

EVERYDAY

JANUARY 1995

WITH **PRACTICAL**

ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

FULLY S.O.R. £2.15

MAGNETIC FIELD DETECTOR

Check your exposure to mains generated fields

MODEL RAILWAY TRACK CLEANER

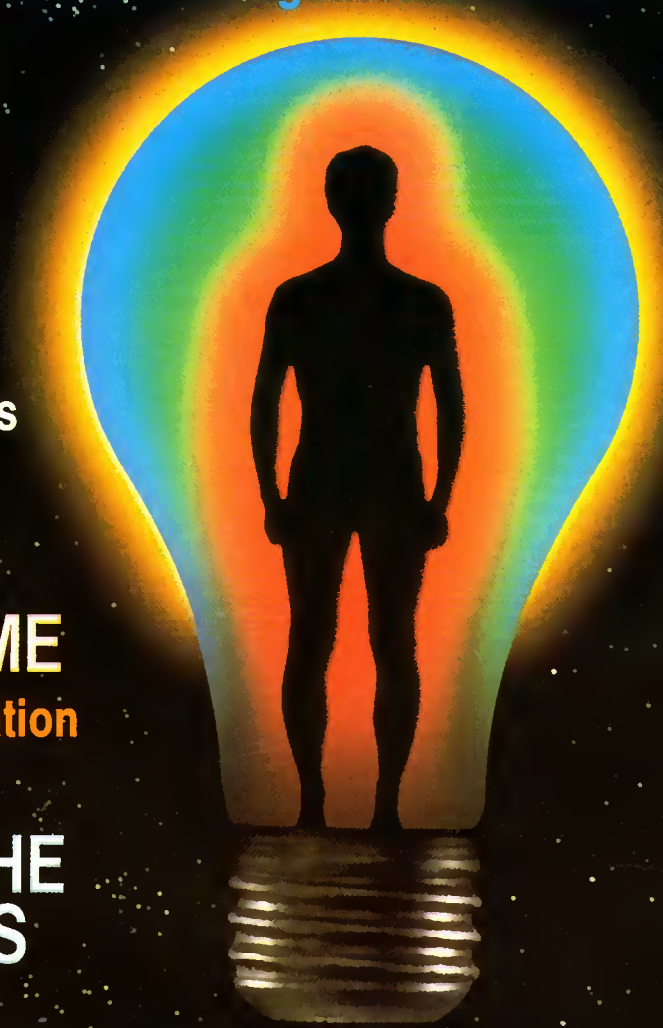
Zap the dirt from model tracks

MOVING DISPLAY METRONOME

Electronic simulation of the original

BEATING THE CHRISTMAS LIGHTS

Keeping the tree lights working



FREE INSIDE

48 Page

DISPLAY NEWS

PLUS **INGENUITY UNLIMITED**
Readers' Circuit Ideas



PC PAL VGA TO TV CONVERTER Converts a colour TV into a basic VGA screen. Complete with built in psu, lead and swave. £49.95. Ideal for laptops or a cheap upgrade.

EMERGENCY LIGHTING UNIT Complete unit with 2 double bulb floodlights, built in charger and auto switch. Fully cased. 6v 8Ah lead acid req'd. (secondhand) £4 ref MAG4P11.

GUIDED MISSILE WIRE. 4.200 metre reel of ultra thin 4 core insulated cable, 28lbs breaking strain, less than 1mm thick! Ideal alarms, intercoms, fishing, dolls house etc. £14.99 ref MAG15P5

SINCLAIR C5 13" WHEELS Complete with centre bearing (cycle type), tyre and inner tube. £6 ea ref MAG 6P10. Ideal go kart

300v PANEL METER 70X60X50MM, AC, 90 degree scale. Good quality meter. £5.99 ref MAG 6P14. Ideal for monitoring mains etc.

ASTEC SWITCHED MODE PSU BM41012 Gives +5 @ 3.75A, +12@1.5A, -12@4A. 230/110, cased. BM41012. £5.99 ref AUG6P3.

TORRODIAL TX 30-0-30 480VA. Perfect for Mostet amplifiers etc. 120mm dia 55mm thick. £18.99 ref APR19.

AUTO SUNCHARGER 155x300mm solar panel with diode and 300mA lead fitted with a cigar plug. 12v 2watt. £9.99 ea ref AUG10P3.

FLOPPY DISCS DSDD Top quality 5.25" discs, these have been written to once and are unused. Pack of 20 is £4 ref AUG4P1.

MOD WIRE Perfect for repairing PCB's, wire wrap etc. Thin insulated wire on 500m reels. Our price just £9.99 ref APR10P8.

12v MOVING LIGHT Controller. Made by Hella, 6 channels rated at 90watts each. Speed control, cased. £34.99 ref APR35.

ECLATRON FLASH TUBE As used in police car flashing lights etc, full spec supplied, 60-100 flashes a min. £9.99 ref APR10P5.

24v AC 96WATT Cased power supply. New. £13.99 ref APR14.

MILITARY SPEC GEIGER COUNTERS Unused and straight from Her majesty's forces. £50 ref MAG 50P3.

STETHOSCOPE Fully functioning stethoscope, ideal for listening to hearts, pipes, motors etc. £6 ref MAR6P6.

OUTDOOR SOLAR PATH LIGHT Captures sunlight during the day and automatically switches on a built in lamp at dusk. Complete with sealed lead acid battery etc. £19.99 ref MAR20P1.

ALARM VERSION Of above unit comes with built in alarm and pir to deter intruders. Good value at just £24.99 ref MAR25P4.

CLOCKMAKER KIT Hours of fun making your own clock, complete instructions and everything you need. £7.99 ref MAR8P2.

CARETAKER VOLUMETRIC ALARM Will cover the whole of the ground floor against forced entry. Includes mains power supply and integral battery backup. Powerful internal sander, will take external bell if req'd. Retail £150+, ours? £49.99 ref MAR50P1.

TELEPHONE CABLE White 6 core 100m reel complete with a pack of 100 dials. Ideal 'phone extns etc. £7.99 ref MAR8P3.

IBM PC CASE AND PSU Ideal base for building your own PC. Ex equipment but OK. £9.99 each REF: JUN10P2.

MICRODRIVE STRIPPER Small cased tape drives ideal for stripping, lots of useful goodies including a smart case, and lots of components. £2 each ref JUN2P3.

SOLARPOWER LAB SPECIAL You get TWO 6"x6" 6v 130mA solar cells, 4 LED's, wire, buzzer, switch plus 1 relay or motor. Superb value kit just £5.99 REF: MAG6P8

SOLID STATE RELAYS Will switch 25A mains. Input 3.5-26V DC 57x43x21mm with terminal screws £3.99 REF MAG4P10

300DPI A4 DTP MONITOR Brand new but shop soiled so hence bargain price!!! ECL Inputs, 15" landscape, 1200x1664 pixel complete with circuit diag to help you interface with your projects. JUST £14.99. REF JUN15P2.

MULTICORE CABLE 300 metre reel of grey 8 core cable ideal for 'phones, intercomms, computers, alarms etc. Comes in special dispensing container to avoid tangles. £15 ref AUG15.

BUGGING TAPE RECORDER Small voice activated recorder, uses micro cassette complete with headphones. £28.99 ref MAR29P1.

ULTRAMINI BUG MIC 6mmx3.5mm made by AKG, 5-12v electret condenser. Cost £12 ea, Our? 7 for £9.99 ref MAG10P2.

RGB/CGA/EGA/TTL COLOUR MONITORS 12" in good condition. Back anodised metal case. £79 each REF JUN79

GX4000 GAMES MACHINES returns so ok for spares or repair £9 each (no games). REF MAG9P1

C64 COMPUTERS Returns, so ok for spares etc £9 ref MAG9P2

FUSELAGE LIGHTS 3 foot by 4" panel 1/8" thick with 3 panels that glow green when a voltage is applied. Good for night lights, front panels, signs, disco etc. 50-100v per strip. £25 ref MAG25P2

ANSWER PHONES Returns with 2 faults, we give you the bits for 1 fault, you have to find the other yourself. BT Response 200's £18 ea REF MAG18P1. PSU £5 ref MAG5P12

SWITCHED MODE PSU ex equip, 60w +5v @ 5A, -5v @ 5A, +12v @ 2A, -12v @ 5A 120/220v cased 245x88x55mm IEC input socket £6.99 REF MAG7P1

PLUG IN PSU 9V 200mA DC £2.99 each REF MAG3P9

PLUG IN ACORN PSU 19v AC 14w . £2.99 REF MAG3P10

POWER SUPPLY fully cased with mains and o/p leads 17v DC 900mA output. Bargain price £5.99 ref MAG6P9

ACORN ARCHMEDES PSU +5v @ 4.4A, on/off sw uncased, selectable mains input, 145x100x45mm £7 REF MAG7P2

GEIGER COUNTER KIT Low cost professional twin tube, complete with PCB and components. Now only £19 REF AUG19.

9v DC POWER SUPPLY Standard plug in type 150ma 9v DC with lead and DC power plug, price for two is £2.99 ref AUG3P4.

AA NICAD PACK encapsulated pack of 8 AA nicad batteries (tagged) ex equip, 55x32x32mm. £3 a pack. REF MAG3P11

13.8V 1.9A psu cased with leads. Just £9.99 REF MAG10P3

360K 5.26 brand new half height floppy drives IBM compatible industry standard. Just £6.99 REF MAG7P3

PPC MODEM CARDS These are high spec plug in cards made for the Amstrad laptop computers. 2400 baud dial up unit complete with leads. Clearance price is £5 REF: MAG5P1

INFRA RED REMOTE CONTROLLERS Originally made for hi spec satellite equipment but perfect for all sorts of remote control projects. Our clearance price is just £2 REF: MAG2

TOWERS INTERNATIONAL TRANSISTOR GUIDE. A very useful book for finding equivalent transistors, leadouts, specs etc. £20 REF: MAG20P1

SINCLAIR C5 MOTORS We have a few left without gearboxes.

NEW BULL ELECTRONICS STORE IN WOLVERHAMPTON

55A WORCESTER ST TEL 0902 22039

Spec is 12v DC 3,300rpm £25 ref MAG25.

NEW PRODUCT

200 WATT INVERTER Converts 10-15v DC into either 110v or 240v AC. Fully cased 115x36x156mm, complete with heavy duty power lead, cigar plug, AC outlet socket. Auto overload shutdown, auto short circuit shutdown, auto input over voltage shutdown, auto input under voltage shutdown (with audible alarm), auto temp control, unit shuts down if overheated and sounds audible alarm. Fused reversed polarity protected. output frequency within 2%, voltage within 10%. A extremely well built unit at a very advantageous price!!! Price is £64.99 ref AUG65.

UNIVERSAL SPEED CONTROLLER KIT Designed by us for the C5 motor but ok for any 12v motor up to 30A. Complete with PCB etc. A heat sink may be required. £17.00 REF: MAG17

MAINS CABLE Precut black 2 core 2 metre lengths ideal for repairs, projects etc. 50 metres for £1.99 ref AUG2P7.

COMPUTER COMMUNICATIONS PACK Kit contains 100m of 6 core cable, 100 cable clips, 2 line drivers with RS232 interfaces and all connectors etc. Ideal low cost method of communicating between PC's over long distance. Complete kit £15.99 Ref MAR16P2.

MINICYCLOPS PIR 52x62x40mm runs on PP3 battery complete with shrill sander. Cheap protection at only £5.99 ref MAR6P4.

ELECTRIC MOTOR KIT Comprehensive educational kit includes all you need to build an electric motor. £9.99 ref MAR10P4.

VIDEO SENDER UNIT. Transmits both audio and video signals from either a video camera, video recorder, TV or Computer etc to any standard TV set in a 100' range! (tune TV to a spare channel) 12v DC op. Price is £15 REF: MAG15 12v psu is £5 extra REF: MAG5P2

FM CORDLESS MICROPHONE Small hand held unit with a 500' range! 2 transmit power levels. Reqs PP3 9v battery. Tuneable to any FM receiver. Price is £15 REF: MAG15P1

LOW COST WALKIE TALKIES Pair of battery operated units with a range of about 200'. Ideal for garden use or as an educational toy. Price is £8 a pair REF: MAG 8P1 2 x PP3 req'd.

MINIATURE RADIO TRANSCIVERS A pair of walkie talkies with a range of up to 2 kilometres in open country. Units measure 22x52x155mm. Complete with cases and earpieces. 2xPP3 req'd. £30.00 pair REF: MAG30.

COMPOSITE VIDEO KIT. Converts composite video into separate H sync, V sync, and video. 12v DC. £8.00 REF: MAG8P2.

LQ3600 PRINTER ASSEMBLIES Made by Amstrad they are entire mechanical printer assemblies including printhead, stepper motors etc etc. In fact everything bar the case and electronics, a good stripper! £5 REF: MAG5P3 or 2 for £8 REF: MAG8P3

SPEAKER WIRE Brown 2 core 100 foot hank £2 REF: MAG2P1

LED PACK of 100 standard red 5mm leds £5 REF MAG5P4

UNIVERSAL PC POWER SUPPLY complete with flyleads, switch, fan etc. Two types available 150w at £15 REF MAG15P2 (23x23x23mm) and 200w at £20 REF: MAG20P3 (23x23x23mm)

FM TRANSMITTER housed in a standard working 13A adapter! the bug runs directly off the mains so lasts forever! why pay £700? or price is £26 REF: MAG26 Transmits to any FM radio.

FM BUG KIT New design with PCB embedded coil for extra stability. Works on any FM radio. 9v battery req'd. £5 REF: MAG5P5

FM BUG BUILT AND TESTED superior design to kit. Supplied to detective agencies. 9v battery req'd. £14 REF: MAG14

TALKING COINBOX STRIPPER originally made to retail at £79 each, these units are designed to convert and ordinary phone into a payphone. The units have the locks missing and sometimes broken hinges. However they can be adapted for their original use or used for something else?? Price is just £3 REF: MAG3P1

100 WATT MOSFET PAIR Same spec as 2SK343 and 2SJ413 (8A, 140v, 100w) 1 N channel, 1 P channel, £3 a pair REF: MAG3P2

TOP QUALITY SPEAKERS Made for HI FI televisions these are 10 watt 4r Jap made 4" round with large shielded magnets. Good quality. £2 each REF: MAG2P4 or 4 for £8 REF: MAG6P2

TWEETERS 2" diameter good quality tweeter 140R (ok with the above speaker) 2 for £2 REF: MAG2P5 or 4 for £3 REF: MAG3P4

AT KEYBOARDS Made by Apricot these quality keyboards need just a small mod to run on any AT, they work perfectly but you will have to put up with 1 or 2 foreign keycaps! Price £6 REF: MAG6P3

PC CASES Again mixed types so you take a chance next one off the pile £12 REF: MAG12 or two the same for £20 REF: MAG20P4

HEADPHONES Ex Virgin Atlantic. 8 pairs for £2 REF: MAG2P8

PROXIMITY SENSORS These are small PCB's with what look like a source and sensor LED on one end and lots of components on the rest of the PCB. Complete with fly leads. Pack of 5 £3 REF: MAG: 3P5 or 20 for £8 REF: MAG8P4

***SOME OF OUR PRODUCTS MAY BE UNLICENSEABLE IN THE UK**

SNOOPERS EAR? Original made to clip over the earpiece of telephone to amplify the sound-It also works quite well on the cable running along the wall! Price is £5 REF: MAG5P7

DOS PACKS Microsoft version 3.3 or higher complete with all manuals or price just £5 REF: MAG5P8 Worth it just for the very comprehensive manual! 5.25" only.

DOS PACK Microsoft version 5 Original software but no manuals hence only £3 REF: MAG3P8 5.25" only

PIR DETECTOR Made by famous UK alarm manufacturer these are hi spec, long range internal units 12v operation. Slight marks on case and unboxed (although brand new) £8 REF: MAG8P5

WINDUP SOLAR POWERED RADIO AM/FM radio complete with hand charger and solar panel! £14 REF: MAG14P1

MOBILE CARPHONE £6.99 Well almost! complete in carphone excluding the box of electronics normally hidden under seat. Can be made to illuminate with 12v also has built in light sensor so display only illuminates when dark. Totally convincing! REF: MAG6P6

ALARM BEACONS Zenon strobe made to mount on an external bell box but could be used for caravans etc. 12v operation. Just connect up and it flashes regularly! £5 REF: MAG5P11

FIRE ALARM CONTROL PANEL High quality metal cased alarm panel 350x165x80mm With key. Comes with electronics but no information. sale price 7.99 REF: MAG8P6

REMOTE CONTROL PCB These are receiver boards for garage door opening systems. Another use? £4 ea REF: MAG4P5

6"X12" AMORPHOUS SOLAR PANEL 12v 155x310mm 130mA. Bargain price just £5.99 ea REF MAG6P12.

FIBRE OPTIC CABLE BUMPER PACK 10 metres for £4.99 ref MAG5P13 ideal for experimenters! 30 m for £12.99 ref MAG13P1

LOPTX Line output transformers believed to be for IBM hi res colour monitors but useful for getting high voltages from low ones! £2 each REF: MAG2P12 bumper pack of 10 for £12 REF: MAG12P3.

HEATSINKS (finned) TO220, designed to mount vertically on a pcb 50x40x25mm you can have a pack of 4 for £1 ref JUN1P11

WATERPROOF JUNCTION BOX 65mm dia 33mm deep. Four cable entry exit points (adjustable for any size cable) snap fit lid. Ideal for TV, satellite use. £2 ea ref APR2 or 6 for £10 ref APR10P7.

BOTH SHOPS OPEN 9-5.30 SIX DAYS A WEEK

INFRARED LASER NIGHT SCOPES

Second generation image intensifier complete with hand grip attachment with built in adjustable laser lamp for zero light conditions. Supplied with Pentax 42mm camera mount and normal eye piece. 1.6kg, uses 1xPP3, 3xAA's (all supplied) £245+Vat

NEW HIGH POWER LASERS

15mW, Helium neon, 3 switchable wave lengths .63um, 1.15um, 3.39um (2 of them are infrared) 500:1 polarizer built in so good for holography. Supplied complete with mains power supply. 790x65mm. Use with EXTREME CAUTION AND UNDER QUALIFIED GUIDANCE. £349+Vat.

*****WE BUY SURPLUS STOCK*****

TURN YOUR SURPLUS STOCK INTO CASH. IMMEDIATE SETTLEMENT. WE WILL ALSO QUOTE FOR COMPLETE FACTORY CLEARANCE.

1994 CATALOGUE

MINIMUM GOODS ORDER £5 00. TRADE ORDERS FROM GOVERNMENT, SCHOOLS, UNIVERSITIES, & LOCAL AUTHORITIES WELCOME! ALL GOODS SUPPLIED SUBJECT TO OUR CONDITIONS OF SALE AND UNLESS OTHERWISE STATED GUARANTEED FOR 30 DAYS. RIGHTS RESERVED TO CHANGE PRICES & SPECIFICATIONS WITHOUT PRIOR NOTICE. ORDERS SUBJECT TO STOCK. QUOTATIONS WILLINGLY GIVEN FOR QUANTITIES HIGHER THAN THOSE STATED.

3FT X 1FT 10WATT SOLAR PANELS

14.5v/700mA £33.95

(PLUS £2.00 SPECIAL PACKAGING CHARGE)

TOP QUALITY AMORPHOUS SILICON CELLS HAVE ALMOST A TIMELESS LIFESPAN WITH AN INFINITE NUMBER OF POSSIBLE APPLICATIONS, SOME OF WHICH MAY BE CAR BATTERY CHARGING, FOR USE ON BOATS OR CARAVANS, OR ANYWHERE A PORTABLE 12V SUPPLY IS REQUIRED. REF: MAG34

PORTABLE RADIATION DETECTOR

£49.99

A Hand held personal Gamma and X Ray detector. This unit contains two Geiger Tubes, has a 4 digit LCD display with a Piezo speaker, giving an audio visual indication. The unit detects high energy electromagnetic quanta with an energy from 30K eV to over 1.2M eV and a measuring range of 5-9999 UR/h or 10-99990 Nr/h. Supplied complete with handbook. Ref MAG50.

BULL ELECTRICAL

250 PORTLAND ROAD HOVE SUSSEX BN3 5QT

MAIL ORDER TERMS: CASH PO OR CHEQUE WITH ORDER PLUS £3.00 POST PLUS VAT.

PLEASE ALLOW 7 - 10 DAYS FOR DELIVERY TELEPHONE ORDERS WELCOME

TEL: 0273 203500 FAX: 0273 323077



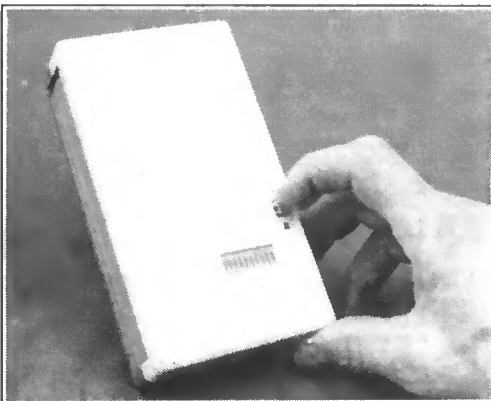
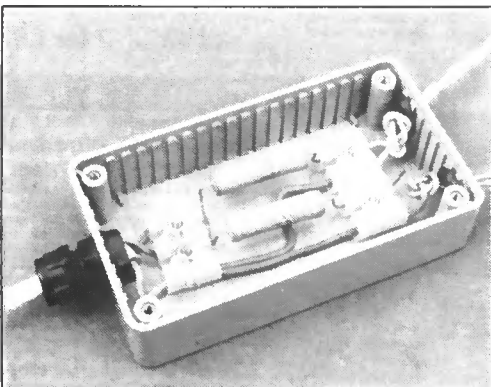
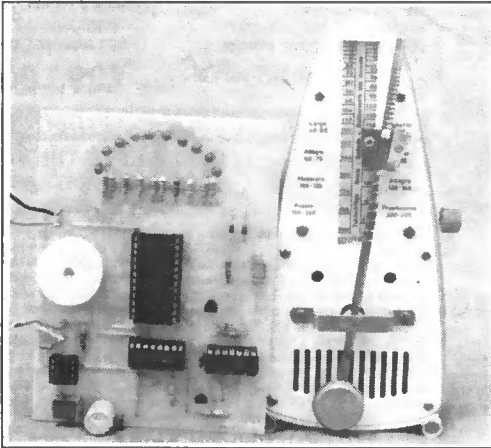
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 COMMENT ... POPULAR FEATURES ...

VOL. 24 No. 1 JANUARY 1995

EVERYDAY WITH PRACTICAL ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

The No. 1 Independent Magazine for Electronics,
 Technology and Computer Projects



Merry Christmas
 and a prosperous
New Year
 to all our readers

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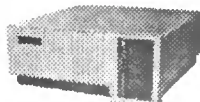
Surplus always wanted for cash!

THE ORIGINAL SURPLUS WONDERLAND!

THIS MONTH'S SELECTION FROM OUR VAST EVER CHANGING STOCKS

Surplus always wanted for cash!

LOW COST PC's - ALL EXPANDABLE - ALL PC COMPATIBLE



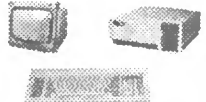
SPECIAL BUY
AT 286
40Mb HD + 3Mb Ram

LIMITED QUANTITY only of these 12Mhz HI GRADE 286 systems Made in the USA to an industrial specification, the system was designed for reliability. The compact case houses the motherboard, PSU and EGA video card with single 5 1/4" 1.2 Mb floppy disk drive & Integral 40Mb hard disk drive to the front. Real time clock with battery backup is provided as standard. Supplied in good used condition complete with enhanced keyboard, 640k + 2Mb RAM, DOS 4.01 and 90 DAY Full Guarantee. Ready to Run!
Order as HI GRADE 286

ONLY £149.00 (E)

Optional Fitted extras:	VGA graphics card	£29.00
	1.4Mb 3 1/2" floppy disk drive (instead of 1.2 Mb)	£32.95
	NE2000 Ethernet (thick, thin or twisted) network card	£49.00

PC SCOOP
COMPLETE
COLOUR SYSTEM
ONLY £99.00



A massive bulk purchase enables us to bring you a COMPLETE ready to run colour PC system at an unheard of price! The Display Electronics PC99 system comprises of fully compatible and expandable XT PC with 256k of RAM, 5 1/4" 360k floppy disk drive, 12" CGA colour monitor, standard 84 key keyboard, MS DOS and all connecting cables - just plug in and go! Ideal students, schools or anybody wishing to learn the world of PC's on an ultra low budget. Don't miss this opportunity. Fully guaranteed for 90 Days.

Order as PC99COL **£99.00 (E)**

Optional Fitted extras:	640k RAM	£29.00
	2nd floppy drive, specify 5 1/4" 360k or 5 1/4" 720k	£29.95

Above prices for PC99 offer ONLY.

THE OFFER OF 1994!



Computer Controlled
Laser Video
Disk Player

One of the most amazing surplus deals that we ever been able to offer you!
The Philips VP410 LaserVision player, in as new condition, unit features full computer control, Plays standard 12" LaserVision disks with startling visual and audio quality in two channel stereo or mono. When controlled by a computer, it may also be used as a versatile high quality storage / retrieval medium. It will play back either LaserVision CAV (active play) or CLV (Long Play) discs (which covers most types of commercially available video discs). Some of the many features of this incredible machine are:
RS-232 INTERFACE RGB / COMPOSITE VIDEO OUTPUT
BNC+SCART INTERFACE PAL / RGB DECODER
IR-WIRED REMOTE CONTROL FAST RANDOM ACCESS

SPECIAL PURCHASE Only **£399.00 (F)**

BBC Model B APM Board



WIN £100 CASH!
£100 CASH FOR THE MOST NOVEL DEMONSTRABLE APPLICATION

BBC Model B type computer on a board. A major purchase allows us to offer you the PROFESSIONAL version of the BBC computer at a parts only price. Used as a front end graphics system on large networked systems the architecture of the BBC board has so many similarities to the regular BBC model B that we are sure that with a bit of experimentation and ingenuity many useful applications will be found for this board! It is supplied complete with a connector panel which brings all the I/O's to 'D' and BNC type connectors - all you have to do is provide +5 and +12 v DC. The APM consists of a single PCB with most major ic's socketed. The ic's are not numerous to list but include a 6502 / 6512 CPU, RAM and an SAA5050 teletext chip. Three 2712B EPROMS contain the custom operating system on which we have no data. On application of DC power the system boots and provides diagnostic information to the video output. On board DIP switches and jumpers select the ECONET address and enable the four extra EPROM sockets for user software. Appx. dims: main board 13" x 10". I/O board 14" x 3". Supplied tested with circuit diagram, data and competition entry form.

Only **£29.95**

2 for £53 (B)

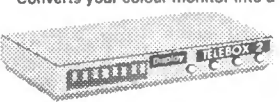
FLOPPY DISK DRIVES 3.5" - 8"

5.25" from £22.95 - 3.5" from £24.95
Massive purchases of standard 5.25" and 3.5" drives enables us to present prime product at industry beating low prices! All units (unless stated) are BRAND NEW or removed from often brand new equipment and are fully tested, aligned and shipped to you with a 90 day guarantee and operate from standard voltages and are of standard size. All are IBM-PC compatible (if 3.5" supported on your PC).
3.5" Panasonic JU363/4 720K or equivalent **£24.95 (B)**
3.5" Mitsubishi MF355C-L 1.4 Meg. Laptops only * **£36.95 (B)**
3.5" Mitsubishi MF355C-D 1.4 Meg. Non laptop **£29.95 (B)**
5.25" Teac FD-55GFR 1.2 Meg **£29.95 (B)**
5.25" BRAND NEW Mitsubishi MF501B 360K **£22.95 (B)**
* Data cable included in price.
Shugart 801/801 8" SS refurbished & tested **£195.00 (E)**
Shugart 851 8" double sided refurbished & tested **£250.00 (E)**
Mitsubishi M2894-63 8" sided switchable NEW **£250.00 (E)**
Mitsubishi M2896-63-02U 8" DS simline NEW **£285.00 (E)**
Dual 8" drives with 2 mbyte capacity housed in a smart case with built in power supply. Ideal as exterior drives! **£499.00 (F)**

HARD DISK DRIVES

End of line purchase scoop! Brand new NEC D2246 8" 85 Mbyte of hard disk storage! Full industry standard SMD Interface. Ultra hi speed data transfer and access time, replaces Fujitsu equivalent model. complete with manual. Only **£299.00 (E)**
3.5" FUJII FK-309-26 20mb MFM I/F RFE **£59.95 (C)**
3.5" CONNER CP3024 20 mb IDE I/F (or equiv.) RFE **£69.95 (C)**
3.5" CONNER CP3044 40mb IDE I/F (or equiv.) RFE **£99.00 (C)**
3.5" DIME RO3057S 45mb SCSI I/F (Mac & Acorn) **£99.00 (C)**
5.25" MINISCRIBE 3425 20mb MFM I/F (or equiv.) RFE **£49.95 (C)**
5.25" SEAGATE ST-238R 30 mb RLL I/F Refurb **£69.95 (C)**
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NEC CGA 12" colour IBM-PC compatible. High quality ex-equipment fully tested with a 90 day guarantee. In an attractive two tone ribbed grey plastic case measuring 15" x 13" x 12". The front cosmetic bezel has been removed for contractual reasons.
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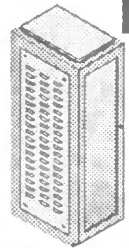
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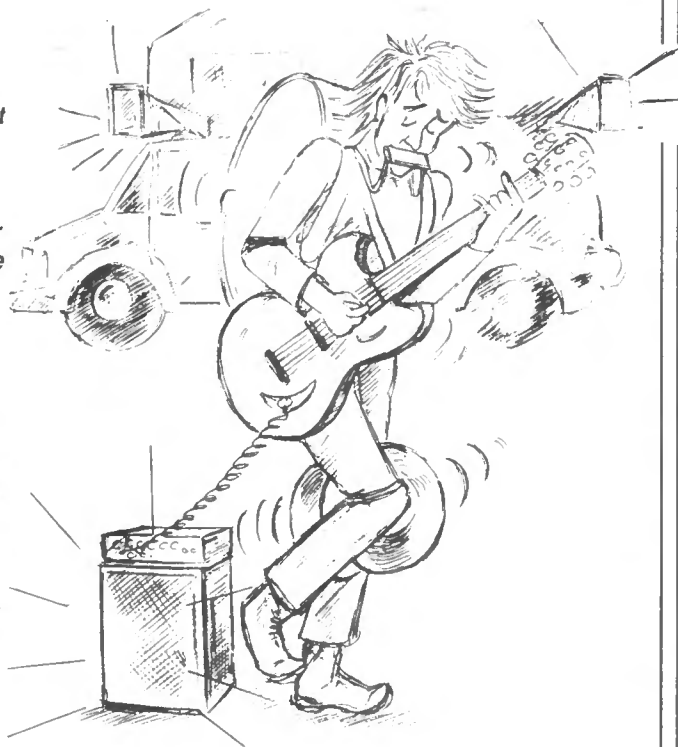
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12V, 35W PUBLIC ADDRESS AMPLIFIER

This audio power amplifier has been designed to operate from 12V d.c. and provide up to 35W r.m.s. power. It is a public address amplifier with a line output for loudspeaker distribution systems. An output transformer is used to obtain the 100V line, offering flexibility to wind secondaries to individual requirements. A low impedance winding for direct loudspeaker connection and two 100V secondaries for the line output are recommended. The line outputs are normally operated in parallel but if connected in series, the unit can provide 240V to function as a converter.

Four inputs are provided, each with a separate volume control. Two inputs are amplified for signals from microphones or guitar pickups, while the other two are for higher level inputs suitable for CD players, cassettes etc. A mixer stage combines all four signals and a fifth potentiometer provides a master volume control.

The amplifier is fully discrete and uses well-tryed circuitry with an output stage using MOSFETs. Often it seems that i.c.s must be used wherever possible but for a transformer output, public address amplifier, discrete designs can perform adequately, are inexpensive and usually more serviceable.



ULTIMATE SCREEN SAVER

Most laptop computers have sophisticated power management facilities, which shut down the screen and hard disk after a period of inactivity to save battery life. Until recently these facilities have not been available on desktop computers. Some "Green" PCs are now becoming available, with the aim of reducing power consumption when they are not actually being used. However, if your existing PC is OK, spending over a thousand pounds on a new one just to save a few pounds worth of electricity does not make economic sense!

Software screen savers are available, mostly running under Microsoft Windows, but all these do is prevent a static image burning into the phosphor of the CRT. Indeed some of these are sold more on their amusement value than their original purpose!

The unit described here takes the screen saver idea to its logical conclusion. If the keyboard and mouse are not used for a preset period, the monitor is switched off. As soon as you touch the keyboard or mouse, the monitor is switched back on again. This not only prevents phosphor burn, but also saves electricity. In addition it will reduce the emission of electromagnetic radiation and positive ions, if these things concern you. Moreover, it costs no more than a screen saver software package.

If you leave your computer on all the time but only use it for a few hours each day, this unit could save you over £70 per year in electricity charges.

FOOT-OPERATED DRILL CONTROLLER

This project was designed as an aid to precision drilling work by hand. For example, when drilling p.c.b.s using a handheld 12V drill, the author has often experienced problems with the drill bit skating across the surface of the board. This causes off-centre holes, damages the surface of the board and its tracks, and can cause drill bits to break.

The effect is partly due to the high speeds at which such p.c.b. drills operate, typically 15,000 r.p.m. The jerks caused by the large acceleration when the drill starts are not easily tamed when hand-holding the drill. This project offers some relief from the problem.

Firstly, it uses a footswitch to start and stop the drill, thus freeing one hand to help stabilise the drill, or to hold the item being drilled. Secondly, when the footswitch is pressed, the drill speed is gradually allowed to build up to a presettable maximum speed.

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EXTENSION

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Genuine SUMA kits available only direct from Suma Designs. Beware inferior imitations!

UTX Ultra-miniature Room Transmitter

Smallest room transmitter kit in the world! Incredible 10mm x 20mm including mic. 3-12V operation. 500m range.....£16.45

MTX Micro-miniature Room Transmitter

Best-selling micro-miniature Room Transmitter
Just 17mm x 17mm including mic. 3-12V operation. 1000m range.....£13.45

STX High-performance Room Transmitter

Hi performance transmitter with a buffered output stage for greater stability and range. Measures 22mm x 22mm including mic. 6-12V operation, 1500m range.....£15.45

VT500 High-power Room Transmitter

Powerful 250mW output providing excellent range and performance. Size 20mm x 40mm. 9-12V operation. 3000m range.....£16.45

VXT Voice Activated Transmitter

Triggers only when sounds are detected. Very low standby current. Variable sensitivity and delay with LED indicator. Size 20mm x 67mm. 9V operation. 1000m range...£19.45

HVX400 Mains Powered Room Transmitter

Connects directly to 240V AC supply for long-term monitoring. Size 30mm x 35mm. 500m range.....£19.45

SCRX Subcarrier Scrambled Room Transmitter

Scrambled output from this transmitter cannot be monitored without the SCDM decoder connected to the receiver. Size 20mm x 67mm. 9V operation. 1000m range.....£22.95

SCSX Subcarrier Telephone Transmitter

Connects to telephone line anywhere, requires no batteries. Output scrambled so requires SCDM connected to receiver. Size 32mm x 37mm. 1000m range.....£23.95

SCDM Subcarrier Decoder Unit for SCRX

Connects to receiver earphone socket and provides decoded audio output to headphones. Size 32mm x 70mm. 9-12V operation.....£22.95

ATR2 Micro Size Telephone Recording Interface

Connects between telephone line (anywhere) and cassette recorder. Switches tape automatically as phone is used. All conversations recorded. Size 16mm x 32mm. Powered from line.....£13.45

UTLX Ultra-miniature Telephone Transmitter

Smallest telephone transmitter kit available. Incredible size of 10mm x 20mm! Connects to line (anywhere) and switches on and off with phone use. All conversation transmitted. Powered from line. 500m range.....£15.95

TLX700 Micro-miniature Telephone Transmitter

Best-selling telephone transmitter. Being 20mm x 20mm it is easier to assemble than UTLX. Connects to line (anywhere) and switches on and off with phone use. All conversations transmitted. Powered from line. 1000m range.....£13.45

STLX High-performance Telephone Transmitter

High performance transmitter with buffered output stage providing excellent stability and performance. Connects to line (anywhere) and switches on and off with phone use. All conversations transmitted. Powered from line. Size 22mm x 22mm. 1500m range.....£16.45

TX900 Signalling/Tracking Transmitter

Transmits a continuous stream of audio pulses with variable tone and rate. Ideal for signalling or tracking purposes. High power output giving range up to 3000m. Size 25mm x 63mm. 9V operation.....£22.95

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LED and piezo bleeper pulse slowly, rate of pulse and pitch of tone increase as you approach signal. Gain control allows pinpointing of source. Size 45mm x 54mm. 9V operation.....£30.95

CD600 Professional Bug Detector/Locator

Multicolour readout of signal strength with variable rate bleeper and variable sensitivity used to detect and locate hidden transmitters. Switch to AUDIO CONFORM mode to distinguish between localised bug transmission and normal legitimate signals such as pagers, cellular, taxis etc. Size 70mm x 100mm. 9V operation.....£50.95

QTX180 Crystal Controlled Room Transmitter

Narrow band FM transmitter for the ultimate in privacy. Operates on 180 MHz and requires the use of a scanner receiver or our QRX180 kit (see catalogue). Size 20mm x 67mm. 9V operation. 1000m range.....£40.95

QLX180 Crystal Controlled Telephone Transmitter

As per QTX180 but connects to telephone line to monitor both sides of conversations. 20mm x 67mm. 9V operation. 1000m range.....£40.95

QSX180 Line Powered Crystal Controlled Phone Transmitter

As per QLX180 but draws power requirements from line. No batteries required. Size 32mm x 37mm. Range 500m.....£35.95

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Complete System (2 kits).....£50.95

Individual Transmitter DLTX.....£19.95

Individual Receiver DLRX.....£37.95

MBX-1 Hi-Fi Micro Broadcaster

Not technically a surveillance device but a great idea! Connects to the headphone output of your Hi-Fi, tape or CD and transmits Hi-Fi quality to a nearby radio. Listen to your favourite music anywhere around the house, garden, in the bath or in the garage and you don't have to put up with the DJ's choice and boring waffle. Size 27mm x 60mm. 9V operation. 250m range.....£20.95

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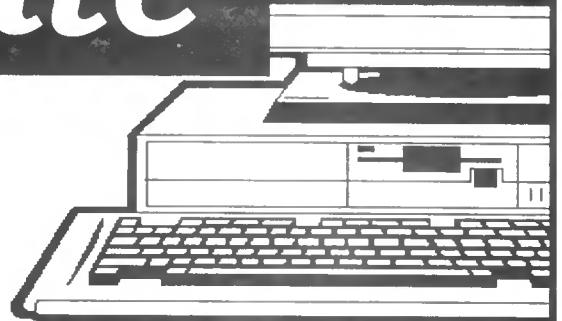
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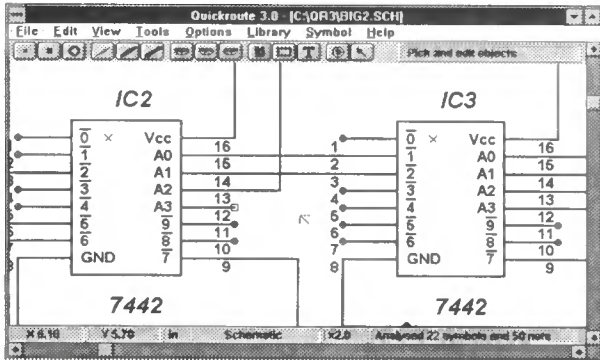
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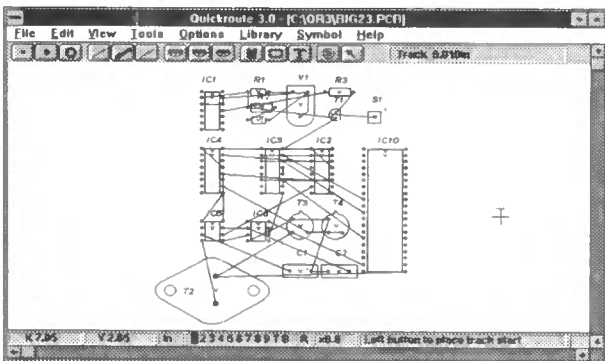
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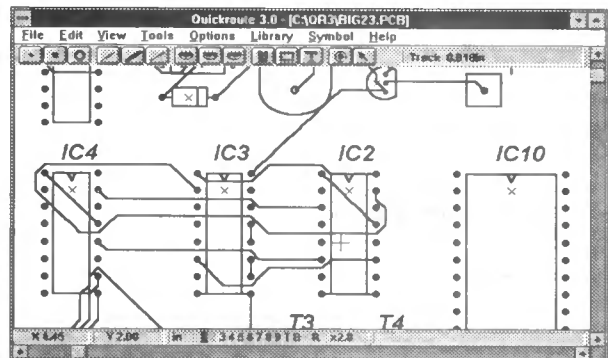
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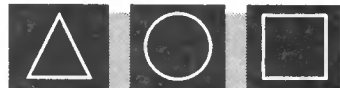
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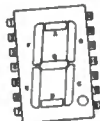
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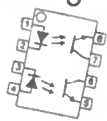
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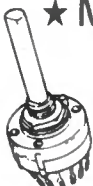
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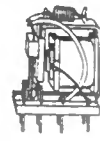
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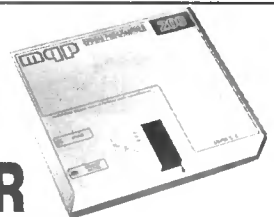
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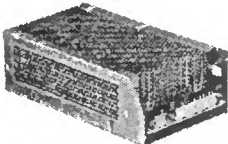
YUASA



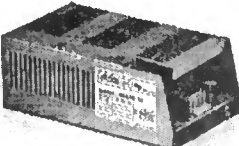
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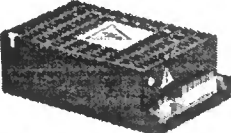
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10 HD 3.5" disks (5 each of two titles) for just

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Z5961 Shure 527B professional fist microphone with push to talk switch. Superb quality and value with all these features:
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List Price is an incredible

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Our Price

£29.95



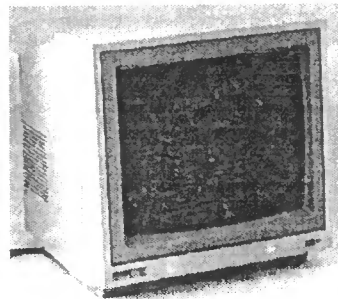
Z5964 Audix HM2305/Tact UDM100 professional dynamic mic with on/off switch and cardioid characteristics. 5m lead with XLR skt fitted mic end. Impressive spec! Supplied with clip and adaptor, individually boxed.

List Price
£44.06

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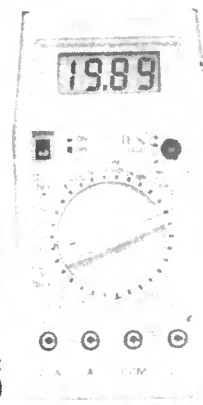
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AC volts:	0-200m-2-20-200-750V _{ac} ±0.8%
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CD current:	0-20µ-200µ-2m-20m-200m-2A-20A _{dc} ±0.5%
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Dims:	176x88x36mm

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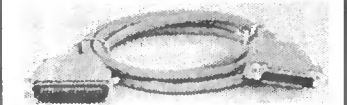
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All pins connected
- 1.5m long
Order Code CSL20

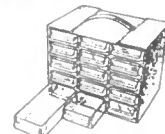
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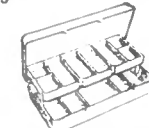
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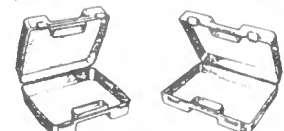
0600 15 Drawer storage cabinet 230x160x180mm. Only **£4.50**



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All with HD44780 controller (and HD44100 on larger displays)

CODE	PART No.	SIZE	CHAR	HT	PRICE
Z5482D	TLCM1620	16X2	5X7	4.27	£6.00
Z5484D	TLCM2011	20X1	5X7	5.20	£4.80
Z5486D	TLCM4021	40X2	5X7	5.20	£9.50

A data sheet is included in the price.
Application notes: A 16 page booklet is available, price **£2.00** order code Z2842

£1 BARGAIN PACKS - List 1

1,000 items appear in our Bargain Packs List - request one of these when you next order.

- 1 x 12V Stepper Motor. 7.5 degree. Order Ref: 910.
- 1 x 10 pack Screwdrivers. Order Ref: 909.
- 2 x 5 amp Pull Cord Ceiling Switches. Brown. Order Ref: 921.
- 5 x reels Insulation Tape. Order Ref: 911.
- 4 x 14mm Bull-races. Order Ref: 912.
- 2 x Cord Grip Switch Lamp Holders. Order Ref: 913.
- 1 x DC Voltage Reducer. 12V-6V. Order Ref: 916.
- 1 x 10 amp 40V Bridge Rectifier. Order Ref: 889.
- Lightweight Stereo Headphones. Moving coil so superior sound. Order Ref: 896.
- 2 x 25W Crossovers. For 4ohm loudspeakers. Order Ref: 22.
- 2 x NiCad Constant Current Chargers. Easily adaptable to charge almost any NiCad battery. Order Ref: 30.
- 18V-0-18V 10VA mains transformer. Order Ref: 813.
- 2 x White Plastic Boxes. With lids, approx. 3" cube. Lid has square hole through the centre so these are ideal for light operated switch. Order Ref: 132.
- 2 x Reed Relay Kits. You get 8 reed switches and 2 coil sets. Order Ref: 148.
- 12V-0-12V 6VA mains transformer, p.c.b. mounting. Order Ref: 938.
- 1 x Big Pull Solenoid. Mains operated. Has 1/2" pull. Order Ref: 871.
- 1 x Big Push Solenoid. Mains operated. Has 1/2" push. Order Ref: 872.
- 1 x Mini Mono Amp. 3W into 4 ohm speaker or 1W into 8 ohm. Order Ref: 495.
- 1 x Mini Stereo 1W Amp. Order Ref: 870.
- 15V DC 150mA p.s.u., nicely cased. Order Ref: 942.
- 1 x In-Flight Stereo Unit is a stereo amp. Has two most useful mini moving coil speakers. Made for BOAC passengers. Order Ref: 29.
- 1 x 0-1mA Panel Meter. Full vision face 70mm square. Scaled 0-100. Order Ref: 756.
- 2 x Lithium Batteries. 2.5V penlight size. Order Ref: 874.
- 2 x 3m Telephone Leads. With BT flat plug. Ideal for 'phone extensions, fax, etc. Order Ref: 552.
- 1 x 12V Solenoid. Has good 1/2" pull or could push if modified. Order Ref: 232.
- 4 x In-Flex Switches. With neon on/off lights, saves leaving things switched on. Order Ref: 7.
- 2 x 6V 1A Mains Transformers. Upright mounting with fixing clamps. Order Ref: 9.
- 2 x Humidity Switches. As the air becomes damper, the membrane stretches and operates a micro switch. Order Ref: 32.
- 5 x 13A Rocker Switch. Three tags so on/off, or changeover with centre off. Order Ref: 42.
- Mini Cassette Motor, 9V. Order Ref: 944.
- 1 x Suck or Blow-Operated Pressure Switch. Or it can be operated by any low pressure variation such as water level in tanks. Order Ref: 67.
- 1 x 6V 750mA Power Supply. Nicely cased with mains input and 6V output lead. Order Ref: 103A.
- 2 x Stripper Boards. Each contains a 400V 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers, etc. Order Ref: 120.
- 12 Very Fine Drills. For PCB boards etc. Normal cost about 80p each. Order Ref: 128.
- 5 x Motors for Model Aeroplanes. Spin to start so needs no switch. Order Ref: 134.
- 6 x Microphone Inserts. Magnetic 400 ohm, also act as speakers. Order Ref: 139.
- 6 x Neon Indicators. In panel mounting holders with lens. Order Ref: 180.
- 1 x In-Flex Simmerstat. Keeps your soldering iron etc always at the ready. Order Ref: 196.
- 1 x Mains Solenoid. Very Powerful as 1/2" pull, or could push if modified. Order Ref: 199.
- 1 x Electric Clock. Mains operated. Put this in a box and you need never be late. Order Ref: 211.
- 4 x 12V Alarms. Makes a noise about as loud as a car horn. All brand new. Order Ref: 221.
- 2 x (6" x 4") Speakers. 16 ohm 5 watts, so can be joined in parallel to make a high wattage column. Order Ref: 243.
- 1 x Panostat. Controls output of boiling ring from simmer up to boil. Order Ref: 252.
- 2 x Oblong Push Switches. For bell or chimes, these can switch mains up to 5A so could be foot switch if fitted in pattress. Order Ref: 263.
- 50 x Mixed Silicon Diodes. Order Ref: 293.
- 1 x 6 Digit Mains Operated Counter. Standard size but counts in even numbers. Order Ref: 28.
- 2 x 6V Operated Reed Relays. One normally on, other normally closed. Order Ref: 48.
- 1 x Cabinet Lock. With two keys. Order Ref: 55.
- 6 1/2 Watt Speaker. Order Ref: 824.
- 1 x Shaded Pole Mains Motor. 3/4" stack, so quite powerful. Order Ref: 85.
- 2 x 5 Aluminium Fan Blades. Could be fitted to the above motor. Order Ref: 86.
- 1 x Case, 3 1/2 x 2 1/4 x 1 3/4 with 13A socket pins. Order Ref: 845.
- 2 x Cases. 2 1/2 x 2 1/4 x 1 3/4 with 13A pins. Order Ref: 565.
- 4 x Luminous Rocker Switches. 10A mains. Order Ref: 793.
- 4 x Different Standard V3 Micro Switches. Order Ref: 340.
- 4 x Different Sub Min Micro Switches. Order Ref: 313.

