use, simple to install. Powered by single PP3 battery. On presentation card with full instructions. Size 220 × 40 × 30mm. Attractive wood grain finish.
Price .... **Reduced to £9.95**

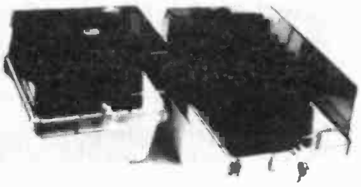
Z8837 EXXON DUAL SHEET FEEDER Z200. Overall 395 × 210 × 285mm. Brand new and containing some very high class electronics. Although of little practical use as it stands, it makes a great break down unit. It contains:
3 × 12V 36R 7.5° stepper motors by Airpax and associated gear trains drive belt etc.
2 × 12V Solenoids.
1 × 12V electronic buzzer.
2 extremely sensitive micro-itches.
1 PCB containing 4 × TIP115, 4 × TIP110, 2 × 7404, LM3302 comparator + T's, R's, C's, plugs, sockets etc.
1 control panel containing 4 LED illuminated push buttons + green LED on small PCB
1 × OPB703A opto coupler
1 × OPB711 opto coupler

Obviously a very expensive piece of machinery to produce - but once again our contacts in the trade have enabled GREENWELD to procure a few hundred for a fairly modest sum, allowing us to offer them at a bargain price.
Price **£17.95**

FLEXIBLE LIGHT

Body takes 2 × AA cells and has a large clip, or can be mounted in large suction base supplied. Flexible arm 85mm long has prefocus lamp fitted.
Order code **128**
Price .... **£1.95** 25+ 1.20

FINISHED ITEMS

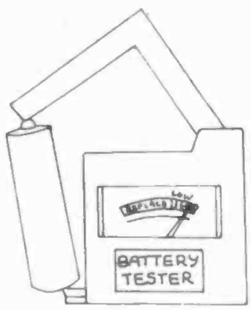


Z8860 Floppy disc storage boxes. The only problem is they are for 8" discs! Beautifully made locking boxes with clear lids and cream base. Complete with plastic dividers. holds 90 discs. Size 250 high × 240 wide by 350 deep. (List £40.00)
Our Price **£14.00**
Z4154 Discs for above box. BASF Flexydisc SS/DD in packs of 10 (List £32.00) **£9.00**
Z4155 As above but DS/DD (list £37.00) **£12.00**

Z8873 Industrial compressed air 'cyclone' moisture trap and filter.
Moisture trap works by generating a chamber full of circulating air which centrifuges out moisture droplets and particulate matter. A scintered brass filter removes any remaining particles. Max pressure 250psi (16 BAR) 1.5" BSP fittings.
Height 250mm; Length 200mm; Width 100mm.
Price .... **Reduced to £17.95**

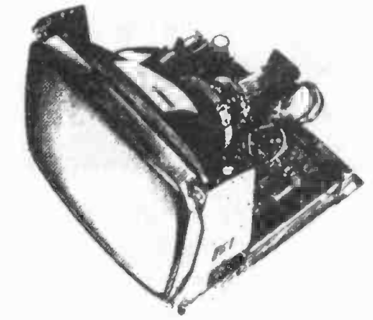
CAR ALARM

This is quite a sophisticated little circuit, built onto a PCB 75 × 35mm with large (45mm dia) piezo sounder attached. There's also a trembler strip which, when moved activates the alarm. Powered by a PP3 or the car battery, the only other connection required is to a switch. After switching on, there is a low bleep for 15 seconds to indicate the car is alarmed. If it is then tampered with, the piezo sounder emits a high level tone.
Order code **Z5099**
Price .... **Excellent value £5.95** 25+3.00

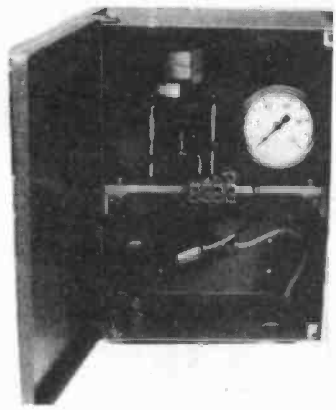


BATTERY TESTER

Z5113 Neat unit measuring only 52 × 54 × 23mm that will check a variety of batteries - AAA, AA, C, D, PP3 and watch batteries. Meter shows GOOD, SUSPECT and REPLACE.
Only **£1.75**



Z8924 Hi-res mono monitor with 9" screen by Matsushita. TTL input. 12V operation. Uncased. Supplied with connection data and circuit diagram. Only a few available - be quick!
Price **£25.00**
Z8925 CRT's for above monitor Type M23/E1GRN.
Price **£5.00**



Z8872 Air pressure regulator with motor drive. This unit consists of a strong steel case (175mm W × 250mm L × 100mm H) which is suitable for wall mounting. Air inlets and outlets are fixed to the bottom of the base and fit 1⅛" olives.
Inside there is a pressure regulator (between 100 and 2psi) max input pressure 150psi. The regulator has one air output leading to the outlet, another leading to a pressure gauge (by Budenberg) reading to 100psi. Size: 65mm dial. The motor drive consists of a 250 rpm @ 50Hz motor wired for 100 Vac use (wirable for 220V). Fixed to the motor is a 500:4 reduction gear box, the output shaft of which is connected to the regulator adjustment screw.
The motor is stopped between two limits by micro switches. Height of motor and regulator 190mm.
Price .... **Reduced to £29.95**

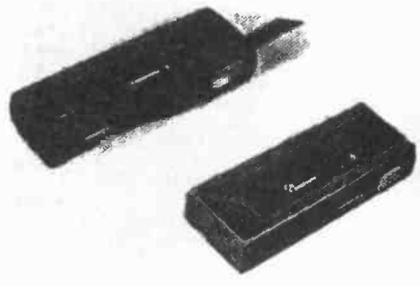
The 1992
GREENWELD
Catalogue is out now!
132 pages of electronic and modellers supplies.

Only £2 (UK/ BFPO; £4 O'seas)

ORDER NOW!
See order form for details

CAMERA BONANZA!

Job lot of 'returns' just arrived, offering the amateur photographer a bargain buy in 110 & 35mm cameras. We've been asked not to mention the manufacturer's name, but it's well known for its equipment and available in all photographic and chemist shops (Boots) etc. There are a number of different models, but to simplify matters we've grouped them into 4 main types:
(a) 110mm manual; (b) 110mm motor driven; (c) 35mm manual. All are complete and intact and look OK, so the faults (if any) are probably minor. Because they're so cheap, you can afford to buy 2 or 3 - we're sure you'll be delighted with the value we're offering! - but please do remember these are **returns** and are sold without guarantee.



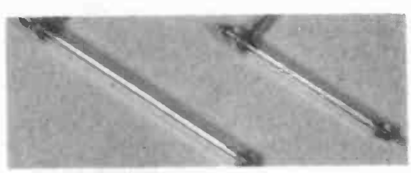
Z5028 110mm Manual models include 110LF and 110TF, many have built in flash.
Prices .... **£3.50 ea** **5 for £14.00**

Z5030 35mm Manual. Models include 35HL, 806, 35CT, DL10, DL7. Most have built in flash.
Prices .... **£4.50 ea** **5 for £18.00**
Z5032 Broken cameras. These have parts missing. A parcel of 6 assorted, all 35mm including manual, motor driven, autofocus, twin lens types.
Price **£15.00**

Another job lot have just arrived. One new type in this batch is a 35AFX auto focus motorized camera with pop up flash. These look perfect, but are returns, so sold without guarantees shop price £60+.
Order Code Z5128 .... **Our price £9.50**

Flash Units

Z5129 Flash unit. Small PCB 40 × 25mm with inverter circuit, and 220uF 350V capacitor and flash tube and reflector.
Price only **£1.50**



XENON FLASH TUBES
Z1655 56mm long × 3.5mm dia. No other data at present.
Price .... **2 for £1.00**
Z1656 40mm long × 3mm dia.
Price .... **2 for £1.00**

ALL PRICES IN **BOLD** TYPE INCLUDE VAT: PRICES IN LIGHT DO NOT

CAMERA CLEARANCE

A selection of 110 and 35mm Hanimex cameras offered at outstanding prices. They are all brand new in original packaging.

Z6104 110CF Pocket camera with telephoto and flash.
Price **£7.00**
Z6114 110FL Pocket camera very similar to above but slightly longer case.
Price **£7.00**
Z6128 110LF Virtually identical to above model.
Price **£7.00**
Z6137 35C2s Autoflash compact camera with motor.
Price **£14.00**
Z6147 35HL Focus free compact camera with flash.
Price **£11.00**
Z6160 Concord 818. Very similar to above.
Price **£11.00**

And some flash guns:
Z6072 × 214 electronic flash.
Price **£6.00**
Z6075 × 215 electronic flash.
Price **£5.00**
Z6079 TZ1 .... **£12.00**
Z6082 TZ2020 .... **£20.00**
Z6083 TZ7000 .... **£20.00**

And a quantity of lenses:
Z6015 28-70mm. AF macro zoom 1:3.5-4.8. 55m. PK.
Price **£45.00**
Z6027 28-200mm macro zoom 1:4.0-5.6. 72mm. PK.
Price **£45.00**
Z6050 70-210mm A/F zoom 1:4.0-5.6. 52mm. PK.
Price **£40.00**

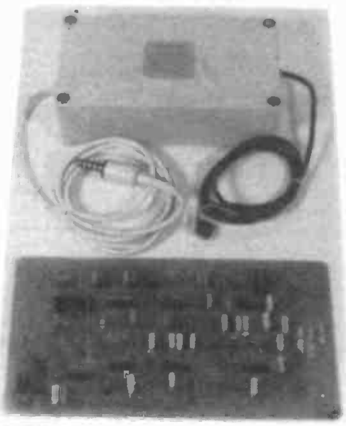
HIGH QUALITY SLIMLINE
LOGIC PROBE/ PULSER

Top quality slim (18mm dia) precision instrument for troubleshooting and analysis of logic circuits. It works as a level detector, pulse detector and pulse stretcher. It is circuit powered, has LED indicators and comes with additional probe lead and clip, and instruction sheet. An excellent addition to your Test Gear at an unrepeatable price. We have purchased all available supplies and can offer this superb instrument for around half the normal selling cost.

Order Code M625

ONLY £10.00

Line Termination Unit



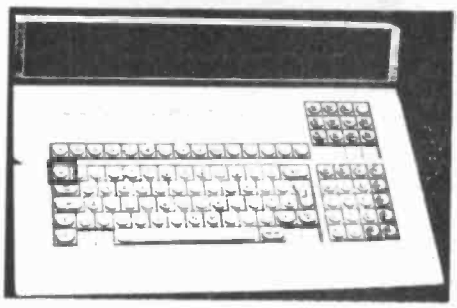
Comes in 2 parts:

Z035 Grey ABS case 197×106×60mm with lid contains PCB with 2 relays, transformer etc. A 3m lead with 4 pole plug (old type) is fitted one end and a 6 way lead 1m long the other which connects to:

Z036 a PCB 265×143mm. This contains 5×LM348, 4016, 4093 & ZNA2H006E chips + transistors, R's, C's, xtal, etc.
Both for £4, or individually Z036 £3.00; Z037 £1.00

Z4133 Corgi telecontrol. Neat 2 part black plastic case 100×60×25mm with 3 red control switches, 2W, 3W and 8W. believed to come from a low cost game. 1m long 5 core lead attached. 60p

Z5122 Stapler Bargain - nice quality small stapler with 500 No. 10 staples. Retail around £2.
Our low price .... **£1.00** 24 + 0.60



VISTEL II
Total Communication for Deaf People

Vistel II is a visual telephone plus 'answerphone' which allows everyone to communicate over the telephone network.

By simply dialling a number and typing in your message you can be in touch with anyone else with similar equipment - whether they are across the road or at the other end of the country.

By pressing one clearly marked button you can send or receive typed messages even when you are out. Additionally you can prepare and send a message at a particular preset time (during cheap periods to save you money).

With Vistel II not only can you talk to other Vistel II users but Vistel I (of which there are over 1,000 already in use by deaf people throughout the UK), Telecom Gold, Breakthrough trust's BKU Mailbox Network, Mailink, the RNID telephone exchange or any other computer with a modem.

Specification

- Dimensions: 34cm × 45cm × 13.7cm
- Weight: 4.5kg
- Full 'QWERTY' keyboard plus 'function' keys for ease of use.
- 40 character screen which displays your messages quickly, clearly and quietly.
- Text editor for preparing recording and storing information.
- Memory for up to 9,500 characters.
- Auto-answering capability for receiving calls even when you are not there.
- Auto-dialling capability for sending messages during cheap rate telephone periods.
- Real time clock.
- Personal telephone directory for storing your most commonly used numbers.
- Calculator.
- Printer interface for connection to a printer.
- Telecom Gold, or BKU mail box, function key.
- Vistel II runs from mains with battery back-up so memory is retained even when Vistel II is turned off.
- For connection your only requirements are a power point and a British Telecom jack plug socket.

Options:
- Printer

This unit formed a telecommunications link for deaf people. The basic unit is the Vistel II which has an internal modem that handles the following standards V23 auto hunt, V23 originator, V23 answer, V21 originator, V21 answer. Note the auto hunt is a special function that allows the modem to determine the nature of the modem at the other end, either V23O or V23A.

All files from the transmitting terminal can be stored in memory or sent directly to a printer. Messages can be composed and stored in memory before transmission.

Other useful features include time, date, calculator, storage of often used numbers, parallel printer port, costing of calls, alarm clock, all PSTN features are fully BT approved.

On a component level useful items include a 105 key keyboard with serial output. A linear power supply with the following outputs +12V @ 1A, 2 × +5V @ 2A, -5V @ 100mA, -12V @ 100mA. useful components include 2×78T05 3A regulators with heatsinks, assorted fuses. A main circuit board containing a µPD8085 micro processor, 3 µPD8255 universal peripheral interface IC's, 3×27126 EPROM, 2×µPD4364 memory IC's, 1×µPD8251A USART programmable communications interface ic, HD146818P RTC (real time clock with 12/24 hour time date and leap year day) IC, and various other micro processor related IC's, other board parts include assorted resistors and capacitors, a 4.8V memory backup nicad. A 40 character 5×7 dot matrix VFD with cursor. A communications board with assorted approved relays, capacitors and opto-isolators.

Although the unit can only be used as a stand alone unit, it is possible to modify it so that it can talk to other equipment via a RS232 port.

These units are new and boxed, but because the company who manufactured them has gone bankrupt they are offered without guarantee. There is a comprehensive 143 page instruction manual provided. These units originally sold for over £500.

Our Bargain Basement Price **£75**

If you want to look through the manual first, send £12 (£10 deposit + £2 post); £10 refunded on its return.

FINISHED ITEMS

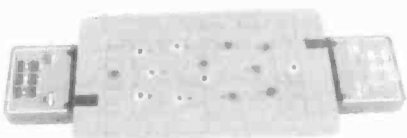
Bib®

Some 'BIB' accessories have come our way. These are all new and boxed, offered at a fraction of their original cost.

BCC8 Computer terminal maintenance kit for screen, keyboard and printer. Content: Soft brush for keyboard and stiff brush for printer and print cleaning fluid. Aerosol can of air-blast; Kleen-Screen, an antistatic liquid; cleaning cloths. All this is contained in a presentation pack for just **£2.95**

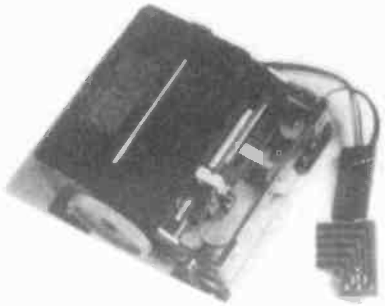
BCC11 Liquid Static Eliminator. A spray can of special formula liquid giving long term neutralisation of all harmful static charges from all glass and plastic surfaces. Comes complete with cloth........................ **£1.00**

'JIMMY'®
the electronic football game of skill



Z817 Exciting electronic football game - Waddingtons' 'JIMMY'. Brand new models in full working order, but without plastic peripherals, stickers etc. Red plastic case 420mm long × 93mm wide contains keypad and 7 segment LEDs to keep score either end. The centre section 'players' are represented by red 5mm LEDs, 14 altogether. The main chip is the TMS1000, programmed to make odd noises whilst playing and a tune when a goal is scored. Also inside are 13 plastic transistors, 57mm 8R speaker, power supply socket, Rs, Cs etc. Powered by 2 × PP3 batteries. Solo or dual play. Supplied with instruction sheet, playing field complete with coloured 'players'. Good fun to play as a game with good value for the electronics within. Originally retailed at £19.95.
Price .... **Only £5.00**

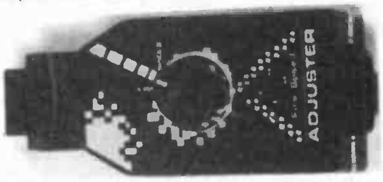
Z4199 60 second timer. High quality instrument by Micron. Can be set by knob on top to any time from 0-60 seconds, after which time a pair of contacts close. Although these are 110V, they work off standard 230V mains with the series resistor included. Notes about its operation are also supplied. Overall size 105 × 63 × 80mm. Individually boxed.
Price **£3.75**



Z4177 Printer mechanism model SF3002 by Copal. Thermal type requiring conductive silver type paper, 17 Alphanumeric characters per line, 7 pin print head. 22V DC supply, some basic connection data supplied.
Price **£10.00**

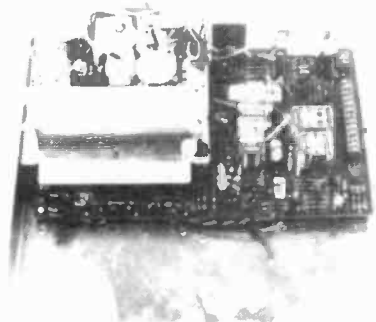
Z8854 Intercom unit by Tunstall Byes and Co Ltd. Extremely robust plastic case 235 × 160 × 70mm. Contains PCB 95 × 80mm with 4PCO 12V continental relay; SPCO telecom relay; 3 × BC301; 2 × ZTX107; 2 × ZTX108; 8 × 1N4001 + C's, R's etc; 3 position keyswitch and 12 way term block. 4½" Fane speaker and 12 pole gold plated jack socket mounted in the case. The cases are in poor condition, (but not broken) having paint and scuff marks on them, but the parts inside are in good condition. The biggest drawback is their weight (about a kilo) so they're expensive to post.
Prices .... **£4.95** 2+ 3.45 5+ 2.55

Z4190 Disk Drive Power Supply Kit. Ideal for powering single 3 ½" or 5¼" drive. Mains input, stabilised smoothed outputs, 12V @ 1A and 5V @ 1A. Simple, easy to assemble kit with full instructions, at an excellent price **£5.95**



Z4132 Firing speed adjuster. Neat device for connecting between joystick and Atari/ Commodore etc computers. Switched pot enables firing speed to be changed. 9 pin 'D' in and out.
Price .... **Only £1.00** 100+ 0.35

Z4136 'Stethophone' mini stereo headphones, complete with stereo jack plugs. 8R. Hinged headband.
Price **£1.75**



Z8885 TAPE DECK PANEL. A type of telephone answering machine believed to have been used as an alarm system - a recorded message was sent down a BT line if premises were being entered illegally. Steel chassis 245 × 220 × 35mm contains PCB 228 × 145mm and an 8 track cassette unit almost identical to Z4307. This is attached to the panel by 3 screws and is easily removable, being connected to the PCB with a 5 way socket. The output from the tape head is fed into an MC3301 quad op - amp. The PCB also has 10 CMOS gates, 3 relays, isolator transformer, several transistors, R's, C's etc. 12 way connector for BT line, 12V supply etc, also plug and socket arrangement for Auto/ Manual and Bell delay. Made by Munford & White PLC.
Price .... **Reduced to £7.95**

A parcel of 'Touchmaster' interfaces has just arrived:
Z5130 Spectrum interface. PCB has 28 way DS edge connector one end and socket the other, with a single Z80A PIO chip. There's a 20 way IDC socket on the end of a metre long piece of ribbon cable, too. Vacuum formed plastic case.
Price £2.00

Z5131 Similar to above, but for Dragon. 20 way DS edge socket one end of PCB, plug the other. On board: 68A21 and LS32 chips. Same 20 way lead as above. **Price £2.00**

Z5132 CBM interface. This only has a 12 way 0.156" DS socket and lead. **Price £1.50**

We still have a few CASIO KEYBOARDS left. These were stocked some years ago, but were not particularly good sellers.

MT55 3.5 octave, 6 note polyphonic, mini keys; 12 preset sounds; 12 auto rhythms; Casio chord and fingered chord system; melody and chord memories; built in speaker; accessories: test batteries supplied. Was £79.95. To clear at
Price **£50.00**

ALL PRICES IN **BOLD** TYPE INCLUDE VAT: PRICES IN LIGHT DO NOT

A selection of our surplus semi's; we have large quantities of many different devices - linear and logic IC's, transistors, diodes etc. Ring or write with specific enquires.

(a) Diodes

BAV20 Signal diodes .... **100/£2.00; 1000/£12.00**

Z2111 IN279 diode. These are in individually sealed packs in boxes of 10.
Price per box **£1.00**

Z728 Stud rect 6A 300V. BYX38-300 ex-equip, but guaranteed.
Price 10/ **£1.00** 100/ 6.10 1k/ 52.20

K399 Heavy current stud rectifier - 1R 25G5. RAted 50V 60A. List prices is over £8.
Our special low price **£2.00**

Tuning Diode

MV1404 - very high capacitance change - for a change in bias from 1-10V, there is a change in capacitance from 10pF-150pF, making this suitable for AM radio broadcasts. DP £17.94 - which makes them about 12 times as valuable as gold!
Our special price **£6.00**
100 + 3.00

(b) Zeners

Bulk pack of 400mV zeners, 10 each of following values: 3V6 4V3 4V7 5V6 6V2 6V8 8V2 9V1 11V 13V 16V 20V 24V 27V 30V 33V
160 altogether for **£5.00**
Individual values listed above available in packs of 100 at **£3.35**

1N3326B 36V, 50W **£1.00**

Z2000 IN5347B 10V 5W Zener diodes. List 34p.
Our price .... **8 for £1.00** 100 + 0.07 1k + 0.045

(c) Bridges

Z1996 Bridge rectifier S4VB20 200V 4A in square package 16.5mm, mounting on 10mm centres.
Price .... **Pack of 3 for £1**
100 + 0.22 500 + 0.15

Z4366 Massive bridge rectifier 57 × 57 × 25mm, but only rated 200V 10A. Tag connections.
Price **£1.00**

BYW 20 BRIDGE 25A 50V **TO CLEAR: 10 for £10**

Z1408 Ex new equipment 25A 50V bridge rect, metal case 28 × 28mm, 0.25" tabs. Made by Diodes Ltd.
Prices £1.00 10/ 6.95 25/ 15.70 100/ 52.20

Z2356 KBLO8 3A 800V in-line bridge with preformed leads.
Price .... **2/£1.00** 100 + 0.25
Z2347 KBPO2 4A 200V in-line bridge by GI.
Price .... **6/£1.00** 100 + 0.09 1k + 0.06

(d) Transistors

Z506 New 2N3055B. Reduced spec, but OK for many applications .... **4 for £1.00**
Z724 BDX88A power darlington transistor – T03 case, PNP, 60V, 12A, 117W. Hfe 7540 @ 6A ...... **2 for £1.00**

Small quantities of 2 Mosfets;
Z2147 IRF843 TO220 case. Think these are 500V 125W devices.
Price .... **£1.50 each**
Z2148 IRF457 TOP3 case. Believed to be 500V 180W
Price .... **£3.00 each**

Z704 Heatsink 50 × 36mm with BU826 (removed from equip).
Price **50p**
Z721 2 matched 2N397 Ger. PNP alloy transistors.
Price **40p**

Z1770 Small signal NPN Silicon transistor - like BC182L, numbered 2SC945. Amazing value.
Price .. **Sealed packs of 250/ £8.00** Box of 2000/ 34.80

(e) SCR's/Triacs

CR201C	TO5	SCR	1A	200V	30p
XF7559	Odd	SCR	3A	400V	25p
MACR69-2	TO220	SCR	15A	50V	40p

MAC11-4 Triac, 200V, 10A .... **25p; 10/£2.00**

(f) Voltage Regulators

Type	Case	Volts	Current	£2 pack	100 +
723	TO99	+ 2 to 37V	0.1A	**6**	0.16
79L12	TO99	-12V	0.1A	**16**	0.07
79MO5	TO220	-5V	0.5A	**12**	0.08
78M12	TO220	+ 12V	0.5A	**12**	0.08
LM317MP	TO220	1.2 to 37V	0.5A	**8**	0.12
LM323K	TO3	+ 5V	3A	**1**	1.00
79MG	DIP	2 to 30V	0.5A	**6**	0.16
78MGUIC	TO220	5 to 30V	0.5A	**6**	0.16
LM2931A	TO220	5V	0.4A*	**4**	0.25

*Low Drop Out

Z2131 LT1085CT variable voltage regulator. This is a + 1.2V to + 29V 3A device in a TO220 case. DP £4.32.
Price **£2.00**

(g) Linear IC's

Z1864 Hybrid audio amplifier type SI-1010G. These are an extremely high quality amp in an 8 pin SIL package with integral heat sink, overall size 62 × 40 × 10mm. 4mm pitch. Max output 10W RMS into 8R. Supply 34V or ±17V @0.5A. FR 20-100,000Hz. Supplied with comprehensive data.
Price **£2.50**
Z1865 PCB 103 × 67mm for mounting of the above plus external components.
Price **50p**

NE531 Op-amp - hi slew rate TO99 case.
Price **75p**

RC107 Op-amp - general purpose compensated. TO99 case.
Price **£1.00**

Z4315 3240E - 1 Dual 3140 MOSFET amp in 14 pin package compatible with 747. Their price £2.24.
Less than half price .... **Only £1.00**

SPEECH CHIP

As mentioned in Bargain List 29, we have a quantity of speech chips, type SP0256A-AL2. We have now learned (thanks to a couple of our brainy customers!) that the LA05 is a high speed CMOS ULA and the R0984CS is used as a index for the SP0256. All these chips are used in the Currah u μ speech. We can offer all three chips for just £3.00 and this price includes circuit diagram, PCB layout and construction info on making a 'speak board' using the SP0256 (not the other two chips), suitable for the Spectrum, ZX81, BBC B, C64 and VIC20 computers.
Z733 3 chips as described + data **£3.00**
Substantial discounts for large quanitites
.... **1000 off £850.00**

Z2130 ZN449D Ferranti surface mount 8 bit A/D converter. Supplied with data sheet. DP£3.73.
Price **£1.50**

(i) Computer IC's

INS8048/9/50 Single chip 8 bit micro computer. Each 40 pin chip contains system, timing, control logic, ROM, RAM and 27 I/O lines. Supplied with data sheet.

	RAM	ROM	PRICE
INS8048	64 × 8	1k × 8	**£3.00**
INS8049	128 × 8	2k × 8	**£4.00**
INS8050	256 × 8	4k × 8	**£5.00**

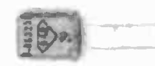
Z1435 TC5517APL-2 2k×8 RAM. Ex-equip ... **40p each**
Blown EPROMS: 2764 .... **£1.50**

Z1661 27C32Q-35 EPROM's. These are ex-equip & not in perfect condition. Sold in packs of ...... **8 for £4.00**
Z1662 8050AH Single chip 8 bit micro. These are ex-equip & so presumably ROM has been programmed. Supplied with some data (27 A5 pages of data – order code F116 £2.00) **£1.00**

(j) Crystals

Z2151 2.45760 MHz crystal by Hy-Q HC33-U. Baud rate generator
Price .... **50p** 10 + 0.30 100 + 0.15
Z2079 14.000 HC18U **60p**
100 + 0.25

Z1418 25mHz crystal HC6U **£1.00**
Miniature HC18U wire ended.
Z412 8.867238MHz
Price £1.00 10/ 4.35 100/ 26.10
Z1663 HC6W 2.4576MHz, needs 32pF load capacitor.
Price £1.00 10/ 5.20 100/ 34.80



Z1654 8.863256MHz wire ended **50p**
Z1744 Crystal by IQD, wire ended 4000MHz **50p**

Crystal oscillator modules. Sealed all metal package with pins on std DIL layout. 5V DC operation.
Z1424 1.2288MHz **£2.50**
Z1425 24.0000MHz **£2.00**

More semis on Page 37

FANTASTIC MOSFET OFFER!!

Take advantage of our buyuing skills and help yourself to some FETs and Mosfets at incredibly low prices! All goods are new full spec by Siliconix, IR and are offered at well below normal prices! Limited stock of some types, so order now!

POWER MOSFETS

Type	Case	N/P	V_{DS}	R_{OS}	I_D	P_D	Price 1 +	Pack
2N7004	4PINDIP	N	100	0.6	1.0	6.25	55p	5/ £2
2N7005	4PINDIP	N	200	1.5	0.6	6.25	65p	4/ £2
2N7006	4PINDIP	N	350	5.0	0.32	6.25	70p	4/ £2
2N7014	TO220	N	100	0.8	3.5	19.5	60p	5/ £2
BUZ31	TO220	N	200	0.2	12.5	75	£1.60	
BUZ41A	TO220	N	500	1.5	4.5	75	£1.50	
IRF122	TO3	N	100	0.4	7.0		£1.85	
IRF150	TO3	N	100	0.055	40	150	£4.00	
IRF250	TO3	N	200	0.085	30	150	£5.00	
IRF620	TO220	N	200	0.8	5.0	40	60p	5/ £2
IRF710	TO220	N	400	3.6	1.5	20	40p	6/ £2
IRF720	TO220	N	400	1.8	3.0	40	40p	6/ £2
IRF820	TO220	N	500	3.0	2.5	40	65p	4/ £2
IRF9230	TO3	P	200	0.8	6.5	75	£3.50	
IRF9520	TO220	P	100	0.6	6.0	40	85p	3/ £2
IRF9620	TO220	P	200	1.5	3.5	40	£1.20	2/ £2
VN0300D	TO220	N	30	1.2			60p	5/ £2

K576 Mixed pack of TO220 & 4 pin DIP devices from above list with data & pin outs. 25/ £8.00

SMALL SIGNAL MOSFETs

Code	Case	N/P	R_{DS}	I_D	P_D	Price
BST72A	TO92	N	10	0.3	0.83	5/ £1
VN2222L	TO92	N	7R5	0.15	0.4	5/ £1
★VN2222LL	TO92	N	7R5	0.15	0.4	5/ £1

★ Internal Gate Source Zener

SMALL SIGNAL JUNCTION FETs

Code	Case	N/P	V_{DS}	V_{GS}	I_G	P_D	Price
J112	TO92	N	35	5	.05	.36	5/ £1
J113-18	TO92	N	35	3	.05	.36	5/ £1
J271	TO92	P	30	2	.05	.36	3/ £1
J300B	TO92	N	25	7	.01	.36	4/ £1
J305-18	TO92	N	30	3	.01	.36	5/ £1
U1899	TO92	N	40		.01	.36	5/ £1
2N4220	TO18	N	30	4	.01	.3	2/ £1

K578 Mixed pack of small signal FETs from above lists with data & pin outs 30/ £5.00

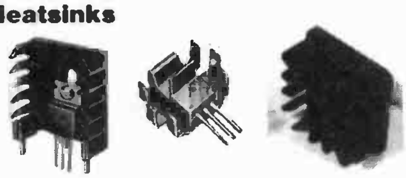
SURFACE MOUNT FETs

Code	Case	Device Mkg	N/P	Type	Ratings		mA	mW	Price
SST215	SOT143	D15	N	DMOS	30V	50R	50mA	350mW	10/ £1
★SST4340	SOT23	P40	N	JUNCTION	50V		50mA	350mW	10/ £1
★SST4341	SOT23	P41	N	JUNCTION	50V		50mA	350mW	10/ £1
★SST4392	SOT23	C92	N	JUNCTION	35V		50mA	350mW	10/ £1
★SST4857	SOT23	C57	N	JUNCTION	40V		50mA	350mW	10/ £1
★SST5458	SOT23	P58	N	JUNCTION	25V		16mA	350mW	10/ £1
★SST5459	SOT23	P59	N	JUNCTION	25V		16mA	350mW	10/ £1
★SST5460	SOT23	S60	P	JUNCTION	40V		16mA	350mW	10/ £1
★SST5461	SOT23	S61	P	JUNCTION	40V		16mA	350mW	10/ £1
★SST5462	SOT23	S62	P	JUNCTION	40V		16mA	350mW	10/ £1
2N7001	SOT23	701	N	MOS	240V	45R	45mA	200mW	10/ £1
2N7002	SOT23	702	N	MOS	60V	7R5	115mA	200mW	10/ £1

★ These are surface mount versions of 2N numbers
K577 Mixed pack of surface mounted FETs, including above types with data & pin outs 50/ £4.00

HARDWARE

Heatsinks



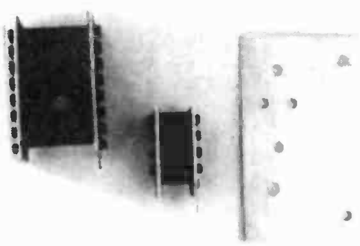
Z1812 T0126/220 Heatsink 30 × 30 × 12mm with lugs for insertion into PCB.
Price .... **Pack of 6/ £1.00**

Z740 Heatsinks, clip on type for T0220 package. Farnell type 170-067. Their price 27p.
Our price **10/ £1.25** 25/ 2.20 100/ 6.95

Z032 Chunky TO3. 46 × 46 × 19mm. Weighs 37g.
Price **60p**

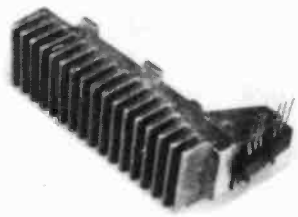
Z2314 Heatsink for TO126/220 devices with lugs for locating into PCB. 30 × 25 × 12.5mm. **Pack of 8 £1.00** 100+ 0.08 1k+ 0.05

Z5146 Redpoint heatsink - nice chunky ally sink finished in black, type W. Size 102 × 130 × 32mm drilled with 3 × 5mm holes. (DP £5+). **£3.00**



Z1524 Heatsink 32 × 23 × 15mm.
Price **5/ £1.00**

Z356 Heatsink 80 × 50mm for TO3.
Price **4/ £1.00**



Z611 Heatsink from Enterprise, 86 × 27 × 38/20mm, fitted with 2 × 7805 regs + plastic cover.
Price **£1.00**

Z2047 Heat sink. Black aluminium plate 167 × 51 × 4.7mm thick drilled for 4 × TO3 devices and fixing holes.
Price **£1.00**

Z2069 Thin heatsink (1.2mm) 57 × 57 formed to accept single TO3 device.
Price .... **5 for £1.00**

> **Please Note:**
>
> The Free Gifts offered in the Main Catalogue are not available with goods from Bargain Lists.

Z5076 Steel panel 210 × 190mm stove enamelled with 7.5mm hole in each corner.
Price **50p**

Z2043 Trigger module FY506 by Lite-pac - believed to be for a Xenon tube with a B9A base - there are 2 high voltage leads and 2 other leads attached. No further information.
Price **£2.00**

Solder

Z5170 500g reel of 16SWG resin cored solder at an exceptional price .... **£3.95** 10+ 2.95 50+ 2.60

Z683 Solder washers 0.3" OD, 0.2" ID, in plastic pots of 2500 (sample free).
Price £2.50

Z5099 Ersin multicore HMP (high melting point) solder, 22 swg on 500g reels. Composition: 5% tin, 93.52% lead, 1.5% silver. Melting temp 301 C. Rec. bit temp 350 C. DP £18.00.
Our price **£8.00**

Mounting Kits

Z1378 TO3 mounting kit 10 TO3 mica washers and 20 bushes. Their price £1.21.
Our price 60p 10/ 3.50 100/ 3.90

Z1379 TO3 mica washers.
Price .... Pack of 100 £2.50 500/ 7.80

Z4392 Diode mounting insulating list. Pack contains 50 each mica washers, PTFE washers & solder tags.
Price **£2.00**

Z2329 Grey plastic strip 470 × 40 × 2 (make handy rules!)
Pack of 5 .... **£1.00**

Z5149 Black self amalgamating tape. High stretch, easy build up. 0.8mm thick 13mm wide. Large reels 350mm dia contain about 125m. DP on this is over £35.00.
Our Price **£15.00**

Z5164 As above but 21mm wide **£20**

Z5150 Heatsink -TO3 type 7.1°C/W 46 × 46 × 26. DP £1.00.
Our Price **2/ £1.00**

Z2330 Heatsink -TO220 type 30°C/W 11 × 22 × 19. DP 53p.
Our Price .... **5/ £1.00 100+** 0.09 1k+ 0.06

Z2331 Heatsink -TO220 type 21°C/W 19 × 22 × 19. DP 53p.
Our Price **4/ £1.00**

Z2332 Antivibration mount. 2 studs 13mm × 6mm dia. Overall 25mm dia.
Pack of 6 .... **£1.00**

Z2333 Ceramic insulating beads 3.4mm long. OD 3.4mm; ID 1.8mm.
Pack of 200 .... **£1.00**

Z5151 Some odd pieces of Clear perspex; 45 × 22 × 1 with central 3.5mm hole; 82 × 61 × 2.8 with 3.8mm hole near edge; 100 × 64 × 1.9mm with a couple of slots.
Pack of 20 assorted **£1.00**

Z2334 Right angle steel bracket 38 × 22.5 × 10. Length drilled with 2 × 4.8mm holes; width drilled with 7mm dia hole. 2mm thick.
Pack of 10 .... **£1.00 100+** 0.06 1k+ 0.045

Z2335 Stand off insulated terminal 24mm high with 3.5mm threaded insert.
Pack of 5 .... **£1.00**

Z2336 Stand off insulated terminal 11mm high with 2.5mm threaded insert.
Pack of 10 .... **£1.00**

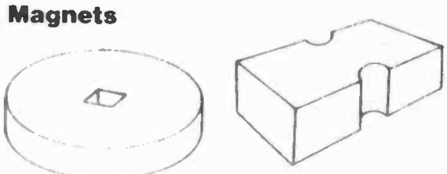
Z5152 Pack of plastic bits - stand offs with PCB clip incorporated, cable tie bases etc.
100 assorted **£1.00**

Z2337 6BA × 12 pan head pozidrive plated steel screws.
Pack of 200 .... **£1.00** 1k+ 3.50

Z2338 Current shunt. 15A 75mV mounted between 2 brass terminals with 10mm holes 100mm apart.
Price **50p**

Z9234 An unusual device known as a left handed throggle flange, with many applications in computing and compost making. Available in limited quantities only.
Price .... **£17.42** 10+ £11.62

Magnets



Z1889 Magnet 20mm × 5mm thick. Hole in centre is 3mm square.
Price .... **Pack of 10/ £1.60** 100+ .09 1k+ .06

Z1890 Magnet 26.5 × 11.5 × 8.7mm. Indent either side.
Price .... **Pack of 10/ £2.00** 100+ .12 1k+ .08

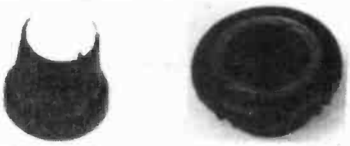
Knobs

Z2311 High quality black finish solid aluminium knob with marker. 22mm dia × 14mm high. 6.35mm fixing by grub screw. **3/ £1.00** 100+ 0.20

Z2312 Matches above 15.5mm dia. **4/ £1.00**

Z4054 High quality collett knob in matt black finish for 6.35mm (0.25") Spindle. 36mm dia. Clip on black cap and pointer.
Price .... **40p** 10+ 0.26 100+ 0.17

Z4174 Knob, push on grey 28mm dia with clear skirt marked with red line 47mm dia. Push fit for ¼" spindle.
Price **5/ £2.00**



Z4198 Knobs – Bargain price on black plastic control knobs with coloured tops, similar to K9. 19mm high × 20mm dia. Top available with indent in white, pale blue, beige, mushroom, or green K9 + cap with line costs 30p; these are substantially cheaper, even in small quantites. Only sold with cap.

1-9	**20p each**
10-24	**15p each**
25-99	**12p each**
100+	**10p each**

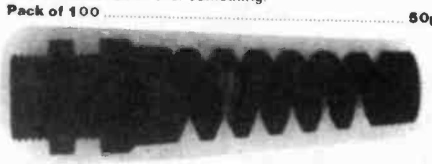
Z718 Knob. Black plastic with ally insert. 27mm dia × 15mm high, for use with 4mm shaft with flat. (Fits inner of Z716). Have you seen a cheaper knob than this? Sample free.
Price **20/ £1.00** 100/ 2.60 1k/ 17.40 10k/ 87.00

Z4053 Antistatic bags. Black 'Velostat' by 3M, these bags are 460 × 350mm. Ideal for cutting up to store static sensitive devices.
Price **4/ £1.00**

Z4201 Solid satinised aluminium equipment handles 194mm long × 47mm high. Fixing by 2 tapped holes on 164mm centres.
Price .... **£1.20 each**

Z01042 Braided Nylon Lacing tape 1.5mm wide, black. 500yd reel.
Our price **£4.00**

Z2054 Small flat brass 'spike' 0.3mm thick as shown. Must be useful to modellers for something!
Pack of 100 .... **50p**



Z4247 Cable gland with strain relief. Overall length 80mm dia 11mm. Takes cables 4mm to 8mm dia.
Price **6/ £1.00**

Z4067 Strain relief bushes for 6mm dia cable. Sample free.
Price **25/ 60p**

Z1432 No6 6mm PK self tapping screws, cross head. Normally £6.90/ 1000
Price .... Only £2.50
Z433 Bakelite washers, 6BA (sample free).
Price 1000/ £2.00
Z1440 Woodscrew with countersunk pozidrive head 8mm long × No 4 black.
Price .... Pack of 100/ 40p Pack of 1000/ 2.20
Z1441 PK screw cross head No 2 × 6mm. Black.
Price .... Pack of 100/ 30p Pack of 1000/ 1.90
Z1871 4BA metal spacer, 25mm long.
Price .... Pack of 30/ £1.00
Z1834 4BA solder tags. Pack of 1000 at half our normal price.
Price £6.70
Z1762 Nut M12 plated brass. As used on many toggle switches.
Price .... Pack of 10/ 40p Pack of 100/ 1.75
Z1848 Terry Clips. Bright chrome finish by Lewis. Spring type 100/ 17, 27mm dia.
Price .... Pack of 10/ £1.00
Z013 Sleeves, silicon rubber, 8mm OD. 5mm ID. Length 15mm.
Price .... Pack of 100/ £1.00
Z742 Polarising key.
Price .... Pack of 10/ 50p
Z2110 M3 metal spacer 25mm long with stud. DP 21p each.
Our price .... 12 for £1.00
Z2115 4 × ¼ Hex self tappers. Bright zinc.
Price/ box of 1000 .... £2.50
Z2175 Pozi pan AB self tappers No4 × 0.5 Inch. Zinc plated.
Price for box of 2000 £2.75

Cable Gland
Z4203 21mm max requires 28mm dia hole.
Price .... Pack of 5 £1.00

Z27111 Rexine covered box with felt lined interior. Overall size 165 × 85 × 45mm.
Price £1.50
Z2062 1.74m long thin multistrand steel cable with a loop at both ends. 0.7mm dia. Very strong and flexible.
Price £1.00

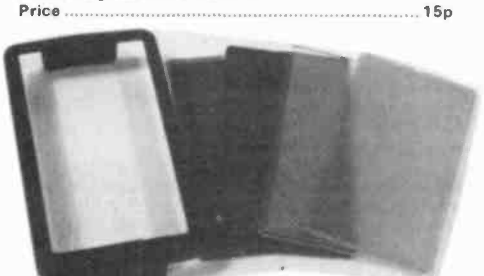
ALFAC PACKS

Discontinued lines from 1988 Catalogue.

EC803	12	EC993/2	8
EC918	10		
EC970/2	6	EC964/2	6
EC970/1	2	EC964/1	8

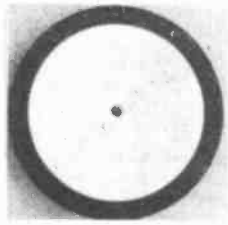
Originally costing £3.45/ 5 sheets.
Prices .... £2.00/ pack 6 asstd packs/ 7.85
Z4273 ⅛" bore red, green, yellow or black nylon compressed air line. 150 psi max.
Price .... 50p/m 15m coil £5.95
Z655 Dispenser tube with valve. As used on cream dispenser. 185mm long, with extra tube and connectors 250mm long.
Price 80p

Z1401 Magnetic catch, 24mm FC.
Price 15p



Z4120 Filter kit for flash used with Halina TB 655/650 cameras. Black plastic frame into which one of 4 coloured (red, green, yellow, clear) lenses 64 × 34mm fit.
Price for complete set 50p

Wheels



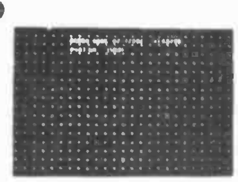
Type B is a solid heavy duty wheel 107mm dia. with a flat rigid tyre 17mm wide. Both have 9mm dia. holes.
Wheel type B .... **50p each**

Z4110 Empty cases from CB aerial eliminators (Z4081).
Price 3/ £1.00
Z9014 Printed Circuit Board Laminate by MAS type FR4. Sheet 365.5 × 369mm comprised of a layer of copper foil sandwiched between fibreglass. Overall thickness 0.8mm. Ideal for screening.
Price/sheet (difficult to pack) **£3.00**
Pack of 25 .... £40.00

Drawer Sliders

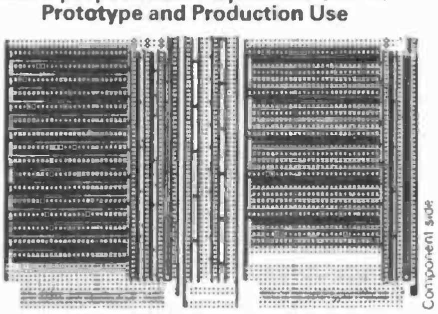
High quality ball bearing sliders by Accuride. 3 different models.
Z5016 More compact model. Closed length 357mm. Slide length 375mm. Only a few of this size.
Price per pair £10.00
Z07076 Dycem 'Gripplpad'. Anti-slip mat in blue. Size 350 × 250. Ideal for modelling or in the home to keep crockery, ornaments from moving. List price £8.28
Our price £4.00

BOARD



3468 0.1" board copper clad in linked pairs. Ideal for use as patch board. 160 × 100mm.
Price £1.20
3950 Socket board, matrix of 12 rows on 0.3" pitch of 50 sockets on 0.1" pitch + V and GND sockets. All gold plated. 100 × 160mm fibreglass.
Price £8.50
0135 0.15 board, plain SRBP 63.5 × 431.8mm.
Price 75p

Uniquard Development Boards
Multi-purpose Micro-systems PCBs for Prototype and Production Use



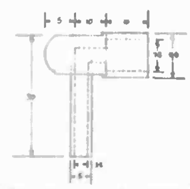
E1S, E2S & E1D series are circuitry develoment boards for memory (both dynamic and static RAM and ROM) and also for combined CPU-memory function.

EPBseries have backplane and motherboard uses (both 3U and 6U) and the smaller lengths are also used for extender cards. A range of profiles with and without mounting flanges and extra busbars are available. Used as high density memory development boards they only require a small amount of extra wiring.

Order Code	Type	Size	Price each
129B-PCB-007SF	E2S-00	3U 0.6"	£12.62
129B-PCB-011SF	EBP-02	Extender 3U-220	£8.46
129B-PCB-012SF	EBP-03	Extender 6U-160	£18.18
129B-PCB-014SF	EBP-05	Horizontal Mtg 6U-112	£11.00

Clock Case

Z472 Clock Case - Oval format. Overall size 130 × 68mm × 87mm deep, with built-in stand. Rear panel has holes drilled to accept 4 switches and audible alarm. Made in high impact white plastic. No front panel.
Price 60p



Z1417 Right angle plastic tube connector, dimensions as shown.
Price .... Pack of 12/ 50p
Z1416 Concentric pulley wheel with lever. Useful for operating switch. 38mm dia.
Price .... Pack of 6/ 50p

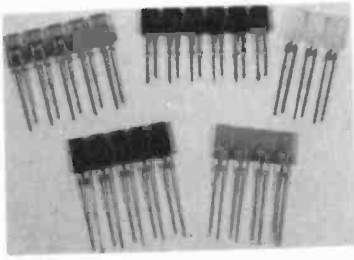
Z27227 Industrial gas spring - as used for holding open lids on machines etc. This one requires 40 Newton force, has a stroke of 200mm with a 6mm dia plunger. 6mm eye one end, 7.5mm recess the other. Overall length 500mm. List price £30.67
Our special price £10.00

Z582 Stick on feet (3M bumpons) 10mm dia × 4mm thick.
Prices .... Sheet of 56/ £1.70
10/ 12.20 25/ 26.10 100/ 87.00
Z4204 White rubber feet. 12.5mm dia × 6.5mm high. Screw fix.
Price .... Pack of 40/ £1.00
Z4378 Self adhesive feet 12.5mm² × 3mm thick, black.
Packs of 24 .... £1.00
Z4379 Screw on feet. Black hard plastic 14mm dia × 10mm high.
Price 50/ £1.00

Z4349 Anybody who has been dealing with us for a very long time may remember our 7" tape spools we were selling many years ago. Standard clear plastic spools for ¼" tape individually wrapped.
Prices .... 3/£1; 20/£5; 100/£18

OPTO

LED's



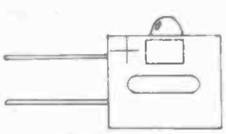
A range of multiple LEDs moulded in strips. As used in car graphic equalizers etc. Each LED is 5 × 2mm ★ (4.5mm × 2mm) separated by a 2mm gap. Easily separable if required. Ideal for making jumbo displays; a 5 × 3 display will give digits 30mm high; (use 3 × Z1460 or 1463); a 9 × 5 display can be used as an alphanumeric display 36mm high × 30mm wide (use 9 × Z1460 or Z1463). Cost compares favourably with conventional jumbo LEDs; a 30mm high dot matrix display cost £4.37 from whilst a 51mm high (7 × 5 matrix) cost £5.06.

Z1460 5 way red★ length 30mm 30p 10/ 2.10
Z1464 3 way white★ (lights up red) 7.5mm .. 20p 10/ 1.40

Z2182 Standard 5mm red LED with 18mm leads, bent at right angles. **18/ £1.00** 100 + 0.03 1k + 0.02 10k + 0.015
Z2302 5mm green LED in panel mounting clip fix holder with translucent domed bezel. Needs 8mm hole.
Pack of 8 £1.00

Z1845 Rectangular LED 7 × 2.5 Red. Unusual size by Hewlett Packard type LMP301.
Price .... Pack of 12/ £1.00

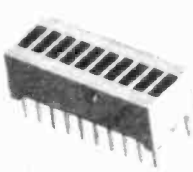
Sub-min LEDs, ideal for model railways. Only red and green though, no yellow. Body size 3 × 2 × 2mm - lens 1mm dia. Axial leads.
Z1802 Pack of 6 red £1.00
Z1803 Pack of 6 green £1.00
Z1804 Also some larger red LEDs with a 2mm dia lens, 5mm dia body. Radial leads.
Price .... Pack of 6/ £1.00



SUBMIN LED'S

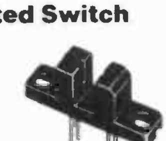
These excellent quality 1.5mm Led's are housed in a 6.2x5x2.4mm package with built in resistor for 5V operation (add 470R resistor for 12V). Available in Green (DP £1.73) or red (DP £1.16).
Z2135 Red .... **3/£1** 100 + 0.15
Z2136 Green .... **2/£1** 100 + .25

Z1968 Infra red LED's 5mm - no other data so offered at **6/£1.00**

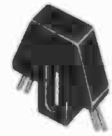


Z1850 9100R Red Bargraph 10" 20DIL package.
Price £1.00

Opto Slotted Switch



Z2122 Vactel Type VTL 10DI - IR emitter and detector can be removed from the plastic housing if required. An extremely cheap version of TIL100/TIL38!
Pack of 5 .... **£1.00** 100 + 0.10 1k + 0.07



Z1499 Opto slotted switch on small (25×26mm) panel Type P850 .... 75p
Z1500 Opto reflective switch type OPB6076 with 3pin connector 75p
PS4005 Opto slotted switch £1.00
Z1436 Reflective optocoupler from sheet feeder type OPB703A, on small PCB with 4 pin plug fitted.
Price **50p**
Z1435 Reflective optocoupler from sheet feeder type OPB711, on small PCB with 4 pin plug fitted.
Price **50p**

Z1743 TIL143 Opto slotted switch. These have cropped leads and some are ex-equip, but are all working.
Price .... **Pack of 3/ £1.00**

LED Displays

0.3in (7.62mm) Display Height

H - 19.05
W- 10.16
D - 5.4

Pin spacing 2.54
Row spacing 7.62

(a) 0.3" (7.62mm) display height; luminous intensity 0.6mCd @ 10mA

Code	7/+1	DP	CC/CA	1+	25+	100+
Z1937	7 seg	LH	CA	**31p**	0.20	0.16
Z1938	7 seg	RH	CA	**31p**	0.20	0.16
Z1939	7 seg	RH	CC	**31p**	0.20	0.16
Z1940	+1	LH	CA	**20p**	0.13	0.10

0.5in (12.88mm) Display Height

H - 19.0
W - 12.7
D - 8.0

Pin spacing 2.54

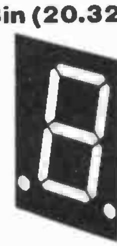
H - 19.05
W - 25.0
D - 8.0

Row spacing 15.24

(b) 0.5" (12.88mm) display height; luminous intensity 0.8mCd @ 10mA

Code	7/+1	DP	CC/CA	1+	25+	100+
Z1941	7 seg	RH	CA	**35p**	0.23	0.18
Z1943	+1	RH	CA	**23p**	0.15	0.12
Z1944	+1	RH	CC	**23p**	0.15	0.12
Z1945	Dual 7 seg	RH	CA	**58p**	0.38	0.30

0.8in (20.32mm) Display Height

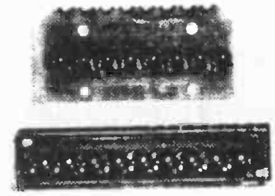


H - 27.7
W- 19.9
D - 8.38

Pin spacing 2.54
Row spacing 15.24

(c) 0.8" (20.32mm) display height; luminous intensity 0.8mCd @ 10mA

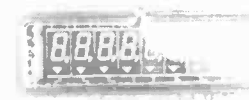
Code	7/+1	DP	CC/CA	1+	25+	100+
Z1948	7 seg	RH	CC	**47p**	0.30	0.24
Z1949	7 seg	LH	CA	**47p**	0.30	0.24
Z1950	7 seg	LH	CC	**47p**	0.30	0.24



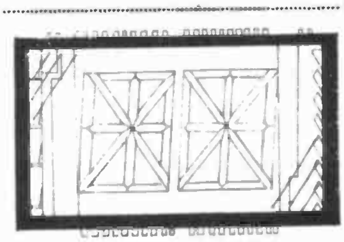
Z415 Display. 8 digit LED multiplexed. With data. 31 × 16mm.
Price 80p
Z416 Display. 9 digit LED multiplexed. With data. 42 × 10mm.
Price 90p

Z1852 6301 Mini 7 segment LED. Red, 8mm high in package 11 × 7mm.
Price .... Pack of 4/ £1.00
Z1853 6910 Dual 7 segment LED 0.6" red.
Price 2/ £1.00

OPTO DISPLAYS

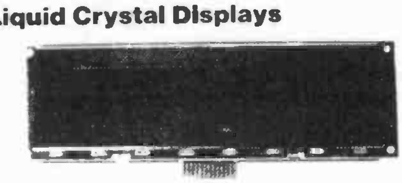


Z1731 NEC Vacuum Fluorescent Display FIP8BII. 8 digit multiplexed output 10mm high. Heater voltage 2V, grid/anode voltage 24V. (Use Z4248 transformer to power).
Price **£3.00**

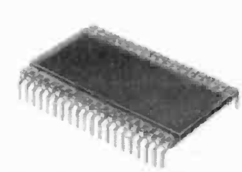


Z5118 Giant 30mm fluorescent 2 character green star burst display, 88 × 49 × 8mm. Futaba type 2-JY-02Z. Needs 3V and 10-18V. Data supplied. **Only £2.00**

Liquid Crystal Displays

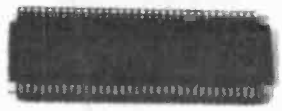


Z4372 Epson LCD module EA-Y40040AT. 40 × 4 character format. Viewing area 156 × 34mm. Full alphanumeric 96 character set contained in the module's own memory. 5V supply. With comprehensive data. List price over £200.
Our special price **£40.00**

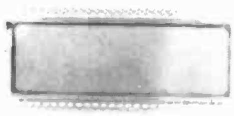


Z2119 4 digit LCD 12.5mm high with low battery and clock symbol. Complete with edge connector.
Price .... **£1.50** 25 + 0.95 100 + 0.65

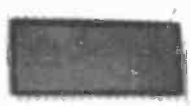
Z027 LCD & driver panel. One PCB contains a 4) digit 12mm display and this is linked to another PCB with an ICM7211AMIPL decoder/driver and 4070. Price of display and driver is normaly over £12.00 – Our price for the pair of panels £4.50



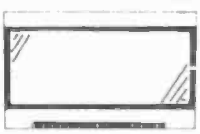
Z4115 8 digit 12.7mm high LCD and holder. These are 14 segment devices allowing alphanumeric display. Normally costing over £15.00 we are offering these for just **£4.50**



Z4148 LCD as Z4115 but 6 digit, 50 pins. Trade price £10.86.
Price **£3.00**



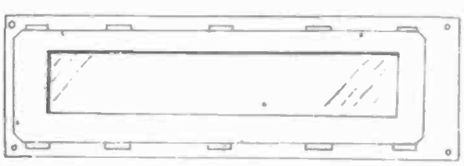
Z1637 LCD Display - Direct drive 3½ digit with 'LO-BATT'. 12.7mm high digits. Op voltage 4-12 RMS @ 32Hz type. Consumes only 25μA with all segments on. Trade price £7.97 each. Supplied with data, but no edge connector.
Prices .... **£1.00** 25+ 0.65 100+ 0.50



Z2163 4 Digit multiplexed LCD, 50 × 30mm probably for an electronic balance-symbols include balance pens, 5 stage bar graph, lb's and kg's etc. Digit height 12mm. Self adhesive pad on back. 13 pin PCB connector. **£2.00**

Two super new displays have just been delivered - liquid crystal with on-board controllers at a fraction of the distributor price! Both will display a full set of alpha-numerical and special characters.