BARGAINS GALORE

- MULTI TESTER.** 19 range, ex-British Telecom, reconditioned. These measure AC and DC volts, DC milliamps and have 3 resistance ranges made to BT specification and 20,000 opv movement. Complete with test prods, £8.50. Order Ref: 8.5P3. Carrying case with handle £2 extra.
- TIME ON SWITCH.** Can be set anywhere from 0 to 90 mins with calibrated knobs. £2. Order Ref: 2P158.
- FLASHING BEACON.** Ideal for putting on a van, a tractor or any vehicle that should always be seen. Uses a XENON tube and has an amber coloured dome. Separate fixing base is included so unit can be put away if desirable. Price £10. Order Ref: 10P123.
- 3rd HORSE POWER 12V MOTOR** (Sinclair C5) £29.50. Order Ref: 29.5P1.
- SPEED CONTROLLER** Suitable for the C5 or other DC 12V motor. Complete kit £18. Order Ref: 18P8, already made £29.50. Order Ref: 29.5P2.
- LEAD LAMP.** Ideal for motorists, normal handgrip and hanging hook, takes 60W bulb protected by glass cover. £4. Order Ref: 4P31.
- ULTRASONIC CAR OR HOUSE ALARM.** Operates from its own battery, nicely cased, is reasonably loud and can be coupled to external horn. £10. Order Ref: 10P76.
- CLOCK MODULE.** 2" LCD display, requires 1.5V battery, goes back to zero when switched off so ideal for timing operations. £2. Order Ref: 2P307.
- QUARTZ CLOCK MECHANISMS.** Complete with 2 sets of hands, modern or period, made up ready to work, £3. Order Ref: 3P111.
- 12V-6V REDUCER.** Plugs into car socket to work radio, etc. £2. Order Ref: 2P318.
- MAINS AXIAL FAN.** Approximately 4x4 top quality German make (PAPST) £8. Order Ref: 8P35.
- MINI BLOW HEATER.** 1kW, ideal under desk etc. but needs simple case. £5. Order Ref: 5P23.
- ANOTHER 12V-0V-12V TRANSFORMER** is a 50VA and is suitable for dropping through the chassis or as it is fitted with 4 pillars it can be mounted above the chassis. Also should you want a 12V 4A transformer, then this one should be quite suitable, you use just one half of the secondary. Price £3.50. Order Ref: 3.5P7.
- 0-2A PANEL METER.** Circular, approximately 1 1/2" diameter, ideal for battery charger or for variable voltage instrument, only £2. Order Ref: 366.
- POWER CONTROLLER.** 0 to 250W, serve as a light dimmer, very simply mounted through circular hexagonal nut, £2. Order Ref: 2P362.
- PHONE LEADS.** 3M long with the standard flat BT plug one end. We've got a lot of these and we want to clear them so are offering 20 leads for £5. Order Ref: 5P246.
- 0V-20V DC PANEL METER.** This is a nice size 65mm sq. It is ideal if you are making a voltage variable instrument or battery charger. Price £3. Order Ref: 3P188.
- COAL EFFECT HEATER.** This is a blow heater with switch control alongside, made to look like a coal fire. It has a fibreglass cover with a light underneath (but it doesn't smoke!) It's on curved iron legs, is free standing and comes complete with flex, ready to go. It looks quite effective, is very efficient and can easily be moved from room to room. Two heat settings, price £12.99, plus £5 special packing. Order Ref: 13P2.
- INSULATION TESTER WITH MULTIMETER.** Internally generates voltages which enables you to read insulation directly in megohms. The multimeter has four ranges, AC/DC volts, 3 ranges milliamperes, 3 ranges resistance and 5 amp range. These instruments are ex-British Telecom but in very good condition, tested and guaranteed OK, probably cost at least £50, yours for only £7.50 with leads, carrying case £2 extra. Order Ref: 7.5P4.
- The same meter but slightly faulty, will not operate on all ranges, probably repairable. We supply diagram. £3. Order Ref: 3P176.
- TOUCH DIMMERS.** 40W-250W, no knob to turn, just finger on front plate, will give more, or less light, or off. Silver plated on white background, right size to replace normal switch. £5. Order Ref: 5P230.
- LCD 3 1/4" DIGIT PANEL METER.** This is a multi-range voltmeter/ammeter using the A-D converter chip 7106 to provide 5 ranges each of volts and amps. Supplied with full data sheet. Special snip price of £12. Order Ref: 12P19.
- 2MW LASER.** Helium neon by Philips, full spec. £30. Order Ref: 30P1. Power supply for this in kit form with case is £15. Order Ref: 15P16, or in larger case to house tube as well, £18. Order Ref: 18P2. The larger unit, made up, tested and ready to use, complete with laser tube, £69. Order Ref: 69P1.
- PHILIPS 9" HIGH RESOLUTION MONITOR.** Black and white in metal frame for easy mounting. Brand new, still in maker's packing, offered at less than price of tube alone, only £15. Order Ref: 15P1.
- 15W 8 OHM 8" SPEAKER & 3" TWEETER.** Made for a discontinued high quality music centre, gives real hi-fi and only £4 per pair. Order Ref: 4P57.
- BUMP'N GO SPACESHIP KIT.** A wonderful present for a budding young electrician. It responds to claps and shouts and, should it strike an object, it will set off in another direction. Kit contains all the parts and a youngster should be able to assemble, but you might have to help with soldering. The assembly instructions are very detailed and a successful spaceship will result. Price is £8.95 for the complete kit. Order Ref: 9P9.
- SOLAR WORKING MODELS.** Non-technical but really educational, a youngster will get considerable pleasure in assembling and watching it operate and there won't be any expensive batteries to buy because they are all solar powered. Ideally, of course, they will work in sunlight but when the sun isn't shining these will operate quite well under an electric light bulb. 3 models available: the Helicopter, Order Ref: 7.5P1, the Monoplane Propeller Aircraft, Order Ref: 7.5P2 and the Antique Horn Gramophone which plays music, Order Ref: 7.5P3. The kits come complete with pre-cut parts, ready to glue together, solar cells, glue and all parts necessary to make them work. Price £7.50 each kit or any 2 for £14 or any 3 for £20.

£1 BARGAIN PACKS - List 2

This is the £1 Bargain Packs List 2 - watch out for lists 3 and 4 next month.

- 3 x Battery Model Motors, tiny, medium and large. Order Ref: 35.
 - 2 x Tuning Capacitors for medium wave radios. Order Ref: 36.
 - Miniature 12V Relay with low current consuming coil, 2 x 3A changeover contacts. Order Ref: 51.
 - 2 x Ferrite Slab Aerials with medium wave coils. Ideal for building small radio. Order Ref: 61.
 - 2 x 25W 8 OHM Variable Resistors. Ideal for loudspeaker volume control. Order Ref: 69.
 - 2 x Wirewound Variable Resistors in any of the following values. 18, 35, 50, 100 ohms, your choice. Order Ref: 71.
 - 4 x 30A Procelain Fuse Holders. Make your own fuse board. Order Ref: 82.
 - 2 x 6 1/2" Metal Fan Blades for 5/16" shaft. Order Ref: 86/6 1/2.
 - Mains Motor to suit the 6 1/2" blades. Order Ref: 88.
 - 1 x 4.5V 150mA DC Power Supply. Fully enclosed so quite safe. Order Ref: 104.
 - 10 each red and black small size Crocodile Clips. Order Ref: 116.
 - 15m Twin Wire, screened. Order Ref: 122A.
 - 100 Plastic Headed Cable Clips, nail in type, several sizes. Order Ref: 123.
 - 4 x MES Batten Holders. Order Ref: 126.
 - Complete Pocket Size MW Radio, believed OK but not tested. Order Ref: 133R.
 - 4 x 2 Circuit Micro Switches (Licon) Order Ref: 157.
 - 1 x 13A Switch Socket, quite standard but coloured. Order Ref: 164.
 - 1 x 30A Panel Mounting Toggle Switch, double-pole. Order Ref: 166.
 - 2 x Neon Numicator Tubes, Order Ref: 170.
 - 100 x 3/8 Rubber Grommets. Order Ref: 181.
 - 6 x BC Lamp Holder Adaptors, Order Ref: 191.
 - 8 x Superior Type Push Switches. Make your own keyboard. Order Ref: 201.
 - Mains Transformer 8V-0V-8V 1/2A, Order Ref: 212.
 - 2 x Sub Min Toggle Switches, Order Ref: 214.
 - High Power 3" Speaker (11W 8ohm) Order Ref: 246.
 - Medium Wave Permeability Tuner. Its almost a complete radio with circuit. Order Ref: 247.
 - 6 x Screwdown Terminals with through panel insulators. Order Ref: 264.
 - LCD Clock Display, 1/2" figures, Order Ref: 329.
 - 10 x Push-On Long Shafted Knobs for 1/4" spindle. Order Ref: 339.
 - 2 x ex-GPO Speaker Inserts, ref 4T. Order Ref: 352.
 - 100 x Sub Min 1F Transformers. Just right if you want coil formers. Order Ref: 360.
 - 1 x 24V 200mA PSU. Order Ref: 393.
 - 1 x Heating Element, mains voltage 100W, brass encased. Order Ref: 8.
 - 1 x Mains Interference Suppressor, Order Ref: 21.
 - 3 x Rocker Switches, 13A mains voltage, Order Ref: 41.
 - 1 x Mini Uni-Selector with diagram for electronic jig-saw. Order Ref: 56.
 - 2 x Appliance Thermostats, adjustable up to 15A. Order Ref: 65.
 - 1 x Mains Motor with gearbox giving 1 rev per 24 hrs. Order Ref: 69.
 - 10 x Round Pointer Knobs for flatted 1/4" spindles. Order Ref: 295.
 - 1 x Ceramic Wave Change Switch, 12-pole, 3-way with 1/4" spindle. Order Ref: 303.
 - 1 x Tubular Hand Mike, suits cassette recorders, etc. Order Ref: 305.
 - 2 x Plastic Slethosets, take crystal or magnetic inserts, order Ref: 331.
 - 20 x Pre-set Resistors, various types and values. Order Ref: 332.
 - 6 x Car Type Rocker Switches, assorted. Order Ref: 333.
 - 10 x Long Shafted Knobs for 1/4" flatted spindles. Order Ref: 339.
 - 1 x Reversing Switch, 20A double-pole or 40A single-pole. Order Ref: 343.
 - 4 x Skirted Control Knobs, engraved 0-10. Order Ref: 355.
 - 3 x Luminous Rocker Switches, Order Ref: 373.
 - 2 x 1000W Tubular Heating Elements with terminal ends. Order Ref: 376.
 - 1 x Mains Transformer Operated NiCad Charger, cased with leads. Order Ref: 385.
 - 2 x Clockwork Motors, run for one hour. Order Ref: 389.
- Prices include VAT. Send cheque/postal order or ring and quote credit card number.
Add £3 post and packing.
Orders over £25 post free.

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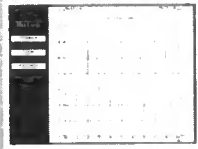
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Data Acquisition for your PC

Easy to use, low cost data acquisition products that allow your PC to be used as a range of useful test and measurement instruments, or as an advanced data logger. Easy installation via a parallel port except the ADC-16 which connects to the serial port. They require no power supply. Take up no expansion slots. Each comes with a comprehensive manual. Software drivers are included for users who wish to write their own software. Software supplied on 3.5" disk.

PicoScope 'Virtual instrument' software. PicoLog



Storage scope with trigger, timebase, rulers and offset. Real time spectrum analysis with min/max frequency and signal averaging. Multiple meters on screen (digital and bargraph). Printer and file handling support.



Advanced data logging software package. Collect store, display and print data from one sample per millisecond to one per day. Record average, min/max or scaled values (linear, equation, table look-up). Report types; monitor (with min/max alarms), y-t graphs, x-y graphs, tabulation.

NEW SLA-16 Logic Analyser

Pocket sized 16 channel Logic Analyser



SLA-16 with power supply and cables £219

- Connects to PC serial port, ideal for desktops or notebooks.
- Supplied with easy to use software, power supply and cables.
- High Speed - up to 50MHz sampling.
- Internal and external clock modes.
- 8K Trace Buffer.

NEW ADC-100 Virtual Instrument

Dual Channel 12 bit resolution



- Digital Storage Scope
- Spectrum Analyser
- Frequency Meter
- Chart Recorder
- Data Logger
- Voltmeter

The ADC-100 offers both a high sampling rate (100kHz) and a high resolution. It is ideal as a general purpose test instrument either in the lab or in the field. Flexible input ranges ($\pm 200\text{mV}$ to $\pm 20\text{V}$) allows the unit to connect directly to a wide variety of signals.

ADC-100 with PicoScope £199
with PicoScope & PicoLog £209

ADC-10

1 Channel 8 bit

- Lowest cost
- Up to 22kHz sampling
- 0 -5V input range

The ADC-10 gives your computer a single channel of analog input. Simply plug into the parallel port and your ready to go.

ADC-10 with PicoScope £49

PicoScope & PicoLog £59

Carriage UK free, Overseas £6
Oscilloscope Probes (x1, x10) £10

Existing ADC 10/11/12/100 users can add PicoLog for £25

ADC-11

11 Channel 10 bit

- Digital output
- Up to 18kHz sampling
- 0 -2.5V input range

The ADC-11 provides 11 channels of analog input in a case slightly larger than a matchbox. It is ideal for portable data logging using a "notebook" computer.

ADC-11 with PicoScope £85

PicoScope & PicoLog £95



ADC-12

1 Channel 12 bit

- High resolution
- Up to 17kHz sampling
- 0 -5V input range

The ADC-12 is similar to the ADC-10 but offers an improved 12 bit (1 part in 4096) resolution compared to the ADC-10's 8 bit (1 part in 256).

ADC-12 with PicoScope £85

PicoScope & PicoLog £95

ADC-16

8 Channel 16 bit+sign

- Highest resolution
- 2Hz sampling - 16bit
- $\pm 2.5\text{V}$ input range

The ADC-16 has the highest resolution of the range, it is capable of detecting signal changes as small as $40\ \mu\text{V}$. Pairs of input channels can be used differentially to reject noise. Connects to serial port.

ADC-16 with PicoLog £115

ADC-10 Simply plug into the parallel port and your ready to go.



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Fax: 01954 - 211880



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EPE MICROCONTROLLER P.I. TREASURE HUNTER

The latest MAGENTA DESIGN - highly stable & sensitive - with μ C control of all timing functions and advanced pulse separation techniques.

- New circuit design 1994
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- Easy to build & use
- No ground effect, works in seawater



- Detects gold, silver, ferrous & non-ferrous metals

- Efficient quartz controlled microcontroller pulse generation.
- Full kit with headphones & all hardware

KIT 847.....£63.95

DIGITAL LCD THERMOSTAT

A versatile thermostat using a thermistor probe and having an I.C.D. display. MIN/MAX memories, -10 to 110 degrees celsius, or can be set to read in Fahrenheit. Individually settable upper and lower switching temperatures allow close control, or alternatively allow a wide 'dead band' to be set which can result in substantial energy savings when used with domestic hot water systems. Ideal for greenhouse ventilation or heating control, aquaria, home brewing, etc. Mains powered, 10A SPCO relay output. Punched and printed case.

KIT 841.....£29.95

PORTABLE ULTRASONIC PEST SCARER

A powerful 23kHz ultrasound generator in a compact hand-held case. MOSFET output drives a special sealed transducer with intense pulses via a special tuned transformer. Sweeping frequency output is designed to give maximum output without any special setting up.

KIT 842.....£22.56

DIGITAL CAPACITANCE METER

A really professional looking project. Kit is supplied with a punched and printed front panel, case, p.c.b. and all components. Quartz controlled accuracy of 1%. Large clear 5 digit display and high speed operation. Ideal for beginners - as the μ F, nF and pF ranges give clear unambiguous read out of marked and unmarked capacitors from a few pF up to thousands of μ F.

KIT 493.....£39.95

ACOUSTIC PROBE

A very popular project which picks up vibrations by means of a contact probe and passes them on to a pair of headphones or an amplifier. Sounds from engines, watches, and speech travelling through walls can be amplified and heard clearly. Useful for mechanics, instrument engineers, and nosy parkers!

KIT 740.....£19.98



1000V & 500V INSULATION TESTER

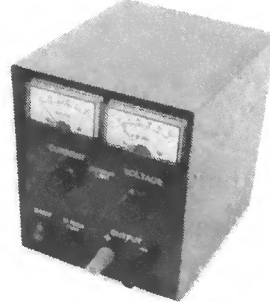
Superb new design. Regulated output, efficient circuit. Dual-scale meter, compact case. Reads up to 200 Megohms. Kit includes wound coil, cut-out case, meter scale, PCB & ALL components.

KIT 848.....£32.95

MOSFET MkII VARIABLE BENCH POWER SUPPLY 0-25V 2.5A

Based on our MkI design and preserving all the features, but now with switching pre-regulator for much higher efficiency. Panel meters indicate Volts and Amps. Fully variable down to zero. Toroidal mains transformer. Kit includes punched and printed case and all parts. As featured in April 1994 EPE. An essential piece of equipment.

KIT 845.....£64.95



ULTRASONIC PEST SCARER

Keep pets/pests away from newly sown areas, fruit, vegetable and flower beds, children's play areas, patios etc. This project produces intense pulses of ultrasound which deter visiting animals.

- KIT INCLUDES ALL COMPONENTS, PCB & CASE
- EFFICIENT 100V TRANSDUCER OUTPUT
- COMPLETELY INAUDIBLE TO HUMANS
- UP TO 4 METRES RANGE
- LOW CURRENT DRAIN

KIT Ref. 812.....£14.81

'COMSTEP' P.C. COMPUTER STEPPING MOTOR INTERFACE

An exciting project supplied with two 200 step motors, interface board, and easy to use P.C. software. Allows independent control of both motors - speed, direction, number of steps, and half/full step mode. Connects to computer parallel port. Requires 12V 1A D.C. supply and printer lead.

KIT 846 (with 2 motors)£62.99 (Printer lead £5.00)

IONISER

A highly efficient mains powered Negative Ion Generator that clears the air by neutralising excess positive ions. Many claimed health benefits due to the ioniser removing dust and pollen from the air and clearing smoke particles. Costs virtually nothing to run and is completely safe in operation. Uses five point emitters.

KIT 707.....£17.75

BAT DETECTOR

An excellent circuit which reduces ultrasound frequencies between 20 and 100 kHz to the normal (human) audible range. Operating rather like a radio receiver the circuit allows the listener to tune-in to the ultrasonic frequencies of interest. Listening to Bats is fascinating, and it is possible to identify various different types using this project. Other uses have been found in industry for vibration monitoring etc.

KIT 814.....£21.44

SPACEWRITER

An innovative and exciting project. Wave the wand through the air and your message appears. Programmable to hold any message up to 16 digits long. Comes pre-loaded with "MERRY XMAS". Kit includes PCB, all components & tube + instructions for message loading.

KIT 849.....£16.99

12V EPROM ERASER

A safe low cost eraser for up to 4 EPROMS at a time in less than 20 minutes. Operates from a 12V supply (400mA). Used extensively for mobile work - updating equipment in the field etc. Also in educational situations where mains supplies are not allowed. Safety interlock prevents contact with UV.

KIT 790.....£28.51

MOSFET 25V 2.5A POWER SUPPLY

High performance design has made this one of our classic kits. Two panel meters indicate Volts and Amps. Variable from 0-25 Volts and current limit control from 0-2.5A. Rugged power MOSFET output stage. Toroidal mains transformer.

KIT 769.....£56.82

INSULATION TESTER

A reliable and neat electronic tester which checks insulation resistance of wiring and appliances etc., at 500 Volts. The unit is battery powered, simple and safe to operate. Leakage resistance of up to 100 Megohms can be read easily. A very popular college project.

KIT 444.....£22.37

DIGITAL COMBINATION LOCK

Digital lock with 12 key keypad. Entering a four digit code operates a 250V 16A relay. A special anti-tamper circuit permits the relay board to be mounted remotely. Ideal car immobiliser, operates from 12V. Drilled case, brushed aluminium keypad.

KIT 840.....£19.86

E.E. TREASURE HUNTER P.I. METAL DETECTOR MKI

Magenta's highly developed & acclaimed design. Quartz crystal controlled circuit MOSFET coil drive. D.C. coupled amplification. Full kit includes PCB, handle, case & search coil.

- KIT INC. HEADPHONES
- EFFICIENT CMOS DESIGN
- POWERFUL COIL DRIVE

- DETECTS FERROUS AND NON-FERROUS METAL - GOLD, SILVER, COPPER ETC.
- 190mm SEARCH COIL
- NO 'GROUND EFFECT'

KIT 815.....£45.95



HAMEG HM303 30 MHz DUAL TRACE OSCILLOSCOPE & COMPONENT CHECKER

Western Europe's best selling oscilloscope - now improved. It now features 30MHz bandwidth, triggering to 100MHz and 2mV/div sensitivity.

Sharp bright display on 8 x 10cm screen with internal graticule. Special component tester built in - allows capacitors, resistors, transistors, diode, and many other components to be checked at a glance.

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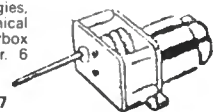
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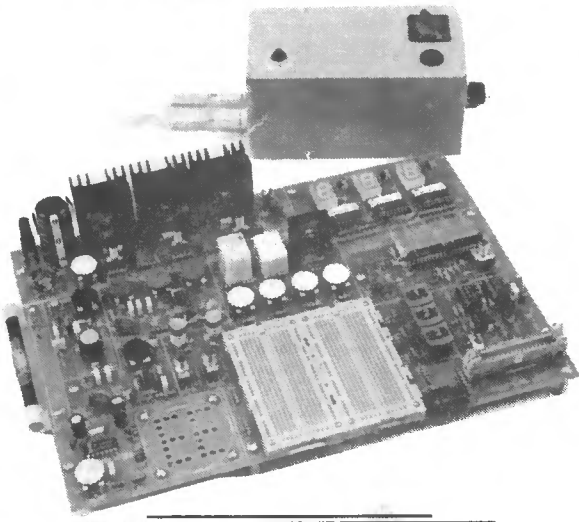
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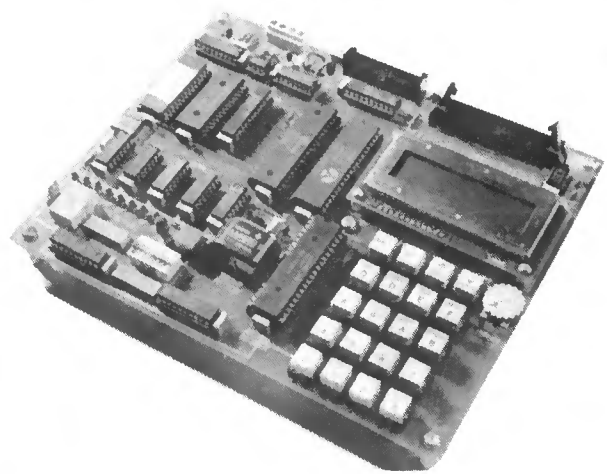
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74LS01 £0.14	4001 £0.20	2N1711 £0.26	BC204C £0.72	BD535 £0.50	CA324 £0.35	2716 £4.46	M 12 Watt	BNC Solder Plug 75R	£0.96					
74LS02 £0.29	4002 £0.17	2N1893 £0.29	BC206B £0.72	BD536 £0.65	CA555 £0.25	2716 £4.46	C 15Watt	BNC Crimp Plug 50R	£0.68					
74LS03 £0.14	4005 £0.10	2N2218A £0.28	BC207C £0.72	BD646 £0.52	CA741CE £0.28	2716-20 £3.00	G 18Watt	BNC Crimp Plug 75R	£0.68					
74LS04 £0.14	4007 £0.10	2N2219A £0.25	BC208 £0.72	BD648 £0.52	CA747CE £0.39	2716-25 £3.36	CS 17Watt	BNC Crimp Skt	£1.08					
74LS05 £0.14	4008 £0.31	2N2222A £0.18	BC209A £0.72	BD650 £0.42	CA308 £0.72	27C128-20 £4.22	XS 25Watt	BNC Socket	£1.08					
74LS08 £0.23	4009 £0.19	2N2646 £0.86	BC212 £0.08	BD707 £0.08	CA310 £0.98	27C128-20 £4.22	ST4 Stand	PL 259 5mm	£0.80					
74LS09 £0.14	4010 £0.23	2N2904A £0.25	BC212L £0.08	BD807 £0.08	CA3130E £0.98	27C256-20 £4.99	35Watt Gas Iron	PL259 1mm	£0.62					
74LS10 £0.14	4011 £0.26	2N2905A £0.23	BC212BL £0.08	BDX32 £1.78	CA3130E £0.98	27C256-20 £4.99	*Gascat* Gas Iron	RND UHF socket	£0.68					
74LS107 £0.23	4012 £0.16	2N2907 £0.20	BC213 £0.08	BDX33C £0.49	CA3140 £0.56	27C512 £3.56	Low Cost 15 Watt Iron	SQR UHF socket	£0.45					
74LS109 £0.21	4013 £0.24	2N2926 £0.16	BC213CL £0.08	BDX34C £0.50	CA3240 £0.56	27C512 £3.56	Desolder Pump	F Plug RG8	£0.30					
74LS11 £0.17	4014 £0.30	2N3053 £0.27	BC214 £0.08	BDX53C £0.47	ICL762 £1.70	6116-10 £1.53	Antistatic Pump	F Plug RG6	£0.30					
74LS112 £0.24	4015 £0.31	2N3054 £0.90	BC214L £0.08	BDX54C £0.50	ICM7555 £0.43	6116-15 £1.78	22SWG 0.5kg Solder	F Plug RG8	£1.60					
74LS114 £0.21	4016 £0.18	2N3055 £0.62	BC237B £0.09	BF180 £0.31	ICM7555 £0.96	6116-20 £2.80	18SWG 0.5kg Solder	N Socket RG8	£1.40					
74LS114 £0.21	4017 £0.35	2N3440 £0.50	BC238C £0.09	BF182 £0.31	LM301A £0.25	6116-25 £3.00	1mm 3 yds Solder	N Socket RG8	£1.40					
74LS112 £0.21	4018 £0.27	2N3702 £0.09	BC239C £0.10	BF185 £0.31	LM348N £0.31	6116-30 £3.36	Desolder Solder	BNC Crimp Pliers	£1.40					
74LS122 £0.31	4019 £0.48	2N3703 £0.10	BC251 £0.13	BF194 £0.13	LF351N £0.42	6116-35 £3.72								
74LS123 £0.21	4020 £0.31	2N3704 £0.10	BC252 £0.13	BF195 £0.19	LF352N £0.42	6116-40 £4.08								
74LS125 £0.21	4021 £0.31	2N3705 £0.10	BC261B £0.24	BF244 £0.15	LM358N £0.27	6116-45 £4.44								
74LS126 £0.25	4022 £0.32	2N3706 £0.10	BC262B £0.24	BF257 £0.33	LM377 £2.57	6116-50 £4.80								
74LS13 £0.14	4023 £0.16	2N3771 £1.44	BC267B £0.30	BF259 £0.33	LM380N £1.12	6116-55 £5.16								
74LS132 £0.21	4024 £0.21	2N3772 £1.51	BC307 £0.10	BF337 £0.36	LM381 £2.70	6116-60 £5.52								
74LS133 £0.36	4025 £0.15	2N3773 £1.79	BC308 £0.10	BF355 £0.38	LM386 £4.48	6116-65 £5.88								
74LS136 £0.16	4026 £0.78	2N3819 £0.39	BC327 £0.10	BF387 £0.16	LM387 £1.62	6116-70 £6.24								
74LS138 £0.24	4027 £0.18	2N3820 £0.66	BC328 £0.10	BF451 £0.19	LM392N £0.78	6116-75 £6.60								
74LS139 £0.25	4028 £0.22	2N3904 £0.10	BC337 £0.10	BF459 £0.29	LM393N £0.29	6116-80 £6.96								
74LS14 £0.25	4029 £0.40	2N3905 £0.10	BC338 £0.10	BF469 £0.36	LM748CN £0.31	6116-85 £7.32								
74LS145 £0.56	4030 £0.17	2N3906 £0.10	BC414C £0.13	BFX29 £0.29	LM1458 £0.26	6116-90 £7.68								
74LS147 £1.26	4031 £0.70	2N4036 £0.31	BC441 £0.40	BFY82 £0.28	MC4558 £0.36	6116-95 £8.04								
74LS148 £0.70	4032 £0.56	2N5296 £0.57	BC461 £0.40	BFY85 £0.32	LM391A £0.72	6116-100 £8.40								
74LS15 £0.14	4033 £0.56	2N5296 £0.57	BC463 £0.29	BFY50 £0.29	LM3915 £0.29	6116-105 £8.76								
74LS151 £0.25	4034 £0.21	2N6107 £0.60	BC478 £0.32	BFY51 £0.28	MC3340 £1.60	6116-110 £9.12								
74LS152 £0.25	4035 £0.29	AC126 £0.30	BC479 £0.32	BFY52 £0.26	MC4558 £0.36	6116-115 £9.48								
74LS153 £0.25	4036 £0.15	2N3773 £1.79	BC490 £0.24	BS107 £0.21	NE531 £1.56	6116-120 £9.84								
74LS154 £0.70	4037 £0.22	AC128 £0.28	BC490 £0.24	BS170 £0.21	NE569N £0.36	6116-125 £10.20								
74LS155 £0.25	4038 £0.48	AC187 £0.45	BC517 £0.20	BSW66 £1.35	NE571N £0.39	6116-130 £10.56								
74LS156 £0.36	4039 £0.46	AC188 £0.37	BC527 £0.20	BU126 £1.70	NE583 £0.80	6116-135 £10.92								
74LS157 £0.22	4040 £0.29	AC177 £0.34	BC528 £0.20	BU205 £1.82	NE583 £0.80	6116-140 £11.28								
74LS158 £0.21	4041 £0.25	AD149 £1.67	BC537 £0.20	BU208A £1.24	TBA120S £0.80	6116-145 £11.64								
74LS160 £0.48	4042 £0.28	AD162 £0.92	BC547C £0.08	BU326A £1.80	TBA810S £0.68	6116-150 £12.00								
74LS161 £0.42	4043 £0.22	BC107 £0.16	BC548C £0.08	BU508A £1.54	TL071CP £1.32	6116-155 £12.36								
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74LS163 £0.32	4045 £0.43	BC107B £0.15	BC549C £0.08	BU526 £2.24	TL072CP £0.68	6116-165 £13.08								
74LS164 £0.26	4046 £0.32	BC108 £0.13	BC550C £0.10	BU806 £1.36	TL061 £0.35	6116-170 £13.44								
74LS165 £0.48	4047 £0.40	BC108C £0.16	BC555C £0.08	BU806 £1.36	TL062 £0.60	6116-175 £13.80								
74LS170 £0.30	4048 £0.56	BC109 £0.17	BC558C £0.08	IRF540 £1.60	TL064 £0.72	6116-180 £14.16								
74LS173 £0.24	4049 £0.50	BC109C £0.17	BC559C £0.08	IRF740 £1.63	TL071CP £1.32	6116-185 £14.52								
74LS174 £0.24	4050 £0.48	BC114 £0.41	BC560B £0.09	MJ11015 £2.11	TL072CP £0.68	6116-190 £14.88								
74LS175 £0.24	4051 £0.48	BC115 £0.41	BC560B £0.09	MJ11016 £2.11	TL074CN £0.48	6116-195 £15.24								
74LS190 £0.25	4052 £0.48	BC115 £0.41	BC560B £0.09	MJ2501 £1.60	TL081 £0.33	6116-200 £15.60								
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74LS192 £0.42	4054 £0.56	BC132 £0.36	BC640 £0.21	MJE340 £0.40	TL084CN £0.46	6116-210 £16.32								
74LS193 £0.24	4055 £0.34	BC135 £0.36	BCY70 £0.21	MJE350 £0.42	UA733 £0.64	6116-215 £16.68								
74LS196 £0.24	4056 £0.40	BC140 £0.25	BCY72 £0.20	MPS42Z £0.12	ULN2003 £0.52	6116-220 £17.04								
74LS197 £0.24	4057 £0.17	BD135 £0.20	BD135 £0.20	MPS42Z £0.12	ULN2004 £0.48	6116-225 £17.40								
74LS20 £0.16	4058 £0.43	BD136 £0.21	BD136 £0.21	MRF475 £2.28	ZN4142 £1.16	6116-230 £17.76								
74LS21 £0.14	4059 £0.30	BD137 £0.23	BD137 £0.23	TIPI21 £0.35	ZN427E £3.03	6116-235 £18.12								
74LS22 £0.14	4060 £0.30	BD138 £0.22	BD138 £0.22	TIPI25 £0.37	ZN427E £3.03	6116-240 £18.48								
74LS221 £0.40	4061 £0.17	BD139 £0.23	BD139 £0.23	TIPI27 £0.40	ZN428E £6.12	6116-245 £18.84								
74LS240 £0.32	4062 £0.38	BD140 £0.25	BD140 £0.25	TIPI32 £0.46	ZN435E £6.19	6116-250 £19.20								
74LS241 £0.32	4063 £0.42	BD150C £0.82	BD150C £0.82	TIPI37 £0.40	ZN448E £7.50	6116-255 £19.56								
74LS242 £0.32	4064 £0.21	BD165 £0.45	BD165 £0.45	TIPI42 £1.08		6116-260 £19.92								
74LS243 £0.30	4065 £0.28	BD166 £0.32	BD166 £0.32	TIPI47 £1.12		6116-265 £20.28								
74LS244 £0.32	4066 £0.26	BD178 £0.16	BD178 £0.16	TIP295 £0.63		6116-270 £20.64								
74LS245 £0.36	4067 £0.55	BD201 £0.31	BD201 £0.31	TIP29C £0.31		6116-275 £21.00								
74LS247 £0.32	4068 £0.18	BD202 £0.40	BD202 £0.40	TIP30S £0.63		6116-280 £21.36								
74LS248 £0.32	4069 £0.31	BD203 £0.40	BD203 £0.40	TIP30S £0.63		6116-285 £21.72								
74LS251 £0.24	4070 £0.56	BD204 £0.40	BD204 £0.40	TIP31C £0.34		6116-290 £22.08								
74LS252 £0.24	4071 £0.56	BD222 £0.40	BD222 £0.40	TIP32C £0.32		6116-295 £22.44								
74LS253 £0.24	4072 £0.17	BD225 £0.42	BD225 £0.42	TIP33C £0.72		6116-300 £22.80								
74LS256 £0.14	4073 £0.18	BD232 £0.38	BD232 £0.38	TIP41A £0.36		6116-305 £23.16								
74LS257 £0.14	4074 £0.38	BD237 £0.32	BD237 £0.32	TIP42C £0.38		6116-310 £23.52								
74LS258 £0.24	4075 £0.40	BD238 £0.32	BD238 £0.32	TIP47 £0.48		6116-315 £23.88								
74LS26 £0.14	4076 £0.30	BD240B £0.37	BD240B £0.37	TIP48 £0.62		6116-320 £24.24								
74LS266 £0.14	4077 £0.16	BD243B £0.50	BD243B £0.50	TIP50 £0.53		6116-325 £24.60								
74LS27 £0.25	4078 £0.32	BD244A £0.53	BD244A £0.53	VN10KM £0.48		6116-330 £24.96								
74LS273 £0.32	4079 £0.51	BD246 £1.06	BD246 £1.06	VN66AF £1.50		6116-335 £25.32								
74LS279 £0.25	4080 £0.40	BD441 £0.41	BD441 £0.41	ZTX300 £0.16		6116-340 £25.68								
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We have recently been carrying out some research into readers' views of *EPE*, in fact the process will continue for some time yet, probably culminating in a readers' questionnaire inserted in the issue. To those selected readers who have attended meetings or interviews, organised by the research company, thanks for your assistance and forthright views.

One or two points that came out early in the process have already started us thinking about improvements to the magazine and the first noticeable change can be seen in the introduction of our *Back Numbers* page. It appears that some readers are not aware of the availability of back numbers for *EPE*. In fact we carry past issues going back about five years; although some are sold out after a year or two we can always provide a photostat of an article from any issue published in the last five years. For full information on this service, and on the content of recent *EPEs* see our new *Back Numbers* page in this issue.

HELP

Another point which has come out of our research is that a number of readers are not aware that we can assist if you have problems with one of our projects, or even if you have a query on electronics theory or circuitry in general (although there are strict limitations on this general area which I will point out later).

If you have built one of our projects and you are having problems we can often answer brief queries on the 'phone (see above right for the editorial address and 'phone numbers). If the problem will take some investigation we ask you to write in with full details (*and an s.a.e. please*), we can then give the matter some thought and/or ask the designer to make some suggestions. But, please make sure you have read the article thoroughly and checked everything carefully before contacting us, also please read *Shop Talk* if it is a component buying problem. On the subject of more general queries not related to published projects, we can often help with these through our *Circuit Surgery* column, thanks to our "surgeon" Alan Winstanley. However, it is not generally possible to produce designs to meet the needs of individual readers and we cannot undertake to answer queries on commercial equipment or on the modification of equipment or designs. We are also unable to give advice on the purchase or use of commercial products.



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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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We advise readers to check that all parts are still available before commencing any project in a back-dated issue.

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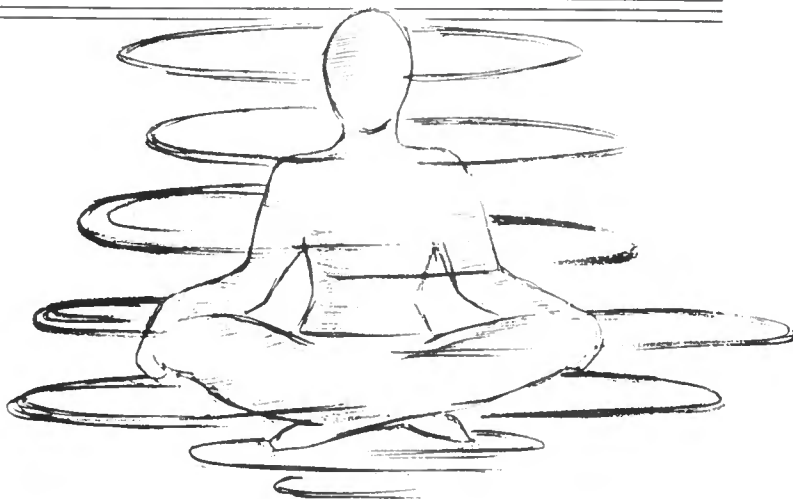
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MAGNETIC FIELD DETECTOR



ANDY FLIND

How exposed are you to alternating magnetic fields? Build this simple audio/visual detector to locate any "hot spots" around your home.

WE ARE constantly surrounded by magnetic fields of various types and strengths. Some, like the Earth's own field or those from devices containing permanent magnets, are static in nature. Modern man, however, is ever more often exposed to a variety of alternating magnetic fields of various frequencies, emanating from the huge variety of electrical and electronic devices which now form an integral part of modern living.

Over the last few years these fields have become a source of concern to some people, who feel that constant exposure to them may constitute a hazard to health. A vast amount of research on this has been carried out, much of it by the electricity authorities who are understandably concerned about the safety of their product, but to date results have been inconclusive.

However, since these fields cannot generally be seen, felt or heard, a means of detecting them may be useful to those who wish to minimise their exposure to this sort of risk. The strength of a magnetic field diminishes rapidly with increasing distance from the source so, if one knows it is there, it is relatively easy to avoid spending long periods close to it.

FIELD EFFECTS

On being told that the author's current project was a magnetic field detector, a number of people responded by saying "You mean from power lines?" Well, power lines do generate magnetic fields, but the chief radiation from the National Grid Company's transmission system is probably electrostatic. A brief explanation of the difference is in order before proceeding.

Electrostatic fields are produced by voltage. A high voltage applied across an insulator, such as the air between a 400kV powerline and the ground below, generates an electrical stress. Minute currents will

flow through the insulator, depending upon its conductivity and the applied voltage. To detect such a field, electrodes followed by an amplifier with a very high input impedance would be required.

Electromagnetic fields, on the other hand, are the magnetic "lines of force" surrounding the flow of current through a conductor. These are much increased in strength if the current is flowing through a coil where, in effect, the same current is flowing through lots of conductors, each adding to the overall field.

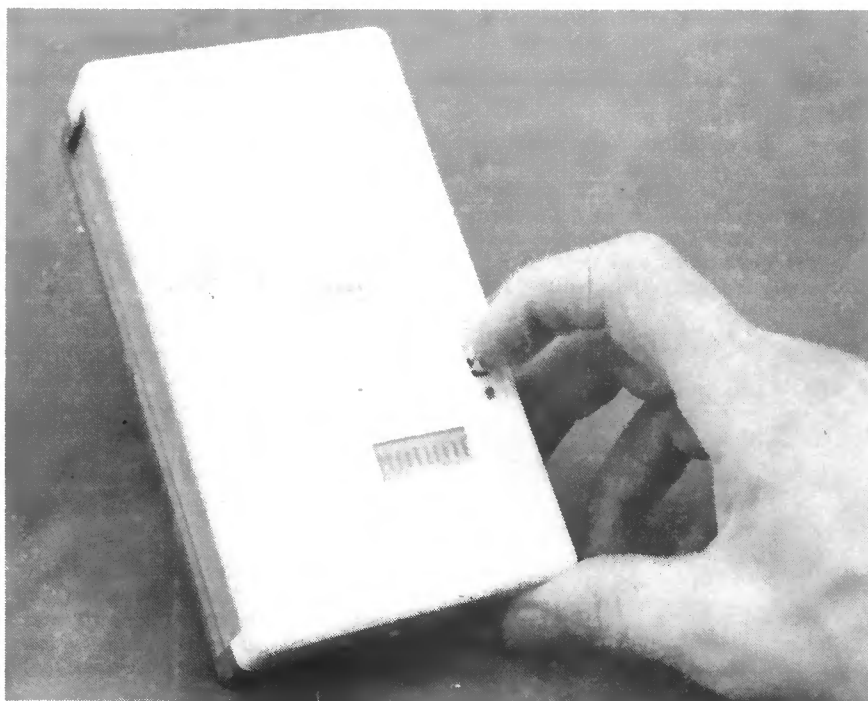
In an average house the voltages are comparatively low, so there will not be much in the way of electrostatic fields to

worry about. There will usually be plenty of examples of current-carrying coils, however, often in close proximity to the occupants. Consequently, exposure to alternating magnetic fields, mostly of 50Hz mains frequency, is likely to be high.

Sources include motors, transformers, fluorescent lamp chokes and the house wiring itself, often surrounding the user on every side. The household electricity meter should not be forgotten either. This contains several coils generating magnetic fields for driving the aluminium disc that increments the dials, and a considerable amount of this field escapes into the surrounding space. A recent TV documentary centred upon the possible hazards of long periods spent near an electricity meter.

SENSITIVITY

Most of the common magnetic fields can be detected with this easy-to-use Magnetic Field Detector project. When brought towards a source of alternating field, it produces an audio tone of rising volume and displays a visual indication of relative strength on a ten-step I.e.d. bargraph. This



has a "logarithmic" response which compensates for the non-linear relationship between field strength and distance from source, and provides coverage of a very wide range of field strengths. It should be noted, however, that the instrument is not calibrated in terms of Tesla values.

At the low end, the instrument is very sensitive indeed. The lowest l.e.d. normally flickers as it is carried around with movement relative to the earth's force-field. When placed against a quartz analogue watch it pulsed strongly at one hertz, in time with the field generated by the watch's internal stepper motor. Since this runs for a year on a single tiny battery, the field being sensed is obviously very weak indeed.

A useful side-effect is that permanent magnets within equipment can easily be detected. So long as the instrument and magnet are moving relative to each other a reading appears. As soon as the motion ceases output stops. Quite small magnets can be detected at ranges of up to a foot in this way.

When setting out to design this instrument, the first decision concerned the element to be employed for field sensing. Hall effect devices were rejected as perhaps being insufficiently sensitive, leaving a coil of some kind as the most viable cheap option.

Plenty of turns were obviously necessary and experiment suggested that for low-frequency use, something with a large iron core would be preferable. Excellent results were obtained using an old relay coil of about 500 ohms d.c. resistance but these are not, of course, generally available "off the shelf".

A lot of 36s.w.g. wire wound upon a nail also worked, but not as well as hoped. Thinner wire might have brought improvement, but would have been difficult to handle. The characteristics of the iron from

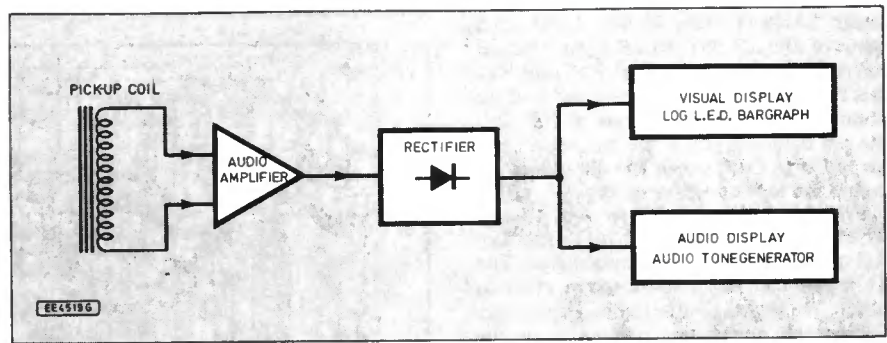


Fig. 1. Basic block diagram for the Magnetic Field Detector.

which nails are made may not be consistent either! Finally, a small, cheap transformer was chosen for the task.

An interesting aspect of this project has been the discovery of the extent to which magnetic flux leaks from small transformers. Efficiency in this area is not their forte! Fortunately, flux leaks into them just as well as it leaks out, resulting in a most effective sensor for field detection. They are even reasonably directional, having greatest sensitivity in line with the winding axis.

HOW IT WORKS

A simple block diagram of the project appears in Fig. 1. The primary winding of the transformer is used as the signal source, and is coupled into a high-gain amplifier with a frequency response extending well below the normal audio range. This is followed by a rectifier which drives the visual and audio output circuits.

It will be of interest to know that at one point the display was going to be a moving-coil meter. This was abandoned when it was realised that, being an electromagnetic device, the meter would give rise to all sorts of feedback instability problems! Its type and positioning would have been critical.

The full circuit diagram for the Magnetic Field Detector is shown in Fig. 2. Transformer T1 is the sensor, with the primary winding used as the input. The "detected" input signal passes through capacitor C1 to the inverting input of op.amp IC1a which is configured as an a.c. amplifier having a voltage gain of about 200 and a frequency response extending to below 10Hz. Diode D1 ensures rapid settling when the instrument is first switched on.

The output from IC1a is rectified by the circuit around op.amp IC1b, which senses the peak positive value of the waveform input to it. Resistors R9 and R10 give this stage a gain of two, so with an a.c. input of one volt peak-to-peak, with a peak positive value of 0.5V, produces an output of 1V d.c.

Preset potentiometer VR1 facilitates adjustment of "zero" to just above the negative supply voltage, close to the threshold of the first display l.e.d. Resistor R8 and diode D2 prevent large negative excursions of the input voltage to IC1b which might otherwise cause unpredictable results, whilst R11 and C8 reduce ripple, noise and jitter in the output signal.

Bargraph driver IC3 is an LM3915 which is the "log-scale" version of the

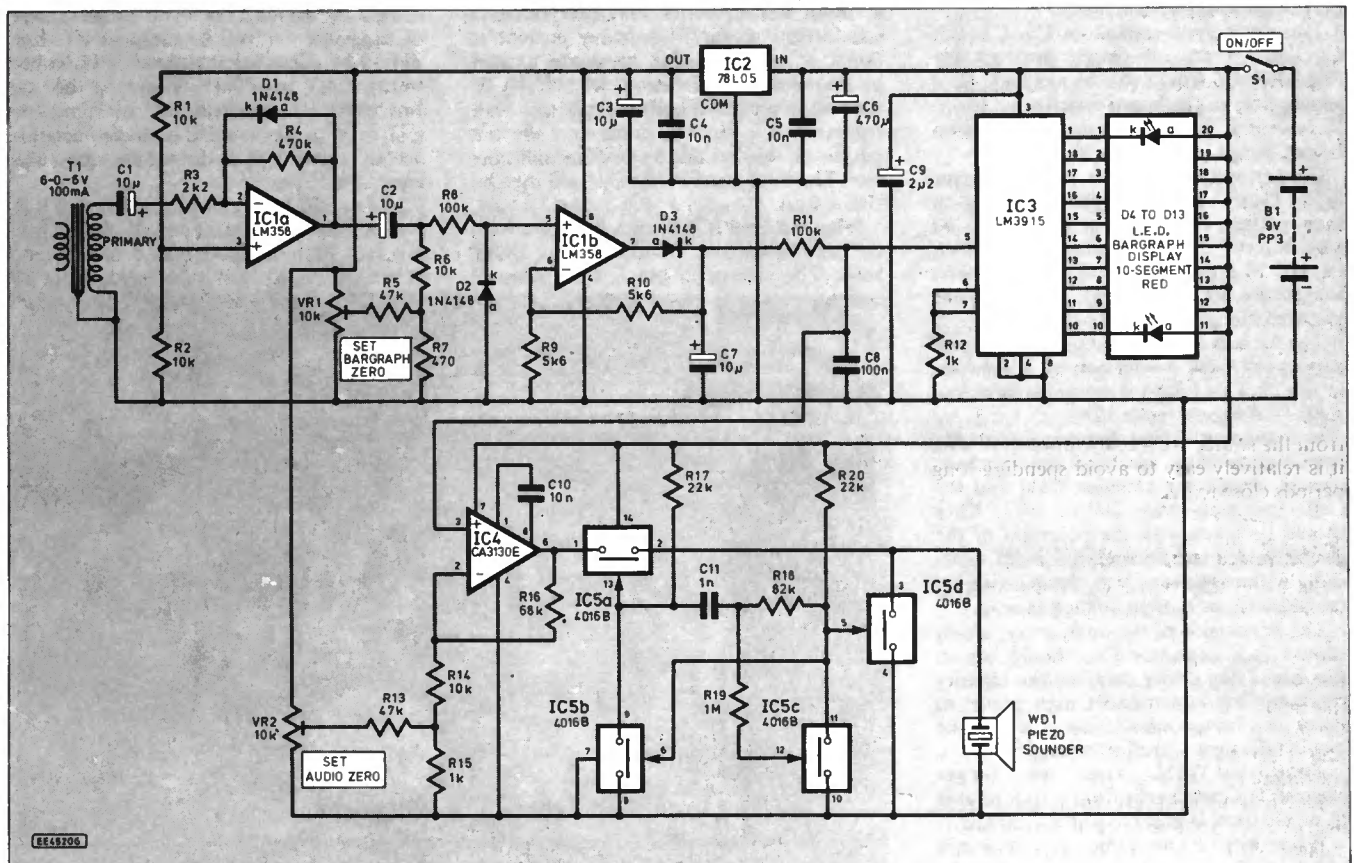


Fig. 2. Complete circuit diagram for the Magnetic Field Detector. The secondary winding of "detector" transformer T1 is left unconnected.

linear LM3194 chip. It has a full-scale input of about 1.25V, as set by an internal reference voltage generator. Resistor R12 sets the current to each illuminated i.e.d. to about 10mA. The ten outputs of IC3 sink the ten cathodes (k) of the bargraph i.e.d. array D4 to D13, which has all anodes (a) connected to the positive supply.

From R11 the signal also goes to IC4 which has a gain of about eight to produce full output from the peak input signal. The 3130 amplifier IC4 was chosen in order to obtain the highest output voltage possible, to generate maximum volume from the piezo sounder WD1 used for the audio output. The 3130 output can swing to within millivolts of either supply rail.

Preset VR2 allows the output of this stage to be adjusted to the audio threshold.

To turn the voltage into an audio signal, two CMOS analogue switches, IC5a and IC5d, connect the input of sounder WD1 alternately to the output of IC4 and to the negative supply rail at a frequency of about 4kHz. This results in a signal having amplitude dependant upon the output voltage from IC4. Analogue switches IC5b and IC5c are used to form an oscillator for driving IC5a and IC5d.

Power for the circuit is supplied by a 9V PP3 battery. Regulator IC2 supplies a steady 5V to IC1 to ensure stable operation. This is also used by the two threshold adjusters to minimise drift of their settings.

CONSTRUCTION AND TESTING

All components for this design, including the display and sounder, are mounted directly onto a printed circuit board (p.c.b.). So that the design can be fitted into a compact case, with the i.e.d. display protruding through a hole cut in the side, construction has been designed to be as "low-profile" as possible. To protrude through the hole, the display must stand slightly proud of all the other components when fitted.

The electrolytic capacitors C1, C2, C3, C6 and C7 are all placed horizontally. Capacitor C6 would still be too high, so a square hole in the board is provided for it. Regulator IC2 and capacitor C9 can also be positioned horizontally if preferred.

Capacitor C8 is a 100n polyester layer type. These vary in height according to their voltage ratings, so if the one to be used is too tall this may also be placed on its side. In order to maintain a low profile, sockets are not used for the i.c.s, which are soldered directly to the board.

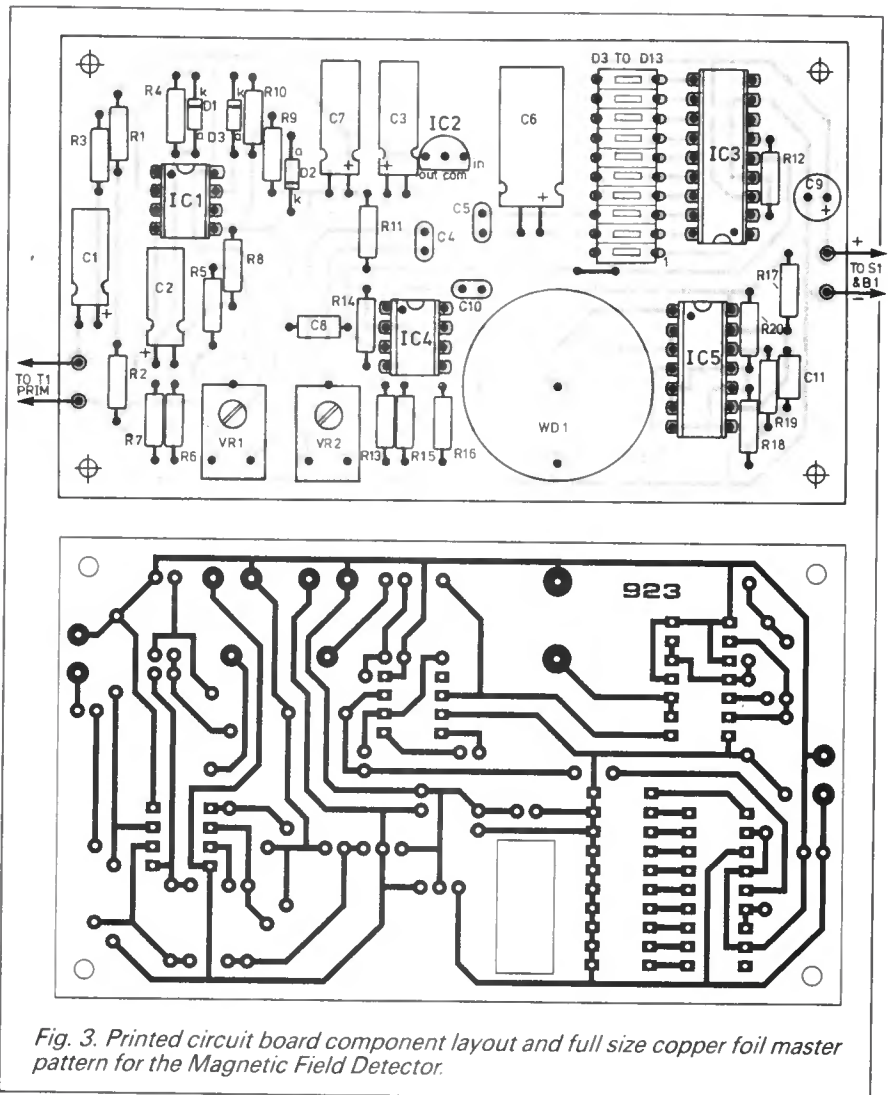
The p.c.b. component layout and full size copper foil track master pattern are shown in Fig. 3. This board is available from the *EPE PCB Service*, code 923.

Construction should commence with the fitting of the link wire and the resistors, presets, capacitors, sounder WD1 and the i.e.d. bargraph-array D4 to D13. Care should be taken with the polarities of the electrolytic capacitors and the diodes, especially with capacitor C9 as the marking on tantalum beads is often difficult to read.

The anode side of the i.e.d. array, which should face capacitor C6, should be on the side of the device carrying the identity markings but constructors may prefer to check this before installation as a mistake would take time and effort to rectify.

Sounder WD1 and the larger electrolytics can benefit from a spot of glue to secure them in place to prevent rattles!

Before any i.c.s are fitted, the circuit can be powered and checked to ensure that the supply current taken is negligible. This is

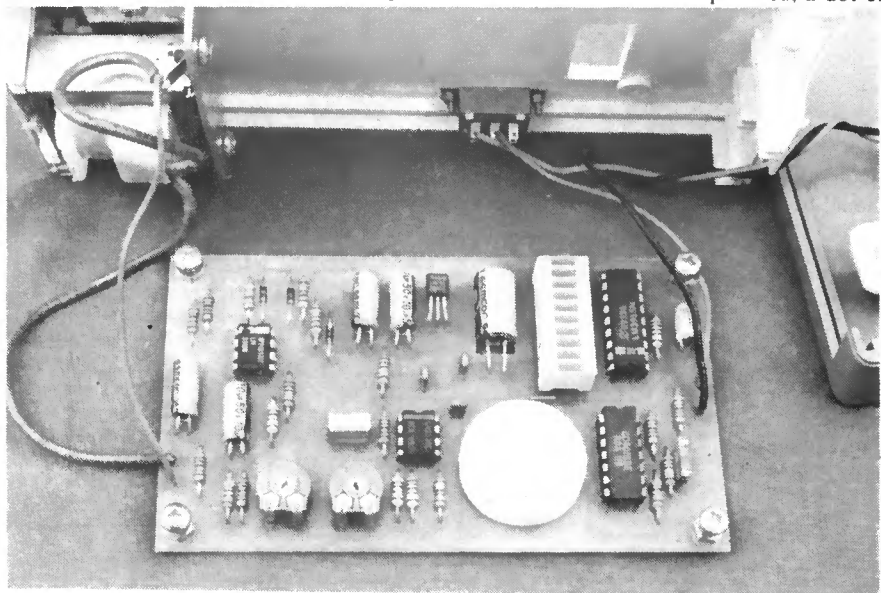


a useful test to verify that everything is satisfactory so far. If a heavy current is taken, it could be due to shorts caused by poor soldering, or incorrect polarity of capacitors C6 or C9. Following this test, regulator IC2 can be fitted and the 5V output of this verified as present and correct. The total drain current should then be about 4mA.

When op.amp IC1 is soldered into place, the supply current should rise to about 5mA. The voltage at pin 1, IC1a output,

should be about 2.5V. The positive side of capacitor C7 will be close to 0V, but should be adjustable by preset VR1 to between 20mV to 100mV. Touching the circuit input (the positive side of capacitor C1) may cause a small voltage increase across capacitor C7, depending upon the local "hum" level.

IC3 should be fitted next, noting that it is oriented the opposite way to the others, i.e. pin 1 at bottom right instead of top left. When the board is first powered, a dot of



The completed circuit board wired to the "field" sensor transformer.

COMPONENTS

Resistors

R1, R2,	
R6, R14	10k (4 off)
R3	2k2
R4	470k
R5, R13	47k (2 off)
R7	470
R8, R11	100k (2 off)
R9, R10	5k6 (2 off)
R12, R15	1k (2 off)
R16	68k
R17, R20	22k (2 off)
R18	82k
R19	1M
All 0.6W 1% metal film	

See
**SHOP
TALK**
Page

Potentiometers

VR1, VR2, 10k horizontal preset.
(2 off).

Capacitors

C1, C2,	
C3, C7	10 μ radial elect. 50V (4 off)
C4, C5,	
C10	10n monolithic ceramic (3 off)
C6	470 μ radial elect. 16V
C8	100n polyester layer
C9	2 μ 2 tantalum bead. 35V
C11	1n polyester layer.

Semiconductors

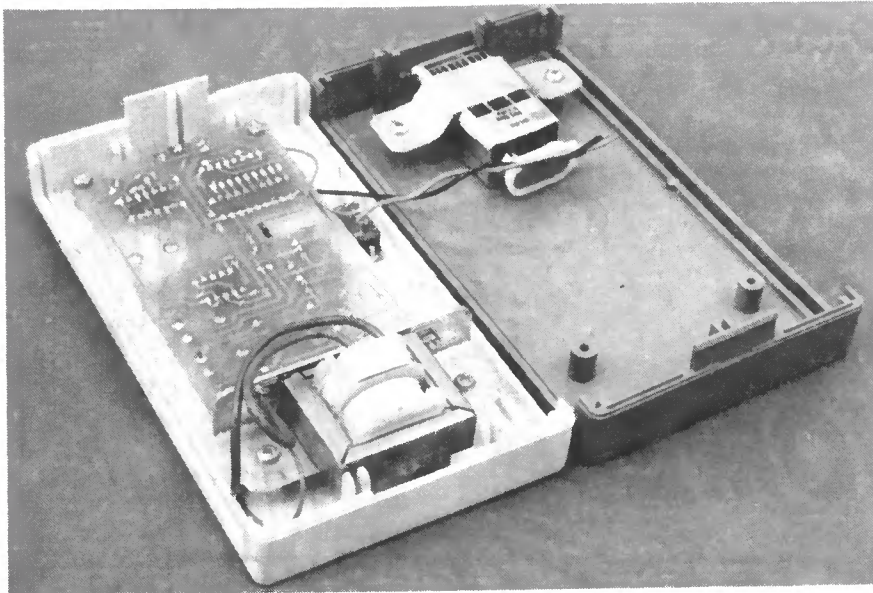
D1, D2,	
D3	1N4148 silicon diode
D4 to	
D13	10-segment bargraph i.e.d. array, red
IC1	LM358 dual op.amp
IC2	78L05 + 5V 100mA voltage regulator
IC3	LM3915 log. bargraph display driver
IC4	CA3130E CMOS op.amp.
IC5	4016B CMOS quad switch

Miscellaneous

T1	6V-0V-6V 100mA sub-min. mains transformer
WD1	piezo buzzer, p.c.b. mounting
S1	s.p.s.t. slide switch
Printed circuit board available from <i>EPE PCB Service</i> , code 923; two-part plastic case with aluminium front and back panels, size 153mm x 84mm x 39.5mm (w x d x h); 9V PP3 battery, with clips; multistrand connecting wire; aluminium bracket; mounting nuts and bolts; solder etc.	

Approx cost
guidance only

£23



Layout of components inside the case.

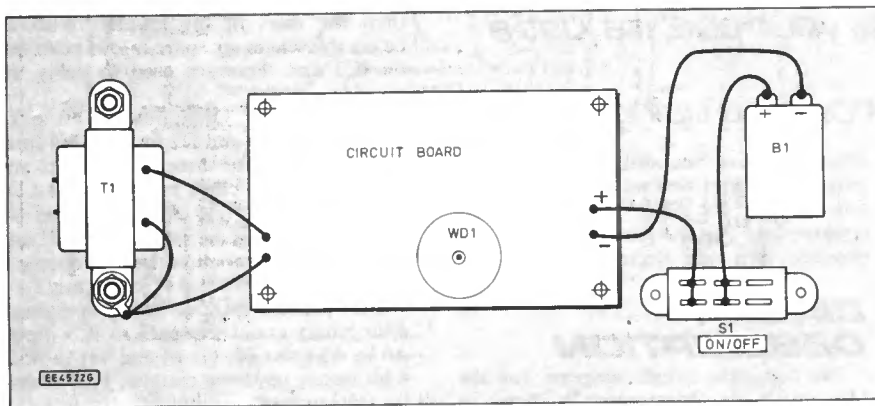


Fig. 4. Interwiring to all off-board components.

light will probably flicker along the display as the circuit settles. One of the lower i.e.d.s may remain on.

Preset VR1 should be adjusted carefully so that the lowest i.e.d. just ceases to glow.

Touching the input will probably now produce a reading on the display. The on-chip reference voltage of IC3, about 1.25V, should appear across resistor R12 but it is not necessary to check this unless problems are experienced.

AUDIO STAGE

Progressing to the audio side, IC4 should be soldered in next. This chip, and IC5 are both CMOS devices, so the usual handling precautions are advised to prevent damage.

The output from IC4 pin 6 should be variable by preset VR2 between zero and about 400mV. Starting at the high end, it should be adjusted downwards until it just reaches zero.

Here again, touching the circuit input at capacitors C1 may produce a rise in output voltage. The setting of preset VR1 influences the setting of VR2, so these two adjustments must be carried out in sequence.

Finally, IC5 can be fitted. There should now be a "bleep" with the flicker of the bargraph when power is applied, and touching capacitor C1 should produce both audio and visual outputs. The overall supply current depends on what is being driven, but as a rough guide it will be about 10mA to 15mA when the display is not illuminated, rising to around 30mA when an input is present.

ENCLOSURE

The general layout in the case can be seen from the photographs, and the various wiring connections are shown in Fig. 4. The transformer is mounted on an aluminium bracket, steel being inadvisable as it could distort the field being sensed.

The transformer primary winding is connected to the circuit input and the secondary is left unconnected. It is essential that the secondary leads should not touch, however, as this would seriously reduce sensitivity. They can be cut short and insulated if necessary. The transformer metalwork is connected to the negative side of the input to reduce stray pickup.

A hole is cut in the case for the bargraph to project through, and the position of the p.c.b. is adjusted with four screws, one at each corner, with nuts either side for accurate height setting. A small slide switch, S1, provides the power on-off function.

PRACTICAL USE

In use, the instrument is simply switched on and pointed towards suspected sources of alternating magnetic field. Constructors will probably be surprised at some of these. Most of the small plug-in power supplies so common these days radiate strongly and can be detected from well over a foot away.

Electric fan motors produce strong fields. Some dimmer switches are quite strong sources when operating, probably because of their suppression chokes. Fluorescent lamp chokes are strong producers.

Fridges and freezers seem relatively low-level in comparison, probably because of

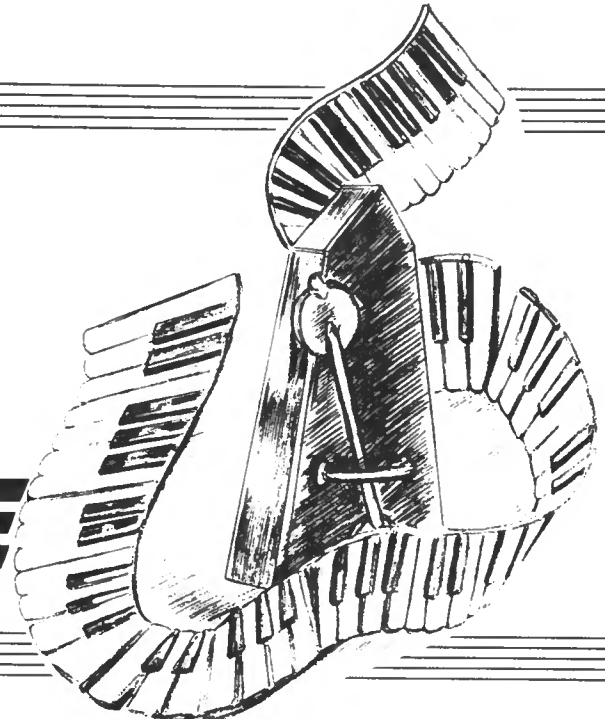
their steel cases, whilst the electricity meter often basks in a field that can be picked up at several feet. Those living in terraced houses may find high-level "hot-spots" on walls where their neighbours have appliances on the other side!

Of the other sources that can be detected, it will probably be noticed that the lowest i.e.d. flickers a little when the instrument is carried around, even outside and well away from any known source. The instant it is put down, this will usually stop. The most likely cause of this effect is movement through the earth's magnetic field.

Magnets of any description moving nearby will cause a strong response. Finally, as mentioned earlier, a quartz analogue watch usually has a stepper motor with a coil that is pulsed once a second, and when placed very close, the instrument may be able to detect this. □

MOVING DISPLAY METRONOME

CAROL JACKSON



There is no need to miss your cue, its just a matter of timing.

A pendulum effect metronome using l.e.d.s

THE TRADITIONAL mechanical metronome, with its weighted swing-arm provides an audio and visual indication of beats per minute, but many simple electronic metronomes often overlook the visual aspect, with at best, a flash from an l.e.d. on every beat.

The Moving Display Metronome described here fills this shortfall. It's based on a 4067 16-Channel analogue multiplexer/demultiplexer with a 10 l.e.d. display. When the arm of a mechanical metronome swings from side to side it appears to slow down towards the end of its travel. To simulate this motion electronically, the

outer l.e.d.s of the display stay on for longer. This produces an effective moving dot display similar to its mechanical counterpart. The metronome "clicks" are produced by a piezo electric buzzer.

CIRCUIT DESCRIPTION

The complete circuit diagram for the Moving Display Metronome is shown in Fig. 1. The heart of the circuit lies around IC3 which acts like a 16-way, single-pole switch. To achieve a pendulum motion, the outer l.e.d.s need to stay on for longer

than the ones in the middle. With 10 l.e.d.s this leaves six spare in/out positions on IC3 and these are used to delay the outer l.e.d.s.

By wiring l.e.d. D1 to outputs Y0 to Y2 (IC3 pins 9, 8, 7) and D2 to Y3 to Y4 (pins 6, 5), D1 is on for three clock pulses and D2 is on for two clock pulses. L.E.D.s D3 to D8 are on for one clock pulse and D9 and D10 are wired the same way as D1 and D2. Thus it appears that the metronome is slowing down at the end of each travel.

The l.e.d.s are incremented by applying a 4-bit binary count sequence to IC3 inputs A0 to A3 (pins 10, 11, 14 and 13). A 4516 4-bit binary up/down counter, IC2, is used for this purpose.

After IC2 counts up to 16, the count must be reversed to change the direction of the l.e.d.s. This is achieved by using half of IC4, a 4013 dual D-type flip-flop, which

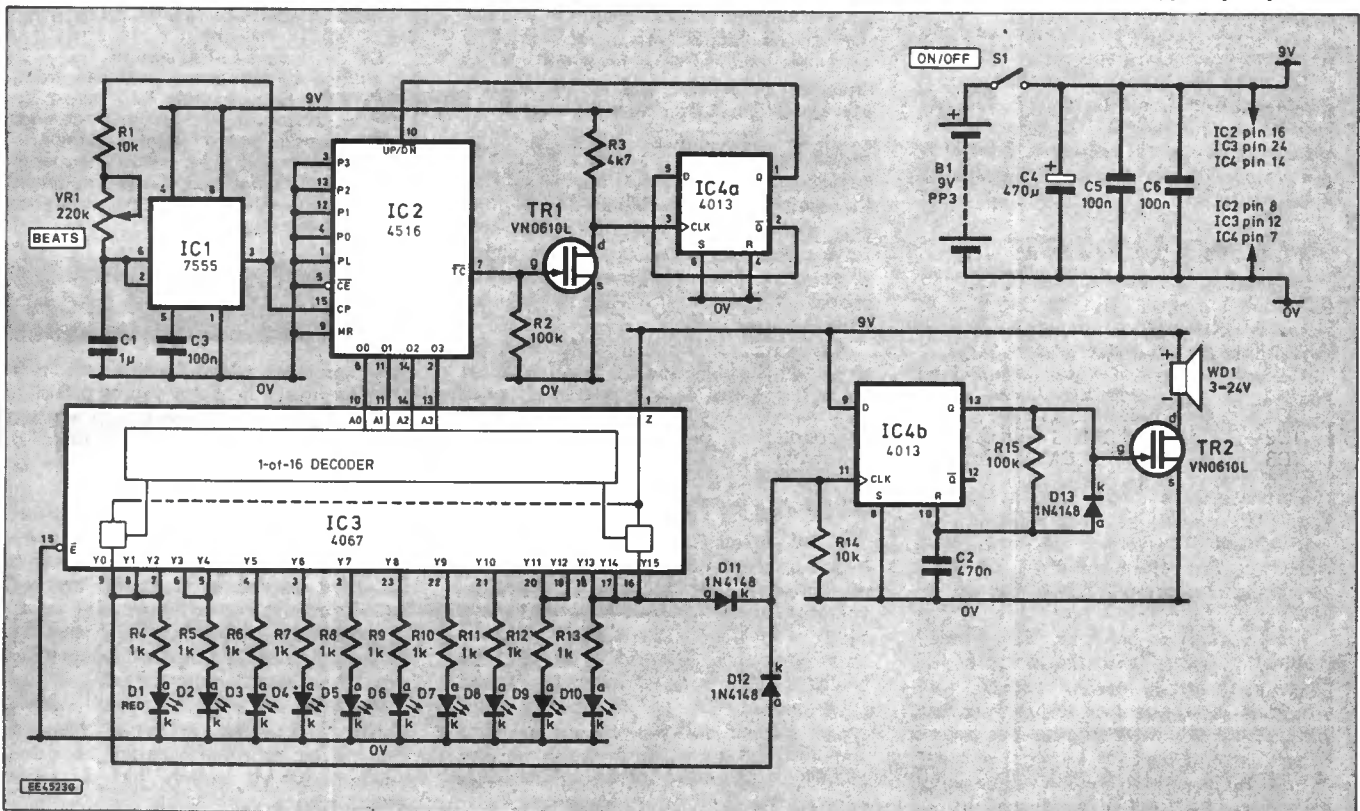


Fig. 1. Complete circuit diagram for the Moving Display Metronome.

is wired to provide a toggle action when clocked.

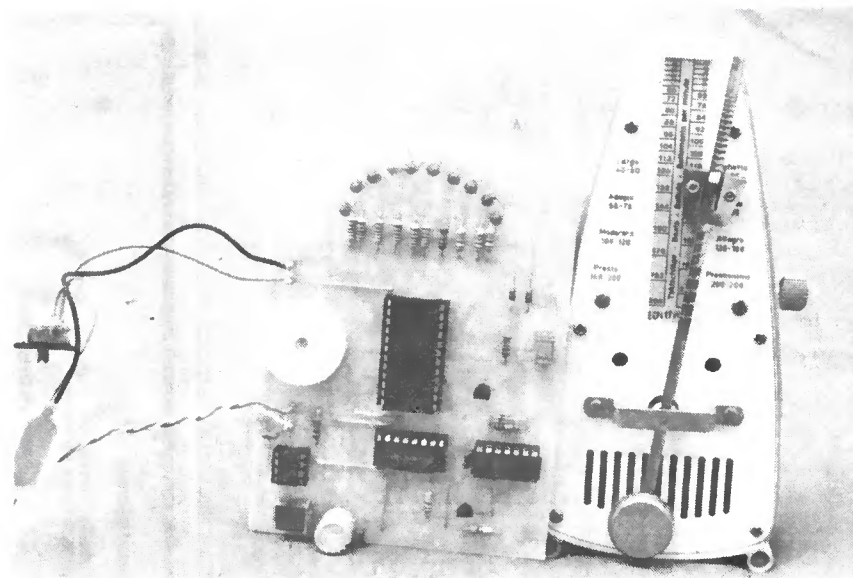
When the count reaches 16, pin 7 of IC2, goes low for one clock pulse. This pulse is inverted by f.e.t. transistor TR1 and fed to pin 3 of IC4a. This toggles the flip-flop and sends IC4a pin 1 low. Pin 10 of IC2 is now low for the next 16 clock pulses, therefore providing the down count. When the count reaches 0, pin 7 of IC2 goes low again for one clock pulse, which toggles IC4a pin 1 high, causing the count to change direction again.

COUNTING SPEED

The speed of the count sequence is controlled by IC1, a 7555 low power CMOS timer. This configuration provides an equal mark-to-mark space astable output.

Assuming the output, pin 3, of IC1 is low and capacitor C1 is at half the supply voltage, C1 will continue to discharge through resistor R1 and potentiometer VR1. When the voltage on C1 falls to a third of the supply voltage, trigger input, pin 2, sets an internal flip flop and pin 3 goes high. Capacitor C1 now charges up through R1 and VR1, until two thirds of the supply voltage. The threshold input, pin 6, then resets the internal flip flop, where C1 will once again discharge, thus creating a square wave output.

By varying potentiometer VR1, the clock frequency, and therefore Beats Per Minute (BPM) increases or decreases. With the components shown the BPM ranges from approximately 20 to 270. The range is slightly larger than a normal metronome's to allow for component tolerances.



Comparing the old pendulum type metronome with the new I.e.d. version.

The metronome "clicks" are produced through a small solid-state buzzer WD1. When D1 or D10 are illuminated, a pulse is sent to pin 11 of IC4b, via diode-OR network, D11, D12 and resistor R14. IC4b is configured as a positive edge triggered monostable.

When pin 11 of IC4b is triggered the Q output (pin 13) is set high and capacitor C2 starts charging through resistor R15 until the voltage on C2 is high enough to reset pin 13. When this happens, C2

is rapidly discharged through diode D13. This ensures that the pulse width of the metronome "click" is constant, regardless of the clock pulse width. Pin 13 of IC4b is fed to WD1, via transistor TR2.

Capacitors C4 to C6 provide power supply decoupling. The average current consumption of the unit is 7mA. An ordinary 555 timer can be used in place of the CMOS 7555 (IC1). If this is done, the current consumption will rise by 3mA.

COMPONENTS

Resistors

R1, R14	10k (2 off)
R2, R15	100k (2 off)
R3	4k7
R4 to R13	1k (10 off)
All 0.25W 5% carbon film	

See
SHOP
TALK
Page

Potentiometer

VR1	220k min. rotary carbon, lin.
-----	-------------------------------

Capacitors

C1	1 μ polyester
C2	470n polyester
C3, C5, C6	100n monolithic ceramic (3 off)
C4	470 μ radial elect. 16V

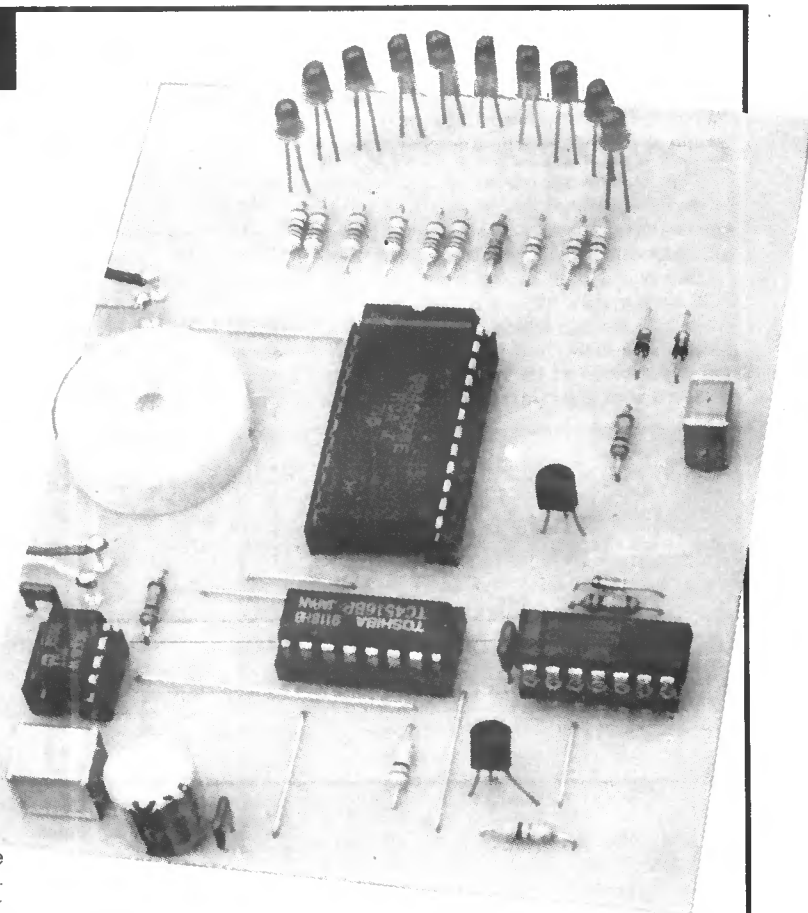
Semiconductors

D1 to D10	3mm red I.e.d. (10 off)
D11 to D13	1N4148 signal diode (3 off)
TR1, TR2	VN0610L n-channel f.e.t. (2 off)
IC1	7555 CMOS timer
IC2	4516 CMOS 4-bit up/down binary counter
IC3	4067BEY CMOS 1-of-16 analogue switch
IC4	4013 CMOS dual D-type flip flop

Miscellaneous

B1	9V PP3 battery, with connecting clips
WD1	low-profile p.c.b.-mounting buzzer
S1	sub-miniature s.p.d.t. slide switch

Printed circuit board available from *EPE PCB Service*, code 925; plastic case to choice; 8-pin d.i.l. socket; 14-pin d.i.l. socket; 16-pin d.i.l. socket; 24-pin d.i.l. socket; I.e.d. clips optional (10 off); solder pins (4 off); multistrand connecting wire; p.c.b. mounting nuts and bolts; solder etc.



Layout of components on the completed printed circuit board.

Approx cost
guidance only

£20

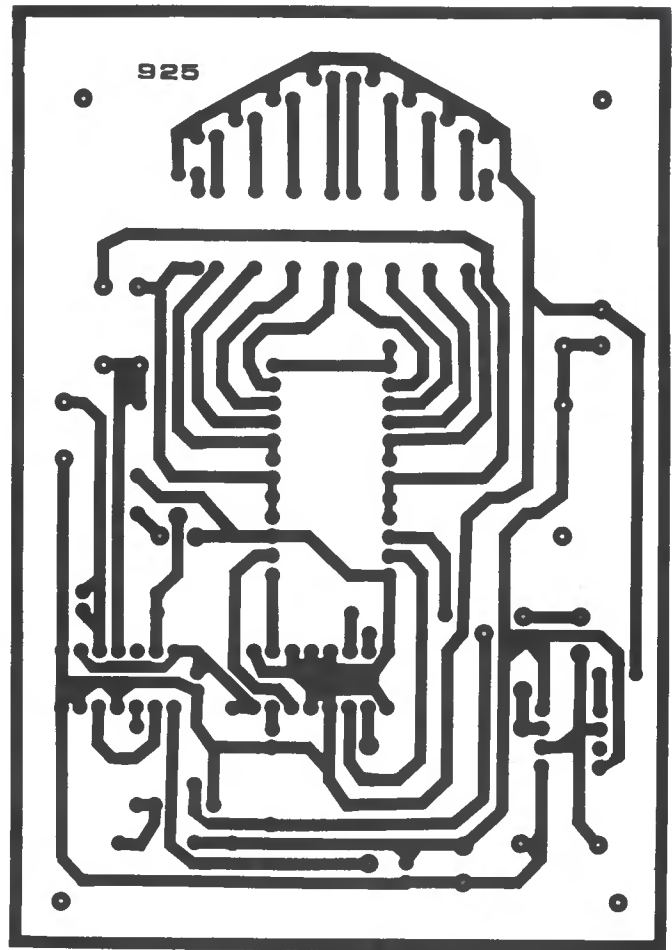
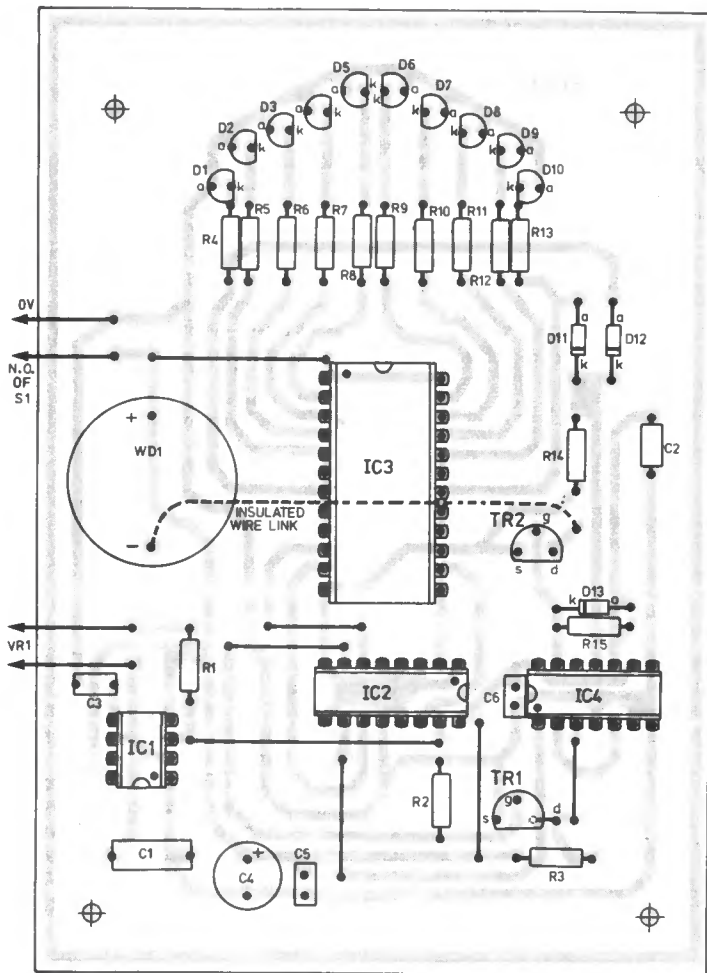


Fig. 2. Metronome printed circuit board component layout and full size underside copper foil master pattern. Note: the insulated link is soldered to the copper track side. Also shown (right) are the pinouts for the l.e.d.s, diodes and f.e.t.s.

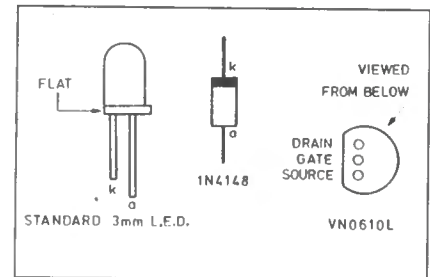
CONSTRUCTION

The Metronome circuit is built on a single-sided printed circuit board (p.c.b.). The underside copper foil master pattern and component overlay are shown in Fig. 2. This board is available from the *EPE PCB Service*, code 925.

It's not critical which order the components are fitted, but you will probably find it easiest to fit the smallest parts first i.e. seven wire links (insulated link inserted

later), resistors and diodes and so on. Transistors TR1 and TR2 should be fitted last.

Make sure components such as diodes and l.e.d.s are fitted the correct way round. Pinouts for these and the transistors are also shown in Fig. 2. Transistors TR1, TR2 and IC1 to IC4 are CMOS devices and the usual handling precautions should be observed. Buzzer WD1 is a low profile p.c.b. mounting type, with the polarity marked on the underside of the casing.



Once all the components have been fitted, place an insulated wire link from the drain (d) of TR2 to the negative side of the sounder WD1 on the track side of the p.c.b., see Fig. 2. Next, wire the slide switch S1, PP3 battery clip and VR1 to the p.c.b. as shown in Fig. 3.

TESTING

Before you switch the Metronome on, check that the components and i.c.s are inserted correctly and there are no solder bridges or splashes on the underside of the p.c.b.

With the battery connected and the supply switch on, the l.e.d.s should appear to move like a pendulum. If nothing happens, disconnect the battery, and check your wiring. If any of the l.e.d.s don't illuminate, they're probably the wrong way round. Check the l.e.d. pinouts, shown in Fig. 2.

When the two outer l.e.d.s light a click should be heard from WD1. If there is no sound, check the wire link from the drain of TR2 to the negative (-ve) side of WD1. If this is OK, WD1 might be the wrong way round.

Adjusting VR1 in a clockwise direction should increase the speed of the display. If the opposite is true, check the wiring to VR1. □

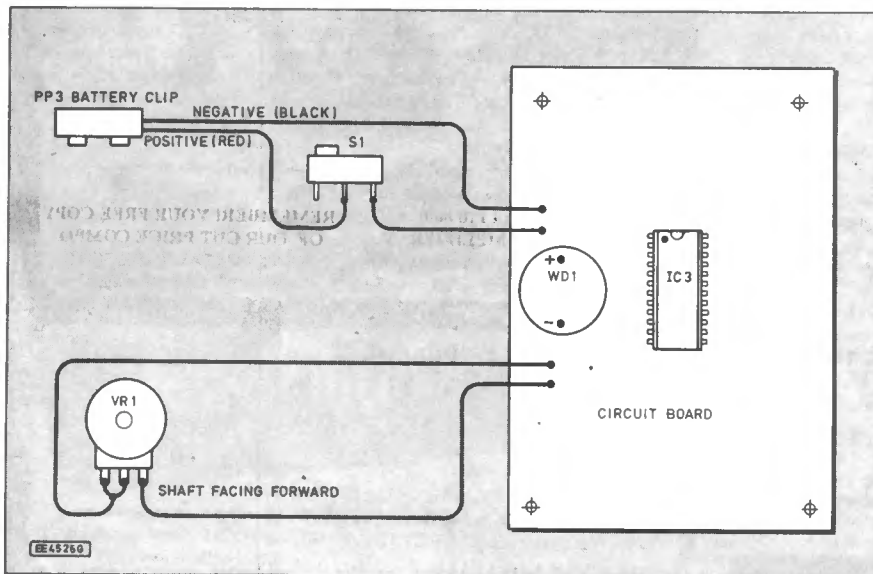


Fig. 3. Interwiring from the battery clip, beat control VR1 and on/off switch S1 to the p.c.b.

EXPRESS COMPONENTS

MAINS IONIZER KIT. Very useful kit that increases the flow of negative ions, helps clear cigarette smoke, dust, pollen etc. Helps reduce stress and respiratory problems. £15. kit, £20 built.

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LEAD ACID CHARGER. Two automatic charging rates (fast and slow), visual indication of battery state. Ideal for alarm systems, emergency lighting, battery projects etc. £12 kit, £16 built.

PHONE LINE RECORDER. Device that connects to the 'phone line and activates a cassette recorder when the handset is lifted. Ideal for recording 'phone conversations etc!. £8 kit, £12 built.

ROBOT VOICE. Turns your voice into a robot voice! answer the phone with a different voice!. £9 kit, £13 built.

PHONE BUG DETECTOR. This device will warn you if somebody is eavesdropping on your 'phone line. £6 kit £9 built.

PHONE BUG. Small bug powered by the telephone line. Only transmits when the phone is used. Popular surveillance product. £8 kit, £12 built.

STROBE LIGHT. Bright strobe light with an adjustable frequency of 1-60hz. (a lot faster than conventional strobes!) £16 kit, £20 built.

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3 CHANNEL LIGHT CHASER. 3x 800w output, speed and direction controls, can be used with 12 led's (supplied) or TRIACS for mains lights (also supplied). 9-15v DC. £17 kit, £23 built.

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SOUND EFFECTS GENERATOR. Produces any thing from bird chips to sirens! add sounds to all sorts of things £9 kit £13 built.

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50 larger electrolytic mixed capacitors

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PREAMP MIXER. 3 channel input, independent level and tone controls. Ideal for use with the hi power FM transmitters. £15 kit, £19 built.

TREMBLER ALARM. Designed for bikes etc, adjustable sensitivity, preset alarm time, auto reset. Could be adapted for all sorts of "borrowable" things £12 kit, £16 built.

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PORTABLE ALARM SYSTEM. Small 9v alarm system based on a mercury switch. The alarm continues to sound until disabled by the owner. Buzzer included. £11 kit £15 built.

800W MUSIC TO LIGHT EFFECT. Add rhythm to your music with this simple sound to light kit £8 kit, £12 built.

MOSQUITO REPELLER. Modern way to keep the midges away! Runs for

about a month on one 1.5v battery. Frequency is set to drive away mosquitos etc. £7 kit, £11 built.

3 CHANNEL SOUND TO LIGHT. Can be used anywhere as no connection is made to hi fi. Separate sensitivity controls for each channel, 1,200W power handling. Microphone included. £14 kit, £19 built.

MINI METAL DETECTOR. Detects pipes, wires etc up to 20cm deep. Useful before you drill those holes! £8 kit, £12 built.

0-5 MINUTE TIMER. Simple time switch adjustable from 0-5 mins, will switch 2A mains load. 12v op. Ideal for laboratory, photographic projects etc. £7 kit, £11 built.

7 WATT HI FI AMPLIFIER. Useful, powerful amplifier 20hz-15khz, 12-18vdc. Good for intercoms, audio systems, car etc. £7 kit £11 built.

INCAR SOUND TO LIGHT. Put some atmosphere in your car with this kit. Each channel has 6 led's that create a beautiful lighting effect! £10 kit, £14 built.

VOX SWITCH. This is a sound activated switch, ideal for use on transmitters, CB's, tape recorders etc. Adjustable sensitivity, built in delay. Mic input. £7 kit, £11 built.

LIQUID LEVEL DETECTOR.

Useful item, can be used to detect fluid levels in watertanks, baths, ponds fish tanks etc. Could also be used as rain alarm with an easily constructed sensor. £5 kit, £9 built.

FM TRANSMITTER. Mini FM transmitter 2 transistor, comes with FET miniature mic and is tuneable from 63 to 130MHZ. £7 kit, £11 built.

FUNCTION GENERATOR. Generates sinusoidal, saw tooth and square waveforms from 20hz up to 20khz. Separate level controls for each waveform. 24vac. £15 kit, £20 built.

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TELEPHONE AMPLIFIER. Very sensitive amplifier which using a 'phone pickup coil (supplied) will let you fol-

low a telephone conversation without holding the handset to your ear! £11 kit £15 built.

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SNORERS AND SUPER-COOLERS

More safety for marriages,
motorists and microchips?

— by Hazel Cavendish

WILLY JOHNSON, of Microsharp Wonder Screen fame, and Sean Martin-dale have invented an electronic cure for snorers. Called *Schnornomor*, it makes use of a new microchip designed by the pair in a device resembling a miniature hearing aid, and is intended to be worn by snorers when they retire to bed.

Activated by a small microphone, *Schnornomor* picks up the low note of the snore and converts it into a high frequency note which sounds an alarm in the brain, making the sleeper move his or her head slightly, which disturbs the relaxed muscles causing the snore.

Willy Johnson has countered the possibility of a person becoming used to such a sound by ensuring that the random bleep ranges through different frequencies, is irregularly timed and varies in volume, so that if snoring recurs it will be diverted by a different sound.

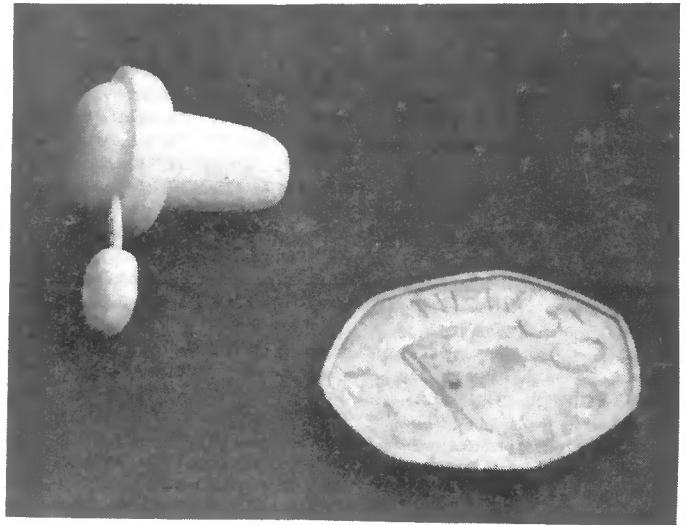
"We have done a great deal of testing, and the device has been psychologically proven," says Johnson, who claims that the advantage of the joint invention is that it does not actually wake the snorer, who continues in a deep and undisturbed sleep — no doubt to the intense relief of a spouse.