Z2172 40 character × 1 line LCD by Optrex (Japan). High quality double height display with 192 character ROM; other characters can be displayed by generation in RAM. Other features include cursor with control, blink character, scroll display, read and write display data, single +5V supply, data and power inputs by one 16 pin 0.05" SIL socket, pin outs standard and compatible with other Optrex displays, contrast control, easily interfaced with either 4 or 8 bit uP's. Supplied complete with data. Dimensions: Characters are 5 × 12 dot arrays measuring 3.2 × 10mm
Display size 170 × 17.5mm
Module size 220 × 40mm
DP over £50.00 **Our Price £15.00**



Z2171 24 character × 2 lines LCD by Optrex.
High quality display with 192 character ROM; other characters can be displayed by generation in RAM. Other features include: EL type back light (details of high voltage generator supplied); cursor with control, blink character, scroll display, read and write display data, +5V and -7V supply with 150V AC required for backlight, data and power inputs by solder contacts on board, pin outs standard and compatible with other Optrex displays, extended temperature range (253 to 343°K), easily interfaced with either 4 or 8 bit uP's. Supplied complete with data.
Dimensions:
Characters are 5 × 7 dot arrays with separate cursor
1 Character measures 3.2 × 6.0 mm including cursor
Display size 93 × 16mm
Module size 118 × 35mm
DP around £30.00 **Our Price £10.00**

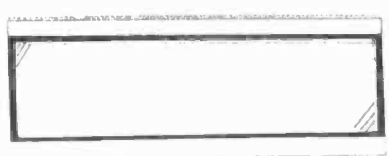
BULK LED's

Now! Standard LED's at prices from less than 2p each! This parcel was supposed to contain a variety of shapes and colours for our LED packs - but there are too many standard red ones to mix in, hence this too good to miss offer!!

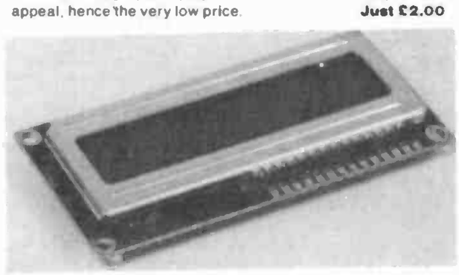
Code	Colour	Size	Shape	Manf'r/Type	Lead length	£1 pack	100+	1k+
Z2090	Red	5mm	○std	QTMV5752	28.5	15	0.032	0.025
Z2091	Red	5mm	□std	Liton LTL9223A	29.5	12	0.038	0.030
Z2092	Green	5mm	○std		13.5	14	0.035	0.028
Z2094	Red	3mm	○min	MLR327	17	18	0.030	0.022
Z2098	Red	7 × 2.55	Rect	Senior elecSE6511D	32	12	0.038	0.030
Z2095	Red	5mm	Rect*	Phillips HR44DL	26	12	0.038	0.030
Z2096	Clear(IR)	4.5 × 1.5	Rect	Honeywell 8406	20	8	0.060	0.040
Z2097	Red	5 × 2	Rect	GIMV57123	29	12	0.038	0.030

* Square with rounded corners

10k + mix of any of the above 0.02
100k + mix 0.016
Total available 250k +



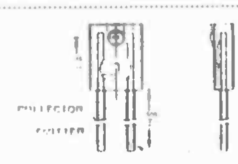
Z5119 Communications LCD. This large (140 × 40mm) display (made for Marconi) has 110 pins and shows a variety of symbols and power levels used in radio communication. Includes a bargraph display. No further info and only limited appeal, hence the very low price. **Just £2.00**



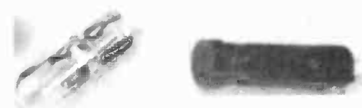
LCD MODULE

Z5096 16 character × 1 line. Very similar to our Z1814 but slightly larger character 6.3x3.15 (8 × 5 dots). Type LCDM16166 by Refac. Supplied with data. Uses Hitachi HD44780AOO chip.
Price **£8.00**

Z1847 4 Phototransistor SDP8405 with data.
Price £1.00



Z1846 2 pairs of infra red emitter/ receiver SDP8406/ 8506 by Honeywell with comprehensive data.
Price £1.00



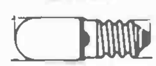
Z1466 GI lamp type 286-002. this is a 12V 1.2W wedge lamp 18mm long × 4.8mm dia. (
Their price 23p each.
Our price .... **12p; 25/£2.50; 100/£7.00; 500/£25.00**

Z712 Amber indicator 12V 80mA. 35mm long. Needs 8mm hole.
Price 25p

Z1922

Z1923

Z1924



Z1927

Z1928

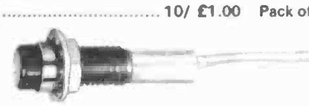
Z1929

Z1930

Z1931

Z1922	MBC 220V neon indicator	**5 for £1.00**
Z1923	Slide (PO type) 220V	**5 for £1.00**
Z1924	Small slide base 48V 25mA T5.5	**5 for £1.00**
Z1925	Small slide base 24V 20mA T5.5	**5 for £1.00** **100/£10**
Z1926	Small slide base 60V 20mA T5.5	**5 for £1.00**
Z1927	LES 6.5V 0.15A	**6 for £1.00**
Z1928	MES 110V neon indicator	**5 for £1.00**
Z1929	T3/4 (10mm) wedge base 28V 60mA	**5 for £1.00**
Z1930	Small wedge base (5mm dia) 24V 30mA	**8 for £1.00**
Z1931	Sub-midget flanged 12V 30mA T1	**3 for £1.00**

Z1407 Min wire ended bulb 6 × 3mm. 5V
Price .... **10/ £1.00** Pack of 100/ 6.10



Z4314 indicator 14V 40mA Opal. Their price 97p.
Our price **2/ £1.00**

Z5042 MES lamps rated 10V 0.2A. These have a larger bulb than normal.
In boxes of 50 for **£5.00**

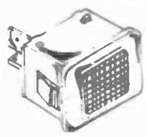
OPTO STATIONERY

A parcel of IMO Neon indicators and various other lamps has just been delivered and offers the hobbyist a selection of top quality components at rock-bottom prices! Why are they so cheap? They're all for 110/120V! However, that's no problem because with every indicator we supply a suitable resistor for mains operation.

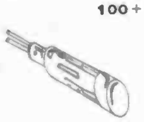
Type A - Panel mounting 33 × 15mm with 0.25" tags. Clip fix, requires 25 × 12.5mm cut-out.

Z1899 Green

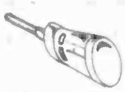
Price: **(Any mix) 5 for £1**
100 + 0.10 1k + 0.06



Type B - Panel mounting 36.5 × 26.5mm with 0.25" tags. Clip fix, requires 30 × 22.5mm cut-out.
Z1901 Red
Z1902 Green
Z1903 Amber
Z1904 White
Price: **(Any mix) 5 for £1**
100 + 0.10 1k + 0.06

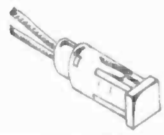


Type C - Small round face 10mm dia. Clip fix, requires 9mm dia hole.
Z1905 Red
Z1906 Green
Z1908 White
Price: **(Any mix) 5 for £1**
100 + 0.10 1k + 0.06

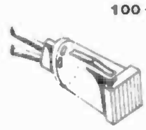


Type D - Large round face 13.5mm dia. Clip fix, requires 12.5mm dia hole.

Z1910 Green
Z1912 White
Price: **(Any mix) 5 for £1**
100 + 0.10 1k + 0.06

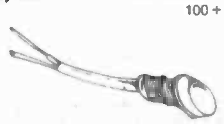


Type E - Small square face 10.5mm. Clip fix, requires 9.5mm dia hole.
Z1914 Green
Z1915 Amber
Z1916 White
Price: **(Any mix) 5 for £1**
100 + 0.10 1k + 0.06



Type F - Large square face 13.5mm. Clip fix, requires 12.5mm dia hole.
Z1917 Red
Z1918 Green
Z1919 Amber
Z1920 White
Price: **(Any mix) 5 for £1**
100 + 0.10 1k + 0.06

Type F - large square face 13.5mm, clip fix. Requires 12.5mm dia hole. ¼" tabs.
Z2063 Green
Z2064 Amber
Z2065 White
Price (any mix) .... **5 for £1.00**
100 + 0.10 1k + 0.06



Type G - Small round face 7.5mm dia, threaded body, requires 6.5mm dia hole.
Z1921 Red
Price: **5 for £1; 100 + 0.10; 1k + 0.06**

Type H - Body dia 17.5mm - chrome bezel. Wire ends.
Z2066 Clear
Price .... **5 for £1.00**
100 + 0.10 1k + 0.06

K700 Pack of indicators, types A-G. May include any of those listed above. Great value for money! **20 for £2.50**

Z511 Mains neon, clear 0.25" tabs require 15mm hole.
Prices 20p 10/1.30 100/10.45
Z510 As above, but red. Same prices.
Z514 As above, but 110V red. Same prices.
Z517 Mains neon, orange. Square face. Req 12mm hole.
Prices 20p 10/1.30 100/10.45
Z518 Mains neon, white. 0.187" tabs. Req 15mm hole.
Prices 20p 10/1.30 100/10.45
Z529 Mains neons - 90V neon + resistor with clear sleeve over and leads 70mm long. Some have dry joints.
Price .... **100/£6.00**

INDICATORS

A couple of snap-in 12V indicators. Panel mounting, they require 25 × 12.5mm cut-out. 0.25 tabs.
Z2138 Red .... **5 for £1.00**
Z2139 Amber .... **5 for £1.00**

We are always looking for new lines to add to our lists. Send details/ samples of goods available to:

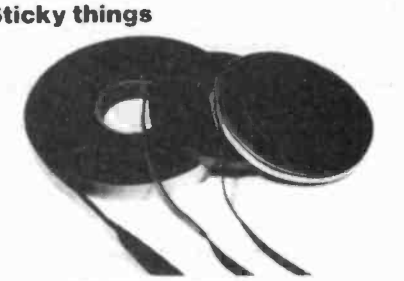
The Managing Director
Greenweld Electronics Ltd
27 Park Road
Southampton
SO1 3TB

STATIONERY

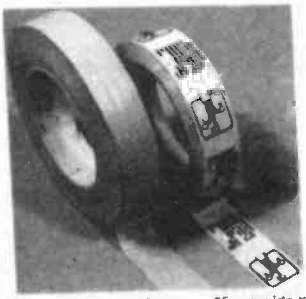
(a) Stationery products - mostly as used in plotters.
Pentel Rolling Writers. These fine point cartridges are essentially complete pens without an outer casing, so can be used as they are. Current price is around 60p. Now look at our prices! (State 2nd choice)
Z23199 Black
Z23201 Blue
Z23200 Red
Z23202 Green (only a few)
Prices (any mix) .... **30p each**
24 + 0.20 96 + 0.15

Z01268 Staedtler/Mars lumochrom leads. Pack of 12 in dispenser. Blue 2mm. Fits all standard lead holders.
Prices .... **30p** 10 + 0.20 50 + 0.15
Z01158 Tube of 12 × 2H leads 2mm dia.
Prices .... **25p** 10 + 0.17 50 + 0.12
Z01159 Tube of 12 Green leads 2mm dia.
Prices .... **30p** 10 + 0.20 50 + 0.15
Drawing Ink Staedtler/Mars 23ml plastic bottles in 4 colours. Normally £1.87
Z23183 Black
Z23184 Red
Z23185 Blue (few only)
Z23186 Green
Prices (any mix) .... **£1.00 ea**
10 + 0.70

Sticky things



3 types of adhesive backed foam strip.
Z04001 12mm wide 2mm thick. Roll of 10m.
Price **£2.00**
Z03763 8mm wide 2mm thick. Roll of 10m.
Price **£1.50**



Z5002 3M, or similar masking tape. 25mm wide × 50m long. Normally all at over £2.
Our price **£1.50**
Z23162 Reel of white 25mm wide × 66m long adhesive tape printed with colour coding of wires for 13A plugs. Repeats every 75mm.
Price **£1.50**
Z4282 High insulation adhesive tape, like brown translucent sellotape. 33m reel × 12mm wide.
Price **70p**
Z4283 Self adhesive profiled sealing strip. Cross section 9x4mm (sample free).
Price .... **20p/ metre** 50m roll/ 5.22
Z592 Yellow adhesive tape, 66m roll 3mm wide.
Price **30p**
Z5001 Bulk pack of Araldite 1500 GB twin pack yellow epoxy encapsulant. Bag is divided by clip which when withdrawn enables resins and hardener to mix. Contents can then be squeezed out of bag as required.
Price **£3.00**
Z23221 Antistatic adhesive labels. Sheet of 45 18 × 12mm. Black print on yellow background.
Price **£1.00**
Z23222 As above, but includes wording 'Caution static sensitive. Observe precautions.' Sheet of 21 45 × 13mm.
Price **£1.00**
Z01152 Scotch sensing markers for magnetic computer tape, ⅛" wide, 1" long tabs. 250 on a reel.
Price **£1.50**

A bigger, better range of component packs - all our packs contain new, full spec components (unless otherwise stated) giving great value for money! Please note most packs are calculated by weight - quantities are approximate.

HARDWARE

K553 2BA screw mix. Mostly steel, few brass/nylon etc, cheesehead and countersunk, mainly in lengths from 3-38mm. Excellent selection.
Price **100/ £2.50**
K551 6BA/ 8BA screw mix. Again an amazing mixture of lengths from 3-38mm. Nearly all cheesehead and countersunk in steel.
Price **200/ £2.40**
K811 6BA screws. Nearly all pan head pozi in plated steel. Lengths to 16mm.
Pack of 100 .... **£1.50**
K806 M2.5 screws. Various heads - mostly pan and c/s pozi. All plated steel. Lengths to 10mm.
Pack of 100 .... **£1.50**
K807 M3 screws. Good selection of sizes including a few brass. Most heads. Lengths to 35mm.
Pack of 100 .... **£1.50**
K808 M4 screws. Huge variety! Pan, c/ s, cheese, set, slot, pozi. From 4-50mm long. All steel, plated, black/ hi-tensile.
Pack of 100 .... **£1.60**
K809 M5 screws. As above.
Pack of 100 .... **£2.00**
K820 Large bolts and set screws. Could weigh as much as 150g each (up to 16mm dia × 90mm long). Practically all are steel. Many different heads
Parcel weighing 5kg **£10.00**
K817 Small washers. Big variety including shakeproof, spring and plain. A few brass and non-metal. 5-16mm OD, 2.4-8mm ID.
Pack of 500 .... **£2.00**
K599 Captive, shakeproof and locking nuts in sizes from 2BA to 6BA, mostly alloy.
Price per pack of 100 .... **£3.20**
K598 Solder tags. Good variety of sizes from 3-11.5mm ID. Includes some small crimp types. Most are double ended. Great value.
Price **200/ £2.20**
K527 Hardware Pack. This has a large variety of PK (caps) and self tapper screws from 2 × 1½" up to 8 × 1 ¼" also washers, some BA, metric and Whit. Screws plus other miscellaneous brackets, captive nuts and bits and pieces. 1kg (up to 1000 pieces).
Prices **1kg/ £4.00**
K535 Spring Pack. Approx 100 assorted compression, extension and torsion springs up to 22mm diameter and 30mm long.
Price **£1.70**
K550 Self tapping screws, both pointed (AB) and blunt (B) in an assortment of sizes from 6mm to 32mm long. No4 to No8, hex and Pozi head. Excellent value. **Price 200 for £1.50**

CAPACITORS

K544 Mullard Polyester Caps. Cosmetic imperfections, electrically OK. Wide range of values from 0.01 to 0.47µF in 100, 250, 400V working.
Price **200/ £4.75**
K546 Polystyrene/ Mica/ Ceramic Caps. Lots of useful small value caps up to about 0.01µF in voltages up to 8kV. Good variety.
Price **100/ £2.75**
K528 Electrolytic Pack. Axial and radial, some ready cropped for PCB mounting. This pack offers excellent value for money. Good range of values and voltages from 0.47µF to 1000µF, 6V to 100V.
Prices **100/ £4.50**
K518 200 Disc Ceramic Caps. Big variety of values and voltages from a few pF to 2.2µF; 3V to 3kV.
Price **£2.00**
K530 100 Assorted Polyester Caps. All new modern components, radial and axial leads. All values from 0.01 to 1µF at voltages from 63 to 1000!!
Super value at **£3.95**
K582 Polystyrene Caps. An amazing range of values from a few pF to .01. Tolerances 1-20%. Voltages to 500V. Outstanding value!
Price .... **Pack of 200/ £4.00**
K714 Power Supply Capacitors. All cans, mostly computer grade including popular values like 10,000µ 40V etc. Big mix of values and voltages up to 100V or more and 50,000µF.
Price for box of 25 .... **£12.50**

RESISTORS

K540 Resistor Pack. Mostly ⅛, ¼ and ½W, also some 1 and 2W in carbon film, oxide etc. All have full length leads. Tolerances from 2 to 20%. Excellent range of values.
Price **500/ £2.95**
K523 Resistor Pack. 1000 - yes, 1000 mainly ⅛W 5 & 10% carbon/ carbon film resistors with preformed leads for PCB mounting. Fair range of preferred values.
Price .... **Only £2.95**
K529 Bandoliered resistors in bulk, ideal for schools and colleges etc for soldering practice. Up to 5k (depending how they are packed) of one value. Our choice of values and types may include ¼/ ½/ 1W, 1/ 2/ 5/ 10%.
Price .... **Pack of 100,000/ £85.00**

K580 Metal Oxide resistors, TR4, 0.25W by Electrosil. Wide range of values, mostly 5%, few closer tolerances. Super value pack.
Price .... **Pack of 200/ £2.00**
K531 Precision Resistor Pack - High quality, close tolerance R's with an extremely varied selection of values mostly ¼W and ½W, tolerances from 0.1% to 2% - ideal for meters, test gear etc.
Prices **250/ £3.00**
K572 Resistor Networks. Both SIL and DIL in here, from 6 to 16 pin. Plenty of popular values like 1k, 4k7 and 10k, and a good sprinkling of many other values.
Pack of 100 .... **£3.95**
K503 100 Wirewound Resistors. From 1W to 12W, with a good range of values.
Price **£3.50**
K525 Preset Pack. Big, big variety of types and sizes - sub-min, min and std, MP, slider, multiturn and cermets are all included. Wide range of values from 20R to 5M. 100 assorted.
Prices **£6.75**
K505 20 Assorted Potentiometers. All types including single, ganged, rotary and slider.
Price **£2.30**

K827 Cermet Trimmers. Contains a good selection of multi turn types in a wide range of values from manufacturers like Murata, Bourns, Diplohmatic etc. **Pack of 50** **£7.95**
K828 Low value Wirewound Resistors. A remarkable selection of sizes and types, all less than 5R, going down to less than OR1! Wattages from 3W to 25W. A great pack at a terrific price. **Pack of 50** **£4.30**

PLASTIC/ SLEEVING

K564 PCB Stand-offs. A mixture of 5 different styles and sizes from 4.75 to 12.7mm high.
Price **100/ £2.95**
K826 Jumbo pack of plastic stand off's and a few cable clips and other bits and pieces.
Price .... **1000 parts £9.95**
K533 Silicon Rubber Sleeves. 20mm long, 2mm bore, 1mm wall.
Price **200/ £1.20**
K818 Pillars and stand-offs. This includes conventional threaded pillars and standoffs, also unusual shaped types too, up to 60mm long. Mostly steel, some ally and non-metal. Nearly all M3/6BA or larger.
Pack of 50 .... **£2.00**

SWITCHES AND RELAYS

W4700 Push Button Banks. An assortment of latching and independent switches on banks from 2 to 7 way. DPCO to 6PCO. A total of at least 100 switches.
Prices **100/ £6.50**
K587 A selection of toggle switches, mainly from page 122 of our 1990 Catalogue. Includes single pole to 4 pole sub min and min. Pack of 50, £30 at cat prices.
Price **£14.95**
K520 Switch Pack. 20 different assorted switches - rocker, slide, push, rotary, toggle, micro etc. Amazing value!
Price **£2.50**
K542 Reed relays. Mostly DIL, single pole & double pole also some changeover, these are manufacturers rejects, but a good proportion work. 5V-50V coils 50 assorted.
Price **£3.30**
K569 Reed Switch Pack. A selection of about 15 types of reed switch from submin 12mm long to 5A rated 50mm long, mosly form A (make), few form C (changeover).
Pack of 30 .... **£3.25**
K715 DIP Switch Pack Tremendous selection of DIP switches, mostly from Page 121 of 1991 catalogue. Everything from 1-9 way at an astonishingly low price!
Pack of 20 .... **£3.25**

K824 Rocker switch packs. Excellent selection of single pole and double pole rockers, illuminated (all 240V), large, miniature and standard in a variety of colours. Purchased individually they would cost over £15.00!!
Our price 25/ £4.95

OPTO

K539 LED Pack. Not only round but many shaped LEDs in this pack in red, yellow, green, orange and clear. Fantastic mix.
Price **100/ £6.50**
K806 LED Pack Contains only Red LED's - round, square, rectangular etc, from 3mm to 7 × 2.5mm.
Price **100/ £5.00**
K524 Opto Pack A variety of single point and 7 segment LEDs (incl dual types) of various colours and sizes, opto isolators, numicators, multi digit gas discharge displays, photo transistors, infra red emitters and receivers.
Price .... **25 asstd/ £4.50**
K801 Seven seg LED pack. Big variety of sizes in this pack. May include Red and Green, also overflow/ polarity displays, single/ double digit, also 7/ 8/ 9 digit magnified displays. Sizes from 0.11" to 0.8". 20 pieces for just .. **£3.95**
K804 Lamp Pack. A superb quality pack containing a wide variety of small lamps. Many different types - wire ended, bi-pin, slide, MBC, MES, LES, TI, wedge, miniflange etc in voltages from 2.5V to 220V. Most are marked with voltage/ current.
Pack of 50 .... **£4.00**

CONNECTORS

K557 Terminal Blocks. In all shapes and sizes, solder and screw from single way to 12 way in many different current ratings.
Price **20/ £2.95**
K803 PCB headers pack with/ without ears, straight and right angle from 10-64 way.
Pack of 20 .... **£5.50**
K802 Pack of DIN41612 connectors. These popular PCB connectors come as 32/ 64/ 96 way. Both plugs and sockets, some with pins missing. Normally costing £1- £3 each.
Pack of 25 .... **£8.00**
K822 'D' Type Connectors. A pack of these popular multipin connectors in 9, 15, and 25 way, may also include 37 and 50 way plugs and sockets, PCB, chassis and cable mounting types.
Price **20/ £3.95**
K821 Terminal Pin Pack. A wide selction of various dia pins and insulators for both single and double sided PCB's.
Price .... **Pack of 200/ £1.50**

SEMICONDUCTORS

K538 Diode Pack - full spec small signal diodes like 1N4148 etc at a price never before seen!!
Price/ 1000 .... **£4.00**
K547 Zener Diodes. Glass and plastic, 250mW to 5W ranging from 3V to 180V. All readily identifiable, with list supplied.
Price .... **100 for £4.95**
K709 Bridge Rectifiers. Another superb value pack - could include anything from ½ amp to 35A, 25V to 1000V, plastic and metal.
Price .... **20 for £6.95**
K710 SCR's & TRIACS. Big mixture could include all types from TO92 plastic up to DO5 stud mounting with a chance of everything in between! 25V to 1000V, 100mA to tens of amps. Marvellous value.
Price .... **25 for £5.95**
K708 Voltage Regulators. This is an excellent pack, made up from a huge variety of the +ve, -ve, fixed and variable regulators from 1.2V to 37V, 100mA to 5A, plastic and metal.
Price .... **25 for £6.95**
K517 Transistor pack. 100 assorted full spec. marked plastic devices PNP NPN RF AF. Type numbers include BC114, 117, 172, 182, 183, 198, 239, 251, 214, 255, 320, BF198, 255, 394, 2N3904 etc, etc. Retail cost £16+.
Special low price **£5.95**
K575 Plastic Power pack. Mainly TO126 and TO220 transistors, SCRs, Triacs etc. All new full spec marked devices offering fantastic value. Lots of TIP and BD types.
Price **50/ £7.95**
K576 Mixed pack of TO220 and 4 pin power mosfets with data and pinouts. Types may include: 2N7004/5/6/14, IRF620/710/720/820, IRF9520/9620, VN0300D etc.
Price .... **Pack of 25/ £8.00**
K577 Surface mount FETs including SM versions of 2N4340/1, 4392, 4857, 5488/9/60/1, also 2N7001/2 etc. Big variety at a low price!
Price .... **Pack of 50/ £4.00**
K536 74 Series Pack. 'On board' chips for you to desolder - containing many LS and other types. Good mix.
Price **100/ £4.00**
K711 74 Logic Pack. All brand new full spec devices from basic gates to complex logic. May include 54 & 64 types as well as 74 in L, LS, S, ALS, H, HC, HCT, etc.
Price for pack of 100 .... **£6.50**
K537 IC Pack - a mix of linear and logic chips, from 6 to 40 pin. All are new and marked, but some may not be full spec.
Price/ 100 .... **£7.50**

COMPONENT PACKS

MOTOR + GEAR PACK

K579 This pack contains 10 assorted battery powered motors (mostly 3V) + 90 gears etc. 16 - 60mm dia + worms and shafts. Amazing value.
Price **£7.95**

MISCELLANEOUS

K555 Fuses. A marvellous selection of 15, 20, 25 and 32mm fuses both cartridge and wire ended in quickblow and antisurge varieties. May be anything from 32mA to 50A!!
Price **100/ £3.95**

K823 Pack of 10 piezo and electromagnetic transducers, PC mounting and with leads. Various sizes and shapes from 15-30mm dia. Manf'rs include Star and Murata. Supplied with info sheet showing drive circuits etc. **£2.50**

K829 Transducers. Piezo, electromagnetic, permanent magnet in assorted sizes from 15mm dia upwards. Lovely mix. **Pack of 25** **£3.50**

K574 Wire link pack. A wide range of sizes from 3mm to 50mm for use with Breadboards or PCBs. Some are bare, a few are not preformed.
Price per pack of 250 .... **£1.00**

K561 Coils and Chokes. Pot cores, IF cans, open wound coils, chokes, etc from a few µH upwards in a wide variety of sizes and values.
Prices **50/ £2.80**

K573 Pack of assorted TOKO RCL coils, mainly in 10 × 10mm screened cans.
Price **100/ £6.00**

K541 Printed Circuit Boards. A wide variety of high quality printed circuit boards including audio, RF, digital etc all covered in components - resistors, capacitors, transistors, ICs, LEDs, switches etc, etc. A big pack of 2kg.
Price .... **Only £7.00**

K712 Crystals. Mostly HC60 and HC18U in a wide variety of frequencies from a few hundred kilohertz to many megahertz and the odd crystal oscillator module or two.
Price .... **20 for £5.95**

K713 Fuseholders. Panel and chassis mounting from a basic clip to high current enclosed types for 15, 20 and 32mm fuses.
Price for pack of 50 .... **£4.00**

Transducer/ Sounder Parcel
Remains of STC sounder on P120 of 1991 cat + other piezo devices. A parcel of 10 assorted.
Price **£9.95**

Power Supply Parcel
K586 This one's an absolute gem! Contains a selection of conventional and switch mode power supplies, including AA12531, Z4215, Z4311 + 7 others!! Parcel of 10 originally selling for £40+.
Price **£25.00**

PHOTOGRAPHIC

K716 Odds and ends of Flash units, dedicated Flash Modules, Lens converters, incomplete cameras (at least 3).
Price **£15**

£1 PACKS

EVERY SINGLE PACK IN THESE PAGES COSTS JUST £1.00!!

There is an enormous variety of electronic components, hardware, and other interesting parts. We have divided the packs up into various classifications to make selection quick and simple - so look through these pages at:

THE CLASSIFIED COLLECTION

We're sure you'll find something to interest you at a price to delight you!

List of categories

No.	Description	No.	Description	No.	Description	No.	Description
3	Capacitors (Tant bead)	11	Computer accessories	34	IC's (Digital)	53	Resistors
4	Capacitors (Electrolytic)	12	Connectors	35	IC's (Micro)	58	SCR's & Triac's
5	Capacitors (Ceramic)	14	Diodes (Bridge)	37	Crystals	65	Switches and Reeds
6	Capacitors (Polyester etc)	15	Diodes (Power)	38	Indicators	68	Thermistors
10	Coils, chokes, & transformers	16	Diodes (Signal)	40	LED's	70	Tools
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		25	Fuses & Holders	45	Opto devices	72	Transistors
		29	Hardware	46	PCB's	80	Voltage Regulators
		33	IC's (Linear)	48	Pots & Presets	85	Wire, Cable, Leads
				50	Relays		

3 Capacitors (Tant bead)

Code	Value	Description	Qty
K173	1.5µF	25V Tant bead caps	12
K246	0.1µF	35V Tants	20
K350	2.2µF	16V	15
K351	15µF	16V	10
K352	10µF	35V	6
K353	220µF	10V	1
K354	2.2µF	35V	10
K355	100µF	10V	2
Z741		Tubular tant cap 15µF 35V	6

4 Capacitors (Electrolytic)

Code	Value	Description	Qty
K135	4.7µF	10V Radial elecs.	30
K146	330µF	4V Axial caps.	25
K201	1000µF	6.3V PC mntg electrolytics.	25
K205	0.33µF	50V Radial lead electrolytics.	40
K206	0.47µF	50V Radial lead electrolytics.	40
K250	10µF	40V PC mntg electrolytics.	25
K258	2000µF	10V long leads.	10
K259	10,000µF	6.3V long leads.	6
K264	10,000µF	16V can.	2
K266	4,700µF	16V Mullard can. Tag end 50 × 25mm dia.	3
K267	10,000µF	25V Elma can, with clip; tag ends 50 × 31mm dia.	2
K268	4,700µF	16V ITT Radial leads. 37 × 18mm dia.	3
K269	330µF	100V ITT Axial leads. 50 × 22mm dia.	3
K271	8µF	25V Sprague axial leads. 13 × 6.5mm dia.	20
K359	1µF	50V axial 12.5 × 5mm.	12
K360	1500µF	16V radial 40 × 16mm.	
K364	220µF	10V radial min.	30
K407	470µF	25V Axial.	10
K408	10µF	16V radial.	30
K409	220µF	16V radial.	15
K410	4µ7	63V radial.	30
K411	1µF	100V radial.	25
K412	10µF	63V radial.	15
K413	100µF	25V radial.	15
K414	2200µF	40V can.	5
Z822		800µF 250V can 76 dia 38.	1

5 Capacitors (Ceramic)

Code	Value	Description	Qty
K124	0.02µF	Disc ceramic.	50
K126	3000pF	63V Polystyrene preformed caps.	100
K278	0.1µF	32V disc ceramic 14.5mm dia.	25
K278A	1000pF	4kV Disc ceramic.	10
K279	2200pF	2kV ceramic.	10
K356	0.47µF	Dipped multilayer, 50V.	5
K357	0.022µF	Ceramic plate, 50V.	20
K358	0.047µF	Ceramic disc, 12V.	25
K518		Disc ceramic mix.	200
Z1539	4700pF	Disc ceramic 380Vac. 15mm dia.	15
Z1540	2200pF	Disc ceramic 380Vac. 9mm dia.	25

6 Capacitors (Polyester etc)

Code	Value	Description	Qty
K140	0.05µF	50V Mylar caps.	30
K141	0.01µF	400V Axial caps (C296).	40
K277	0.015µF	630V Axial.	15
K361	0.33µF	63V mini-polyester 5mm pitch.	6
K362	0.47µF	63V mini-polyester 5mm pitch.	6

10 Coils, chokes and transfomers

Code	Description	Qty
K149	Ferrite rods, cat type Z036.	12
K280	Mixture of 33, 56 & 100µH axial chokes.	20
K402	Transformer 12-0-12V 100mA.	1
K588	TOKO Can type 113CN12249HM.	10
K589	TOKO Can type 113CNK1881EK.	10
K590	SIGMA Axial choke type SC10, 150µH.	10
Z1386	Ferrite core.	10
Z1433	12V Sheet feeder solenoid	1
Z1537	Choke 16mm long × 11mm dia. 3.3mH.	5

11 Computer Accessories

Code	Description	Qty
Z610	Enterprise demo cassette.	6
Z1614	PR280 red/ black ribbon for puma.	1
Z1615	Olivetti ribbon. No code number.	1
Z4132	Joystick firing speed adjuster.	1
Z4156	Multistrike film ribbon for Ricoh RP600.	1
Z4159	Fabric black for qume no. 80009-02.	1

12 Connectors

Code	Description	Qty
K133	3 way term block 5A.	20
K157	16 pin QIL-QIL IC sockets.	12
K240	2W tag strip.	25
K261	Mini 2 way tag strips.	25
K314	22pin gold plated IC socket 0.4 spacing.	10
K315	3.5mm mono screened plug.	4
K404	Push on crimp connectors.	100
K413	40 way 0.1" header plug.	5
K414	34 way 0.1" header plug.	6
K415	44 way 0.1" header plug.	5
K416	20 way 0.1" header plug.	8

*ALL PRICES IN **BOLD** TYPE INCLUDE VAT: PRICES IN LIGHT DO NOT*

K417	26 way 0.1" header plug.	8
K418	34 way IDC card edge connector.	2
Z522	Amp terminal pins on carrier strip. 0.1" pitch.	200
Z576	2.1mm power socket, chassis mntg.	10
Z586	Phono PC mntg socket.	10
Z743	24 way socket. Connector on 5mm centres.	10
Z782	Transistor socket. 4 pin TO5 PTFE.	6
Z1370	Amp connector, 3 way 0.156" pitch.	100
Z1381	10 way PCB mntg 0.1" pitch, single sided edge connector.	10
Z1382	10 way commoning block, 2 × 5 way 0.1" pitch.	10
Z1476	Sealectro connector contex 75R.	1
Z1477	Sealectro connector SRM 50R.	1
Z1495	Line socket for old BT 4 pole plug.	1
Z1543	3 row DIN 41612 socket. Rows 6, 7, 13 + 14 missing.	1
Z1544	2 row DIN 41612 64 way plug. Right angle pins.	1
Z1545	3 row DIN 41612 96 way plug. Rows 2, 5, 8, 11, 14, 17, 20, 23, 26, 32 missing.	2
Z1551	12 way DIL header socket 0.1" pitch.	25
Z1552	12 way DIL header plug with standoff.	10
Z1555	CRT socket. 10 way green plastic.	4
Z1557	'F' socket, single hole female RF connector.	4
Z1652	31 way 0.15 pitch single header plug, gold plated.	6
Z1688	Edge connector. S/ S 0.1 pitch 38 way, solder tags.	2

14 Diodes (Bridge)

K249	800V 4A in-line bridge rect.	2
K301	Semikron Bridge SKB2/02 (like BY164).	4
K306	BSK B80 C600 Semikron Bridge.	5
K307	µE B380C800W Bridge.	4
Z1408	50V 25A bridge rectifier.	1

15 Diodes (Power)

K450	AA132100V 10mA Ge point contact.	8
K451	AA133130V 10mA Ge point contact.	8
K452	BA12875V 50mA Si diode.	10
K453	BA13025V 75mA Si diode.	10
K454	BA14715V 50mA Si diode.	10
K455	BA155150V 100mA Si diode.	10
K456	BA21850V 10mA Si switching.	10
K322	BAX12A Silicon glass 90V 400mA.	20
K323	BAX16 Silicon glass 150V 200mA.	25
K457	BB104 Dual capacitance Si 34-39 pF.	3
K324	BB121A	
K325	BB142	
K326	BB221 Variable capacitance diode 1.8-2.2pF 28V.	5
K327	BB329 Variable capacitance diode 2.5-3.2pF 28V.	4
K458	BY196100V 1.2A fast rect.	5
K328	BY197200V 1.2A fast rect.	5
K459	BY198400V 1.2A.	4
K329	BY199600V 1.2A fast rect.	4
K460	BY212-750R 800V 1A Si 'tophat' rect.	10
K330	BY250 Pinnacle supplied in a neat clear plastic case.	5
K461	BY4011A rect.	15
K462	BY550-100100V 5A Si rect.	
K463	BYX22-400 400V 1.4A Si 'tophat' rect.	10
K464	BYX36-300 300V 1A rect.	20
K331	BYX55-300 Silicon rect 330V 1A.	25
K465	DK14 80V 120mA Ge diode.	8
K466	HG5085 Small signal diode.	20
K332	IN277 Germanium diode 125V 100mA.	8
K467	IN446 Si.	20
K468	IN459 175V 3mA Si.	20
K469	IN627 100V 30mA switching Si diode.	20
K470	IN643 200V 5mA switching Si diode.	20
K471	IN916A 75V 10mA switching Si diode.	20
K333	IN2069 Silicon rect 200V 0.75A.	25
K472	IN3890 100V 40A rect.	2
K473	IN4149 75V 10mA Si.	20
K474	IN4154 25V 30mA Si.	20
K475	IN4446 75V 10mA Si.	20
K476	IN4447 75V 20mA Si.	20
K477	IN4448 75V 5mA Si.	20
K478	IN4454 75V 10mA Si.	20
K479	IN4744 15V 1W 10% zener diode.	15
K480	IN4752 33V 1W 10% zener diode.	15
K334	IN4821 Silicon rect 500V 1.5A.	15
K335	IN4933 Fast (150ns) rect 50V 1A plastic.	12
K481	IN5062 800V 1A Si rect.	15
K482	IN5257 33V 400mW 20% zener diode.	20
K483	I5021 Top hat.	10
K484	I5410 Stud mntg 3A 100V.	6
K485	I5423 Stud mntg 10A 400V.	2

16 Diodes (Signal)

K112	3A 50V wire ended rects.	14
K113	DA002 150V 0.5A rects.	30
K222	GR05R 50V 4A stud mntg rects.	5
K229	IN4006 Rectifier diodes 1A 600V.	30
K245	BYX10 1400V rects.	10
K248	S05M1 1A 50V rects.	30
K287	Silicon 6A diode by Motorola. Like MR752.	12
K292	BY299, 2A 800V diode preformed for H mntg.	8
K295	SK4G4/ 04 switching diode 400V 1A preformed for H mntg.	10
K302	BYX10 Diodes.	10
K308	CV8308 Diodes.	10
K313	BY206 Diode. Fast recovery 0.5A 400V.	4
K316	31 DQ03 Diode by IR. Schottky 3.3A 40V.	3
K319	IN4001.	30
Z728	Stud rect 6A 300V BYX38-300.	10

17 Diodes (Zener)

K121		7V5 400mW zeners.	20
K123		56V 1W zeners.	10
K171		11V 400mW zeners preformed.	25
K194		22V 400mW Preformed for horiz mntg.	30
K224		12V 1W zeners.	10
K225		33V 1W zeners.	10
K226		20V 400mW zeners.	20
K227		9V1 400mW zeners.	20
K228		56V 1.3W zeners.	10
K247		24V 5W plastic zener.	5
K275		BZY88CV7 400mW 4.7V zeners. Long preformed leads for horiz mntg on 15mm pitch.	25
K281		BZX79C 6V2 zener, preformed leads.	30
K336	BAT85	30V 200mA High speed.	20
K337	ZY150	150V 2W Zener.	12
K338	IN5267B	75V 500mW Zener.	20
K340	IN754A	6V8 400mW Zener.	20
K341	IN755A	7V5 400mW Zener.	20
K342	IN758A	10V 400mW Zener.	20
K343	IN959A	8V2 400mW Zener.	20
K344	IN960B	9V1 400mW Zener.	20
K345	IN963B	12V 400mW Zener.	20
K346	IN965B	15V 400mW Zener.	20
K347	IN973B	33V 400mW Zener.	20
K348	BZX70C12	12V 2.5W Zener.	6
K349	BZX95C15	15V 1.5W Zener.	12
K365		39V 400mW Zener.	20
K431		12V 400mW.	20
K432		5V6 400mW.	20
K433		18V 1.3W.	10
K336	BAT85	30V 200mA High speed.	20

25 Fuses & Holders

K156	1¼" chassis mntg fuseholder.	15
Z349	Wire ended fuse, glass body with end caps 20 × 5mm. 1.5A A/ S. Wires could be snipped off and fuse used in holders.	20
Z692	Fused mains inlet/ outlet.	1
Z1395	15mm panel mntg fuseholder, size 00. Belling Lee L575. Finger or screw release. Solder tags.	5
Z1536	PC mntg. 20mm fuseholder.	15

29 Hardware

K148	Transformer formers. Cat type X228.	30
K153	TO5 heatsinks. Cat type G104.	30
K244	Nylon cupboard latch.	6
K252	Transistor mntg pads.	500
K255	Terry clips 8-12mm.	12
K434	0.5" pillar ID6 0D9.5.	30
K435	M3 × 10mm BOLT, PAN, POZI.	100
K436	M3.5 × 40mm PAN, POZI.	50
K437	2BA × 1" HEX head.	30
K438	4BA × 0.75" HEX head.	100
K439	2BA shakeproof washer.	300
K440	4BA shakeproof washer.	300
K441	2BA fibre washer.	200
K442	M3.5 internal tooth washer.	300
K443	M3.5 nut.	150
K444	Magnet 20mm dia × 5mm.	6
K445	Magnet 26 × 11 × 9mm.	5
Z611	Enterprise heatsinks.	1
Z718	Black plastic knob.	20
Z740	Clip on TO220 type heatsinks.	10
Z4053	Antistatic bags.	4
Z4109	Scope probe steel case.	1
Z4110	CB aerial elim cases.	3
Z4174	Knob, push on grey 28mm dia with clear skirt marked with red line 47mm dia. Push fit for ¼" spindle.	4
Z4204	White rubber feet. 12.5 dia × 6.5mm screw fix.	40
Z4203	Cable gland 21mm max requires 28mm dia hole.	5

33 IC's (Linear)

K223		RC4131T Op-Amps.	3
K339	LA1385	TV chip.	1
K311		UDN 6116A driver chip.	4
K312		SL521.	3
Z732		XK1444 CMOS buffer 16 pin chip.	10

34 IC's (Digital)

BP801	7401	10
BP802	7407	10
BP803	7410	10
BP804	7413	10
BP805	7437	10
BP806	7440	10
BP807	7443	10
BP808	7450	10
BP809	7460	8
BP810	7470	8
BP811	7472	10
BP812	7480	10
BP813	7481	10
BP814	7482	10
BP815	7483	10
BP816	7484	10
BP817	7491	8
BP818	7492	8
BP819	7493	8
BP820	7494	8
BP821	7495	8
BP822	7496	8
BP823	74104	8
BP824	74105	8
BP825	74110	8
BP826	74118	8
BP827	74119	8
BP828	74141	5
BP829	74151	8
BP830	74153	8
BP831	74155	8
BP832	74156	8
BP833	74157	8
BP834	74160	8
BP835	74161	8
BP836	74164	8
BP837	74165	8
BP838	74167	8
BP839	74173	8
BP840	74174	8
BP841	74175	8
BP842	74181	5
BP843	74182	8
BP844	74191	8
BP845	74193	8
BP846	74195	8
BP847	74196	8

COMPONENT PACKS

BP848	74197	8
BP849	74199	8
BP850	74LS11	10
BP851	74LS14	8
BP852	74LS20	10
BP853	74LS26	10
BP854	74LS33	10
BP855	74LS42	6
BP856	74LS55	8
BP857	74LS73	8
BP858	74LS74	8
BP859	74LS76	8
BP860	74LS93	6
BP861	74LS95	8
BP862	74LS122	6
BP863	74LS148	6
BP864	74LS153	6
BP865	74LS173	8
BP866	74LS221	6
BP867	74LS273	6
BP868	74LS275	6
BP869	74LS279	8
BP870	74LS393	6
BP871	74LS669	3
K363	4040 surface mount.	4

35 IC's (Micro)

K233	C500 calc chips + data	2
Z1662	8050AH single chip 8 bit micro. Ex equip so probably ROM programmed.	1
K303	SL-A-4032 chips by GI. 14DIL	4
K305	SL-D-2128 chips by GI. 14DIL	4

37 Crystals

K320	Watch crystal 32.768 kHz. 8 × 3mm dia.	2
Z1418	20MHz crystal. HC6U.	1

38 Indicators

K142	Wire ended neons cover case size 90V.	25
K277	28V 0.04A min flange lamps by GI.	10
Z321	Lamp LES 6V 0.06A L15 dia 5mm.	7
Z323	Lamp MF 6V 0.1A L15 dia 6mm.	6
Z324	Lamp MF 12V 0.1A L15 dia 6mm S × 6s.	6
Z325	Lamp MF 28V 0.08A L15 dia 6mm S × 6s.	6
Z330	Lamp MES 50V 0.05A L28 dia 10mm.	10
Z335	Lamp MBC 240V neon L28 dia 10mm.	6
Z337	Lamp MBC 6.5V 0.3A L24 dia 11mm.	10

40 LED's

K151	3mm Red LEDs.	12
K152	5mm Red LEDs.	10
K284	Large (7 × 5.5mm) rectangular pink LED.	6
K309	LD261-4LED. Infra red emitter, sub min 0.1 pitch.	4
Z1663	Red LEDs 7 × 2.5mm.	15

43 Miscellaneous

Z1655	Xenon flash tube. 56mm long × 3.5 dia.	1
Z1656	Xenon flash tube. 40mm long × 3 dia.	1
Z4081	CB Aerial eliminator.	1

45 Opto devices

Z1435	OPB703A reflective optocoupler.	1
Z1436	OPB711 reflective optocoupler.	1

46 PCB's

Z696	PCB, 34W IDC plug, LS245, LS125, LS04, LS74 etc.	1
Z1438	Sheet feeder control panel.	1
Z1699	Mini inverter.	3

48 Pots and Presets

K130	470RV 0.1W Presets.	25
K159	0.3W presets 500kV knurled knob.	20
K161	0.3W presets 2K5V.	20
K162	0.3W presets 2M5V knurled knob.	20
K176	150R 0.1W V presets.	24
K177	470R 0.1W H presets.	24
K178	470R 0.1W V presets.	24
K179	2k 0.1W H presets.	24
K181	2k2 0.1W H presets.	24
K272	Slider 1k8 lin 40mm travel.	20
K273	Pot 100k lin. Min stereo. Square body. 17 × 19 (shaft 23mm × 4mm).	6
K274	Dual pot × DPSW 5k 24mm dia body. Shaft 40mm × 6.35mm.	4
K368	500k Unipot 22.5mm dia ¼" spindle is 15mm long.	10
Z004	Skeleton joystick.	1
Z577	5k edgewise pot with switch, no knob.	10
Z716	5 gang pot. All 22k. PC mntg.	4
Z1398	Cermet open preset. Horiz mntg 2k5.	10
Z1471	1¼" trimpot. Plessy type 200P 10k.	4
Z1535	Convergence type pot with knob 1k.	6
Z1572	100R carbon preset by AB.	25
Z1573	100R carbon preset by Piher.	25
Z1576	470R preset. Carbon by AB.	25
Z1583	220k Carbon preset by AB.	25

50 Relays

Z202	3V 35R SPCO at 3A 32 × 20 × 11. Low profile PC mntg.	1
Z203	4V 20R 4PCO at 3A 35 × 27 × 21. PC mntg.	1
Z209	12V 1000R SPCO at 1A 20 × 10 × 10. PC mntg. Reed 500Hz.	1
Z210	50Vac 750R 4PCO at 3A 35 × 27 × 21. Plug in.	1
Z212	12V 400R DPCO at 1A 20 × 15 × 15. PC mntg.	1
Z233	100V 12K DPCO 47 × 39 × 39.	1
Z236	24V 650R DPCO at 3A 35 × 27 × 21. PC mntg.	1
Z245	6V 52R DPCO at 3A 30 × 320 × 19. Plug in continental.	1
Z259	24V 700R DPCO at 3A 309 × 30 × 15. Plug in continental.	1
Z265	Omron G2V-2 relay. DPCO 9V.	1

53 Resistors

K144	1R5 3W W/W.	30
K163	15R ¼W 5% preformed vert mntg R's.	400
K219	OR47 0.7W resistors.	30
K238	6R2 5% 5W metal clad resistor.	12
K294	SIL resistor network, 8 × 500R.	10
K366	OR47 10% ½W resistor.	100
K367	1R 10% ½W resistor.	100
K401	1R2 2½W W/W.	25
K402	1R5 2½W W/W.	25
K403	100R 2½W W/W.	25
K404	60Vac varistor.	12
K405	Bourns 3386W trimpot, 1k.	5
K406	Bourns 3296X multiturn pot, 100R.	3
Z1370	16 pin DIL resistor network 8 × 10K. Beckman.	10
Z1371	16 pin DIL resistor network. 8 × 22R. Beckman.	10
Z1468	H2 10K 0.1% 25ppm precision by Holsworthy.	3
Z1469	H2 5M0 1% 25ppm precision by Holsworthy.	1
Z1470	H8 100R 0.2% 15ppm precision by Holsworthy.	5

58 SCR's and Triac's

K108	2N5060 30V, 0.8A TO92 case SCR's.	8
K429	TIC225D.	3
K430	TIC226B.	5

65 Switches and Reeds

K150	Switches (cat type W430).	10
K158	SPCO centre off white rocker switch.	6
K231	4W DIL switch.	4
K232	8W DIL switch.	2
Z420	Min slide switch SPCO with 2 leads.	10
Z1522	Switch. Alps SRS 40 way. As used in CB's for channel switching. Body 20 × 20mm 6mm dia. Shaft with M9 fixing nut. 7 bits per strip. Data sheet supplied.	1
Z1694	S103/ 14 thermal switch. Glass encased with B7G base. At 24V cold start 70 secs to energise, hot start 10 secs. 5A.	1

68 Thermistors

K253	VA1112 thermistor 22k-4k2.	10
K276	15k Siemens thermistors.	6
K289	PTC thermistor marked 630H. Measures 4R @25°C and rises to 30M @ 200°C.	6
K290	NTC thermistor 8.3k @ 25°C reducing to 100R@ 100°C.	5
K293	Dual thermistor 2322 662 98009.	3
Z1472	Thermistor as sused on BT phones. Bead type with negative temp co-efficient. R@25°C = 120K.	1

70 Tools

Z314	Bow compass.	1

71 Transducers

Z945	5" × 3" 80R 1W speaker.	1

72 Transistors

K102	BC349A transistors.	15
K103	BC546B transistors.	10
K109	BC114 transistors.	15
K114	XK6116 (BF241) transistors.	15
K119	2N5401 PNP 160V TO92 transistors.	10
K134	Unmarked untested OC71 type transistors.	50
K136	AC187K transistors.	4
K182	PN72 plastic BCY72 TO92 case.	15
K208	SGS127212 NPN TO5 H_{FE} 75 V_{CE} 50V.	10
K209	SGS26907 NPN TO5 H_{FE} B_{CE} 40V.	11
K211	ED1502B TO106 NPN SI switching.	16
K212	TJ525 TO92 NPN SI 60V.	20
K213	FW5247 TO5 NPN SI.	25
K215	E5444 TO92 NPN SI 30V.	25
K216	22-6025 TO5 PNP Si 80V H_{FE} 50.	10
K217	7-4659C TO18 NPN SI H_{FE} 100 40V. Sim BC107.	12
K218	648005 TO3 GE Hi-Gain 30V.	2
K221	LD270 Sub-min transistors.	10
K288	Gen purpose NPN SI TO92 like BC182.	20
K291	BC238 preformed TO5 spacing.	20
K304	Matched pair 2SD96 & 2SB496 TO1 case.	4
K310	TO39 case transistor, like BFY51.	8
K317	2N6666	2
K318	BD676	3
K419	TIP132	4
K420	TIP137	4
K421	TIPP31	12
K422	TIPP32	12
K423	TIP111	6
K424	BC327A	20
K425	BDW93	2
K426	BDW94	2
K427	BCX38B	15

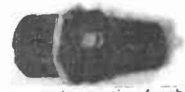
K428	ZTX601B	**15**
VP701	AC141K	**6**
VP702	AC176K	**6**
VP703	AC179	**8**
VP704	AC180	**8**
VP705	AC181K	**6**
VP706	AC186	**8**
VP707	AC187K	**6**
VP708	AC188	**10**
VP709	ACY40	**6**
VP710	ADY26	**2**
VP711	AF116	**4**
VP712	AF118	**4**
VP713	AF127	**5**
VP714	AF200	**5**
VP715	BC115	**15**
VP716	BC136	**12**
VP717	BC149C	**12**
VP718	BC154	**15**
VP719	BC157	**20**
VP720	BC159	**20**
VP721	BC159B	**20**
VP722	BC172B	**20**
VP7152	BC173B	**20**
VP723	BC175	**8**
VP724	BC178	**15**
VP725	BC181	**15**
VP726	BC182B	**15**
VP727	BC166	**15**
VP728	BC208	**15**
VP729	BC208A	**20**
VP730	BC209B	**20**
VP731	BC214L	**20**
VP732	BC214B	**20**
VP733	BC251A	**20**
VP734	BC302	**7**
VP735	BC312	**6**
VP736	BC328	**20**
VP737	BC546	**20**
VP738	BC558	**20**
VP7153	BCY31	**5**
VP739	BCY32	**5**
VP740	BCY33	**5**
VP741	BCZ11	**5**
VP742	BDZ12	**5**
VP743	BD177	**4**
VP7101	BD244A (TIP2955)	**3**
VP744	BD312	**4**
VP745	BD609	**4**
VP746	BF152	**10**
VP747	BF160	**10**
VP748	BF254	**10**
VP749	BF255	**10**
VP750	BF257	**8**
VP751	BF355	**10**
VP752	BF355	**5**
VP753	BF494	**20**
VP754	BF495	**12**
VP755	BF649	**6**
VP756	BF679S	**6**
VP757	BF961	**4**
VP758	BF595	**10**
VP759	BFR50	**8**
VP760	BFT83	**8**
VP761	BFX19	**8**
VP762	BFX29	**8**
VP763	BFX30	**8**
VP764	BFX84	**8**
VP765	BFX86	**8**
VP766	BFX87	**8**
VP767	BFX88	**8**
VP768	BFY43	**8**
VP769	BFY52	**8**
VP770	BRY56	**4**
VP771	BSX21	**8**
VP772	BSY95A	**8**
VP773	CV7001	**10**
VP774	CV7735	**5**
VP775	CV7580	**5**
VP776	CV9507 (BFX30)	**10**
VP777	CV9790 (2N2905A)	**10**
VP778	GET885	**6**
VP779	2G401	**5**
VP780	ME1120	**20**
VP781	MPSA06	**10**
VP782	MPSA56	**10**
VP783	OC41	**8**
VP784	OC42	**8**
VP785	OC45	**8**
VP786	OC70	**8**
VP787	OC72	**8**
VP788	OC74	**8**
VP789	OC75	**8**
VP790	OC76	**8**
VP791	OC79	**8**
VP792	OC82	**8**
VP793	OC200	**4**
VP794	OC201	**3**
VP795	OC203	**4**
VP796	OC204	**3**
VP797	OC205	**3**
VP798	OCP71	**10**
VP799	TIS43	**10**
VP7100	TIS90	**12**
VP7102	ZTX109	**15**
VP7103	ZTX504	**12**
VP7104	ZTX531	**10**
VP7105	ZTX550	**10**
VP7106	2N696	**10**
VP7107	2N706	**15**
VP7108	2N708	**12**
VP7109	2N717	**8**
VP7110	2N718	**8**
VP7111	2N726	**10**
VP7112	2N727	**10**
VP7113	2N743	**12**
VP7114	2N914	**12**
VP7115	2N929	**6**
VP7116	2N1131	**10**
VP7117	2N1132	**10**
VP7118	2N1613	**10**
VP7119	2N1711	**8**
VP7120	2N1893	**6**
VP7121	2N2102	**6**
VP7122	2N2193	**6**
VP7123	2N2217	**10**
VP7124	2N2218	**10**
VP7125	2N2219	**8**
VP7126	2N2219A	**8**
VP7127	2N2220	**10**
VP7128	2N2221	**10**
VP7129	2N2221A	**10**
VP7130	2N2368	**10**
VP7131	2N2369	**12**
VP7132	2N2411	**4**
VP7133	2N2412	**4**
VP7134	2N2904	**10**
VP7135	2N2904A	**10**
VP7136	2N2906	**12**
VP7137	2N2906A	**12**
VP7138	2N2907A	**12**
VP7139	2N3011	**12**
VP7140	2N3114	**8**
VP7141	2N3416	**20**
VP7142	2N3704	**20**
VP7143	2N3708	**20**
VP7144	2N3710	**20**
VP7145	2N3711	**20**
VP7146	2N4058	**15**
VP7147	2N4060	**15**
VP7148	2N4061	**15**
VP7149	2N4220FET	**3**
VP7150	2N5172	**12**
VP7151	2N6122	**5**
Z506	2N3055B transistors.	**4**
Z724	BDX88A TO3 case PNP 60V 12A 117W H_{FE} 750@6A.	**2**
Z1534	PNP TO39 transistor. Sim to BC303.	**10**

85 Wire, Cable, Leads

Z486	Computer lead 1.8m long; co-ax to phono plug.	**4**
Z487	3 pin DIN to 3 pin DIN. 1.8m.	**3**
Z603	5 pin DIN - 8 pin DIN line skt, and 5 pin DIN 180° line skt. Overall length 285mm.	**4**
Z612	5 pin DIN 180° plug one end and 200mm twin cable.	**8**
Z665	Cream dispenser wiring harness.	**1**
Z1430	Resistance wire T2 alloy. 95.4% nickel, 1.8% Ma, 1.6% Si, 1.2% Al, 2.521Ω/ metre, 0.0148" dia. Sold in 5m lengths.	**1**

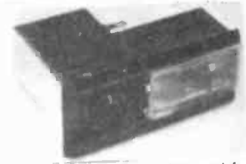
If you like what you see in this supplement make sure you don't miss future bargains - only £2 (UK/ BFPO; £4 O'seas) for the next 6 issues - see order form for details.