"Sean and I believe our invention could be of very real benefit to mankind, as snoring is said to contribute to many a marital break-up", says Johnson, a fact confirmed by Chest Physician John Stradling, who runs the Sleep Apnoea Clinic at the Churchill Hospital in Oxford. He says he has 20 people referred to him with a snoring problem every week of the year.

"I can categorically say Johnson will make millions if it is successful", said Dr Stradling.

He recalls, though, that an earlier invention of an electronic wrist watch, which gave a sleeping person a small electric shock when snoring, failed its objective trials because the snorer got used to it. Johnson's repost is that a shock to the wrist makes the hand move and not the head.

Another application of the invention is intended to keep sleepy drivers awake on the Motorways, as the slightest relaxing of the muscles indicating the onset of sleep could be checked by a shrill bleep alerting the drowsy driver — and could save many lives.



INSTANT COOLING

Johnson is also working independently on an electronic instant cooling system likely to prove valuable in the new "electron-squeezing" technology, and in a fast retrieval situation.

"We have microwaves which heat things up quickly, so I am now experimenting with a simple way of cooling things down equally quickly", says Johnson. Although the real value of this invention will be in cooling electronic systems rapidly to give greater power, it should also prove a boon to wine waiters as it should be possible to cool bottles of wine, or indeed cans of cola, in just 30 seconds. "They will not be American-Martini chilled it is true, but they should be pleasantly cool to the palate," says Johnson.

The one unfulfilled ambition Willy Johnson cherishes is to see his inventions bought and manufactured in Britain. "I know now that I will have no difficulty finding companies abroad to take them up, but I would like, more than anything, to contribute to the British manufacturing industry and see an invention of mine benefit my own people."

FUNNY MONEY FINDER

"Funny Money rife in High Street," a local newspaper recently announced. If you feel at risk of losing money by accepting forged banknotes then this clever unit from Maplin could let you sort out the fakes from the bona-fides. It simply shines UV light on them, and whereas genuine notes absorb UV light, forgeries reflect it. If the note is genuine, very little light is reflected when it is held under the ultraviolet tube. A fake note, though, lights up with a bright violet colour.

The mains powered bank note checker is supplied in a rugged black plastic housing that is designed for desk or counter use. The unit is fitted with a top mounted on/off switch and approximately 1m of mains lead, complete with 13A plug. Its dimensions are 180mm x 120mm x 75mm, and, it costs only £7.99, including VAT.

It would be good if a portable version were also to be introduced for shoppers!

For further information, contact any of Maplin's nationwide shops, or phone their head office on 0702 554161.



MERSEY GAMES

The UK has notched up its latest inward investment success as Japanese electronic giant, Sony, has recently decided to locate on Merseyside. The project, which will create 250 new jobs, was secured with the help of a £1.75 million DTI grant.

Sony Electronic Publishing Limited (SEPL) will site its software development and support centre in the Wavertree Technology Park in Liverpool. The centre will carry out product development for the whole of the company's computer games market in Europe.

HAPPY BIRTHDAY BULL!

It is Bull Electrical's birthday! They have been selling electronic "goodies" for fifty years! They have also produced their biggest ever catalogue, 100 pages in the latest 1995 issue. If you did not get a free copy with last month's *EPE* then one will be included with your next order, or alternatively just send them 45p in stamps and they will post you a copy.

For further information, contact Bull Electrical, Dept. EPE., 250 Portland Road, Hove, Sussex BN3 5QT. Tel: 0273 203500, Fax: 0273 323077.

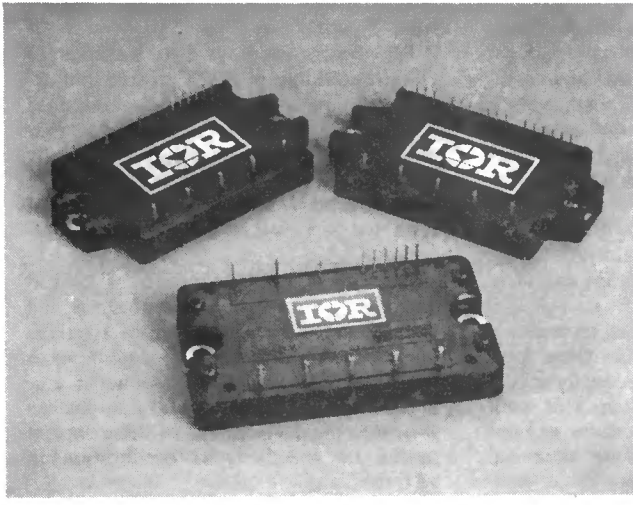
IMPROVED MOTOR CONTROLLERS

International Rectifier has introduced a new family of intelligent power modules that uses a new architecture to offer greatly reduced motor controller complexity and cost compared to either discrete components or existing modules.

IR's integrated driver technology eliminates input opto-isolators, and three of the four isolated power supplies required by existing intelligent power modules. The higher level of integration in these multi-chip power modules increases efficiency and performance by packaging the latest-generation IGBTs and HEXFRED[®] diodes together with an IR2130 power integrated circuit driver on an electrically-isolated, thermally-conductive base.

The initial products in the family, the IPM1560 and IPM2060, are 15A and 20A, 600V devices. They comprise three-phase bridges of IGBTs driven by an IR2130, which provides both high-voltage isolated drive and fast protection functions. These devices target one and two horsepower motor controllers. Other modules are scheduled for introduction in early 1995.

For further information contact International Rectifier, Holland Road, Hurst Green, Oxted, Surrey RH8 9BB. Telephone (0883) 713215.



TEL-GUARD FOR YOUR HOME

A young, Surrey based company called ComTel Ltd have come up with a fresh concept in home security using the existing BT telephone network. Currently the installation work, is carried out by Gate-A-Mation Ltd of Woking Surrey, supplier and installer of automatic gate, door and barrier systems.

By using the existing telephone network, it is claimed that TelGuard enables the user to remain in control of their property from anywhere in the world. It permits instant reliable communications between an automatic entrance and any number of locations where a telephone is installed – your home, your office, or even your car – in fact, up to 1,000 locations from a single TelGuard. Access can therefore be gained from any call point programmed into the system, be it Birmingham, England or Birmingham, USA!

It is also claimed to be less costly than large hard-wired audio entry systems which require expensive cable runs and often costly regular maintenance, TelGuard is a virtually circuit-free system that uses the existing BT telephone network to activate the command, whether it is "open gates", "open doors", "turn on light", or a range of other commands that can be activated simply by pressing a series of buttons on your own telephone.

Provided the system is linked to BT's DTMF telephone network, a variety of commands can be programmed.

The visitor enters the correct reference number on the key pad and then presses the "call" button. This instructs the system to secretly dial a specific telephone number, enabling the visitor to hear the connection. The occupant answers the telephone and screens the visitor. They then press a code number on their own telephone, followed by a # for the gate or door to open (e.g. 1 #). TelGuard automatically activates the command, returns a short constant tone of its own and then disconnects the call. This is confirmation to the occupant that the instruction has been accepted and carried out.

Each resident has a 4-digit PIN number, which, when entered into the keypad, allows instant access. For further information contact either: Gate-A-Mation Limited, Unit 1, Boundary Business Centre, Boundary Way, Woking, Surrey GU21 5DH, (Tel: 0483 747373) or ComTel Ltd, P.O. Box 192, Dorking, Surrey, (Tel: 0306 877889).

Everyday with Practical Electronics, January 1995

PLEASE TAKE NOTE

Stereo HiFi Controller

July/Aug '94

August issue pages 630 and 633: The type number for IC12 used in the Expansion and Display circuit should be LF353 and not LF347. The components list is also incorrect.

Resistor R46 should be removed and a link put in its place. If not removed, it forms a potential divider to a.c. signals with C20 and R49. This effectively reduces the sensitivity of IC3/IC4 in detecting signals, and will therefore not stop the expansion board counting from 0 to 3. In an otherwise faultless board the unit will still work, but not as well.

SMART BANK

Schlumberger signs smartcard development contract with Visa, signalling fundamental shift in international banking card practice. First world-scale smartcard application, conforming to international bank standards developed jointly by Visa, Mastercard & Europay.

Visa International has selected Schlumberger Smart Cards & Systems as a technological partner to develop a smartcard-based customer card. The new card will provide Visa with enormous potential to develop its range of financial services, coupled with a much more secure platform for electronic payment compared with conventional magnetic stripe technology.

The design will additionally conform to new international banking transaction standards developed by a working group composed of Visa, Mastercard and Europay (VME). This, it is claimed, will make it a potential worldwide smartcard application.

The contract covers the development of the software architecture for a powerful microprocessor-based smartcard chip, possessing a very high degree of flexibility for the creation of future financial service applications.

PLANE TALKING

In-flight holiday makers may well have heard cabin announcements to the effect that the use of mobile phones on the aircraft is prohibited and possibly dangerous to flight safety.

Now there may be a remedy for at least some inveterate cordless chatters cut off from their addiction. A new in-flight telephone service, has recently been announced by Trade and Technology Minister Ian Taylor.

BT has been granted a Telecommunications Act licence to operate ground stations in the UK to provide Terrestrial Flight Telephone System (TFTS) services. TFTS will enable passengers to make telephone calls from aircraft during flights.

Mr Taylor said: "This innovative and UK developed service will add a vital link in our communication infrastructure and shows how government is exploiting the radio spectrum to promote the introduction of new technology."

Mounted in a wall or on a plinth, one TelGuard unit can serve an entire estate.



New Technology Update

Variable colour I.e.d.s are becoming a distinct possibility and seismic servo techniques are set to improve i.c. manufacturing yields.

LIGHT emitting diodes have been available for many years now. Standard red I.e.d.s are widely available for just a few pence. They are used in vast quantities as cheap and reliable indicators, replacing the incandescent bulbs which were almost the only option a number of years ago. In addition to this they also find widespread use in alphanumeric displays, although other less current hungry devices are tending to dominate this field now.

Limitations

Despite their widespread acceptance there are still many limitations to I.e.d. technology. One of the most obvious is the limited range of colours which are available. Red is the most common and the easiest to produce. Other colours including orange, green, yellow and blue are available, but they are often more expensive. In fact it was a number of years after the first red I.e.d.s were introduced before any other colours were available.

This shows some of the difficulties which have been encountered in developing and manufacturing these new colours. Different processes are needed in the manufacture of these variants. However, a new development which is being undertaken at the University of California has made significant progress in streamlining the manufacture of different coloured I.e.d.s and making devices which can change their colours.

Organic Colours

The new I.e.d. is based around a structure which contains two different types of layer. One consists of an organic substance called p-paraphenylene vinylene and the other is an inorganic substance called cadmium selenide. In the new structure it is found that the cadmium selenide layer will emit light when a forward bias around four volts is applied. The colour is dependent upon the size of the cadmium selenide crystals, and varies from red to yellow. This means that exactly the same process can be used to manufacture I.e.d.s of differing colours; only some of the conditions need to be changed.

Of more interest, however, is the p-paraphenylene vinylene. It is found that as the bias increases, this layer starts to emit light, and eventually becomes the dominant light source. This emits a green light, and purely by changing the bias on the device the colour changes.

This work is still in its early stages of development, and a number of problems need to be overcome. At the moment the device only has a limited life when it is running since the efficiency falls. Currently the p-paraphenylene vinylene layer has the

shortest life falling away to nothing leaving only the cadmium selenide layer active. Despite this problem it does show the way in which I.e.d. developments may progress in the future.

I.C. Manufacturing Improvements

The sizes of components in i.c.s are falling at an amazing rate. Dimensions not thought possible a few years ago are now commonplace with today's i.c.s. To achieve this has not been easy. Many new techniques have had to be employed, and many millions of pounds have been spent in research. Manufacturers and designers alike have had to overcome various limitations in the basic processes of lithography, diffusion, and etching which are used in the manufacture of these devices.

Whilst the spotlight has fallen on methods of improving these techniques there have been many other areas where equally important work has been undertaken. This work may not have received the same amount of publicity, but it has been just as crucial to the development of the smaller i.c. technologies.

Bad Vibrations

One of these areas is in the limitation of vibration, particularly during the photographic processes. When the first CDs were manufactured there was a lot of publicity given to the fact that they had to be manufactured under conditions of minimal vibration. However, it is not always realised that micro-inch displacements on a chip undergoing lithography or ion implantation can have disastrous effects. Unfortunately all areas of the world are subject to some degree of vibration, and this can be a major factor affecting the yields of i.c.s during manufacture.

As a result of this, manufacturers have to go to vast lengths to mechanically isolate the relevant pieces of their equipment. Critical items are often placed on suspended floors which are themselves mounted on shock absorbing pillars. Even then areas where there are low levels of vibration have to be sought. This requires expensive geological searches to be performed and it usually results in having to set up the facility in a remote location away from any sources of vibration.

Once the location has been found, building and running the facility is more costly than if it could be located in a more convenient place. Accordingly, any methods of reducing vibration, and enabling more convenient sites to be chosen would be welcomed by i.c. manufacturers.

Phased Compensation

To help overcome this problem a company called Barry Controls based in Brighton, Massachusetts, U.S.A. has developed an active compensation system. This senses any external low frequency vibrations and generates vibrations in the opposite phase to cancel out any movement and keep the work piece absolutely still.

The system employs two methods of vibration limitation. Both passive and active techniques are successfully combined to give an improvement of a factor of four or five over anything else which is currently available. In fact it is effective in limiting vibrations between 0.3Hz and 200Hz and it is quoted as giving an isolation level of 99 per cent.

The system is based around a central computer controller which analyses the data presented to it and generates signals to operate the active system. The first input to the system is taken from geophones embedded into the floor. Careful thought has gone into the development of these sensors so that they exactly detect the vibrations in all three planes.

Pedestal Power

Floor movements are analyzed by the controller and the resulting information is used to generate control signals for the three pedestals on which the work floor is mounted. Each pedestal contains five transducers which perform the active vibration isolation. They use the piezoelectric effect to convert the high voltage signals from the controller into mechanical displacements to counteract the vibrations. The pedestals also carry additional sensors which are used to feed back additional vibration information to the controller.

The system is so versatile that even vibrations created on the work area itself are detected and eliminated. This is particularly vital because the high speed movements needed to make many of the processes like ion implantation viable create their own vibrations. In fact the new system is so successful at eliminating these vibrations that many of the machines are able to operate faster than they would normally be able, making the system even more cost effective.

The new Barry Controls system is likely to be a major contribution to the cost reduction in the manufacture of large i.c.s. It may be of particular benefit because it might allow fabrication plants to be located in areas more suitable for the manufacturer. □

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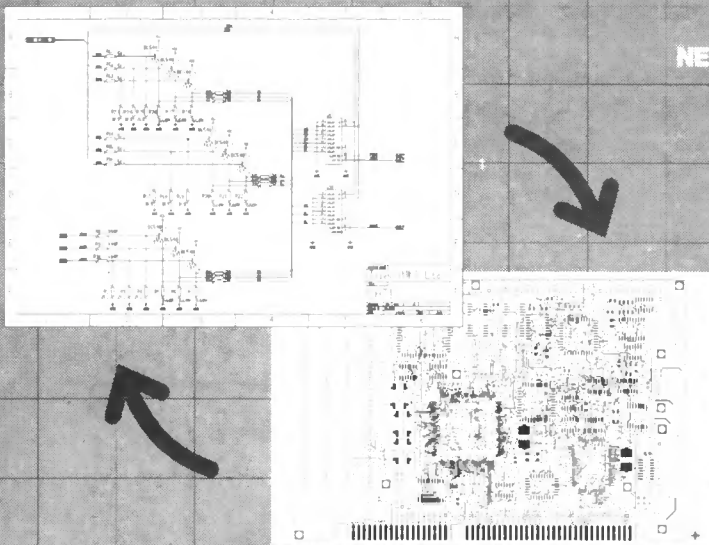
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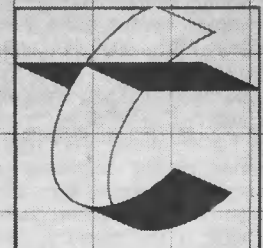
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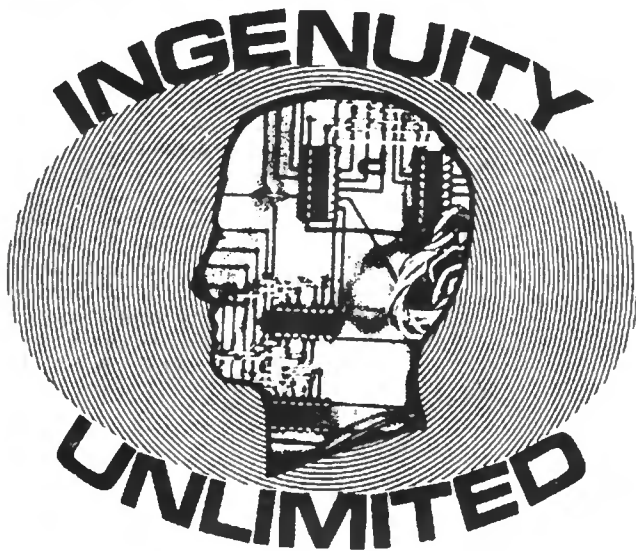
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Send your circuit ideas to: Alan Winstanley, *Ingenuity Unlimited*, Wimborne Publishing Ltd., Allen House, East Borough, Wimborne, Dorset, BH21 1PF. They could earn you some real cash!

Audio Cable Tester

— sorts out loose wires

The circuit diagram shown in Fig. 1 can be used to test most audio and hi-fi cables for open and short circuits, in one simple operation. The design is based around three l.e.d.s D3 to D5 in series, which are connected in parallel with the cable under test via the two "test" sockets SK1 and SK2. These connectors could be phono or jack sockets for instance.

Under normal conditions, D3 and D5 are shunted by the core and screening shield respectively, while D4 passes current between the two and is therefore normally illuminated. However, if either the core or the screening shield are open circuit, or there is a short between the two conductors, the pattern of l.e.d.s will change, which will indicate the problem instantly.

The remainder of the circuit, based around transistor TR1, forms a simple 10mA current sink. This is required to maintain a constant current through the

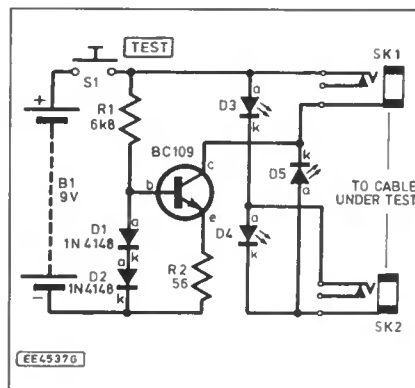


Fig. 1. Audio Cable Tester circuit diagram.

light-emitting diodes no matter how many l.e.d.s, if any, are actually in circuit.

To test a cable, connect the suspect lead into both sockets and press switch S1. The status of the l.e.d. display indicates the condition of the cable according to Table 1.

Table 1:
L.E.D./Cable Status Condition

D3	on	core is open circuit
	off	core is OK (*)
D4	on	core-shield is OK (*)
	off	core shorted to shield
D5	on	shield is open circuit
	off	shield is OK (*)
(*) indicates cable PASS condition		

As well as audio cables, this circuit can test twin-conductor cables, including BNC and aerial leads. The type of cable simply depends on your choice for SK1 and SK2, or test leads could be used instead.

Neil Johnson,
Camberley, Surrey

Simple D.C. Servomotor Controller — for models, robotics etc.

My second circuit diagram, see Fig. 2, will drive small d.c. servo mechanisms such as those used in radio control models. It consists of IC1, a 741 or similar op.amp configured as a comparator and driven from a split $\pm 12V$ supply. IC1 monitors the voltage set at its non-inverting input (pin 3) by the Position control VR1, and the voltage at the inverting input (pin 2) is determined by the servo position potentiometer VR2 which is coupled mechanically to the servo motor shaft in the normal fashion. The output drives a complementary pair of driver transistors TR1/TR2 via the preset VR3 which should be trimmed to the minimum required for driving the transistors satisfactorily.

Resistor R5 provides a degree of current feedback: if the motor is under a heavy load it passes more current which consequently increases the voltage drop across R5. This reduces the voltage across the motor. Negative feedback passes via R4 to the inverting input which therefore causes the drive signal to be increased.

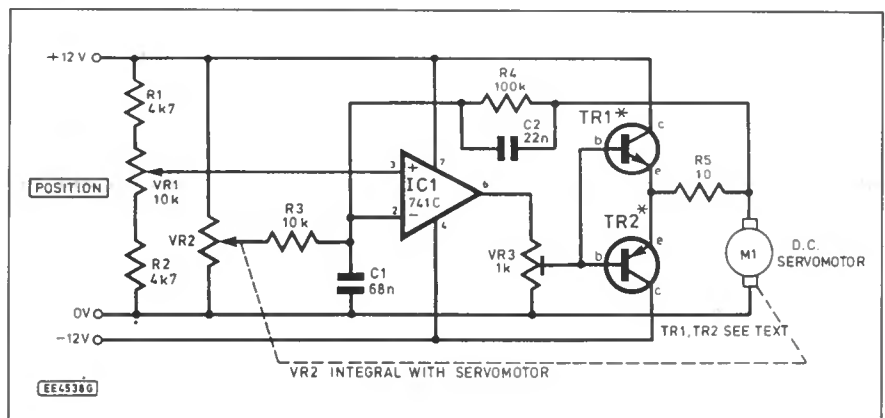


Fig. 2. Circuit diagram for a Simple D.C. Servomotor Controller.

Since this circuit evolved from my junk box, the use of preset potentiometer VR3 enables the circuit to be fine-tuned to almost any npn/pnp pair, e.g. BFX51/

BFX40. The rest of the circuit component values are not too critical.

Neil Johnson,
Camberley, Surrey

900Hz Audio Line-Up Oscillator

— sine wave signal source

The circuit of Fig. 3 was originally designed to be incorporated into a Four-channel Stereo Mixer to provide a source of constant amplitude tone, to help set the recording level on tape recorders. It could equally be adapted as a signal injector to check that an audio project works properly.

It was designed to be powered from an existing $\pm 15V$ d.c. split supply and comprises a square wave oscillator followed by a low pass filter. The total assembly cost is approximately £5.

Since a square wave consists of the fundamental frequency plus all odd-numbered harmonics of that frequency decreasing in value by the reciprocal of the harmonic number, if the low pass filter has a sufficiently large attenuation at the third harmonic, then a fairly good sine wave will result.

A dual low-noise op.amp (type TL072), IC1 and associated components form a 900Hz square wave oscillator. For convenience, the ratio of resistor R2 and R3 was chosen for the $\pm 15V$ supply to make the output frequency approximately equal to:

$$f = \frac{1}{CI(R1 + VR1)} \text{ Hz.}$$

The rest of the circuit is a 3-pole 3dB passband ripple Chebyshev low pass filter, chosen for its steep roll off. Values were calculated so that the largest capacitor would be under $1\mu F$. The off-the-shelf values shown deviated from the theoretical values by just $\pm 1.2\%$

The combination of resistors R4, R5 and R6 effectively form the filter input resistor. R4 and R5 attenuate IC1a square wave output to approximately 2V. If the output impedance of IC1a is zero, then R4 and R5

are paralleled to produce 3k1. This is increased to 11k by adding R6, actually 6k8 and 1k1 resistors in series. With the three "series" resistors equal to 11k, the cut off frequency is 928Hz.

The output of IC1b is fed through resistor R9 and trimmed by control VR2, R9 preventing instability with capacitive loads (e.g. cable capacitance) when VR2 is at its maximum setting. The output is about 1.4V r.m.s., and it was assumed that a d.c. blocking capacitor would be present in the equipment under test.

Since the actual cut-off frequency of the filter depends on the actual capacitance values, I recommend setting the oscillator frequency to match that of the filter as

follows: set preset VR1 to minimum resistance and connect a suitable meter to the output. Slowly increase VR1 to reduce the frequency, and observe the output increasing to a maximum. Then decrease VR1 so that the output falls slightly (say 1dB). VR1 could then be replaced by a fixed value of the setting so found.

Stability and frequency depend solely on the voltage regulators in the power supply. After eight hours use there was no discernible change, distortion was about 0.5% which is more than adequate for this application. Since IC1a generates a 28V p-p square wave, careful power rail decoupling is needed, as shown. Mount capacitors C5, C6 and C7 near to IC1a pins 4 and 8.

B.J. Taylor,
Rickmansworth, Herts.

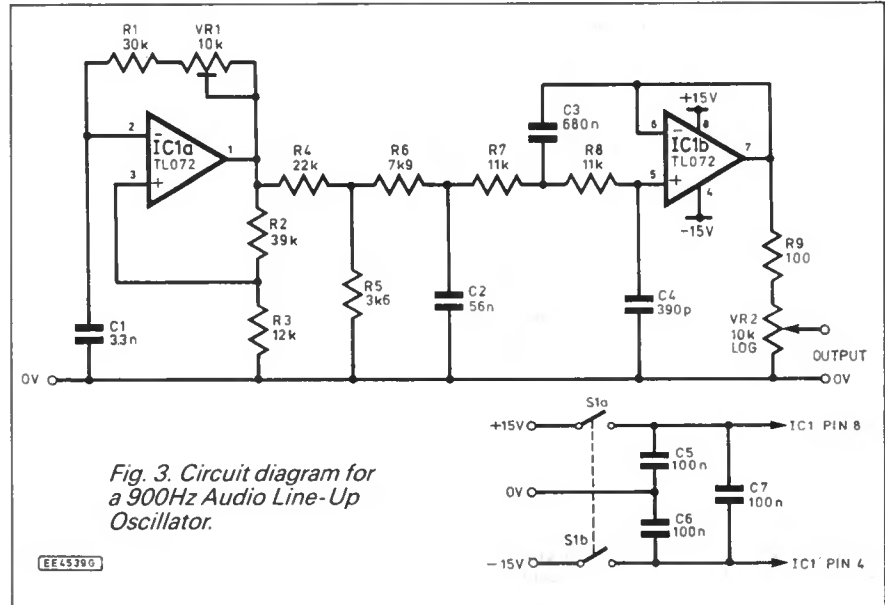


Fig. 3. Circuit diagram for a 900Hz Audio Line-Up Oscillator.

SHOP TALK

with David Barrington

EPE Fruit Machine

Due to postal delays, we only received news of a change of address for some of the "special" items needed to complete the *EPE Fruit Machine* project after our "printing date".

The ready programmed PIC16C57 controller chip is available from the authors, price £12. They also have a consignment of the 0.8in 7-segment, common cathode, displays and are offering a set of three for the sum of £5; this seems a very fair price. The coloured, self-adhesive front panel overlay is also available from the same source for the sum of £2.

All orders (*Strictly Mail Order Only*) should be sent to the following address: Mr. B. Gossage, 119A Victoria Road, Ruislip, Middlesex HA4 9BN. All monies should be made payable to B. Gossage. Please add 50p for UK p&p and £2.50 for Overseas postage and packing.

Finally, please note that the servo motor is the Futaba FB.S148 type. The printed circuit board is available from the *EPE PCB Service*, code 914.

Magnetic Field Detector

Ideally, the case used to house the *Magnetic Field Detector* should be an all

plastic one and certainly *must not* be a steel type. However, the one chosen does have aluminium front and back panels. This was picked for its compactness and rigidity. (The "ali" does not have an effect on the "field").

The case is from the Vero series 200 and was obtained from **Maplin**, code LL08J. This is fairly expensive and no doubt most of our component advertisers will be able to offer an alternative.

For those readers who do not wish to search for a suitable "field sensor" transformer, the one used in the model is a sub-miniature mains transformer with a 6V-0V-6V secondary 100mA output. This was also purchased from the above named source, code WB00A. The same applies to the p.c.b. mounting piezo sounder, code JH24B.

Make sure you order the "log" bargraph display driver i.c. The 10-segment l.e.d. array is now widely stocked by our component advertisers. The printed circuit board is available from our *EPE PCB Service*, code 923.

Model Railway Track Cleaner

Only one item is likely to cause concern when ordering up parts for the *Model Railway Track Cleaner* and that is the step-up transformer. It is a ready made type based on

a ferrite pot-core intended for use in ionisers. It was purchased from **Maplin**, code JL94C (Ion. Tran).

A suitable mains transformer would be the same one as listed for the *Magnetic Field Detector* mentioned above. The printed circuit is available from the *EPE PCB Service*, code 923 (see page 79).

Moving Display Metronome

We have been unable to locate a source for the VN0610L *n*-channel f.e.t. used in the *Moving Display Metronome*. We cannot see any reason why the 2N5459 f.e.t. should not be used instead (not tried on model). However, the pinout is different i.e. reading top to bottom in Fig. 2 inset, it should be *gate*, *source* and *drain*. The low profile buzzer is the one listed by **Maplin** as code KU58N.

The printed circuit board is available from the *EPE PCB Service*, code 925.

Beating The Christmas Lights

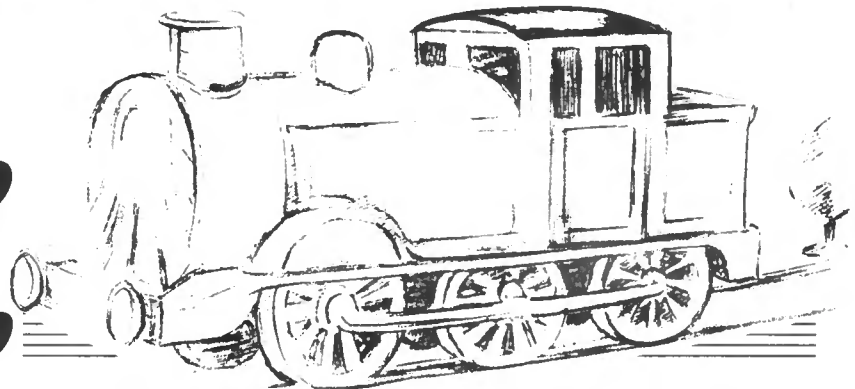
You may have some difficulty in finding a three watt wirewound resistor that matches the value shown in the table for the *Beating The Christmas Lights* project. You can, of course, use one with a higher rating providing it is of the correct value.

Video Modules

We do not expect any component buying problems to arise when shopping for parts for the *Dynamic Noise Limiter* or *System Mains Power Supply*, the last of the *Video Modules*. The printed circuit boards are available from the *EPE PCB Service*, codes 919 (DNL) and 920 (System PSU).

MODEL RAILWAY TRACK CLEANER

ROBERT PENFOLD



Don't delay, keep your model trains running on time.

MOST model trains operate well at high and medium speeds, but are often less convincing when run at slow speeds. The train controller is often the main culprit, and very basic types do not provide good speed regulation. This tends to give erratic speeds, particularly when the train is running very slowly. Worse than this, before too long the train usually comes to a sudden halt.

There can be several causes of this problem, but the most common one is simply grease or other dirt on a small length of track. This gives a poor electrical contact and a momentary loss of power to the locomotive.

If only a very short length of track is affected, the momentum of the train, even at slow speeds, will take it over the dirty piece of track. The train will continue on its journey, but will give a noticeable and unrealistic shudder.

Due to its lack of momentum a slow moving train is likely to come to an abrupt stop if more than a few millimetres of track are affected. High quality controllers are less prone to this problem than very basic types, but if a significant length of track is affected, contact will always be lost with the train, and it will come to a halt.

DIRT ZAPPING

The best solution to the dirt problem is to simply keep the track scrupulously clean, but this can be quite time consuming. Also, it can be difficult to get every millimetre of track really clean, particularly

when some of the track is far from new. An alternative approach is to keep the track as clean as reasonably possible, and to use an electronic track cleaner to "zap" any remaining small amounts of dirt on the tracks.

This "zapping" is done by applying a high voltage across the tracks when the train loses electrical contact with the tracks. Although a thin layer of dirt may act as an effective insulator at the low voltage used to power the train, it will not do so at a higher potential of around 200V. The high voltage therefore breaks down the film of insulation, and restores power to the train. Where the train would otherwise have come to a standstill, it instead carries on with no more than a momentary hesitation.

Although using a high voltage across the tracks might seem to be dangerous, this voltage is at a high impedance. The available current is therefore very low, and the equipment is unlikely to give even a moderate electric shock. The maximum output current is a matter of microamps rather than milliamps.

HOW IT WORKS

The block diagram of Fig. 1 shows the simple arrangement used in this Model Railway Track Cleaner. The circuit is powered from a simple non-stabilised mains power supply unit, or a 9V battery supply can be used if preferred.

The low voltage d.c. supply is stepped up to a high voltage a.c. type by an oscillator

operating at a high audio frequency, and a step-up transformer. The latter is a ready-made type based on a ferrite pot-core. It provides an unloaded output of around 200V r.m.s.

On the face of it some sensor circuitry is needed in order to determine whether or not the train is in contact with the track, and to switch on the oscillator if it is not. In practice this is not necessary due to the high source impedance of the high voltage signal.

Take Care

Extreme care must be exercised when constructing this project as it involves making mains connections, any reader who is unsure of being able to make a safe connection must seek the advice of a qualified person. Also, the circuit MUST be built in an Earthed metal case.

Although the output from the Model Railway Track Cleaner is far from lethal, it does provide a high voltage, and might give a noticeable electric shock to anyone coming into contact with it. It is best to avoid contact with any high voltage sources, even high impedance ones.

If the high voltage supply is permanently connected to the track it will normally have no significant effect. The electric motor in the train will provide a very low impedance across the tracks which virtually short circuits the output from the transformer. The voltage across the tracks is only a fraction of a volt, and the current flow through the motor in the train is under one milliamp.

If the train loses electrical contact with the track there is an extremely high impedance across the tracks, and the output from the transformer almost immediately jumps to its normal level of around 200V. It then breaks down the film of insulation, contact is restored with the motor in the train, and normal operation is restored.

In practice things are not quite as simple as this. There will not necessarily be a high impedance across the tracks when the train is not connected across them. This is simply due to the fact that the output from the train controller will still be connected to the tracks, and will probably place a low impedance across them.

The presence of the controller will almost certainly quench the output from the transformer. If it does not there is the risk of the high voltage from the transformer finding its way into the controller circuit, where it could obviously cause a lot of damage.

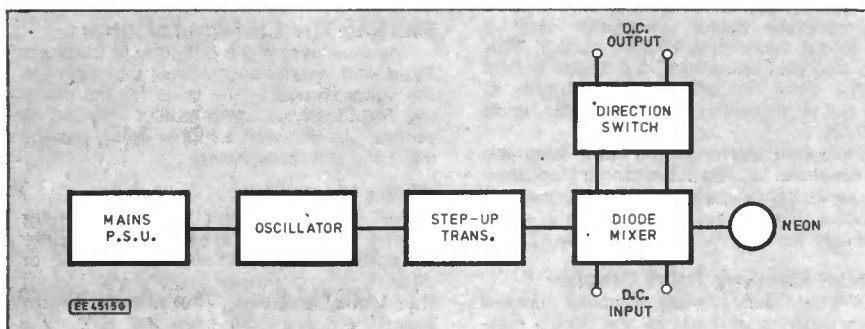
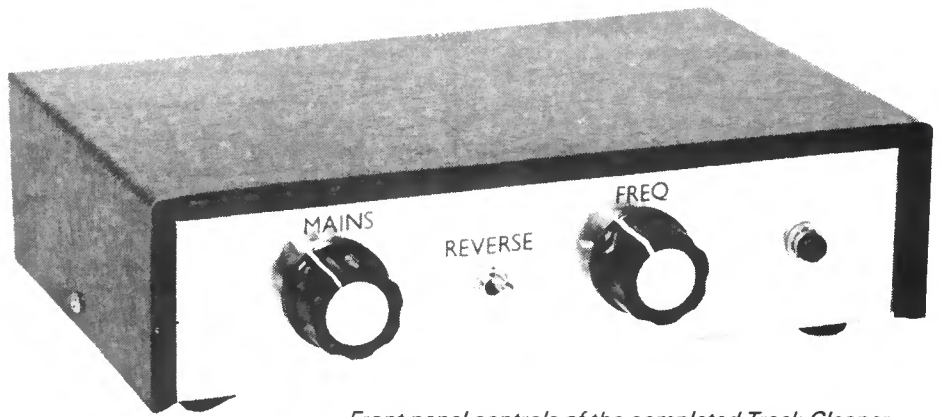


Fig. 1. Block diagram for the Model Railway Track Cleaner.

DIODE MIXER

In order to overcome this problem it is merely necessary to use a simple diode mixer to combine the outputs of the train controller and the track cleaner. Basically all the mixer does is to connect the higher voltage source through to the output, while preventing one source from forcing a current into the other.

With the model train in contact with the track the controller provides the higher voltage and powers the track. With the train out of contact with the track the transformer provides the higher voltage, and breaks down the film of insulation. Thus the circuit automatically switches between the two voltage sources in the required manner.



Front panel controls of the completed Track Cleaner.

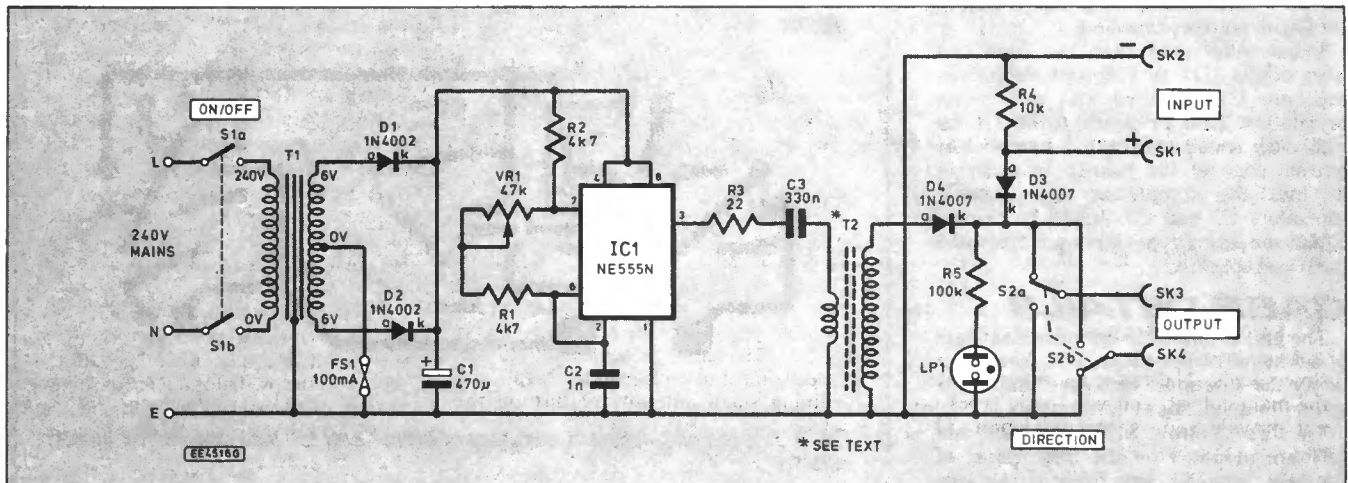


Fig. 2. Full circuit diagram for the Model Railway Track Cleaner. The neon indicator LP1 flashes when a high voltage is present on the track.

A neon indicator is connected at the output of the diode mixer, and this flashes when the high voltage signal is connected to the track. This provides confirmation that the unit is being brought into operation, and it also helps to identify any stretches of track that are contaminated with grease or dirt.

For the diode mixer circuit to work properly it is essential that the polarity of the input voltage from the train controller is correct. The direction of the train is altered by changing the polarity of the voltage across the tracks. The track cleaner is therefore fed with a voltage of the correct polarity from the controller, and the direction of the train is governed by a polarity switch at the output of the track cleaner circuit, not by the controller's direction switch.

CIRCUIT OPERATION

The full circuit diagram for the Model Railway Electronic Track cleaner appears in Fig. 2. The mains power supply is a conventional full-wave type having push-pull rectification provided by diodes D1 and D2.

As the current consumption of the main circuit is only a few milliamps, the loaded supply voltage provided by a 6V 100mA mains transformer is approximately 9V. It is possible to power the circuit from a fairly high capacity 9V battery (e.g. six HP7 cells in series). S1, T1, D1, D2, and FS1 are then omitted, and the battery is connected across capacitor C1 via a s.p.s.t. on/off switch.

The oscillator stage utilizes a 555 timer IC1 in the standard astable mode.

Potentiometer VR1 is used to adjust the operating frequency of IC1 to obtain optimum efficiency of the step-up transformer T2. It is not advisable to use a low power 555 for IC1 as many of these have relatively low maximum output currents, and they might not work well in this circuit.

Oscillator IC1 drives the primary of step-up transformer T2 via capacitor C3 and current limiting resistor R3. The drive level has to be something of a compromise. If too little drive is used the unit will be ineffective, but with too much drive there is a risk of the unit delivering a significant electric shock. A value of 22 ohms for resistor R3 was found to give a high enough output voltage to counteract dirt on the track, but gives an output signal of high enough source impedance to keep the unit safe.

In normal operation the input signal from the controller is fed to the output sockets (SK3 and SK4) via diode D3 and direction switch S2. Diode D4 prevents the controller from forcing a high current through the secondary winding of T2.

If the train loses electrical contact with the track, the high voltage output from T2 is half-wave rectified by D4 and fed to the track via S2. Diode D3 and resistor R4 then prevent the controller from quenching T2 output, and also prevent the high output voltage from being fed to the controller.

LP1 is the neon indicator, and this should be a type having an internal series resistor for 240V mains use. Resistor R5 provides further current limiting which prevents LP1 from drawing too much of the available output current from T2.

COMPONENTS

Resistors

R1, R2 4k7 (2 off)
R3 22
R4 10k
R5 100k

All 0.25W 5% carbon film

Potentiometer

VR1 47k rotary carbon, lin.

Capacitors

C1 470µ radial elect. 10V
C2 1n polyester
C3 330n polyester

Semiconductors

D1, D2 1N4002 100V 1A rect. diode (2 off)
D3, D4 1N4007 1000V 1A rect. diode (2 off)
IC1 NE555N timer i.c.

Miscellaneous

LP1 mains panel neon having internal series resistor
FS1 100mA 20mm anti-surge fuse
S1 rotary mains switch
S2 d.p.d.t. toggle switch
T1 mains primary, 6V-0V-6V 100mA secondary
T2 "loniser" transformer
SK1 to SK4 4mm socket (4 off)
Printed circuit board available from EPE PCB Service, code 924; metal instrument case about 203mm x 127mm x 52mm; mains lead and fused (2A) plug; 8-pin d.i.l. socket; pair of 20mm fuse-clips; wire; solder; etc.

Approx cost guidance only

£30

CONSTRUCTION

The printed circuit board (p.c.b.) component layout and the actual size copper track pattern appears in Fig. 3. This board is available from the *EPE PCB Service*, code 924.

Construction of the p.c.b. is largely straightforward. Fuse FS1 is mounted on the board via a pair of 20mm fuse-clips. FS1 should be an anti-surge fuse, and not a quick-blow type (which might "blow" at switch-on as capacitor C1 charges up).

Step-up transformer T2 has a polarising pin, so it is not possible to fit it to the board the wrong way round. This component is fairly expensive, and it is made from a very hard but brittle material. It should therefore be treated with due respect. Dropping it onto a hard surface could easily result in the ferrite pot-core smashing.

Make quite sure that the four rectifier diodes (D1 to D4) and electrolytic capacitor C1 are fitted with the correct orientation. Also be careful to fit IC1 the right way round (with pin 1 towards the bottom edge of the board). In order to fit into the component layout easily capacitors C2 and C3 should be printed circuit mounting types having 7.5mm (0.3 inch) lead spacing.

CASE DETAILS

The unit is housed in an instrument case of *all metal* construction. For reasons of safety the case must be a type that has a screw fitting lid, not a clip-on type.

The three controls (S1, S2 and VR1) and LPI are mounted on the front panel of the case, with S1 well towards the left-hand end of the panel. Sockets SK1 to SK4 are fitted on the rear panel of the case. Four millimetre sockets are used on the prototype, but it is acceptable to use another type if it fits in better with your controller, etc.

A hole for the mains lead is made in the rear panel of the case, roughly opposite on/off switch S1. This hole should be fitted with a grommet to protect the cable.

Transformer T1 and the printed circuit board are mounted on the base panel of the case, with T1 towards the left-hand end of the unit. A chassis connection point is required, and this can be provided by a solder tag mounted on one of T1's mounting bolts.

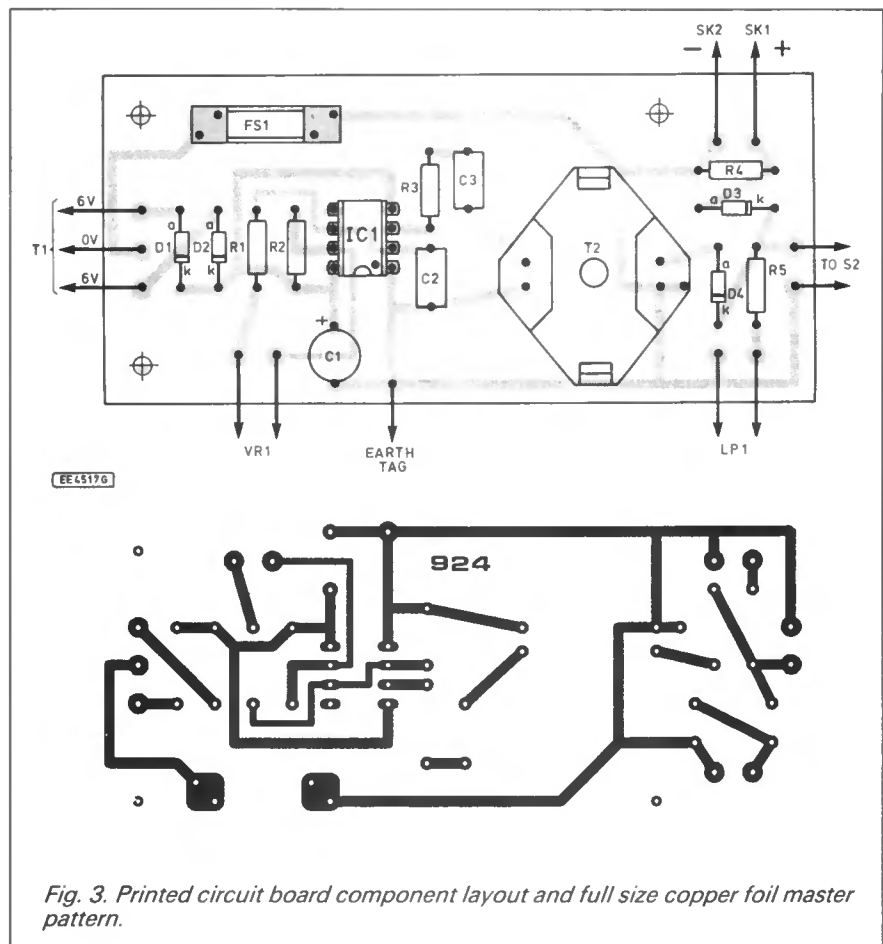


Fig. 3. Printed circuit board component layout and full size copper foil master pattern.

The p.c.b. must be securely fixed in place, and in this case it is recommended that M3 or 6BA screws rather than plastic stand-offs be used. Spacers about 6mm to 10mm long are used over the fixing screws so that the underside of the board is kept well clear of the metal case.

Once everything is installed in the case the hard wiring is added as shown in Fig. 4.