Fuseholders

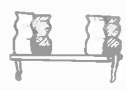


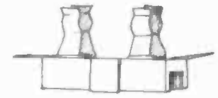
Z1395 15mm panel mounting fuseholder, size 00. Belling Lee L575. Finger or screw release. Solder tags. List price £1.84. Our giveaway prices.
Price 5/ £1.00 25/ 3.50 1000/ 10.45

Z1365 PC mounting 20mm fuseholder. Paxolin base.
Price 10/ 50p 100/ 3.05 1000/ 26.10



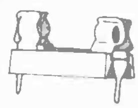
Z1693 Neat mains inlet filter plug and fuseholder (32mm combined by Corcom. Rated 6A 250V. Mounting hole 66 × 27mm.
Price **£3.00**

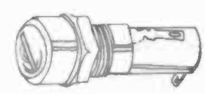




Z4217 20mm PC mounting, Paxolin.
Price **15/ £1.00** 100/ 4.35

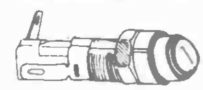
Z4218 20mm Chassis mounting.
Price **10/ £1.00** 100/ 6.95





Z4219 20mm PC mounting, plastic.
Price **12/ £1.00** 100/ 6.10

Z4220 20mm Panel, screwdriver. Slot 6.3A max.
Price **3/ £1.00** 100/ 21.75



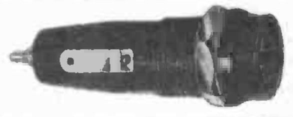
Z4221 20mm Panel, screwdriver. Slot 10A max.
Price **3/ £1.00** 100/ 21.75

Z4222 20mm Fuseclips, PC mounting.
Price .... **100/ £2.00** Box of 1000/ 14.80

Z1747 Fuse clip, RS412-784 (our F001).
Price .... **Pack of 100 £1.00**

Z1721 Fuseholder. Vertically mounting PCB model. Bulgin F456 rated 10A 250V for 20mm fuses. Screwdriver release. Farnell sell these at £1.09 each.
Our low price **3/ £1.00**

Z1753 Fuseholder, how cost 20mm PCB mounting. Farnell type. 148-476. Their price 13p.
Our price **12/ £1.00**



Z646 Belling Lee heavy duty fuseholder for 32mm fuses. Includes 3A fuse. Complete with rubber shroud. Screwdriver release. Rated 15A. Ex-equip.
Price .... **2/£1.00**

Z2343 Siemens 32A 550V standard fuse carrier **£1.00**

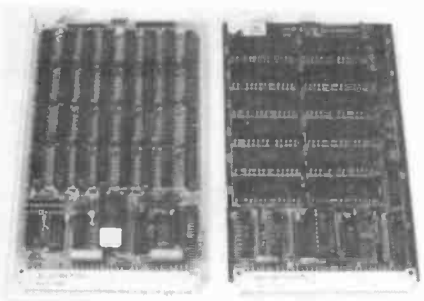
Z2134 Highland-Airpax circuit breaker rated 30A 250V. Size 51 × 42 × 19mm, screw terminals.
Price **£2.00**

Please Note:

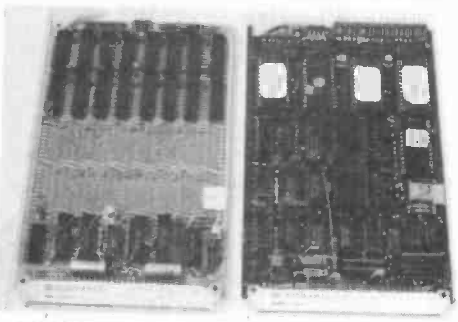
The Free Gifts offered in the Main Catalogue are not available with goods from Bargain Lists.

PANELS

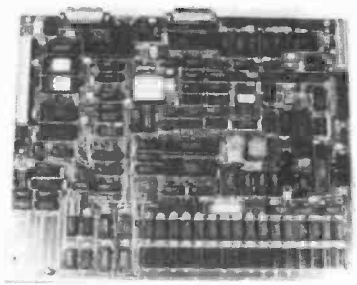
A collection of 4 panels, all Eurosize (160×100mm) with 64 way DIN plugs fitted.



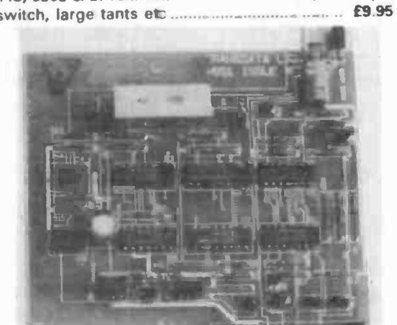
Z5089 32×TC5514AP-3 1k×4 STATIC RAM, plus few other chips etc.
Price **£3.00**
Z5090 12 × M5M5165P-15L 8k×8 STATIC RAM, plus few other chips etc.
Price **£4.00**
Z5091 8 × 2716 EPROM all in sockets and few other chips.
Price **£2.00**
Z5092 8 × HM3-6514-9 (1k×4?) RAM plus few other chips.
Price **£1.00**



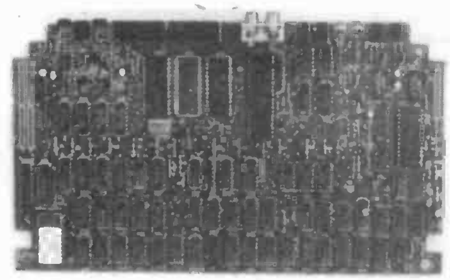
Z5100 16 × HM6167LP-8 + few other odd bits **£2.00**
Z5101 2 × M5M5165P-10C + few other chips **£1.50**
Z5102 Same as Z5091 but with EPROM chips removed.
Price **50p**
Z5114 This one has an 8085 microprocessor chip + 4×2732's all in sockets, also 20 or so other chips.
Price **£2.00**



Z4210 Panel 260×210 which could plug into the above board. Lots of memory on this one: 36×4116-20. Also 8085AC, 8202 & 2716 in skts + 55 other mainly LS chips, DIL switch, large tants etc £9.95

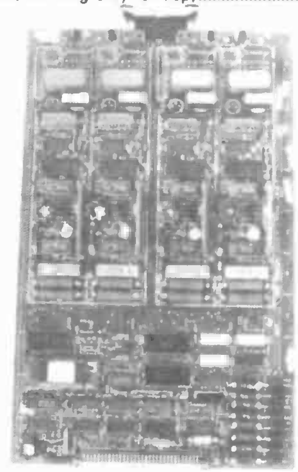


Z653 Control PCB, 140×115mm with 2×4013, 4020, 4011, 4081, 4071, E211, LM3909, SafC2.003TIP130, 5×2N3906, switch, C'S R's, LED etc. £1.50

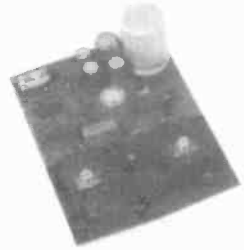


Z494 Newbrain Motherboard Microprocessor panel 265×155mm. Complete PCB for computer, Z80, EPROM, etc. 68 chips altogether + other associated components, plugs, sockets etc. Brand new in original packing.
Price **£5.00**

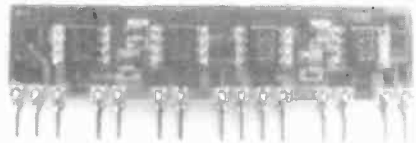
Z672 Newbrain motherboards. Complete but probably faulty £3.50
Z674 Newbrain data. Interfaces and connector pin out i/p, o/p, port map, cct diagram + data on CP420C. (This lot replaces cct diag only for 75p) £2.00



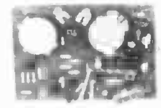
Z4052 PCB323×200mm packed with useful components. It's a 4 port exchange line unit with integral SPM. Each of the 4 pots has 2×6V BT relays, reed relay, BF258, 2N3440 + heatsink, D2911A-1 PCM codec, D2912 PCM line filter, + lots of other bits. The lower part of the panel has 22 chips inc 3×P8243 input/output expander, 3×ULN2003 and NS87P50D-6 microprocessor in socket. This chip is designed to take an EPROM piggy back and has a 2732 on it. Can be used as a prototyping aid for the INS8048/9/50 series. There's a 64 pin DIN plug, too. List price of chips alone is well over £300!!
Price of the complete board **£10.00**



Z469 AL30A amp. Panel 90×64mm. 10W RMS with 30V supply. Popular audio amp module, these are ex-equip, but believed to be working.
Price .... **Reduced to £1.50**



Z347 4×LM358 op amps surface mounted on a ceramic substrate. Easily removable. 5 panels (20 LM358). Supplied with circuit.
Price **£1.00**



1W Amplifier - mono

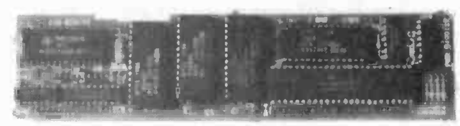
Z914 Audio amp panel 95×65mm with TBA820 chip. Gives 1W output with 9V supply. Switch and vol control. Just connect battery and speaker. Full details supplied.
Prices .... **Only £1.50** 25+ 0.80 100+ 0.60

1W Amplifier - Stereo

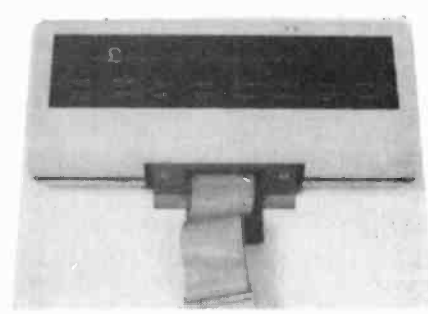
Z915 Stereo version of above 115×65mm, featuring 2×TBA820M and dual volume control.
Prices reduced to .... **£3.00** 25+ 1.80 100+ 1.20

Z1699 Mini inverter - This handy PCB 31×23mm uses a 2 transistor circuit to provide a 60V peak ac supply (20V dc @ 1mA) from a 3-7V dc input. Can be used to drive Z1637 LCD or for powering vacuum displays. Originally used in Newbrain computer.
Price 3/ £1.00

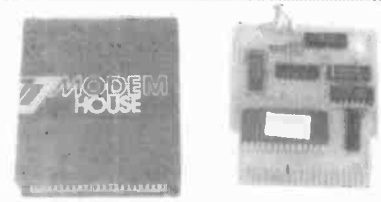
Z696 160×100 (Eurocard size) with 34 way IDC plug, LS245, LS125, LS04, LS74, LM324, and 40DIL skt with the SAA5070 viewdata peripheral IC missing £1.00



Z4254 68008 Panel - This is the old Z620 PCB from ICL's 'one per desk' but some of the chips are missing. All panels have the MC68008P8 in a socket, TMP5220, 74LS08, 38, HCT138, 245, but up to 3 of the other 4 socketed chips (pre-programmed ROMs) may be missing. Originally sold at £5.00
Price .... **Now reduced to £2.50**

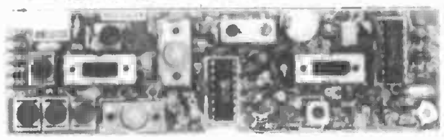


Z5093 Till display. Plastic housing 200x95x45mm contains PCB 195 x70mm with 8 7-seg HP LED'S type 5082-7651, red 0.43 CA,, 16.5mm red leds, 8255 programmable interface and other chips etc.
Price **£2.50**



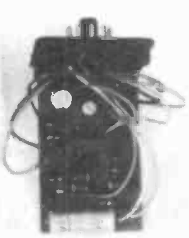
Z030 This add-on connects to the user port of the C64 and gives a serial output to a 5 way domino plug. Believed to be new and working. Components on the panel are 27256, 6502, 02, 174, 4049, 52, 60. Cased.
Price .... **Reduced to £3.95**
Z031 As above, but uncased now only **£2.95**

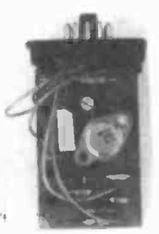
Z1642 Another model T200A serial/parallel. This uses several large chips, 3850, 3858 & 3871 & comes with 8 page booklet £3.00



Z910 391 × 39mm. This panel has soldered in components - TCA4500A and TBA651R. AM radio with IF amp. Probably complete RF section of radio, as IF's and trimmer are on board + R's, C's, etc.
Price **60p**

Z912 RF panel 103 × 39mm with a TDA 1200 FM/ IF chip and UPC1176C noise canceller + R's and C's including tants. Chips worth around £8.00
Price **60p**



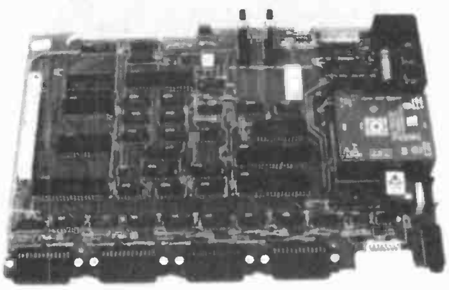


Z492 M Module. 11 pin in module in 80×50×50mm case. PCB within contains 5×BC184L, + T05 transistor, R's, C's etc. Useful housing for small projects 3/£1.00

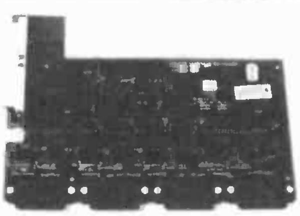
Z493 D Module. As above, but PCB has 3 × BC184L, BD124, Rs, Cs etc.
Price **£2.00**

MODEM PANELS.

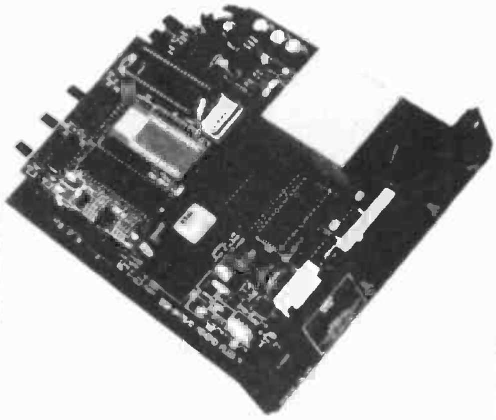
Another parcel of panels from Dowty. These are all believed to have come from discontinued units and as far as is known are not faulty. However, please note some have missing chips or boards cut to prevent re-use. They are therefore being sold for their component value only, not as working units.



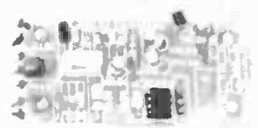
Z4320 Kilostream Multiplexer Panel 300 × 210mm with 4 × 25 way 'D' sockets, 15W 'D' socket Z84C42 × 3, Z84C30 × 2, CMOS Z80 CPU, 6264 RAM, 30 assorted CMOS/ TTL/ Linear chips and nice power supply comprising a potted transformer with mains input and 0-9V, 0-9V outputs both at 1A, 7812, 7915 and 7805 regs. Also Xtal, 64 way connector, switches etc. Now even better value.
Price .... **Reduced to £4.50**

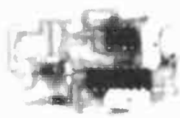


Z4321 Expander Panel for above. **230** × 170mm with 4 × 25 way 'D' sockets, 2 × Z84C42, Z84C30, 8 × 45406 + 7, 74 chips. Also short length of 64 way ribbon cable with IDC socket. This panel is complete.
Price .... **Reduced to £3.00**



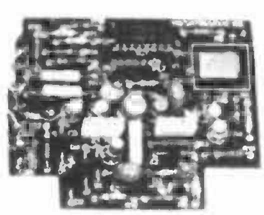
Z4323 Minimo Plus ^ Panel 180 × 158mm; secondary panel 90 × 85mm and front panel 165 × 43mm on which is mounted a 25 way 'D' type socket and a BT socket. On the large board is a mains transformer with (presumably) 2 outputs feeding LM317 and LM327 variable voltage regs, and 7805 on a small heatsink. Also 80C32 (in socket), 8256 UART 6264 RAM and several other chips. There are 3 switches, 5 LEDs, 2 relays, a speaker and the usual Ts, Rs and Cs. The smaller panel has M6951 and M85C154 'piggy back' chip and 4HCT chips, 18.432 Xtal module etc. An excellent selection of components.
Price .... **Reduced to £4.50**



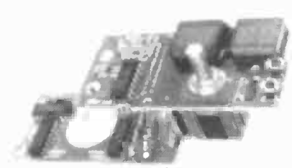


Z4319 Small panel 85 × 43mm with 555 timer, BS107 FET, BC109, 3 × BFW43, 47µF 35V tant + other Rs, Cs etc.
Price .... **3/ £1.00** 100 + 0.15

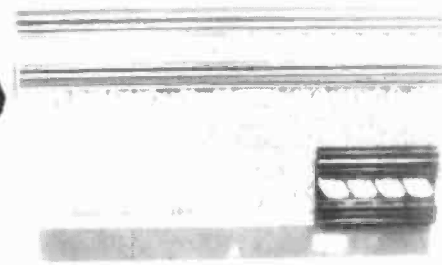
Z4313 PCB 57 × 39mm from seat belt alarm. Partially assembled, it contains a 4011 and 555, a dozen or so Rs, Cs and diodes. Supplied with circuit.
Price **3/ £1.00**



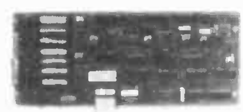
Z4318 Ex - BT tone divider PCB. Panel 84 × 69mm has on it 2559 tone divider chip, 3.579545 Xtal, 7 small signal transistors, tants, Rs, Cs, etc. Produces required tones for telephone system.
Price .... **£1.00** 100 + 0.30



Z4279 Interesting little panel (75mm × 40mm) with 16 position BCD channel switch (24 pins), 2 dual green 7-segment displays: 2 min keyboard switches, and a short A4093. Attached by a short length of ribbon cable is a second panel (same size) with 4518, 4019 and 2 × 5068 chips. Supplied with circuit.
Price .... **Only £2.20**

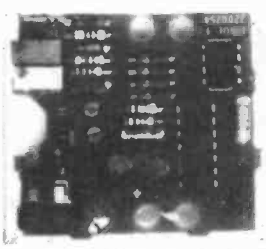


Z8883 Extremely large panel 510 × 335mm. Consists of 2 PCBs each 245 × 285mm joined together by an ally strip along one side and a finned heatsink 510 × 105mm along the other. This has mounted on it 12 assorted power transistors - 2N3055/ 3772/ 3789. Another smaller heatsink 152 × 105 × 24mm has 4 × 2N3055. There are 3 more 2N3055 on the PCB, also an assortment of chips, 30 transistors, wirewound Rs, Cs + 2 heavy duty 12V relays in sockets with 3 sets of changeover contacts rated 6A.
Price **£9.50**

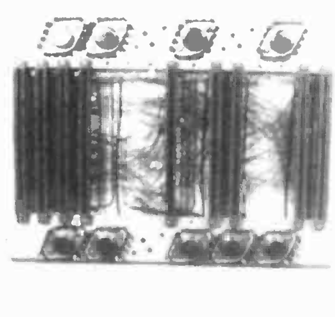


Z4293 Panel 225 × 95mm with a number of tuned circuits using small pot cores and close tolerance caps. Also on board is a 10 way DIL switch, 17 mostly LS chips and 7 × 741 in TO99 case.
Price £2.00

Z4294 Neat panel 213 × 37mm with 5 keyboard switches, 3 red LEDs and a DL1416 4 digit LED display with built in memory. There's half a metre of grey ribbon cable attached to a 34 way IDC socket.
Reduced to **£3.00**

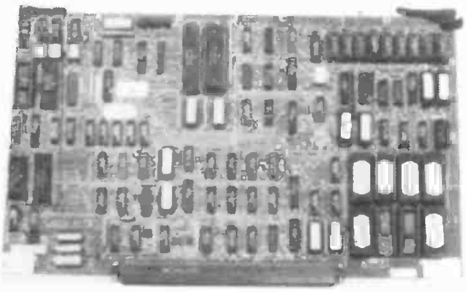


Z1794 Small PCB 45 × 47mm with 9402, OP07, 78L15, 2N3703, 2 trimpots Rs, Cs, etc.
Price **2/ £1.00**



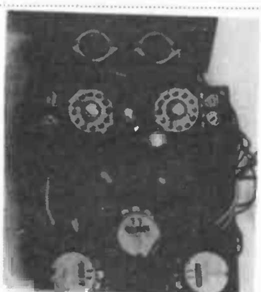
Z4296 Metal chassis 310 × 230 × 25mm with 9 × 50 way double sided 0.1 edge connectors + 9 × LM309k steel 5V 1.2A/ TO3 voltage regulators on small heatsinks.
Price **£10.00**

PANELS

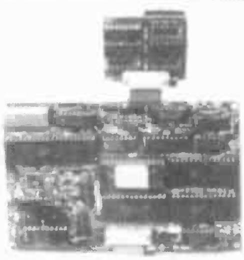


Z4235 Superb panel 340 × 200 packed with high quality parts, giving outstanding value for money! 6809 microprocessor in socket 6840, 6850, 6844 support chips; 6 × 27128-25 EPROMS in sockets; 9 × 8264A-10 RAMs; over 50 other chips, LS, linear etc.
Price .... **Reduced to £15.00**

Z4236 2 × 27C256-20 EPROMS that fit onto above board into 2 vacant sockets. Supplied in sealed plastic box.
Price **£3.00**

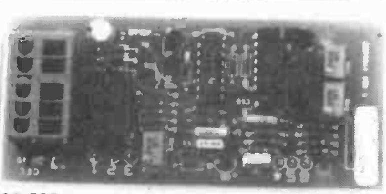


Z974 Mixer Amp Panel 115 × 115mm and gives 1W O/P from a TBA820M chip. There are 2 inputs, one via a pre-amp, from phono sockets and separate volume controls. A third pot is used to fade from one input to the other. There are also 2 4p 3w rotary switches. Attached to the PCB by flying leads is a panel on which are mounted the 2 input sockets, 2 × 5 pin DIN sockets and 2 pin DIN speaker socket. A data sheet is supplied.
Price .... **Only £2.50**



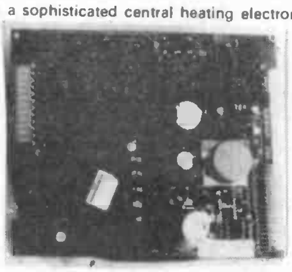
Z4295 Error Correction Card, made by Tulsedata Ltd. This 130 × 86mm board contains a 80C85A microprocessor; 82C51 × 3; 5864-15; 2764-15; +9 other chips; a 10 way DIL switch; Rs, Cs, etc. There's a 14 way ribbon cable to a small PCB with 2 × 1489. Originally cost over £70.00.
Our low price - now even lower **£5**

> ## Please Note:
> The Free Gifts offered in the Main Catalogue are not available with goods from Bargain Lists.



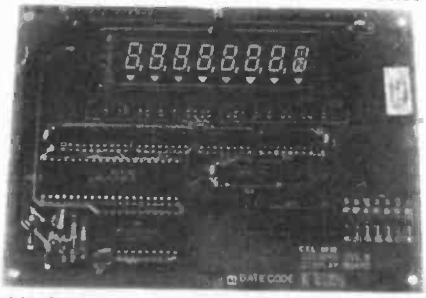
Z1795 PCB 110 × 50mm with 9400, LM339, 24V DIL relay, 2 × BC182L, BC212L, 3 trimpots, Rs, Cs, etc.
Price **£1.00**

Parts from a sophisticated central heating electronic timer;

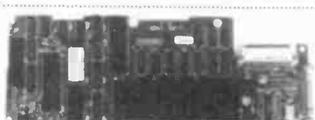


Z4240 Power supply PCB. Panel 154 × 128mm containing mains transformer Z4248; 5 relays Z1718; 4.8V 110mA back-up battery; 5 fuseholders Z1721; 4 way DIL switches; 2 × W005 bridges; SKB2/02 bridge; 8211; Rs, Cs; 7805 and 7824 on small heat sink.
Price **£7.00**

Z4241 Wiring Termination Board 148 × 114mm with 2 × 16 way termination blocks and a couple of header plugs.
Price **£1.00**



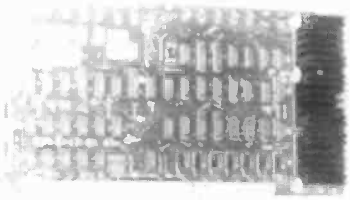
Z4243 Display panel 152 × 112mm with NEC 8 digit display (Z1731); 8279-5; MC146818; 3 × UPA80C; and a couple of LS chips, crystal, etc.
Price **£2.90**



Z4285 Complete CPU panel from LIBERATOR COMPUTER. 272 × 98mm containing D70008, 27C256 EPROM, 9 × D4364C-20L plus other chips, connectors etc.
Price .... **SOLD OUT**

Z4286 Partially assembled panel, as above. Contains 20 LS chips, D70008C; HN61364; TC5517BPL-20. None of these are soldered in.
Price **£5.00**

Z1815 Facilities Cartridge. Inside a plastic case 60 × 50 × 16 with a 48 way plug is a 27256 Eprom. Supplied boxed with instructions for use with Liberator.
Price **£2.00**



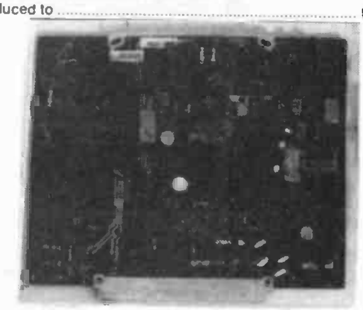
Z4300 Nice panel 330 × 170mm with 3 chunky heatsinks 47 × 36 × 32mm, each with TO220 voltage reg. Also 56 × 74 series ICs including L+LS. 3 × 40W IDC plugs, few tants etc. Attached to the board are 2 × 0.5m long twisted and flat ribbon cables terminated in 50 way IDC sockets.
Price **£4.00**

Z4297 Panel 95 × 57mm with 2 × 18 way D/S 0.156 inch edge connectors plus 34 way IDC plug.
Price **£1.00**

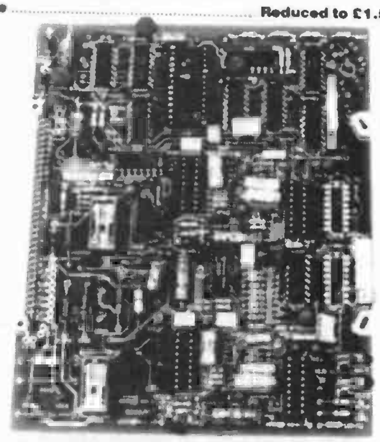
Z4298 Panel 95 × 57mm with 18 way D/S 0.156 inch edge connections plus 50 way IDC plug. Also 8 way DIL switch.
Price **£1.00**

Z4325 A few more Newbrain panels have become available. This one is a Motherboard only partly populated. Z80/ROMs/EPROMs are missing, but all the other 60 chips are in place not soldered, so removal is simple. Nearly all are LS - but there's also a couple of CM358 and MC1488/9. How can you go wrong at 6p a chip?
Price **£3.60**

Z4337 Display Panel. Comprises PCB 153 × 50mm with LS259 and 2 × 6118, also DC-DC PSU. This is the driver circuit for the 5 digit gas discharge display which is mounted on a panel 172 × 54mm at right angles to the board. Believed to be from petrol pumps.
Reduced to **£3.00**



Z631 PCB 170 × 135mm with 2 × LM324; 2 × ILQ74; 2 × MC14416; 4519; 2 × 4510; 2 × 4099; 4001; 4584; 2 × 741; HC14 LS05; 74125; 2 relays, Rs, Cs, etc.
Price .... **Reduced to £1.50**

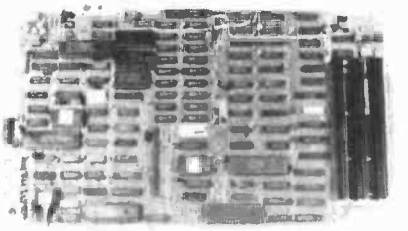


Z629 Occasionally we obtain repeat supplies of panels - this one was featured on B/L 30, and is 170 × 35 with 2 × MC3419 loop interface 4510, LS505, LS514, 4584 all in sockets, also LM324, 4519, 2 × 4099, 4013 plus 2 × 4.5V DPCO BT type relays. Also 64 way DIN plug, 2 bridge rects, 6 transistors, Rs, Cs, etc.
Price .... **Reduced to £1.00** 100+ 0.60

Z925 DPCO 12V 185R relay, 12V DPCO relay with heavy duty contacts, SC146D 400V12A triac, 555 timer, 11 × 1N4001, 2N5061 SCR, 3 × 2N37043, Rs, Cs, etc.
Price **£1.90**

Z926 Similar to above, but instead of heavy duty relay, a T2800D 400V 12A triac and C122O 400V 12A SCR. Both boards 100×75mm **£1.85**

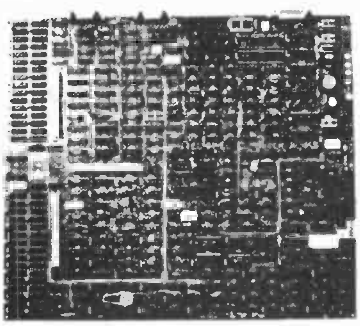
Z927 2×6V reed relays by Alma, 6×2S3230, R's and diodes .... **Only 60p**



HIGH QUALITY ICL COMPUTER PANELS – 2 types, the first a mother board and the second a panel which plugs into the first.

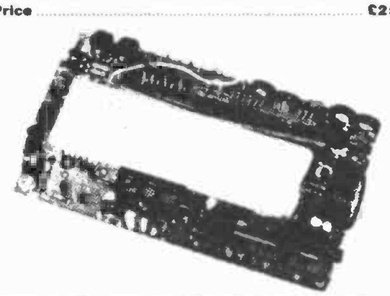
Z4209 Panel 360×210mm covered in high quality chips: 8085AHC, 8255, 8257, 8251A×2, 8253 -5, 8275, 8202A, 2732, 2716, all in sockets; 18×4116-2 + other mainly LS chips + min switches, LED's, oscillator, large tants, 3x50 way double sided edge connectors. Amazing value at only £16.95
Reduced to £9.95

Z4210 Panel 260×210 which could plug into the above board. Lots of memory on this one: 36×4116-20. Also 8085AC, 8202 and 2716 in sockets + 55 other mainly LS chips, DIL switch, large tants etc.
Reduced to £5.95



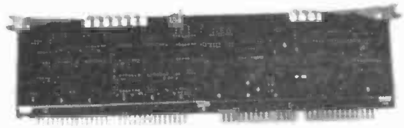
½MEG MEMORY BOARD

Z8900 Massive panel 460×400mm smothered in chips. Could be a complete computer judging by the IC's on the board. Made by Whitechapel Computer Works. Contains at least the following (some panels have extra chips):
64×4164-15 RAM's; over 200 74LS, F and other logic chips; 3×4016-3, 2×8253-5,8251, 2×5516, 6 xtals, 3×'D' Plugs and sockets, 3×DIN 64 way socket, + R's, C's etc. Price equivalent to 4164's @ 30p each and rest of chips @ 3p each!
Price £25.00

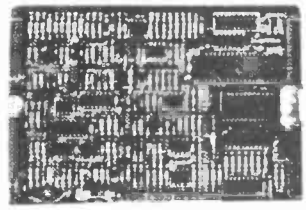


Z559 MICROVISION PANELS

Incomplete panels from the famous SINCLAIR MICROVISION. The 135×75mm panel is packed with useful components; 9 transistors, multiturn preset, 6 single turn cermets, 22mm dia mylar film speaker, power socket, headphone socket, R's, C's and diodes. Supplied with circuit too! These were £1 each - now reduced to
3 for £1.00 **12 for £3** **50 for £10**

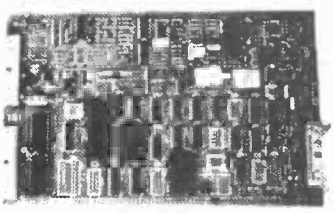


Z4368 Panel 310×90mm with 20 CMOS chips, 3×MC1488, 2×MC1489, 6×C251 opto isolators and a 64 pin chip MB60504.
Reduced to £2.00

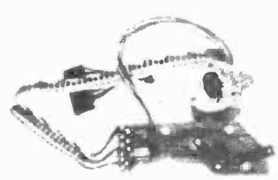


Controller Boards

PCB 175×122mm containing a wealth of components - 80C39 CPU, 4×TL066, TL094, CMOS and 74 series chips, 8×TO126 transistors, 13 TO92 transistors and lots of R's and C's etc - also a 3V lithium battery. 3 connectors on it go to (a) card reader (b) motor panel & (c) display panel which is identical to our Z027 (P111 of Catalogue).
Order Code **Z5047**
Reduced to .... £2.00 100+ 1.00



Z5048 Panel 275×178mm containing some excellent components: 2×D8243 I/O expander, 8035 CPU, 8253 timer, 2651 USART all in sockets, 2×2111A-4 RAM, 25 mostly CMOS chips, 8×TO126 transistors, 5×TO92 transistors, R's, C's etc; 26W IDC plug, 2×34W IDC plugs, 2 xtals.
Only £3.00

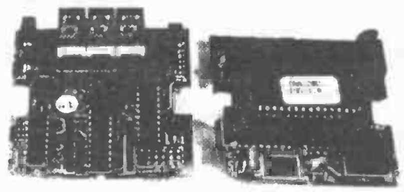


Motor Panels

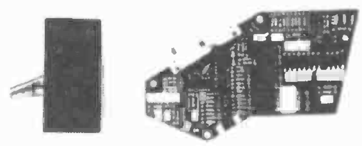
PCB 92×31mm with mercury tilt switch, 2 VTL 10D2 opto slotted switches, length of 11 core cable with socket and stepper motor as described above.
Order Code **Z5046**
Prices .... £3.50 100+ 2.20

If you like what you see in this supplement make sure you don't miss future bargains - only £2 (UK/ BFPO; £4 O'seas) for the next 6 issues - see order form for details.

Panels



Z5044 Neat display panel comprising 2 boards, each 66×63mm held together by 4W, 6W and 18W plugs and sockets. Top panel has 3×7 seg 0.3" amber displays MAN4610A in sockets, 2× HC374, HC368, 3×BC184 + R's, C's etc. Lower panel has 27C64 in socket, HD63B03, HC138, HC373, R's, C's etc.
Excellent value at £2.50



Z1436 Control panel from sheet feeder. 90×45mm. PCB fitted with 4 illuminated push switches (all with yellow LED), and separate green LED.
Price £2.00

Z4090 PCB overall 170×105mm from sheet feeder. Contains drive circuits for stepper motors - 4×TIP110, 4×TIP115, LM3302, 7407×2, MPSA×4, Rs, Cs, Diodes, etc. IDC 34W plug.
Price £2.00

Z5075 Interesting panel 155×80mm crammed with top quality components: SAB80C535 CMOS microcontroller for external RAM in socket (DP £10.95); 27CP128 EPROM in socket; 5×LM339 + other chips, SIL resistors, DIL switch, IDC plugs and 5×24V relays with DPCO contacts
Price £4.50

Z5163 PCB 140×120 with some nice bits - 0-15, 0-15, 0.2A mains transformer BFX85×2, BC107×2, TL084, LM339, 4081, VN10KM, 7815 + lots of C's, R's etc.
Price £2.00

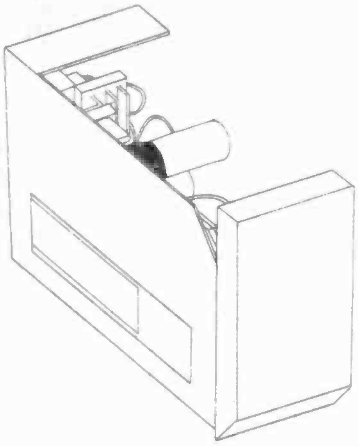
Z5168 Superb panel 340×130mm with 2 large finned heatsinks 130×100×31mm, each with 2×BUZ25 high power MOSFETS. Also a couple of small FET's, W/ W R's C's etc, including 4700µ 100V.
Price £12.00

The 1992 GREENWELD Catalogue is out now! 132 pages of electronic and modellers supplies.

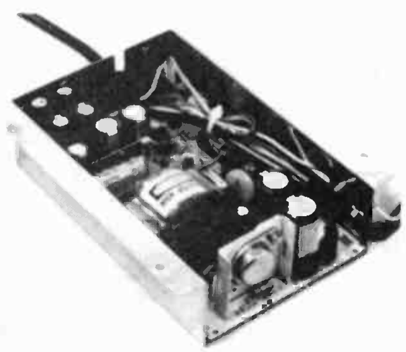
Only £2 (UK/ BFPO; £4 O'seas)

ORDER NOW!
See order form for details

SWITCH MODE POWER SUPPLIES



Z8921 Apricot PSU - beautiful unit 160 × 110 × 55mm with IEC switched mains inlet. Made by Astec, Model BM43024. 120/ 240V input. Outputs: +5V@2.5A; +12V@2A.
Price **£12.95**



We still have good supplies of yet another Astec model. This one is partially cased, the overall size being 160 × 104 × 45mm. The PCB measures 160 × 100mm. Input and Outputs are on flying leads, all colour coded. There is also an additional IEC socket to extend mains to another unit.

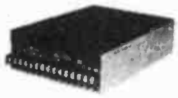
Specification:

Model Number	**AA12531**
Input	115/ 230V, 50/ 60Hz
Outputs	+5V 5A
	+12V 0.15A
Total Wattage	50W
Price **£6.95**	25+ 5.43 100+ 4.53

HAVE YOU PURCHASED AN AA12531 SWITCH MODE PSU?

If so, we have a conversion kit to change the output to the same as the AC8151 **plus** an additional output!! (+5V 2.5A; +12V 2A; -12V 0.1A; and -5V 550mA). The PCB on both these PSU's is identical - by changing a few components and adding a few more, the above outputs can be achieved.

Complete kit of parts and full instructions **(K725)** **£3.50**
Instructions only **(K726)** **£1.00**

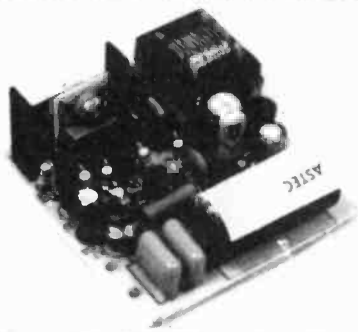


Z60536 Weir SMM 30/ 12. 30 watt cased unit 174 × 100 × 51mm with three outputs: 5V@3A; +12V@0.6A; -12V@0.6A. List price £87.40
Our price **£20.00**

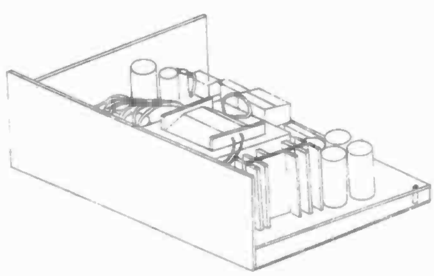
Z06544 Weir SHS100/ 5. 100 watt cased unit 210 × 115 × 60mm. Believed to be 5V@20A output. List over £120
Our price **£20.00**

Z06521 Weir SMM 100/ 12. 100 watt cased unit 260 × 152 × 55mm. Outputs: 5V@10A; +12V@2A; -12V@2A. List price £143.17
Our price **£30.00**

Z06543 Advance P500/ 225FC 600 watt cased fan cooled unit. Outputs 5V 60A; +12V 7A; +12V 7A; -12V 7A; -5V 7A. List over £500.
Our price **£75.00**



Z660 Astec switched mode PSU type AA7271. This small PCB, just 50 × 50mm will accept 8-24V input and give a stable 5V dc at up to 2A output. The 6 transistor circuit provides current overload protection, thermal cut-out and excellent filtering. Offered at a remarkably low price.
Price **£5.00**



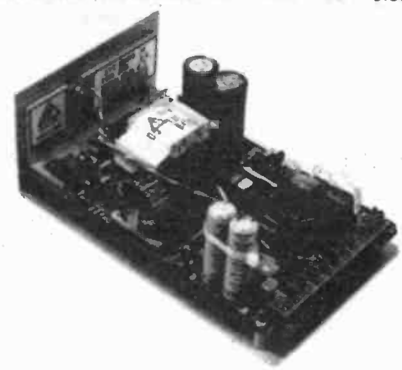
Z8923 Intelligence SM060 80 Watt unit 180 × 110 × 57mm.120/ 240V input, and unusually 4 outputs: (Max rating per output quoted - total load must not exceed 80W): +5V@6A; +12V@2A; +25V@3A; -12V@500mA.
Price **£22.95**

Over the years, we've had many different switch mode power supplies, but this latest unit is without doubt one of the finest we've ever seen! Made by Astec, it is a totally enclosed steel cased unit measuring 175 × 136 × 65mm, which has incorporated in it a switched and fused IEC mains inlet. Inside, the PCB is 160 × 80mm with output pins fitted on one end. A connector to these pins to extend the outputs to the exterior of the case is provided.

Specification:

Model Number:	**BM41012**
Input:	115/ 230V, 50/ 60Hz
Outputs:	+5V 3.75A
	+12V 1.5A
	−12V 0.4A
Total Wattage:	65W
Prices **£14.95**	25+ 11.70 100+ 9.75

Z8890 DC-DC CONVERTER BOARD
These panels 220 × 195 require 50V DC input for 5V 19.5A output. Inputs and outputs on DIN41612 connector. These brand new panels made by STZ are now being offered at just:
Prices .... **£7.95** 25+ 5.20 100+ 3.89



Z8887 Made by STC, this 160 × 100mm panel is attached to an aluminium chassis. 165 × 102 × 65mm and has a single 5V 6A output. Supplied with connection details, we can offer these at a fraction of their normal cost!
Price .... **£5.95** 10+ 4.30 100+ 3.43

Z8888 A larger version of the above, PCB 220 × 100mm and chassis 225 × 102 × 65mm providing a single 5V 10A output. Supplied with connection details.
Price .... **Only £8.95** 10+ 6.50 100+ 5.20

*ALL PRICES IN **BOLD** TYPE INCLUDE VAT: PRICES IN LIGHT DO NOT*

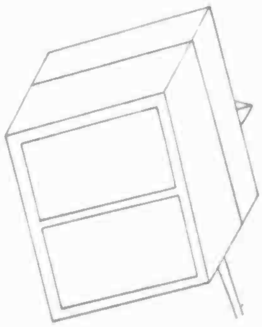
Two 5 watt regulators PCB mounting, DC-DC converters. These are encapsulated in a 51x51x10mm package with output pins on 0.1 pitch. These are ex-equip but guaranteed. DP £59.75.

Z1893 Input 48V (43-52V), output 5V 1A.

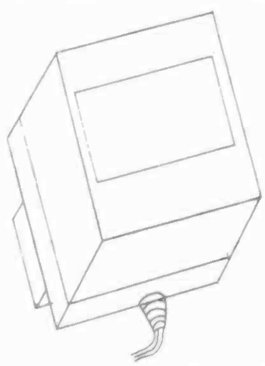
Price .... **£2.50** 100+ 1.00

Z1894 Input 48V (43-52V), output 12V 420mA.

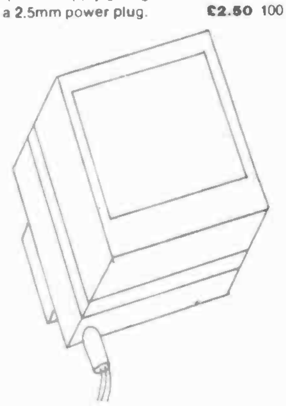
Price .... **£2.50** 100+ 1.00



Z5133 'Touchmaster' PSU. 2 pin plug in wall type with 2.5mm power socket. Output 6V 300mA DC. **Price £1.50**



Z5143 Plug in power supply giving 7.5V 600mA on the end of a 2m lead with a 2.5mm power plug. **£2.50** 100+ 1.80



Z5135 Nicad charger; plug in the wall type power supply with a 5.3V 140mA output, ideal for charging 4 × AA cells. Output is on a 1.8m long lead terminated in a 3.5mm plug.

Only **£2.50**

Z5027 PSU by Micropad. Nice solid steel case 200 × 110 × 52mm with a lead from either end; one 3m long terminated in a 3pin DIN plug, the other a mains lead 1m long. Inside, a 30VA torroidal transformer with 2 × 12V secondaries. These are fed into some regulation circuitry giving 21V @ 25W output. Limited quantity.

Price **£7.50**

Small quantity of Gardners NV22 series DC-DC converters. All are 90 × 63 × 30mm and have terminating pins on the base, for PC mounting. All have inhibit and oscillator output pins. Normally costing £70+, these are exceptionally cheap to clear. Few only.

Z1585 24V dc input, output 5V. 3A

Price £8.00

Z1792 6V 400mA PSU with moulded on European 2 pin plug. Mains input. Output lead 1.5m long fitted with 2.5mm power socket.

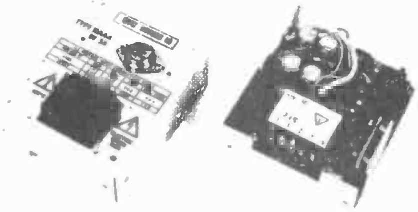
Price £2.00

Z4215 Siliconix mains input, 4.5V DC 150mA output to 3.5mm jack plug on 2m lead. Built-in continental 2-pin plug. Size 62×46×35mm **£1.50**

MW88 This popular versatile plug in power supply which gives 3, 4½, 6, 7½, 9, or 12V at 300mA, is available as a wholesalers return. They have been tested to ensure the transformer is OK, but there may be minor faults on the switch/plug/skt. Complete with spider lead. Normally £3.95.

Price .... **Only £2.00**

Also available untested in bulk **25/ 26.10** 100/ 87.00



STC POWER SUPPLIES

These are extremely well made linear power supplies by STC (series 15) offering exceptional value for money. Chassis size 124 × 100 × 41mm. Input voltage can be 100, 120, 220, 230, 240V. There is over-voltage protection on both models.

Z8898 Type 15AAA. Output 5V @ 3A. STC price in 1987 £43.99.

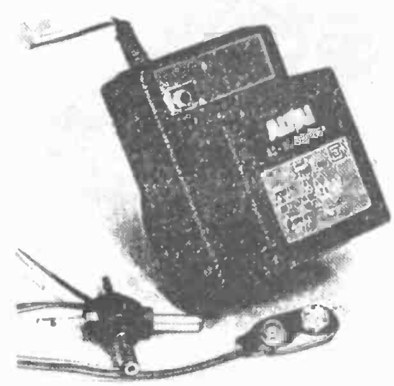
Our Price **£8.00**

Z8915 Type 15AAC. Output ± 15 V 0.5A. STC price in 1987 was £60.38.

Our price **£10.00**

Z975 PSU - Mains input via 13A built in plug. Output 14V 600mA AC. Case 00 × 00 × 00.

Price **£3.50**



Cancelled Power Supply Order

One of our ex-customers ordered 1000 of these 12V PSU's then decided they didn't want them - so their loss is your gain!

P007K 13A 3 pin plug-in model with reversing switch and output spider lead fitted. 12V 500mA unregulated output. Protection by thermal fuse. Normally sells for around £3.50

Offer Price .... **£2.00** 100+ £1.50

MODEL RAILWAY CONTROL & SWITCHING UNIT

This ready built versatile piece of equipment allows:

- ★ Full forward and reverse control of trains using regulated and smoothed supply (1.5A)*
  *Requires 3 components (supplied) to be soldered into panel.
- ★ Relay control of 5 separate circuits. (10A change over contacts; ideal for points operation).
- ★ Powering of auxiliary equipment - 2 separate 5V 1A outputs.

A mains powered panel 185 × 105mm contains all electronics. All voltages are fully stablilized and both input and output are fused.

Connections, both input and output are by screw terminals which are clipped onto the on-board pins.

The five 12V relays are controlled by transistor circuits which require only 5V 30mA supplied by the on board power supply.

Supplied uncased with circuit and wiring diagram. (SAE for free copy.)

Suitable black ABS plastic case **£3.50**

Order Code Z8897 **Price Reduced to £14.95**

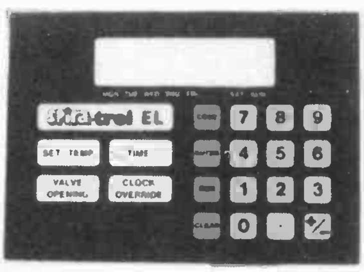
KEYBOARDS

Z8848 Keyboard by Cherry. Room for 104 keys, all normal keys (65) fitted. Chips on board: LS373 × 2, LS374, LM3086 × 2, LS138 × 3, 555, LS08, 6805. Size 442 × 175mm.
.... **£12.00**

Z8852 Keyboard: Superb brand new keyboard 392×181 with LCD displaying 1 line of 10 characters and a further line with various symbols. 100 keys, inc separate numeric keypad. Chips on board are 2×74HCO5, 80C48. LCD + driver chips are easily re-movable from board. Looks like it was used with a comms package.
Price **£10.00**

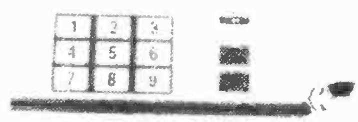
Z8863 Keyboard. High quality unit made by Micro Switch. 69 pale grey and blue keys. 6 red 5mm LED's, 15 various LS chips and socketed D8048 by Intel. Output via 7 way plug and there's a 4 way edge connector too. Keyboard frame is 317 × 128mm. PCB on which it's mounted is 285 × 170mm.
Price .... **Excellent value at £12.00**

Z8842 Tatung VT4100 keyboard. Cased 85 key units with separate numeric keypad. With circuit. Has 2 or 3 broken key tops. 450 × 65 × 125mm.
Price **£9.95**

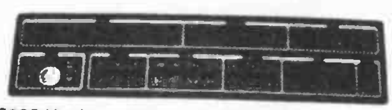


Z1797 Membrane keyboard 155 × 113mm with 80 × 22m aperture for display from case Z4245. 22 keys. Output to 11 way flexible connector. Self adhesive.
Price .... **Only £1.00**

Z4354 Computagraph Colorwriter panel 352 × 67 × 12mm. Ally frame supports a membrane keyboard which has 22keys. On the rear of the panel are 6 yellow submin LED's, a 3mm red LED and 2 × 19W edge conns.
Price **£1.00**



Z4363 Membrane keyboard 225 × 84mm with 11 keys - 1-9 & 2 others. Output (common bus) on 12 way ribbon cable. Could be cut down to 95 × 70mm if only 1-9 needed.
Price .... **60p** 100+ 0.30



Z5026 Membrane keypad. Essentially a PCB 365 × 92mm. Used as a front panel. 30 keys connected to a 16 pin plug. Cut outs for 2 displays (80 × 22mm) and 10 lamps/LED's (13 × 8mm).
Price **£2.00**

Z8882 Keyboard from Liberator Computer. 278 × 124mm. 62 keys. Some of these have been used. Output to 20 way connector.
Price **£5.00**

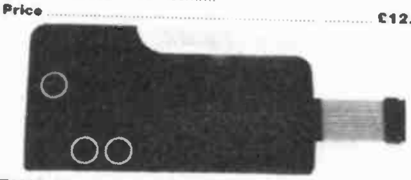
KEYPADS

Neat keypads in various styles by ORCOM, both with encoded and matrix outputs. All PCB's have room for coder chip (74C922) to be fitted. All feature 0-9 keys and other characters as shown. Output via 20 pin plug. Data supplied.

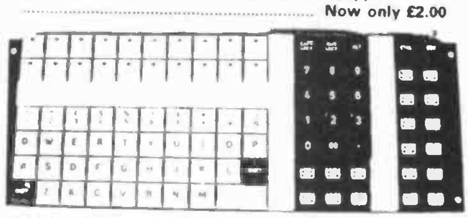
(a) No chip fitted:
Z5107 3 × 4 (★ #) **£2.00**
Z5108 4 × 4 (A-F) **£2.50**
Z5109 4 × 5 (A-F, F1-F4) **£3.00**
(b) 74C922 fitted:
Z5110 3 × 4 (★ #) **£2.50**
Z5111 4 × 4 (A-F) **£3.00**

ASCII KEYBOARDS

Z8933 5 1 key QWERTY keyboard by McMurdo Orcom with 6 bit ASCII encoded parallel output. Measuring 240 × 115mm makes it ideal for rack mounting applications. With control, shift and shift lock keys this keyboard can generate all 128 standard ASCII codes.
The keyboard requires a +12V and +5V power supply connected via a 20 way header type plug. The remaining connections on the plug are DSR, DTR and STR, the strobe and data set ready are switchable to be negative or positive going pulses. The controlling IC is a General Instrument AY-5-3600-PRO chip.
Price **£8.50**
Z8934 As above but supplied in a vacuum formed grey plastic case 280 × 185 × 60mm.
Price **£12.00**

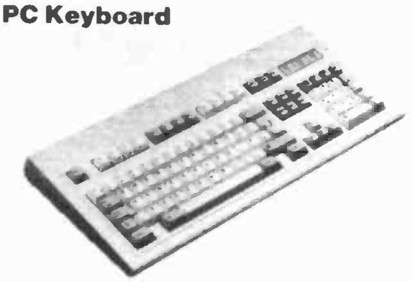


Z4116 24 way (8×3) membrane keypad. Large (200×90mm) area – these were originally used as a teaching aid. Overlay template and pinout supplied.
.... **Now only £2.00**



Z8922 Made by Devlin, this keyboard has 94 keys (18 without caps; 20 with removable tops) and runs off a single 5V supply. Serial ASCII output + switch to emulate AT and XT keyboards.
Price **£12.00**

PC Keyboard



Z8946 Standard 102 key keyboard made by Cherry with 5pin DIN connector to plug straight into your PC! (switchable between MF/AT/XT) - Oh yes, nearly forgot - the keys have a Russian character set (in addition to English) so you can practice a bit of peristroika!
Only £20.00

Please Note:

The Free Gifts offered in the Main Catalogue are not available with goods from Bargain Lists.

ALL PRICES IN BOLD TYPE INCLUDE VAT: PRICES IN LIGHT DO NOT

Interesting Parcel of Diplohmatic Cermet Trimmers

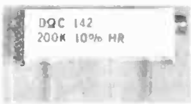
This is a high quality product from Denmark, at about ¼ the original price. It originated from a distributor who went into liquidation last year. A full colour brochure is available on request. We have about 32,000 pieces.

Multiturn


Type 141
Power Rating .... 0.5W@ 40°C
Tolerance 10%
Max Temp .... 100°C
Mech Travel 20x
Dimensions .... 19 × 6.35 × 4.9
Values available:

10R	250R	10k	250k
20R	500R	20k	500k
25R	1k	25k	1M
50R	2k	50k	2M
100R	2k5	100k	
200R	5k	200k	

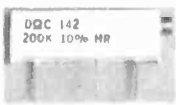
Order as **141 + value**
Prices (any mix) .... **1 + 29p** 100 + 0.14



Type 142
Power Rating .... 0.5W@ 70°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel 20x
Dimensions .... 19 × 6.35 × 4.9
Values available:

50R	1k	20k	1M
100R	2k	50k	
200R	5k	100k	

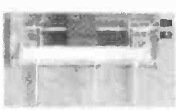
Order as **142 + value**
Prices (any mix) .... **1 + 29p** 100 + 0.14



Type 151
Power Rating .... 0.5W@ 40°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel 20x
Dimensions .... 19 × 6.35 × 4.9
Values available:

10R	1k	20k	200k
20R	2k5	25k	500k
50R	5k	50k	1M
500R	10k	100k	2M

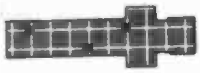
Order as **151 + value**
Prices (any mix) .... **1 + 32p** 100 + 0.16




Type 152
Power Rating .... 0.5W@ 40°C
Tolerance 10%
Max Temp .... 100°C
Mech Travel 20x
Dimensions .... 19 × 6.35 × 4.9
Values available:

20R	1k	20k	100k
100R	2k	50k	

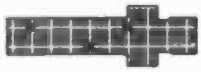
Order as **152 + value**
Prices (any mix) .... **1 + 32p** 100 + 0.16

Type 144
Power Rating .... 0.5W@ 40°C
Tolerance 10%
Max Temp .... 100°C
Mech Travel 20x
Dimensions .... 19 × 6.35 × 4.9
Values available:

50R	2k	20k	200k
100R	2k5	25k	500k
200R	5k	50k	1M
1k	10k	100k	2M

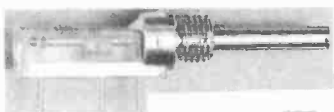
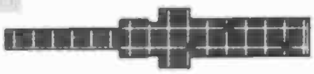
Order as **144 + value**
Prices (any mix) .... **1 + 50p** 100 + 0.25



Type 154
Power Rating .... 0.5W@ 70°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel 20x
Dimensions .... 19 × 8 × 4.9
Values available:

10R	500R	10k	250k
50R	1k	20k	500k
100R	2k	25k	1M
200R	2k5	50k	
250R	5k	100k	

Order as **154 + value**
Prices (any mix) .... **1 + 52p** 100 + 0.26

Type 146
Power Rating .... 0.5W@ 40°C
Tolerance 10%
Max Temp .... 100°C
Mech Travel 20x
Dimensions .... 19 × 6.35 × 4.9
Values available:

50R	1k	25k	1M
100R	2k	50k	2M
200R	2k5	200k	
250R	5k	250k	
500R	10k	500k	

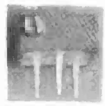
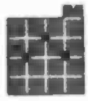
Order as **146 + value**
Prices (any mix) .... **1 + 52p** 100 + 0.26


Type 381
Power Rating .... 0.5W@ 70°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel 20x
Dimensions .... 10 × 10 × 5
Values available:

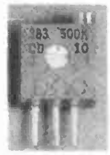
50R	1k	20k	1M
100R	2k	50k	2M
200R	5k	100k	
500R	10k	500k	

Order as **381 + value**
Prices (any mix) .... **1 + 44p** 100 + 0.22

DΩC

Type 382
Power Rating .... 0.5W@ 70°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel 20x
Dimensions .... 10 × 5 × 10
Values available: 10k
Order as **382 + value**
Prices (any mix) .... **1 + 44p** 100 + 0.22

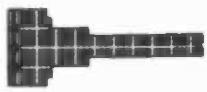



Type 383
Power Rating .... 0.5W@ 70°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel 20x
Dimensions .... 10 × 10 × 5
Values available:

50R	1k	10k	100k
100R	2k	20k	200k
500R	5k	50k	500k

Order as **381 + value**
Prices (any mix) .... **1 + 44p** 100 + 0.22

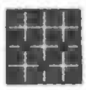
Single Turn

Type 341
Power Rating .... 0.5W@ 70°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel .... 270°
Dimensions .... 10 × 10.6 × 5
Values available:

2k	5k	10k	2M

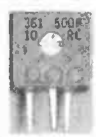
Order as **341 + value**
Prices (any mix) .... **1 + 50p** 100 + 0.25

Type 351
Power Rating .... 0.5W@ 70°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel .... 270°
Dimensions .... 10 × 5 × 10
Values available:

1k	2k5	50k	100k

Order as **351 + value**
Prices (any mix) .... **1 + 29p** 100 + 0.14




Type 361
Power Rating .... 0.5W@ 70°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel .... 270°
Dimensions .... 10 × 10 × 5
Values available:

100R	1k	10k	50k

Order as **361 + value**
Prices (any mix) .... **1 + 29p** 100 + 0.14

Type 362
Power Rating .... 0.5W@ 70°C
Tolerance 10%
Max Temp .... 125°C
Mech Travel .... 270°
Dimensions .... 10 × 5 × 10
Values available:

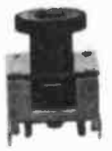
100R	10k

Order as **362 + value**
Prices (any mix) .... **1 + 44p** 100 + 0.22

RESISTORS

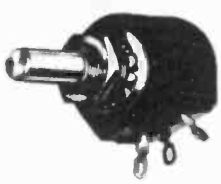

0.1W PRESETS - all Horizontal mounting

Code	Value	Mnfr	Type	25	100	1000
Z1575	470R	Piher	Carbon	£1.50	£4.00	£30.00
Z1577	1k	Piher	Carbon	£1.50	£4.00	£30.00
Z1578	1k	Bourn VAO5	Cermet	£4.00	£12.00	£90.00
Z1579	4k7	Bourn VAO5	Cermet	£4.00	£12.00	£90.00
Z1580	4k7	Piher	Carbon	£1.50	£4.00	£30.00
Z1581	10k	Bourn VAO5	Cermet	£4.00	£12.00	£90.00
Z1584	220k	Bourn VAO5	Cermet	£4.00	£12.00	
Z1574	2M7	Piher	Carbon	£1.50	£4.00	£30.00

Z1398 Cermet open preset, horizontal mounting. 2k5
Prices **10/ £1.00** 100/ 6.10
Convergence pots-preset wirewound pots rated 1W.
Z756 5R .... **Pack of 10/ 60p**
Z755 1k .... **Pack of 10/ 60p**
Z1535 Convergence type pot, with knob. Value 1k.
Price .... **Pack of 6/ £1.00**

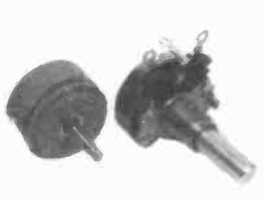
Wirewound Pots



We are overstocked on many values of 1W wirewound pots, as shown on page 62 of our catalogue. All the following values are available, whilst excess stocks last.
Prices .... **60p each** 10/ 4.35 25/ 9.55 100/ 30.45
Z320 10R, 12R, 50R, 100R, 2k, 2k5, 5k, 10k, 20k, 25k, 50k.

Z531 Colvern 4W wirewound pots all with 1¼" spindles. Type 4001/22. Available in the following values: 10R, 250R, 500R, 2k, 5k, 10k, 20k.
All at a fraction of the normal price (around £3 each).
Prices .... **Only 80p each**
Any 10/ 5.20 25/ 11.30 100/ 34.80
Prices ... **Only 80p ea** Any 10/ 5.20 25/ 11.30 100/ 34.80

Pots



Z1388 Precision 360° pot Spectrol 157 series. 22mm dia spindle 13mm long, 3mm dia. 10k + 2%. List price over £18.00.
Our price **£4.00**
Z1363 50R wirewound pot. Ideal for speaker volume controls etc. Rated 2W. 0.25" spindle 15mm long.
Prices .... 25p 25+ 0.16 Box of 200/ 21.75

Z1728 Spectrol multiturn pot, 10K. Rated 1W. 25mm long body. Adjusting spindle can be accessed from either end.
Price **2/ £1.00**

Z716 5 gang pot, all 22k long. Strange one this - inner shaft operates switch and one gang, and when pushed in operates another 2 gangs. Outer shaft operates rest. PC mounting. Dia 18mm, body length 40mm.
Price **4/ £1.00** 25/ 3.50 100/ 8.70 1000/ 52.20

Z577 5k edgewise pot with switch, no knob.
Prices **10/ £1.00** 25/ 1.75 100/ 4.35

Sliders

Z040 Piher 40mm sliders. Overall size 69 × 16 × 9mm. Value 220R.
Price **35/ £1.30**

Wirewound Resistors

Z2098 Very low resistance 2½W WW R's, 0R04.
Price for pack of 6 .... **£1.00**
Z2099 As above, but 0R068.
Price for pack of 6 .... **£1.00**

Z19105 High wattage (100W?) wirewound resistor on mounting bracket. 3R 10%.
Price **£2.00**

Wirewound 11W CGS C14 vitreous enamel low value Rs:
Z1877 OR1 .... **6/ £1.00** 100/ 10.50
Z1878 OR27 .... **6/ £1.00** 100/ 10.50

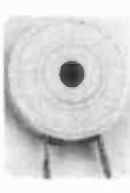
Precision Resistors by Holsworthy

Z1469 H2 5MO 1% 25ppm .... **£1.00 each**
Z1468 H2 10K 0.1% 25ppm .... **3 for £1.00**

Z1739 0.1% precision metal film by Holco, type H2 0.5W in 1M.
Price **4/ £1.00**

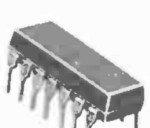
Z749 1% 0.4W metal film resistors, ideal for series resistors in multimeters – 6 values: 1R 10R 100R 9K 90K 900K. 5 of each, total 30 for 1.50
All except 900k available at £3.00/100

Z4074 330R 3W 5% wirewound resistors on cards of 25.
Prices 50p 10/ 3.50 100/ 26.10



Z988 RS power section 7R 0.7A.
Price **4/ £1.00**

DIL Networks

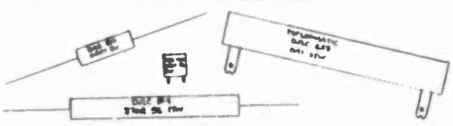


Z1370 16 pin DIL resistor network 8 × 10k. Beckman.
Price **10/ £1.00** 100/ 5.20
Z1371 16 pin DIL resistor network 8 × 22R. Beckman.
Price **10/ £1.00** 100/ 5.20
Z786 9 pin SIL resistor: 8 × 100K.
Price .... **Pack of 10/ £1.00**

Z1978 SIL Resistor Network. 10 pin package containing 9 × 10k 5% resistors.
Pack of 8 .... **£1** 100+ 0.06
Z1979 DIL Resistor network by Beckman. 16 pin DIL containing 15 × 10k 1% resistors. Normally around 60p each.
Price .... **4/£1.00** 100+ 0.10
Z1980 DIL Resistor Network by Beckman. 16 pin DIL containing 8 × 4k7 1% resistors. Normally around 60p each.
Price .... **4/£1.00** 100+ 0.10

Z1369 14 pin DIL resistor network 7 × 220R. Piher.
Prices **10/ £100**; 100/ £6.00

Wirewound Resistors



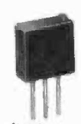
(d) Power wirewound resistors, all cement coated except* which is metal clad. All 5%

Code	Value	Wattage	Type	1+	100+
Z2102	0R1*	10	TAGS	**30p**	0.15
Z2101	0R15	5	PC	**20p**	0.10
Z2103	0R47	5	WE	**20p**	0.10
Z4401	1R	5	PC	**20p**	0.10
Z2104	1R	6	WE	**20p**	0.10
Z4402	1R	25	TAGS	**70p**	0.35
Z2105	50R	15	TAGS	**40p**	0.20
Z2106	225R	23	TAGS	**50p**	0.25
Z4403	370R	17	WE	**40p**	0.20

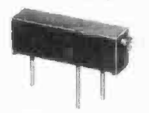
Low value, close tolerance wirewound resistors:
Z1966 OR5 5W 1%
Price .... **Pack of 5 £1**; 100+ 0.12
Z1967 OR1 3W 1%
Price .... **Pack of 5 £1**; 100+ 0.12

Z1962 Delay line by MCG Electronics Inc. Model SLP-4-100V25.
Price .... **2 for £1.00**

Presets

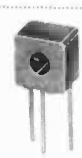


A number of cermets now available:
(a) Bourns 3296W or similar series (11mm sq multiturn)
Z1971 200R .... **2/ £1** 100+ 0.28
Z1972 5k .... **2/ £1** 100+ 0.28
Z1973 100k .... **2/ £1** 100+ 0.28
Z2095 2k W (top screw).
Price .... **2/£1** 100+ 0.28
Z2096 1k X (side screw).
Price .... **2/£1** 100+ 0.28



(b) Bourns 3006 (¾" multiturn)
Z1974 25k .... **3/ £1** 100+ 0.20

(c) Bourns 3362
(single turn 6.35mm sq; in-line leads)
Z1975 20k .... **3/ £1** 100+ 0.20



(d) Bourns 3386P
(9.5mm sq single turn)
Z1997 50K **3 for £1.00**

(e) Murata 3321H
(6.6mm dia single turn)
Z1998 50R **2 for £1.00**
Also 3386W single turn (11mm).
Z2097 25k .... **5/£1** 100+ 0.12
Z1471 10k trimpot, 1.25 by Plessey. Pack of 4.
Price **£1.00**

RESISTOR NETWORKS

Another mega deal means we can offer a quarter of a million SIL and DIL Matsushita networks at astoundingly low prices!!!

Types may be mixed to obtain quantity pricing (minimum quantity of each value as £1 pack)

Code	Type No	Pins*	Value	Qty	£1 Pack	100+	1k+
Z2202	EQ4	5S4	470R	1700	**15**	0.033	0.025
Z2203	EQ4	5S4	4k7	980	**15**	0.033	0.025
Z2204	EQ4	5S4	6k8	1500	**15**	0.033	0.025
Z2204A	EQ4	5S4	22k	6510	**15**	0.033	0.025
Z2206	EQ5	6S5	2k2	426	**14**	0.036	0.028
Z2207	EQ5	6S5	4k7	35	**14**	0.036	0.028
Z2208	EQ5	6S5	22k	576	**14**	0.036	0.028
Z2209	EQ5	6S5	47k	62	**14**	0.036	0.028
Z2210	EQ6	7S6	470R	1550	**13**	0.040	0.031
Z2211	EQ6	7S6	1k	1294	**13**	0.040	0.031
Z2212	EQ6	7S6	4k7	699	**13**	0.040	0.031
Z2213	EQ6	7S6	100k	388	**13**	0.040	0.031
Z2261A	VS4	8S4	33R	24,000	**10**	0.050	0.040
Z2277	VS4	8S4	100R	1270	**10**	0.050	0.040
Z2277A	VS4	8S4	150R	675	**10**	0.050	0.040
Z2263	VS4	8S4	270R	1000	**12**	0.044	0.034
Z2263A		8S4	330R	3300	**12**	0.044	0.034
Z2264	VS4	8S4	390R	1872	**12**	0.044	0.034
Z2265	VS4	8S4	680R	600	**12**	0.044	0.034
Z2266	VS4	8S4	1k8	1650	**12**	0.044	0.034
Z2267	VS4	8S4	2k2	1494	**12**	0.044	0.034
Z2269	VS4	8S4	3k3	600	**12**	0.044	0.034
Z2269A	VS4	8S4	4k7	16,328	**12**	0.044	0.034
Z2269B		8S4	10k	7000	**12**	0.044	0.034
Z2269C		8S4	22k	19,194	**12**	0.044	0.034
Z2272	VS4	8S4	47k	780	**12**	0.044	0.034
Z2273	VS4	8S4	68k	815	**12**	0.044	0.034
Z2273A		8S4	220k	1685	**12**	0.044	0.034
Z2274	VS4	8S4	330k	1681	**12**	0.044	0.034
Z2275	VS4	8S4	470k	400	**12**	0.044	0.034
Z2214	EQ7	8S7	100R	21,550	**12**	0.044	0.034
Z2215	EQ7	8S7	270R	5500	**12**	0.044	0.034
Z2216	EQ7	8S7	330R	3296	**12**	0.044	0.034
Z2217	EQ7	8S7	680R	2500	**12**	0.044	0.034
Z2218	EQ7	8S7	1k	129	**12**	0.044	0.034
Z2218A		8S7	1k8	3698	**12**	0.044	0.034
Z2219	EQ7	8S7	2k2	18,500	**12**	0.044	0.034
Z2212A	EQ7	8S7	4k7	15,360	**12**	0.044	0.034
Z2212B		8S7	6k8	96	**12**	0.044	0.034
Z2213A	EQ7	8S7	10k	2000	**12**	0.044	0.034
Z2214A	EQ7	8S7	47k	2129	**12**	0.044	0.034
Z2215A	EQ7	8S7	220k	4000	**12**	0.044	0.034
Z2284		8S7	1M	1500	**10**	0.050	0.040
Z2217A	EQ8	9S8	33R	1365	**11**	0.048	0.037
Z2218A	EQ8	9S8	68R	2824	**11**	0.048	0.037
Z2219A	EQ8	9S8	100R	245	**11**	0.048	0.037
Z2220	EQ8	9S8	150R	190	**11**	0.048	0.037
Z2221	EQ8	9S8	180R	900	**11**	0.048	0.037
Z2222	EQ8	9S8	270R	6000	**11**	0.048	0.037
Z2223	EQ8	9S8	390R	500	**11**	0.048	0.037
Z2224	EQ8	9S8	680R	2216	**11**	0.048	0.037
Z2225	EQ8	9S8	1k	2280	**11**	0.048	0.037
Z2225A		9S8	1k2	275	**11**	0.048	0.037
Z2226	EQ8	9S8	6k8	990	**11**	0.048	0.037
Z2226A		9S8	27k	165	**11**	0.048	0.037
Z2227	EQ8	9S8	68k	2993	**11**	0.048	0.037
Z2228	EQ8	9S8	150k	475	**11**	0.048	0.037
Z2229	EQ8	9S8	220k	8600	**11**	0.048	0.037
Z2230	EQ8	9S8	330k	900	**11**	0.048	0.037
Z2231	EQ8	9S8	680k	1000	**11**	0.048	0.037
Z2231A		10S5	4k7	11,200	**11**	0.048	0.037
Z2281		10S5	22k	2000	**10**	0.050	0.040
Z2281A		10S5	1M	1000	**11**	0.048	0.037
Z2233	EQ9	10S9	470R	100	**10**	0.050	0.040
Z2234	EQ9	10S9	1k	2999	**10**	0.050	0.050
Z2235	EQ9	10S9	2k2	5650	**10**	0.050	0.050
Z2236	EQ9	10S9	4k7	950	**10**	0.050	0.050
Z2237	EQ9	10S9	10k	50	**10**	0.050	0.040
Z2239	EQ9	10S9	100k	1000	**10**	0.050	0.040
Z2240	EQ9	10S9	220k	74	**10**	0.050	0.040
Z2241	EQ9	10S9	1M	446	**10**	0.050	0.040
Z2241A		11S10	10k	100	**10**	0.050	0.040
Z2241B		12S6	220R	2000	**10**	0.050	0.040
Z2242	RA13	14D13	100R	6900	**10**	0.050	0.040
Z2243	RA13	14D13	270R	5580	**10**	0.050	0.040
Z2244	RA13	14D13	1k5	800	**10**	0.050	0.040
Z2245	RA13	14D13	2k2	1334	**10**	0.050	0.040
Z2246	RA13	14D13	3k3	800	**10**	0.050	0.040
Z2247	RA13	14D13	47k	42	**10**	0.050	0.040
Z2250	RB7	14D7	100R	200	**10**	0.050	0.040
Z2251	RB7	14D7	270R	83	**10**	0.050	0.040
Z2252	RB7	14D7	1k	300	**10**	0.050	0.040
Z2253	RB7	14D7	1k8	5698	**10**	0.050	0.040
Z2254	RB7	14D7	2k2	583	**10**	0.050	0.040
Z2254A		14D7	100k	180	**10**	0.050	0.040
Z2256	RB8	16D8	47R	6293	**10**	0.050	0.040
Z2256A		16D8	150R	214	**10**	0.050	0.040
Z2257	RB8	16D8	220R	900	**10**	0.050	0.040
Z2258	RB8	16D8	270R	98	**10**	0.050	0.040
Z2259	RB8	16D8	6k8	700	**10**	0.050	0.040
Z2260	RB8	16D8	15k	500	**10**	0.050	0.040
Z2260A	RB8	16D8	22k	1313	**10**	0.050	0.040
Z2261	RB8	16D8	100k	20,000	**10**	0.050	0.040

*Pins: 1st character = No of pins; 2nd character = SIL or DIL; 3rd character = No of resistors in package

MEMORIES ETC

Loc	Type	Qty	1+	100+
M	**TC511000Z-12**	349	**£5.00**	3.00
M	**MSL27128K**	142	**£2.50**	1.50
M	**MB81256-20**	296	**£5.00**	3.00
M	**TMM2063P-10**	92	**£3.00**	2.00
M	**MB81C68-35**	624	**£2.00**	1.30
M	**TMS4161-15NL**	3102	**£1.00**	0.60
M	**TMS2516JL**	184	**£1.20**	0.70
M	**TMS2114L-45**	141	**£0.60**	0.40
M	**MC68A50P**	77	**£1.00**	0.60
M	**HN482764-4**	98	**£2.00**	1.30
M	**HM4864-2**	226	**£1.50**	1.00
M	**MK4118N-2**	33	**£2.00**	1.30
132	**SAB8088-P**	300	**£4.00**	2.00
OSL	**27C64-2**	40	**£2.00**	1.30
OSL	**AM2952DC**	96	**£1.00**	0.60
OSL	**MM582748N**	100	**£2.50**	1.50
132	**AM2966DC**	780	**£1.00**	0.60
132	**MC10131L**	600	**£1.00**	0.60
132	**MC8T95**	188	**£1.00**	0.60
132	**UPB8282D**	180	**£1.00**	0.60
132	**MC10109L**	425	**£1.00**	0.60
132	**M5L2732K**	112	**£1.50**	1.00
132	**R65C22P2**	127	**£2.00**	1.30
132	**SCN2681A**	88	**£3.00**	2.00
132	**LH5164D-10**	400	**£2.00**	1.30
132	**TMM2016P-1**	154	**£1.00**	0.60
261B	**D4364-12**	27	**£2.00**	1.00
261B	**HM3-2064U-5**	14	**£2.50**	1.50
261B	**HM6264-12**	91	**£2.50**	1.50
261B	**HM62256-12**	176	**£5.00**	3.00
261B	**SAA5231**	55	**£4.00**	2.00
261B	**SAB3035**	41	**£4.00**	2.00
503	**Z80A CTC**	52	**60p**	0.40
503	**Z80A PIO**	68	**60p**	0.40
503	**Z80A DART**	55	**£1.50**	0.80
503	**R6502**	56	**£2.00**	1.10
503	**M80C85A-2**	144	**£2.50**	1.30
503	**P8259A**	21	**£1.00**	0.60

We are always looking for new lines to add to our lists. Send details/ samples of goods available to:

The Managing Director
Greenweld Electronics Ltd
27 Park Road
Southampton
SO1 3TB

Small parcel of IC's just received.

Code	Description		Price	100+
74HC4060	Binary Counter	DP 65p	**4/ £1.00**	0.15
CD4052BLN	Multiplexer	DP 50p	**5/ £1.00**	0.10
ICL7660CPA	Voltage Converter	DP £1.85	**2/ £1.00**	0.30
M6242B	Real Time Clock	DP £3.51	**£1.00**	0.60

DP - distributor price. Data sheets 10p each.

(k) New items - not previously listed

Z2301 Delay unit. Welwyn 100016-9006-033BJ. Sealed case 20pin DIL 0.6" pitch. Thick film circuit inside, but no info. **50p**

Z2321 Semikron diodes. 'Semipack'. Thyristor/ diode module type SKKH26/ 04D rated 25A 400V. These have screw connections and an integral heatsink. Size 92 × 30 × 20. FC = 80. DP £15.00!
Our price .... **£4.00** 100+ 2.50

Z2322 As above but single diode rated 80A 400V. Only a few of these.
Price **£3.00**

Z2323 Controlled bridge rectifier by IR. 2 SCR's and 2 diodes in module 45 × 32 × 15 rated 600V 25A. FC = 50. DP £24.
Our Price **£6.00**

Z2324 Delco DTS701 high power TO3 Silicon transistor rated 800V 1A 50W.
Price **£3.00**

Z2325 LM340AK-15 TO3 15V regulator rated 1.5A.
Price **£1.00**

Z2326 Small aluminium heatsink mounted with a BD243AS and BD244AS.
Price .... **2 for £1.00**

Z2327 Small aluminium heatsink mounted with a BD439 and BD440.
Price .... **3 for £1.00**

Z5148 Heavy duty finned heatsink 82 × 56 × 40 with single high power rectifier, SSIG3883 + 2 terminal posts.
Price **£3.00**

Z2328 BAX16 signal diodes.
Pack of 25 .... **£1.00**

TRANSDUCERS

SOUNDERS & SIRENS

A range of piezo-ceramic sounders made by STC. These are top quality units with extremely high output, up to 115dBm. Now reduced even further to ¼the original 1 off trade price!!

Current consumption 8mA
Frequency 2.7KHz
Sound level at 1 metre .... 80dB(A)
Connections .... Red +ve, black -ve
Fixing .... requires 2 off M3 nuts
Lead length 230mm
Dimensions .... 60×60×10mm

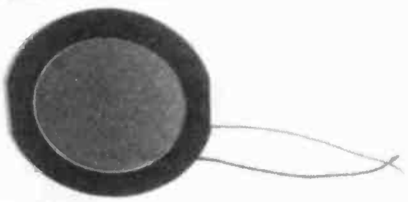
Z102 Model U350R, 12Volts, Level 80dBm **£1.00**
Z103 Model U350R, 24 Volts, level 80dBm **£1.00**

Current consumption 10mA
Frequency 2.7KHz
Pulsing frequency .... 2 04 10Hz selectable
Sound level at 1 metre .... 85dB(A)
Dimensions .... 60×33×70mm

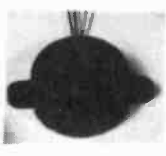
Z108 U25ORD1D2, 24V, level 85dBm **£1.70**
Z109 U25ORD1D2H, 24V, level 90dBm **£2.00**

Z5120 9V buzzer - like our A391 series. List price is 80p.
Special price .... **3 for £1** 100+ 0.20
Z2032 High power 'Pensee' siren 46mm high × 50mm dia. 60mm FC giving out steady or pulsed tone.
Price **£2.00**

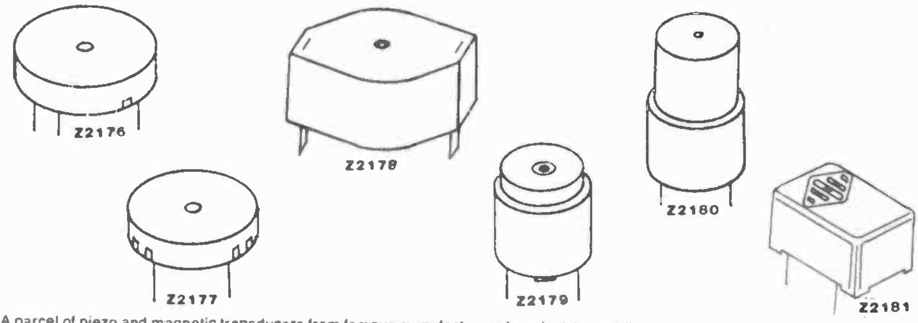
Piezo Transducer



Z1429 Murata piezoelectric speaker type VSB41D25. Only 2mm thick×50mm dia, weight 3.3gm. Freq. res. 500Hz-20kHz. Z=1.2k at 1kHz. Max input 200mW. Normally £2.33
Our prices .... **75p each** 10+ 0.52 100+ 0.40



Z1610 Piezo transducer in plastic case 31mm dia×11mm high. 3 wires. Needs 2 resistors and transistor to oscillate (supplied, with circuit). Voltage from 3V upwards by changing R. **70p**
Z1808 Small piezo transducer 24mm wide × 4mm thick.
Price **2/ £1.00**

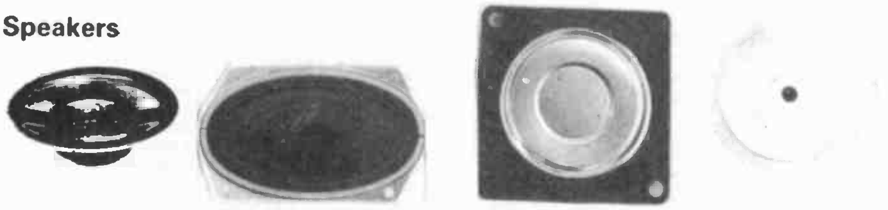


A parcel of piezo and magnetic transducers from famous manufacturers from just 4p each!!

Code	Manf'r	Type	*P/M	Size	£1 Pack	100+	1k+
Z2176	Murata	PKM25-6AO	P	25×8	6	0.08	0.06
Z2177	Star	SEC2437P	P	21×7	8	0.06	0.04
Z2178	Fuji	168H008	P	25×20×8	6	0.08	0.06
Z2179	Star	QMB-12	M	15×14	5	0.10	0.07
Z2180	Star	QMB-12A	M	15×22	4	0.12	0.09
Z2181	Star	SMX12	M	17.7×14×11	4	0.12	0.09

* P - Piezo; M - Magnetic
K829 Pack of mixture of above - 25 assorted **£3.50**

Speakers

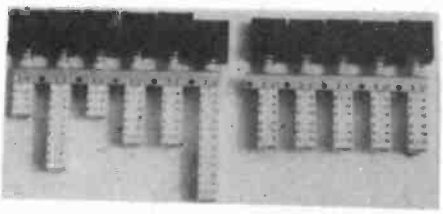


Submin speakers with mylar diaphragms suitable for use in damp situations.
Z1764 29mm dia × 9.5mm deep. Made by Star, model DS-29A. Rated 8Ω 0.1W.
Price **2/ £1.00**

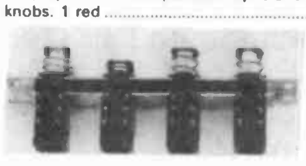
Z578 Super flat speaker 30×30×3mm by Fuji, rated 16R 0.4W. DP £1.50.
Our Price .... **60p** 25+ 0.35 100+ 0.22 1k+ 0.15
Z533 Danavox transducer - used as a speaker in pocket pagers. Impedance 50R. 20mm dia leads 90mm long. Extremely high quality unit.
Prices **50p** 10/ 3.65 50/ 14.80

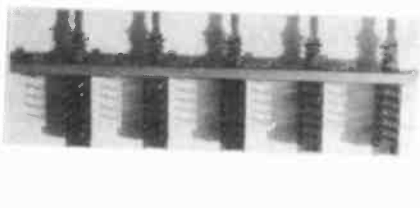
SWITCHES

Push Switch Banks

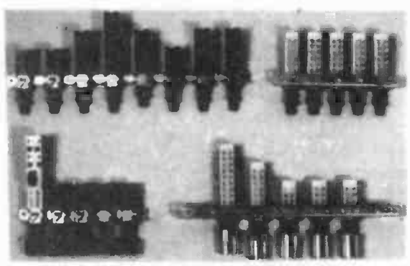


Z667 Switch bank – 5 way interlocking each 4p c/o complete with black knobs **50p**
Z668 Switch bank 6 way. 4 are interlocking; 8p c/o; 2×4p c/o; 2p c/o. 2 independent 6p c/o & 2p c/o. 5 black knobs. 1 red **65p**

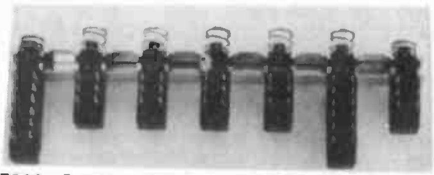




Z643 4 way interlocking, each DPCO
Price .... **30p each** 10/ 1.75 100/ 10.45
Z648 5 way interlocking, each 4 pole c/o
Price .... **40p each** 10/ 2.20 100/ 13.05



Z4365 8 switches, 6 interlocking (4×4PCO, 1× DPCO, 1×6PCO); and 2 independent (both DPCO). No knobs.
Price .... **3/ £1.00** 100+ 0.15
Z4366 5 interlocking switches (2×DPCO, 1×4PCO, 1×6PCO, 1 blank); with shiny chrome round knobs.
Price .... **3/ £1.00** 100+ 0.15
Z4367 5 switches, 3 interlocking (2×DPCO, 1×mains, DP on/ off); 2 independent (both DPCO). Shiny chrome oblong knobs.
Price .... **3/ £1.00** 100+ 0.15
Z4368 5 switches, 4 interlocking (all 4PCO); 1 independent 4PCO. No knobs.
Price .... **5/ £1.00** 100+ 0.10

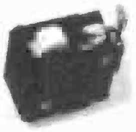


Z644 7 way. End 2 are independent, other 5 are interlocking.
Price .... **40p each** 10/ 2.20 100/ 13.05

Proximity Switch

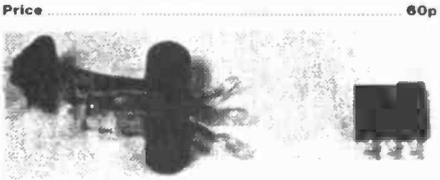
Z2041 Proximity switch 39 × 10 × 5mm by Flight Refuelling type RSMO6 A15.
Price **£3.00**

Microswitches



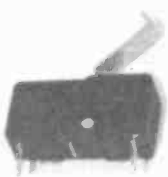
Z4370 Burgess 20A microswitch. Incorporates 2 switches into one housing 20 × 12.5 × 17.5mm - 1 changeover and 1 break.
Price .... **2/ £1.00** 100 + 0.25

Z1437 Standard size microswitch with wire lever requires only 5 gm pressure to operate.
Price **60p**



Z2084 Skeleton microswitches. SPCO, 5A rating. Two 3.5mm mounting holes on 10mm centres. They are designed to be mounted side by side - in theory the number is only limited by the length of bolts available! (each switch is 5mm thick).
Price .... **Pack of 4 for £1.00** 100 + 0.15

Z1984 Sub miniature microswitch, Omron type D2MQ-1. These have a body size of 8 × 6 × 2.6mm.
Price .... **2/£1** 100 + 0.25



Z2165 Omron miniature type SS rated 3A 250V. Single break contact operated by bent lever.
Price .... **5 for £1** 100 + 0.12 1k + 0.08

Z2166 Omron standard type VL631C. These are for signal switching, contact rating 0.1A 125A AC/30V DC. Single make contact.
Price .... **6 for £1** 100 + 0.09 1k + 0.05

Z1821 Long lever micro switch. Standard V23 body, rated 5A. Lever 60mm long may be corroded
Price **2/ £1.00**

Z5158 High current microswitch by Siemens, model 3 SE3 rated 10A 380V AC. Fully shrouded screw terminals (4); 1 pair make and 1 pair break terminals. Overall size 28 × 30 × 32.
Price **£1.50**

Key Operated Switches

A couple of key operated switches by C&K requiring 20mm hole. Yale type key can be withdrawn in any position. 2 keys supplied.

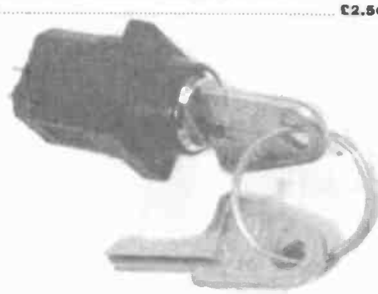
Z2100 Single pole changeover low current 0.4VA, 20V max.
Price **£2.00**

Z2107 Single pole 4 way rated 2A 250V ac.
Price **£2.50**

Z2050 Key operated cabinet latch with 2 keys.
Price **£1.00**

Z2041 Key operated switch, 4 position, switches a low current single pole wafer and a double pole 2A mains switch. Yale type key can be removed in any position.
Price **£2.50**

Z2342 Yale key mechanism intended for fitting to switch unit. Extremely heavy duty and well made by Siemens.
Price **£2.50**

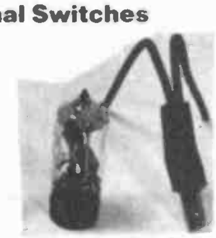


Z2168 Superb quality British made (TOK). Gold plated DPCO contacts. Key can be removed in either position. PC mounting or clip fix - needs 15x15mm cut-out. Ideal for alarms etc.
Price .... **£1.95** 25 + 1.20 100 + 0.80

Mercury Switches

Z2118 Metal enclosed in case 7.5mm dia × 9mm long. 10mm flange one end.
Price .... **2/ £1.00** 100 + 0.25 1k + 0.18

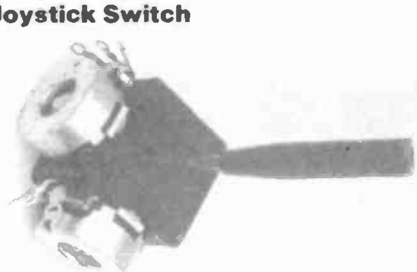
Thermal Switches



Z1694 S103/1K Thermal switch. Glass encased with B7G base. At 24V, cold start 70 secs to energise, hot start 10 secs. De-energises in 12 secs both cases. SPM contact rated 5A or so £1.00

Z1698 Thermal Switch – contacts, normally closed open at approx 40°C. Rated 2A £2.00

Joystick Switch



Z004 Skeleton Joystick, switch type. Good quality, made by AB. Brass spindle has 44mm long black plastic handle attached. Body has 4 mounting holes. These really are a fantastic bargain!! **ONLY £1.00**

Toggle Switches

Z548 Toggle by Arco DPDT rated 13A 250V. Plastic toggle and fixing nut.
Price **£1.20**

Z1710 Toggle switch double pole on/ off rated 10A 250V ac. Threaded bush with plastic and metal nut, also can be clipped in panel.
Price **£1.50**

Z1711 Another toggle switch, very similar to above. No rating printed on body, but looks about 10A. This one does not have a clip fix.
Price **£1.20**

Toggle switches by Bonella. High quality, high current, solder tags. All are rated 10A 250V ac

Z352 Type N11LNZ SPCO (4 tags) Metal dolly **56p**
Z354 Type N41LNZ DPCO (6 tags) Metal dolly **84p**
Above 4 types less 25% for 25+; less 50% for 100+.

Z1486 Toggle switch rated 1A, DPDT with paddle **75p**

Z1816 Miniature PCB mounting switch, SPCO. Gold plated pins. Red flat toggle.
Price **3/ £1.00**

Slide Switches

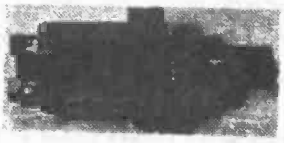
Z2067 Sub min DPCO slide switch, just 11 × 6 × 5mm. PC side mounting. Nice quality.
Price .... **5 for £1.00** 100 + 0.12

Push Switches

Z1836 Flexibutton switch. Low cost high quality sealed push button switch. Ideal in damp or even wet environment. Black body, white or yellow (few only) button. SPCO rated 5A 250V ac. Normally £5.98 each.
Our Price **£1.50**

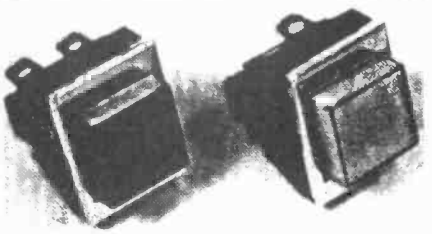
Z1837 Lightweight push button switch. Double pole momentary action. 15.8mm sq cut-out. Uses T13/4 wedge lamps. Supplied with our Z1466 12V 1.2W. Lens available in white, red, green, blue or yellow. Normally £10.28 complete.
Our low price **£2.50**

SWITCHES

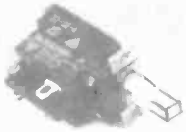


Z1957 High quality, high current push to make switch by Arcolectric. Rated 250V 1A. Single hole fixing, needs 12mm dia hole. Plunger 7.5mm dia × 10mm long.
Price ... **2/£1.00**

Z4352 Metal bracket with push to make switch (W241).
Pack of 5 for ... **£1.00**



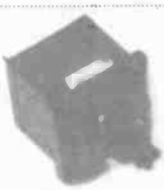
2 attractive push-on, push-off indicator switches, standard rocker mounting hole 30 × 23mm. Chrome surround, single pole 10A contacts.
Z1994 Red mains ... **80p**
Z1995 Amber 12V (ideal for dashboard mounting in car).
Price ... **80p**



Z1689 Push on push off power switch rated 5A 250V. Mounting by 2 tapped holes on 20mm centres. No knob.
... 3 for £1.00

Keyboard Switches


Z1523 PCB mounting illuminated keyboard switch. High quality single pole reed with 5V lamp made by FR. Model 18 × 18mm. No tops unfortunately.
Price ... **3/ £1.00**
Z1393 PCB mounting keyboard switch with in built yellow LED. SP. Size: 12.5 × 12.5mm. No tops.
Price ... **5/ £1.00**
Z528 Switch top, 2 part. Clear plastic top clips over blue base. Fits over 3.5mm sq spigot. Size 12 × 12mm.
Price ... **Pack of 20/ £1.00**
Z1756 PCB mounting keyboard switch, white. Type D6 square by ITT. Their price 44p.
Our price ... **5/ £1.00**



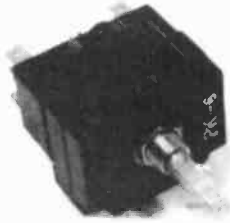
Z2167 Keyboard switch, single pole clip-in type with standard + stem for cap. 13.6 × 12.9mm. 7.5mm pitch. DP 75p.
Our low price ... **6 for £1** 100+ 0.10

Rocker Switch

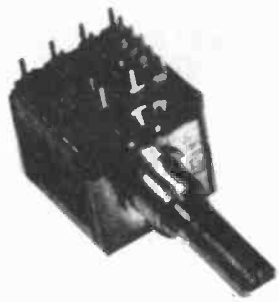
Z1819 Rocker switch in black plastic. SP on/ off rated 16A 250V ac. Needs 30 × 12mm cutout.
Price ... **Pack of 4/ £1.00**

Rotary Switches

Z2108 PCB mntg rotary switch, 4 pole 3 way by C&K.
Price ... **3 for £1.00**
Z2140 4P 3W rotary switches (cat type W025) with cut down (10mm) shaft, pc mounting.
Price ... **Pack of 4 for £1.00**



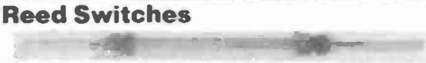
Z4185 Switch, high current, 11 terminal device, its 6 positions give a variety of connexions. Data supplied. Standard 0.375" bush & ¼" spindle. Rated 2A 250V, 3A 125V or 10A 20Vac ... 60p



Z1522 Switch, Alps SRS 40 way. As used in CB's for channel switching. Body 20×20mm. 6mm dia shaft with M9 fixing nut. Not sure if these are binary or BCD. 7 bits per step. Data sheet supplied. ... £1.00
Z5159 Heavy duty 7 position rotary switch by Siemens complete with knob rated 6A 380V AC.
Price ... **£2.00**
Z5160 Similar 3 position ... **£1.00**

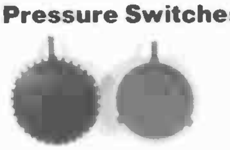
> **Please Note:**
>
> The Free Gifts offered in the Main Catalogue are not available with goods from Bargain Lists.

Reed Switches



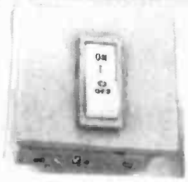
Z798 Large reed switch, 50.8mm long body. Rated 5A 400V max
Price ... **Pack of 10/ £1.50**
25/ 2.60 100/ 8.70 250/ 17.40 1k/ 60.90

Pressure Switches

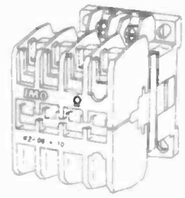



These are operated by very low air pressure – just blowing down the tube will operate the SPCO microswitch within. Useful in a 'spark free' environment.
Z024 80mm dia×45 total depth. SPCO switch rated 16A 250 Vac ... 80p
Z025 Similar to above, but 37mm thick ... 80p
Z4200 Pressure switch model LDQ by Actu. Can be activated by gas or air at very low pressure. Range 13 – 150mm w.g. Switch is a SPCO micro switch rated 230V 2A. Precision instrument overall dia 110mm × 48mm
... £2.00

Miniature Circuit Breakers



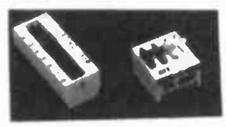
Z4106 10A switch/ circuit breaker. Extremely neat clip fix by Airfax. 3 pole, 12.5A max. 50 × 41 × 39mm.
Price ... **£2.00**



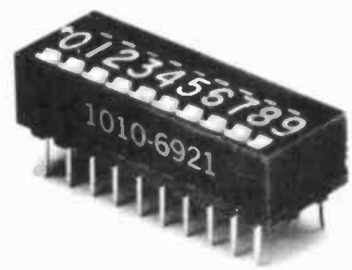
Z5154 MCB 3 pole + N rated 32A 240/ 415V AC. Standard DIN rail fixing. Siemens model no 5 SN6. Individually boxed.
Price ... **£10.00**
Z2351 As above but rated 16A ... **£10.00**
Z2352 As above but rated 50A ... **£10.00**
Z5155 MCB 2 pole rated 50A 240/ 415V AC. Standard DIN rail fixing. Siemens model no 5 SN8.
Price ... **£8.00**
Z2353 As above but rated 3A ... **£8.00**
Z5156 MCB single pole rated 6A 240/ 415V AC. Also aux contacts. Standard DIN rail fixing. Siemens model no 5 SN7.
Price ... **£3.00**
Z5157 MCB single pole rated 16A 240/ 415V AC. Standard DIN rail fixing. Siemens model no 5 SN1.
Price ... **£3.00**
Z2354 As above but rated 10A ... **£3.00**

Z5086 Klippon SAKR 240V 10A isolating switch 4mm. DP 1.17 each.
Price ... **Box of 80 £5.00** 1k+ 0.03

DIL Switches



Z1752 DIL switch, 16 pin 1 pole 8 way by ERG. Gold plated.
Price ... **75p**
Z1755 DIL switch, colour coded by ERG. 8 pin 4 way on/ off.
Price ... **30p**



3 Different Styles
Style A - CTS 'Piano Key' type in 4, 8 and 10 way.

		1+	25+	100+
Z1622	4 way	**30p**	0.17	0.13

Style B - SAE 'Push' type in 1-10 ways (except 4 way). All have gold plated pins.

		1+	25+	100+
Z1625	1 way	**20p**	0.12	0.08
Z1627	3 way	**30p**	0.17	0.13
Z1629	6 way	**40p**	0.23	0.17
Z1630	7 way	**45p**	0.25	0.19

Style C - 'Piano Key' type by Grayhill 76PSB105 in 10 way.

		1+	25+	100+
Z1635	10 way	**50p**	0.35	0.26

Z2341 Low cost 4 pole changeover DIP switch, 16DIL. Use screwdriver to change position to 1, 2 or off. Amazing value!
Pack of 5 ... **£1.00** 100+ 0.10 1k+ 0.07

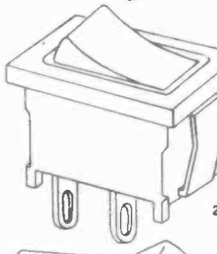
REMARKABLE RUSSENBERGER ROCKER REDUCTIONS ! ! ! !

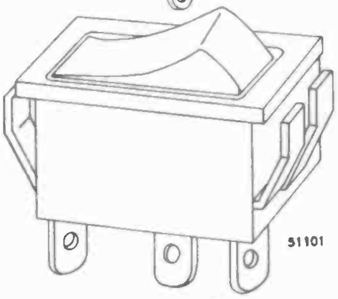
A range of rocker and push switches, clip fit by Russenberger. Top quality, complying to all relevant approvals.

MINIATURE ROCKER

Size 14x21x15mm require, 19.3x13mm contact. All single pole rated 8A 250V DC. Solder tags.