This is very straightforward, *but as the dangerous mains supply is involved it is important to proceed*

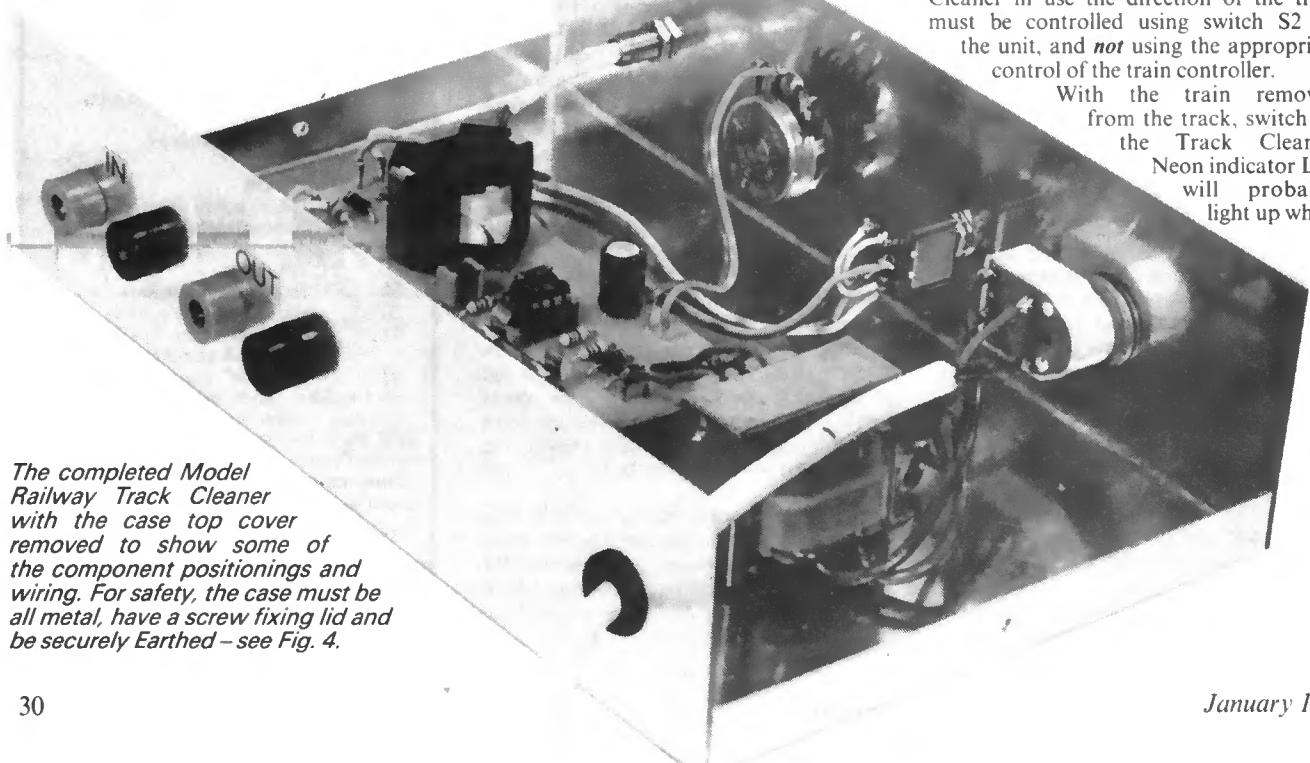
more carefully than normal. The mains lead must be a three-core type, with the Earth lead reliably connected to the chassis connection point. The mains plug should be fitted with a 2A fuse. Double check all the wiring, particularly that to S1 and T1, before testing the unit.

TESTING AND USE

Commence testing by first checking that the unit is passing the input supply through to the output. It will only do so if the input supply has the correct polarity, but the right polarity can be found by trial and error if necessary (*with the Track Cleaner turned off*). Remember that with the Track Cleaner in use the direction of the train must be controlled using switch S2 on the unit, and *not* using the appropriate control of the train controller.

With the train removed from the track, switch on the Track Cleaner.

Neon indicator LPI will probably light up when



The completed Model Railway Track Cleaner with the case top cover removed to show some of the component positionings and wiring. For safety, the case must be all metal, have a screw fixing lid and be securely Earthed - see Fig. 4.

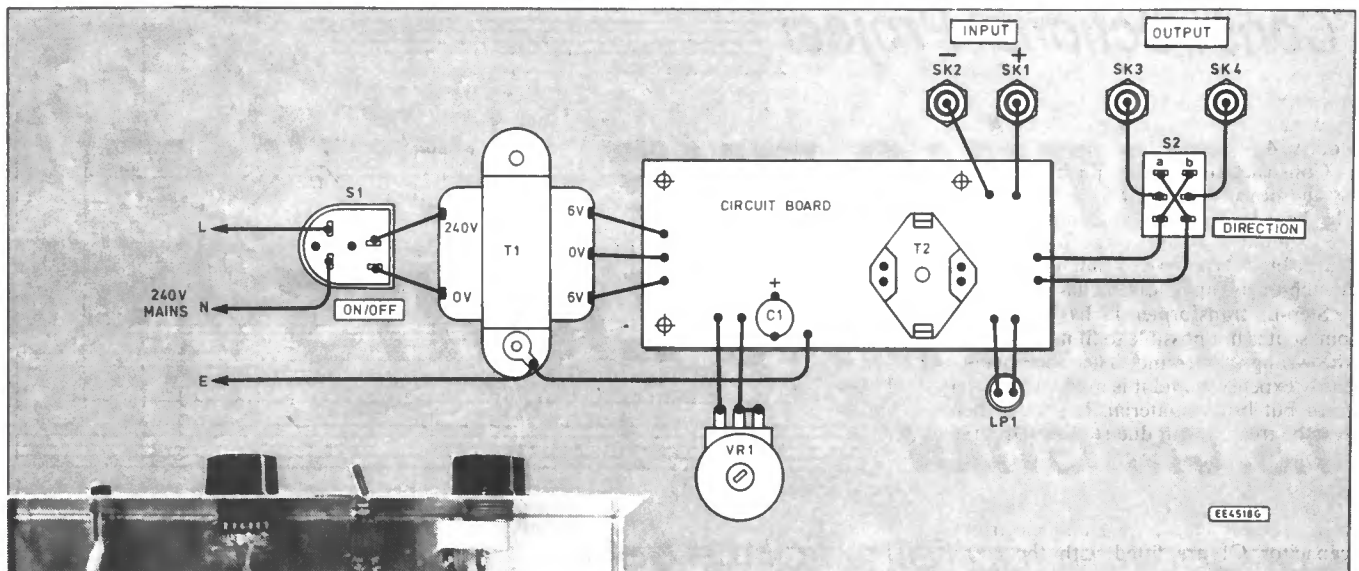
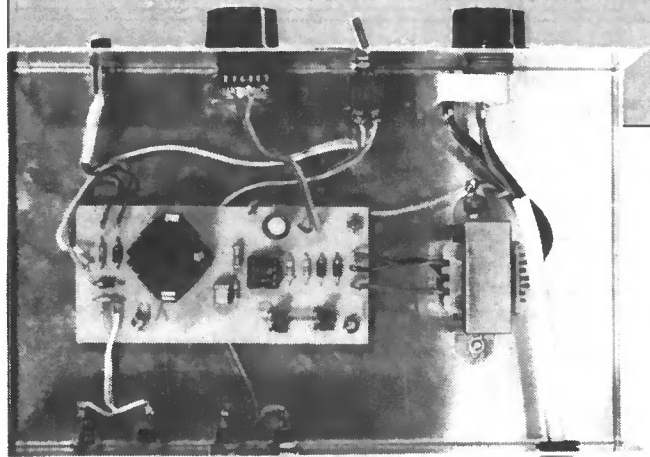


Fig. 4. Interwiring between the various components and p.c.b.

the unit is switched on, although it will probably not light up very brightly. By adjusting VR1 it should be possible to find a setting that gives reasonably brightness from LPI with no flickering.

Once VR1 has been given the optimum setting it will probably not need any readjustment unless alterations are made to the track layout. Putting the engine in place on the track should result in LPI switching off. If power is then applied to the train it will probably be found that LPI flashes each time the train passes problem pieces of track, but this obviously depends on the cleanliness of the track.

Although the output from the *Model Railway Track Cleaner* is far from lethal, it does provide a high voltage, and might give a noticeable electric shock to anyone coming into contact with it. It is best to avoid contact with any high voltage sources, even high impedance ones. □



Layout and wiring inside the metal case. The mains lead and transformer primary connections to the on/off switch should be covered with insulating sleeving.

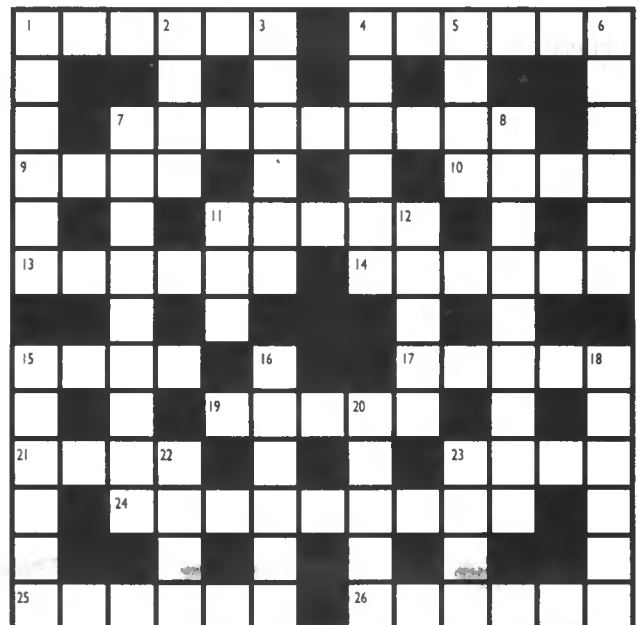
ELECTRONICS CROSSWORD

ACROSS:

1. Sailors measure conductance, we hear. (6)
4. Connections, end to end. (6)
7. This takes charge. (9)
9. None confused over this indicator.
10. A prefix for 10^{12} . (4)
11. In a state of flux? (5)
13. A line of repetitive networks. (6)
14. You've got me there! (6)
15. Locked up with a 5-electrode valve – without the poetry. (4)
17. Study transport. (5)
19. A good one is often needed between electronic systems. (5)
21. No current flows in this circuit. (4)
23. A man from 12 down? (4)
24. Everything's in tune here. (9)
25. A forceful scientist? (6)
26. An adjustment in 7 across that produces 24 across. (6)

DOWN:

1. Carries the information. (6)
2. Second part of 6 down. (4)
3. Try always to make your projects this. (6)
4. Can be used in place of 11 across for some jobs. (6)
5. First part of 6 down. (4)
6. A measure of alternating quantities. (4, 4, 6)
7. Earlier name for 7 across.
8. X marks the opposition. (9)
11. Two in the colour code. (3)



12. Pole discovered in neither this nor that. (5)
15. It's a part of the nucleus. (6)
16. The French fool in a salt water lake. (6)
18. Fixing hardware with 10^6 ohms looks spicy. (6)
20. Graphic plan, for example. (5)
22. Derogatory name for a haphazard circuit. (4)
23. Observe the trace. (4)

(Solution on page 35)



BEATING THE CHRISTMAS LIGHTS

T.S. CHRISTIAN

Longer lasting fairy lights can keep the festive spirit aglow beyond twelfth night.

WHY IS IT that just because we have a technical hobby, we are expected to be able to fix everything around the house – instantly? You only have to be able to tune a radio to more than one station to be hailed as the saviour of every piece of electrical gear in the house!

In our house, the worst time is Christmas. Not just all those presents that require plugs, or the new toys that demand inexhaustible supplies of batteries (when they work, that is). No, the problems peak before the gifts are unwrapped: doomsday is when they get the fairy lights out.

LOOK FIRST

Admittedly, we have more than a fair share of the darned things. They dominate the Christmas decorations. Some are inherited, some donated and some even purchased. Every year, the first of the festive duties comprise untangling, servicing and maintaining them and, as with any series-connected arrangement, fault-tracing can be a nightmare.

True, an initial inspection will generally reveal those screw fittings that are loose and those push-fittings that have parted company. However, finding the open-circuit lamp in a forty-lamp string,

carefully entangled in a structure assembled from sections of green lavatory brush precariously hung with fragile glass ornaments, is a tedious process, not at all helped by the exhortations of the assembled family to "mind the decorations".

USEFUL LIFE

The life expectancy of the type of miniature tungsten filament lamps that comprise these abominations is about 50 hours at full power: about two days if they are left on overnight. Moreover, as Fig. 1 shows, their life is strongly dependent on the current passed: a five per cent change either way can affect life expectancy by a factor of three.

Thus, the type of lamp that obligingly fails short-circuit so you can find it, simply increases the voltage on, and thus current through, the rest of the string of lights, with a consequent decrease in their life expectancy.

THE FIX

Some reduction in the stresses and labours of Christmas was achieved initially by operating fairy lights from lamp dimmers. Since these can be more expen-

sive than the light sets themselves, and someone will always turn them up full when you are not looking, an alternative approach was sought.

This resulted in what is now the standard modification to all "authorized" fairy-light strings and their relatives: the ballast resistor box. Every lamp string includes a small plastic box enclosing a wire-wound resistor of ample rating connected in series with the lamps, as shown in Fig. 2.

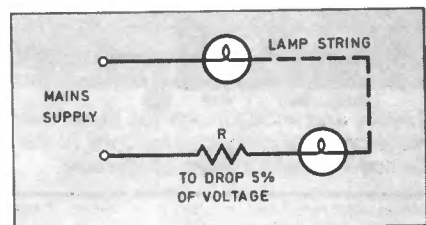


Fig. 2. A resistor in series with a string of lights not only reduces current but also switch-on surge. As Fig. 1 shows, there is hardly any reduction in brightness for the 5% reduction in current suggested.

Table 1: Ballast resistor values for fairy lights.

No. of lamps	Usual current	Ballast ohms	Resistor watts
5	0.06A	180	3
7	0.1A	120	3
12	0.15A	82	3
20	0.05A	220	3
40	0.05A	220	3

Note: 5-lamp and 7-lamp data are for continental-style bridges.

Resistor values depend on the rating and number of lamps in the string, but are chosen to drop about 5% of the operating voltage (12V or so for UK mains). Values for commonly available lighting strings are given in Table 1.

BOXING DAY

Choose the plastic box with care, and make all connections carefully and safely. Standard project boxes are probably quite suitable. Use a 5A terminal strip bolted to the base of the box for internal connections and for supporting the resistor(s) clear of the plastic, as in Fig. 3. Since dissipation is low, the temperature rise is small.

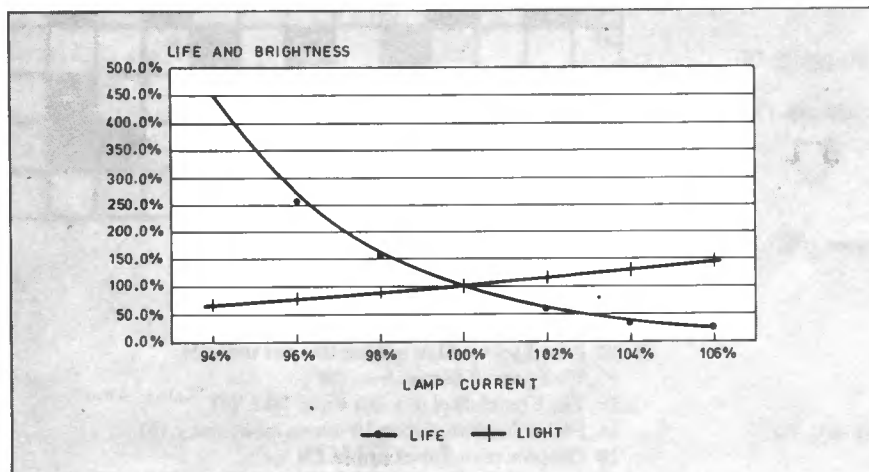


Fig. 1. Curve of life expectancy against current for series-connected miniature tungsten filament lamps. (Source: Handbook of the American Illumination Engineering Society.)

For decorative bridges, or where several chains of lights are used, the resistor and connections can usually be fitted inside one box. A suggested substitute for a plastic box is a modern electrician's ceiling rose screwed to a piece of 10mm plywood. There are usually sufficient screw connectors inside for all connections required, and to mount the resistors securely. Moreover, both insulation and fire resistance correspond to National Standards.

It is good practice to run 3-core cable to the box, so that an Earth is present. Fit cable clamps or clips so that wires won't pull out. Check the safety of the light string while you are at it, examining it for breaks, chippings and chafings, and the like.

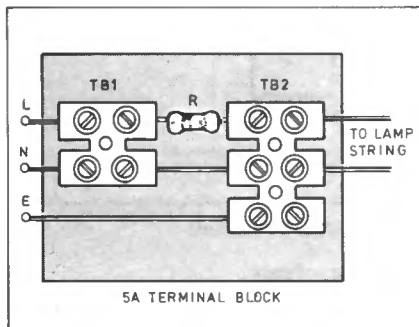
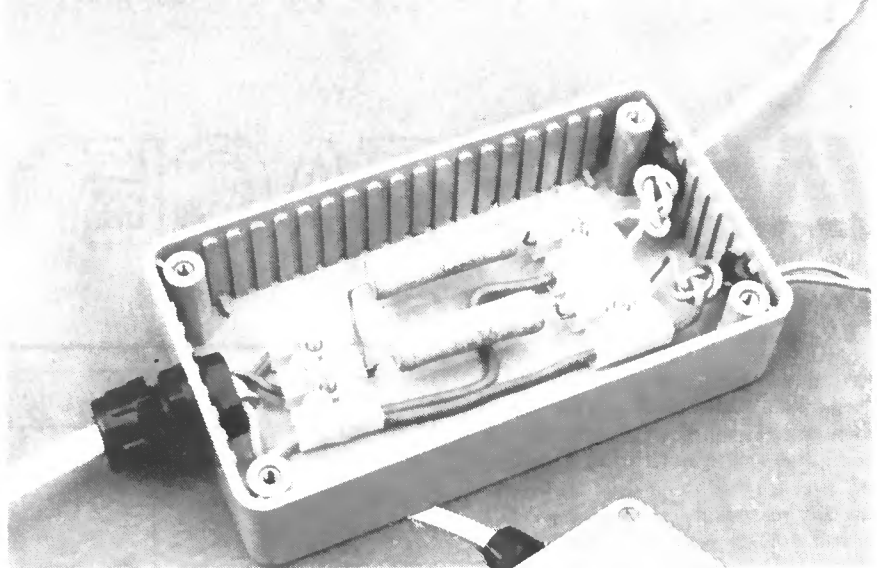


Fig. 3. Series resistor and connections can be made inside a plastic project box using terminal blocks, as shown, or in a standard ceiling rose. Make sure that connections are tight and cables securely clamped.



A completed "two string" lights protector. The resistors must be proud of the case-floor. Never remove the lid if the unit is still plugged into the MAINS and use a proper cable clamp for the mains lead..

CHRISTMAS SPIRIT

These simple additions have transformed my experience and perception of Christmas for the last three years. Failure rate has fallen dramatically: more than predicted by Fig. 1, since the initial switch-on surge is also limited by the resistor.

A twelve-lamp string that could once be relied upon to fail at least three times in the Twelve Days has not failed in three years. Thus not only is the cost of the ballast unit more than defrayed by the savings



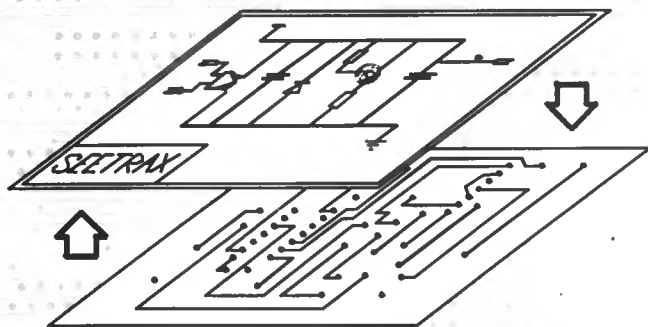
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in replacement lamps, but the spirit of Christmas reigns again. (Apart, that is, from the plugs, the batteries, the broken toys the...).

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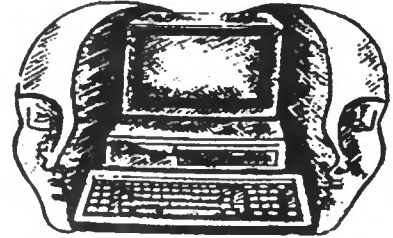
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INTERFACE

Robert Penfold



THIS month we conclude our look at serial data transmission via fibre-optic links with an f.s.k. (frequency shift keying) system that will operate at up to 19200 baud over a range of at least 20 metres using any reasonably good quality cable. We will not consider the basic way in which an f.s.k. system operates, since this was covered in the *Interface* article that appeared in the November issue of *EPE*. The system featured here is a conventional type using two tones to represent the two logic levels of the serial signal.

The use of an f.s.k. system inevitably results in circuits that are substantially more complex than those used in the direct coupled link described previously. However, there is a major advantage in an f.s.k. system in that it will work quite happily if only a relatively weak light signal is present at the receiver.

Apart from giving a greater maximum operating range, this also gives better reliability over shorter ranges. With the direct coupled system everything has to be just right if it is to function properly. If (say) the cable of an f.s.k. system is not fully pushed "home" into one of the photocells, it will probably go on working flawlessly!

Two Timing

The circuit for the transmitter appears in Fig. 1. It is based on a 4046BE CMOS micro-power phase-locked-loop (p.l.l.). In this case it is only the voltage controlled oscillator (v.c.o.) that is utilized, and no connections are made to any of the other sections of IC1.

The output from IC1 is a good quality squarewave signal at normal CMOS logic levels. This signal drives l.e.d. D2 via an emitter follower stage based on transistor TR2. Resistor R7 is the current limiter for the l.e.d., and it sets the "on" current at approximately 40mA. This gives an average l.e.d. current of about 20mA.

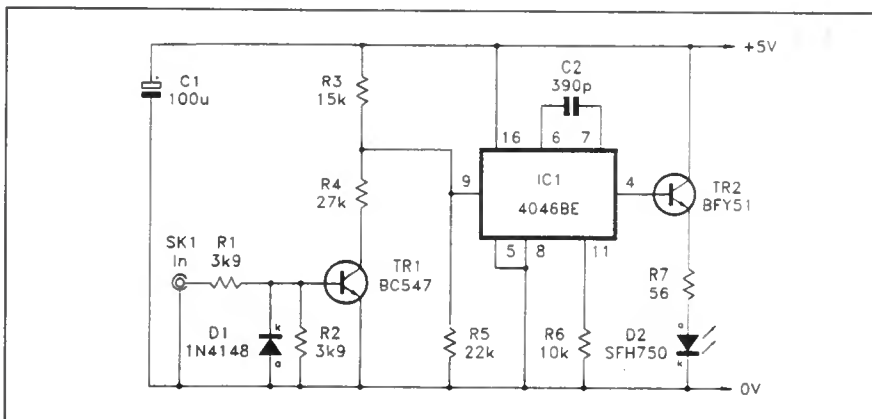


Fig. 1. The frequency shift key (f.s.k.) fibre-optic transmitter circuit.

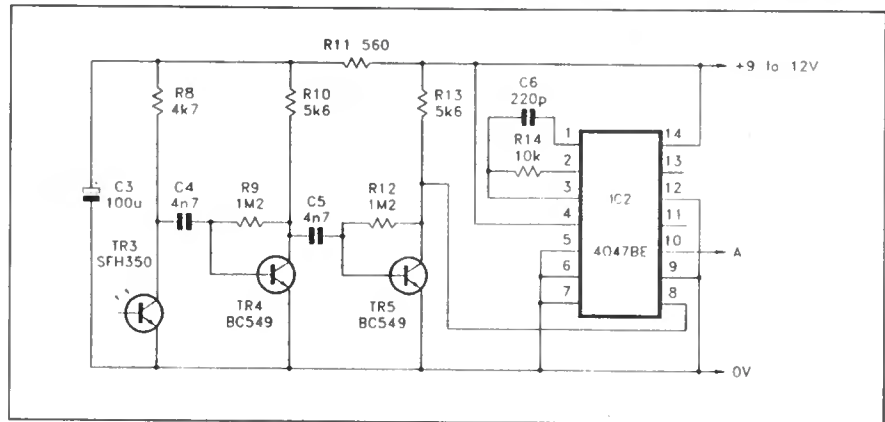


Fig. 2. Amplifier and monostable stages of the receiver.

Capacitor C2 and resistor R6 are the timing components for the v.c.o. Resistors R3 and R5 provide a control voltage to IC1 that is normally about 3V. This gives an output frequency of typically just over 70kHz.

A high input level results in transistor TR1 switching on, and resistor R4 being shunted across resistor R5. This reduces the control voltage to only about 2V, and reduces the output frequency to a little over 40kHz. As the input signal switches to and fro between the low and high logic levels, the output frequency of the transmitter switches back and forth between these two frequencies.

It is important that this circuit is powered from a reasonably accurate 5V supply. A different supply voltage would result in the l.e.d. current being altered. More importantly, even a small change in the supply potential would substantially alter the two carrier frequencies. This change to the carrier frequencies would almost certainly prevent the system from functioning. A different supply voltage should only be used if the values of the relevant resistors are changed to suit this supply potential. The current consumption of the transmitter circuit is typically a little over 20mA.

Pulse Counting

The circuit for the amplifier and monostable stages of the receiver is shown in Fig. 2. The photocell is a phototransistor (TR3), and its collector to emitter leakage is used to provide a light dependent resistance. The pulses of red light from the transmitter produce an increase in the leakage through TR3, which results in small negative pulses being generated at TR3's collector. No connection is made to the base terminal of TR3, but this terminal can be wired to the 0V supply rail if there are any problems with stray pick up here.

The amplifier is a two stage common emitter type having capacitive coupling. It provides about 80dB or so of gain at 40kHz to 70kHz, which is sufficient to drive TR5 into clipping even if only a relatively weak input signal is present. The monostable is a CMOS 4047BE used in the positive edge triggered mode. Capacitor C6 and resistor R14 are the timing components, and the specified values give an output pulse duration of approximately six microseconds. This gives an average output voltage of a little under half the supply voltage with the carrier frequency at 70kHz, reducing to only about one quarter of the supply voltage with the carrier at 40kHz.

In order to extract the average output voltage from IC2 it is merely necessary to use some lowpass filtering. With a 19200 baud input signal the maximum input frequency is 9.6kHz (i.e. alternate "marks" and "spaces" give a 9.6kHz squarewave). This is obviously not that far removed from the minimum carrier frequency of just over 40kHz, making it essential to use some high slope filtering in order to obtain a glitch free output signal.

The circuit diagram for the filter and output stages is detailed in Fig. 3. Originally a fourth order (24dB per octave) filter was tried, but this was found to give a slightly jittery output signal.

Much better results are obtained using the

FOX REPORT by Barry Fox



CODED TV STANDARDS

At the International Broadcasting Convention in Amsterdam in September, a panel of industry experts asked themselves: *Is MPEG-2 future proof? Is there anything better around the corner?*

First let's recap on the current state of play. MPEG is the technology which makes all the new digital video and television systems possible, and makes the government's plans to waste valuable u.h.f. frequencies on an analogue Channel 5 all the more absurd.

More accurately, MPEG is the standard for digitally coding pictures by Discrete Cosine Transform compression. This involves throwing away redundant information and rebuilding the pictures by predicting where moving objects should be. If the prediction fails, for instance where there is random motion such as smoke or downhill race skiers weaving between posts, the picture can dissolve into a mosaic of coloured blocks.

For a good example of this look at the music Video CDs recently released by PMI. When Kate Bush moves fast she turns into a multi-coloured chessboard.

MPEG confusingly stands for the committee that set the standard. The Moving Pictures Expert Group is part of ISO, the International Organisation for Standardisation, usually called the International Standards Organisation.

FIELD SAMPLING

Digital expert John Watkinson has a much more accurate but unofficial definition of MPEG: Motion Predicted Educated Guesswork.

The MPEG-1 standard covers low bit rates, around 1.5MBit/s as used for Video CD. MPEG-2 is for higher bit rates, around 3MB/s to 20MB/s, and is used for broadcasting. One difference is that the MPEG-1 bit rate is constant. The MPEG-2 rate can vary, depending on the picture content. And MPEG-1 saves bits by working at reduced resolution.

It does this by taking each full picture frame, halving the number of lines which make up the picture, and coding only those lines. So it codes at 25 pictures a second. On replay, the decoder reconstructs pictures with half the normal number of lines but displays each picture twice over to make up the full TV picture speed of 50Hz. So there is no flicker, but some clarity is lost and there may be some motion artefacts, e.g. judder when the camera pans past vertical objects like lampposts.

For MPEG-2, each field is coded and decoded separately, at 50Hz, to deliver an interlaced display, like broadcast TV.

MPEG-3 was originally intended to cover HDTV. Now it has been absorbed into MPEG-2 which covers data rates high enough for HD.

Until the MPEG-2 standard is finally set, and chips are ready, the broadcasters are using MPEG-1 at higher bit rates. And even with the MPEG-2 standard, there is still need for a further set of standards to define the modulation techniques used. This is why 140 electronics companies and broadcast organisations in Europe have got together to form the wholly voluntary DVB, or digital video broadcasting group. DVB is doing, for free, the kind of job the EC Eurocrats in Brussels are paid to do.

Philips' Theo Peek describes the spirit of collaboration amongst the DVB Group as "almost Japanese".

The DVB Technical Committee or "Module" agreed a standard (MPEG-2 with QPSK, Quadrature Phase Shift Keying) for satellite broadcasting in December 1993 and for cable (MPEG-2 with 64 QAM, Quadrature Amplitude Modulation) in January 1994. The Committee expects to agree on a standard for terrestrial broadcasting (MPEG-2 with COFDM, Coded Orthogonal Frequency Division Multiplex) before the end of this year. Audio decoders will be flexible, to cope either with stereo Musicam, Dolby AC-3 or Musicam multi-channel. These standards go first to the DVB Steering Board, and then to the European Standards Organisation ETSI for rubber stamping.

CODING RATES

Things are moving fast. Philips and Pace/NTL were both receiving DVB satellite broadcasts in Amsterdam, with consumer receivers based on chips made by Thomson. At the Live '94 Consumer Electronics Show held at Earl's Court in London a few days later, the UK Widescreen Forum stand was receiving digital TV broadcasts made by the NTL from a 70 watt transmitter at Croydon, on UHF channel 34. The data rate was 15MB/s, MPEG-1, using ODFM to spread the data over 512 carriers with 16 QAM modulation. Reception was on a standard 18 element domestic aerial.

The future MPEG-4 will cover coding at much lower rates, under 100 kilobits/second, e.g. for telephone transmission or disc and chip storage of motion pictures. Fractal compression has been tipped for MPEG-4. Whereas DCT breaks the picture into blocks, fractal coding works by analysing the tiny component shapes from which all images are built.

Dr Michael Barnsley of Iterated Systems, the company behind fractals, was billed as a late entry to the IBC panel. But he never appeared. This was a pity because Chris Birch of Scientific Atlanta, Canada, was very dismissive of fractal technology for MPEG-4. He was equally dismissive of wavelets compression technology. This is a variant of DCT coding. Whereas DCT coding works with fixed block sizes, wavelets technology varies the block size to suit the signal.

Birch suggested that that one way to achieve super-low coding rates may be to use "image synthesis". This compares with MIDI sound coding.

Whereas a MIDI decoder stores wave tables, which are digital snatches of musical instruments which are then moulded by the playback unit, image synthesis would store basic images, like the President of the United States. But the tables would need updating. "George Bush would not want to be confused with Bill Clinton", says Birch.

CALCULATIONS

Dr. Leonardo Chiariglione, of Italy is the dynamic Chairman of the MPEG committees. He had nice way of answering a suggestion from a member of the audience that new technology such as wavelets might be better than MPEG.

"The last time I calculated, a year ago, it had taken 600 man years to put together a working MPEG standard. If you can find 600 man years and put together a working system, I am sure you will find some buyers".

Chiariglione confirms that the MPEG-2 Committee is now extending its scope to new areas which include the control of remote storage media, non-backwards compatible audio coding and 10-bit video coding. The final draft for MPEG-2 should be ready by November 1995.

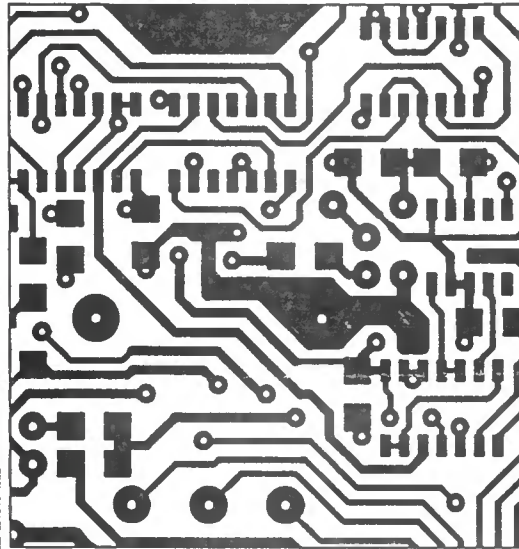
Paul Ratliff of the BBC Research Department in the UK predicts that the broadcast industry may have to move to programmable software decoding, as currently used by the computer industry. The decoder is just a powerful processor and memory which works with whatever decoding algorithm it receives.

Says Chiariglione "We will still need to categorise the algorithm, always within limits. For MPEG-4 we are considering this, perhaps with the decoder storing a range of different algorithms, so that the program just tells it - Use algorithm 25".

As the seminar Chairman reminded in his summing up: "Anyone who thinks we do not need standards should just try putting a MAC disc in an IBM PC, and see what happens".

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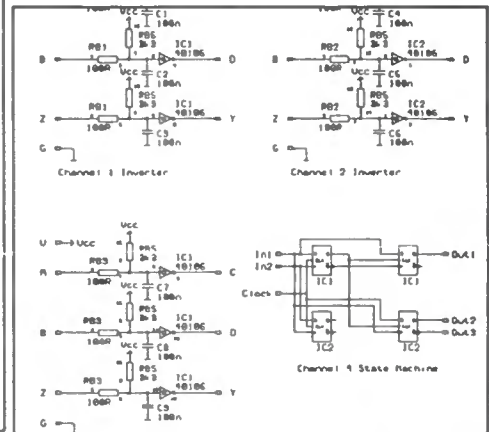
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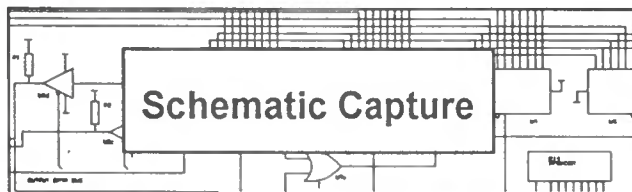
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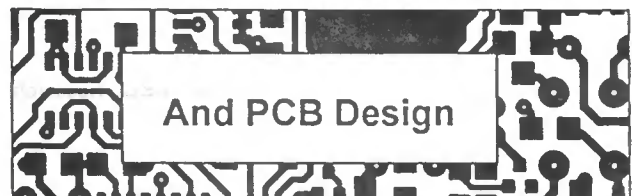
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ELECTROMAGNETIC COMPATIBILITY

ANDREW CHADWICK

The implications of the new EMC regulations, although not yet fully clear, will have a profound effect upon the electronics industry, and even, it is claimed, upon some aspects of the hobbyist market.

ELECTROMAGNETIC compatibility, or EMC, is defined as "the ability of a device to function satisfactorily in its electromagnetic environment without introducing intolerable disturbances to that environment or to other devices therein."

Despite the seemingly academic definition, manufacturers of electrical and electronic equipment are currently taking a great deal of interest in the subject, mainly due to the necessity of meeting new legislation which came into force in 1992.

The problem is not new. In 1933 international organisations held a meeting in Paris to discuss radio interference, which led to the formation of the Comite International Special des Perturbations Radioelectriques or CISPR. Since its inception the CISPR has produced a number of reports and standards, mainly on radio interference. Many of these have been adopted by CENELEC, the organisation responsible for electrical standards in Europe. In the UK the main legislation on the subject has been contained in the Wireless Telegraphy Acts of 1949 and 1967.

HARMONISATION

However, in recent years the situation has become far more complex. The development of mobile phones, personal computers and microprocessor-controlled household appliances has brought with it the risk of detrimental interference to all kinds of electronic appliances, not only to radio receivers.

A growing awareness of this led to recognition of the need for the more wide-ranging concept of compatibility. Standards on EMC were written but these were limited to certain product groups and were often specific to a particular country. Recent legislation has changed all that and imposed EMC requirements on virtually all electrical and electronic equipment intended for sale in the European Community.

The new legislation on EMC, known as the EMC Directive, is part of the effort to remove the physical, technical and fiscal barriers to free trade in the European

Community. Conforming to differing technical standards in member states leads to increased manufacturing costs and delays the marketing of innovative products. The process of removing these sorts of restraint has acquired the rather charming title of harmonisation. It will hopefully lead to the practical realisation of the single internal market, which was established, in principle, at the beginning of 1993.

STATUTORY REQUIREMENTS

The EMC directive was adopted in 1989, and became part of the British legislature in the form of what is known as a Statutory Instrument, entitled The Electromagnetic Compatibility Regulations. The essential requirements are that apparatus should be constructed so that:

"The electromagnetic disturbance it generates does not exceed a level allowing radio and telecommunications equipment and other apparatus to operate as intended.

"The apparatus has an adequate level of intrinsic immunity to electromagnetic disturbance enabling it to operate as intended."

These two separate aspects of the problem are usually referred to as emission and immunity, respectively.

The term electromagnetic disturbance covers not only radio frequency effects but also other unwanted signals such as transients on the mains and control cables, electrostatic discharges and magnetic fields. However, nuclear electromagnetic pulses are excluded!

TRANSITIONAL COMPLIANCE

Although deceptively simple in summary the scope and implications of this directive are very wide-ranging. The original intention was that it should come into force on 1st January 1992. However, as a result of widespread protest by the industry at the impossibility of achieving this, the directive was delayed until 28th

October 1992 and an amendment was agreed giving manufacturers until 1st January 1996 to comply. In the current transitional period manufacturers may either comply with the new directive or with the regulations at present in force in the state concerned.

Like any other legislation there must be a method of enforcing the EMC directive, and penalties for those who contravene it. Each state in the European Community can choose its own method of enforcement. Britain has opted for a complaint-driven system using the existing trading standards organisation. Although the maximum penalties of a £5000 fine or a three-month prison sentence may not seem very harsh, the main deterrent is likely to be the possibility of a product being excluded from the market.

The scope of the EMC directive is very wide, and effectively applies to all equipment produced since 28th October 1992. Where a manufacturer has taken advantage of the transitional period and currently only complies with existing standards, he will still need to meet the directive by the 1996 deadline if the product is to remain on the market.

EXEMPTIONS

There are some exemptions to the legislation. Equipment for use outside the EC countries and secondhand equipment are two examples. Equipment that is unaffected by electromagnetic disturbances and does not emit unwanted electromagnetic disturbances is described as "benign", and is also excluded.

In the hobby field, radio amateur apparatus which is not available commercially is exempt, but CB equipment is not, as it is classed as consumer electronics. Designs for projects appearing in the hobby electronic press are obviously not within the scope of the directive as there is no commercial supply of equipment.

General electronic components are also excluded as they have no "intrinsic function intended for the end user". However, kits of parts supplied commercially will have to conform, as they are sold for the purpose of constructing a specific piece of equipment. This is likely to have serious implications for companies specialising in this area.

There are also certain product groups, such as active implantable medical devices and motor vehicles, where a general directive has already been implemented which includes requirements for EMC. These then take precedence over those in the EMC directive.

NEARLY UNIVERSAL

Despite these exceptions most electronic and electrical equipment is affected.

The basic method of showing compliance with the directive is for the manufacturer to demonstrate that a product conforms with the relevant EMC standards. This involves either the manufacturer or a third-party specialist company testing the product in accordance with the standards.

One of the difficulties of achieving the original 1992 deadline was that the scope of the standards which existed was restricted to certain aspects of EMC, in a limited range of equipment. The situation now is that there are a handful of product and product family standards and two generic standards.

EN 55014, which is issued as BS 800 in this country, is an example of a product family standard, and deals with emission (of an electromagnetic kind!) from household appliances. Most of the current product standards are harmonised versions of those which were in existence before the EMC directive came into force. Work is being carried out on a wide range of new product standards but it may be some time before these are issued.

The generic standards are intended to cover a wide range of equipment in a particular environment and apply when no suitable product standard exists. The two currently available are EN 50081-1 and EN 50082-1 which deal with emission and immunity in residential, commercial and light industrial premises. Similar generic standards for industrial environments are in preparation.

TECHNICAL COMPLIANCE

The other way in which a manufacturer can demonstrate compliance is by means of a technical construction file. This is a collection of drawings, descriptions of EMC provisions and calculations relating to these, and the results of any tests performed. The technical construction file is submitted to a "competent body" for approval.

So far about 30 competent bodies have been appointed in the United Kingdom. Some are divisions of existing manufacturers and research organisations but many are specialist companies specifically set up to handle what promises to be a rapidly-growing (and lucrative!) demand for EMC expertise.

One exception to the above is equipment incorporating a radio transmitter which must be submitted to a notified body for testing. There are four of these bodies in the UK each dealing with a different type of equipment.

Once compliance has been demonstrated, the manufacturer must make a Declaration of Conformity describing the equipment and citing the evidence for compliance. The CE (Communaute Europeene) symbol may then be used on the equipment, allowing it to be marketed unhindered in any state in the European Community.

The CE marking is not specific to EMC, but simply shows that a product complies with relevant "new approach" European directives. Consequently if other directives apply to a product it must also comply with these before the symbol can be used. Readers may have seen the CE symbol on many toys, showing they comply with the Toy Safety directive.

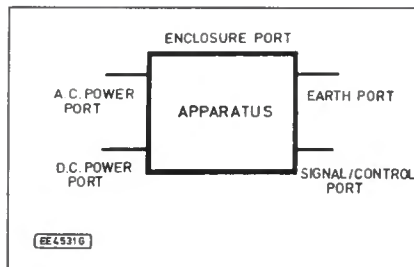


Fig. 1. The five emission ports recognised by EMC standards.

RADIATION PORTS

The extent of the testing required to demonstrate compliance can be seen by glancing through the residential, commercial and light industry generic standards. EN 50081-1 and EN 50082-1. In these standards a piece of apparatus is considered to consist of a number of "ports" as shown in Fig 1.

The standards recognise five categories of "ports" which are capable of transmitting electromagnetic disturbances to and from apparatus. A mains cable, for instance, would be classified as an a.c. power port.

The generic emission standard specifies the maximum electromagnetic radiation from each of the ports and gives a reference to another basic standard which details the test method. The electromagnetic field strength from the enclosure port, for instance, must not exceed 30dB ($\mu\text{V}/\text{m}$) at 10m over a frequency range of 30-230MHz, or 37dB over the range 230-1000MHz. This is an example of a radiated emission requirement and would normally be checked using an Open Field Test Site or OFTS.

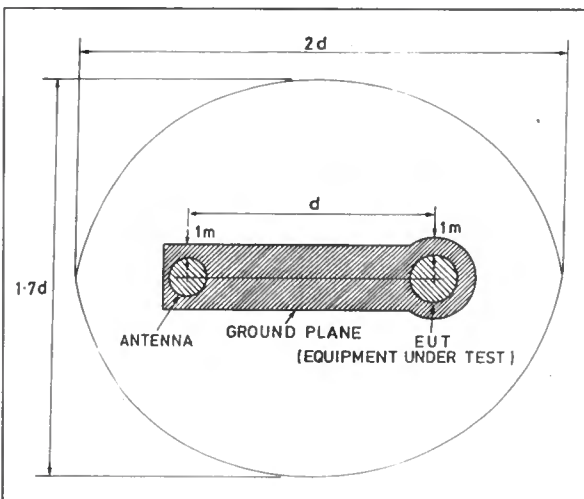


Fig. 2. Minimum dimensions of an Open Field Test Site and ground plane.

TEST SITE

An OFTS is an elliptical piece of flat (to within 50mm) ground whose dimensions are defined as shown in Fig 2. Even for a distance d of 10m this requires an area of 20m by 17m. Furthermore, there must be no large reflecting surfaces, such as buildings close to the perimeter of the site.

The equipment under test, or EUT, is placed at one of the foci, and a receiving antenna at the other. The antenna is connected to a suitable instrument, such as a spectrum analyser or receiver, which is capable of measuring the field strength over the appropriate frequency range.

Some of the radiated emission will travel directly to the antenna and some will be reflected from the ground, as shown in Fig. 3. The amount reflected is very dependent on the condition of the soil, and so for consistent results it is usually necessary to install a conducting ground plane, consisting, for example, of a metal mesh with dimensions as shown in Fig. 2.

It is also necessary to adjust the position of the antenna and rotate the EUT to obtain the worst-case readings. The other major problem with an OFTS is masking of emissions from the EUT by ambient noise such as transmissions from local taxi radios!

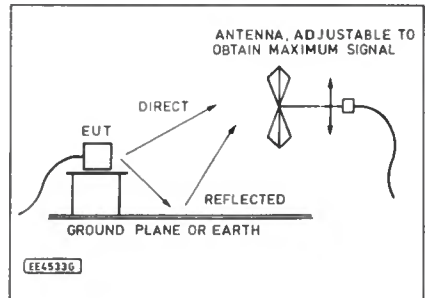


Fig. 3. Direct and reflected paths for radiated emission.

The generic emission standard also specifies limits for continuous conducted interference from the equipment to the mains supply, the mains "port", over the frequency range 150kHz to 30MHz. This is measured using the set-up shown in Fig. 4.

The artificial mains network provides a constant standard impedance to the EUT, and attenuates signals from the mains that could interfere with the measurements. It may also be necessary to provide additional mains filtering or perform the measurements in a screened enclosure to eliminate outside interference.

Harmonic components of the mains current in the range 0 to 2kHz produced by the equipment must also be limited. A low value resistor in the supply or a current transformer is used to monitor the current, and a spectrum analyser identifies and measures the harmonics. During the tests the mains supply must be maintained within two per cent of the nominal voltage and 0.5 per cent of frequency.

Limits are also set on discontinuous interference, such as clicks when, for example, a

thermostat operates, and on voltage fluctuations.

IMMUNITY STANDARDS

The generic immunity standard is more extensive and includes specifications for immunity to RF electromagnetic fields over a wide frequency range, electrostatic discharges, magnetic fields, high voltage transients, voltage dips and variations.

Each specification has an associated performance criterion of A, B or C. Performance criterion A means that the equipment must perform as intended

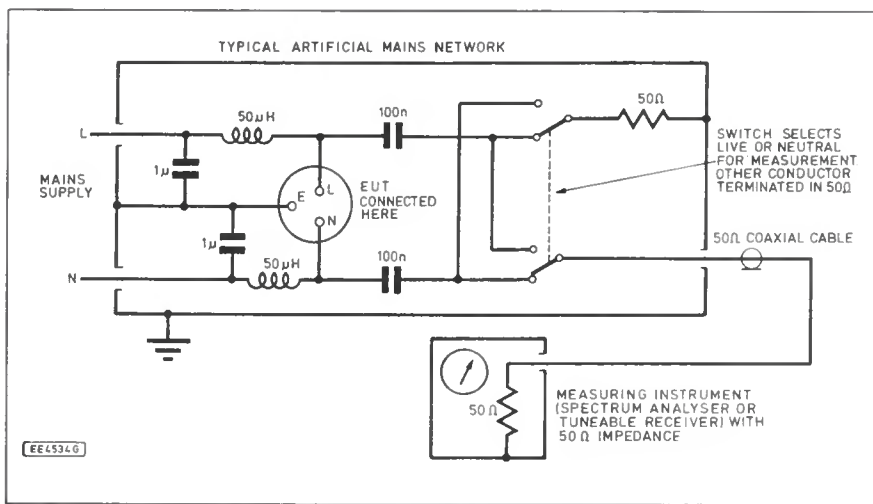


Fig. 4. Measuring conducted interference using an artificial mains network.

during the test, B that it should operate as intended after but not necessarily during the test, and C that there may be a temporary loss of function that is recoverable either automatically or by means of the controls.

The simplest set-up for testing immunity to radiated R.F. fields is shown in Fig. 5. The field strength at the EUT is specified by the standard as 3V/m over a frequency range of 27-300MHz. This is monitored by field probes on or near the EUT as the frequency is swept over the range. The tests have to be carried out in a screened chamber to prevent the strong electromagnetic fields that are generated interfering with the monitoring and other equipment in the immediate surroundings.

Results using this method of testing can be misleading due to reflections and standing waves set up in the screened chamber. More recent draft standards, which are

likely to come into force soon, extend the range of frequencies at which tests must be carried out up to 1GHz, and include modulated fields. The preferred test set-up has been revised to an anechoic chamber or absorber-lined shielded enclosure to avoid the problems of reflections and non-uniform field strength.

The electrostatic discharge tests are designed to simulate the effect of the equipment being touched by a charged person. Simply walking across a synthetic carpet can lead to a build-up of charge, resulting in potentials as high as 10kV. Contact with a piece of equipment produces a rapid discharge to earth with peak currents of maybe 10A.

The test method uses a discharge generator which incorporates the electrical equivalent of the human body, as shown in Fig. 6. In the air discharge test the capacitor is charged to 8kV and the dis-

charge electrode brought near to the EUT until a discharge occurs. This is repeated at other points on the accessible surface and to nearby conducting surfaces.

UNCERTAIN IMPLICATIONS

The above brief descriptions should give an idea of the extent and complexity of the testing required to demonstrate compliance with the EMC directive. It is difficult to judge the full implications of the legislation at the moment, particularly as many of the standards are still only available in draft form. However, it is apparent that there will have to be a good deal of investment in specialised test facilities, equipment and training.

Many of the larger manufacturers of consumer electronics, domestic appliances and telecommunication and IT equipment already possess EMC test facilities of some sort, and for them the new legislation may only involve an extension of current practice. Smaller companies whose products are subject to EMC requirements for the first time will be affected more severely.

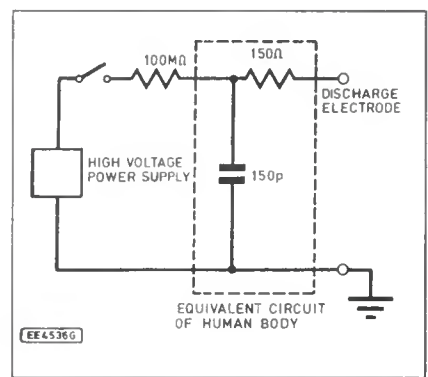


Fig. 6. Simplified electrostatic discharge generator.

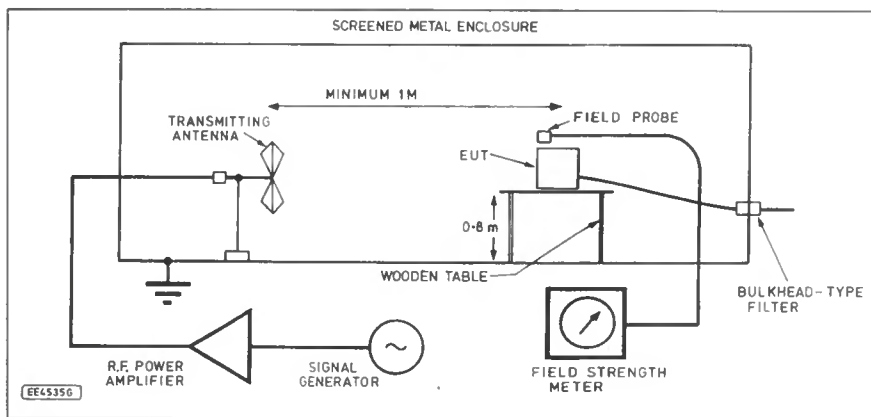


Fig. 5. Testing for radiated immunity.

For example, compliance testing by a third-party test house might typically take three days, one day for emission and two for immunity, at a cost of £600-£1000 a day. With an anechoic chamber costing maybe £500,000, investing in your own facilities is out of the question. However there is likely to be a market for low-cost DIY test rigs that will give a rough indication of whether equipment is likely to comply, before it is submitted for a full test.

Many people regard the EMC Directive as the most complex and far-reaching of all the Directives aimed at achieving a single European market. Hopefully the benefits in terms of compatibility and unrestricted trade will make it all worthwhile. □

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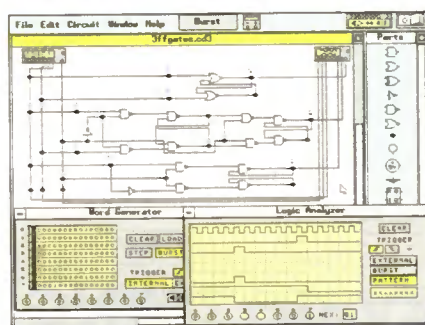
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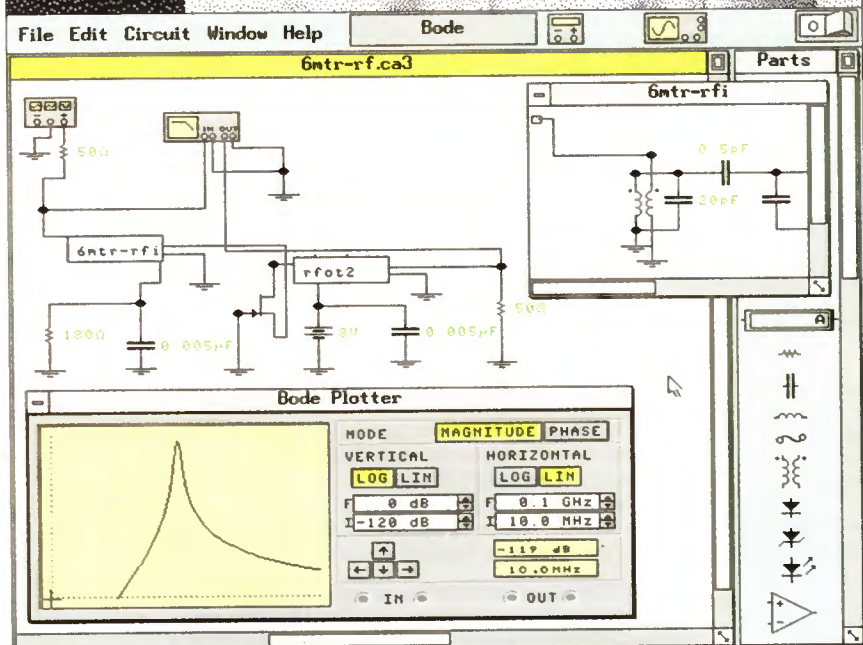
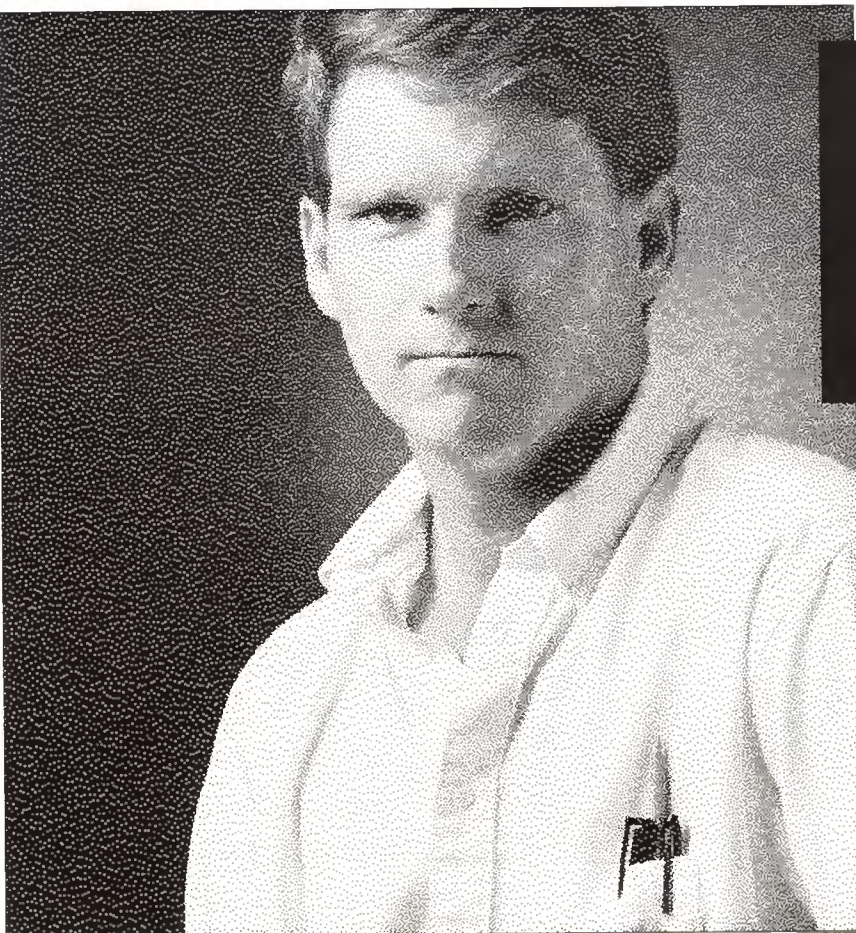
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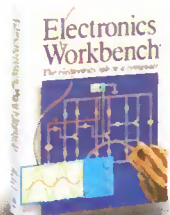
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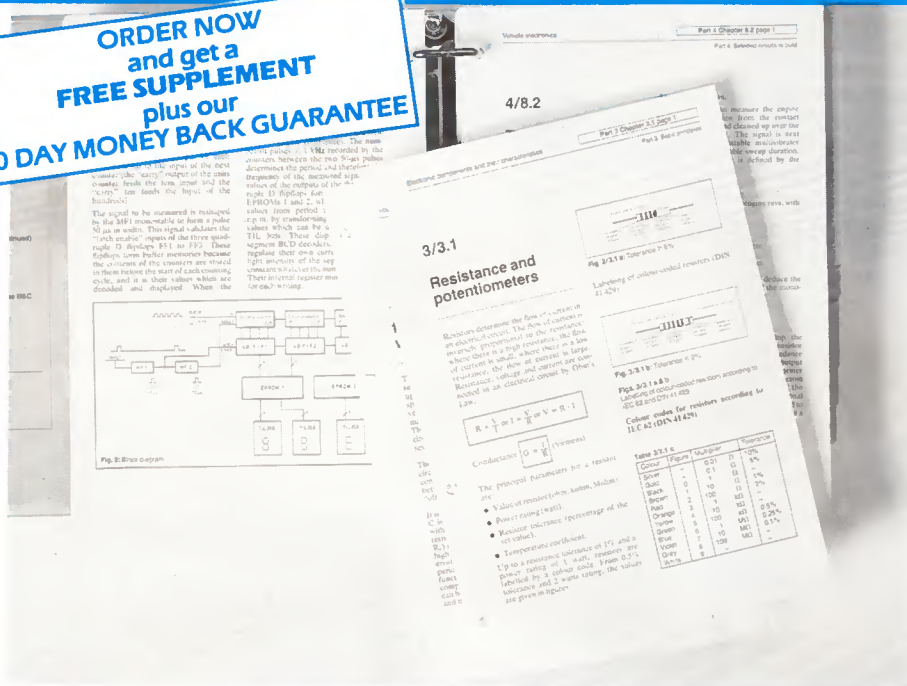
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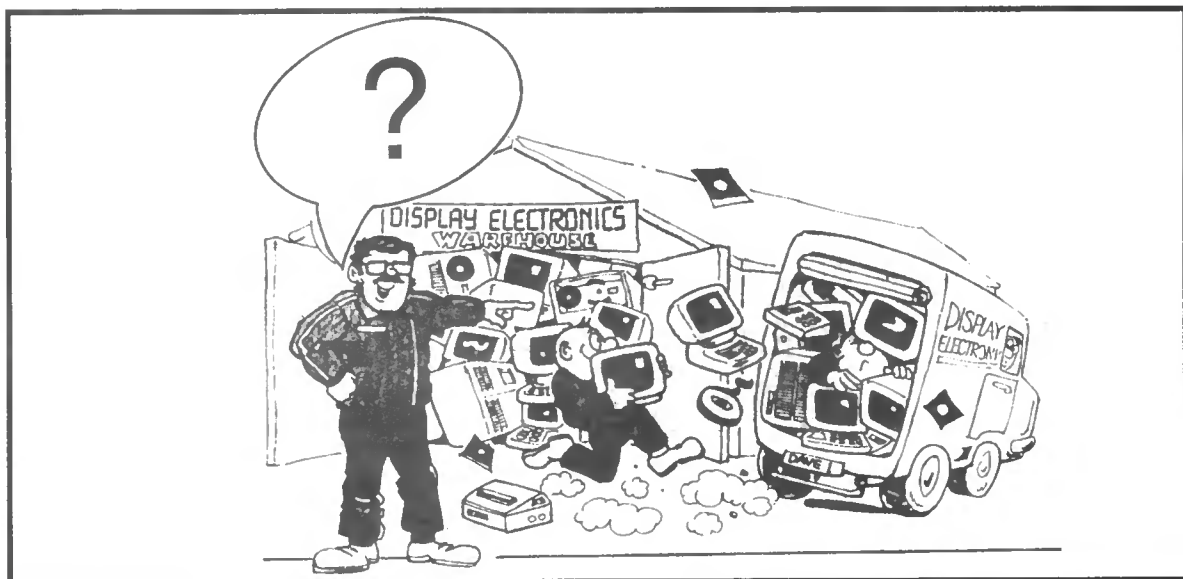
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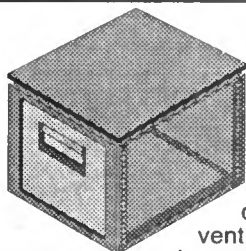


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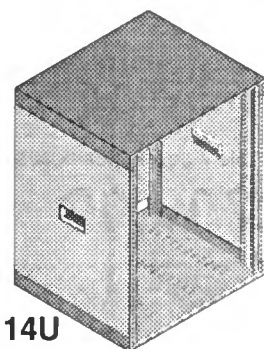


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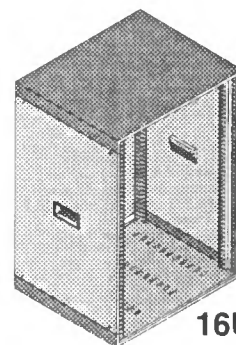
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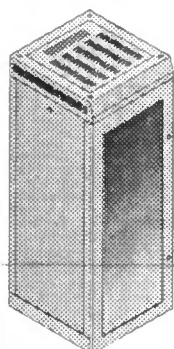
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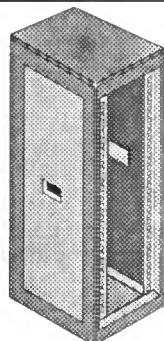


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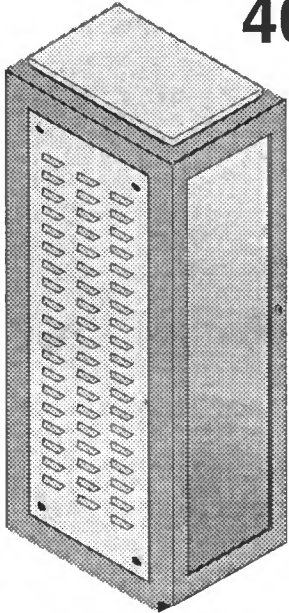
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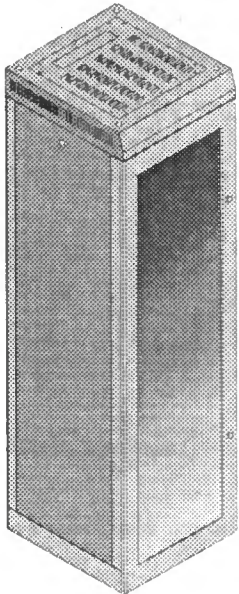
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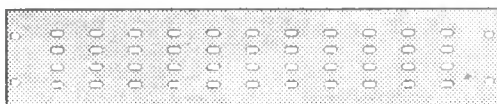
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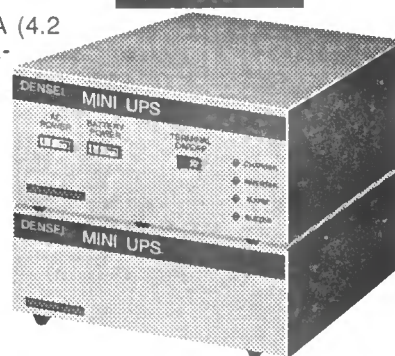
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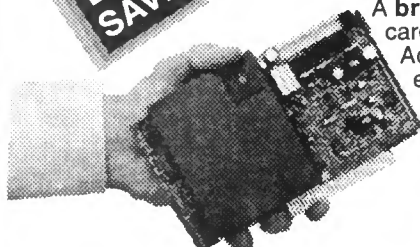


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INPUT:	Phase= Single	Voltage= 240v ± 15%	Frequency= 47-53hz	Capacity= 1.8kVA
OUTPUT:	Phase= Single	Voltage= 240v ± 2%	Frequency= 50hz ± 0.5%	Capacity= 1.0kVA
	Current= 4.2 A max	Instantaneous voltage variation = ± 10% or less. Setting time 100ms or less		
BATTERY:	Sealed lead acid	Time available from interrupt = 15 minutes at full load		

Emerson 'Accucard' Internal PC UPS

BIG £ SAVER

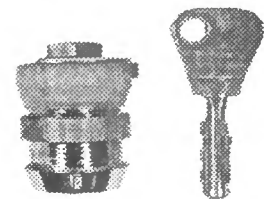


A brand new 8 Bit half length PC compatible card for all IBM XT/AT compatibles. The ¾ length card provides DC power to all internal system components in the event of power supply failure. The Accusaver software provided uses only 6k of base RAM and automatically copies all system, expanded and video memory to the hard disk in the event of loss of power. When power is returned the machine is returned to the exact status when the power failed, even if you were in the middle of an application! The unit features full self diagnostics on boot and is supplied with full fitting instructions, software and manual. Normal price £189.00.

Only £69.00 each (B) 2/£120.00 (C)

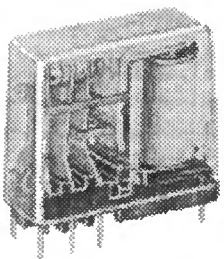
Chubb High Security Barrel Lock

10 lever very secure steel lock, as used on cash registers, alarm systems, banking equipment, and Welsh John's wallet. Spare keys are *not available* or copyable by locksmith's and must be obtained direct from Chubb Ltd. Each lock is supplied with two keys and every lock supplied has an individual combination. The key is made of solid brass and is particularly unobtrusive measuring only 44mm in length. The barrel lock is mounted via a 19 mm hole and threaded ring (supplied) and has a 9 mm square shaft and lock nut to accept a host of tounges.



Only £3.99 (A) 10 / £25.00 (A)

Relays



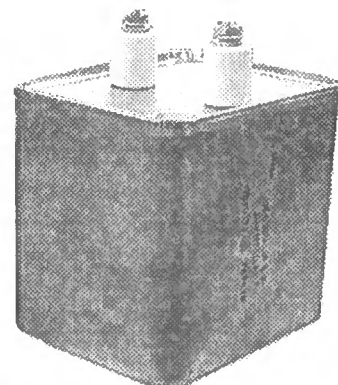
These are all fully shrouded "Continental" type relays. Contacts typically rated at 5 amps. Dimensions only vary slightly - about 1¼"H x 1"W x 5/8"D.
PLEASE ORDER RELAYS BY THE PART NUMBER LISTED.

CR-1	6 vdc. 52 ohms. 2 c/o	£2.25	CR-2	12 vdc. 185 ohms. 2 c/o	£2.25
CR-3	12vdc. 185 ohms. 4 c/o	£2.25	CR-4	12vdc. 200 ohms. 1 c/o	£1.95
CR-5	12vdc. 250 ohms. 1 c/o. 10 A	£2.95	CR-6	12vdc. 260 ohms. 1 c/o. 16 A	£3.95
CR-7	12vdc. Latching. 2 c/o	£3.25	CR-8	12vdc. 330 ohms. 6 c/o	£3.25
CR-9	24vdc. 700 ohms. 2 c/o	£2.25	CR-10	48vdc. 1700 ohms. 2 c/o	£2.25

Shipping for all relays is (A)

Jumbo High Voltage Capacitor

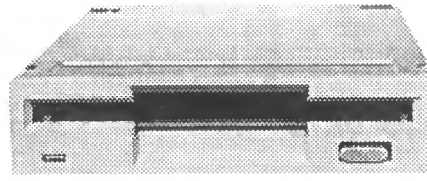
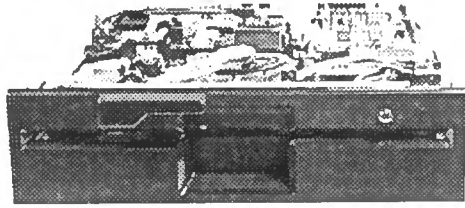
It's not often you see a non electrolytic capacitor of this size and voltage - and especially at this price! Made by General Electric USA, Cat Ref 28F2011 and rated at 8 mf at a massive 4,250 V DC this item will deliver a massive amount of energy in a fraction of a second! Normally used in high voltage pulse circuits such as radar or for the firing of Xenon flash tubes or pulse type lasers. Completely hermetically sealed with electrical connections made by two bolts mounted on top of the two porcelain insulators. A push on tag-connection is provided to safety earth the all metal casing. The unit is supplied with a shorting link to prevent static electricity in the air from self charging, possibly resulting in an electric shock hazard - *this must not be removed until required for use.* Dimensions: 5" w x 6" h x 8"



Only £14.95 each (B)

Please be warned that electricity and high voltages can be dangerous and lethal. If at all in doubt seek expert advice before purchase or use of this item.

Floppy Disk Drives



Note: We supply only first grade floppy disk drives of well known brands. Unless otherwise stated, all are new or removed from new equipment and are totally standard in every way.

3 1/2" 720 K or 5 1/4" 360K £24.95 (B) or 3/£69 (C)

5 1/4" 720K £22.95 (B) or 3/£65 (C)

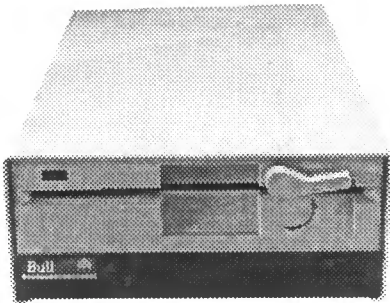
3 1/2" 1.44 M or 5 1/4" 1.2 M £29.95 (B) or 3/£84 (C)

Laptop Floppy Disk Drives

Ultra compact 1" height 3 1/2" 1.44 Mb drives for use in laptop computers. Such drives differ from the more normal desktop drives in that no separate power connector is provided. The power for the drive goes up two of the wires of the data cable. This cable is supplied and terminates in a 34 way female IDC connector.

£36.95 (B) or 3 for £99.95 (C)

5 1/4" 1.2 Mb External Floppy drives With PSU's



Brand new and boxed external 5 1/4" 1.2 Mb floppy disk drives complete with integral power supply. These are Teac FD-55GFR which is one of the state of the art 96 TPI floppies which will read and write double sided, double density plus high density with equal ease. Comes complete with all necessary cabling. Your existing data cable is replaced with the one supplied, which has an extension to a slot plate bearing a 37 way female D socket, as does the drive itself. 37 way connecting cable included. This drive was in fact made as an add on to a Zenith range of laptops but is equally at home with any PC compatible which supports 1.2 Mb drives. Measures 12"L x 6"W x 2-3/4"H. Two tone grey metal case, extremely sturdily made. Complete with installation and user manual.

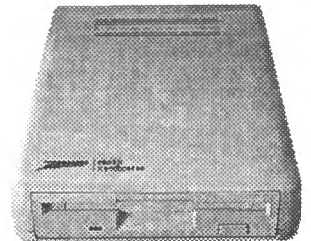
Only £49.95 each (C)



Last Chance !

To Buy a 720K

3 1/2" External Floppy Drive For Your Zenith Minisport Laptop!

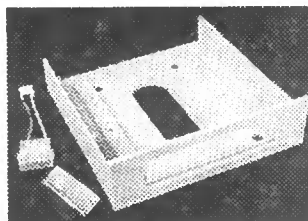


Brand new Zenith packaged 3 1/2" 720K external floppy disk drive made for Zenith's Minisport laptop computer. Would probably work with other laptops if the sub-miniature 20 pin D plug were changed, as internally the drive is a standard Panasonic with a standard 34 way connector and separate power socket. Comes complete with installation manual. Measures 7-1/4"D x 4-3/4"W x 1-1/8"H. To the best of our knowledge Zenith have ceased production of these drives and we have only limited quantities - so buy now or forever hold your peace!

Only £59.95 each (B)

5 1/4" to 3 1/2" Disk Drive Conversion Kit

Another most useful item, Converts your 5 1/4" disk drive bay on a standard IBM or compatible system to accept a 3 1/2" floppy disk drive. Kit even comes complete with screws and adaptor cables to change the data and power connections to the different format used on 3 1/2" floppy disk drives. Makes that upgrade job a breeze !



£7.95 each (A)

8" FLOPPY DRIVES

BY

SHUGART

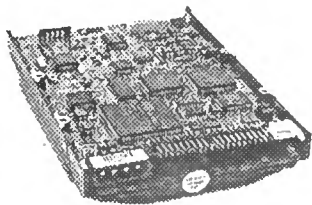
TANDON

MITSUBISHI

EX STOCK

CALL FOR DETAILS

Hard Disc Drives



All our Hard Disk Drives and controllers are new or removed from equipment and **extensively tested** before shipment to you. We have over 65 different types **Ex Stock** so please call us with your requirements.

CAPACITY	TYPE	FEATURES	PRICE
10 megabyte	ST-506 MFM interface	Tandon TM-502 full height 5¼"	£39.95(C)
20 megabyte	ST-506 MFM interface	NEC Model D5126 half height 5¼"	£54.95(C)
20 megabyte	ST-506 MFM interface	Fuji FK-309-26 half height 3½"	£59.95(C)
20 megabyte	ATA (IDE) interface	Conner CP-321 half height 3½" (or equiv.)	£69.95(C)
30 megabyte	ST-506 RLL interface	Seagate ST-238R half height 5¼"	£69.95(C)
40 megabyte	ATA (IDE) interface	Conner CP-3044 1" high 3½" (or equiv)	£89.00(C)
42 megabyte	ST-506 MFM interface	CDC Wren II 94205-51 half height 5¼"	£69.95(C)
45 megabyte	SCSI interface	Rodime RO-3057S half height 3½" BRAND NEW	£99.00(C)
85 megabyte	SMD interface	NEC D2246 full height 8" BRAND NEW	£299.00(E)
160 megabyte	SMD interface	Fujitsu M2322K full height 8"	£195.00(E)

HARD DISK CONTROLLER CARDS

TYPE	INTERFACE	FEATURES	PRICE
8 Bit XT Type	ST-506 MFM interface	Short card for 1 or 2 hard drives only	£34.95(A1)
8 Bit XT Type	ST-506 MFM interface	Full length card for 1 or 2 hard drives and floppy drives	£49.95(A1)
16 Bit AT Type	ST-506 MFM interface	3/4 length card for 1 or 2 hard drives only	£29.95(A1)
16 Bit AT Type	ST-506 MFM interface	3/4 length card for 1 or 2 hard drives and floppy drives	£44.95(A1)
16 Bit AT Type	ST-506 RLL interface	3/4 length card for 1 or 2 hard drives only	£34.95(A1)
16 Bit AT Type	ATA(IDE) interface	Short card for 1 for 2 hard drives and floppy drives	£24.95(A1)
MCA (IBM PS-2)	SCSI interface	Adaptec AHA-1640. Current RRP £275	£129.00(A1)



Outstanding Deals on 5¼" Floppy Disks!

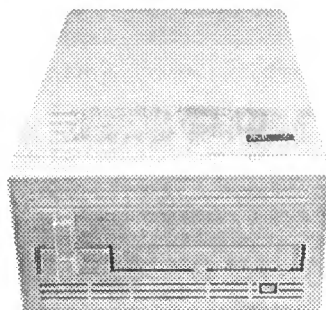
Maxell MD2-D double sided double density Gold Standard 5¼" floppy disks at an unheard of price. Brand new and boxed, straight from the manufacturer! 100% Certified! We bought up an entire surplus stock from a big user and are passing the savings on to you. Buy whilst we still have some left!

Box of 10 - Only £3.45 (A)



Brand new and boxed high density 5¼" 1.2 megabyte floppy disks at an unbeatable price. These diskettes are made for Victor by a brand name manufacturer. Box contains 10 disks with all the necessary labels. At this price you just have to buy!

Box of 10 - Only £4.99 (A)



150/250 Mb External SCSI Tape Streamer

Brand new and boxed Archive VP series model 250e external extra high capacity tape streamers for all who need large backup storage either on their own machines or for multi-user networks including Novell and the popular versions of Unix. Suitable for PC-XT-AT and PS-2. Uses DC6150 for 150 megabytes and DC6250 for 250 megabytes, or equivalents, 1/4" industrial type cartridges for total reliability and security. Requires a SCSI interface card or Archive's own 402 (PC's) or 409A(PS/2) controller. Suggested software is QICstream 4.0, PCTools version 8 or Norton back-up utilities. The data transfer rate is 112 Kb per second and reliability is less than 1 error in 1010 bits. Fully recommended for high reliability and/or network use.

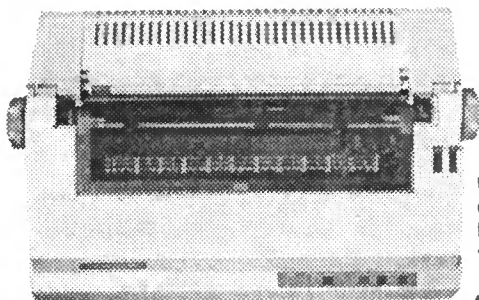
Only £299.00 each (D)

40/80 Mb External Tape Streamers

Brand new and boxed XL series model 5240. It has 40 Mb capacity (80 Mb compressed if the driving software supports Data Compression) or 60 Mb with extended length cartridges (120 Mb compressed). Suitable for PC-XT machines. Uses Maynard 340 (for 40 Mb), Maynard 1120B (for 60 Mb) or equivalent tape. The interface required is PC compatible floppy. Data transfer rate is 1.2 Mb per minute. Suggested software is QICstream although other utilities may well support this drive.

Only £99.00 each (D)

Qume Daisywheel Printer For Parts Or For Use As Is



Brand new and boxed Qume LetterPro 20 printer complete with Elite 12, 96 ASCII character daisywheel, ribbon and 120 page manual. Uses the QS-3 parallel interface. A gift if you use that interface or can convert it to Centronics, but most people will want it for the treasure trove of brand new parts. The platen motor alone costs three times our price for the whole machine! **Hundreds of parts for DIY**, robotics and hobbyists. It's worth the money just for the fun of taking it apart! Contains several DC motors with precision optical

positioning mechanisms. The manual supplied is very full and describes the Centronics, Serial and QS-3 interfaces which are installed in different models of this printer. Also includes a stand alone fully encased switch mode power supply providing +16 vDC and +5 vDC. In summary - a gift!



Only £34.95 (D)

General Purpose Oscilloscope Probes

General purpose passive oscilloscope probes. BS-100 is switchable 1:1 and 10:1, BS-010 is 10:1 only. They both come with a full complement of accessories: spring loaded test hook, IC test tip, insulating tip, BNC adaptor, compensating tool for trimmer adjustment, 20 cm ground lead and probe tip. Both also feature nice "ultraflex" cable 1.2 metres long. Specifications for BS-010 and BS-100 in 10:1 position are the same.



Attenuation	1:1
Bandwidth	DC to >25 Mhz
Rise Time	14 ns
Input resistance	1 MΩ (scope input)
Input capacitance	90pf (+ scope input)
Working voltage	200 vDC including pk AC derating with frequency

Attenuation	1:1 and 10:1
Bandwidth	DC to >250 Mhz
Rise Time	<1.4 ns
Input resistance	9 MΩ +/-1% (10 MΩ for scopes with 1 MΩ input)
Input capacitance	16pf
Working voltage	500 vDC including pk AC derating with frequency

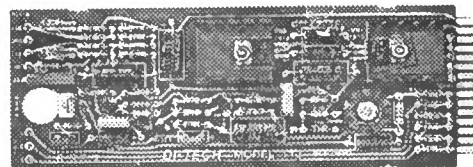
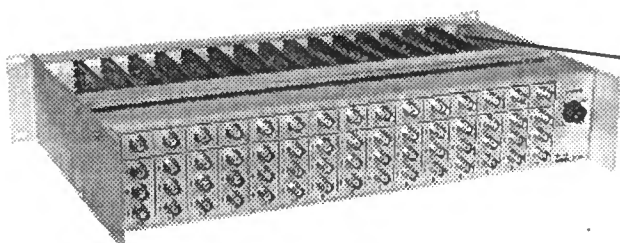
BS-010 £14.95 (A)

BS-100 £19.95 (A)

££££ SURPLUS WANTED TOP CASH WAITING! ££££

Display Electronics has a constant requirement for quantities of surplus / obsolete and redundant stocks. All kinds of electronic / computer / test equipment / power supplies / components / connectors / semiconductors / IC's / printed circuit boards / radio equipment / motors / racks / relays etc. always wanted. We are able to give a fast quote on lists of items available, or by viewing 'that pile in the corner'. We are also happy to negotiate a '**Confidential Reward**' for any information leading to a purchase. Distance or quantity no problem - Fax or call Dave Fisher or Gavin Mac for further information now!!

1 in 3 out X 15 Video Distribution Amplifiers



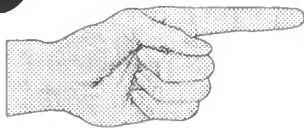
Professional Video Distribution Amps (VDA's) made in the USA by the **DI-TECH Corporation** type number 113 as a card or 1130 as a complete rack system. The video amp on the single card features a full

bandwidth (ideal for colour) input with on board adjustment for gain and frequency response with electronics to give up to three individual buffered outputs for driving direct into 75 ohms at 1 v peak to peak. All connections to the PCB are via a 15 way 0.15" gold plated edge connector. The single board unit board features two on board regulators to control the wide range + and - 14.5 to 24 volt dc rail inputs and LED status indicators for both the DC rails. A complete 2U (3.5") rack chassis mounting unit complete with edge connectors is also available to accept up to 15 x 3 output VDA's with all inputs and outputs terminated on the rear panel via BNC sockets, giving a total of 45 outputs. Module dims. 190 mm x 70 mm x 20 mm. Rack dims 485 x 70 x 20 mm. Current requirements 100 Ma per VDA. Supplied in fully tested condition with data. Order individual boards as VDA-PCB and complete rack unit with 15 off VDA as VDA-R.

VDA-PCB £29.00 each (A)

VDA-R £375.00 (D)

BIG £ SAVER
SPECIAL SCOOP
MicroTouch



£300 off manufacturers price!!

1024 x 1024 Resolution
Touch Screen System

Fully PC / Amiga / Mac Compatible

In our quest to find the most interesting value for money surplus items, this must rate as close to #1 as any ! State of the art technology at prices you can now afford !! The MicroTouch, touch screen system consists of a flat clear glass panel measuring 11.75" x 9.25" which is invisibly divided into 1024 x 1024 x and y (almost 1,500,000) touch points !! When connected to its accompanying controller board an RS232 serial connection constantly outputs two ASCII numbers giving the exact X,Y location of a finger when touching the screen, this X,Y number is computed in amazingly less then 8 milliseconds giving virtually instantaneous response. Simple software which can be written in Basic, C, Pascal or assembler etc can be used to decode these real time numbers for a host of applications where keyboard input is not practicable, possible or desired. The mechanics of the touch screen offer some most useful features such as unaffected by dirt or grease buildup, fully protected against radiated interference and electrostatic voltages up to 25KV, impervious to liquids, may be written on with felt tip pen, metallic objects ignored. Plus many more too numerous to mention here. Just a few of the 1000's of possible applications include:



Point of Sale Terminals. Multiple answer response when used with the touch screen placed in front of a monitor or over diagram / plan - eliminates need for keyboard skills or fragile mouse.



Control Panels and Automation. Use with or without a video monitor, coloured card or lighted panel may be placed behind touch screen, just imagine a control panel with 2,000 switches in a space only 11" x 9" !!



Disabled Persons Computers / Controllers. Any area from a few pixels to a whole screen can be defined for touch response, ideal for machine / computer interface for persons with limited co-ordination / movement or computer training. For instance use of a finger in Windows instead of a mouse or even direct 'finger painting' onto CRT.



The applications for this item are only limited by your imagination !!

Unit supplied complete with mounting frame, data sheet, fully assembled controller PCB which connects direct to touch screen via 9 way 'D' plug. Controller outputs data via serial RS232 connection which is connected direct to PC serial port. Supplied complete with fully enclosed power supply. RFE Fully Tested & Guaranteed for 90 days.

Normally over £420! Our Price Only £145.00 (B)

Touch Screen:

Overall panel dimensions: 11 3/4" x 9 1/2" Analogue output to controller via 9 way 'D' plug.

Controller:

Fibre glass PCB dimensions 7 1/4" x 5 1/2". Touch screen input via 9 way 'D' socket, RS232 serial data i/o via 25 way 'D' socket. Power supply requirements +5v DC 200 ma ±12v DC 100 ma. each rail.



FREE MicroTouch SOFTWARE

To enhance the use of the **MicroTouch** touch screen system, a full suite of software and drivers with accompanying documentation is available, including the latest patches and drivers for other computers such as Amiga & Macintosh - call the **MicroTouch** bulletin board on (USA) 0101 508 683 0358 up to 9600 baud supported.

TouchWare. Software system compatible with DOS, Windows and Windows NT, provides full mouse emulation via touchscreen.

TruePoint Touch Monitor. Full demo software, Diagnostic, Configuration etc.

DrivePoint. TSR software program to greatly simplify custom programming. The drivers functions can be called (via software interrupt 17h) from programs written in Basic, C, Pascal, or Assembler.

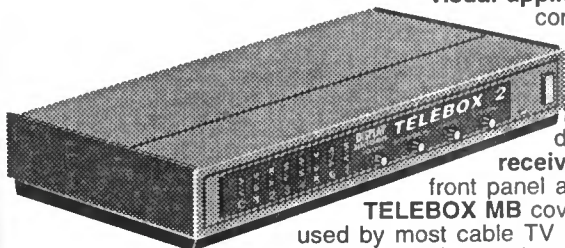
Pad Manager. Full utility for a programmer to easily define touch zones or pads (up to 2048 on one screen !!). Pads and zones may be defined as buttons or menu options. Use of the Pad Manager saves performing tedious calculations and drastically reduces implementation to a few commands.

**Complete PC Software Pack
 with full manuals £29.00 (A)**

The complete software pack (4 disks) for IBM PC with printed manuals is also available from us:

The Amazing "Telebox"

Computer type video monitors, are by necessity, constructed to a much higher standard than domestic television receivers. Better electronics and far higher definition CRT tubes are chosen to give long term reliability and superior picture quality. Very often costly computer type monitors are under-utilised by being dedicated to a particular computer system - and then only being used for computer purposes. The Display Electronics TELEBOX will enable the same dedicated computer monitor to be used for a host of other audio visual applications, giving more effective use of equipment, for instance - connect direct to a composite video monitor and you instantly have a quality 7 channel colour TV !!



The TELEBOX consists of an attractive fully cased mains powered unit, containing all electronics ready to plug into a host of video monitors made by manufacturers such as MICROVITEC, ATARI, SANYO, SONY, COMMODORE, PHILIPS, TATUNG, AMSTRAD and many more. The composite video output will also plug directly into most video recorders, allowing reception of TV channels not normally receivable on most television receivers (TELEBOX MB). Push button controls on the front panel allow reception of 8 fully tuneable 'off air' UHF colour television or video channels.

TELEBOX MB covers virtually all television frequencies VHF and UHF including the HYPERBAND as used by most cable TV operators. Composite 75 Ω and RGB video outputs are located on the rear panel (RGB outputs on RGB version only) for direct connection to most makes of monitor. Measures 15¼W x 6½D x 3¼H. For complete compatibility - even for monitors without sound - an integral 4 watt audio amplifier and low level Hi Fi audio output are provided on all models. Also ideal for low cost video / audio source for Desk Top Video applications.

Order As:	TELEBOX ST	Standard unit with composite video and audio outputs.	£34.95
	TELEBOX STL	As ST - with fitted integral loud speaker.	£37.50
	TELEBOX MB	As type ST but fitted with Multiband tuner for VHF, UHF and Hyperband.	£69.95
	TELEBOX MBR	19" Rack mount PRO version of MB, BNC video output . XLR Audio. etc.	£175.95
	TELEBOX RGB	As MB but with added RGB and composite sync outputs.	£89.50

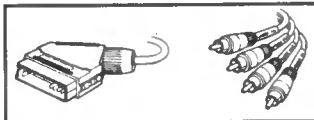
All Teleboxes are shipping code (B)

RGB Telebox also suitable for IBM type multisync monitors with RGB analog & composite sync inputs down to 15.625 kHz. For sync on green / overseas and custom versions VHF and UHF please call. SECAM / NTSC versions not available. Colour CRT required to see a colour picture. Cable outlet required to receive signals in Hyperband. Unit will not make tea!

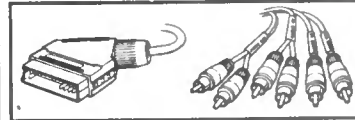
**SPECIAL OFFER
FOR NON SIGHTED PERSONS.**
A special version of the TELEBOX is available for use as a 'TV sound only tuner'. Complete with internal speaker It is offered at a concessionary price inclusive of shipping and VAT **£45.00.**
Available to sight impaired persons only.
Order as: TELEBOX B-ST

SCART / PERITEL CABLE SPECIAL

As used on most types of video recorders and televisions. These cables enable direct connection of audio and video signals from equipment to equipment. Far superior pictures and sound quality can be obtained, especially when copying from tape to tape. Both types fitted with phono plugs and 1.5 Meters long.

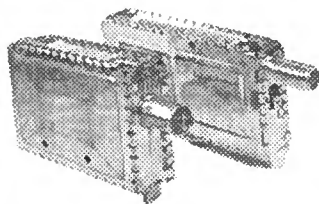


SC1 2 Video and 2 Audio connections **£5.95 (A)**



SC2 2 Video and 4 Audio connections **£6.95 (A)**

TV & Satellite Front End Tuner Modules



BIG DISCOUNTS FOR QUANTITY - CALL

Used in a host of applications including most TV's and VCR machines. Front end tuner units take care of the wide band television signals which are constantly in the atmosphere (when being transmitted)! The TV aerial or satellite LMB output signal is connected directly to the tuner and the internal electronics and selectivity, by various means tune to the particular frequency required. Two methods of tuning are generally used, Varicap and Phase Lock Loop. Varicap tuning simply uses a DC control voltage via a variable resistor, and as the voltage decreases or increases so the tuner linearly tunes through the required frequency spectrum. The phase lock system uses external digital logic which counts the output frequency (normally supplied by an internal ÷256 divider) and enables stable locking of the required frequency via a digital method. The outputs of the following tuners are at a standard IF frequency of 38 Mhz. All tuners are supplied with data sheets on request.

PHILIPS U341 LO Covers the UK UHF TV frequency band, (431 to 855 Mhz) varicap tuned by external DC voltage 0 to 32 volts. Signal input via co-ax cable, Operates on 12 V dc. Dimensions 18 mm W x 55 mm H x 87 mm L Tested NEW RFE **£8.95 (A)**

PHILIPS UV615S. Most versatile tuner, varicap tuned with a frequency coverage from the bottom end of the VHF to the top of the UHF TV spectrum in 4 DC switched bands, (48.25 to 112.25 Mhz, 119.25 to 294.25 Mhz, 303.25 to 423.25 Mhz and 431.25 to 855.25 Mhz) this includes the *mystical* HYPERBAND as used by most cable TV companies and not receivable on most TV sets, indeed, the very same tuner as used in the MB TELEBOX. The Printed circuit mount tuner requires 12 volts to operate with a DC voltage spread of 0-32 for tuning. Dimensions W 19 mm, x H 55 mm x L 85 mm. Co-Ax socket input. **Brand New £16.95 (A)**

PHILIPS U743/600 Covers the UK UHF TV frequency band, varicap tuned by external DC voltage. signal input side mounted via long reach (32 mm) co-ax socket. Operates on 12 V dc. Tuner case Dimensions W 20 mm, H 38 mm case L 66 mm + 33 mm connector snout, **Brand New £9.95 (A)**

SHARP BSFA75G08 Standard tuner for satellite receiver applications. Frequency coverage from 950 to 1750 Mhz. Phase lock loop tuning. Requires 12v dc . Input via screw type 'F' connector socket. Dimension 13 cm L x 1.7 cm W x 4.6 cm H **LARGE QUANTITY & BIG DISCOUNTS AVAILABLE - Brand New £10.95 (A)**

THE LOW COST PC SPECIALISTS!

LARGE QUANTITIES AVAILABLE - CALL FOR VOLUME PRICING

8088 XT PC-99 COLOUR

A perfect entry machine with 8088 processor and CGA colour monitor in good used condition and guaranteed for 90 days. Fully IBM PC compatible.

- High Quality - USA made
- 256K RAM fitted - expandable to 640K
- 360K double sided 5¼" floppy
- 2 serial and 1 parallel ports
- MS-DOS 4.01 included
- High quality keyboard
- Complete with 12" CGA colour monitor



Optional Fitted Extras - and they really are optional - the basic PC-99 above is fully operational on its own.

• 640K RAM	£39.00
• Second 5¼" 360K floppy (or 720K)	£29.95
• 20 megabyte internal hard drive with controller	£79.00

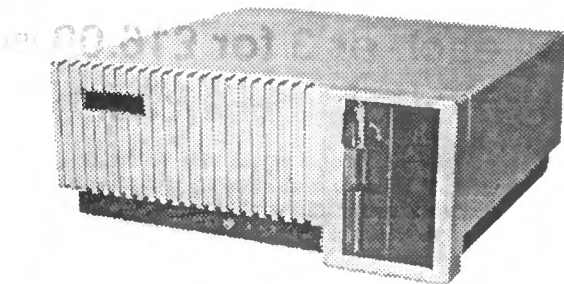
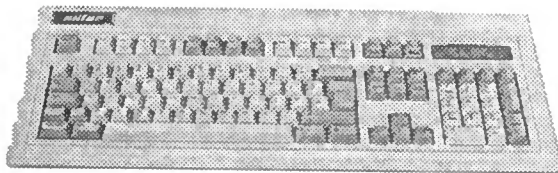
£99.00 (E)

**PRICE
BREAKERS**

HIGRADE 286

For the serious home user or small business.
Supplied in good used condition
and fully guaranteed, just compare this spec:

- 3MB RAM installed
- 12 Mhz Landmark speed
- 1.2 meg 5¼" floppy
- 40 megabyte hard drive
- Complete with MS-DOS 4.01
- EGA video board fitted
- 2 serial ports 1 parallel
- Co-processor socket for 80287
- Complete with high quality keyboard



Optional Fitted Extras for the HIGRADE 286 -

• 256k VGA graphics card	£29.00
• 1mb SVGA graphics card	£49.00
• 1.4Mb 3½" Floppy Drive (instead of 1.2 Mb)	£25.95
• NE2000 Ethernet (Thick, thin or twisted)	£49.00
• Maths Coprocessor 80287 FITTED	£29.95
• Forefront MTS-9600/S or /H SVGA - SAVE	£10.00

A very highly specified 286 PC which defies its price and really made to last with all metal construction and small desktop footprint. Comes complete with: 101 Key enhanced keyboard, and with 3 Megabytes of total memory you have room to spare with all your applications. What's more you can save £10 on the purchase of a Forefront MTS-9600 SVGA multisync monitor when purchased together with the HIGRADE 286 system. *Display Electronics - unbeatable for value !!*

£149.00 (E)

Solid State Relays

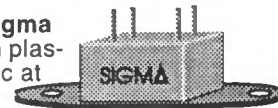


International Rectifier type D2402 thyristor output solid state relay rated at **2½ amps** in the range 48 to 280 vac. Minimum control voltage is 3 vdc at 2 ma with a maximum of 32 vdc. Single pole, normally open. Normal input impedance is 1500W. The 1 second RMS overload current is 5 amps and the peak blocking voltage is 500 volts. Solid state relays have many advantages over the magnetic type, particularly reliability, no contact bounce and zero voltage point turn on and zero current point turn off. Screw (not supplied) terminals and brand new. Dims: 2¼" L x 1¾" W x ¾" H.

£6.95 each (A) 5 for £26 (B) 50 for £235 (D)

Sub Miniature 7 amps - 240 vAC

Measuring only 2-1/2cm x 1-1/2cm x 1cm this miniature single pole single throw **solid state relay** by Sigma type 226RE-2-12A1 exhibits an enormous switching capability of **7 amps at 240 v AC**. Encapsulated in plastic on a metal mounting plate which bolts down to the chassis or heatsink in TO-3 spacing. Needs 12 vdc at 13 ma to energise. Use solid state for nil bounce!



£6.95 each (A) 5 for £34 (B) 50 for £225 (D)

High Power Solid State Relays

25 Amps - 240 vAC



Only slightly larger physically, than the Sigma yet able to **switch a load of 25 amps** at 240 volts AC. Control voltage can vary between 3 and 30 volts DC. At 3 volts it draws 2 ma, at 15 volts about 10 ma. Mounting holes are 1-3/4" apart. The body of the relay measures 1-1/8" L x 1" W x 3/4" H. Screw fixing. Brand new prime stock from Grayhill model 70S2-03-C-25-S.