CODE	CONTACTS	BODY	ROCKER	QTY	£1 PACK	100+	1000+
21102	ON/OFF	BLACK	WHITE	4583	6	.12	.08
21201	ON/OFF	WHITE	BLACK	3000	6	.12	.08
21202	CHANGE OVER	WHITE	WHITE	6779	5	.14	.10

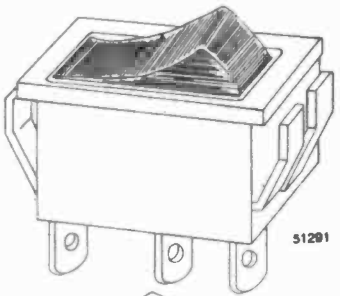

21102


51101

STANDARD ROCKER

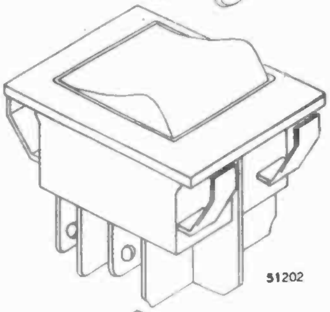
Size 20x14x16mm requires 27x12mm cutout. * Size 31.5x14x22mm requires 30x12mm cutout. All single pole, 12A 250V ac or 12-28V DC 0.25" tabs.

CODE	CONTACTS	BODY	ROCKER	QTY	£1 PACK	100+	1000+
51101	CHANGE OVER CENTRE OFF	BLACK	BLACK	4262	6	.12	.08
51802	CHANGE OVER CENTRE OFF	WHITE	WHITE	3116	6	.12	.08
1600 NBS	ON/OFF	WHITE	RED NEON	2000	5	.14	.10
*51102	ON/OFF	BLACK	WHITE	1739	6	.12	.08
*51291	ON/OFF	WHITE	AMBER NEON	1600	5	.14	.10


51291

Size 31.5x25x34mm requires 28x22.5mm cutout.

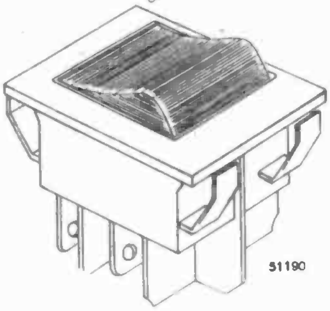
CODE	CONTACTS	BODY	ROCKER	QTY	£1 PACK	100+	1000+
51190	SP ON/OFF	BLACK	RED NEON	2755	5	.14	.10
51192	SP ON/OFF	BLACK	GREEN NEON	6907	5	.14	.10
51202	SP ON/OFF	WHITE	WHITE	3814	6	.12	.08
51390	DP ON/OFF	BROWN	RED NEON	1498	4	.16	.12


51202

ILLUMINATED PUSH SWITCHES

Size 31.5x 25x34 requires 28x22.5mm cutout. (Same as large rocker switches). Mains Neon. The difference between the two types listed is that 21200 has solder tags; 51200 has 0.25" tabs.

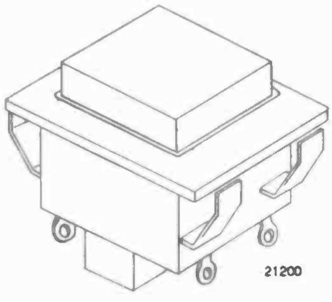
CODE	CONTACTS	BODY	INSERT	QTY	£1 PACK	100+	1000+
21200	SPCO	WHITE	WHITE	4912	6	.12	.08
51200	SPCO	WHITE	WHITE	1000	6	.12	.08


51190

INDICATORS

Size 31.5x25x34mm requires 28x22.5 cutout. These match above push switches and rockers. Available with a black body and lens colour as listed. Mains Neon.

CODE	COLOUR	BODY	QTY	£1 PACK	100+	1000+
51100A	AMBER	BLACK	500	6	6	.09
51100C	CLEAR	BLACK	600	6	6	.09
51100G	GREEN	BLACK	100	6	6	.09
51100N	NO LENS	BLACK	2500	14	14	.03


21200

SWITCHES, RELAYS

Submin rotary switches by Erni

Distributor price over £3.00 each! Body 9mm dia × 9mm long. (13mm 0n 2 wafer types) 3mm dia spindle. 4-8mm bush. Gold plated contacts. Supplied with nuts.

Code	Poles	Ways	1+	10+	25+
Z2183	2	3	**40p**	0.30	0.20
Z2184	2	6	**50p**	0.40	0.25
Z2185	1	12	**50p**	0.40	0.25
Z2186	4	4	**60p**	0.48	0.30
Z2187	2	8	**60p**	0.48	0.30

Professional Digital Switches

Excellent quality digital switches in various sizes. Push button type by Hartmann Geratebau in decimal, BCD and Hexadecimal (BCH) Available in 4 sizes mostly black, few grey. (DP - distributor prices).

Code	Type	Output	Size H × W × L*	DP	1+	10+	100+
Z2188	PICO-D-301-AK2	BCH	14 × 7.5 × 26	4.73	**£1.00**	0.60	0.40
Z2189	SMC-D-301-AK2	BCH	22 × 7.5 × 34	6.62	**£1.00**	0.60	0.40
Z2190	SMC-D-301-AK1	BCD	22 × 7.5 × 34	6.14	**£1.00**	0.60	0.40
Z2191	DPS8-111-AK2	DEC	24 × 8 × 35	6.00	**£1.00**	0.60	0.40
Z2192	SMC-137-AK2	BCD	22 × 7.5 × 34	6.14	**£1.00**	0.60	0.40
Z2193	DPS9-131-AK2	BCD	30.5 × 7.5 × 41	6.00	**£1.00**	0.60	0.40
Z2194	DPS9-301-AK2	BCH	30.5 × 7.5 × 41	6.00	**£1.00**	0.60	0.40
Z2195	DPS9-111-AK2	DEC	30.5 × 7.5 × 41	6.00	**£1.00**	0.60	0.40
Z2196	MHE-301-AK2	BCH	39 × 10 × 58	6.00	**£1.00**	0.60	0.40
Z2197	MICO-131-AL2	BCD	30.5 × 10 × 81	6.00	**£1.00**	0.60	0.40

*Inc solder pads

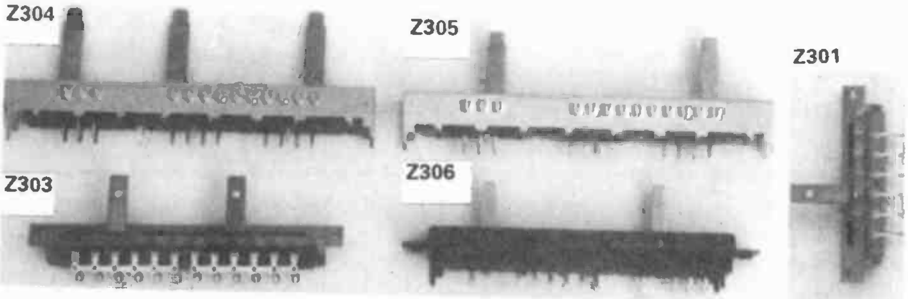
Z2198 End checks (grey only) to match Z2193,4 + 5. Left and right hand. Free until stocks exhausted with any orders for Z2193/ 4/ 5.

Z2199 'Blanks'. Bits of plastic same size as Z2189/ 90/ 92 to fill gaps in cut-out. Free with orders for above types. (only about 50 available).

S049 Miniature DPCO paddle switch by C&K rated 0.4VA. Body size 13 × 12 × 10mm. Clip fix, needs 15 × 12mm cut-out. **Price 5/ £1.00** 100+ 0.12

S018 PC mounting with integral support push switch rated 0.4VA - push to changeover, locking. Body size 13 × 9 × 7mm. 6mm threaded bush. Plunger 3mm dia × 7mm long. **Price 8/ £1.00** 100+ 0.08

Slide Switches



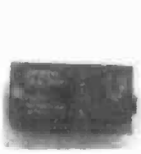
Code	Body Length	Mntg	Pitch	Pos'n	Tags	Arrangement
Z301	40mm	PC/ C	0.1"	6	12	Connects each pair in turn
Z303	70mm	Ch		12	12	2 × 1p 6w
Z304	95mm	PC	4mm	13	14	2 × 1p 4w plus 3 pairs
Z305	77mm	Ch		11	17	1p 8w plus 2p 3w
Z306	95mm	PC	4mm	13	6	1p 4w or 1p 4w plus 3 pairs

All the same price, any mix: **10/ £1.20** 25/ 2.20 100/ 7.85 250/ 15.65 1000/ 52.20 **Clear the lot at 3p each**

RELAYS

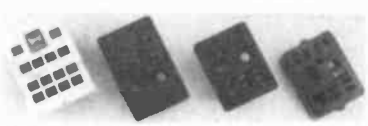
Fig 2 Fig 3 Fig 11

Code	Volts	Coil R	Contacts	Man'r/Type	Size	Fig	Notes	Price
Z202	3V	35R	SPCO@3A	AZ535	32 × 20 × 11	2	Low profile PC mntg	£1.00
Z275	24V	480R	DPCO@10A	Releco MR54.2	55 × 35 × 35	X	Octal Base	£2.50
Z258	24V	520R	3PCO@10A	B&R D43	53 × 37 × 36	X	11 pin plug in	£2.50
Z250	24V	700R	DPCO@1A	Perivale PC2	30 × 24 × 19	X	Plug in 'Continental'	80p
Z225	24V	2000R	SPCO@2A	Hamlin HE721	21 × 8 × 5	11	DIL relay	£1.50
Z226	24V	2000R	SPM@5A	Hamlin HE751	21 × 8 × 5	11	DIL relay	£1.30
Z251	36V	1250R	4PCO@1A	Perivale PC4	30 × 30 × 19	X	Plug in 'Continental'	80p
Z252	48V	2500R	2PCO@1A	Perivale PC2	30 × 24 × 19	X	Plug in 'Continental'	60p
Z253	48V	2500R	4PCO@1A	Perivale PC4	30 × 30 × 19	X	Plug in 'Continental'	80p
Z219	50V ac	750R	4PCO@3A	MY4	35 × 27 × 21	3	Plug In	£1.00
Z233	100V	12K	DPCO	Keyswitch KMK32	47 × 39 × 39	X		£1.00
Z261	240V ac	12K	2PCO@7.5A	P&B KU11A15	46 × 36 × 31	X	Octal plug in	£3.00



Z280 Relay, DIL 24V coil 288R. SP contacts. OMRON G6B-1114P.
Price **£1.00**

Z1718 Solid state relay 43 × 25 × 70mm. Control voltage 3-24V DC switches 240V ac 4A. DP £7.82
Price **£3.00**



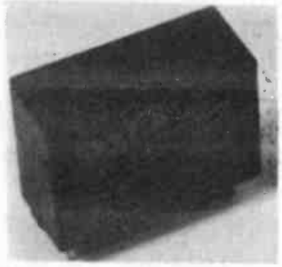
Z296 Holder for 4PCO MY4. Solder tag.
Price **30p**

Z297 Holder for 2PCO 'continental' solder tag.
Price **25p**

Z298 Holder for 4PCO 'continental' solder tag.
Price **30p**

Z299 Holder for 2PCO 'continental' PCB mounting.
Price **25p**

12V relay from 25p



Z2137 Superb quality potted relay 29x20.5x12.5mm with pins on 0.1 pitch. Coil 12V DC. Single contact relay 5A 12V DC or 5A 230V AC.
Price .... **50p each** 10+ .39 25+ .31 100+ .25

12V relay bargain

Z2120 Same size and contact arrangement as W853 in our catalogue at £1.42 (15.6 × 10.6 × 10.5mm. SPDT contacts rated 1A@ 28V DC) but different pinout. Standard DIL spacing.
Only .... **£1.00** 25+ 0.70 100+ 0.60

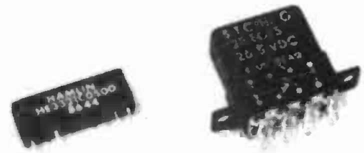
Z2045 Omron LY2 relay 220/240 ac coil. DPCO contacts rated 10A. List price on these is over £5.00.
Our price **£2.50**

Z2046 Chassis socket for above. DP 89p.
Our price **40p**

Z2047 Omron time delay relay. Sub min 4 pole c/o type H3Y-4-U5. 110V AC coil. 0.1-5 sec timing range. List price over £25.
Our price **£6.50**

Z2049 Relay miniature low profile flat pack. 24V DC coil, 4 pole c/o contacts. Mounts on 0.1 grid. DP £5.45.
Our price **£2.00**

Z2316 Elapsed time Indicator by Curtis 0-5000 hours 5V DC 42mm long × 9 × 4mm. Wire ended. **£1.50**



Z1958 Hamlin SIL reed relay type HE3321CO500. SPCO, 1200R coil. 5V operation. List price on these is over £5!
Our special price **£1.50**

Z218 26.5V sealed relay 675R DPCO @ 1A. Made by STC 22 × 20 × 10mm.
Price **60p**

Z2048 IMO Octal relay, 24V DC coil 2 pole c/o 10A contacts. List price over £5.
Our price **£2.50**

Z2309 PCB mounting 20mm high × 20 × 16mm. 12V coil SPCO 3A contact. **£1.00** 25+ 0.70

Z2310 AX400F-X091. PC mounting reed relay 10.5mm high × 32.5 × 13mm. 5V coil SP break contact. **50p** 100+ 0.32 1k+ 0.25

Z2164 PCB relay with SPCO contacts rated 8A, 250ac. 24V coil. Fully enclosed, size 27.5 × 25.8 × 11 on 0.1 pitch, made by Zetter. Operating range 15V-30V.
Only 75p 100+ 0.35 1k+ 0.25

Z2174 High quality Aromat PC mounting relay, size 35 × 10 × 10mm. 0.1" pitch. Unusually, these are 4 pole changeover. 9V Coil (operates from 5-12V). Pinout printed on relay. Model DS4E-S-DC9V. Contacts rated 2A 30V DC.
Price .... **£3.00 each** 25+ 2.20 100+ 1.80

Z610 Demo cassettes from Enterprise Computer. C8 tape in library case.
Price **4/ £1.00**

Z1701 Stereo cassette head .... **Only £1.00**

We are discontinuing our software service because of poor sales, and selling it as a complete library. We have 630 different programs on both 3.5" and 5.25" disks. There are however about 1000 disks of each size because many programs have 2 or more disks. The price represents little more than the cost of the media, and includes plastic lockable storage cases for the 5.25" disks, cardboard boxes for the 3.5" disks, and master index/catalogue disks.

Complete Library on 3.5" Disks **£450**
Complete Library on 5.25" Disks **£300**
Both **£700**

GET READY FOR 1992

GET READY FOR 1992

Now our ties with Europe are becoming closer, you'll need to learn a foreign language. Just so happens we've purchased a job lot of language tapes to prepare you for this eventuality - and we don't just stop at the EEC! Expand your horizons - learn Russian too!

These are Normans Language Courses. Each consists of a C90 EMI cassette tape in library case with a 32 page book covering a wide variety of subjects, supplied in a plastic wallet. OK, so its not your Linguaphone course, but very useful - especially at the price we are asking!!

Z5060 Italian **£2.00**
Z5061 German **£2.00**
Z5062 Portuguese **£2.00**
Z5063 Spanish **£2.00**
Z5064 Russian **£3.00**

We also have a number of Erotone books - a 32 page 'Listen,Repeat & Learn', and a 48 page 'Phrases & Useful Information for the Traveller'. (No tapes with these.)

Z5065 French (2 books) **£1.00**
Z5066 Spanish (2 books) **£1.00**

Finally, having learned your foreign language and journeyed to the country of your choice you'll need a map to get around, won't you? So to the first 100 customers who order a cassette we'll give you a FREE MAP, overall size 360 × 360mm. Only slight problem is if you're not going to France or Spain - we only have maps of those 2 countries!!

Z2126 Map of France
Z2127 Map of Spain

Two more audio cassettes arrived with this parcel:

Z2124 'Public Speaking' by Dorian Williams - C90 tape giving some very useful information on the subject. **£2.00**

Z2125 Hans Christian Anderson's Fairy Tales. A C90 cassette with 7 stories on it - inc The Gingerbread Man, Goldilocks, 3 Little Pigs, etc. **£2.00**

If you like what you see in this supplement make sure you don't miss future bargains - only £2 (UK/ BFPO; £4 O'seas) for the next 6 issues - see order form for details.

We are always looking for new lines to add to our lists. Send details/ samples of goods available to: The Managing Director
Greenweld Electronics Ltd
27 Park Road
Southampton SO1 3TB

TRIPLERS

Two types: both fully encapsulated with connecting leads.

Z5094 Made by Konig for Remo type D126 for Telefusion and ITT models.
Price .... **£1.50** 10+ 0.90 100+ 0.45

Z5095 Remo type D125 for 22-26 Korning 429 models.
Price .... **£2.00** 10+ 1.20 100+ 0.65

Z5103 Another tripler, type D125 .... **£1.00**

TOOLS

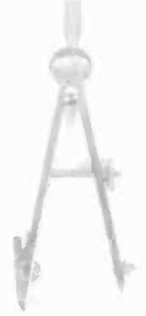
TWEEZERS

A wide variety of sizes and styles, from a small 86mm tweezer to a robust 205mm pair for heavy duty work. Sold in sets as described below at a substantial saving over the individual price; typically £6 per pair.

Z4192 Pack of 6 large pairs (over 130mm) **£6.95**
Z4193 Pack of 6 small pairs (up to 150mm) **£4.95**
Z4194 Pack of 6 selected pairs across the range **£5.50**

Z4255 These tweezers are finest quality stainless steel 130mm long with serrated ends.
Price **75p**

Z9235 A special tool for worglemongering anti-clockwise thripples.
Price **£24.85**



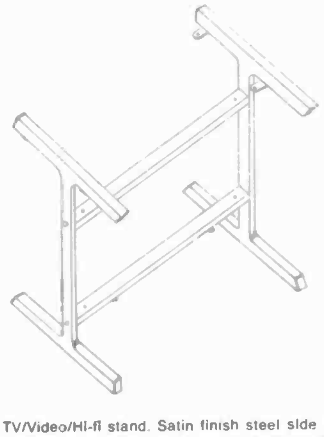
Z314 Precision spring bow compasses 88mm long. Max circle dia 70mm. Replaceable pencil lead and steel tip
Price **£1.00**

Z2315 Allen key, 4mm 27mm × 110mm **25p**

Please Note:

The Free Gifts offered in the Main Catalogue are not available with goods from Bargain Lists.

TV Stand



Z8930 TV/Video/Hi-fi stand. Satin finish steel side pieces with black ends held apart by veneered timber. Overall dimensions 485 wide × 350 deep × 450 high.
A bargain at .... **£2.50** 100+ 1.25

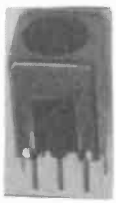
WOUND PRODUCTS

CHOKES/ COILS

TOKO RCL Coils all in 10 × 10mm screened cans.

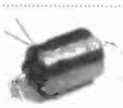
Code	Marking			
Z1561	90D0	162	002	86023
Z1562	90D0	156	002	86023
Z1563	00D0	920	002	84343
Z1564	90D0	180	002	86049
Z1565	00D0	915	002	86059
Z1566	90D0	175	000	86032
Z1567	00D0	163	002	84214
Z1568	90D0	913	002	85363
Z1569	00D0	086	002	84214
Z1570		919	002	8551X

All one price .... **25p each** 25+ 0.15 100+ 0.08
Any mix



Z588 Min coil in screened can. TOKO type 113CN 2249 HM.
Price .... **10/ £1.00** 100+0.04 1k+ 0.25
Z590 Sigma axial choke type SC10, 150μH.
Price .... **10/ £1.00** 100+0.04 1k+ 0.25

Z1817 Miniature axial choke SC30. 1mH.
Price **10/ £1.00**



Z1837 Choke 16mm long × 1mm dia 3.3mH.
Price .... **Pack of 5/ £1.00**

Z1760 Choke, high current, Ferrite rod 25mm long × 12.5mm dia wound with 120 turns of 22 swg enamelled copper wire. Useful in crossover networks.
Price **3/ £1.00**
Z1767 Choke, 56mH 10mm × 9mm dia.
Price .... **Pack of 10/ £1.00**
Z1964 50mH choke, fairly low current. PC mounting. Adjustable. 13mm dia × 12mm long.
Pack of 3 for **£1.00**

Fused Suppressor

Z003 This neat potted unit 60 × 45 × 30mm has screw terminal input for mains, 20mm fuseholder and output tags for appliance. Ideal for the suppression of small motors, etc.
Price .... **99p** 25+ 0.50 100+ 0.35

The 1992 GREENWELD Catalogue is out now! 132 pages of electronic and modellers supplies.

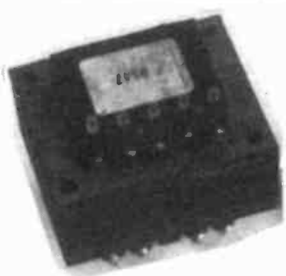
Only £2 (UK/ BFPO; £4 O'seas)

ORDER NOW!
See order form for details

Transformers

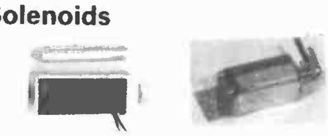
Z4316 Small mains transformer, 230V ac pri, sec 11-8-0-8-11V at about 100mA. Ex-equipment.
Price .... **Now reduced to 75p**

Z402 Double wound mains input 6-0-6V 100mA secondary. UK made, clamp construction. FC 55mm. Size 45 × 37 × 35mm.
Price .... **£1.00** 10+ 0.74



Z4248 Mains transformer, 110/ 240V input via PCB pins. Secondary; 6.5V @ 8VA; 22V @ 8VA; 22V @ 1VA; 1.5-0-1.5V @ 1VA. Nicely made by Skot.
Price **£3.00**
All mains primary. Secondaries as listed.
Z4213 25V 1.5A. Clamp type 70 × 57 × 47mm terminated with wires.
Price **£3.00**
Z4206 20-0-20 @ 3A + 24V @ 200mA plus a tap to increase these values by 10%. 86 × 72 × 86mm. High quality 'drop through' design. Tags.
Price **£7.00**
Z4292 Mains transformer size 80 × 80 × 66mm. 110/ 230V primary, 9V 6A secondary.
Price **£5.00**

Solenoids

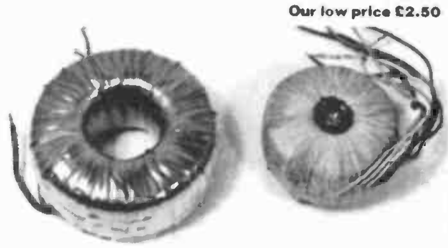


Z738 6V solenoid single hole fixing. 46×16×18mm.Slug is 45mm long×6.5mm dia with tapped cross hole and slot. 25mm pull... ... **£1.75**
Z2132 24V DC solenoid. Chunky coil made by Benson Ltd, type BDC3/62. 36 × 32 × 25mm with 4 tapped holes. Core 12.5mm dia × 37mm long with slot and hole.
Price **£2.00**
Z1433 12V solenoid by Airpax. Body is 37mm long × 19mm dia. Threaded bush 14mm dia for fixing. Plunger is 8mm dia and has attached a wire link. 3mm movement with supplied bracket attached - probably capable of more.
Price **£1.00**

Z2339 Heavy duty iron cored open wound choke by Siemens 58 × 23 × 26. B82503-U-A14 rated 100μH 10A 380V Ac. Probably more useful for the wire it uses - 50g of 16g ECW (about 3m).
Price **2/ £1.00**
Z2340 Encapsulated choke 77 × 32 × 27 by Siemens with screw terminals rated 65μH 25A. 9mΩ 500V
Price **£2.00**
Z5153 High quality totally screened mains filter unit by Siemens, B84112 rated 20A. 0.25 tags for line and load. Size 100 × 84 × 40.
Price **£6.00**

Transformers

Z9001 0-110-115-120, 0-110-115-120 primary, secondary 240V 10A and 6.3V 1A. Use as step up, step down or isolating transformer.
Price **£60.00**
Z9002 Same primary as above, secondary 23V 14.4A 331VA.
Price **£20.00**
Z9009 0-240V primary, secondary 0-11-12-13V 6.3A and 28-24-0-24-28V 7.2A.
Price **£20.00**
Z9003 0-220-240V primary, secondary 0-22.2-24V 3A & 11.2-0-11.2V 3A.
Price **£12.00**
Z9004 Autotransformer 0-220-225-230-235-240V output, 0-120-240V input. Rated 250VA.
Price **£18.00**
Z9005 0-220-240V primary, secondary 0-8V 1A; 16-0-16V 1A; 28-24-0-24-28V 12A.
Price **£30.00**
Z9006 20VA 12V @ 0.8A twice. DP £6.59.
Our price **£4.00**
Z9007 6VA 6V @ 0.5A twice. DP £3.86.
Our price **£2.00**
Z9008 Filament 6.3V @ 1.8A twice. DP £7.35.
Our price **£4.00**
Z4207 30V @ 1.5A, 6V @ 0.5A. 80 × 65 × 72mm. 4 way fix design. Tags.
Price **£4.60**
Z4212 Mains transformer - 0-110-120-240V primary, secondary 9-0-9V 2A and 20V 2A. Size 100 × 75 × 60mm.
Price **£3.00**
Z4369 Very useful 18VA mains transformer with 0-6, 0-6 secondary, each at 9VA giving 6V @ 3A or 12V @ 1½A. PCB mounting 65 × 52 × 28mm.
Excellent value **£2.50**
100+ 1.40
Z06518 Torroidal Transformer encapsulated unit 92mm dia × 40mm 120/240V input, output 30V 3A.
Price **£4.00**
Z2068 Transformer for line transmission. 2 bobbins, each with 2 windings as shown. 42 × 43 × 35mm. PC mounting.
Price **£2.00**
Z2305 Neat 6VA PCB mounting low profile mains transformer 53 × 44 × 22mm. Primary 0-120V, 0-120V, Secondary 0-15V, 0-15V, each at 0.2A. DP £8.33
£2.50 100+ 1.80
Z2306 6VA PCB mounting mains transformer 43 × 36 × 36mm. Primary 0-120V, 0-120V, Secondary 0-12V, 0-12V each at 0.25A. DP £6.09.
Our low price £2.50



Toroidal Transformers made by Belclere. These are all physically the same size, rated at 35VA but have different windings as listed below. 75mm dia × 33mm thick. Fixing by means of a tapped bush. All mains primaries.
Z4290 Type TR7353 5V 1.4A and 12-0-12V @ 120mA.
Price **£2.50**

Z4291 Type TR7252 12V @ 130mA; 12V @ 80mA; 5-0-5V @ 600mA.
Price **£2.50**

LARGE TRANSFORMERS

For callers only, or you to arrange transport. Although electrically OK, some of these transformers have slight damage on the frames and or chipped paxolin panels.
Z9020 240V pri; 52V 36A sec.
Price **£28**
Z9021 240V pri; 360V 6A sec.
Price **£32**
Z9022 220/230/240V pri; 55V 72A sec.
Price **£22**
Z9023 220/230/240V pri; 0-58.5-60.5-62.5V 20A sec.
Price **£18**
Z9024 220/240V pri; 170V 60A sec.
Price **£60**
Z9025 380V pri; 121V 6A sec. **£10**
Z9026 380V pri; 127V 6A sec. **£10**
Z9027 Choke, 76mH 31A. **£10**

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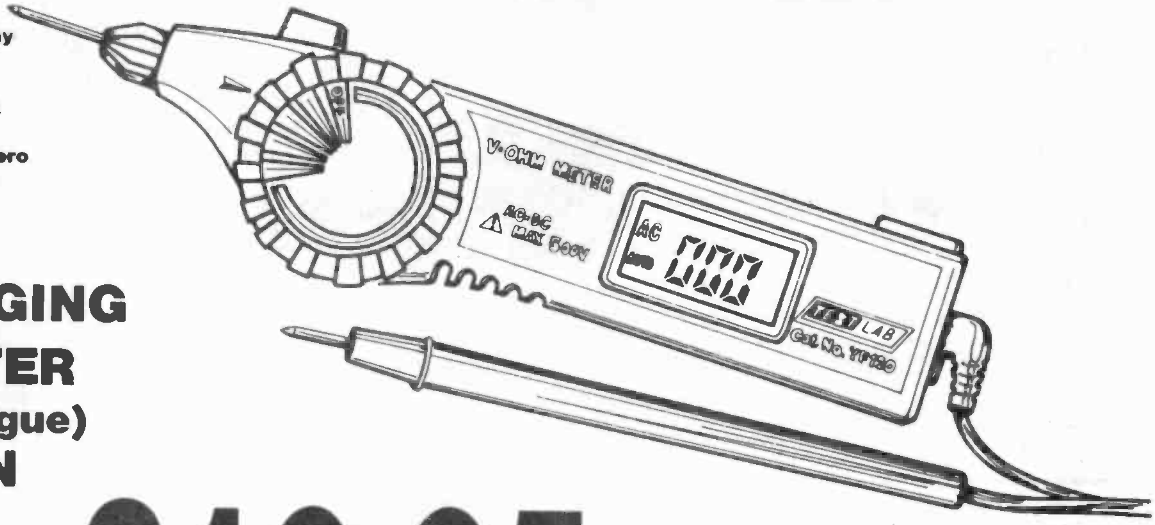

- ★ 3½ digit 8mm LCD display
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A £34.95 AUTORANGING MULTIMETER (1991 Catalogue) LESS THAN ½ PRICE!! YOURS FOR JUST

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AC volts	0-2-20-200-500 Vac ± 2.3%
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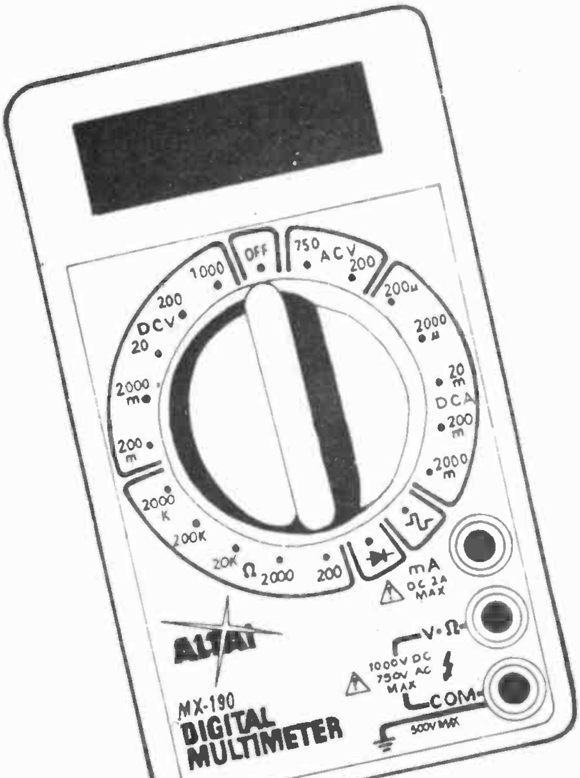
Resistance	0-200-2k-20k-2M-20MΩ ± 2%
Dims	133 × 29 × 17mm



- ★ 19 ranges
- ★ 3½ digit 12mm LCD display
- ★ Signal injector function
- ★ Diode test
- ★ Fuse protection
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- ★ Test leads with 4mm plugs
- ★ Battery and instruction manual included

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Specification

AC volts	0-200-750Vac ± 1.2%
DC volts	0-200m-2-20-200-1000Vdc ± 0.8%
DC current	0-200μ-2m-20m-200m-2Adc ± 1.0%
Resistance	0-200-2k-20k-200k-2mΩ ± 0.8%
Signal Injector	50Hz square wave 5V peak to peak
Dims	126 × 70 × 24mm
Order Code	**MX190**

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Ferrites

Z1386 Ferrite core, double aperture. 5.5 × 7mm .with 2 × 1.5mm dia holes. Few turns of easily removable wire.
Price 10/ £1.00 100/ 6.10

Z4393 Ferrite tube 9.5mm long 4mm OD 2.6mm ID.
Pack of 25 .... **£1.00** 1k + 0.015

Z4394 Ferrite Ring 12mm O.D. 7mm ID. 5mm thick in plastic housing and wound with a few turns of 4 strand wire, terminated on a DIL header plug.
Pack of 8 .... **£1.00**

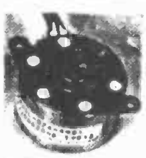
Z1896 Ferrite rings. These torroids are 26mm OD, 14.5mm ID and stand 15mm high. Material unknown. Made in Hungary. A similar size ring sells for around £1.50.
Our low price .... **4 for £1.00**

Stepper Motors

Z4089 12V 36R 7.5° stepper motor by Airpax. Size 58mm dia × 24mm. 20 tooth gear wheel 17.5 mm dia fitted to 6mm shaft.
Price **£4.00**

Z4386 Stepper motor, 48 step (7½°). Nice compact model 51mm dia × 24mm deep. 3mm dia spindle. Farnell model 147-879. Their price £14.40.
Our price **£5.00**

The following three models (and the fan) are all ex-equip, but in good condition. Really good value for the experimenter.



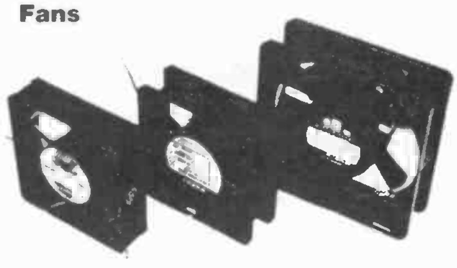
Z2129 24 step NMB PM35L miniature type 35mm dia × 23mm. 2mm dia spindle has brass gearwheel 6.5mm dia. 12V working.
Price **£2.50**

Z5072 Stepper motor by Phillips 58mm dia × 24mm thick. Fixing flange has mounting holes 67mm apart. 12V 36R coil with 15° step (24 per rev) 6mm spindle has 15mm dia gear wheel attached.
Price **£3.50**

Z5070 200 step Astrosyn 23LM-C228-P1. 6V 1.8°. Much heavier duty, this one 57mm dia × 17.5mm long. Attached is a slotted disk 36mm dia.
Price **£5.00**

Z5162 5V 3 phase stepper motor by Siemens. Not many; no further information. Overall length 97mm dia 36mm. Output to 5.8mm dia, 13 tooth gear.
Price **£5.00**

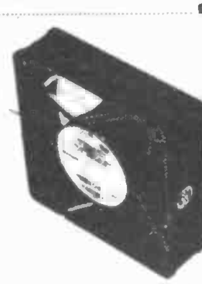
Fans



Z5020 Papst Multifan 3314. 92mm² × 32mm 24V DC nominal (12-30V). List price £20.49.
Our price .... **£10.00** 10 + 7.00

Z5021 Papst Fan. 119mm² × 38mm. Model 4650N 220V 50Hz. All metal construction. Wt 550gm. List price £16.99.
Our price **£8.00**

Z5006 120mm Fan Guard, 110mm FC Chrome plated steel.
Price .... **£1.20** 25 + 0.70



Z5071 Boxer fan 92 × 92mm 12V. Ball bearing, brushless.
Price **£3.00**

Z4056 'Patriot' fan. High quality cooling fan for mounting into equipment. 170mm dia × 51mm. Only probelm is they operate on 48V ac (but still work down to 24V).
Price **£3.00**

If you like what you see in this supplement make sure you don't miss future bargains - only £2 (UK/ BFPO; £4 O'seas) for the next 6 issues - see order form for details.

We are always looking for new lines to add to our lists. Send details/ samples of goods available to: The Managing Director
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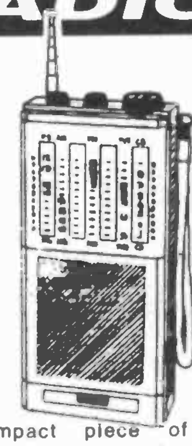
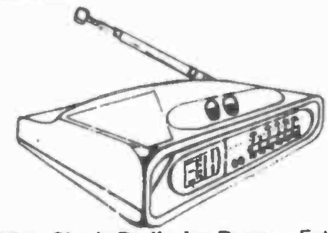
MULTIBAND RADIOS!



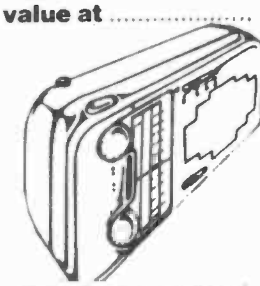
This compact piece of equipment 200 × 95 × 50mm comes in an attractive metallic grey case with controls on top - timing, on/off and volume, squelch. The telescopic aerial extends to 500mm and can be rotated in any direction. The 3 wavebands are:

1) CB, channels, 1-80
2) TV1 54-87 MHz & FM 88-108 MHz
3) AIR 108-145 MHz & PB 145-176 MHz.

The large 3" full range speaker delivers 280mW of undistorted power. There is an earphone jack and DC adaptor jack. The unit is powered by 4 × AA cells. All this technology for just **£17.95**
Order Code **MB100**



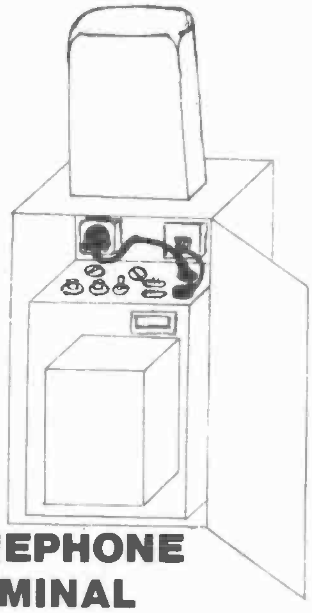
Z4357 Clock Radio by Ross. Extremely neat unit measuring 140 × 80 × 35mm. MW/FM bands, telescopic aerial, stand, carrying pouch and strap. Clock has LCD display and can be used in 12 or 24 hr mode. Alarm. Light. Earphone socket. Takes 2 × AA cells.
Great value at **£13.95**



Z8891 Superb 4 waveband radio by Ross, model RR5. Covers FM 88-108MHz, MW 518-1610kHz, LW 150-275kHz SW 5.7-18.1MHz (16.5-52.6m). Nicely styled case measuring 210 × 145 × 70mm with clear scale markings. Telescopic aerial, headphone socket. Volume, tone and tuning controls. ON/ OFF switch/ waveband selector switch and AFC switch. Mains/ battery. (Takes 4 × C cells). Originally retailed at £19.95
Our Price **£14.95**

ZONEPHONE ZAPPED!!!

You've probably seen in the press the much hailed personal phone has been a dismal flop - with 3 different systems and the restraints imposed on its use meant it had little practical value. Failure seemed inevitable - but there's a silver lining to every cloud and its an ill wind that blows nobody any good, etc, etc ... we've purchased some of the goods with more to follow.



ZONEPHONE TERMINAL

Z8956 These were the units screwed to various buildings throughout the UK which you stood next to whilst making a phone call with your incredibly useful handset! Too bad if you weren't in range (99.9% of the UK wasn't!) but it was a nice toy while it lasted. There was a lot of clever technology involved, and we're selling these at probably about 1% or 2% of their real cost! So what do you get for your money?

Well, a lot of case for a start - in the outer steel case (a) 480 × 300 × 150mm with fibreglass aerial case on top (b) 250 × 160 × 75mm, there's another steel case (c) 325 × 245 × 130mm and inside this there's a plastic box (d) 200 × 15 × 75mm.

(a) contains a metal surface mounting 13A socket and a BT line socket.

(b) has 2 whip aerials 200mm long terminated in PL259 plugs.

(c) contains 8V 3.8Ah sealed lead acid battery, mains transformer (10V 2A Sec), mains filter and a plethora of plugs and sockets mounted on top - 3 BNC and 2 × 9 pin 'D' type, also 2 fuseholders, a lead with 13Aplug and another lead with BT plug, and a power on/ off toggle. Screwed to the inside of the lid is a PCB 250 × 160 with lots of nice bits - 64180 CPU, 27C256 EPROM, 5256-15 256k RAM × 3, LM2940, LM317T, BD680 × 2, 3.6V AA size lithium cell in holder, about 30 various linear/ logic chips, 3 xtals etc, etc. (You're getting great value for money here!)

(d) contains the Tx/Rx panel 170 × 135mm. Lovely bit of kit, this, all surface mount - about 20 chips. Inputs and outputs are taken to 2 min PCB sockets.

There's another panel the same size in this box, with lots of hi-tech devices - 2 × TMS77C82 programmable 8 bit microcontroller, 77C01, TMS320MC10FNL 16/ 32 bit signal processor, LM2984 triple 5V output regulator and another 10 chips, 4 'D' plugs/ sockets and lots of other bits.

And that's about it!

The whole complete unit is yours for just £29.95

ZONEPHONE CASE

Z5165 Zonephone cases. Nicely made leather type finish case 190 × 55 × 35mm with velcro fastening, removable carry strap and further strap to hook on to belt.

To clear at .... 50p 100 + 0.25

NICAD BATTERY PACKS

Z2349 Nicad battery packs. Brand new, intended for use in zonephones comprising 4 × ½A size cells each rated 1.2V 0.45Ah, size 16.1mm dia × 28mm in a plastic housing easily removed. Solder tag connections. DP £9.92.

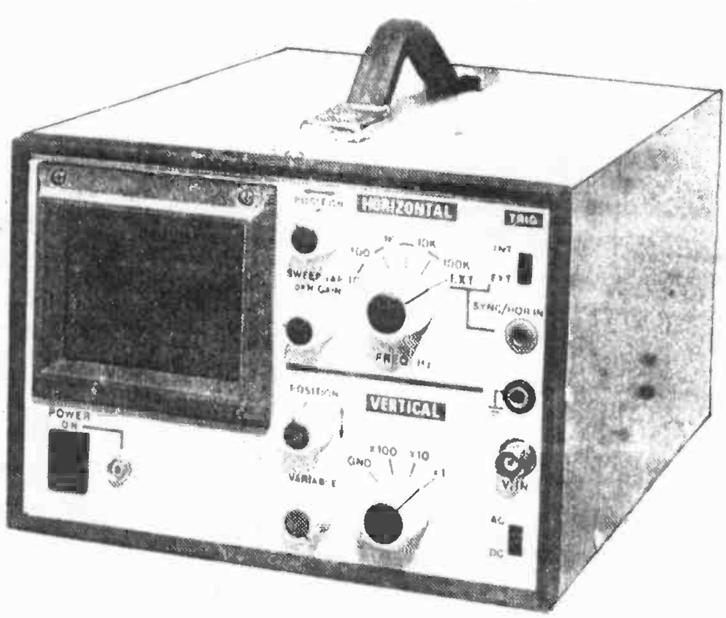
Our price . £2.00 100 + 1.00 1k + 0.70

£99 Oscilloscope

A high quality portable single beam oscilloscope with 3" CRT screen, high vertical sensitivity of 10mV/division, direct cascade amplifiers and a frequency range from DC to 5MHz. Ideal for lab, school and service use.

Vertical axis:	
Frequency range	AC: 2Hz—5MHz DC: DC—5MHz
Deflection sensitivity	10mV/div
Input impedance	1MΩ
Max. input voltage	500V p-p and DC
Horizontal axis:	
Frequency range	DC—5MHz
Deflection sensitivity	250mV/div
Input impedance	1MΩ
Max. input voltage	100V p-p and DC
Sweep range	10Hz—100kHz in 4 steps and H.EXT
Synchronizing	Internal/External
Power	240Vac 50Hz
Dims	160 x 202 x 305mm

Price £99 12+75.00



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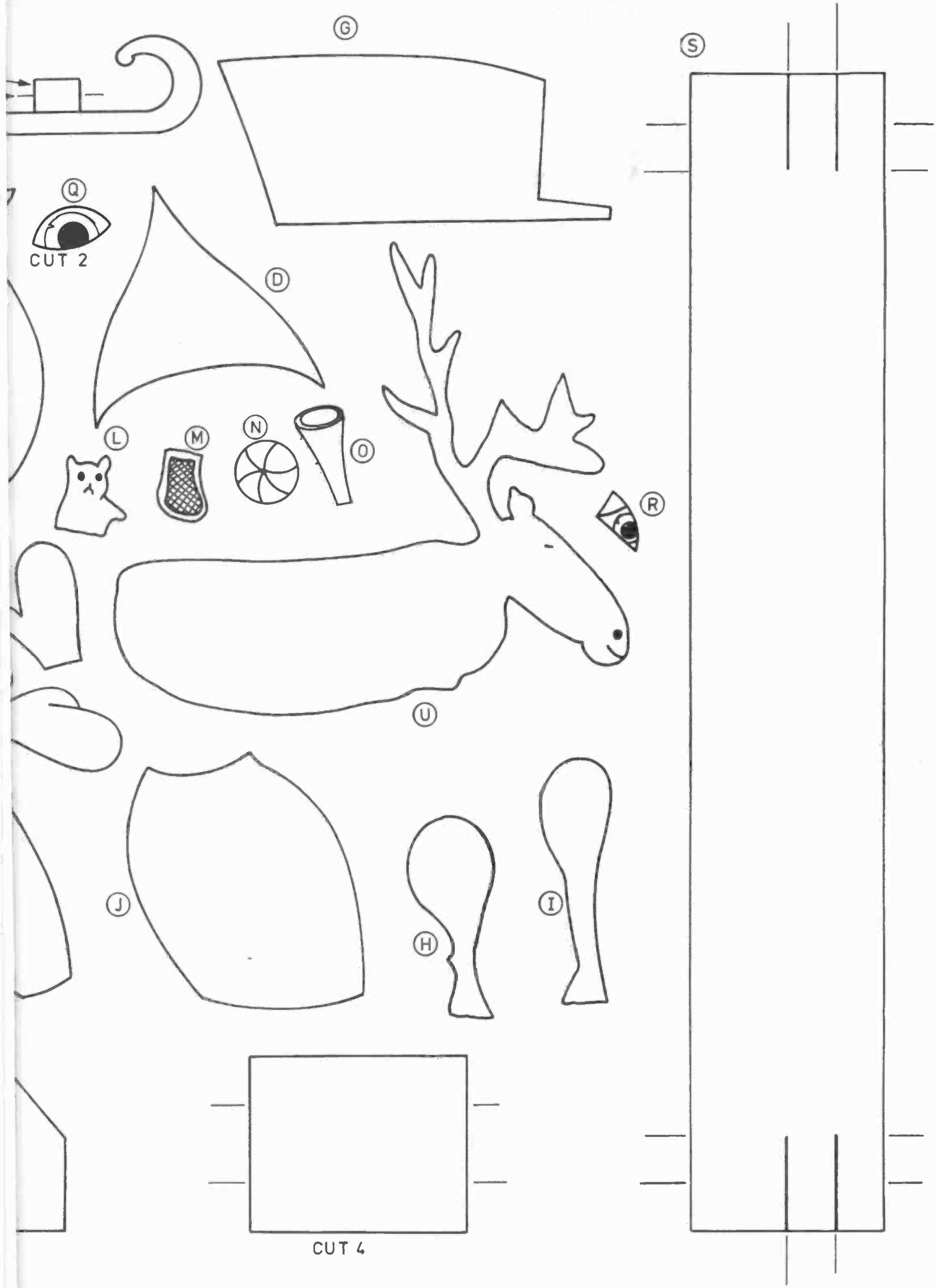
G
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CUT 2
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CUT 4

The runner is attached by two struts. Fold each strut back where it joins the runner (along the line), and fold up the end section at the other line. Glue the end section of each strut to the body of the sleigh. The lower edge of the runner is 20mm from and parallel to the lower edge of the base.

Cut out the sacks (j, k) from coloured card and glue these to the back surface of the sleigh; the larger sack (j) overlaps the smaller (k).

The drawings show a range of goodies to be coloured and glued behind the tops of the sacks, but you can make up your own selection. Perhaps you could draw presents that members of the family have received. Or you could cut out small photographs from the innumerable mail-order catalogues that drop through the letter-box during the pre-Christmas months.

The harness is made from gift-wrapping tape. Ours was a slightly metallised tape in a deep gold colour. Cut two short pieces and wrap them around the neck and body. Glue their ends to the back of the neck and body, leaving the tape fairly loose to give a rounded appearance. Glue a length to the inside of the neck-band, thread it under the body band and glue its other end to the sleigh. Finally, glue another length to the neck-band and let it curve in a graceful way, gluing it to the back to Santa's right hand.

The snowy terrain consists of a trough (s) made from white card, folded and glued, then glued along the lower edge of the baseboard.

Now for the final details. Glue Santa's mouth (p, in red card) in position and draw a semi-circle for his nose. Cut out and colour the eyes. Does he have blue eyes or brown? We thought that brown eyes suited our colour scheme better. The reindeer has a brown eye (r) too.

A visit to a stationer's shop will suggest innumerable ways of making the model look really festive. Ours is adorned with self-adhesive stars in various metallised colours. White cotton wool is used for Santa's beard, moustache and eyebrows, as well as for the trimming on his sleeves and the bobble on his hat. Just spread a little glue in the areas where the cotton wool is to be fixed, roll the cotton wool into shape and press it down. The trough is filled with cotton wool to just touch the runner and the feet of the reindeer.

CIRCUIT

The circuit is based on two astable multivibrators, referred to as the fast astable and slow astable respectively. An astable multivibrator is a circuit unit, the output of which alternates between high (+4.5V in this case) and low (0V) at a fixed rate. The astables comprise two inverting logic gates represented by the triangular symbols in Fig. 1. The outputs are at pin 4 and pin 12 respectively.

The rate at which the astable oscillates is determined by the value of the timing resistor and capacitor. The equation for the frequency of operation is $f = 1/2.2RC$. In the fast astable, R = 3.3M and C = 100n, so f = 1.4Hz. In the slow astable, R = 20M and C = 2µ, so f = 0.01Hz, or one oscillation in 88 seconds. The output from each astable is fed to another inverting gate, which acts as a buffer so that current can flow to the transistor switches without affecting the rate of operation of the astables.

The output of the buffer of the fast astable goes to a transistor switch TR1 which is turned on and off at the rate of 1.4Hz. When it is on, current flows through the

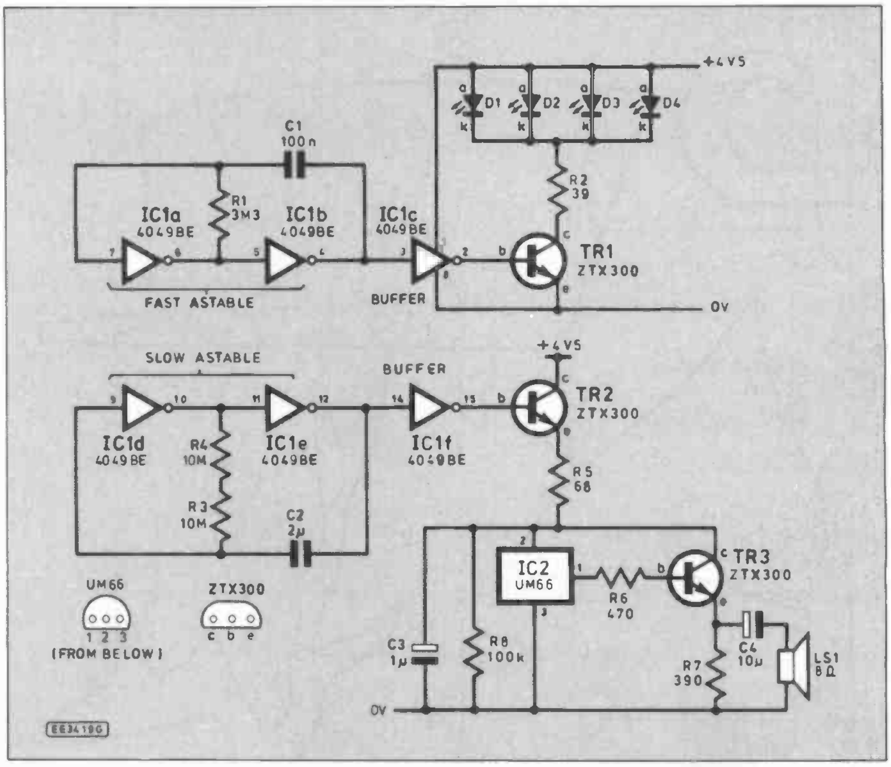


Fig. 1. Circuit diagram for the Christmas Decoration.

four light emitting diodes D1 to D4. These are high-intensity l.e.d.s and take a current of about 20mA each.

The output of the buffer of the slow astable goes to a second transistor switch TR2. When this is on, current flows through R5 to the music sub-circuit. R5 is a voltage-dropping resistor, since the medley i.c. (IC2) operates on a maximum voltage of 3.3V.

When TR2 goes on, a voltage appears across the sub-circuit and is held steady by C3. The medley signal comes from terminal 1 of IC2, is amplified by TR3 and drives the loudspeaker. When the tune has played once, it stops. After about 15 seconds the output from the slow astable falls and TR2 is turned off. C3 discharges rapidly through R8; discharge is essential since the fall to 0V on the sub-circuit supply resets the medley i.c. The medley repeats when TR2 is turned on again.

CIRCUIT CONSTRUCTION

The circuit is assembled on a 100mm square of thick (2mm card). Cut a circular hole for the loudspeaker, a few millimetres less in diameter than the speaker. Make holes in the board, using a sharp point or a 1mm drill. Insert the components (Fig. 2) and cut their leads to about 4mm if necessary. The large capacitor (C2) is laid on its side and held in place by a double-sided adhesive pad, or by Blutack. Its leads are bent sideways and inserted in the holes. Glue the rim of the loudspeaker to the *wiring* side of the board.

Wire up the board circuit as in Fig. 2. Check that the wiring to the loudspeaker does not touch against its rim. Small rectangles of p.v.c. insulating tape are placed where shown to prevent short-circuits between crossing wires.

When complete except for the l.e.d.s, check the following points; IC1 is in its socket the right way round, the transistors and IC2 are properly orientated, C3 and C4

COMPONENTS

Resistors

R1	3M3	
R2	39	
R3, R4	10M (2 off)	
R5	68	
R6	470	
R7	390	
R8	100k	

All carbon, 0.25W, 5%

See SHOP TALK Page

Capacitors

C1	100n polyester
C2	2µ polyester
C3	1µ elect. 15V
C4	10µ elect. 15V

Semiconductors

D1 to D4	high intensity light emitting diode (4 off)
TR1 to TR3	ZTX300 *npn* transistor (3 off)
IC1	4049BE CMOS hex inverting buffer
IC2	UM66 Type 1 medley generator

Miscellaneous

LS1 8 ohm miniature (38mm diam) loudspeaker; 16-way d.i.l. socket; p.c.b. eyelet terminals (3 off); 3-cell battery-box and suitable cells – see text.

Materials required

Thin coloured card (250g/m²), red, green and other colours; medium white card (1mm, 650g/m²) for the terrain and board supports; thick white card (2mm, 1500g/m²) 100mm square and 200mm x 150mm, alternatively painted white printed card as supplied (see Shop Talk and Special Offer pages); Tinsel; coloured self-adhesive stars etc., for decoration; cotton wool (white); clear adhesive.