£12.95 each (A) 5 for £57 (B)

30 Amps - 240 vAC



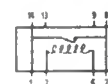
Cordos Model GB2600-602 very high capacity solid state relay with a rating of **30 amps at 240 vAC**. Trigger voltage is 20 vDC at about 8 ma. Connection is standard 0.25" push on or solder connectors. Measurements are 1-3/4" L x 1-1/2" W x 1" H.

£8.95 each (A) 5 for £43 (B)

HEATSINKS RECOMMENDED WHEN USED WITH HIGH POWER

Dual-in-Line Reed Relays

Lovely little dual-in-line single pole normally open dry reed relay. DILR-5 is nominally 5 volts and DILR-12 is nominally 12 volts DC. Both have an operational spread of about 20%. Coil impedance is 500 and 550 ohms respectively. The circuit diagrams of DILR-5 and DILR-12 are the same except that the coil of DILR-12 is connected to pins 2 and 9 rather than 2 and 6. Dimensions, of course, are the same as for a 14 pin dual in line integrated circuit. An overstock position permits us to offer both of these relays at the same price - and you may mix or match!



3/£3.95 10/£9.50 25/£19.95 (A) 100 for £75 (B)

KEYSWITCH Time Delay & Flasher Relays

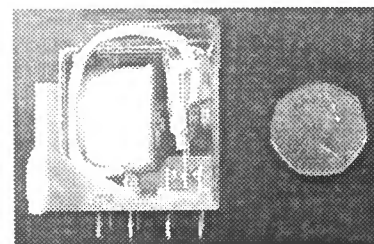


Keyswitch Model SZA 20 time delay before energising relay. Delay is adjustable by a knob on the face between 100 and 1000 seconds. The supply voltage is dual, 220 vac or 24vdc. Relay contacts are rated at 240vac and 15 amps maximum. Standard 48 wide DIN case. Similar to above, Keyswitch SZSD 20. Delay is adjustable from 3 to 30 seconds. The supply voltage is 110 vac or 24 vdc. Keyswitch Flasher Relay Model SZB 20. The unit will accept three different supply voltages: 24vdc, 24vac or 220vac. Choice of flashing times: 1 or 2 per second. It will flash loads up to 3 amps. Ideal for "Piccadilly Circus" lights, attention getting displays and all similar applications.

Either type only £5.95 (A) each or 3 for £16.00 (B)

12v DC Coil, 15 amp Sealed Relay

High quality ARROW relay type MSA30-40 fully enclosed in clear acrylic case. Two separate changeover silver tungsten contact pairs rated at 15 amps AC / 10 amps DC are brought out to solder tags which will also accommodate standard 0.25" lular push on tags. A neat feature is the pre drilled nylon mounting lug which allows the relay to be fixed at any angle on almost any surface. The 12v dc coil is ideal for all automotive and general alarm applications or just as a general purpose relay for the spares box or repair kit. Overall dimensions inc lug length 6.3 cm H x 3.5 cm W x 4.8 cm D

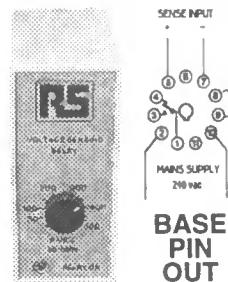


Only £3.75 each (A) 3 / £9.50 (A)

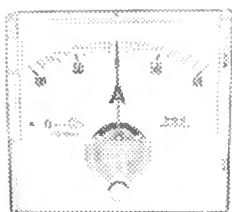
Voltage Sensing Relays

Plug in voltage sensing relays designed to monitor voltages. The user sets a voltage on the front panel dial, when that level is reached, the relay contacts changeover. They release when the triggering voltage drops by 10% or is removed. A resistor may be wired between pins 8 and 9 to increase this hysteresis by about 75%. Shorting these pins causes the contacts to latch when energised. The supply voltage is 225-250 vac at 2.5 va consumption. The sensing voltage range is 50-500v ac(peak)/dc. Contact ratings are 10 amps to 380vac, 10 amps at 25vdc and 1 amp at 250vdc. A front panel LED is provided to show when the relay is on. Dims:3" x 3" x 1-3/8". The octal type base is 11 pin. R S Components Ltd number 348-605. Data sheet included. Ideal for all voltage sensing and control applications.

£19.95 each (A) 3/£55.00 (B)

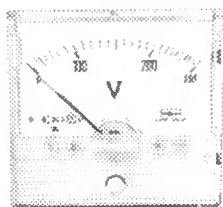


Moving Coil Meters



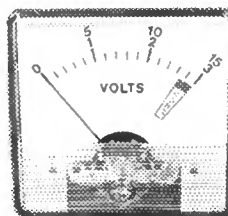
Centre reading milli-volt meter full scale 100 mv dc. The face measures 70 cm square, face in front of panel is 13 mm and 40 mm is required behind the panel

**£7.95 (A)
3/£21 (B)**



300 vac full scale with built in shunt resistor. 70 cm square face, 13 mm thick. A removable rubber gasket is also included. Needs 40 mm behind the panel.

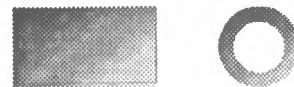
**£7.95 (A)
3/£21 (B)**



1 ma basic meter dual scaled 15 and 3 vdc. Requires external 15K and 3K resistors if scales are used as is. 60 mm square face 10 mm thick, 20 mm required behind panel.

**£3.95 (A)
3/£11 (B)**

FERRITE TUBES



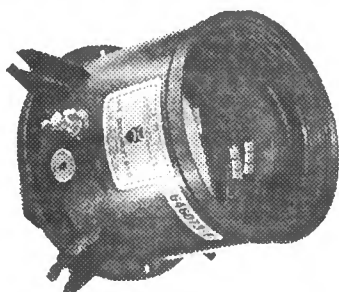
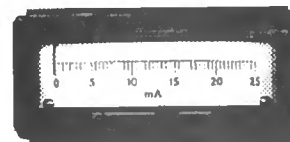
Used for a host of applications including simple chokes, RF1, TVI and general interference suppression etc. Dimensions 17mm long x 9.5 mm diameter with internal bore of 6.5 mm.

**Pack of 16
Only £1.99 (A)
Large qty available**

Ruggedised 25 ma Panel Meter

Direct reading 0-25 ma 65mm scaleplate. Made to the highest spec for BT this fully ruggedised and hermetically sealed edgewise panel meter lends itself to a host of applications. May be used stand-alone or panel mounted via 70 X 33 mm cutout.

£6.95 (A) 3/£18 (B)



Ultra High Precision Hybrid Lens

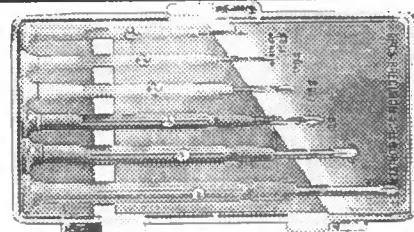
Perfect for all sorts of DIY and experimenting jobs! Delta 20 lens assembly from US Precision Lens Inc as used in high quality projection TV systems. Focal length is two inches and the lens diameter is three and three quarter inches. Complete with four integral mounting brackets and adjustable focussing ring which can be locked in place with a butterfly nut. Illustrated without lens hoods. Brand new - must have cost a fortune to make - but our price is

Only £15.95 each (B) 2/£31.00 (C)

Colour Coded Jeweller's Screwdrivers

Jeweller's precision type screwdrivers in either Philips or slotted and each one has a colour coded plastic grip for easy identification. Slotted in six sizes from 1 to 3.5mm; Philips #0-4 to #1-1. Order PH for Philips or SL for slotted.

Either type £2.49 each or both for £4.50 (A)



Infra-Red Remote Controls

Brand new state of the art infra red remote controls for use with TV's, VCR's Stereo's and other appliances. Almost all of the electronics is contained in a D6124 CMOS LSI chip. The transmitted frequency depends on a ceramic resonator with a frequency between 400 and 500 KHZ. Comes with a 455 KHZ one installed which may be easily changed; the final frequency is the resonator frequency divided by 8 and by 12. Only measures 5-3/4"L x 1-1/2"W x 1/2"H. A very complete data sheet for the D6124 is included on request.

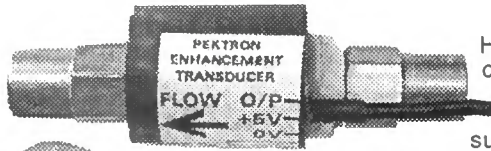
LARGE QUANTITY AVAILABLE

Only £3.95 each (A)- 5/£15 (B) 25/£50 (B) 100/£175 (C)

BIG £ SAVER



Liquid Flow Transducer

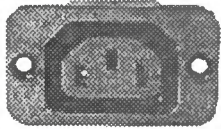


Here's an interesting one for the handyman or the experimenter. These transducers convert the amount of flow of non-corrosive liquid into output pulses. For instance a flow of 10 fluid ounces through the transducer will give 200 pulses out. Output pulses follow the flow rate proportionately. Maximum pressure 80 psi and the unit uses 5vdc supply. By the simple addition of a 1K pull up resistor on the output, the unit will inter-

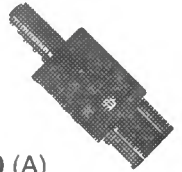
face direct to CMOS or TTL etc. These transducers are hand made by Pektron and each one is individually calibrated. Wire colour coding is noted on the body of the transducer. Overall measurement of the body is 4"L and 1.5"D at the thickest point. Both inlet and outlet pipes are fitted with a standard BSP threaded coupler. Brand new of course and regularly priced at about £150.

Only £22.95 each or 3 for £60.00 (A)

IEC and Mains Plugs/Sockets/Cables



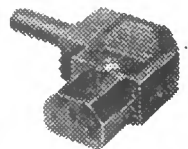
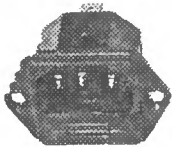
As used on most computers and printers.
All are rated at 240 volts AC.



IEC-1	Standard rewirable 3 pin male in line plugs. Screw fitting. 10 amps	£1.50 (A)
IEC-2	Standard rewirable 3 pin male in line sockets. Screw fitting. 6 amps	£1.25 (A)
IEC-3	Standard chassis mount male sockets with integral 20 mm fuse drawer. 6 amps	£1.20 (A)
IEC-4	Chassis socket as above with built in DPDT rocker switch	£2.25 (A)
IEC-5	Quality moulded 13 amp mains plug on 2 metres of cable terminated in standard IEC moulded female plug	£3.95 (A)
IEC-7	2 metre IEC extension cord. Straight female socket to shrouded male plug	£2.50 (A)
IEC-9	Chassis mount IEC socket with two integral fuses	£2.20 (A)
IEC-10	Right angled re wireable 3 pin cable mount socket with grommet.	£1.99 (A)

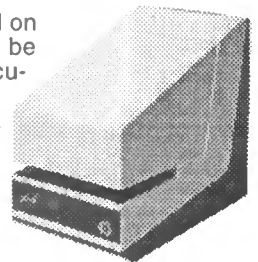
MIX OR MATCH DISCOUNTS

10 to 49 = Less 5% (B) 100 up = Less 10% (D)



Automatic security Time And Date Document Stamper

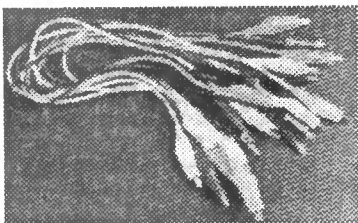
BIG £ SAVER
Heavy duty automatic time and date security stamping machine. **Facile Model 33**. Often used on clock cards or for Security stamping of documents where a reliable and secure time and date can be stamped on to a document or form, rather than hand written. Time and date can only be set via a security key and lock (key supplied) The date may be set in either DD-MM-YY or MM-DD-YY formats and the time is in 24 hour format. 220-240 vAC 50 Hz operation. Attractive two tone beige. Replaceable ribbon. Measures (at highest point) 8"H x 8"L x 5"W. Excellent used condition - fully tested & guaranteed.



Regular price is £345 - our price **Only £149.00 (B)**

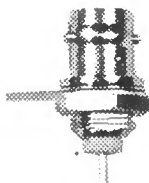
'CROC' LEAD KITS

A must for every bench or toolkit! Kit comprises of 10 x 10" long coloured clip leads each end terminated with an insulated crocodile clip - save hours on hookups / experiments etc.



£2.99 per pack of 10 (A)

½ Price - High Grade BNC Sockets



Greenpar Ltd. D84-16. Chassis mount 75 ohm BNC socket with PTFE inner and gold plated inner. Supplied complete with solder tag and lock nut. Order as GNBNC.

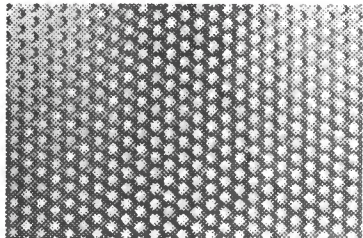
70p each or 10/£6.25 (A)

Amphenol 31-10. **ISOLATED** chassis mount 50 ohm BNC socket. Socket features solder tags for both the inner and outer connections. Supplied complete with nut and locking ring. Order as AMBNC.

90p each 10/£7.50 (A)



LARGE QTY AVAILABLE CALL FOR PRICING



Aluminium Grill Piece

Remember those times you said to yourself "why don't I have a piece of that?" - usually on a Sunday when everything is closed! Just such an item is aluminium grill sheeting. These handy sized sheets measure 9-1/2" x 5" and are 1-1/2 mm thick. The holes are 1/8" diameter. One side is polished so it is ideal for dress up jobs. Buy while you think about it!

2 sheets for £1.00 10/£4.50 (A)

Unbreakable !!! Plastic Sheet

Incredibly strong and only 2.5 mm thick. - strong isn't the word - the test we gave it was to hit it with a 5 Kg sledge hammer from above ones head !!! **It didn't break, mark or crack !!** Just the thing for those **very secure** applications. Makrolon sheet is polycarbonate based and amazingly strong - and therefore expensive. These particular panels were cut drilled for a particular application to cover some high voltage equipment. Cut up and use for your own application..... Tinted 'see through finish' 16.5" x 17.75" **Brand New**

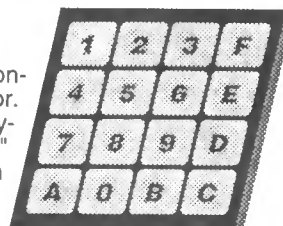
2 sheets for £9.95 (A1)



Hundreds of applications lend themselves to the following items: Alarm Systems, Data Entry, Security, Car Alarms etc etc. And at these prices

High Quality Miniature Hexadecimal

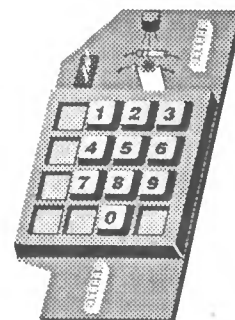
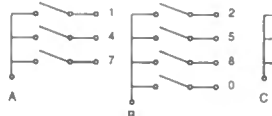
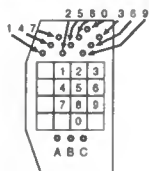
Grayhill 83BC1. Lovely little hexadecimal keypad. New miniature hexadecimal keyboards with a straightforward connection. Each key has one terminal common to them all and one brought out to its own individual connector. Connection diagram on request. **Perfect for any project which needs hexadecimal input.** Black keyboard body and bright white keys with black lettering. The keyboard measures 2" square and stands 3/8" above the mounting panel or printed circuit board. Pads are sculpted and measure 3/8" square. Nice firm key action - a beautiful piece of brand new surplus.



£7.95 each (A) or 5 for £37.95 (A1) or 50 for £350 (C)

Heavy Duty 10 Digit Keypad

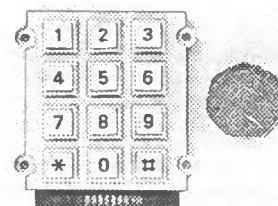
As used in pay type telephones, this versatile heavy duty general purpose 10 key keypad arranged in the matrix shown in the sketch (the connections to the PC board are also illustrated,) lends itself to a host of applications. The keyboard is mounted on, and forms part of, a 6" x 3" printed circuit board which also contains a transistor, red LED, resistors and PC board connectors. The keys feature full travel action and are 3/8" high above their mounting assembly, so there is plenty of room for them to pass through a panel. The keys themselves are legended 0 to 9, in bright white on black and measure 3/8" square. The great advantage of this keyboard is the simplicity of the matrix, making it ideal for 100's of applications such as digital locks, access or security systems etc.



£3.95 each (A) or 5 for £14.95 (B)

12 Button Telephone type Keypads

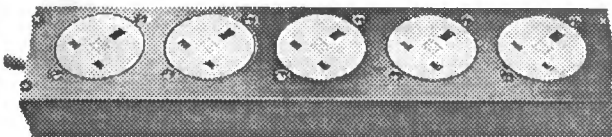
Top Grade keypad made by ALPS type 11KE013A. 12 full travel keys, double shot moulded with large legends 0 to 9 and * and # all mounted on a very strong ABS white plastic moulding, with four fixing holes for front or rear mounting. Internally the normally open pushbuttons are protected by an all over rubber shield making the keypad impervious to dust and liquid splashes. For long term reliability the switches are constructed on a gold plated printed circuit board for good conductivity and low contact bounce. Electrically the switches are on a 4 x 3 matrix with all outputs brought out to 7 solder pads on 0.1" pitch. Overall dimensions 2 3/4" L x 3 1/4" W x 3/4" D.



£1.95 each (A) 10 for £17.00 (B) 100 for £150.00 (C)

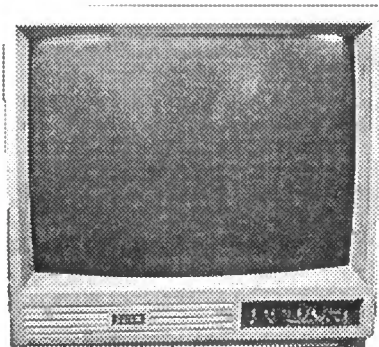
Five Outlet Mains Distribution / Extension Block

High quality 5 way 13 amp socket mains distribution blocks, not the type sold in your local hardware store. Unit features 5 top quality MK 13 amp flush mounted shuttered sockets manufactured to BS 1363, all housed in a heavy gauge, plated steel, totally enclosed box with cable entry at rear. The box is earthed. Sockets are mounted on a 45 degree angle so that the plug cables flow neatly away from the block. Overall dimensions 13"L x 3"W x 1-1/2"H. **Hundreds of uses** for workshop, garage or quality equipment racks etc.



£12.95 each (B) or 3 for £35.95 (C)

Multisync Monitor Madness!



20" SVGA Multisync Monitor

BIG £ SAVER

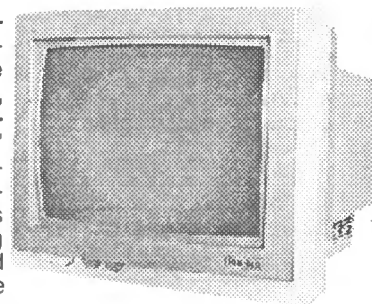
For those who think size really matters! The Microvitec 20H727E 20" Multisync monitor can accept CGA, EGA, VGA, SVGA and the Archimedes, Amiga and the Atari. Its large area makes all your applications larger than life. Scanning frequencies: Horizontal 15-36KHz, Vertical 45-100Hz. 0.31mm dot pitch. Measures 18½"W x 19½"D x 16¾"H. Supplied in good used condition (possible minor screen burns). We have limited stocks so hurry!

Only **£375.00** each (F)

SAVE £10 WHEN PURCHASED WITH HI GRADE 286

SVGA Multisync / Multimode 14" Monitor

A beautiful monitor: the 14" Forefront Model MTS-9600 Super VGA multisync with resolution of 1024 x 768 and 0.28 dot pitch. This monitor features a multisync capability, down to 15KHz, not found in many other types of monitor, this feature enables direct connection to a host of computers such as all types of compatible IBM PC's, in CGA, EGA VGA & SVGA modes, BBC, ARCHIMEDES, ATARI, AMIGA (Inc A1200), SINCLAIR and with the 9600/H model the high resolution monochrome mode of the Atari. A "Text" switch is provided for word processing, spreadsheets and other text based programs plus an overscan switch. The modern case styling and the **deep etched non-glare screen** makes this monitor particularly restful on the eyes and convenient to use. Contrast, brightness and On/Off controls on the front with horizontal and vertical sizing and vertical positioning controls on the rear. Scanning frequencies: Horizontal 15.625-37KHz, Vertical 50-70Hz. Measures 14"W x 14"D x 12"H. Supplied in excellent used condition (possible minor screen burns) and guaranteed for 90 days. Probably one of the best buy in monitors that we - and certainly you - will ever have!



Order as 9600 / S for IBM, COMMODORE, BBC SINCLAIR etc.

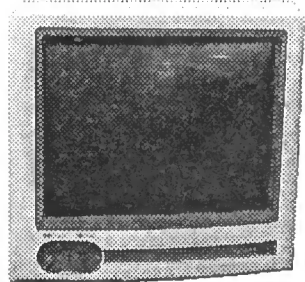
Order as 9600 / H for all above computers + ATARI HI RES

Custom switchbox unit for ATARI ST to switch between colour and mono hi res modes

Tilt & Swivel Stand for Forefront

£129 (E)
£149 (E)
£25 (A)
£15 (A)

12" VGA Multisync Monitor

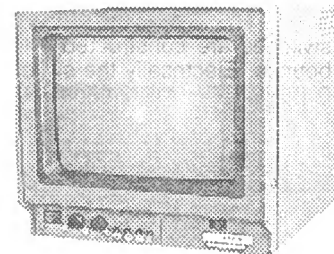


The Electrohome ECM-1211SBU VGA multisync monitor with resolution of 640 x 480. Multi input selection; 9 pin CGA/ EGA type connector; 15 pin Hi-density VGA type connection or 5 BNC connectors. 0.31 pitch. Front panel controls are for brightness and contrast, A "Text" switch is also provided for word pro use. **Compatible with PCs, Amiga, Atari** and others. Measures 12"W x 14½"D x 12"H. Supplied in good used condition (possible minor screen burns). Full 90 day guarantee.

Only **£99** (E)

9" VGA Multisync Colour

An incredible feat of design; The KME17M1005 9" Colour VGA multisync monitor has multiple inputs: 9 pin CGA/ EGA type connector; 15 pin Hi-density VGA type connection or 6 BNC connectors. 0.28mm Dot pitch. Front panel controls are for brightness and contrast, horizontal and vertical size. A front flap conceals adjustments for height / width for all the different types of input. Ideal as a second screen for CAD / CAE or just where size is important. Scanning frequencies: Horizontal 15.625-40KHz, Vertical 40-90Hz. Measures 10¼"W x 12½"D x 10"H. Supplied in good used condition (possible minor screen burns). Guaranteed for 90 days.

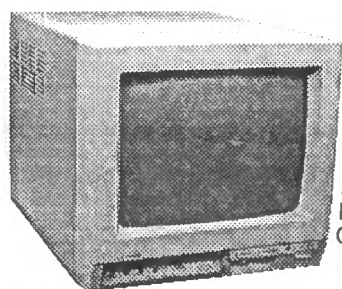


Only **£195** each (E)

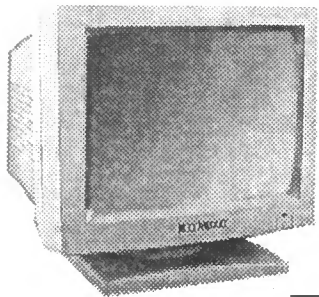
And another 9" VGA Multisync !

NEC Model CMV103NE. 9" Colour VGA multisync monitor has a single 9 pin 'D' connector. Will accept VGA signal with supplied adaptor, and CGA and EGA with normal 9 pin connection. Will also accept an RGB input with the sync on green, dual BNC connectors allowing 'Daisy chaining'. Measures 10¼"W x 9½"H x 14"D. In good used condition (possible minor screen burns). Guaranteed for 90 days.

Only **£179** each (E)



Lynwood 14" SVGA Colour

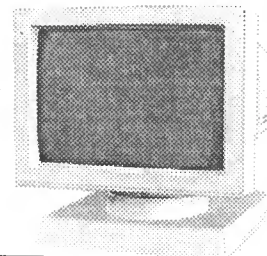


Lynwood model M14C A very modern case design along with a high resolution tube make this monitor an absolute bargain! It has a tilt and swivel base and side mounted controls for contrast and brightness. The tube has a 0.28mm dot pitch. Input is via a 15 pin high density VGA type connector. This monitor has dual scanning frequencies of 31.5 and 35.5 KHz. Maximum resolution 1024 x 768 (Interlaced). Rear controls adjust horizontal and vertical width along with other adjustments. In excellent hardly used condition and fully guaranteed for 90 days.

Only £129.00 (E)

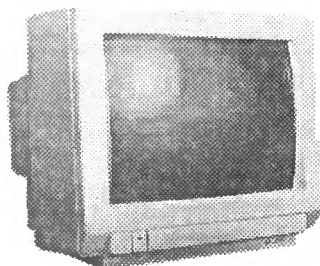
9" VGA Monochrome Black & White Monitor

A delightfully compact unit. Resolution is **standard 640 x 480**. Standard 15 pin Hi-density connector. This unit was manufactured for a point of sale system and is completely standard apart from the tilt/swivel base under which the 240 v AC power and signal cables emerge. The brightness control is on the front. The power switch, contrast, vertical size and horizontal adjustment are on the rear. Measures 9"W x 9½"H x 10"D. Supplied in good used condition (possible minor screen burns). Full 90 day guarantee.



Only £69 (E)

14" CGA / EGA Monitor



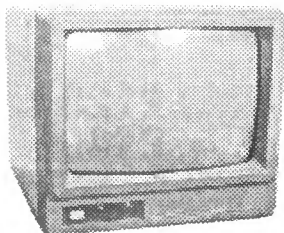
By Philips the 9CM073 14" EGA/CGA monitor. Features both horizontal and vertical shift controls together with the normal contrast and brightness, all front panel accessible. This monitor also has a text mode switch and both amber or green text is selectable, making it ideal for users who do a lot of word processing or spreadsheet work yet still need 640 x 350 graphics capability. Housed in an attractive modern style cream case. In good used condition (possible minor screen burns) with 90 day guarantee. Measures 14"W x 12"H x 13½"D. Input is via a standard 9 pin male socket.

The perfect choice with
the HIGRADE 286.

**BIG £
SAVER**

Only £99 each (E)

10" EGA Monitors



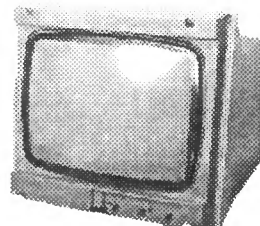
A super deal on state of the art 10" EGA monitors by KME model 15M10004, featuring a high resolution tube for superb clarity. Connection is via a standard 9 pin female D connector. Front panel controls are brightness and contrast, rear panel are focus and sub-brightness. Link selectable at rear for 100/120/220/240 vac. Housed in an attractive two tone brown metal cabinet which matches nicely the dark etched non-glare screen. Measures 12"L x 10"W x 10"H. A tremendous buy in high resolution monitors. In excellent used condition with a 90 day guarantee.

Only £99 Each (E)

£49 !! 12" CGA Monitor Bargain

**BIG £
SAVER**

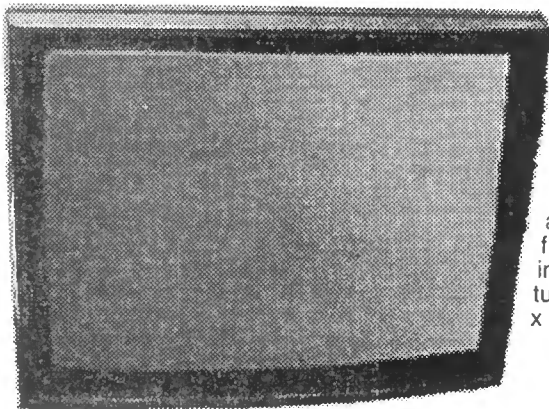
That's right - you read it correctly - a 12" IBM- PC CGA high resolution colour monitor for only £49! How can you refuse that offer! **Runs straight off any PC** or compatible with a standard CGA card. Housed in an attractive two tone grey plastic case with a useful anti glare escutcheon which doubles at the top as a carrying handle.. Three unobtrusive controls on the lower front - Contrast, Brightness and Power. Also features a degaussing control plus vertical and horizontal holds on the rear panel. Measures 16"D x 13"H x 13"W. Supplied fully tested with a full 90 day guarantee. The cosmetic only front trim has been removed for contractual reasons. possible minor screen burns. Buy whilst we still have stocks!



Large Quantity Available - Call for pricing

Only £49 Each (E)

Barco 26" FST RGB + Composite Monitor



Model OCM 2840R. This beautiful professional grade large screen monitor is ideal for presentations and for those who need a high quality screen. The unit has an FST tube with a glass cover (Possible minor screen burns). Has both RGB and composite video inputs, with in / out connections for daisy chaining. All the controls are discretely mounted on the rear of the unit. Has internal modular construction for ease of servicing. Fitted with side mount threaded bushes for bracket mounting or ceiling suspension. Ideal for use with the Philips Laservision player VP410 featured in this issue or any other high quality video application. Measures W24" x H20" x D18½. Limited Quantity Available.

Only £399.00 (G)

Sony Trinitron NTSC TV / Monitor

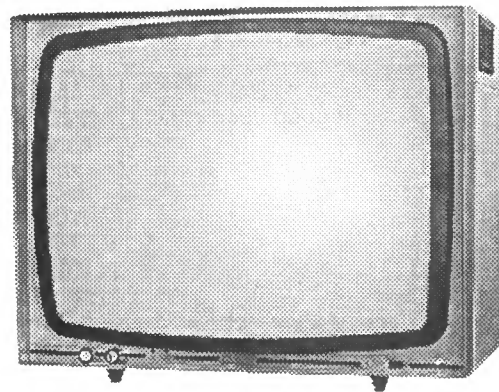
Usual Sony quality item, **Model KT20TR22**. This 20 inch monitor is a high quality NTSC VHF/ UHF television with a standard NTSC composite video input with sound. The mains input voltage is 110 volt 50 or 60Hz, it can of course function on 240 v mains with a suitable step down auto transformer if required. Front panel controls adjust for brightness, volume, contrast and preset tuning. With a Trinitron Tube and very modern case styling this monitor is **perfect for Karaoke** (Most Karaoke Laserdiscs are NTSC) or any other application that requires the NTSC television standard. Measures W20¾ x H19¼ x D19". Supplied in excellent used condition with our standard 90 day warranty.

SPECIAL - Only £199.00 (E)

24 inch Green Screen Monitors

Huge 24" screen size (diagonal) monitors but with a case size of only 22" x 18" x 16". Perfect for clubs, shops, airports and other applications with a **large viewing audience** or where the screen is to be watched from a distance. Standard composite BNC 75 Ω input with a loop through socket for daisy chaining. In **good used condition**, some units may have minor screen burns. Housed in a sturdy metal case with inset carrying handles. Fully tested and guaranteed for 90 days.

Only £65.00 each (E)

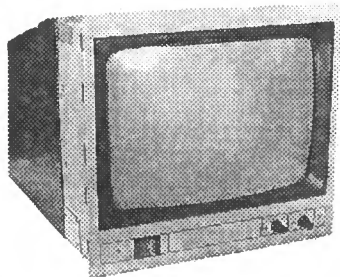


Probably Europe's Largest Range of **LOW COST** video monitors for all applications we have over 5,000 monitors ex stock at any one time.

If your needs are not covered here, please call our sales office.

New products arrive daily.

Super Deal on Analog RGB Monitors Perfect for Amiga & BBC



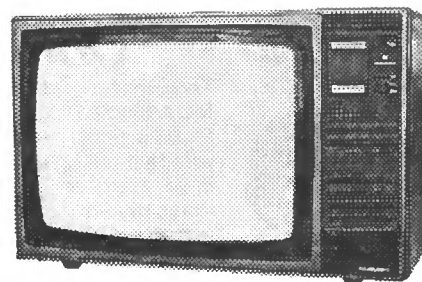
£89.00 (E)

Plus most computers which use analog RGB and combined 15.625 KHz sync (but not the Atari). These are excellent resolution colour monitors at an **excellent price**. They were manufactured for console use but are free standing and enclosed so make a very economical buy as a quality monitor for these machines. The 12" **laser etched CRT** provides particularly high contrast and clarity and the phosphor persistence is such that they are ideal for games and word processing etc. They measure 14"D x 12"H x 12"W and are supplied complete with a data cable for the above machines or with 4 BNC female sockets for others. A termination switch is available on the rear so that the monitor may be used alone or as part of a daisy-chain. Supplied in good used condition (possible minor screen burns) and fully guaranteed for 90 days. Please specify whether Amiga, BBC or BNC connections required.

BIG £ SAVER

20", 22" & 26" **LOW COST** Composite Colour Monitors

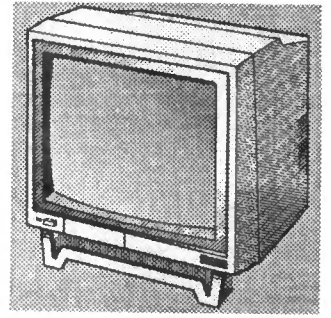
Another bulk purchase of this superb **Rediffusion Mk 4** UK made colour monitor enables even further price reductions on our last advertised price!! Features an integral **PIL tube** with fully isolated chassis utilising state of the art electronics. Features include auto degauss circuitry, auto colour balance and full internal **modular construction** for which we hold a vast amount of spares for **long term technical support**. Housed in attractive teak finish type case to suit any surrounding - home or office. Standard 75 ohm composite video input connects to all forms of video equipment, **ideal for use in Schools, Shops, Disco's, Churches, point of sale and all AV applications**. Supplied in **excellent slightly used condition** with full 90 day RTB guarantee. Dims.(cms) 62W x 46D x 41H. Other available options, integral audio amp, call for pricing.



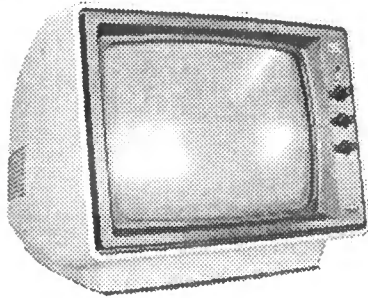
20" ...£135 (E) 22" ...£155 (E) 26" ...£185 (F)

Philips 12" Black & White Data / CCTV Monitors

A recent bulk purchase brings you this **very compact** high resolution video monitor. Made by **Philips type number BM7542 /05G** this monitor will find itself at home for a **host of video applications** including: video camera and surveillance monitors, data computer displays, or point of sale equipment etc. A standard composite video input at 15,625 KHz (+ - 600 Hz) is provided **plus** a low level (100 mV) **audio input** to an **integral audio amplifier and speaker**. Combine these features with the 20 Mhz bandwidth, 850 line resolution and our price and you have **another Display Electronics bargain !!** Inputs are via standard Phono type sockets on the rear panel, with all main controls under a neat drop down flap to the front. Supplied **BRAND NEW** complete with mains cable and 36 page user manual in 99 languages !! (well almost !!)
Dims mm 305 W x 303 D x 280 H



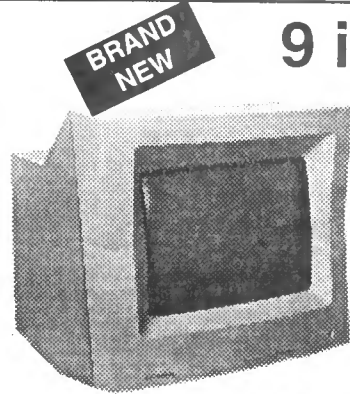
Brand New - Only £69.95 (C)



Bargain 12" Monochrome Displays

12" green screen by NEC, Model JB-1201M(E). Standard 15 khz with composite video input. Output also provided for daisy chaining, both via phono or BNC sockets. Normal brightness, contrast, on/ off/ volume controls on the front with vertical linearity, height, both holds and sub-brightness on the rear. Unusual for a professional use monitor, these also have a sound input and integral speaker. Very attractive swept back case construction in off-white or cream colour. These second user units may have screen burns but carry a three month warranty and are fully tested prior to despatch. Overall dimensions 14"W x 12"H x 12"D.

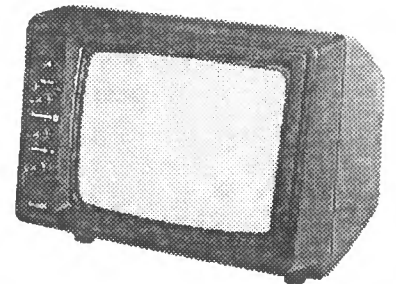
£29.95 each (C) or 10 for £250.00 (G)



Model 901

9 inch Green Screen NEC Monitors

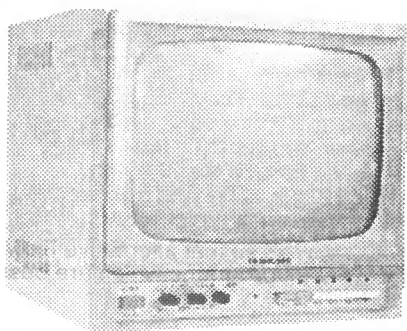
These are **brand new** and boxed 9 inch composite video green screen monitors made by **NEC**. They have deep etched screens for eyeresting non-glare use and the cases are made of tough plastic. **Standard composite 15.625 KHz 75 Ω** video inputs and a switch to optionally route to a high impedance circuit so that a number of monitors can be daisy-chained on one line. An output socket is provided for the optional daisy chaining. Both input and output sockets are standard BNC connectors. The monitors are powered by 220/240v AC by way of a standard IEC male chassis plug. IEC cable supplied. Internal links permit 115v AC operation (902 only). The 901 is two tone grey and its dimensions are 11" x 11" x 11" The 902 is black and measures 9" x 9½" x 10". Superb quality at a knock down price !!



Model 902

Model 901 : £44.95 (C)

Model 902 : £49.95 (C)



High Resolution CCTV Monitor

A super deal on **brand new** Merit 9" black and white monitors for CCTV or any other monitor application. Resolution is **in excess of 750 lines!** 4 composite 0.5 - 2V p-p video inputs are provided via 4 x 5 pin DIN sockets. Individual inputs may either be permanently selected, programmed or automatically sequenced via the front panel switches. A continuously variable speed control on the front panel allows **variable 'dwell'** time for each input. Provision is also made for VCR either input or output, a switch is supplied for Record or Play. A DC supply to power up to four cameras is also provided. Measures only 8½" x 8½" x 9". Many other features including integral audio amp and speaker. Beautifully made in sturdy two tone brown metal case and ideal for all types of CCTV work such as **surveillance of baby rooms**, stores, parking areas, shops plus hundreds of other similar applications. Limited quantities - Note - illustration may differ slightly to product described.

Only £99.00 each (C) 3/£285 (D)

BIG £ SAVER

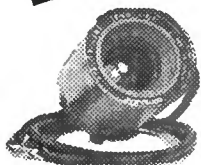
LIMITED QUANTITY

"COMPUTAR" 16 mm f1.3 TV Lenses

To complement any TV video camera system, this top of the range auto iris lens **Computar MCA1613APC** will enhance any video camera. Standard screw thread 'C' mount with focusing ring and lock nut. The lens features **ND filter**, remote control and integral electronics with fast acting **auto iris system** to compensate for all light levels to give the **best possible pictures** in very dark and very bright situations. Connections to the lens enable the composite video signal to automatically control the aperture, with either average or peak light weighting. Requires 8 to 16 v DC at < 30 ma to operate. Supplied complete with instructions. **BRAND NEW & BOXED.**

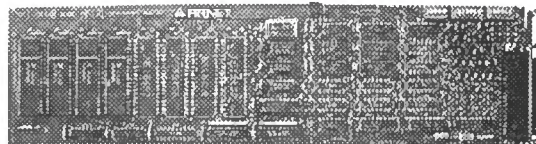
BIG £ SAVER

Current list price £185 - Our Price Only £95.00 (B)



Multiport Expansion Cards

Four way Multiport cards from Arnet Model Multi4 which expand your PC-AT or compatible by adding four serial ports to it. **Brand new** and comes with all necessary software, including diagnostics, on both 720k 3½" and 360k 5-1/4" floppies. Output is via a 62 pin D connector. Comes with mating connector and a split cable terminated in four 25 way D female plugs. An Operators Manual is included which gives very full data on port addresses and so on.

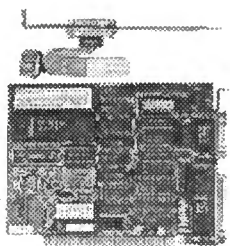


Fully Configurable I/O Card

Only £59.95 (A1)

Suitable for your IBM, PC-XT or PC-AT computer, it will expand your computer to add an additional two serial ports and one parallel port. Short card with one of the serial and the parallel connectors on the end plus a flying leading and mounting plate for the second serial. Comes complete with software, including diagnostics and a full data sheet. In as new condition, fully tested and guaranteed for 90 days.

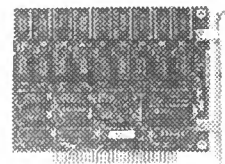
£14.95 (A1) each or 2 for £28.00 (B)



Memory Upgrade Cards

Will increase your PC or PC-XT base memory by either 256k or 512k in 64k steps. They may also be used to fill in RAM above the 640k DOS limit, for special application programs. In as new condition with a full data sheet and fully guaranteed for 90 days.

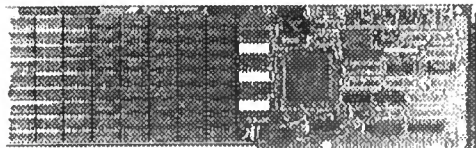
256k£32.95 (A1) 512k.....£48.95 (A1)



Intel 'ABOVE' Memory Expansion Card

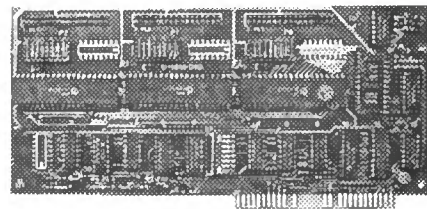
INTEL 'ABOVE' Memory Expansion Board. Full length PC-XT and PC-AT compatible card with **2 Mbytes of memory on board**. Card is fully selectable for Expanded or Extended (286 processor and above) memory. Full data and driver disk supplied. Fully tested and guaranteed. RFE. Windows compatible.

Only £59.95 (A1)



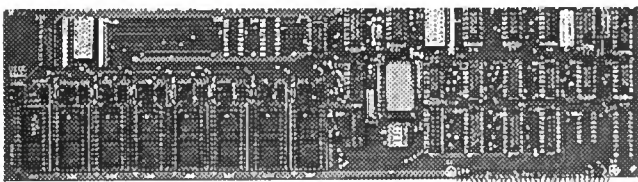
PC Digital Input / Output Card

This is a general purpose digital input and output card, providing six 8 bit parallel I/O ports and six counter timers plus serial data facilities, all under the control of software. Three 65C22 VIA interface devices are used, each of which provides two 8 bit ports with two control lines per port. Three of the ports have facilities on the card for high current output buffers enabling thousands of different types of external equipment to be driven directly, including relays, motors, valves and LEDs etc. The card fits a short IBM or compatible expansion slot and the connection to the outside equipment is via three ribbon cables which plug into the card and pass out of the computer through the slot aperture of the PC. The beauty of this card is that, whilst it can be controlled by short programs in any language, it lends itself to Basic programming and, in fact, all of the examples in the comprehensive manual are in that language. This card is ideal for all applications where a PC user wants to interface his computer with the outside world. Brand new with full loose leaf binder manual.



Only £59.95 each (B)

ROM Expansion/Boot Board



Not to be confused with RAM memory expansion cards, these cards will enable the ROM of an original PC or a PC-XT, or compatibles, to be expanded by up to 64K. Comes with a BiPolar ROM type TBP28S865 which defines the principle operations. For specialised applications a new device could be programmed. Control circuitry is provided onboard for the erasure and writing of EEPROMs. and as supplied,, the board is

configured for use with seven 2764A 8K x 8 EPROMs and one 52B13 2K x 8 EEPROM. The main and important feature of the board is its versatility. DIP switches are used to set the starting memory address, the I/O port address and to define the board's configuration. The starting memory address may be set in 2K increments anywhere within the normal 1Mb PC address space. The I/O port allows software to read the configuration and status of the board. Additionally, each ROM socket has an area of links so that alternative ROM types may be used. Ideal for installing specialist BIOS code, diagnostic routines and many other types of programs which are best sited in ROM. May also be used for converting PCs into diskless systems for dedicated process control and industrial control applications, possibly storing important variables and constants in the EEPROM etc. A data sheet on the board is supplied.

Only £59.95 (B)

IBM PC Graphics Cards CGA EGA VGA SVGA etc

CGA colour / Mono (Composite) graphics card. Suitable for IBM XT. Full length Card. 9 pin D socket output and phono / BNC for composite - RFE Tested.

£19.95 (A1)

Hercules / CGA graphics card. ¾ length card switchable between Hercules (monochrome) and colour (CGA). Both outputs are via the same standard 9 pin D socket. **NEW**

£24.95 (A1)

EGA graphics card. Full length card with 256K on board. 9 pin D socket output - RFE tested.

£29.95 (A1)

EGA graphics card. Half length card with 256K on board. 9 pin D socket output - **NEW**

£35.95 (A1)

VGA graphics card. Half length card with 256K on board. 15 pin Hi Density D socket output. - **NEW**

£39.95 (A1)

SVGA graphics card. Half length card with 1Mb on board. 15 pin Hi Density D socket output. - **NEW**

£49.95 (A1)

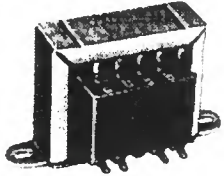


12 Kv Compact EHT Power Supply

Dual output, 12 KV and 400 vdc, with only 24 vdc in and the case only measures a handy 4"L x 3"W x 1½"H plus both output voltages are adjustable! The nominal 12 KV is adjustable from 11 KV to 13 KV and the 400 vdc from 400 to 600 vdc. Rated load is 400 ma into 500pf; load regulation, no load to full load, at nominal input is 12 vdc (0.1%). Line regulation on the 400 vdc output is 0.1 vdc (200 ppm) @ 500 vdc. Brand new, this supply was originally intended for the EHT power for a cathode ray tube; the handy totally enclosed unit makes a very versatile EHT bench supply or for inclusion in all types of equipment. Mounting is by way of two screws on the base. **### WARNING: MUST NOT BE USED AS CAR ANTI THEFT DEVICE ###**

£24.95 (A) each 5 / £110 (B)

Transformers



TR-10-16 Dual primary, wire for 120 or 240v. Dual secondary windings of 10v and 16v. Maximum load 30 and 20 va respectively. 3" x 2.5" x 2.5".

£4.95(A)

TR-15015 240 v primary. 12-0-12v secondary. Max 1 amp. 2.75"x2"x2".

£4.95(A)

TR-MT Multi tap auto transformer. 10 taps at 100, 110, 115, 120, 127, 200, 225, 230 and 240 v. 2.5" x 3" x 3".

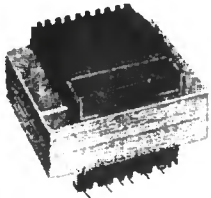
£9.95(B)

TR-MP This is a miniature power supply as it includes integral diodes and supplies 12 vdc full wave from 240vac in. The transformer is split bobbin construction, permitting the ultra miniaturisation. 1.2 va rating. 1.75" x 1.25" sq.

£3.95(A)

TR-TF This transformer includes an integral thermal fuse (110°C) on the 240 volt mains input side of the winding and has a 15 volts secondary with an 11 va rating. Viewing from the top pin 2 and 4 is the primary input via the fuse, 3 & 4 is direct to the primary. Pins 2 & 4 at the bottom is the secondary. PCB mount or can be used stand alone with bolts.

£4.95(A)



TR-20 Miniature mains transformer, 20 volt secondary unloaded. 1 amp capacity. Windings are internally shielded with the shield brought out for grounding. Flying leads and bracket construction. Dims 2-1/4"L x 1-1/2"D x 1-1/4"H.

£4.95(A)

TR-VAR Multi output. Primary 0-220-240. Triple secondaries: 8-0-8v @ 550ma, 19-0-19v @ 700ma, 15-0-15v @ 600ma. Dimensions 3"L x 2"D x 3-1/2"W overall.