Approx cost guidance only **£5**

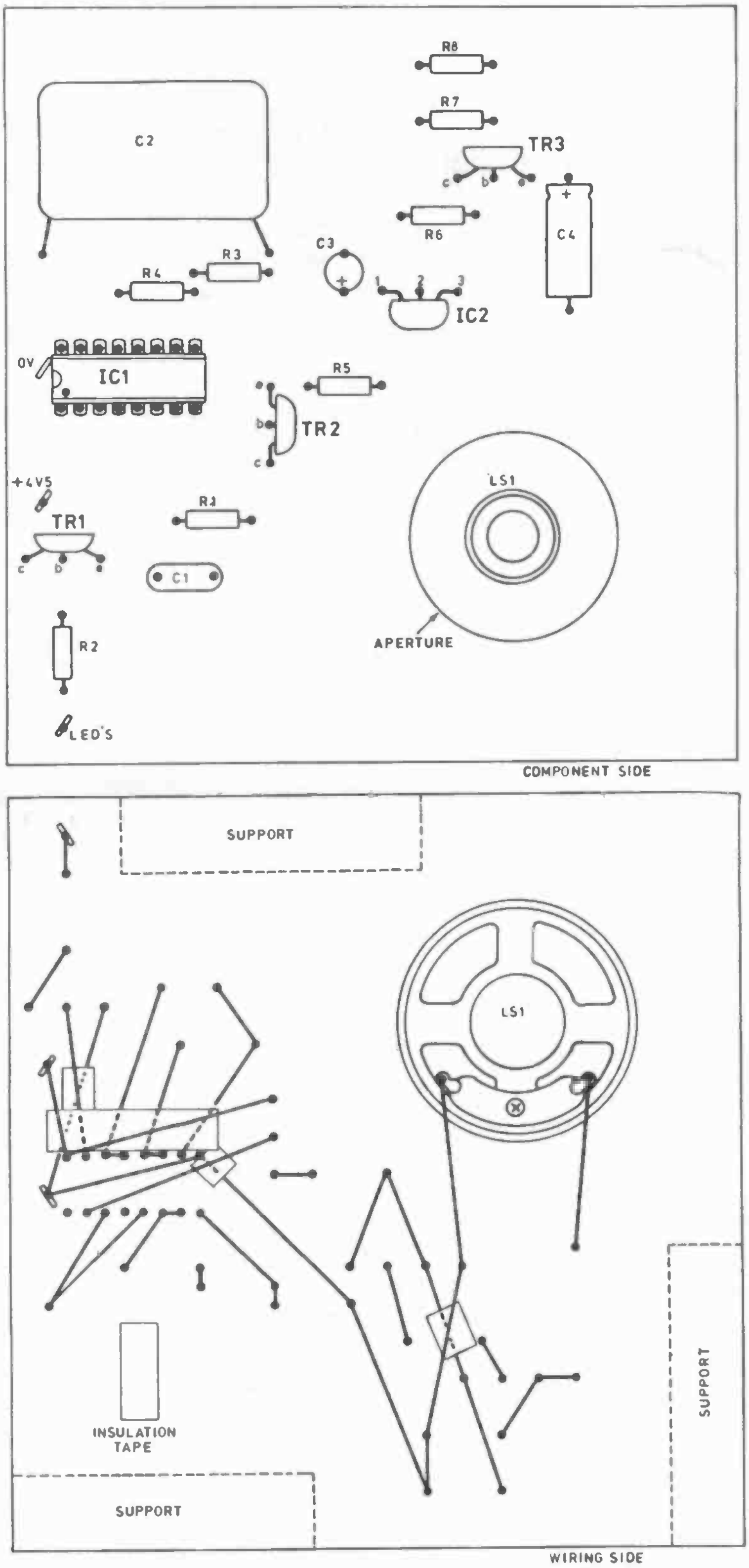


Fig. 2. Circuit card layout and wiring.

are connected with correct polarity, there are no connecting wires touching (particularly in the vicinity of IC1), unwrapped "tails" at the ends of wires are not contacting adjacent wires or pins.

Test the circuit by applying battery power. The circuit operates on 4.5V (three 1.5 cells in a battery box). Operating it on a higher voltage is likely to destroy the medley-making i.c. The tune may start as soon as the power is applied, or there may be a delay of about 30 seconds, depending on the state of the slow astable to begin with.

The voltage level at pin 2 of IC1 alternates between 0V and 4.5V about twice a second; this is the output of the fast astable. If you have a breadboard or a supply of test leads with crocodile clips, temporarily connect the l.e.d.s (in parallel) between the +4.5V terminal and the l.e.d. terminal. The l.e.d.s flash brightly about twice a second. If the circuit is not working, remove the battery, check the wiring and other points again. If the l.e.d.s fail to flash, it may be because they are connected with the wrong polarity. Normally the cathode wire (which connects to the l.e.d. terminal) is identified by a "flat" on the rim of the l.e.d., but we found that the special high-intensity l.e.d.s used in the prototype had the "flat" by the anode wire.

SLOWER

If you feel that it would be better to have the tunes played less frequently, you can make the slow astable run even more slowly by increasing the capacitance of C2. This is best done by using a 4μ7 capacitor or by wiring a second (or even a third) 2μ capacitor in parallel with C2. A second capacitor halves the rate at which the medley is repeated.

The extra capacitors could be stacked on C2, and held in place by adhesive pads. It is essential to use polyester capacitors or another low leakage type. Although electrolytic capacitors have high capacitance and might be thought suitable for the low astable, they have relatively high leakage. The current flowing through the 20M combined resistance of R3 and R4 would mostly leak away through the capacitor, which would thus fail to charge.

When the circuit is working properly, lay it on a sheet of newspaper, wiring side up, cover the loudspeaker with a scrap of paper and spray the board with p.c.b. lacquer. This step is not essential but it serves to hold the wrapped wire more securely in position, especially the wires around the pins of the i.c. socket.

FINAL WIRING

Make three supports from medium-thickness card. Bend these twice. Glue one flap of each support to the wiring side of the circuit board. Glue the opposite end of each support to the rear of the base-board (Fig. 4). Bore holes in the base-board just wide enough to allow the l.e.d.s to be inserted from the rear. A drop of glue holds each l.e.d. in place. Cut their leads to about 5mm long.

Run a wire from the +4.5V terminal to the cathodes of the l.e.d.s. Run a wire from the l.e.d. terminal to the anodes. These are rather long runs, so keep the wires as tight as possible, so that they do not come into contact with each other. Use pieces of insulating tape to separate the wires, if necessary.

BATTERY

The average current consumption is about 40mA, and the model is likely to be run for several hours at a time during Christmas, so it is preferable to use size C or D cells in the battery. A battery box holding three cells in a row can be wrapped in Christmas paper and disguised as a Christmas cracker or as a wrapped gift. Alternatively obtain the supply from a 4.5V d.c. mains adaptor.

READY FOR ACTION

We have not provided a switch, since it is usually more convenient simply to twist one of the power leads around the power terminal when the novelty is to be set working. If it is to be hung on the Christmas tree or among other decorations, attach a loop of tinsel or coloured cord to the upper edge of the base. The battery, suitably disguised as described above, is hung from an adjacent branch. Alternatively, make a cardboard support so that it can be rested upright on a horizontal surface.

The antlers may have flattened by now so spread them out sideways. The upper parts diverge slightly from each other, but the lower, forwardly-directed branches are spread wide apart to give the beast a fierce (!) appearance head-on. □

Special Series

MAGNETIC RECORDING

Part 3: Head Maintenance

VIVIAN CAPEL

Life today would be difficult to imagine without magnetic recording: No audio or video recorders; no computer disks; no payphone cards; no bank cash cards or magnetic security pass cards. In spite of its universal use, magnetic recording and the principles of magnetism are still little understood by most people. In this short series we hope to answer some of the questions most often asked about Magnetic Recording.

THE MAJORITY of problems that occur with audio tape recorders are due to head faults and mechanical failures. Of these, the heads are the most common culprits, which is not surprising considering that in a cassette recorder, 562.5ft (168m) of moving tape is pressed against them every hour of recording or playback.

The principal cause of trouble is loose oxide particles from the tape. While with modern good quality tapes only a very small number of particles in proportion to the total becomes free from the binder, with thousands of feet of tape passing, the number soon builds up.

These are deposited on the head face and attract others. In time a blob of significant size accumulates which is compacted by tape pressure to form a hard mound that adheres strongly to the face.

TENTING EFFECT

What then happens depends upon what part of the head-face it happens to be. Often the particles are pushed by the tape to the furthest point of contact. Being well past the gap, the deposit may not have any great effect. But if it is near the gap, the tape rides over it and produces a *"tenting"* effect whereby the mound holds the tape off from the head-surfaces on either side of it (Fig. 1).

The loss of intimate tape/head contact across the gap affects recording differently from playback. With recording, the flux must pass through the space formed by the "tent" before it reaches the tape. Thus less flux actually penetrates the tape coating, so the recorded level is lower and noise is increased.

It is even worse if the deposit is across the gap itself. Then, in addition to holding the tape off, it also forms a magnetic short-circuit which bypasses a lot of flux. This further reduces the flux reaching the tape and decreases recording level.

The tenting effect is more serious with playback than with recording. The physical size of the field eminating sideways from a bar magnet is dependant on its length. It extends only half the distance compared to another magnet that is four times as long. Now the length of the recorded zones on the tape depends on the recorded wavelength, which in turn depends on the frequency. High frequencies have short wavelengths and therefore short magnetic recorded zones.

This means that the field from a recorded high frequency extends outward from the tape only half the distance compared to that from a frequency that is two octaves below. Tenting effect thereby reduces the fields picked up by the gap from high frequencies, to a greater extent than those received from low frequencies. So, tapes played with a dirty playback head lose more treble than bass and thereby sound muffled and lacking in top.

The fact that dirt on the head has a more serious effect on playback than recording is really an advantage. It has happened that a tape has been recorded, but sounded awful when played back. Examination of the record/playback head revealed it to be dirty.

As the recording was made with the head in this dirty condition, it seemed logical that the recording was ruined and was useless. But this has not always been so. On cleaning up the head and replaying the tape, it has often been found that though not perfect, the recording is quite acceptable.

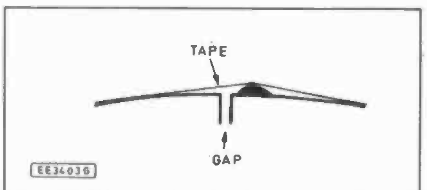


Fig. 1. 'Tenting' effect. A blob of dirt holds the tape off from the gap producing low-level recordings, and loss of field from short magnetic zones (high frequencies) during playback.

Another possible effect from dirt is tape *flutter*. Deposits tend to be sticky and thereby impede the smooth passage of the tape over the head. It passes in a series of minute snatches and jerks as the deposit alternately holds and releases the tape. Sometimes an audible squeak can be heard from the head with the volume turned right down.

The reproduced effect is distortion. If it was present during a recording, it is permanently recorded and nothing can be done to save it. If though it is heard when playing a tape that was previously free from it, there is no permanent damage and cleaning the head should restore things to normal.

HEAD CLEANING

The obvious solution to all these problems is to keep the heads clean, yet it is a chore that is often neglected, and many recorder owners seem unaware of the need of doing so. I once worked in the service department of a well-known tape-recorder manufacturer and was surprised how often machines were returned for repair with nothing wrong with them other than dirty heads.

An easy way to clean heads is to use a head-cleaning cassette which usually contains a length of woven fabric "tape". When this is "played" it removes oxide deposits by friction. The suggested frequency of use is once every 25 hours, but this is not critical enough to warrant keeping an accurate log of playing time.

Unlike a worn gramophone stylus a dirty head will not damage the tape. Overuse could accelerate head wear, so there is something to be said for using it only when the sound begins to deteriorate.

The best method is hand cleaning, which is easier if full access to the heads is obtained by removing the cassette flap. The flap is usually retained in the open position by side pieces that have small side projections which engage against the inside of the case.

Removal can be effected by gently pressing the side pieces inward until the projections disengage, whereupon the flap can be lifted off of its pivot. A spring may also need to be disengaged from its retaining hole. The flap is re-fitted by reversing the process. After the first time, further flap removals and head cleanings are that much easier.

With the flap out of the way, the state of the heads can be observed; a magnifying glass is useful for this. If they are still not very accessible, press the play button to bring them down into the playing compartment. *It is important to ensure that the power lead is disconnected and the* *batteries removed when carrying out this operation.*

Cleaning can now be carried out by using a cotton bud and head cleaning solution. A cheaper alternative to proprietary cleaners is industrial alcohol or methylated spirit. Wet the head face thoroughly and remove all visible deposits, using a magnifying glass to make certain that the smallest deposit has been eliminated.

It is important that after doing so, and *before* the head is dry, the face is polished with a dry bud (the other end of a dual-ended one). If this is not done a sticky film may remain. As the cleaner evaporates quickly, polishing must be started as soon as the dirt has been removed.

Take a look at the rubber pincher roller, drive capstan, and tape guides. Deposits can also collect on these, producing speed irregularities and the effect known as *wow*. Clean as required.

Hand cleaning with buds is gentle and can be done as often as needed without causing head wear. It is also more thorough than cleaning tapes as they can and often do leave stubborn deposits untouched.

WEAR

A flat channel, the width of the tape, is sometimes worn across the head face and gradually gets deeper as wear continues, see Fig. 2. With a permalloy head, the most common and softest head material, the beginnings of a channel becomes evident quite soon after the head is new, but it takes much longer to appear with ferrite or HPF.

Of itself, the wear has little effect until the channel is really deep, providing that it is even. It is when it is uneven that problems arise. A dimple can appear near the gap which prevents intimate tape contact, thereby causing high frequency loss. The edges of the laminations can become rounded or jagged so increasing the effective gap width thereby reducing playback high frequency response.

Part of the shim can break off leaving a cavity in the gap. At best this allows part of the flux to bridge the gap internally instead of externally through the tape, but in addition, oxide deposits can collect in the crevice so providing a low-reluctance path that further reduces the flux through the tape.

Crevices or uneven edges tend to quickly collect debris from the tape, necessitating frequent cleaning of the head. So if a head often needs cleaning it is usually a sign that it is badly worn and it is time to replace it.

Before doing so though, examine it under magnification and if there seems no serious unevenness of wear try a different make of tape. Sometimes a faulty batch of tape comes on the market that sheds oxide readily, though this is rare with the reputable makes.

Cases have been known where the sides of a worn channel grips the edges of the tape causing it to bind or curl. Yet otherwise the wear is even and has no effect on reproduction. In such cases, the edge of the channel furthest from the gaps can be smoothed over by the careful application of a very fine wet-and-dry emery paper, (Fig. 2).

Normally one should *never* introduce an abrasive to the heads, but as the head must otherwise be replaced, nothing is lost by trying to improve matters. Use the paper wet and concentrate the gentle rubbing action against the lower ridge, avoiding the face as much as possible.

This is best done by cutting a strip of wet-and-dry about one-eighth inch wide (3mm) and drawing it sideways back and forth along the edge of the ridge. Leave the other ridge adjacent to the gap strictly alone, it only needs one to be levelled to stop binding; abrading the other will be sure to damage the gaps.

MAGNETIZATION

In time, the head can acquire a degree of permanent magnetization. The effect is to add noise to recordings. *Demagnetization* should be carried out periodically and can be accomplished without the need to remove the cassette flap. A demagnetizer consists of a coil in a plastic handle with a probe running through its centre and extended from the end so that it can be introduced to the head. Some are cranked at the end to facilitate easy application to the head.

The coil is plugged into the domestic mains supply, and the probe placed against the head. A plastic cap prevents it scratching the face. The probe is then gradually pulled away from the head face, which is thereby demagnetized.

What happens is that the head material goes through successive but diminishing *hysteresis* cycles as the probe is drawn away, until finally it is left with zero magnetization. The recorder MUST be switched off for this operation otherwise a very loud hum will result which could damage the speakers.

Some head-cleaning cassettes also demagnetize the heads by means of internal revolving magnets. The effect is rather less positive than the mains operated demagnetizer.

AZIMUTH

Azimuth describes the sideways tilt of a record or playback head. The head gap is a vertical slit which records magnetic zones consisting of a series of vertical stripes, wide ones for low frequencies and narrow ones for high. Imagine a playback head slightly tilted to one side so that the gap is not vertical. The gap now forms a diagonal across two or more adjacent narrow recorded stripes although it may not span more than a single wide one.

The resolution is thereby reduced; the effective width of the gap is increased to that of its vertical projection (Fig. 3). Thus the reproduction of recorded high frequencies is impaired, although that of low frequencies is unaffected.

Let us now consider the situation when the *recording* head gap is tilted. The resulting recorded magnetic zones are not vertical but tilted the same way as the gap. If these are played by a vertical playback head, its gap thereby forms a diagonal across them just as in the previous case, (Fig. 4). So the result is the same, loss of high frequencies when reproduced.

If though the tape with tilted zones is played on the *same* single-headed machine that recorded it, the head gap is aligned to the angle of the zones and there is no h.f. loss. This is why tapes recorded on a machine with a mis-adjusted head sound perfectly normal on the same recorder, but fuzzy on any other, while tapes recorded on other machines sound poor when played on the first machine. This effect often perplexes recorder owners!

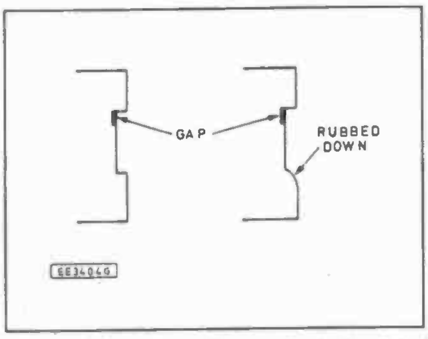


Fig. 2. A channel may be worn in the head that grips the tape, producing speed irregularities (a). The effect can be eliminated by carefully rubbing down the ridge furthest from the head gaps with fine wet-and-dry emery paper.

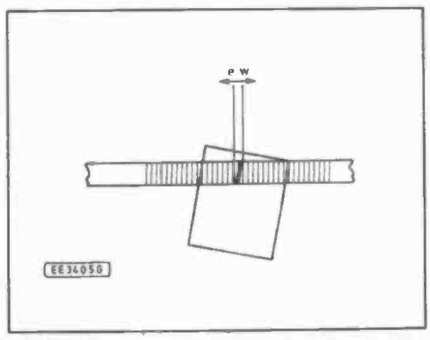


Fig. 3. Incorrect azimuth. The gap of the tilted head spans more than one vertical recorded zone thereby increasing its effective width (e.w.), so reducing resolution and losing high frequencies.

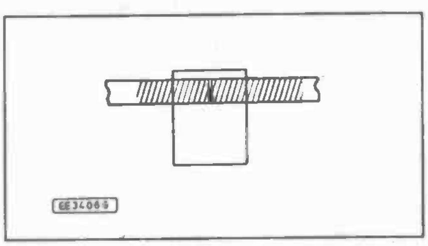


Fig. 4. A tape recorded with an incorrect azimuth head has slanting magnetic zones and so results in high frequency loss when played with a head that is correct. There is no loss when played with the same head that recorded it.

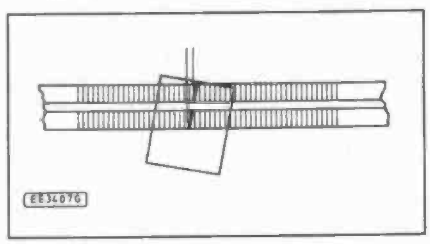


Fig. 5. Playback with a stereo head of incorrect azimuth not only suffers loss of h.f., but has one channel lagging in time behind the other, so producing phase errors between channels and thereby impaired stereo.

IMPAIRED STEREO

There is another effect of mis-aligned heads, and that is impaired stereo. Taking a look at the exaggerated mis-aligned stereo head in Fig. 5, it is evident that one gap is displaced laterally from the other along the tape, whereas they should be exactly vertical. So, one gap will be ahead of the other in reading its track. Phase

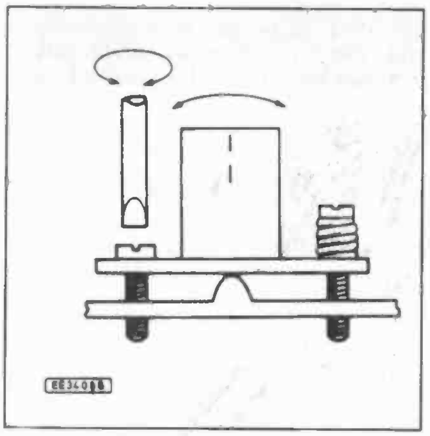


Fig. 6. Azimuth is adjusted by rocking the head over a central pivot against the tension of a spring.

differences, which are really differences, that were present in the original recording will thus be altered, and spurious ones introduced.

As stereo location is conveyed principally by the phase relationship between the two channels, it is evident that a mis-aligned head will give poor and inaccurate stereo. However, a stereo recording made and played back on the same single-head machine will not be impaired because it will be played back as it was recorded.

AZIMUTH ADJUSTMENT

With some machines the record/playback head is bolted rigidly to the sub-chassis and so no adjustment is possible. With others the base of the head is mounted across a ridge running from the back so that it can rock from side to side. There is a flange on each side of the head, each having a screw securing it to the sub-chassis. One of these has a spring under its head which holds the flange in place when the other screw is adjusted (Fig. 6).

The audio engineer adjusts the azimuth by using an audio oscillator and an output meter. A 10kHz signal is recorded on a cassette using a recorder known to have a correct azimuth, or a pre-recorded test tape. The tape is then played on the machine to be adjusted and the head screw rotated to obtain a maximum reading on the output meter.

For a stereo recorder the output of one stereo channel is fed to the *Y* and the other to the *X* plates of an oscilloscope. A *lessajou* figure is obtained that indicates phase difference, (Fig. 7). Azimuth is adjusted for minimum phase difference.

If you have no test equipment, do not despair, an accurate adjustment can still be made if you have a good ear. Record some f.m. interstation noise on a radio cassette recorder that is known to be correctly adjusted. This is known as "*white*" noise.

Play the "noise" tape on the machine to be set up and listen carefully. Set the head for maximum "hissiness", turning the screw to both sides of maximum with decreasing adjustments until it is spot on the maximum setting. Machines carefully adjusted in this way have later been checked with instruments and found to be at optimum, and that no further improvement could be made.

Remember that if the azimuth is incorrect, there will be no impairment of the sound of tapes recorded and played back on the same instrument, but it will be incompatible with all other machines and with pre-recorded tapes.

HEIGHT AND TILT

The height of the head must be such that the tape path past *all* heads and guides is a perfectly straight line. If this is not so the tape will curl and distort, or in the case of a cassette recorder in which the heads move in to engage with the tape, one of the head-guide arms will foul the tape causing a series of creases along one edge (Fig. 8).

Usually, the head height is not adjustable and the guides are fixed to the side of the head, so no height setting is required, but in some models it is adjustable. It is not unknown for a head guide to become loose and mis-positioned, especially on an erase head which, having a plastic encapsulation, does not have its guide welded on as does the metal-cased record/playback head. The result, can be tape damage as described. There may also be fore and aft tilt adjustment but this is normally only found on open-reel machines.

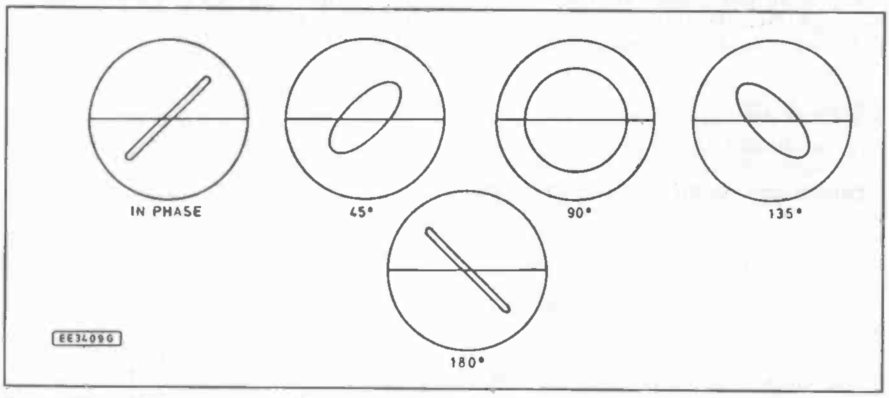


Fig. 7. Phase differences revealed by scope traces. The two stereo channels carrying a recorded fixed h.f. tone, are fed into the X and Y scope inputs. The azimuth is adjusted for the 'in phase' trace.

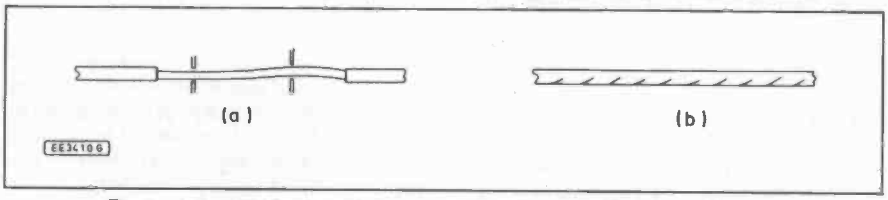


Fig. 8. A tape guide out of line (a), can produce creasing of one edge (b).

ERASING

An essential part of any tape recorder is the *erase* system. It is this that gives the medium its remarkable versatility; tapes can be re-recorded over and over again with no deterioration. Any wear is due to the friction of the tape passing over the heads not by re-recording. An equal amount of wear will result from the same number of playings of the initial recording.

The erase head clears all previous recordings by brute force. In the case of *d.c. bias* it also plays an important part in the actual recording process as described more fully in a previous article. Briefly, the tape is magnetically saturated by the erase head. The bias applied by the record head is of opposite polarity from this so that the operation is brought down to the long straight demagnetization portion of the *hysteresis loop*.

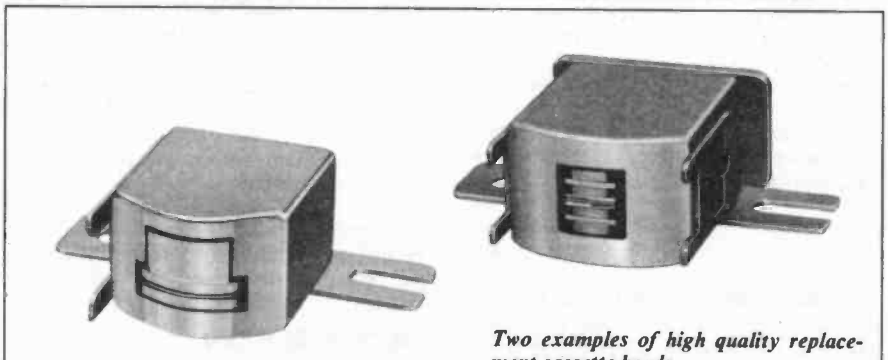
Sometimes d.c. erasure is used with *a.c. bias*. In this case, the tape saturation plays no significant part in the recording and serves only to wipe out previous recordings.

D.C. erasure can be accomplished either by a permanent magnet or a d.c. current passed through the windings of an erase head which is similar in construction to the record head. When a magnet is used it cannot of course be switched off so it must be physically retracted from the tape path during playback.

For ***a.c. erasure***, the full output of the bias oscillator is applied to the erase head. Unlike the bias therefore, its exact value does not need to be pre-set. It is usually about a hundred times the bias current.

The erase-head gap is large, typically 200μm, and thereby penetrates right through the tape coating to leave no trace of signal buried beneath the surface. It also covers almost half the width of the tape, thereby erasing a mono or pair of stereo tracks from tape edge almost to the centre. A narrow centre area is left to avoid erasing any part of the inner track on the other half.

Next month: Head Driver Circuits.



Two examples of high quality replacement cassette heads.
(Courtesy of Hart Electronic Kits.)

Constructional Project

AUTO NIGHTLIGHT

A. R. WINSTANLEY

A simple-to-build unit which operates and automatically dims a low voltage nightlight for the nursery.

DURING the early years of infancy it is often comforting to a child to be able to sleep in surroundings which are illuminated by a gentle nightlight, in order to allay any fear of the dark that the child may have. Hopefully, it is not necessary to keep the room's main light switched on, and with luck a small lamp such as a pygmy-type will have the necessary calming effect.

Often a "plug light" is used, which comprises several neon bulbs encased in a translucent plug top. These form a cheap solution, but they can obviously only be placed where the mains socket is located. An alternative is the traditional candle nightlight, but there are obvious drawbacks relating to safety and peace of mind.

The Auto Nightlight is a simple mains-powered low-level lamp but which has the added attraction of automatically dimming itself over an hour or so, if required; the design is obviously an improvement over a simple plug-type nightlight, since you can firstly select either "auto-dim" mode or "bypass' where the lamp will be continuously alight. Secondly, the lamp itself can be placed exactly where you require it – next to the cot, for instance – since the lamp operates at 12V and there are no potentially hazardous mains cables trailing everywhere.

CIRCUIT DESCRIPTION

The circuit itself is extremely straightforward and is ideal for the less experienced constructor wishing to tackle a simple mains-powered project for the first time. The circuit diagram of the Auto Nightlight is shown in Fig. 1.

Mains voltage is switched through S1, the On/Off control, and passes via a protective fuse FS1 to the primary windings of transformer T1, where it is stepped down to 9V a.c. This lower voltage is full-wave rectified by the bridge rectifier D1-D4 to produce a direct current. Capacitor C1 is a relatively large smoothing capacitor which smoothes out the ripple content of the bridge rectifier output, the net result being a d.c. voltage of approximately 15V-16V no load, 11V-12V on load.

A single pole changeover switch S2, which is a centre-off type, is biased one way. When the switch is moved to the "DIM" position, capacitor C2 charges up from the 12V supply rail; when the switch is released, it returns to the centre-off position but the charge on C2 is retained. Positioning S2 in the other direction would connect C2 continuously to the positive rail.

The Darlington transistor TR1 can be considered as two transistors in one package, as depicted by its schematic symbol. It is a very high gain transistor, a figure of 20,000 being typical. This implies that compared with a normal bi-poplar transistor, TR1 requires only a very tiny base current to saturate the transistor hard on. The Darlington in fact acts as a driver transistor for TR2, with a higher permissible collector current rating than the Darlington itself; hence, TR2 can drive a larger load than could TR1.

Once capacitor C2 is fully charged in the "DIM" mode, both transistors turn on like a switch. TR1 requires its base (b) to be 1.2V more positive than its emitter (e) because it contains two transistor junctions, whilst TR2 base must be just 0.6V more positive for that transistor to conduct.

Since the voltage at C2/R2 junction is about 12V due to the charge stored on capacitor C2, both transistors switch hard on or "saturate". This completes the circuit to lamp LP1, a 12V 2.2W bulb connected via jack socket SK1, and LP1 will therefore illuminate.

Capacitor C2 will discharge very slowly through resistor R2 via the base terminals of TR1 and TR2 to 0V. However, provided that the potential at TR1 base remains at 1.8V or more, both transistors will remain on, and hence the bulb will remain alight. Once the voltage drops to below this figure, the transistors will start to turn off, with the effect that LP1 will be seen to dim very slowly until it has extinguished altogether.

Unfortunately, it is very difficult to predict precisely the time period that will elapse before LP1 extinguishes. This is because of the very large manufacturing tolerance on capacitor C2, typically its value is 330μF −50% +100%.

The prototype Auto Nightlight started to dim after about 50 minutes or so. This was considered adequate for this application. The fact that the lamp stays fully alight for quite some time before starting to dim was also considered beneficial.

As mentioned earlier, if switch S2 is moved to the "ON" position, then the base of TR1 is connected via resistor R2 directly to the positive supply rail. In this case the dimming function is bypassed and the lamp will remain fully alight. Under these circumstances it is necessary to turn off at the mains in order to extinguish the lamp, due to the charge that is stored on C2.

CONSTRUCTION

Most of the components, including the mains transformer, are mounted onto a printed circuit board (p.c.b.), see Fig. 2. This is available from the *EE PCB Service*,

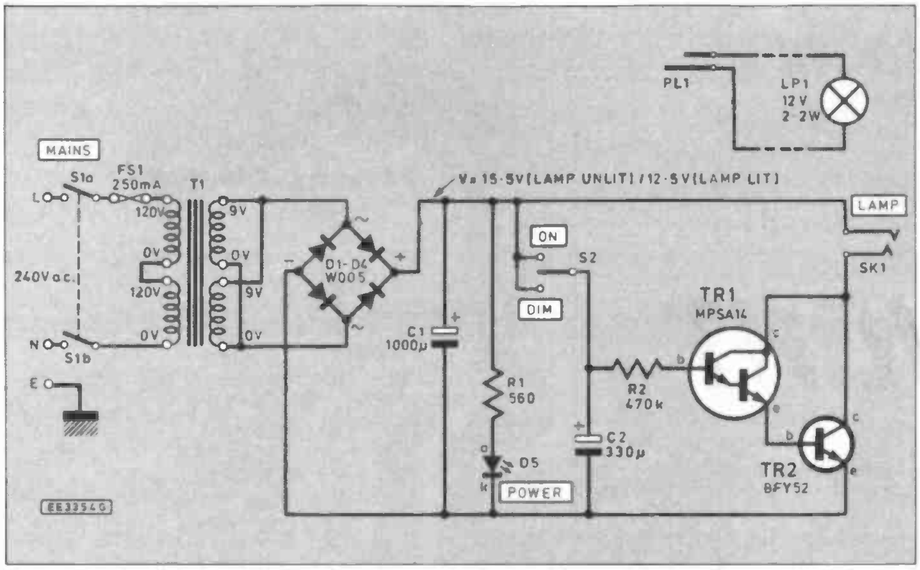


Fig. 1. Complete circuit diagram of the Auto Nightlight.

code EE779, or can be home-made in the usual manner. Only an *experienced* constructor should attempt to translate this circuit onto stripboard instead of using a p.c.b., because the board contains a mixture of mains-operated and low voltage parts.

The p.c.b. was designed, by virtue of its fixing centres, to fit into a Verobox No. 75-1238D measuring 155mm x 85mm x 60mm but any other similar case would suffice. The approved box has a top and bottom moulding in plastic but has front and rear panels made of attractive anodised aluminium.

The layout of the components and full size copper foil master pattern is illustrated in Fig. 2. Even the fuse and mains transformer are p.c.b. mounted, thus reducing mains interwiring and making construction easier and safer.

It is best to start the assembly by soldering the smallest components into place, so start with the resistors and transistors, observing correct orientation of the transistor leads and taking care not to heat the semiconductors excessively. A push-on TO-5 type heatsink was fitted to TR2 to aid dissipation once the bulb starts to dim; it may be possible to omit the heatsink, otherwise fit it prior to soldering the device into place.

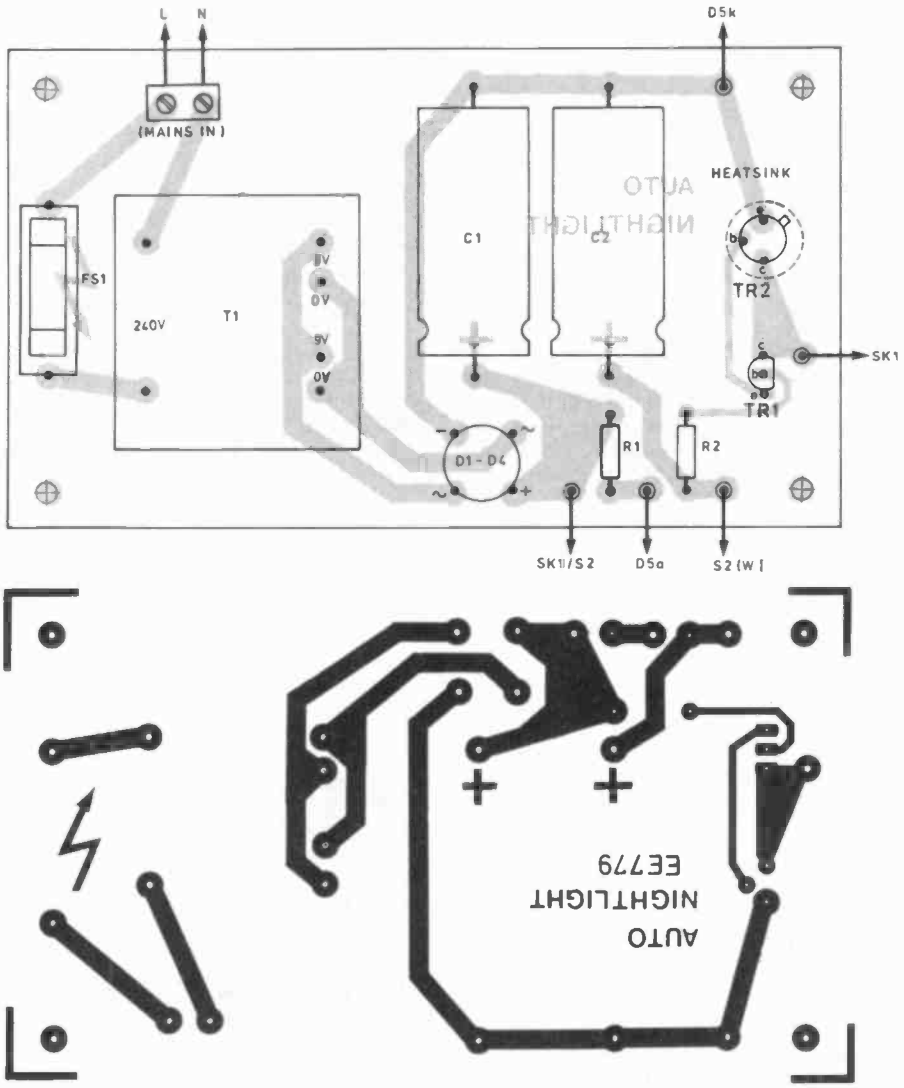
Follow on construction with the bridge rectifier D1-D4 and electrolytic capacitors, and here correct polarity is *essential*. Continue with the two-way p.c.b. screw terminal block, which forms the mains input for the board, then the p.c.b. fuseholder and finally the mains transformer T1.

There are differences between different makes of p.c.b. mains transformers, so it is obviously necessary to ensure that the unit purchased matches the p.c.b. pin layout. The transformer must sit snugly against the surface of the p.c.b. or damage to the copper track may result (the track could lift off eventually due to mechanical vibration).

CASE

Before completing the interwiring, it is necessary to prepare the aluminium front and rear panels of the box, dependent on the type of box purchased by the constructor. The rear panel is drilled to take the mains cable inlet, and this hole must be fitted with a grommet to prevent damage occurring to the cable insulation due to chafing. Further drilling is required for a

Fig. 2. P.C.B. layout and wiring for the Nightlight.



COMPONENTS

See **SHOP TALK** Page

Resistors

R1	560
R2	470k

Capacitors

C1	1000µ axial elect. 25V
C2	330µ axial elect. 25V

Semiconductors

D1-D4	W005 50V 1.5A bridge rect.
D5	red l.e.d.
TR1	MPSA14 *npn* Darlington
TR2	BFY52 *npn* gen. purpose

Switches

S1	D.P.S.T. mains rated toggle
S2	S.P.C.O. centre-off toggle, biassed one way to match S1

Miscellaneous

T1	6VA mains transformer p.c.b. mounting; 240V primary, 9V 6VA secondary
SK1	3.5mm mono jack socket
PL1	3.5mm mono jack plug
FS1	250mA 20mm p.c.b. mounted fuseholder
LP1	12V 2.2W MES bulb in batten holder (see text)

Plastic case, size 155mm x 85mm x 60mm, with aluminium front and rear panel (Vero 75-1238D); single-core screened cable (or "figure-eight" twin-core flex), length to suit; 6A 3-core mains cable; mains rated 2-way p.c.b. screw terminal block; TO5 push-on heatsink; materials for lamp diffuser; connecting wire; solder etc.

Printed circuit board available from EE PCB Service, code EE779.

Approx cost guidance only **£14.50** *plus case*

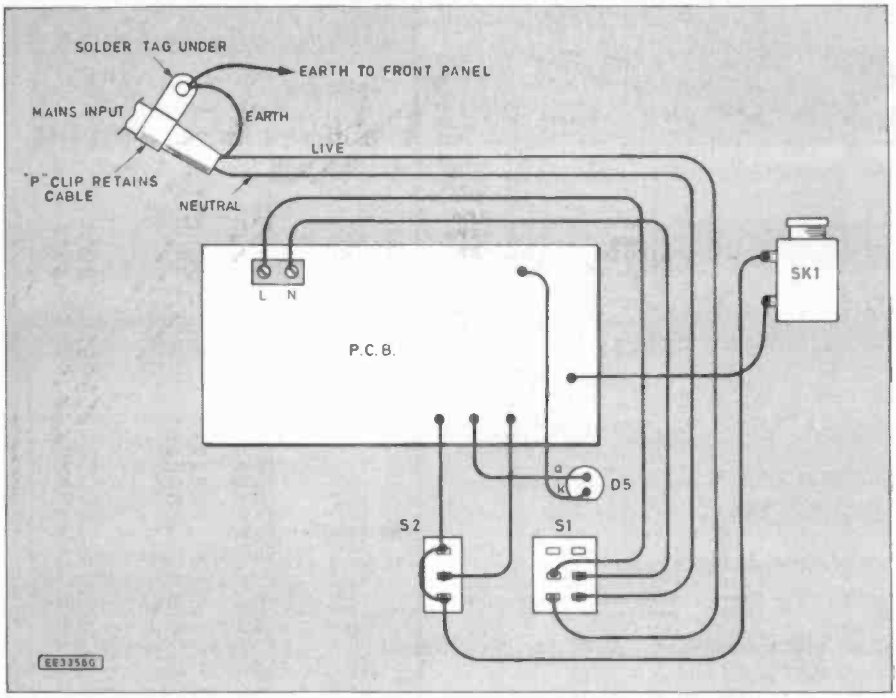


Fig. 3. Interwiring, the front and rear aluminium panels must be earthed.

"p" clip which retains the mains cable, and also a 6mm dia. hole will be required for the jack socket SK1.

The front panel is prepared to accept the toggle switches S1 and S2. If the specified switches are used, then two 6mm holes are needed. One final 6mm hole is required for the power-on indicator D5, which can be retained with an l.e.d. clip or lens bezel. If desired, the front panel can be embellished with rub-down lettering to label the controls, followed by a coat or two of protective clear lacquer.

Interwiring is completed in accordance with Fig. 3. Six amp three-core mains flex (e.g. 3 x 24/0.2mm) is employed for the mains inlet cable and the Earth input is connected via a solder tag to the "P" clip mounting bolt, in order to "ground" the rear panel. The front panel must also be Earthed for safety, and on the prototype this was achieved with an earthing wire (from the rear panel Earth tag) placed under one of the toggle switch mounting nuts.

LAMP UNIT

The lamp unit was constructed using a technique first used by the designer in *Everyday Electronics*, July 1978, no less! The lamp uses an aerosol top as a diffuser, see Fig. 4.

A batten-mounting M.E.S. bulbholder was fitted to a circular piece of 3mm plywood which had been cut to snap fit into the base of the aerosol top. A length of single-core screened cable (twin-core figure eight flex will work equally well) interconnects the lamp and the main unit, and was terminated in a 3.5mm jack plug to fit socket SK1.

Since long trailing cables at mains voltage are to be discouraged, it is best to have the mains flex as short as possible, say one metre long. But the lamp connecting wire, being at 12V d.c. can be as long as necessary, so the lamp can be positioned in any desired location.

FINAL CHECK

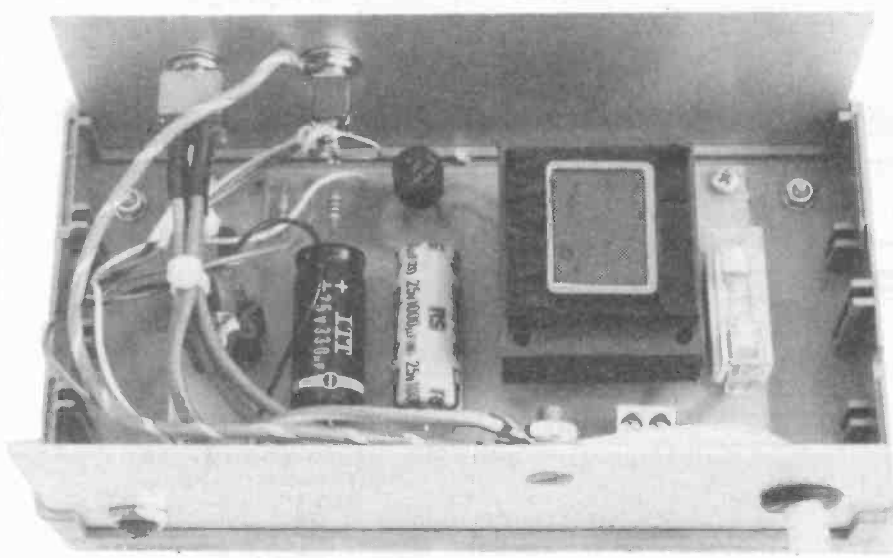
Complete the assembly of the Auto Nightlight by fitting a mains plug *fused 3A*, to the mains lead, and plug in the lamp unit to the jack socket SK1. Prior to plugging in and switching on, thoroughly check the unit for any wiring errors, particularly regarding the polarity of the electrolytic capacitors and transistors. With S1 set to "OFF", plug into the mains and switch on.

Operating switch S1 should illuminate the l.e.d. and by switching S2, the lamp should illuminate. It should stay alight even if switch S2 returns to the centre-off position.

It may be possible to time the period that elapses before the lamp gradually extinguishes. This should be about an hour or so.

As explained earlier, there is a large tolerance on capacitor C2 and if the time period is far too short or too long, then probably the easiest remedy is to raid the junk box and substitute C2 for another value (observing the *correct* voltage rating). Some trial and error may be required in extreme cases.

Finally, it is safe to connect a *second* lamp unit (12V 2.2W max.) in parallel with LP1 without any problems. Or substitute LP1 for a 5W lamp (car type), since there is adequate spare capacity on the transformer and also the output transistor. □



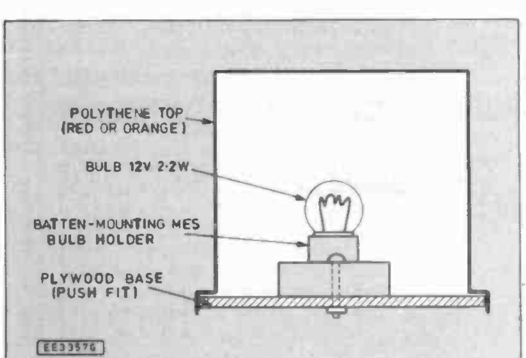
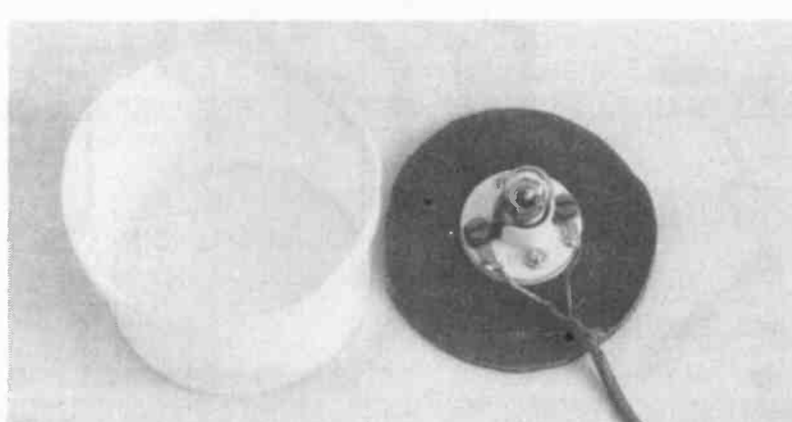
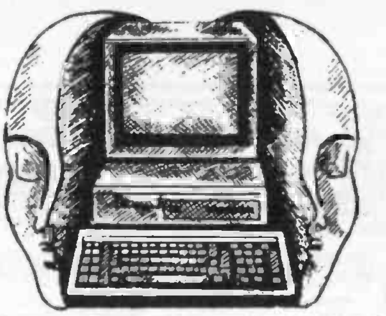


Fig. 4. Lampholder made from the top of a large aerosol can.



*INTER*FACE



Robert Penfold

THIS month we return to the subject of PC interfacing, and a simple 8-bit analogue to digital converter that can be used in a multitude of applications. These include such things as voltage, resistance, and temperature measurement. An analogue to digital converter must be one of the most useful add-ons for a computer, as it enables you to measure and monitor all manner of things with the aid of some simple circuits.

There are a number of suitable analogue to digital converters to choose from when selecting one for use with PCs. Some, such as certain devices in the ADC08** series, are specifically designed to operate in conjunction with 8080 or 8088 style buses. They have read and write inputs that are compatible with the $\overline{IOR}$ and $\overline{IOW}$ lines of the PC control bus. These devices should interface easily to the PC expansion bus, and in my experience there is no difficulty in getting them to work properly with a PC.

The ZN448E

On the other hand, there are several analogue to digital converters which are not specifically designed for a PC type bus, but which are microprocessor compatible. Most of these will also interface to the PC expansion bus quite easily. The device I have selected for this interface is a chip from this second category, and it is the Ferranti ZN448E. This device has been popular for use with 8-bit computers for a number of years now, and many *Everyday Electronics* readers have no doubt used it in add-ons for the Spectrum, BBC model B, etc. It seems to work with the PC every bit as well as with these popular eight bit computers.

Pinout details for the ZN448E are shown in Fig. 1. This is a convenient chip to use as it is microprocessor compatible, has a built-in clock oscillator, and also incorporates a very high quality 2.55 volt reference source. The latter sets the full scale sensitivity at 2.55 volts, or 10 millivolts (0.01 volts) per bit in other words. It is not mandatory to use the built-in voltage reference as there are separate reference inputs and outputs, but in practice there is not usually any point in using a discrete reference generator. If you should decide to do so, the reference voltage should be between 2 and 3 volts.

It should perhaps be explained that the ZN448E is one device from a series of three. These are the ZN447E, ZN448E, and ZN449E. The only difference between these three chips are their guaranteed accuracies. The maximum errors are as follows:

ZN447E ± 0.25 LSB
ZN448E ± 0.5 LSB
ZN449E ± 1 LSB

For most purposes the ZN448E is probably the best choice, and this is the only version offered by some suppliers. Where optimum accuracy is essential the ZN447E can be used, but this is much more expensive. For many applications the cheaper ZN449E would probably suffice, but this version seems to be difficult to obtain these days.

Basic Converter

The circuit diagram for the Analogue to Digital Converter is shown in Fig. 2. R1 is the "tail" resistor for the voltage comparator at the input of the device. I will not give details of the way in which the ZN448E functions, as this has been covered several times in EE over the years. It is a successive approximation converter, and it has a high speed comparator at the input. This requires a negative supply in order to compare voltages right down to the 0 volt supply rail. This represents no problem in a PC context as there are two negative supply rails available. In this case the − 5 volt supply has been used. The current drain from this supply is insignificant at about 60 to 70 microamps.

Clock Oscillator

Components R2 and C1 are the discrete load resistor and decoupling capacitor for the internal voltage reference. C2 is the only discrete component needed in the clock oscillator circuit, and this is used to set the desired clock frequency. A value of 82p sets the clock at approximately 1MHz, which is the highest frequency at which the ZN448E is guaranteed to operate properly.

In practice, most ZN448Es seem to function perfectly well at significantly higher frequencies. Where very fast sampling rates are required, you can therefore try experimenting with lower values for C2 in order to determine the lowest value that gives acceptable results.

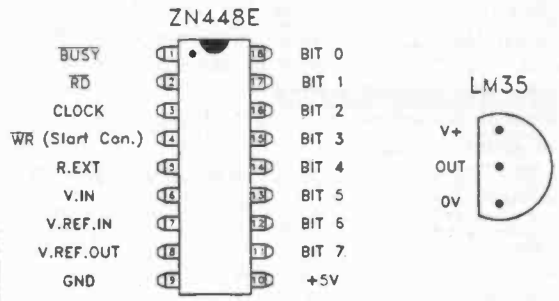
Nine clock cycles are required per conversion, and the converter is thus guaranteed to be able to complete each conversion in no more than 9µs. Most ZN448Es seem able to complete conversions in something more like 6µs. Either way, the conversion rate can be well over one hundred thousand per second, which is sufficient for applications such as audio digitising.

Conversion

In order to start a conversion a dummy value is written to the converter. The value written is unimportant, since it is actually the "write" pulse from the address decoder that initiates the conversion. The ZN448E cannot read the data bus – it can only output data onto it.

PC address decoders will not be considered here, as they have been covered in recent *Interface* articles. The main point to note here is that the address decoder must process the $\overline{IOR}$ and $\overline{IOW}$ lines of the

Fig. 1 (right). Pinout details of the ZN448E and LM35 devices.



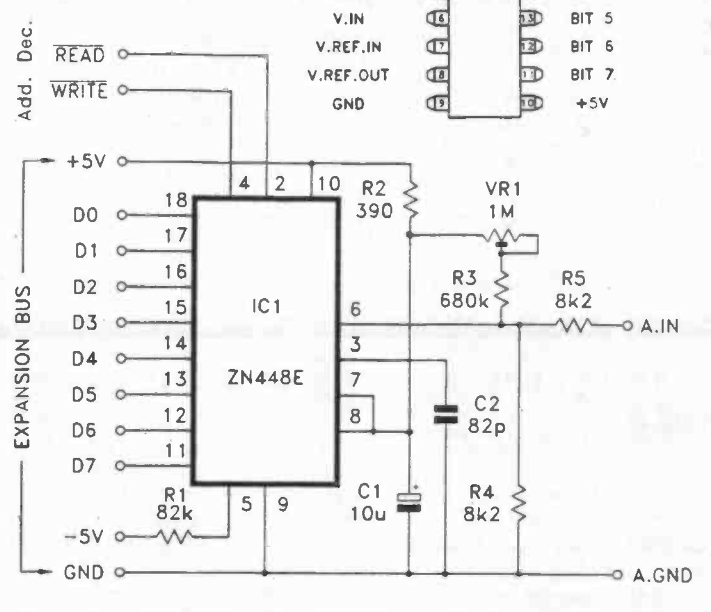


Fig. 2. Circuit for the Analogue to Digital converter.

expansion bus, so as to provide separate "read" and "write" outputs. The circuit of Fig.1 from the *Interface* article in the August 1991 issue is suitable, but the extra gating shown in Fig.3 is needed.

It is essential that the converter is not read before a conversion has been completed. A suitable hold-off can be achieved by monitoring the "Busy" output of IC1, which goes low when a conversion is in progress. However, as the time taken for each conversion is very much the same, a timing loop offers a more simple solution. This avoids the need for a digital input port to monitor the "Busy" line, but a little experimentation might be needed in order to find the optimum delay time.

In many cases readings will only be taken infrequently anyway, and quite a long delay can then be used. Note that with interpreted BASICs such as GW BASIC, or the QBASIC interpreter supplied with MS/DOS 5.0, it is unlikely that even the fastest of PCs could operate fast enough to take premature readings.

The ZN448E has tristate outputs which are activated by a read operation from a suitable input address. These outputs seem to be well able to keep up with the expansion bus without any need for added wait states. As a point of interest, I have recently tried interfacing a number of peripheral chips to the PC, and not one of them needed any added wait states.

Zero Adjustment

For optimum results a zero adjustment circuit is needed on the input side of the converter. This is the purpose of the three fixed resistors and variable resistor VR1. The latter is the zero adjustment potentiometer. This network also acts as an attenuator to reduce the sensitivity of the circuit to the desired level.

In this case the full scale sensitivity is about 5 volts, but for precise results R5 would have to be replaced with a 4k7 fixed resistor in series with a high quality 4k7 preset resistor. The preset would then be adjusted for a full scale sensitivity of precisely 5 volts. The values of R4 and R5 can be altered to produce other full scale sensitivities, but the parallel resistance of these two resistors should always be about 4k.

For zero adjustment a potential of about 10 millivolts (i.e. 0.5 LSB) must be applied to the input of the circuit. This can be provided by a potential divider connected across the +5 volt and 0 volt supplies. Suitable values are 5k1 for the upper arm and 10 ohms for the lower section. With a continuous stream of readings taken, VR1 is adjusted so that the readings fluctuate between 0 and 1. The offset if no zero adjustment is used is not very large, and in some applications there may be no point in bothering with the zero adjustment circuit.

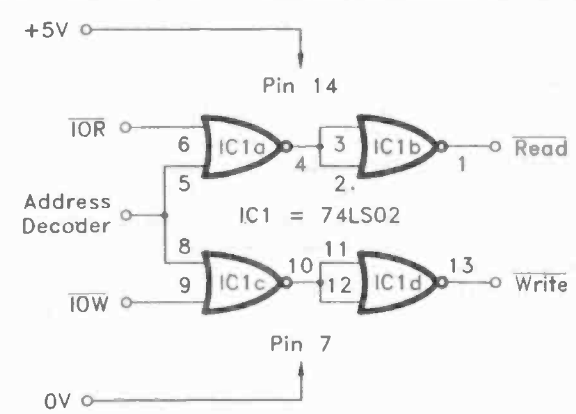


Fig. 3. Address decoder extra gating.

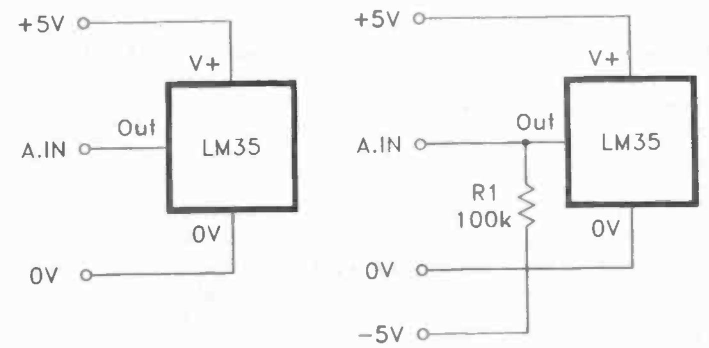


Fig. 4. Two basic methods of using the LM35.

Temperature Sensors

There are now numerous temperature sensing devices available. For a computer temperature interface some of the integrated circuit temperature sensors are ideal. In particular, the LM35 is not too expensive, but is quite accurate and very easy to use. This provides an output potential that is equal to 10 millivolts per degree Centigrade. Fig.1 includes leadout details for the LM35, which is contained in an ordinary TO-92 style plastic encapsulation. Fig.4 shows the two basic ways this device can be used.

The first method is the most basic one, where the LM35 is simply fed with a suitable supply voltage and the appropriate output voltage is produced. The supply potential can be anything from 4 to 30 volts, so the PC's +5 volt supply is suitable. With an LM35CZ this gives a useful operating range of 2 to 110 degrees Centigrade. The LM35DZ is substantially cheaper, and provides a useful range of 2 to 100 degrees Centigrade.

The second method requires a negative supply and an additional resistor. With an LM35DZ this increases the useful operating range to 0 to 100 degrees Centigrade. The improvement with the LM35CZ is even more impressive, it can handle temperatures from −40 to +100 degrees Centigrade using this method. Note though, that negative temperatures produce negative output voltages. Some level shifting would be needed in order to enable the converter to bring these within the input voltage range of the converter.

A very simple way of using these circuits with the A/D converter is to simply connect the output direct to pin 6 of the ZN448E, and to omit R3, R4, R5, and VR1. This will not give particularly accurate results at low temperatures, although in practice it seems to work rather better than the theory would dictate.

The temperature sensor provides an output of 10 millivolts per degree Centigrade, and the converter has a resolution of 10 millivolts. This method is therefore very convenient in that readings from the converter are directly in degrees Centigrade.

There is a severe problem with this system in that readings will never exceed 110, which means that the converter is effectively only operating as a seven bit type. A resolution of only one degree Centigrade is obtained, whereas the converter is capable of a 0.5 degree resolution over a 0 to 110 degree temperature range. With suitable signal conditioning it is possible to obtain better accuracy and resolution, which is one of the topics we will pursue in next month's *Interface* article.

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THIS is the second article in a 12-part series concerning Communication, Information Technology and related matters in the Science National Curriculum. This month we shall look at some of the history of long-range communication and give further suggestions for practical work. This will illustrate how electricity has helped man to achieve long-range communication efficiently and conveniently. Next month, we shall look at the topic of information storage.

Readers who have not been following the series are advised to read Part 1 in last month's issue to see how this fits into the scheme of the original and modified Attainment Targets within the National Curriculum.

Children should first be shown that electricity needs a *circuit* in which to flow. That is, it needs a complete path from one terminal of a battery to the other through components which *conduct* electricity – copper wire, bulbs and so on. Use the simple series circuit shown in Fig. 1. This consists of a PP3 battery, battery connector and a 6V 0.06A bulb in a lamp holder.

If a break is made in the circuit (for example, by unscrewing the bulb), the light goes off. If a break is made in one of the connecting wires and the end 10mm or so of insulation removed from each end, the wires may be touched together to light the bulb – this forms a simple switch. All components for this and the other experiments may be obtained cheaply from a mail-order electronics supplier.

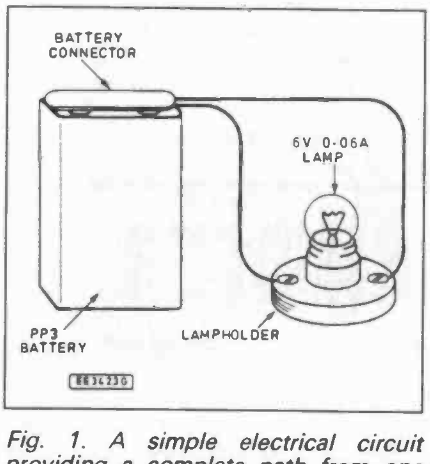


Fig. 1. A simple electrical circuit providing a complete path from one battery terminal to the other.

THE ELECTRIC TELEGRAPH

The Chappe telegraph (described last month) was an *optical* system – it used a visual method to send messages. However, here we are concerned with the *electric* telegraph. This was so important in the history of long-range communication that some time could be devoted to this topic alone.

In the electric telegraph, an operator would make and break an electrical circuit using a code to represent the letters of the alphabet. These signals would pass along the telegraph line and be decoded by another operator at the distant end. The same line could be used to send signals the other way to give a reply.

Although there had been some early experiments in electrical telegraphy, the first "serious" device was not produced until 1837. The messages were decoded by observing the positions of moving pointers (see photograph of *the Cooke and Wheatstone 5-needle telegraph*). The telegraph was further developed by an American, Samuel Morse, who erected his first telegraph line between Washington and Baltimore in 1844. He invented the now famous Morse Code – a series of dots and dashes representing the letters of the alphabet – to send messages (the Morse Code was reproduced in last month's issue).

The messages were sent using a "Morse key". This is a type of switch whose contacts complete a circuit when a knob is pressed – a long press gives a "dash" and a short one a "dot". The most used letters were given the simplest codes. In the English language the letter "E" is the one most used so this is given the simplest code of all – a single dot. As well as all the letters of the alphabet, the Morse code may be used to signal punctuation marks, numbers, etc.

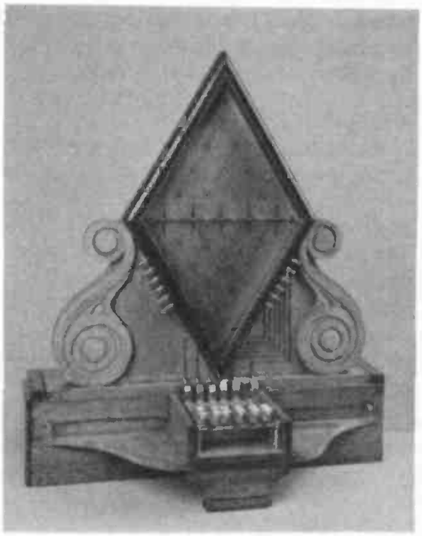
Telegraphy quickly became the principle means of long-range communication with every town of note having its own telegraph office from which messages could be sent and received. The Morse telegraph was soon used to send messages to and from France through a cable laid in the English Channel in 1851.

Soon it became possible to send telegraphic messages between Britain and the United States. For this, a cable had to be laid some 300km in length. This was duly carried out in 1857-8 with the best materials then available for the job. Unfortunately, after just a few hundred messages, the cable broke.

The telegraph was the forerunner of all modern communications systems – since it sent information so quickly, it seemed to make the world a smaller place. The photograph above shows a contemporary poster inviting the public to see the wonder of the age in action.

A HOME-MADE TELEGRAPH

Refer to Fig. 2 and make a Morse key – alternatively, use a real one or a small momentary-action switch from a basic electricity kit. Even a bell-push could be used.



The Cooke and Wheatstone 5 – needle telegraph.

(Reproduced by permission of the Trustees of the Science Museum).

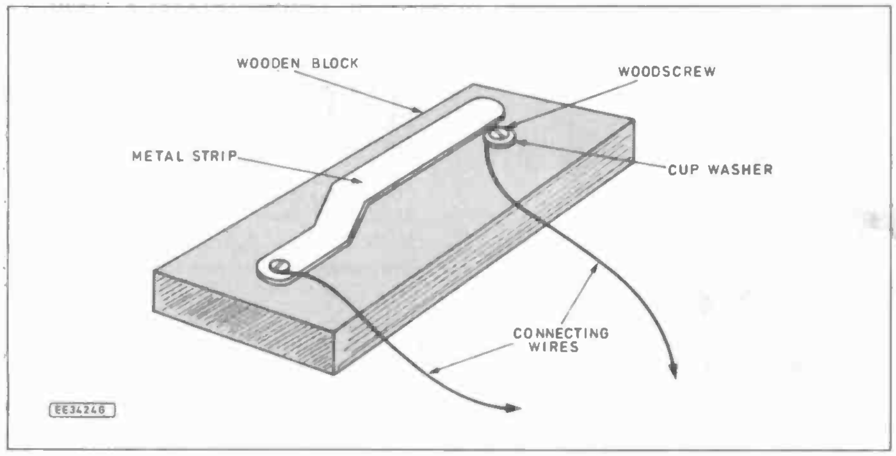


Fig. 2. Construction of a simple Morse key.

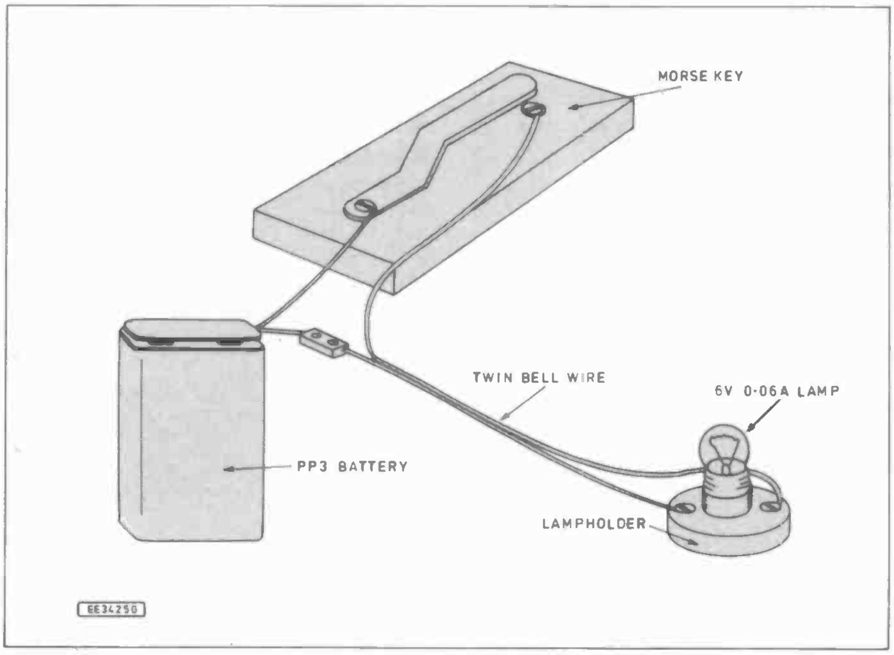


Fig. 3. Series circuit for use with the Morse key.

For the home-made Morse key you will need the following parts:

1 piece of wood 100 x 50 x 15 mm approximately
2 off size No 4 round headed brass woodscrews 12 mm (½ in) long
2 cup washers to fit the woodscrews
Strip of metal (brass, copper or tinplate)
12 mm wide x 80 mm long

You will also need some light-duty twin wire ("bell wire") approximately 20m long, a 6V 0·06A bulb in a lamp holder, a PP3 battery and connector and one section of 3A screw terminal block.

Drill a hole in one end of the metal strip large enough for one of the woodscrews to pass through then bend the metal as shown in the diagram. Drill a pilot hold and partly insert one of the screws in the wood with a cup washer under its head. Strip the end 10mm of insulation from each wire and twist one of them round the woodscrew so that it is gripped by the cup washer when the screw is tightened.

Secure the metal strip in the same way with the second wire gripped under its washer. Check that the metal strip can be pressed so that it makes contact with the woodscrew. It is important that the area of metal making contact with the screw is clean.

Use the PP3 battery, bulb and Morse key to make a series circuit – see Fig. 3. Check that the bulb may be flashed by pressing the key to make dots (short presses) or dashes (longer presses). A buzzer could be substituted for the bulb – use a 6V solid-state buzzer. This will cost approximately 50p.

Children may investigate how far they can communicate using the home-made telegraph. The speed at which messages can be sent and received may be compared with that of modern devices such as the telephone. It must be remembered, however, that telegraph operators became very proficient at using the Morse key.

Soon the telegraph was made automatic so that it produced dots and dashes on a piece of moving paper tape by means of a pen which would rise and fall with the incoming signal. This could be deciphered later. Thus, the information was *stored*. This concept of storage is important and information storage will be discussed in more detail next month.

Since one pair of wires could carry only one message at a time, the telegraph office was often very busy. To send more messages, high speed techniques were invented. In one system, the message was first turned into a series of long and short holes in paper tape. The tape could then be fed through a special machine at high speed. This would switch the current on and off at a much higher rate than would be possible using a Morse key. At the distant end, the code of dots and dashes was printed on to a piece of moving tape by means of the rising and falling pen described earlier. In this way, the telegraph line was able to carry a lot more messages in a given time and thus reduce costs.

THE TELEPHONE

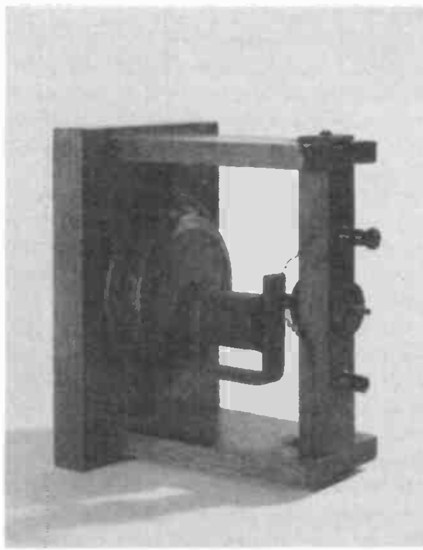
There had been some early experimentation with the telephone – that is, a device which would turn the human voice into electrical signals then back into intelligible speech. The results were, however, very indistinct. The Scottish scientist, Alexander Graham Bell, invented a true working telephone in 1876 (see photograph). With this, he succeeded in sending the spoken word in the form of electrical signals along wires instead of merely dots and dashes as in the telegraph.

The telephone quickly overtook the telegraph in terms of speed and convenience. The telephone had the personal touch lacking in the telegraph in that actual voices were heard. It also provided instant two-way conversation which was not possible with the telegraph.

A HOME-MADE TELEPHONE

This experiment simulates Bell's original telephone apparatus using loudspeakers. You will need two miniature loudspeakers and a long piece (about 20 metres) of bell wire. The best type of loudspeakers to use have a diameter of approximately 60mm and an impedance of 60 to 80 ohms. You should not pay more than about 50p each for these.

This experiment works best when the loudspeakers are used as they are. However, they will then need to be used very carefully to avoid damage. In practice,



Bell's experimental telephone.
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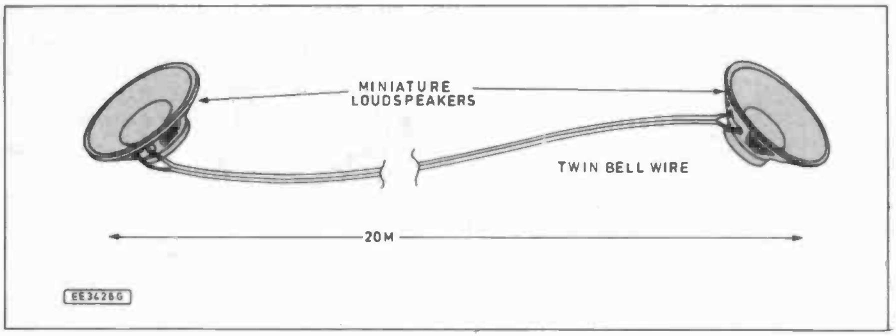


Fig. 4. Using miniature loudspeakers as a crude telephone.

you may need to use some sort of protection – perforated boxes, for example. The children should have an opportunity to look at the paper cone and see that it moves backwards and forwards – take care, though, because this part is very fragile. They will remember from last month that sound is caused by vibrations.

Touch the terminals of one of the loudspeakers briefly on to the terminals of the PP3 battery and a click will be heard. If a few light objects such as small pieces of paper are placed on the cone, they will jump when the battery is connected. This will reinforce the idea that electrical signals may be turned into sound and that sound is caused by vibration. The opposite effect is also true – if the cone is made to vibrate, an electrical signal is produced.

Connect the two loudspeakers together using the bell wire (see Fig. 4). The wires may be twisted carefully on to the terminals, soldered or miniature crocodile clips used. Touch the metal frame of one loudspeaker with a sounding tuning fork (the prongs of a dinner fork may do). If a child listens to the cone of the other loudspeaker, a copy of the original sound will be heard. This was roughly the way Bell's original telephone worked.

Note that no battery is used – the first loudspeaker turns the sound vibrations into electrical signals and the second one turns the electrical signals back into sound. Children find it difficult to believe that electrical signals can be produced without using a battery.

Use the circuit above to see if the children can talk to one another using the home-made telephone. One person goes into a distant room and speaks closely into one loudspeaker. The other listens carefully to the other one. The experiment works best when the children cannot hear one another directly. It should be possible to hear speech, albeit rather faintly. The listener and the speaker now change roles.

In this experiment, the loudspeakers are being used for two purposes just as in Bell's original apparatus. One is acting as a *microphone* while the other is being used as an *earpiece*. The disadvantage of this method is that the electrical signal is very weak and is reduced still further by long wires. The original telephone could only be used successfully over relatively short distances. Even so, it will work over much greater distances than the string telephone described last month.

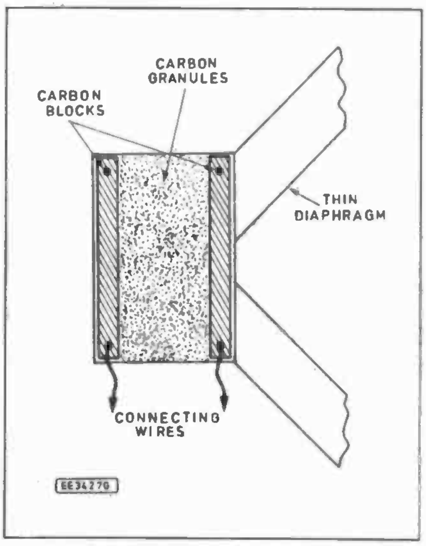


Fig. 5. A carbon microphone as used in later telephones.

TELEPHONE DEVELOPMENT

The telephone was further developed to provide a greater range. A "carbon" microphone (see Fig. 5) was used in combination with an earpiece which worked like one of the miniature loudspeakers. The microphone consisted of a small box containing carbon granules with a carbon block at each end. Carbon is a conductor of electricity (it allows electricity to pass through it). When the granules vibrate due to sound falling on the microphone diaphragm, they will allow electricity to flow between the carbon blocks more or less easily according to whether they are pushed together or allowed to move apart.

A circuit is made using a carbon microphone, earpiece and battery. When the caller speaks near the microphone diaphragm, the carbon granules vibrate. The current flowing is then an electrical copy of the voice patterns. When this changing electrical signal flows through the earpiece at the other end, its diaphragm vibrates with the same pattern so duplicating the original sound,

If any reader wishes to try this out as an experiment, the best way is to obtain a carbon granule microphone from an old dial-type telephone handset. This is easier than making one, although this would be possible. One of the miniature loudspeakers would be suitable to use as the earpiece. A much louder result is obtained although the sound quality may not be as good as in the "Bell" telephone.

Because a battery provides the power, for longer distances a battery having a higher voltage is all that is required. This will send more current through the circuit. Carbon microphones were used in telephones until the development of the modern push-button type and many are sill in use today.

Children can have a lot of fun using the home-made telephone but it must be impressed on them that this is a completely different device compared with the "string telephone" or "speaking tube" experiments described last month. In these, the sound itself travelled along the string or in the air contained in the tube. In the present experiment, *energy conversions* took place – sound to electricity and electricity back to sound. The advantage of doing this is to produce a greater range. Also, the signals can turn corners, etc. You can tie a knot in the wire to show that the electrical signal can still get through!

TELEPHONE EXCHANGE EXPERIMENT

Early telephones were used for private point-to-point communication. Queen Victoria had such a telephone line installed for her personal use. It quickly became apparent that by connecting such private lines together people could talk to one another as they wished. Thus, the first telephone exchange was invented. This was set up in Newhaven, Connecticut in 1878. Soon afterwards, telephone exchanges appeared in all other important centres.

It is fun to show this principle by making and operating a simple telephone exchange using the "Bell" telephone. You will need the following items:

- 1 piece of wood 30 cm square and 15mm thick
- 10 off 25 mm panel pins
- 100m of light-duty twin wire (bell wire)
- 5 off miniature loudspeakers
- 4 off 6V 0.06A lamps and lampholders
- 4 off PP3 batteries and connectors
- 4 off bell pushes
- 4 sections of 3A screw terminal block
- 8 off pieces of stranded wire 30cm in length fitted with a small crocodile clip at each end
- 4 off self-adhesive plastic feet

Hammer the panel pins into the wood as shown in Fig. 6 until the heads are left 12mm above the face of the wood. Attach the plastic feet to the underside. Attach the four lamp holders in the positions shown using small woodscrews. Cut off suitable lengths of twin wire for the remote stations and connect the ends to the panel pins as shown. This is done be removing the end 10mm of insulation and twisting it around the panel pins tightly.

Connect the loudspeakers and the lamp holders. Connect the bell pushes and battery connectors to the distant ends of the wires using the pieces of terminal block as shown. The lamps and batteries will be used by one "subscriber" to call the "operator" and "book" a call to one of the others. Readers with sufficient electrical

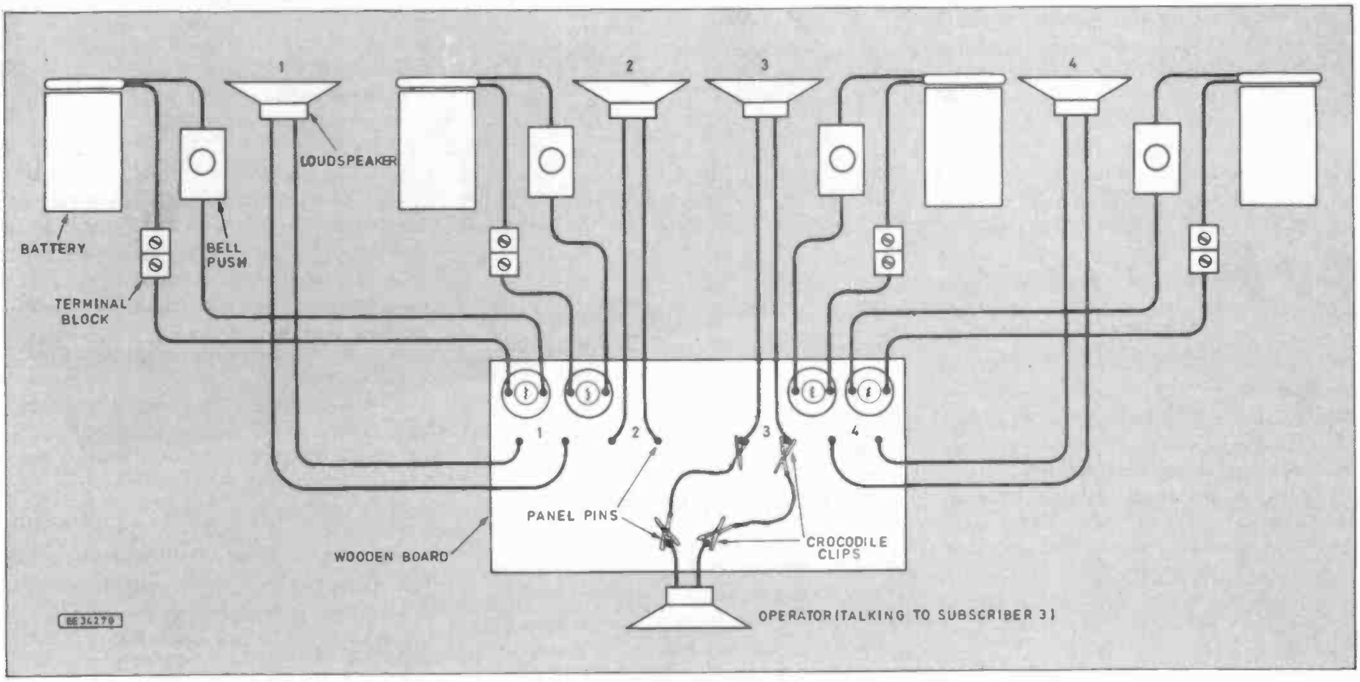


Fig. 6. Construction of a small telephone exchange.

knowledge could simplify the circuit by using a common wire for the lamps and loudspeaker circuits but it may then be difficult for children to follow (although in many cases this will not matter anyway).

EXCHANGE OPERATION

The "operator" sits in one room with the "exchange" and the four "subscribers" sit in other places were they cannot hear one another directly. Each subscriber is given a number 1 to 4. When one person wants to speak to another they first of all flash their lamp to the operator. On receiving this signal, the operator connects his or her loudspeaker to those of the subscriber wishing to make the call using the short wires with crocodile clips on the ends. The operator can then talk to the subscriber and find out which number is wanted.

The operator then disconnects his or her own loudspeaker and connects together the wires of the two subscribers wishing to talk in the same way. The whole activity soon turns into utter chaos with everyone wanting to talk to other people and no one wanting to listen – it is fun, though!

In the early 20th century, telephone exchanges operated on a similar principle to this model but on a much larger scale. Rows of operators were needed to connect together the wires of many hundreds of subscribers wishing to make calls. They used pieces of wire with a "jack plug" on each end to make the connections. Today the switching of the lines is done with totally automatic telephone exchanges.

The story behind the automatic telephone exchange is interesting. It was invented by an American called Almon B. Strowger – a man of argumentative disposition. He had frequent quarrels with telephone operators which led him to invent the automatic telephone exchange. Strowger exchanges used mechanical switches to connect the lines together – many exchanges of this type are still in use throughout the world today. However, the latest automatic exchanges are *electronic* and have no moving parts. These are smaller, silent in operation and extremely reliable.

RADIO COMMUNICATION

Although the telegraph and the telephone were great advances in the history of long-range communication, it had long been the dream of man to send messages without wires – that is, *wireless* communication. This would be much more versatile – it could be used to communicate with ships at sea, for example.

James Clerk Maxwell (1831-79) showed mathematically that "radio waves" should exist. However, Maxwell died before Heinrich Hertz in 1887 actually succeeded in producing them and sending a signal from one part of his laboratory to another. It was a rather primitive experiment but showed the way forward.

Hertz produced radio waves by means of *electric sparks* (we know that the radio crackles when there is a flash of lightning). When the waves were received by a further piece of apparatus, sparks were produced there also – thus, a signal had been sent over a short distance without connecting wires.

In 1894 the Italian, Guglielmo Marconi, used such a spark transmitter in conjunction with a Morse key to send short-range messages (see photograph). This turned out to be an historic event and on it rested the development of all modern radio communication including television.

Marconi gradually improved his apparatus and increased the range of communication – soon messages were being transmitted across the English Channel and to ships at sea. In 1901, he succeeded in sending a signal across the Atlantic Ocean from Cornwall to Newfoundland – a distance of over 3000km. The telegraph companies were not pleased because wireless communication threatened their business and they tried to discredit Marconi.

In 1906, the triode valve was invented by the American engineer, Lee de Forest and this led to the production of far more sophisticated transmitters which did not

Marconi with his transmitter and receiver.

rely on using sparks. For his work in the field of wireless communication, Marconi was awarded the 1909 Nobel prize for physics.

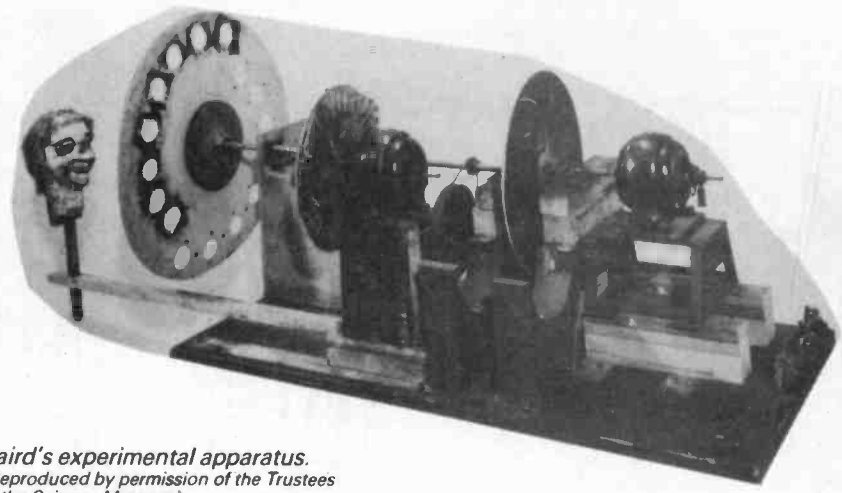
WIRELESS TELEPHONY

Soon it was possible to send the human voice by radio – Wireless Telephony was born. In 1922 broadcasting from London was begun from a station with the famous call sign 2LO and later in the same year this became the British Broadcasting Corporation. People received the programmes using a simple type of radio receiver called a "crystal set". This needed no batteries – the signal received by the aerial providing the power. Unfortunately, the sound was so weak that only headphone reception was possible.

The use of triode valves enabled more powerful and sensitive radios to be made (see photograph of the 1920's receiver). These were capable of operating a horn loudspeaker so that a number of people could listen to the broadcast at the same time. For these radios, a power supply was needed. Battery-powered portable sets were soon produced and even car radios using valves. However, wonderful as they were, valves were large, fragile, unreliable and power-hungry.

The successor to the valve, the transistor, was invented by the team or physicists, Bardeen, Brattain and Shockley. This was demonstrated in 1948. The transistor is much smaller, more reliable, more robust and needs much less power than a valve. Thus, a whole new generation of electronic devices became possible. Smaller and much more reliable battery-operated – even pocket-sized radios – were made.

The invention of the transistor was a major landmark in history and marked the beginning of electronic technology as we know it today.



Baird's experimental apparatus.
(Reproduced by permission of the Trustees of the Science Museum).

CRYSTAL SET EXPERIMENT

The simple radio described here is a modern version of the original crystal set. early listeners used a small piece of "crystal" – this was a piece of galena (lead ore) which was touched with a "cat's whisker" – a thin piece of wire. Today a germanium diode may be used to replace the crystal and cat's whisker, also a modern crystal earpiece replaces the clumsy headphones used long ago. Note that a pair of modern stereo headphones *will not work* in this circuit.

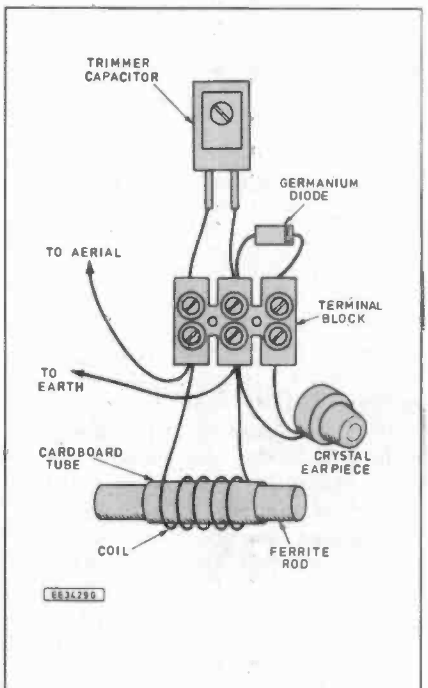


Fig. 7. A modern crystal set.

The crystal set will only give good results if you are fairly near a powerful transmitter and a long aerial is used.

You will need the following components:

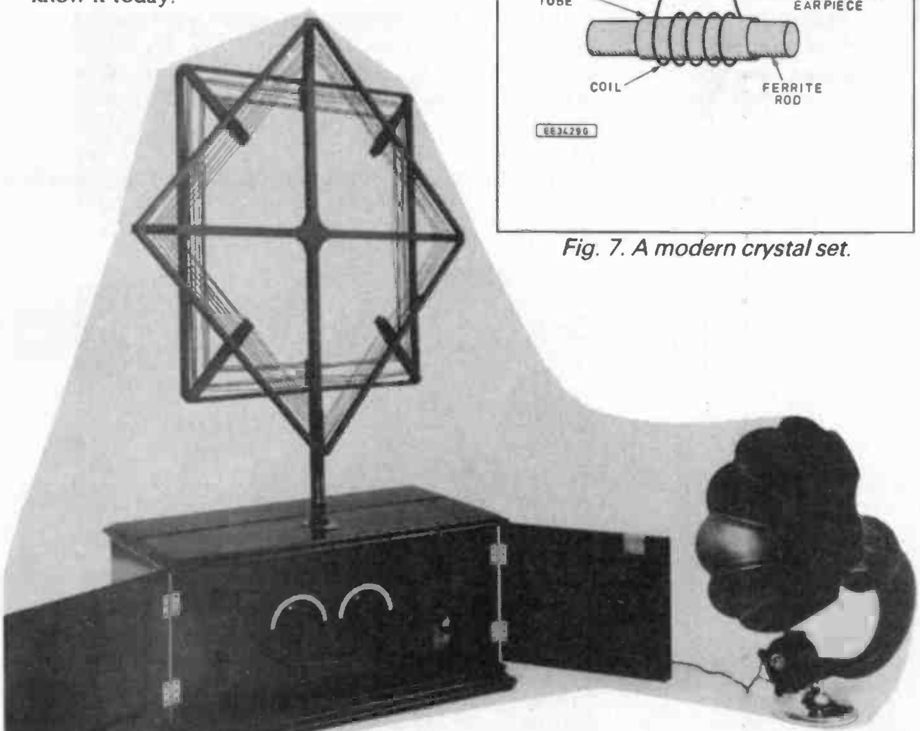
A ferrite rod 8 or 10mm in diameter and 100mm long approx
Sufficient 24 s.w.g. enamelled copper wire (or thin plastic insulated wire) to wind at least 50 turns on the ferrite rod
Crystal (not magnetic) earpiece
20m of plastic insulated wire (for the aerial and earth)
OA90 or OA91 germanium diode
500pF trimmer capacitor
3 pieces of 3A screw terminal block to make all the connections

Begin by making a thin cardboard sleeve about 5cm long which will slide along the ferrite rod. Sellotape it into shape. With the sleeve in position on the ferrite rod, wind approximately 50 turns of wire onto it. Wind only one layer with successive turns touching. Keep the wire fairly tight but not so tight that the paper sleeve cannot slide freely. Leave 10cm of wire free at each end and Sellotape the coil to the sleeve. Now gently scrape the enamel insulation (or remove the plastic) from the end 10mm of each end of the wire.

Arrange the components on the terminal block as shown in Fig. 7 The aerial should be set up outdoors as long and as high as possible. If it is clear of buildings it will work better. Connect a short length of wire to "earth" – this could be connected to a water tap or to a metal rod which is then pushed as far as possible into the ground outside.

Use a small screwdriver to set the screw on the trimmer to approximately mid-position. Listen to the earpiece and "tune" the radio by adjusting the position of the ferrite rod in the coil. Tuning may also be carried out by adjusting the trimmer capacitor. If you are lucky you will hear some radio broadcasts.

Experiment with a different number of



A 1920's radio receiver with horn loudspeaker
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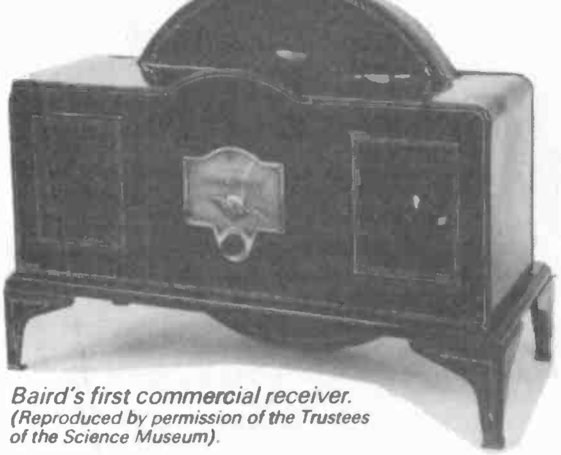

Baird's first commercial receiver.
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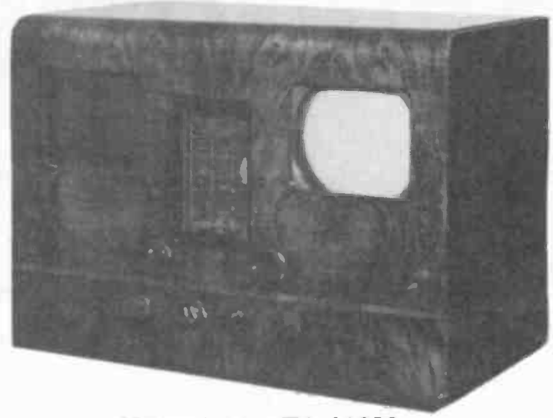

Marconiphone TV of 1936.
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turns of wire on the coil – more turns (around 150-200 turns) will give long wave reception (Radio 4 on 198kHz) and fewer turns, perhaps, 10 to 20 for short waves.

TELEVISION

The spoken word has power but pictures and words have even more impact. With speech and music carried by "wireless", people wondered if it would be possible to send pictures too. In the days of the electric telegraph, methods had been developed to send still pictures (phototelegraphy) but only at slow speed. Sending "live" pictures was a problem. It was clear that pictures could not be sent in their entirety. It would be necessary to split them into parts and to send these in turn very quickly. When re-assembled, it would appear that the complete picture was being seen.

Some form of scanner was needed to divide the picture up then the information of each piece of the picture would be sent by radio waves. The first successful method was demonstrated by John Logie Baird (1888-1946), the son of a Scottish minister. He used a mechanical scanner in a rough and ready arrangement of everyday articles which he bought for practically nothing (see photograph).

Initially the results were very poor but in 1925 he succeeded in sending moving pictures. He even televised colour pictures in 1928. Unfortunately, because Baird used mechanical equipment, it suffered from many problems. His system was used for a short time for commercial broadcasting and receivers were available at the time (see photograph).

In 1928, an electronic system of scanning was invented by the Marconi Company working with EMI. This gave far higher quality pictures than the Baird system and television as we know it was born. The first regular TV service was broadcasted from Alexandra Palace, London, in 1936. The second World War stopped these activities but they re-commenced in 1946 when hostilities were over.

Colour television broadcasting began in America but not in Britain until 1967. Today, teletext information is carried by the radio waves along with the sound and picture. We may now receive almost instantaneous broadcasts from all over the world using satellites. More will be said about this in a later part of the series.

Recording live pictures was a further important advance. Video recorders were being used in the USA for recording television broadcasts as long ago as 1958. Before this, live action had to be recorded on film. Video recording is another example of *information storage* and will be looked at in more detail next month. Today, we use videocassette recorders in our own homes so that we can watch our favourite programmes at times which suit us.

REPORTING AMATEUR RADIO

Tony Smith G4FAI

HAM RADIO AND THE COUP

An intriguing story in the *W5YI Report* reveals that an amateur radio station, R3A, inside the Russian "White House" parliament building, was used by Boris Yeltsin during the recent events in Moscow.

Both CNN and ABC television showed Mr Yeltsin transmitting on the Icom amateur equipment, while the *Wall Street Journal* reported "Mr Yeltsin's efforts to rally support are still being hampered by a lack of communications with the nation. So far his aides have been broadcasting news to ham radio operators on a makeshift short wave transmitter installed on the sixth floor of the Russian parliament."

When it was all over, Dick Ehrhorn, W4ETO, received a handwritten Fax from a radio amateur in Moscow. "Dear Dick, I send you the Fax from the Russian Prime Minister office. We win! Mr Gorbachov back in Moscow. Our special emergency station R3A still operates from "Russian White House". Equipment: IC-726 (transceiver) and Alpha 76 (amplifier). Photos will be! 73! Gene, RA3AA."

Gene is a friend and business associate of Dick who owns Ehrhorn Technological Operations Inc., makers of the Alpha line of amplifiers, one of which was used by the Russian station. In talking to the *W5YI Report*, Dick commented "The average Soviet salary is around 200 to 300 rubles a month . . . which is around ten dollars. . . . No one can afford to buy commercial ham gear. The Alpha amplifier they have came from a flea market in western Europe."

LAUNCH CONFIRMED

I mentioned last month that AMSAT, the Radio Amateur Satellite Corporation, was planning a new super enhanced satellite to be known as phase III D. The European Space Agency has now confirmed an October 1995 launch slot for the doughnut shaped, 1,200-pound, 10-feet wide satellite which will have an orbital period of 16 hours. This will make it consecutively accessible over Europe, USA and the Far East.

Colour imaging, educational broadcasting and other experiments are planned. There are currently twelve *OSCAR* satellites in orbit. The most recent, *OSCAR-22*, was launched last July. *(W5YI Report)*.

NICAD CARE

Icom are advising all users of their equipment containing NiCad battery packs to fully "cycle" the pack a number of times when the equipment is first purchased. Five or six *full* charge and discharge cycles, they say, will extend the time between charges and allow the packs to achieve their full potential.

While NiCads can be extremely good in terms of cost-economy, they are not necessarily the answer to every battery need. Fully charged, they have a typical voltage of 1.2V dropping to 1.0V when exhausted, compared to 1.5 to 0.8V in primary cells which they can usually replace, cell for cell in equivalent sizes.

However, when a high voltage level is required in equipment designed for use with NiCads, such as a transmitter, extra cells are installed to provide the necessary total voltage. Instead of eight primary cells (x 1.5V nom.) providing a 12V supply, for instance, ten NiCads (x 1.2V) are used.

The fact that they hold their full voltage almost to the end of their charge means that it is not always possible to anticipate battery exhaustion. In amateur radio this situation usually occurs when operating in the middle of a field miles from anywhere, just when contact has been made with a rare "Dx" station! Where equipment needs to be kept running, therefore, a spare set of fully charged NiCads is needed for immediate replacement purposes.

Care should always be taken to avoid shorting NiCads. They have a low internal resistance and high current will flow causing damage to the cell. They are not suitable for use in very low power equipment, such as electric clocks, where primary cells are normally replaced about once a year, as they normally self-discharge to exhaustion in about half that time. When not in use at all they will also discharge themselves but this does not affect their capability for recharge.

RECHARGING

Makers recommend using a NiCad until it is discharged, and then recharging it for a specified period at a current appropriate for the particular size cell. Care should be taken in cold weather when low temperatures can cause increased internal pressure of a cell with possible harmful results.

Cells can be recharged before they are fully discharged with the time period correspondingly reduced. In this case some estimate of use should be made, adding about 20 per cent to the estimated expired capacity. But if this is done frequently the practice carries the risk of overcharging and reducing the potential life of the cells.

They may also acquire a "memory" for the reduced charge/discharge cycle, resulting in an inability to take the full charge. Advertisements for NiCads sometimes claim that they will not be harmed if they are charged for longer than the recommended periods. This is true in the short term.

The charging rates recommended are such that cells may safely receive overcharge for indefinite periods, but frequent excessive charging can reduce their overall life due to heating effects. Because of its construction, the PP3 equivalent size NiCad is particularly vulnerable in this connection.

In radio receivers NiCads are fine if the receiver is used frequently. If it is used infrequently the user will be disappointed at the apparent shortness of life following each charge. In use, the cells should be exhausted to the point where the receiver no longer functions satisfactorily and they should then be recharged at normal room temperature.

There are various approaches if you take these and other (not mentioned) precautions seriously. For example, I use a timer/cut-out to restrict the charging time to the recommended period.

An article in an American magazine recently described a unit which discharges cells automatically down to 0·75V to ensure satisfactory discharge before recharging, while preventing accelerated discharge to zero volts and possible "cell reversal". A German magazine featured a charger which samples the voltage across the NiCads under charge every eight minutes; if the new sample is lower than the previous sample full charging has been achieved and the charger is automatically switched off.

Although there are so many aspects to consider to obtain optimum performance from NiCads I doubt if many users bother much about them. After all, if you get only half the number of recharges claimed, it still represents a good saving over buying new batteries every time the old ones run out! The ideal, of course, would be a rechargeable cell giving the full performance claimed by the manufacturers without any of the reservations or provisos associated with NiCads.

SANGEAN SERVICING

I have received a letter from a reader whose Sangean ATS 803A world band receiver has broken down out of guarantee. He has been told by the original suppliers, Comet, that they are unable to obtain spares and cannot repair it for him. If any readers know somewhere he might get it serviced please let me know via the editor.

It will be disappointing if the ATS 803A is now obsolete. The 1991 issue of "Passport to World Band Radio" reviews it as "the best world band radio for under $400 (USA)". However, even the best models become "discontinued" and I'm currently trying to confirm the position with Comet.

In the meantime, if anyone can provide information about the current status of this receiver please let me know. The same set has been sold under their own brand names by Currys, Tandy and Dixons and presumably the supply position is the same with them all?

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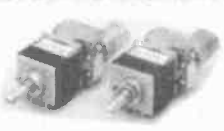

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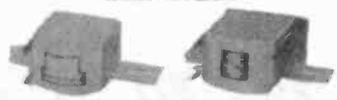

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Constructional Project

KNOCKERBOX

DAVID SMITH

Press the bell push and the door knocker bangs on the door. Its like a ghost standing beside you!

OVER the years, there have been many circuits published regarding electronic door bells, which generate sounds beyond the normal "ding-dong" type of chime. This has enabled the electronics constructor to possess a certain amount of individuality. Visiting family or friends could be greeted with a synthesized rendition of the *William Tell Overture, Star Wars* or *Beethovens 9th*.

There has even been an electronic device allowing the sound of a barking dog to be played, in the hope that it would ward off any potential burglar. The list seems endless, so you could be forgiven for thinking *"Oh no, not another electronic doorbell circuit"*.

Well, it's hard to be different nowadays. Many people are no longer impressed when pushing door bells, only to be confronted with the usual melody chip, generating endless tunes through a tiny loudspeaker. What is needed is something entirely different to announce their arrival and the Knockerbox can fulfil that need.

What it offers, is a return to the "good old days". A time when there was no electronic noise pollution around. What the Knockerbox will provide (once a caller has pressed your bellpush), is a sharp "rat-a-tat-tat" on your door knocker! No, not an electronically generated sound as you might well expect, but the real thing!

HOW IT WORKS

What we need from our circuit initially, is to detect when the bellpush has been pressed. We then need to process this information through an electronic circuit, to finally produce an electrical output capable of driving a solenoid connected mechanically to your front door knocker.

Referring to the block diagram in Fig. 1, we can see that the inherent noise emanating from the bellpush and its associated wiring, has to be cleaned up in some way. This is achieved by the use of an opto-isolator (IC1).

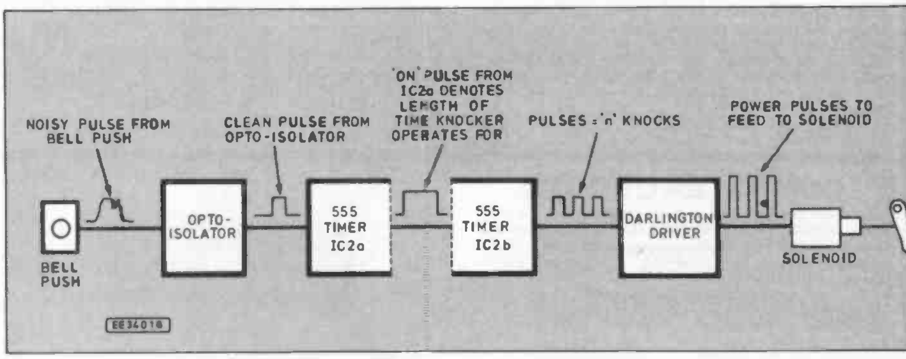
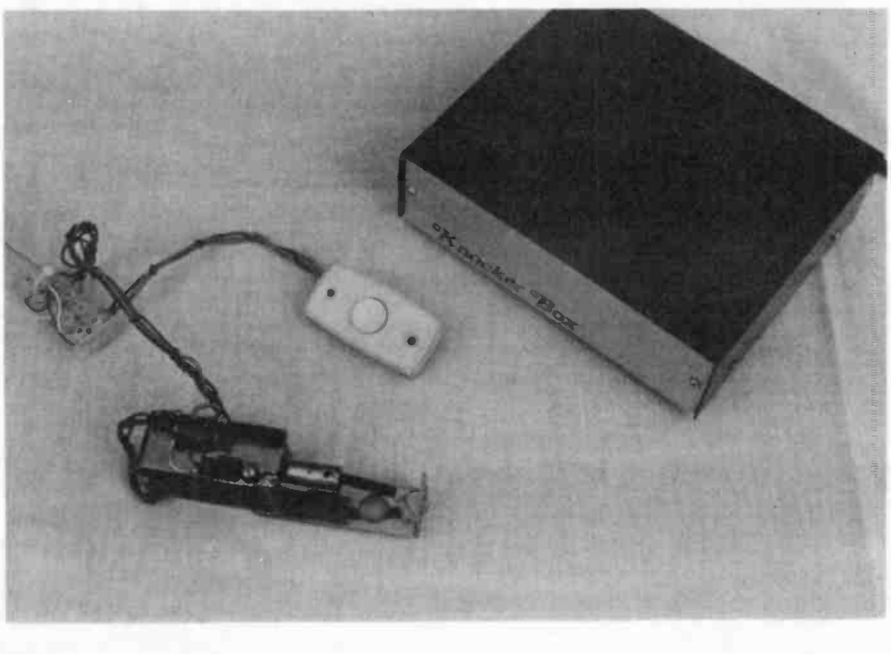


Fig. 1. Block diagram of the Knockerbox.



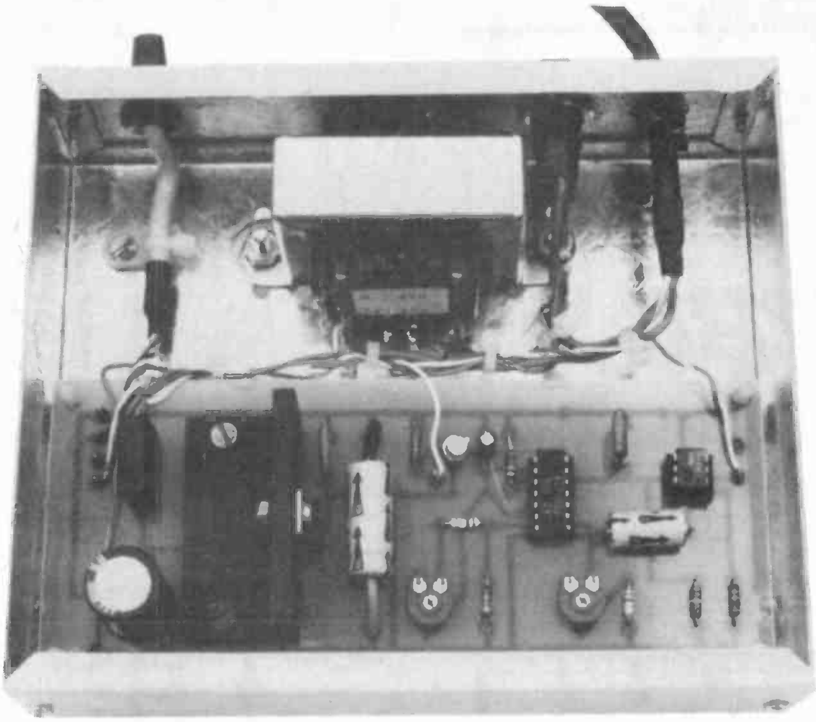
Once clean, this signal can be used to trigger the first of two 555 type timers, both housed in the same package. The first monostable timer provides us with an output pulse sufficiently long enough, to enable the second of our 555 timers (IC2b), to generate a short string of pulses.

These pulses are then fed to a Darlington driver pair of transistors, where the pulses are amplified sufficiently to drive a solenoid. It is this solenoid which operates the knocker on your front door.

CIRCUIT DESCRIPTION

The complete circuit diagram for the Knockerbox is shown in Fig. 2. Because the solenoid requires a fair amount of current to operate, it is impractical to run this circuit from dry batteries. The circuit has therefore been designed to run off ordinary domestic house mains.

If we look at Fig. 2, we can see that the power supply consists of a mains isolation transformer T1, a bridge rectifier D2 to D5 and a 12V stabiliser, IC3. Smoothing is accomplished by capacitors C4, C5 and C6.



COMPONENTS

Resistors

R1	1k	R4	6k8
R2	12k	R5	100k
R3	10k	R6	150k
		R7	1k5

All 0.6W 1% metal film

Potentiometers

VR1 100k horizontal skeleton preset, lin.
VR2 500k horizontal skeleton preset, lin.

See SHOP TALK Page

Capacitors

C1	10n polyester layer
C2	47μ axial elec., 63V
C3	1μ radial elec., 100V
C4	0μ1 disc ceramic, 50V
C5	470μ axial elec., 25V
C6	680μ radial elec., 63V

Semiconductors

D1	1N4005 1A 600V rec. diode
TR1	BC108 *npn* transistor
TR2	TIP31A *npn* power transistor
IC1	2046 transistor opto-isolator
IC2	556 dual timer
IC3	78S12 +12V 2A voltage regulator
D2-D5	1·4A 60V bridge rectifier

Miscellaneous

T1	Mains transformer, 30VA 15V secondary
S1	Doorbell push switch
SOL	12V solenoid (see text)
FS1	0·5A fuse with chassis mounting fuseholder

Metal case, size 160mm x 140mm x 50mm; plastic box, to cover solenoid and TR2/D1; 8-pin d.i.l. socket; 14-pin d.i.l. socket; 8W heatsink for IC3; solder pins (8 off); connecting wire; solder. Leaf spring, wire, pulley etc. as required for door knocker.

Printed circuit board available from EE PCB Service, code EE775.

Approx cost guidance only **£27** *plus cases*

The 12V regulator i.c. can supply up to 2A of current, to drive the solenoid. Of course the type of solenoid used, will depend very much on your own requirements i.e. size of door knocker fitted, the length of stroke that the solenoid has to travel, plus other mechanical considerations.

Resistor R1 provides voltage to the l.e.d. housed inside the opto-isolator IC1. Pressing the doorbell allows this l.e.d. to light up, thereby causing a transistor (also housed within the same chip) to conduct.

A suitable pulse therefore, is fed from the opto-isolators' output at pin 5, to the trigger input of IC2a, at pin 6. This action now provides an output pulse from IC2a at pin 5. The length of this output pulse is controlled by adjusting the setting of preset VR1 (used to determine the *length* of knock required).

Connecting IC2a's output (pin 5) to the trigger input pin of the second timer (IC2b, pin 10), initiates our second set of pulses at pin 9. These are the short repetitive pulses which will eventually form our "rat-a-tat-tat" sound, the speed of which is controlled by preset VR2 and its associated components resistors R4, R5 and capacitor C3.

Transistor TR1 receives these short pulses and passes them onto the solenoid driving transistor TR2, this being a TIP31A. Diode D1 offers protection against any back e.m.f., from the solenoid coil, which may cause damage to TR2.

CONSTRUCTION

A metal case should be used to house the project, as *safety* is of paramount importance. Three-core mains flex should be used in order to earth the circuits "ground rail", *plus* the metal casing of the enclosure.

Having selected a suitable metal case, drill two small holes in the base of the case to enable it to be fixed to the wall. Also at this stage, and before mounting components on the circuit board, you should use the board as a template to mark out the best positioning for the boards four corner fixing holes on the inside of the case bottom surface.

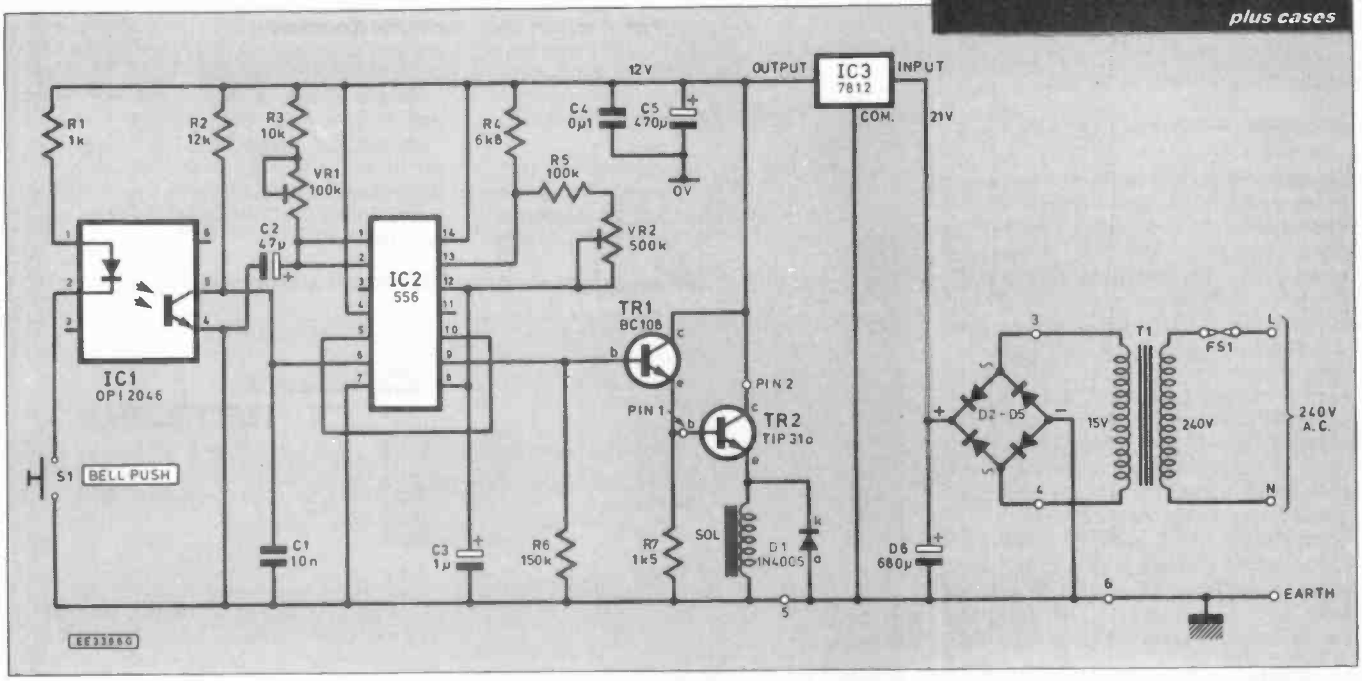


Fig. 2. Circuit diagram of the Knockerbox.

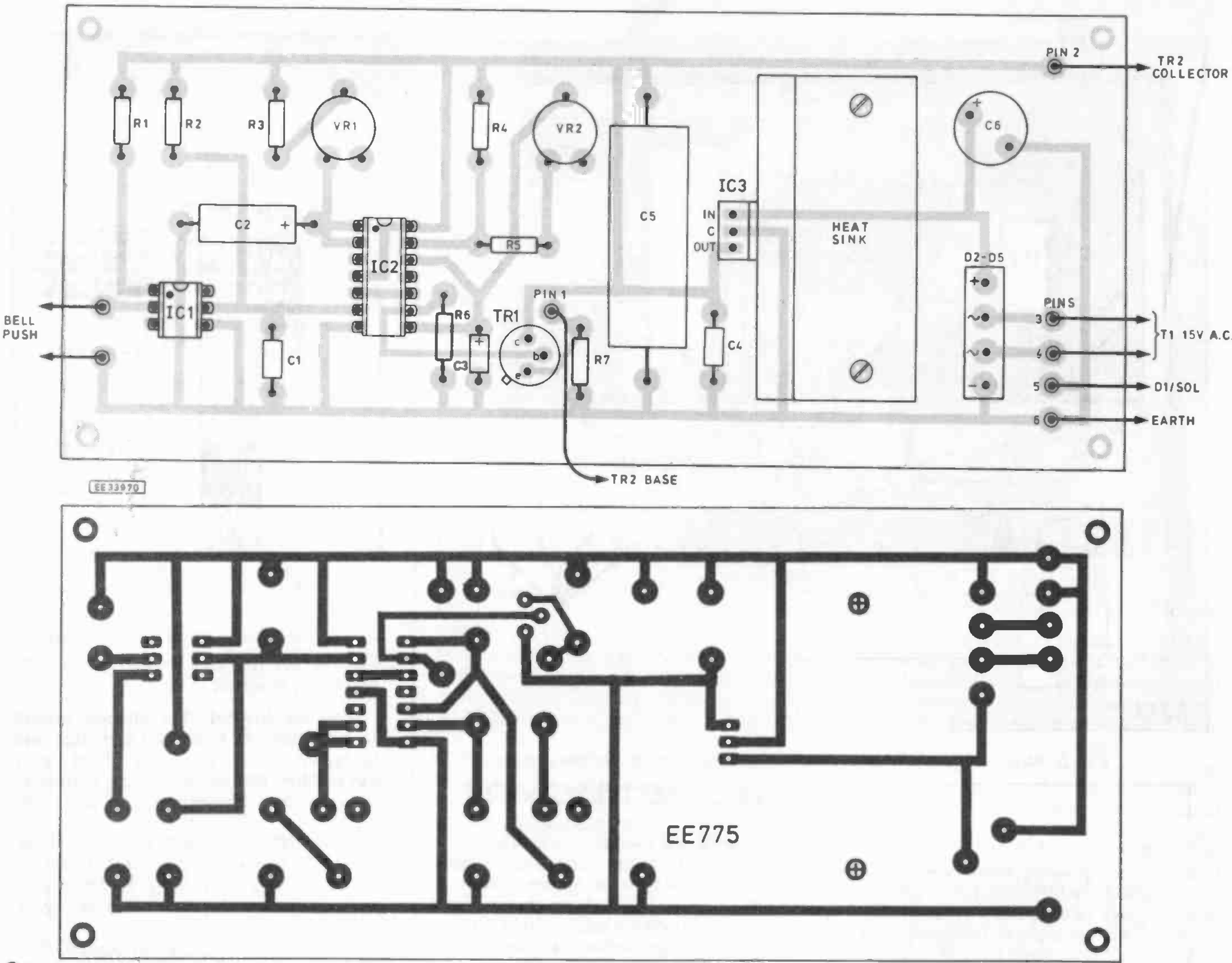


Fig. 3. Printed circuit board layout and wiring.

Once they have been marked you can decide whether to use self-adhesive stand-off pillars or drill through the case at the marks and use nuts (three per bolt) and bolts, preferably nylon, to secure the board in position later. The case should now be put to one side and attention turned to the printed circuit board.

The printed circuit board component layout and full size copper foil master pattern is shown in Fig. 3. This board is available from the *EE PCB Service*, code EE775.

Mount the components onto the printed circuit board as shown in Fig. 3. Before fixing the 12V regulator i.c. to the heat-sink, spread a little heat transfer compound between the two mating surfaces to improve thermal conductivity.

When fitting the transistors, diodes and electrolytic capacitors, check carefully their polarity. Also make sure that the i.c.s are correctly orientated.

Note that power transistor TR2 is not mounted on the p.c.b., but against the body of the solenoid, which in turn acts as a heatsink. Diode D1 is also connected directly to the transistor emitter lead, see Fig. 4. Both these components and the solenoid are mounted on the door.

Alternatively, TR2 and D1 could be mounted inside the case which houses the other components. The choice is yours, but do bear in mind that the TIP31A has a maximum current carrying capacity of 3A. Something to think about when choosing your solenoid.

WIRING

When all the components have been soldered into place, mount the board inside the case by way of the p.c.b.s four corner fixing holes. Referring to Fig. 5, mount the other components as shown, paying particular attention to the mains wiring.

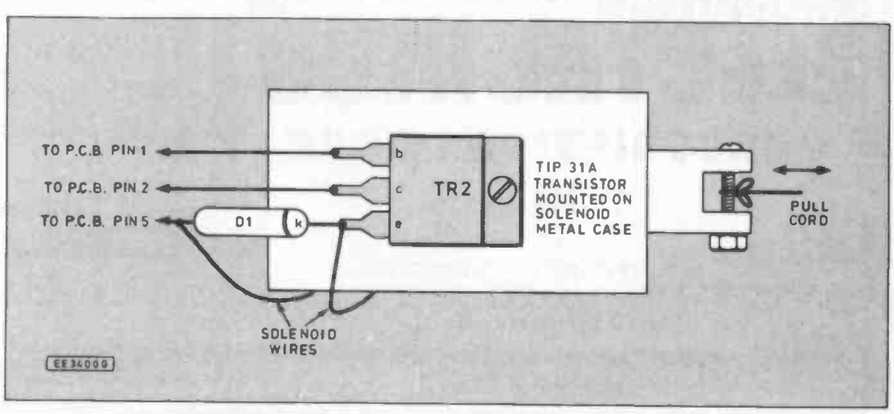
The "live" mains wire should be connected to the *rearmost* tag of the fuseholder FS1. Then, in the event of a fuse having to be replaced, the outer contact of the fuse holder, (easily touched by accident), will not be in contact with the mains!

Finally, the box, which *must* be fully enclosed, should be mounted near the front door. The mains lead should be run to the nearest 13A socket. Twin bell wire should be connected between the box and bellpush, and the wires used for the solenoid should be extra flexible and looped in such a way from the box to the door to incur minimum bending; see Fig. 6.

A smaller box can be fitted over the top of the door mounted solenoid to give it a neater appearance. This box also covers the power transistor TR2, so ample "air space" should be provided inside the box.

As the choice of solenoid is left to the individual's own requirements, the final "mechanical" arrangement of linking it to the door knocker may vary. However, the suggested method shown in Fig. 7 should prove to be the best approach for most set-ups.

Fig. 4. Mounting and wiring of TR2 and D1 on the solenoid.



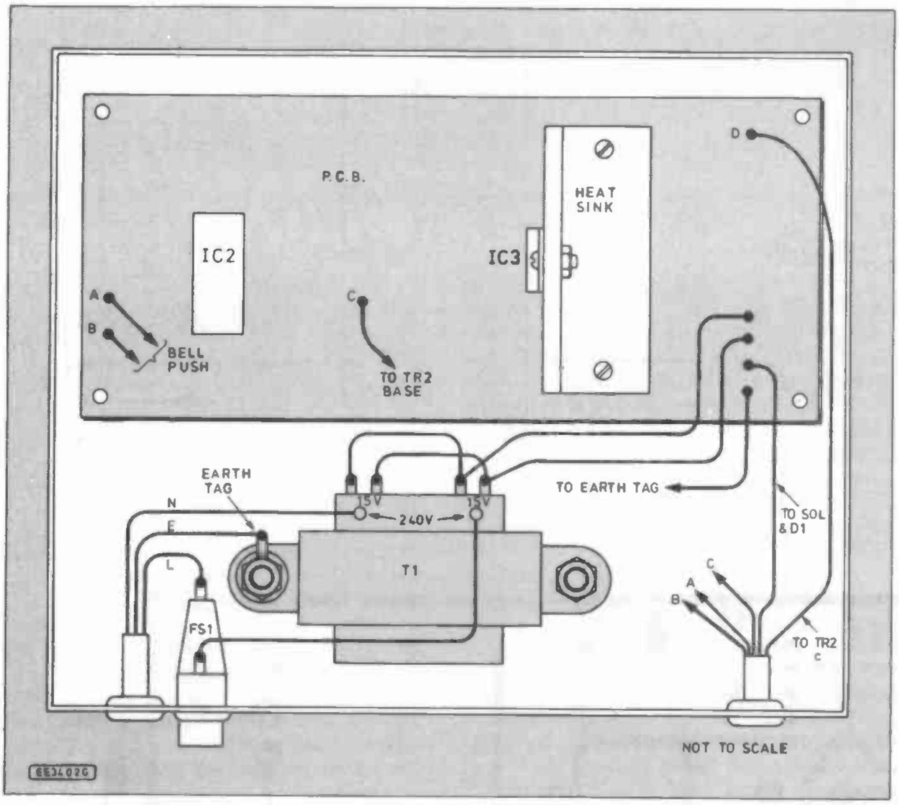


Fig. 5. Interwiring of the case mounted components and the p.c.b.

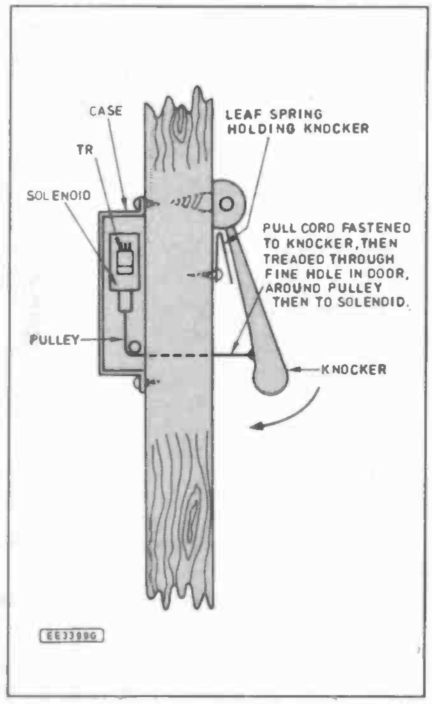


Fig. 7. Fitting and operation of the solenoid/knocker.

ADJUSTMENTS

As the following adjustments are best made with the circuitry connected to the front door solenoid and mains, it would be wise to make sure no one is likely to walk in through the door, and that toddlers and or pets are safely distanced.

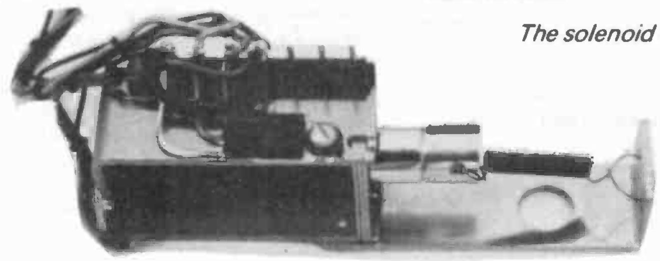
Because of the presence of mains voltage extreme care must be exercised when carrying out adjustments.

First set preset VR1 to its longest "on" period. This will enable the setting of preset VR2 to take place over a longer period.

Press the doorbell. The solenoid should start to pulsate; if it does not, this will be because pulses are being "fired" at it too quickly, thereby not giving it time to return to rest before the next pulse appears.

Turn VR2 slowly either way until the speed of "knocking" you desire has been achieved. You may have to repeatedly press the bellpush in order to re-trigger the circuit.

Once happy with the "knocking" *frequency*, reduce the setting of VR1 until the initial triggering pulse only allows the correct number of "knocks" to occur during one bell press. An average guide would be about six knocks over a period of two to three seconds. □



The solenoid with TR2 and D1.

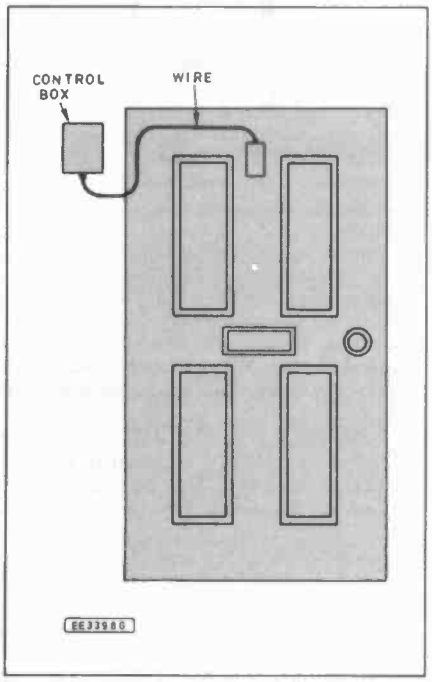


Fig. 6 (left). Fitting the unit to the door.

ROBOT ROUNDUP

Nigel Clark

MUSEUM OF AUTOMATA

One man's love of things mechanical has resulted in a new tourist attraction in York and the encouragement of an interest in robotics in a growing number of people. The *Museum of Automata* was opened in March last year in an old warehouse between Cliffords Tower and the River Ouse, in the ancient capital of the North of England.

In its first year (Mar.-to-Dec.) it attracted 50,500 visitors and this year as its fame has spread further afield the figures should show a 50 per cent increase. Up until the end of September, about 60,000 people had visited the museum. One major boost came at the *Robot Olympics* held last year at the Turing Institute in Glasgow when one of the exhibits, the Japanese Archer, took the Gold Medal in the Javelin class, beating many newer and apparently more sophisticated devices in the process.

The museum is the brainchild of a Surrey property developer, Jon Robertson, and his wife Andrea. His early childhood, spent on a farm, left him with a fascination for machines. Later he bought a singing bird box as an engagement present for his future wife and they were hooked.

Holidays would often include visits to antique shops and flea markets and the collection grew. They later were able to combine their collection with that of another enthusiast, Jack Donovan, when his collection was offered to them. Donovan used to run a hotel in Bournemouth where his automata helped to entertain the guests. He later dealt in automata with people from all over the world.

DISPLAY

Four years ago Jon and Andrea exhibited all their automata, which, despite being extremely fragile and needing skilled and careful handling and maintenance, were all in working order. From that came a suggestion that they be put on permanent display alongside more contemporary works, of which there are a growing number in Britain. Soon afterwards Robinson bought a disused warehouse in York and the idea began to blossom.

From the start the intention was to educate as well as to display. To this end the first thing visitors see is the video wall giving a five minute history of automata, beginning with the ancient Greeks who developed mechanical marvels such as singing birds and automatic washbasins based on their knowledge of gears, pneumatics and hydraulics and ending with specially-commissioned pieces.

This is followed by the displays of the actual devices. Unfortunately most of the older and more complex pieces are too delicate to be shown working but each display has a video showing how each piece works.

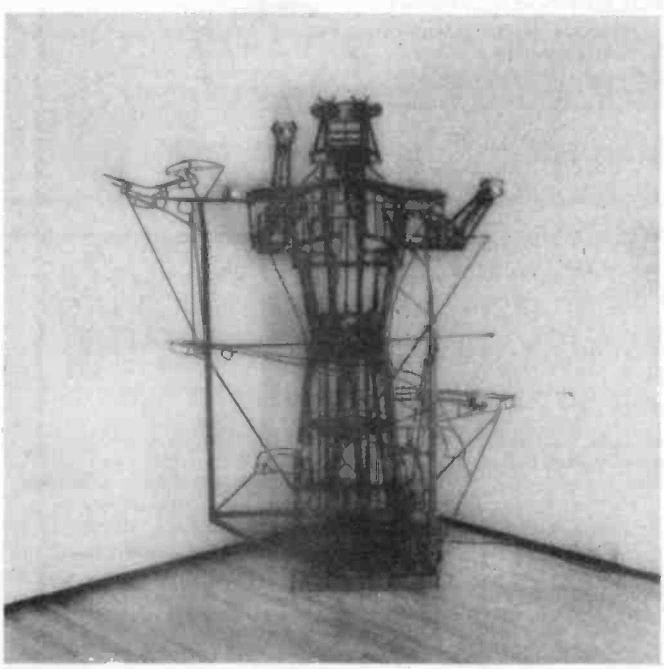
However many of the clocks, which include small automata as decoration or to chime the hours, are working. It is worthwhile being around on the hour to see many of them perform although there is also something to see on the quarters as well.

FRENCH CONNECTION

It is the French section showing models from the 19th century where the creations have been developed to such a degree that they meet one of the definitions of automata with no difficulty. That is that they be man-made objects which mimic the movements of living things, their mechanisms having their motive power so concealed that they appear to move spontaneously.

All the French models, which include smoking monkeys, musicians and jugglers meet the criteria. To give visitors some idea of how the "magic" is created some models have been stripped down to show their mechanics while other displays show the elements which make up the automata.

Dex the Robot (Simon Blades, 1989) can be seen at the Museum of Automata, York.



MODERN VERSION

The modern robots or automata are less concerned with hiding their mechanics than with showing off how they perform their activities. Dex, which stands in the lobby is a perfect example of this. It has metal balls moving on various tracks around its body and is so fascinating that it often holds up the flow of visitors as they watch it before going into the museum.

Many of the modern automata encourage a hands-on approach from the visitors who can press buttons to activate them, some with their workings showing and some without. Possibly the most interesting are the ones where people provide the motive power such as the Wave Machine and an ingenious device which passes balls around, requiring cooperation by a number of people to get the ball from one position to another.

WORKSHOPS

Apart from the experience of going around the displays the museum is concerned with education in the wider sense, using the robots and exhibits to encourage an interest in craft and technology generally. As part of this the museum runs a series of workshops based around a visit followed by study of the mechanisms involved in the exhibits.

Workpacks are provided to go with the workshops, these are designed to meet the requirements of particular levels of the National Curriculum. And this year a competition has been held to design a piece of automata with a prize of £100. The response was excellent with entries from the large number of schools which have had the opportunity to take advantage of what the museum has to offer. The best of the entries will be put on display.

The growing reputation of the workshops can be gauged by the response to the series was offered in the early autumn. Within a few days of the series being promoted all the places were full.

Despite its success, or even because of it, the museum is looking at ways of developing and expanding its facilities. Only recently an extra room was added for use as a special exhibition area or for workshops.

As has often been noted in this column moving machines like robots and automata have a fascination for a large number of people. This museum enables them to feed their fascination in an accessible and interesting way.

THANKS

This is the last of the regular *Robot Roundups*. Many thanks to all those who have helped me to fill the column over the years and for your interest.

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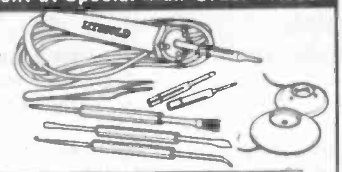

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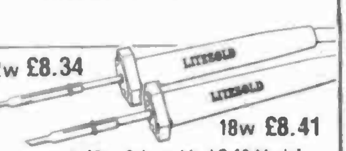

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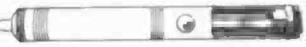

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INTRODUCING DIGITAL ELECTRONICS (published by *Everyday Electronics*)
Michael J. Cockcroft
Although this book is primarily a City & Guilds Introductory level course (726/301), approximately 80% of the information forms a very basic introduction to electronics in general, it therefore provides an excellent introductory text for beginners and a course and reference book for GCSE students.
Full details on registering for C&G assessment, details of assessment centres, components required and information on the course in general are given.
The City & Guilds introduction to module 726/301 reads: "A candidate who satisfactorily completes this module will have a competence to identify basic components and digital integrated circuits and connect them together to form simple working circuits and logic units." This provides an excellent introduction to the book.
112 pages (A4 size) Order code TI4 £2.95

ELECTRONIC PROJECTS – BOOK 1
Published by *Everyday Electronics* in association with Magenta Electronics.
Contains twenty of the best projects from previous issues of EE each backed with a kit of components. The projects are: Seashell Sea Synthesiser, EE Treasure Hunter, Mini Strobe, Digital Capacitance Meter, Three Channel Sound to Light, BBC 16K Sideways Ram, Simple Short Wave Radio, Insulation Tester, Stepper Motor interface, Eprom Eraser, 200MHz Digital Frequency Meter, Infra Red Alarm, EE Equaliser Ioniser, Bat Detector, Acoustic Probe, Mains Tester and Fuse Finder, Light Rider – (Lapel Badge, Disco Lights, Chaser Light), Musical Doorbell, Function Generator, Tilt Alarm, 10W Audio Amplifier, EE Buccaneer Induction Balance Metal Detector, BBC Midi Interface, Variable Bench Power Supply, Pet Scarer, Audio Signal Generator.
128 pages (A4 size) Order code EP1 £2.45

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Published by EVERYDAY ELECTRONICS
Due to the demand from students, teachers and hobbyists we have put together a range of articles from past issues of *Everyday Electronics* that will assist those involved with the construction of electronic projects.
The book contains the complete *Project Development for GCSE* series.
Contents: Features – First Steps in Project Building; Building with Vero; Project Development for GCSE; Getting your Project Working; Guide to Printed Circuit Boards; Choosing and Using Test Equipment – The Multimeter, The Oscilloscope, P.S.U.s, Logic Probes, Digital Frequency Meters, Signal Generators, etc; **Data** – Circuit Symbols; Component Codes; Resistors; Identifying Components; Capacitors; Actually Doing It – Understanding the Circuit Diagram, Component Codes, Mounting circuit boards and controls, Understanding Capacitors; **Projects** – Lie Detector; Personal Stereo Amplifier; Digital Experimentsr's Unit; Quizmaster; Siren Effects Unit; UV Exposure Unit; Low-cost Capacitance Meter; Personal Radio.
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Mike Tooley BA (published by *Everyday Electronics*)
A complete course that can lead successful readers to the award of a City and Guilds Certificate in Introductory Microprocessors (726/303). The book contains everything you need to know including full details on registering for assessment, etc. Starting with basic terminology, integrated circuits, logic families and numbering systems the text builds in stages, with revision and assessments built in, up to programming, languages, flow charts, etc. The course is ideal for the newcomer to the subject.
80 pages (A4 size) Order code TI-88/89 £2.45

Computers and Computing

COMPUTERS AND MUSIC – AN INTRODUCTION
R. A. Penfold
Computers are playing an increasingly important part in the world of music, and the days when computerised music was strictly for the fanatical few are long gone. Computer-based music systems in the past have tended to be either horrendously expensive, very crude, or both! These days, prices are much more modest and the potential of the equipment is much greater. Consequently a lot of musicians are being tempted into the unfamiliar territory of computer music systems.
If you are more used to the black and white keys of a synth keyboard than the QWERTY keyboard of a computer, you may be understandably confused by the jargon and terminology bandied about by computer buffs. But fear not, setting up and using a computer-based music making system is not as difficult as you might think.
This book will help you learn the basics of computing, running applications programs, wiring up a MIDI system and using the system to good effect, in fact just about everything you need to know about hardware and the programs, with no previous knowledge of computing needed or assumed. This book will help you to choose the right components for a system to suit your personal needs, and equip you to exploit that system fully.
174 pages Order code PC107 £7.95

A CONCISE INTRODUCTION TO MS-DOS
N. Kantaris
This guide is written with the non-expert, busy person in mind and, as such, it has an underlying structure based on "what you need to know first, appears first". Nonetheless, the guide is also designed to be circular, which means that you don't have to start at the beginning and go to the end. The more experienced user can start from any section.
The guide covers versions 3.0, 3.1 and 3.2 of both PC-DOS and MS-DOS as implemented by IBM and other manufacturers of "compatible" microcomputers, including the AMSTRAD PC's. It covers both floppy disc-based systems and hard disc-based systems.
64 pages Order code BP232 £2.95

AN INTRODUCTION TO Z80 MACHINE CODE
R. A. & J. W. Penfold
Takes the reader through the basics of microprocessors and machine code programming with no previous knowledge of these being assumed. The Z80 is used in many popular home computers and simple programming examples are given for Z80-based machines including the Sinclair ZX-81 and Spectrum, Memotech and the Amstrad CPC 464. Also applicable to the Amstrad CPC 664 and 6128.
144 pages Order code BP152 £2.75

AN INTRODUCTION TO 68000 ASSEMBLY LANGUAGE
R. A. & J. W. Penfold
Obtain a vast increase in running speed by writing programs for 6800 based micros such as the Commodore Amiga, Atari ST range or Apple Macintosh range etc., in assembly language. It is not as difficult as one might think and this book covers the fundamentals.
112 pages Order code BP184 £2.95

THE ART OF PROGRAMMING THE ZX SPECTRUM
M. James, B.Sc., M.B.C.S.
It is one thing to have learnt how to use all the Spectrum's commands and functions, but a very different one to be able to combine them into programs that do exactly what you want them to. This is just what this book is all about – teaching you the art of effective programming with your Spectrum.
144 pages Order code BP119 £2.50

A Z80 WORKSHOP MANUAL
E. A. Parr, B.Sc., DC.Eng., M.I.E.E.
This book is intended for people who wish to progress beyond the stage of BASIC programming to topics such as machine code and assembly language programming, or need hardware details of a Z80 based computer.
192 pages Order code BP112 £3.95

NEWNES COMPUTER ENGINEER'S POCKETBOOK (Second Edition)
Michael Tooley
An invaluable compendium of facts, figures, circuits and data, indispensable to the designer, student, service engineer and all those interested in computer and microcomputer systems. It will appeal equally to the hardware or software specialist and to the new band of "software engineers". This data is presented in a succinct and rapidly accessible form so that the book can become part of an everyday toolkit.
205 pages (hard cover) Order code NE01 £10.95

UNDERSTANDING PC SPECIFICATIONS
R. A. Penfold
If you require a microcomputer for business applications, or a high quality home computer, an IBM PC or compatible is often the obvious choice. They are competitively priced, and are backed up by an enormous range of applications programs, hardware add-ons, etc. The main difficulty for the uninitiated is deciding on the specification that will best suit his or her needs. PCs range from simple systems of limited capabilities up to complex systems that can happily run applications that would have been considered beyond the abilities of a microcomputer not so long ago. It would be very easy to choose a PC system that is inadequate to run your applications efficiently, or one which goes beyond your needs and consequently represents poor value for money.
This book explains PC specifications in detail, and the subjects covered include the following: Differences between types of PC (XT, AT, 80386, etc); Maths co-processors; Input devices (keyboards, mice, and digitisers); Memory, including both expanded (EMS) and extended RAM; RAM disks and disk caches; Floppy disk drive formats and compatibility; Hard disk drives (including interleave factors and access times); Display adaptors, including all standard PC types (CGA, Hercules, Super VGA, etc); Contains everything you need to know if you can't tell your EMS from your EGA!
104 pages Order code BP282 £3.95

Theory and Reference

ELECTRONIC HOBBYISTS HANDBOOK
R. A. Penfold
Provides an inexpensive single source of easily located information that the amateur electronics enthusiast is likely to need for the day-to-day pursuance of this fascinating hobby. Covers common component colour codes. Details the characteristics and pinouts of many popular semiconductor devices, including various types of logic ICs, operational amplifiers, transistors, FETs, unijunctions, diodes, rectifiers, SCRs, diacs, triacs, regulators and SMDs, etc. Illustrates many useful types of circuits, such as timers and oscillators, audio amplifiers and filters, as well as including a separate section on power supplies. Also contains a multitude of other useful data.
88 pages Temporarily out of print

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST
G. T. Rubaroe, T. Eng (C.E.I.), Assoc.I.E.R.E.
The object of this book is to supply the hobbyist with a background knowledge tailored to meet his or her specific requirements and the author has brought together the relevant material and presented it in a readable manner with minimum recourse to mathematics.
128 pages Order code 228 £2.50

NEWNES ELECTRONICS POCKET BOOK
E. A. Parr
Newnes Electronics Pocket Book has been in print for over twenty years and has covered the development of electronics from valve to semiconductor technology and from transistors to LSI integrated circuits and microprocessors. To keep up to date with the rapidly changing world of electronics, continuous revision has been necessary. This new Fifth Edition takes account of recent changes and includes material suggested by readers of previous editions. New descriptions of op.amp. applications and the design of digital circuits have been added, along with a totally new chapter on computing, plus other revisions throughout.
315 pages (hard cover) Order code NE02 £10.95

ELECTRONICS – A "MADE SIMPLE" BOOK
G. H. Olsen
This book provides excellent background reading for our *Introducing Digital Electronics Teach-In* Book and will be of interest to everyone studying electronics. The subject is simply explained and well illustrated and the book assumes only a very basic knowledge of electricity.
330 pages Order code NE10 £4.95

PRACTICAL DIGITAL ELECTRONICS HANDBOOK
Mike Tooley (Published in association with *Everyday Electronics*)
The vast majority of modern electronic systems rely heavily on the application of digital electronics, and the *Practical Digital Electronics Handbook* aims to provide readers with a practically based introduction to this subject. The book will prove invaluable to anyone involved with the design, manufacture or servicing of digital circuitry, as well as to those wishing to update their knowledge of modern digital devices and techniques. Contents: Introduction to integrated circuits; basic logic gates; monostable and bistable devices; timers; microprocessors; memories; input and output devices; interfaces; microprocessor buses. Appendix 1: Data. Appendix 2: Digital test gear projects; tools and text equipment; regulated bench power supply; logic pulser; verstaile pulse generator; digital IC tester; current tracer; audio logic tracer; RS-232C breakout box; versatile digital counter/frequency meter. Appendix 3: The oscilloscope. Appendix 4: Suggested reading. Appendix 5: Further study.
208 pages Order code PC100 £6.95

ELECTRONIC MODULES AND SYSTEMS FOR BEGINNERS
Owen Bishop
This book describes over 60 modular electronic circuits – how they work, how to build them, and how to use them. The modules may be wired together to make hundreds of different electronic systems, both analogue and digital. To show the reader how to begin building systems from modules, a selection of over 25 electronic systems are described in detail, covering such widely differing applications as timing, home security, measurement, audio (including a simple radio receiver), games and remote control.
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Explains in crystal clear terms the absolute fundamentals behind electricity and electronics. Really helps you to discover and understand the subject, perhaps for the first time ever.

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Then help is at hand with this inexpensive book. In as simple a way as possible and without too much complex mathematics and formulae.
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Component Identification

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K. H. Recorr
Shows the reader how, with just a test-meter to go about recording the particular signature of an unmarked i.c. which should enable the i.c. to then be identified with reference to manufacturers' or other data. An i.c. signature is a specially plotted chart produced by measuring the resistances between all terminal pairs of an i.c.
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RADIO AND ELECTRONIC COLOUR CODES AND DATA CHART
B. B. Babani
Although this chart was first published in 1971 it provides basic information on many colour codes in use throughout the world, for most radio and electronic components. Includes resistors, capacitors, transformers, field coils, fuses, battery leads, speakers, etc. It is particularly useful for finding the values of old components.
Chart Order code BP7 £0.95

Testing and Test Gear

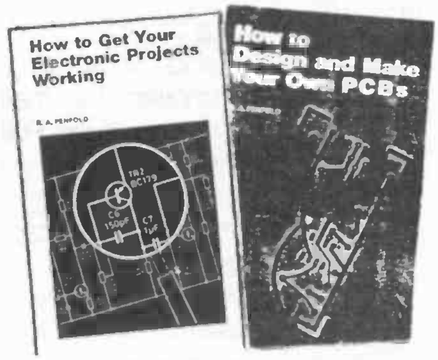
TRANSISTOR RADIO FAULT-FINDING CHART
C. E. Miller
Used properly, should enable the reader to trace most common faults reasonably quickly. Across the top of the chart will be found four rectangles containing brief description of these faults, *vis* – sound weak but undistorted, set dead, sound low or distorted and background noises. One then selects the most appropriate of these and following the arrows, carries out the suggested checks in sequence until the fault is cleared.
Chart Order code BP70 £0.95

HOW TO USE OSCILLOSCOPES AND OTHER TEST EQUIPMENT
R. A. Penfold
This book explains the basic function of an oscilloscope, gives a detailed explanation of all the standard controls, and provides advice on buying. A separate chapter deals with using an oscilloscope for fault finding on linear and logic circuits. Plenty of example waveforms help to illustrate the control functions and the effects of various fault conditions. The function and use of various other pieces of test equipment are also covered, including signal generators, logic probes, logic pulsers, and crystal calibrators.
104 pages Order code BP267 £3.50

Project Building

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
R. A. Penfold
We have all built projects only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.
96 pages Order code BP110 £2.50

HOW TO DESIGN AND MAKE YOUR OWN P.C.B.s
R. A. Penfold
Deals with the simple methods of copying printed circuit board designs from magazines and books and covers all aspects of simple p.c.b. construction including photographic methods and designing your own p.c.b.s.
80 pages Order code BP121 £2.50



A BEGINNERS GUIDE TO MODERN ELECTRONIC COMPONENTS
R. A. Penfold
The purpose of this book is to provide practical information to help the reader sort out the bewildering array of components currently on offer. An advanced knowledge of the theory of electronics is not needed, and this book is not intended to be a course in electronic theory. The main aim is to explain the differences between components of the same basic type (e.g. carbon, carbon film, metal film, and wire-wound resistors) so that the right component for a given application can be selected. A wide range of components are included, with the emphasis firmly on those components that are used a great deal in projects for the home constructor.
166 pages Order code BP285 £3.95

BEGINNER'S GUIDE TO BUILDING ELECTRONIC PROJECTS
R. A. Penfold
Shows the complete beginner how to tackle the practical side of electronics, so that he or she can confidently build the electronic projects that are regularly featured in magazines and books. Also include examples in the form of simple projects.
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O. Bishop
These projects range in complexity from a simple colour temperature meter to an infra-red laser. There are novelties such as an electronic clock regulated by a resonating spring, and an oscilloscope with solid-state display. There are scientific measuring instruments such as a pH meter and an electro-cardiometer. All projects have a strong scientific flavour. The way they work, and how to build and use them are fully explained.
144 pages Order code BP104 £2.95

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F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.
Especially written for those who wish to participate in the intricacies of electronics more through practical construction than by theoretical study. It is designed for all ages upwards from the day one can read intelligently and handle simple tools.
80 pages Order code BP92 £1.75

Audio and Music

PRACTICAL MIDI HANDBOOK
R. A. Penfold
The Musical Instrument Digital Interface (MIDI) is surrounded by a great deal of misunderstanding, and many of the user manuals that accompany MIDI equipment are quite incomprehensible to the reader.

The Practical MIDI Handbook is aimed primarily at musicians, enthusiasts and technicians who want to exploit the vast capabilities of MIDI, but who have no previous knowledge of electronics or computing. The majority of the book is devoted to an explanation of what MIDI can do and how to exploit it to the full, with practical advice on connecting up a MIDI system and getting it to work, as well as deciphering the technical information in those equipment manuals.
128 pages Order code PC101 £6.95

MUSICAL APPLICATIONS OF THE ATARI ST's
R. A. Penfold
The Atari ST's are now firmly established as *the* computers to use for electronic music applications. The range and sophistication of these applications are much greater than most people may realise, but there are still a lot of misconceptions about just what can and cannot be achieved. This book will help you sort out the fact from the fallacy and to get the most musically from the ST's.

A wide selection of topics are covered, including the internal sound chip; MIDI; applications programs such as sequencing and score writing, etc; simple but useful add-on projects and MIDI programming.
90 pages Order code BP246 £5.95

AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN
V. Capel
This book explores the various features, good points and snags of speaker designs. It examines the whys and wherefores so that the reader can understand the principles involved and so make an informed choice of design, or even design loudspeaker enclosures for him or herself. Crossover units are also explained, the various types, how they work, the distortions they produce and how to avoid them. Finally there is a step-by-step description of the construction of the *Kapellmeister* loudspeaker enclosure.
148 pages Order code BP256 £2.95

COMPUTERS AND MUSIC. See Computers section opposite

Circuits and Design

PRACTICAL ELECTRONIC BUILDING BLOCKS – BOOK 1

PRACTICAL ELECTRONIC BUILDING BLOCKS – BOOK 2
R. A. Penfold
These books are designed to aid electronic enthusiasts who like to experiment with circuits and produce their own projects, rather than simply following published project designs.

BOOK 1 contains: Oscillators – sinewave, triangular, squarewave, sawtooth, and pulse waveform generators operating at audio frequencies. Timers – simple monostable circuits using i.c.s, the 555 and 7555 devices, etc. Miscellaneous–noise generators, rectifiers, comparators and triggers, etc.

BOOK 2 contains: Amplifiers – low level discrete and op-amp circuits, voltage and buffer amplifiers including d.c. types. Also low-noise audio and voltage controller amplifiers. Filters – high-pass, low-pass, 6, 12, and 24dB per octave types. Miscellaneous – i.c. power amplifiers, mixers, voltage and current regulators, etc.

BOOK 1 *128 pages* Order code BP117 £1.95
BOOK 2 *112 pages* Order code BP118 £1.95

MODERN OPTO DEVICE PROJECTS
R. A. Penfold
In recent years, the range of opto devices available to the home constructor has expanded and changed radically. These devices now represent one of the more interesting areas of modern electronics for the hobbyist to experiment in, and many of these have useful practical applications as well. This book provides a number of practical designs which utilize a range of modern opto-electrical devices, including such things as fibre optics, ultra bright l.e.d.s and passive IR detectors etc.

While many of these designs are not in the "dead simple" category, they should be within the capabilities of anyone with a reasonable amount of experience in electronics construction and some of the more simple designs are suitable for beginners.
104 pages Order code BP194 £2.95

ELECTRONIC ALARM CIRCUITS MANUAL
R. M. Marston
One hundred and forty useful alarm circuits, of a variety of types, are shown in this volume. The operating principle of each one is explained in concise but comprehensive terms, and brief construction notes are given where necessary.

Aimed at the practical design engineer, technician and experimenter, as well as the electronics student and amateur.
124 pages Order code NE11 £12.95

DIGITAL LOGIC GATES AND FLIP-FLOPS
Ian R. Sinclair
This book, intended for enthusiasts, students and technicians, seeks to establish a firm foundation in digital electronics by treating the topics of gates and flip-flops thoroughly and from the beginning. This is not a constructor's book in the sense of presenting circuits to build and use, it is for the user who wants to design and troubleshoot digital circuitry with considerably more understanding of principles.

Topics such as Boolean algebra and Karnaugh mapping are explained, demonstrated and used extensively, and more attention is paid to the subject of synchronous counters than to the simple but less important ripple counters.

No background other than a basic knowledge of electronics is assumed, and the more theoretical topics are explained from the beginning, as also are many working practices. The book concludes with an explanation of microprocessor techniques as applied to digital logic.
200 pages Order code PC106 £8.95

ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS
Robert Penfold
Robots and robotics offer one of the most interesting areas for the electronics hobbyist to experiment in. Today the mechanical side of robots is not too difficult, as there are robotics kit and a wide range of mechanical components available. The micro controller is not too much of a problem either, since the software need not be terribly complex and many inexpensive home computers are well suited to the task.

The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge this gap.
92 pages Order code BP179 £2.95

ELECTRONIC POWER SUPPLY HANDBOOK
Ian R. Sinclair
This book covers the often neglected topic of electronic power supplies. All types of supplies that are used for electronics purposes are covered in detail, starting with cells and batteries and extending by way of rectified supplies and linear stabilisers to modern switch-mode systems, IC switch-mode regulators, DC-DC converters and inverters.

The devices, their operating principles and typical circuits are all dealt with in detail. The action of rectifiers and the reservoir capacitor is emphasised, and the subject of stabilisation is covered. The book includes some useful formulae for assessing the likely hum level of a conventional rectifier reservoir supply.
136 pages Order code PC108 £7.95

HOW TO USE OP-AMPS
E. A. Parr
This book has been written as a designer's guide covering many operational amplifiers, serving both as a source book of circuits and a reference book for design calculations. The approach has been made as non-mathematical as possible.
160 pages Order code BP88 £2.95

MICRO INTERFACING CIRCUITS – BOOK 1
MICRO INTERFACING CIRCUITS – BOOK 2
R. A. Penfold
Both books include practical circuits together with details of the circuit operation and useful background information. Any special constructional points are covered but p.c.b. layouts and other detailed constructional information are not included.

Book 1 is mainly concerned with getting signals in and out of the computer; Book 2 deals primarily with circuits for practical applications.
BOOK 1 *112 pages* Order code BP130 £2.75
BOOK 2 *112 pages* Order code BP131 £2.75

SENSORS AND TRANSDUCERS
Keith Brindley
There are a considerable number of transducers. Look through any electronic components catalogue and you'll find a wide variety of types, and each type has many versions. It's not easy to choose a transducer correctly for a particular function. In many specifications, terms and procedures are referred to which might deter you from using one that is, in fact, the best for the job. Yet, opting to use a transducer merely because it is easier to interface into the measuring system is not the answer. A greater knowledge of all types of transducers capable of doing the task is the ideal, and only then can a totally satisfactory decision be made to use one in particular.
179 pages Order code NE17 £14.95

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R. N. Soar
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components – the light-emitting diode (LED). Also includes circuits for the 707 common anode display.
64 pages Order code BP42 £1.95
BOOK 2 50 more l.e.d. circuits Order code BP87 £1.95

Radio, TV, Satellite

AN INTRODUCTION TO AMATEUR RADIO
I. D. Poole
Amateur radio is a unique and fascinating hobby which has attracted thousands of people since it began at the turn of the century.

This book gives the newcomer a comprehensive and easy to understand guide through the subject so that the reader can gain the most from the hobby. It then remains an essential reference volume to be used time and again. Topics covered include the basic aspects of the hobby, such as operating procedures, jargon and setting up a station. Technical topics covered include propagation, receivers, transmitters and aerials etc.
150 pages Order code BP257 £3.50

SIMPLE SHORT WAVE RECEIVER CONSTRUCTION
R. A. Penfold
Short wave radio is a fascinating hobby, but one that seems to be regarded by many as an expensive pastime these days. In fact it is possible to pursue this hobby for a minimal monetary outlay if you are prepared to undertake a bit of d.i.y., and the receivers described in this book can all be built at low cost. All the sets are easy to construct, full wiring diagrams etc. are provided, and they are suitable for complete beginners. The receivers only require simple aerials, and do not need any complex alignment or other difficult setting up procedures.

The topics covered in this book include: The broadcast bands and their characteristics; The amateur bands and their characteristics; The propagation of radio signals; Simple aerials; Making an earth connection; Short wave crystal set; Simple t.r.f. receivers; Single sideband reception; Direct conversion receiver.

Contains everything you need to know in order to get started in this absorbing hobby.
88 pages Order code BP275 £3.95

AN INTRODUCTION TO SATELLITE TELEVISION
F. A. Wilson
As a definitive introduction to the subject this book is presented on two levels. For the absolute beginner or anyone thinking about purchasing or hiring a satellite TV system, the story is told as simply as such a complex one can be in the main text.

For the professional engineer, electronics enthusiast, student or others with technical backgrounds, there are numerous appendices backing up the main text with additional technical and scientific detail formulae, calculations, tables etc. There is also plenty for the DIY enthusiast with practical advice on choosing and installing the most problematic part of the system – the dish antenna.
104 pages Order code BP195 £5.95

AN INTRODUCTION TO AMATEUR COMMUNICATIONS SATELLITES
A. Pickford
Communications and broadcast satellites are normally inaccessible to individuals unless they are actively involved in their technicalities by working for organisations such as British Telecom, the various space agencies or military bodies, even those who possess a satellite television receiver system do not participate in the technical aspects of these highly technological systems.

There are a large number of amateur communications satellites in orbit around the world, traversing the globe continuously and they can be tracked and their signals received with relatively inexpensive equipment. This equipment can be connected to a home computer such as the BBC Micro or IBM compatible PCs, for the decoding of received signals.

This book describes several currently available systems, their connection to an appropriate computer and how they can be operated with suitable software.
102 pages Order code BP290 £3.95

AERIAL PROJECTS
R. A. Penfold
The subject of aerials is vast but in this book the author has considered practical aerial designs, including active, loop and ferrite aerials which give good performances and are relatively simple and inexpensive to build. The complex theory and mathematics of aerial design have been avoided.

Also included are constructional details of a number of aerial accessories including a pre-selector, attenuator, filters and tuning unit.
96 pages Order code BP105 £2.50

INTERNATIONAL RADIO STATIONS GUIDE
P. Shore
Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed to guide him or her around the ever more complex radio bands. This new edition has been completely revised and rewritten and incorporates much more information which is divided into the following sections:

Listening to Short Wave Radio; Choosing a Short Wave Radio Receiver; How to Use the IRSG; Abbreviations; Country Codes; Worldwide Short Wave Radio Stations; European, Middle Eastern and African Long Wave Radio Stations; European, Near and Middle Eastern and African Medium Wave Radio Stations; Canadian Medium Wave Radio Stations; USA Medium Wave Radio Stations; Broadcasts in English; Programmes for DXers and Short Wave Listeners; UK FM Radio Stations; Time Differences From GMT; Wavelength/Frequency Conversion.
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PCB SERVICE

Printed circuit boards for certain constructional projects are available from the PCB Service, see list. These are fabricated in glass fibre, and are fully drilled and roller tinned. All prices include VAT and postage and packing. Add £1 per board for airmail outside of Europe. Remittances should be sent to **The PCB Service, *Everyday Electronics*, 6 Church Street, Wimborne, Dorset BH21 1JH.** Cheques should be crossed and made payable to *Everyday Electronics* **(Payment in £ sterling only).**

NOTE: While 95% of our boards are now held in stock and are dispatched within seven days of receipt of order, please allow a maximum of 28 days for delivery – overseas readers allow extra if ordered by surface mail. Please check price in the latest issue.

Boards can only be supplied on a payment with order basis.

We do have older boards in stock – please enquire.

PROJECT TITLE		Order Code	Cost
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Electron A/D Interface	MAY'89	645	£4.84
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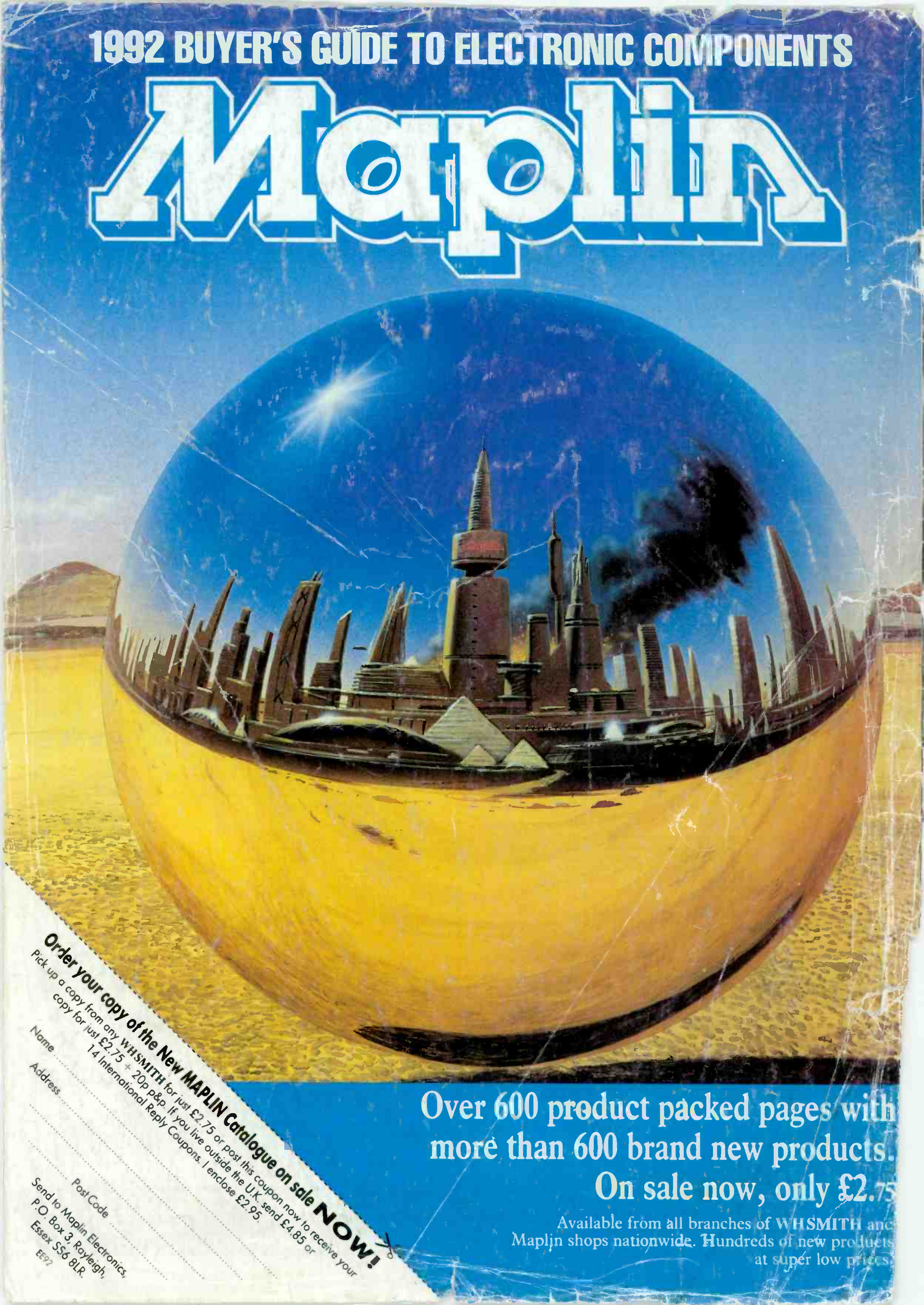

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