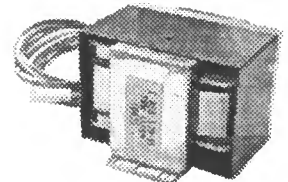
£6.95(B)

TR-POT Ultra compact potted printed circuit board mount. Twin primaries 0-120vAC & twin secondaries of 9vAC 4 VA. Both may be connected in series or parallel. **RS Components Ltd.** catalogue number **208-254**. Measures only 2" x 1-3/4" x 3/4" above PCB board.

£4.95 (A)

Profusely Shielded Mains Transformer

An unusually well made and generously shielded 220/240vac fully shrouded mains transformer with triple secondaries giving 9 volts @ 2A, 18 volts @ 1 amp and 24 volts @ 1 amp, all continuous - increase by about 50% for intermittent applications. 60 va. The secondaries are all fully isolated. Flying lead connections: white, purple and red for neutral, 220v live and 240v live respectively on the primary and yellow, orange and red for 9v, 18v and 24v on the secondaries. Dimensions: 3-3/8"L x 2-3/4"W x 2-3/8"H. Sony part number 1-450-530-11. Part replacement cost is normally £60!!

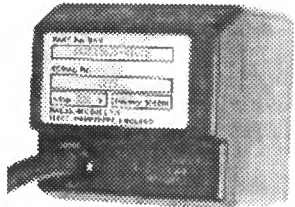


Only £9.95 (B) or 3 for £27.00 (C)

Fully Encased Dual Secondary

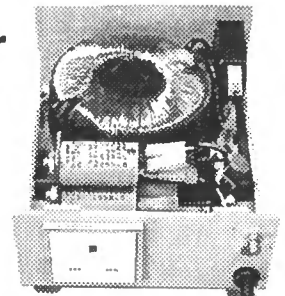
A fully encased transformer by Racal-Milgo model 4415X302A, ideal in applications where safety is a factor. 230 vAC primary (2 metre 3 core cord) with two centre tapped secondaries: 15 - 0 - 15 (yellow, black, violet) at 1 amp and 11 - 0 - 11 (red, white, orange) at 1.5 amps. 25 va capacity. The secondary leads, and a ground lead, exit from the bottom of the transformer, the mains input from the top. Mounting is by four screws to the bottom. Overall measurements are 2½" square by 3" high.

Only £5.95 (B) 3/£16.50 (C)



Fully Encased 'Hy Grade' Mains Isolator* and Filter

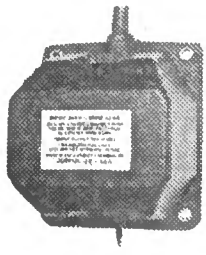
Very high efficiency mains spike and noise filter. A 1:1 massively built toroidal transformer providing 240 vac in and the same out is capable of acting as an isolator by the *removal of one internal link. Nominal capacity is 1.04 amps; the output is monitored by a circuit breaker which breaks at 1.88 amps. Filtering is provided by two off of 2 mfd 450 vac capacitors which form a resonant circuit with the secondary winding. This being tuned to 50 hz provides additional filtering to give excellent protection against mains spikes and dips. The input lead is terminated with a quality 13 amp mains plug. Output is taken from an integral 13 amp socket. In good used condition fully guaranteed for 90 days. Measures 8½"L x 4"H x 6½"W. Illustrated with cover removed.



Only £49.00 each (D)

ADAPTORS / PSU'S

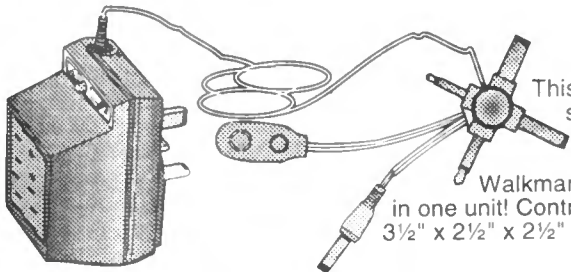
Protected AC Adaptor



This adaptor has an input of 240 vac at 45 va and an output of 19 vac at 1.6 amps. The internal transformer (which can be accessed by overdrilling the rivets) has double protection. On the secondary is a 5 amp glass fuse complete in a cup holder. The primary is protected by a PC-Tron subminiature super fast fuse rated at 3 amps. These devices have current limiting capabilities, enabling them to go open circuit before the full short circuit is applied, providing excellent overload protection. Complies with BS6301 and manufactured to BS 415. Overall dims: 3 1/2" x 2 1/2" x 2 1/2".

£9.95 each (B) or 2 for £18.95 (B)

Regulated Multi-Voltage Adaptor



This handy regulated power adaptor simply plugs into the mains and supplies switch selectable outputs of: 1.5, 3, 4.5, 6, 7.5, 9 and 12 volts DC. Output current is 500 ma (200 ma @ 3 or 4.5v settings). No less than 6 output connectors are supplied: both sizes in miniature jack plugs and power together with a 1.1mm Walkman type powerplug and a PP3 battery snap. All the voltages and all the connectors in one unit! Controls include a voltage select slide, a power slide and power on indicator. Measures 3 1/2" x 2 1/2" x 2 1/2" overall.

£9.95 each (B) or 2 for £18.95 (B)

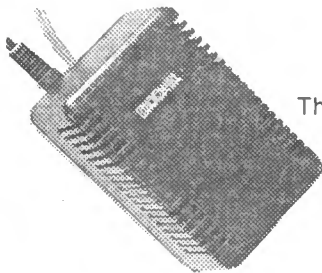
BT Approved "GEC" Adaptor

GEC D143640 BT Approved. 240vac input, 15vdc 150ma output. Bare wires in and miniature 3.5mm plug out. Dims: 3 1/2"L X 1 1/2"H x 1 3/4"W.



£3.95 each (A) 3/£10.95 (B)

Heavy Duty 9 vdc 1 amp Adaptor

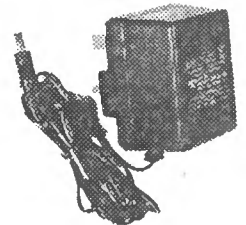


This is a 230 volt ac mains adaptor delivering 1.3 amp peak, 1 amp nominal at 9 volts DC on the output under load; off load it outputs 12 volts. Full wave rectification is utilised and integral spike suppression is featured. The input is by flying wire and the output to a 2.5mm power plug with the centre connection negative. The adaptor measures 3 3/4"L x 2 1/2"W x 2"H. A high quality adaptor complete with ventilation vents.

£5.95 each (A) 3/£16.95 (B)

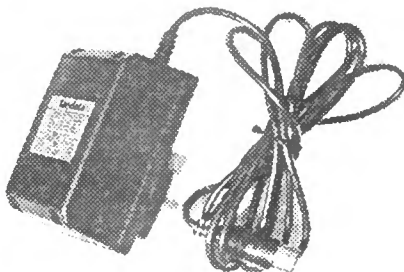
9 VAC Adaptors

230 vac mains adaptor with 9 vac 300 ma output at 2.7 va. Plugs straight into a normal mains wall socket. The extra long two metre lead is terminated with a 2.5mm power plug. Measures 2 1/2"H x 2"W x 2"D.



£3.95 each (A) 3/£10.95 (B)

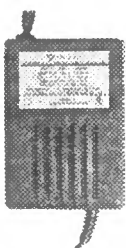
Multi Output Adaptor



A particularly versatile adaptor because the DC outputs are ideal for feeding into a regulator to get + 12 vdc, + 5 or 6 vdc and - 5 or 6 vdc. The actual outputs are + 16 vdc @ 100 ma, + 8 vdc @ 500 ma and - 8vdc @ 40 ma. Tandata model SA 195WALU PA. Plugs straight into the normal 13 amp mains socket; the 1-1/2 metre output lead is terminated in a 4 way DIN plug. Measures 3 1/2"L x 2"D x 2"W.

£5.95 (A) 3/ £16.95 (B)

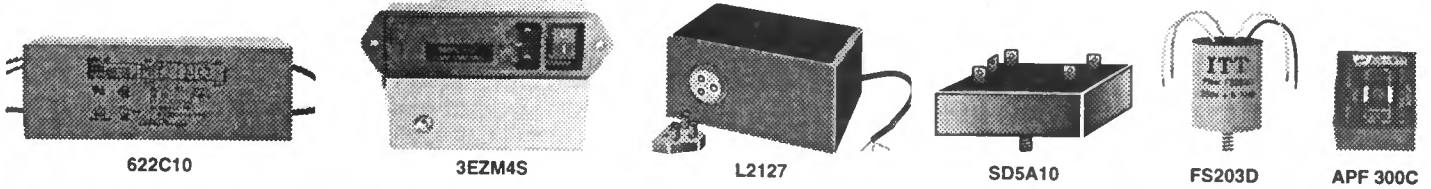
Fully Enclosed 9vdc 220ma PSU



Made for Visicorp for continuous operation of their pointing devices. Rated at 240 vac input and 9vdc 220ma output. Flying leads on the input cable and miniature jack plug on the other. Measures a compact 3" x 2" x 1 1/2". Ideal for replacement of most 9 volt PP3 battery applications.

£4.95 each (A) 3/£13.95 (B)

Mains Suppressors and Filters



Potter Model 622C10 high capacity mains suppressor rated at 250 volts AC at 10 amps. A number of pieces of equipment can be protected with this unit to give protection against surges and transient spikes. Fully enclosed so it does not have to be mounted inside the equipment which it protects. Fixing is by way of two bolt holes on ears at the bottom of the suppressor and electrical connection via flying leads. Circuit diagram which indicates the connections is printed on the top of the unit. Measures 5 1/4" L x 2 3/4" H x 2" W. **£10.95 (B) each or 3 for £29.95(C)**

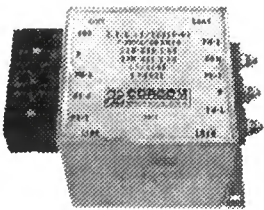
Corcam Model 3EZM4S. This unit is perfect for computers suffering from mains borne interference and transient spikes. It has a built in IEC socket (male) and an On/Off rocker switch together with integral fuses accessible from the front. It is link selectable for 100, 120, 220 and 240 vAC and rated at 2 amps @ 240 vAC and 3 amps @ 120vAC. The mains connection is at the rear by way of push on connectors. Measures 4" x 3" x 1 1/4" overall. **£6.95 (A) or 3 for £19.95(B)**

Belling-Lee type L2127 mains RFI filters rated at 250 volts 3 amps maximum. Comes complete with a built in mains cable (English coding), and a three pin miniature non-reversible socket. A mating plug, which goes to the equipment is also supplied. Ideal for those who are bugged by RF interference and who require a particularly compact suppressor yet which has sufficient capacity to cover most applications. Dims 3-1/8" x 2.5" x 1.5". **£4.95 (A) each or 3 for £12.95(B)**

Suppression Devices Type SD5 A10. Rated at 115/250 vAC and 5 amps. This is a single bolt compact suppressor measuring only 1 3/4" L x 1-1/8" W x 5/8" H excluding the mounting bolt and connection tabs, which are snap connectors as shown; these are live and neutral in and out and earth. This is a particularly easily mounted and compact suppressor - perfect when space is restricted. **£3.95 (A) each or 3 for £10(B)**

ITT Type FS203D. Rated at 250 vac and 6 amps. Bolt down can type with flying leads exiting at the top of the can. They are 12" long. Measures 1-7/8" H x 1-3/8" D. **£4.95 (A) each or 3 for £14(B)**

Wimpey-Dubilier Type APF 300C. Printed circuit board mount mains suppressor rated at 250 vAC 3A. Contains a network of 4700pf capacitors and 680mh inductors. Measures only 1-3/8" L x 1-3/16" W x 3/4" H. **£4.95 (A) or 3 for £12.95(A)**



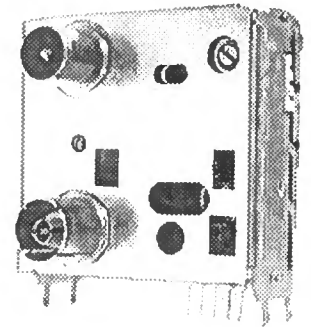
Single/Three Phase Extra Heavy Duty Suppressors

Very high capacity and versatile mains suppressor. May be wired for Delta or Star three phase configuration and will handle up to 30 amps or may be used for single phase. Voltage capacity is 120-208 vAC or 240-416 vAC, 47/63 Hz. Has shielded barrier strip screw down input and bolt fixing output connections. Measures 6" long including connectors by 4" square.

Only £39.00 each (C)

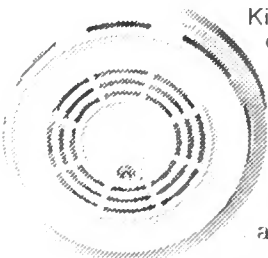
UHF Video & Audio Modulator

High quality unit made by **ALPS part number MDLK5D** for incorporation into video recorders players or any application to provide a UHF modulated signal from a monochrome or colour composite video and low level sound source. Fully encased in tin plated box, unit features co axial input and output sockets to give a 'loop through' function thus when used with a domestic type television set there is no need to unplug the standard aerial input. An internal switchable 'boost' amp gives 3-4dB of gain to the UHF off air signal right across the 47 to 854 MHz spectrum. Another nice feature is the incorporation of a tuning switch - when activated a black and white bar is modulated on to the UHF output to aid tuning to the correct channel. Standard 75 ohm video signal with 100mv 10k ohm audio input. Printed circuit or solder tag connection. Unit comes pre tuned to UHF channel 38, a pre set pot allows adjustment of video output channels 30 to 39. Operates on single 5vDC rail at 70 ma. Dimensions mm 44 W x 50 H x 28 D. Supplied complete with data sheet.



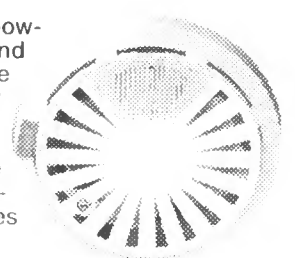
Only £6.95 (A) 10 / £65.00 (B) 50 / £55.00 (C) 100 / £495.00 (D)

Ionisation Smoke Alarms



Model K-101

Kidde Models KSA-300 and K-101 are UL and BS 5446 PL1 approved battery powered smoke alarms. Both are ionisation types for superior performance and have advanced design single ionisation chambers for the prevention of false alarms and particularly triggering from atmospheric pressure and humidity changes. They also both feature self test buttons so that the alarm can be activated to make sure that it is operational, exceptionally high intensity alarms and easy two screw installation. Model KSA-300 has an integral escape light. KSA-300 measures 6" diameter by 1 1/2" high and uses two PP-3, 9 volt batteries. K-101 uses one PP-3 and is 4 1/4" diameter and the same height. Both types are brand new, packaged and come complete with a full instruction booklet.

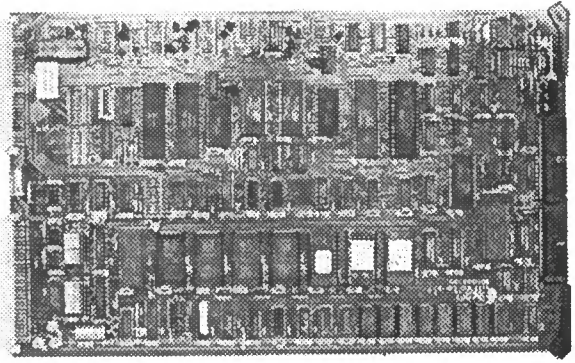


Model KSA-300

Model K-101 £8.95 (A)

Model KSA-300 £11.95 (A)

Single Board "Professional" BBC B Type Computer



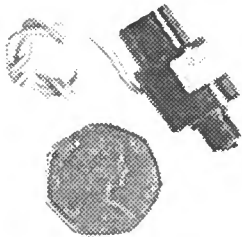
Only £29.95 !!! Plus the chance to win £100 cash !!! A major purchase allows us to offer you the **PROFESSIONAL** version of the BBC computer at a parts only price PLUS the chance to **WIN £100.00**. Used as a front end graphics system on large networked systems, the architecture of this board has so many similarities to the regular BBC model B that we are sure that with a bit of experimentation and ingenuity many useful applications will be found for this board!! The board is supplied complete with an input/output connector panel which brings all the I/O to 'D' and BNC type connectors - all you have to do is provide +5 and ≈ 12 v DC. The Professional consists of a single PCB with most **major IC's socketed**. Three 27128 EPROMS contain the custom operating system on which we have no information. On application of DC power the system boots and provides diagnostic information on the video output. On board DIP switches and jumpers select the **ECONET** address and enable the four extra EPROM sockets for user software. The main IC line up includes 6502 or 6512 CPU, 8 x 4564 Ram IC's, 2 x 6522 pio's, SAA5050 teletext ic, (that's worth £10.00 on its own !!) 6845 screen controller, 68B54 Econet controller, 3 x 27128 EPROMS, 3 x ACORN ULA type IC's plus **approx 62 other IC's**. Inputs and outputs on the connector panel are labelled ECONET, ANALOG RGB OUT, PARALLEL PRINTER, COMPOSITE VIDEO OUT, RGB OUT, KEYBOARD IN, KEYBOARD OUT, IS IN, IS OUT, and SERIAL PRINTER. Dims: main board 13½" x 9¼", I/O board 14½" x 3½", front panel 2" high. **Supplied tested and complete with circuit diagram and competition entry form.**

Only £29.95 or 2 for £53 (B)

**FREE COMPETITION
WIN £100 CASH!**

We will award £100 cash to the person or establishment who offers the most novel application, which must be demonstrable with this amazing board. We will be the sole judge of the winner and reserve the right to publish the winning entries. An entry form with details and conditions comes with each board - buy 10 and make 10 entries!

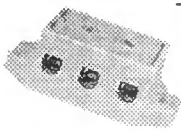
12V DC Miniature Push Solenoid



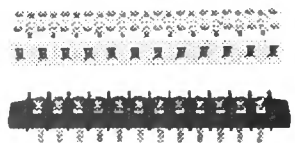
These solenoids are brand new and made for a well known daisywheel printer manufacturer. It is the hammer solenoid which strikes the letter on the wheel to force it against the ribbon and paper. They are therefore powerful little solenoids with a throw of about 5/16", so are capable of very high operating speeds. They require 12vdc and their pulse consumption is 3 amps. The actual consumption will depend on the pulse frequency and width, in other words how many times the solenoid is used and for how long.

SOL-12: £3.95 (A) or 5 for £17.95 (B)

Various Terminal Blocks

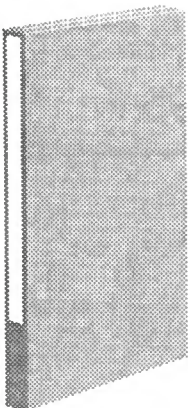


Three different types of barrier strips. BA1 is a 12 way professional type with leaf springs to prevent conductor damage by the clamping screws, rated 20 A 440vAC. BA2 is a 12 way right angled block rated at 15 A 750 vAC and BA3 is 3 way, totally shrouded by a cover with moulded sequential markings, rated at 36A 500 vAC and 600 vDC. R.S. Components Ltd. numbers are 423-598 = BA1, 423-374 = BA2 and 424-563 = BA3. At a fraction of normal cost:

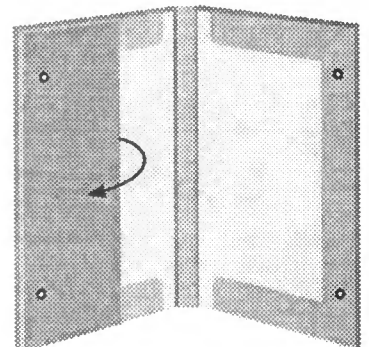


BA1...£1.49 BA2...£0.85 BA3...£1.25 (A)
Discounts (mix or match): 10-99=10%

Drawing Files & Carrying Cases

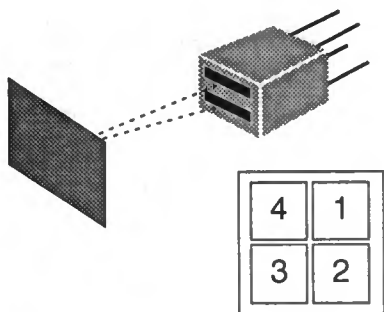
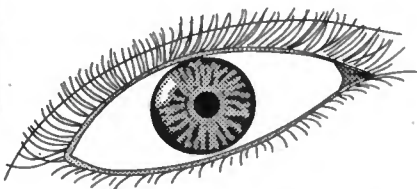


An unusual item for us but a very useful one if you want to store or carry large documents, such as drawings, music, blueprints and so on. They are made of durable cardboard and the two halves are kept closed by Velcro buttons so that everything doesn't fall out! It opens out as shown in the sketch on the right and then the inner pocket, also secured with Velcro, opens. In its closed position it measures 24½" high by 12½" wide by 1½" thick. When first opened the width doubles and with the inner pocket opened the width is 34". The maximum size of document therefore is 34" x 24".



Box of 5 for £10.95 (B)

OPTO-ELECTRONIC SALE !!



1 = Sensor transistor collector
 2 = Sensor transistor emitter
 3 = Xmitter LED anode
 4 = Xmitter LED cathode
 Pin 1 is indicated by a dot on top of the case. Pin 4 by a shorter lead. Above is the bottom view.

Infrared Reflex Transmitter/Sensors

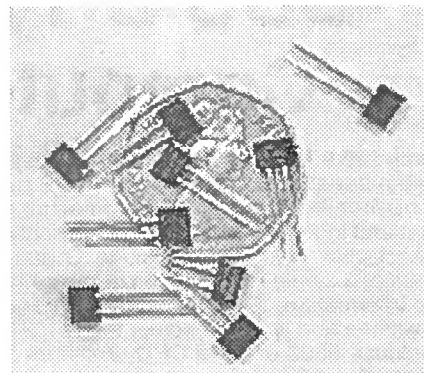
Type OPB 706A reflex transmitter sensors from TRW Optron. Similar in size to a TO-92 plastic transistor, these reflex opto devices consist of an infrared transmitter and sensor in the same case. Any reflective surface sends the transmitted beam back to the sensor, interruption of the beam can therefore be sensed. The transmitter is a light emitting diode and the sensor a photo transistor. Specifications are as follows:

Transmitter LED:

Maximum reverse voltage = 3 volts

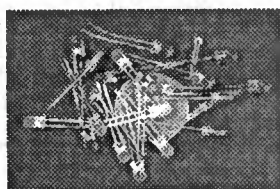
Sensor transistor:

Minimum Output current = 500 ma
 Maximum forward current = 20 ma-
 Vce = 5 volts
 Distance to reflective surface = 0.05"



£1.95 each (A)

5 for £8.95 (A)



LED Assortment Sale

Two assortments of LEDs. Red, amber, clear, green and infra red. Many sizes and shapes - round and rectangular 3mm, 8mm, 10mm etc. Fill up your stock box whilst we have excessive stock! All brand new and unused.....

25 for £2.95 100 for £8.95 (A)

10 Bar Dual In Line LED Array



Siemens RBG1000. Ten individual red LED elements housed in a 20 pin dual in line package forms a very compact linear bar display, which may be end stacked for extended lengths. Ideal for bargraphs, level displays and solid state meter movements. Each LED element is intensity matched to give an excellent uniform appearance overall. Typical power requirements per LED: 2 volts at 10 ma. Maximum 6 volts and

25ma.

£2.95 each or 10 for £26.00 (A)

Red and Amber LED Pairs

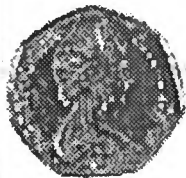
ily removable for separate use if required and can therefore be interchanged. Come with the red on top.

One red and one amber LED arranged in a holder, one over the other. Extremely useful when you need a "stop and ready" display. The LEDs are standard 5 mm and are easily



Four pairs for £1.99 (A) 10 pair £4.50 (A)

7 Segment Dual Numeric Displays



Matsushita type LN526RA dual 7 segment LED numeric displays with right hand decimal points. 9/16" character height 3/8" width including the decimal point. Normal dual in line pins. Feature low power dissipation with high luminosity. Red colour. The modules are end stackable so that any number may be used. Common anode with all segments and decimal points separately addressable.

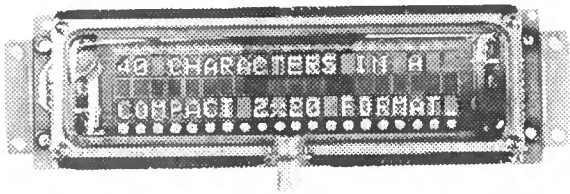
£2.95 each (A) 5 for £13.95 (A)

Gap Type Opto Detectors

Two different types of opto detectors: Texas Instruments TIL 143 and TRW Optron OPB 813. They are virtually identical electrically - detector current 200 ma at 10 volts and 20 ma but differ slightly in the gap size. TIL 143 has a gap width of 2.6 mm width and 6.5 mm length whilst OPB 813 is 3.3 mm and 8.7 mm. Either type mix or match.....



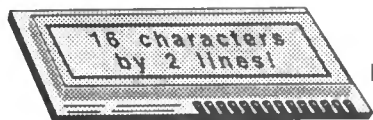
5 for £2.95 (A) or 10 for £5.50 (A)



5 volt DC Fluorescent Display Modules

You read right, a compact Vacuum Fluorescent Display Module that needs only a single 5 vdc supply - how? - there is an integral DC to DC voltage converter on board which boosts the 5 vdc to the 100 or so volts required by vacuum fluorescents. This results in highly readable, bright (typically 175 fl) blue-green alphanumeric characters which, if required, can be filtered to blue, green, aqua, yellow or red. The characters are arranged on a two line by twenty format utilising a 5 x 7 dot matrix so that lower case letters, numerals, symbols and punctuation may all be used; indeed, the entire ASCII 96-character set can be displayed. In addition, the distinctive characters of the General European, German and Scandinavian fonts, as well as a selection of scientific symbols, can be produced under software control. This IEE-FLIP 3600-44-040 also includes an improved on board microprocessor which features advanced control features, enhanced serial data interface and a faster display refresh rate. Most of the ASCII control functions are supported, including carriage return, line feed, advance and backspace cursor, character blink fields, visible or invisible cursor, blinking or non-blinking underbar and so on. Four end of line modes are also supported, including horizontal scrolling from right to left on the bottom line after it has been filled. The brightness of the display may be controlled by software in four steps and interfacing is extremely simple, it may be either parallel or 1200 baud serial. Little if any extra hardware is required. In parallel mode the display module is addressed as two RAM memory locations in a memory map I/O configuration. For serial interfacing a complete asynchronous receiver with TTL compatible input is built in. Complete descriptions of the two interfaces are included in the data sheet provided. Data may be entered in the normal left to right mode or randomly with the addressable cursor. Power rating of the module is 5.5 watts, in other words it draws about 1.1 amps. Overall it measures 6½" L x 2" W x 1½" H without the connectors on the rear, which are standard edge connectors - one for power and reset, the other for data. The 3600-44-040 is an amazingly versatile display featuring a high degree of user friendliness both in its interfacing and power requirements. It may be used with ease in virtually any application for which it is suited. They are brand new, are supplied with a complete data and application booklet and normally cost about £139 each.

£39.00 each (A) 3 for £90.00 (B)

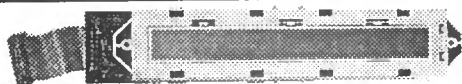


Miniature 16 x 2 LCD Display

Hitachi model LM052L 16 characters by 2 line standard ASCII LCD display panel. The ASCII controller HD44780 is built in. Only a single +5 vdc supply is required and typical current draw is a minuscule 1 ma! Resolution is excellent with a maximum 40 dots per character making the total

screen capacity 1280 dots. One useful function is that data may be sent to the module in either 4 bit parallel two operation mode or 8 bit parallel single operation, so that it can be interfaced to either 4 or 8 bit MPUs. The LM052L is therefore very easy to use - you simply enable, select write and send the data. In addition to sending data, instructions may be sent to the module in order to control the cursor, to issue clear display commands, cursor direction commands and so on. The data sheet supplied contains details of how to issue instructions to the internal register. Brand new and unused. See the May to July 1990 issues of Practical Electronics for a general description of the applications of almost identical displays!

£8.95 each (A) 3 for £25.00 (A) 10 for £80 (B)

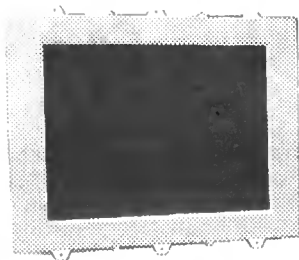


Large Back Lit Liquid Crystal Point of Sale Displays

Super bright back lit LCD displays of the type that you see at supermarket checkout tills. Both made by Alps - LDSEA3022B features VERY LARGE 12 mm characters organised as 2 lines by 16 and is supplied in the smart case illustrated. LDSCB2021B is a single line of 24 LARGE 7 mm characters and is the top illustration. Both have characters made up of a 5 x 7 matrix. Both units feature Hitachi inbuilt driver IC's and are driven by a simple 8 bit parallel interface by way of a 20 way male IDC plug provided. The displays require a single +5vdc rail to operate and a separate voltage to power the filament type lamps which provide the backlighting. As supplied the miniature flange type push in bulbs are rated at 24 volts but can be easily changed to suit your own voltage requirements. The viewing area of the larger display is 6-5/8" x 1-5/8" and 5½" x 5/8" the smaller. Overall the displays measure 8" x 2½" and 7½" x 1½". The case in which LDSEA3022B is housed is swivel and tilt, stands 5½" high is 8¾" long and 2½" thick. These displays are particularly recommended where a high degree of legibility is required at a distance. The orange type backlight gives a very readable but unobtrusive effect. Both displays brand new with full data.

LDSC...£19.95 (A1) LDSE...£39.95 (A1)

11.5" Backlit LCD 640 x 840 VGA Flat Displays



A masterpiece of engineering the SHARP LM64048Z VGA LCD backlit display is the same type used on laptops, data displays etc. Unit features all internal drive electronics to obtain a pixel resolution of 640 x 480 with a dot pitch of 0.33. All connections to the display are made via a 14 way ribbon cable. The backlighting is achieved by a unique internal optical system whereby a miniature white fluorescent tube light is evenly distributed across the entire screen face. Panel display area measures diagonally 11.25" vertical 7" horizontal 9.25". Overall the unit measures 12" W x 9.5" H x 1" deep. Supplied with full manufacturers data. Removed from NEW equipment- Guaranteed

**LARGE QTY
AVAILABLE**

Only £125.00 (B)

BIG £ SAVER

Extra Strong Equipment / Brief / Suit Case Deal



Originally made as special equipment cases, these are a **perfect size** to be used as an **equipment case - or a brief case- or even a suitcase!** Inside is a built in 10" square leather pocket (ideal for probes, papers or shirts!) and a ½" thick piece of foam plastic glued to one side to provide safety to that valuable equipment - or the shirts! Press down automatic locks for security and a key is also supplied. The moulded handle is sprung loaded so that it lays flush when not in use. The case has **extra strong** hook and rod hinges and reinforced metal fittings. The case is made with **immensely strong** dark brown ABS with extra strengthening in matching matte black ribbed metal - yet it **weighs only 2 kg!!**. Measures 20"W x 15"H x 6"T. **Brand new** with four sturdy feet and **complete with 2 keys**. Whether you want to carry equipment, tools, papers or clothes this case will do the job and at this price how can you lose? **Brand new surplus. DON'T MISS THIS ITEM !!**

£24.95 each (B) 2 for £48 (C) 5 for £108 (D)

Laptop Computer, Equipment, Carry-On, Holdall



A terrific buy in high quality holdalls by a **household name manufacturer**, originally intended for carrying laptop computers or other equipment. They are of **superior quality** to the normal holdall which can be bought in baggage stores because they both have a **multiplicity of pockets and pouches** and use stout zips. Velcro fastening and very **generous padding throughout**. Both types are brand new and come to us in original manufacturers' packaging. As can be seen from the photographs they are very similar to each other with slightly differing features, so we will describe them individually:
Hold-1: This is the one in the top photograph on the left. It measures 17"H x 14"W x 5"T overall without any contents. The main pouch has a stiffener around the inside so it will not lay totally flat, on the other hand clothes and such like would get less creased. The shoulder strap may be used or removed and is adjustable in length. The handle is in two parts, when used the two sections attach with Velcro. The main pouch contains a padded



divider which can be attached to one side of the pouch; built into that side of the pouch, and therefore covered by the divider, are three pockets. The secondary pouch is padded and does not contain extra pockets. Both pouches are secured with high quality zips.

Hold-2: Measurements are an inch or so greater than Hold-1 all round, the handle and shoulder straps are virtually identical. The main pouch, like Hold-1, has a padded divider but instead of the three pockets of Hold-1 there are 6 small ones, provision for pens and an owners label, and a large secondary internal pouch. A removable padded retaining "bar" is also provided. The outside pouch is secured by a Velcro fastened front flap which covers the whole pouch, rather than a zip. Also has large stout rubber feet on the bottom. In summary Hold-2 is a little larger and has more internal pockets than Hold-1, on the other hand Hold-1 benefits with the main pouch stiffener, particularly if it is intended that the holdall be used for clothes.

Hold-1: £12.95 (B) 2/£23.95 (C)

Hold-2: £13.95 (B) 2/£26.95 (C)

Call for further generous discounts on quantities of holdalls!

BIG £ SAVER

Micro Miniature R-T Curve Matched NTC Thermistor

When we say **Micro Miniature**, we mean it! Just the size of a pinhead!! This NTC 10K ohm thermistor **RS part number 151-237** exhibits A **VERY closely matched** spec from device to device over a wide temperature range. **Nominal resistance of 10k ohm at 25°C** with a temperature range of -80°C to +150°C. Tolerance over range 0°C to +70°C is ±0.2°C. Epoxy encapsulated with long 75 mm leads. Ideal for a host of applications including accurate temperature measurement etc.

Normal price £3.50 Each - Our Price £1.95 10 / £18.00 100 / £165.00 (A)



Betamax Tapes

For those of you who still appreciate the superb quality of the now defunct Betamax video recorder system (as does the writer!), this may well be one of your last chances to obtain **BRAND NEW** tapes for this machine. Tapes are top quality 'Scotch 3M' brand and have a run time of 1hr and 5 minutes.



Only £2.95 (A)
4 / £10.00 (B)

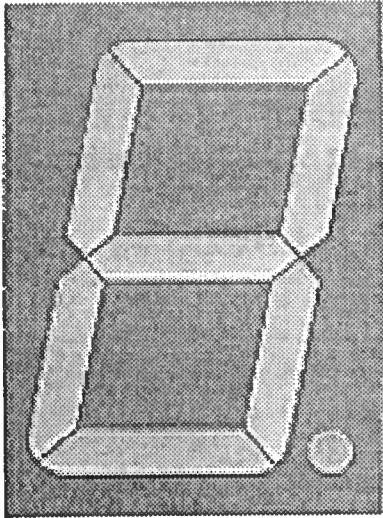
Industrial Grade Intelligent Barcode Wand



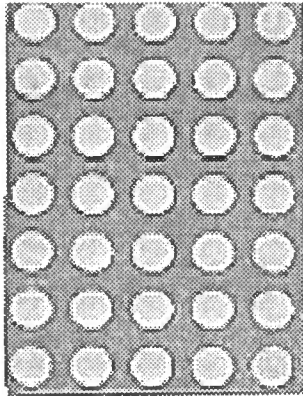
Only £19.95 (A)

A Masterpiece of engineering this heavy duty barcode wand has to be seen to be appreciated. Externally the wand is made of high impact ABS plastic with a very durable lens system mounted to one end. Inside a complete fibre optic system concentrates a high output red LED into a pin light source, when swiped across a barcode, internal optics reflect the light source back into the wand and convert these into serial data output fully TTL 5v compatible logic levels, equivalent to the barcode read, for interfacing with computers etc. Requires 12 V dc at 100 ma Supplied fully tested complete with 4 foot curly cord & Data sheet.

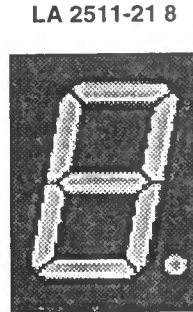
7 Segment And Dot Matrix LED Displays



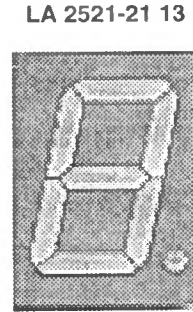
LA 2311-41



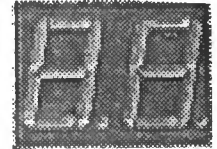
LJ 2021-21 12
LJ 2041-21 12



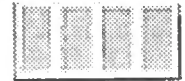
LA 2511-21 8



LA 2521-21 13



LA 5622-11 11



LTL 2820G
LTL 2720Y
LTL 2620HR

Illustrations shown approximately actual size

BRIEF SPECIFICATIONS OF THE DISPLAYS

Heights refer to the actual digit size.

Luminous Intensity in mcd @ 10ma

LA 2311: Jumbo sized 2.3" high, red 7 segment displays with decimal. Common anode. Grey face. Regular price £6.26 each.

LJ 2021 (green) 2 mcd LJ 2041 (orange) 2.2 mcd, jumbo sized 35 dot matrices with X-Y selection. 2" x 1-3/8" display area. Side stackable and locking to give any display length. Grey face. Regular price £4.24 each.

LA 2511: Large red 1" 7 segment with decimal. 1.0 mcd. Common anode. A black face provides exceptionally high contrast. Regular price £3.22 each.

LA 2521: Large green 1" 7 segment with decimal. 3.3 mcd. Grey face. Regular price £3.22 each

LA 5622: Dual "normal" size 0.56" green 7 segment displays. Common anode. 1.85 mcd (each). Approx. regular price £2.87 each.

LTL series in high intensity red, green and yellow. Each package contains 8 LEDs in 4 bars of 2 LEDs each. All diodes may be individually lit. Appx. regular price £1.80.

A "once in a lifetime" buy of various brand new surplus display boards from a well known leisure company enables us to bring you a fascinating assortment of boards to be used as is or for the valuable displays they contain. A full data sheet is provided which gives pinouts and operating data for all of the displays and notes on the operation of some of the boards - at press time we are still accumulating further data! The IC's on the boards are all MM5450N which are 34 segment LED drivers accepting a serial clocked data input signal. Data on this chip is included in the data pack. We don't have room to describe the boards in full but a brief description of each follows:

Board A: Contains 14 off LA 2521-21 green 1" 7 segment displays mounted in a cross formation, IC's and several transistors. 10 way IDC connector on rear. 8"H x 10 1/2"W. **Order #877** £9.95 (B)

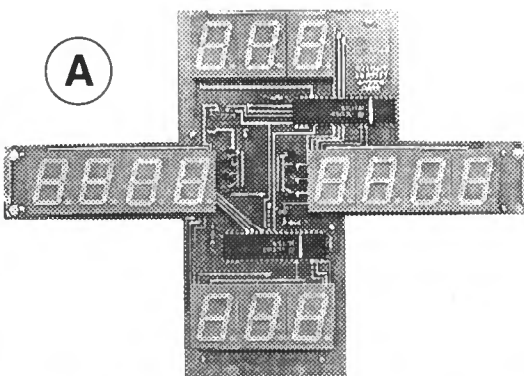
Board B: 6 off LJ 2021-21 large green 35 dot matrix displays, 8 off LTL series LED Bar Arrays (4 green, 2 yellow and 2 high intensity red), 4 IC's and several transistors. 1 each of 26 way, 10 way and 20 way IDC and 1 off 8 way header connector. 13"W x 6 1/2"H. **Order #875** £12.95 (B)

Board C: 6 off LJ 2041-21 large 35 red dot matrix displays, 2 off IC's. 10 way IDC and 8 way header on rear. 14 1/2" x 2-1/8". **Order #874** £12.95 (B)

Board D: 4 off LA 2511-21 red 1" 7 segment displays with 1 off 16 way IDC on rear. 4 1/2"L x 2-3/8"H. These are ideal if you just want a four digit display as all connections for the displays are simply taken to the IDC connector on the rear. **Order #873** £6.95 (B)

Board E: 4 off LA 2311-41 huge red 7 segment displays, a dual LA 5622-11 green 7 segment display with a 16 way IDC on the rear. 7 3/4"L x 5 1/4"H. This is a fascinating board; for one thing the jumbo displays have to be seen to be appreciated, they are so large. Also the inclusion of the green provides a distinct method of displaying seconds in a clock or hundredths in a counter. Like Board D the display pins go straight to the connector, providing a very simple interface for clock, counter or other circuitry. Worth the price just to look at the size of them! **Order #872** £9.95 (B)

A

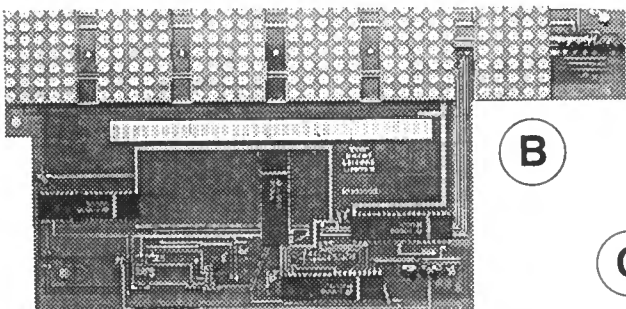
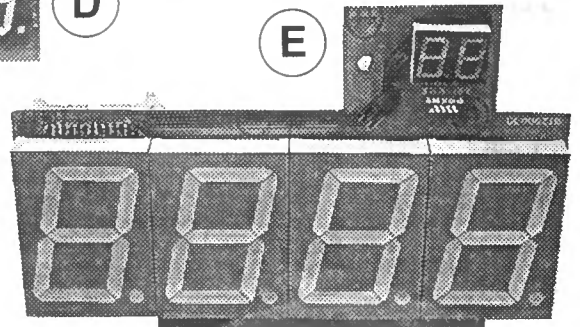


Any 10 boards less 10% discount.



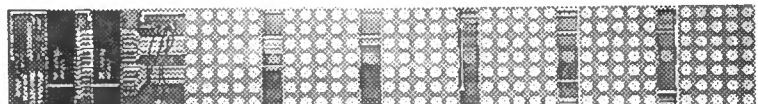
D

E



B

C



Intel Maths Co - Processors for PC's



The most economical way of speeding up your PC is to install a Math Co-Processor in your PC-XT, 286 or 386 machine. It speeds up applications such as AutoCAD, Lotus123, Excel and many more. Please check with your PC manufacturer the type of unit you require before ordering.

TYPE	SUITABLE FOR	PRICE
8087-	IBM XT 8088 MACHINES (RFE) DIL PACKAGE	£34.95(A)
80287-10	IBM AT 80286 MACHINES 8-12MHz (RFE) DIL PACKAGE	£34.95(A)
80C287-12	IBM AT 80C286 CMOS CHIP MACHINES 12-16MHz DIL PACKAGE	£39.95(A)
80387SX-16	IBM AT 80386SX MACHINES @ 16MHz. PLEASE STATE PGA OR PLCC PACKAGE	£44.95(A)
80387DX-25	IBM AT 80386DX MACHINES @ 25 MHz. PGA	£44.95(A)



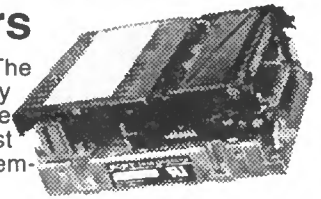
30 pin, 1 Mb 80 ns SIMMS

BRAND SPANKING NEW - FULLY GUARANTEED FOR IBM PC XT AT TYPE COMPUTERS

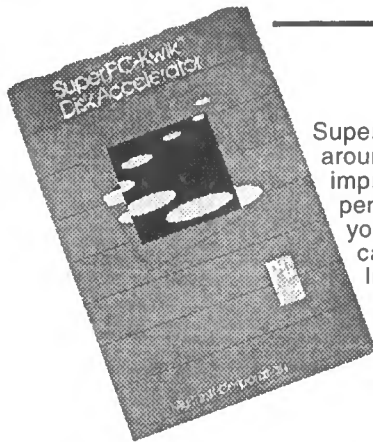
1 Mb x 9	80 ns SIMM 3 chip	£23.50 each (a)
1 Mb x 9	80 ns SIMM 9 chip	£22.50 each (a)

Apricot 3½" Disk Drives for Spares and DIYers

Brand New **Sony 3½"** disk drive type **OA-D31V-04**, made specifically for an early **Apricot** computer. The drive is for single sided use as it has only one head. We imagine that it is 40 track, although there is a tiny little slide switch on the back which looks suspiciously like a 40 / 80 track selection switch. Quality made item and apart from its obvious use as a spare drive it also offers a major source of parts for the hobbyist including miniature stepper motor, hall effect 300-400 rpm brushless motor and a precision rack slide assembly plus IC's and many other useful components. We have no data on it and because of this it is going at a knock down price. Measures 5" x 4" x 2"



Only £10 (B)



Super PC-Kwik Disk Accelerator Software

Super PC-Kwik (version 3.53) from **Multisoft** is one of the best known, and most efficient, programs around for speeding up your computer's access to floppies and hard disks. After installation, a dramatic improvement in the speed of your computer, regardless of its existing speed, will be seen. The exact percentage of improvement cannot be stated as it depends totally on the type of work for which you use your machine. As a general rule of thumb, if your applications access the floppies or hard disk a lot you can look for a **doubling in apparent machine speed**. PC-Kwik works by creating a cache in RAM. In that cache it stores the sectors of the media which you use most. When you call for a file or data that is cached then PC-Kwik goes to RAM for it and thus **saves a disk access**, which although seemingly fast is in fact one of the main operations in slowing down a system. **Brand new in original packaging** - supports expanded and extended memory - at under half its normal price.

Only £7.95 each (A)

Quarterdeck QEMM-386 Expanded Memory Manager

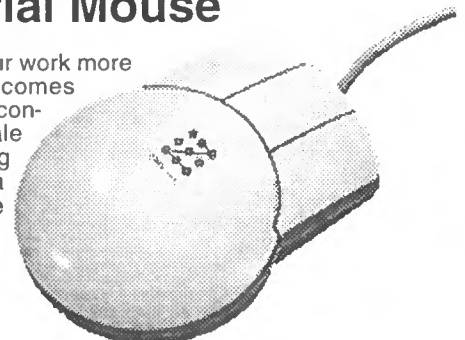
The Quarterdeck Expanded Memory Manager - 386 (QEMM-386) version 6.02 is a memory manager for 386, 486 and Pentium PCs and PS/2s. **And more.** QEMM-386 manages all of your PC's memory- however you want to use it. As such, QEMM-386 is not only an expanded memory manager, but it is also an extended memory and a high (640-1024K) memory manager - all in one! QEMM-386 is compatible with all the current industry memory specification standards. With QEMM-386 you can load drivers (for example, a network), TSR'S, and DOS resources in any available high memory. The benefit to you is **more memory below 640K for your DOS program**. QEMM-386 sets up your memory as optimally as it can -automatically with its Optimize feature. The goal, of course, always, is to give you the maximum utilisation of your most precious PC resource, memory-in the easiest way possible. This software is on 3½" media, brand new at a bargain price.



Only £24.95 each (A)

Microsoft Compatible Three Button Serial Mouse

This new ergonomically designed mouse fits efficiently and neatly into your hand making your work more easy and productive. Assembled in the Far East by Z-Nix Inc, this state of the art mouse comes complete with all software on 3-½" disk only. The limp type cable is terminated in a 9 pin D connector and a 9 to 25 way D connector adaptor is also supplied, for those with a 25 way male socket on their serial ports. Fully compatible with the Microsoft mouse standards, including ballistic acceleration. All parameters may be set by the software, which also includes as a bonus Pop-Up menu software allowing you to enhance programs such as Lotus 1-2-3, dBase and many other programs which do not usually support a mouse.



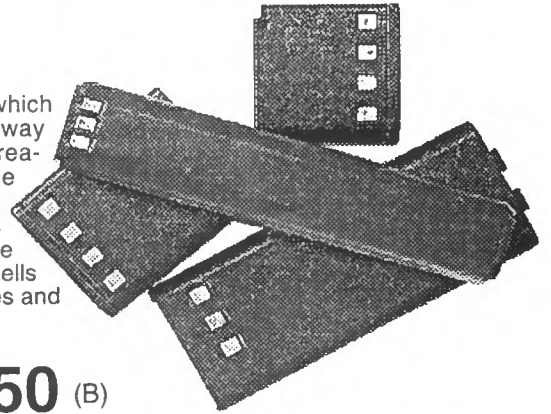
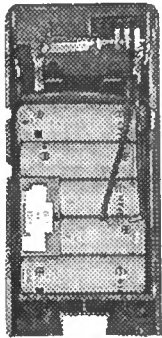
Only £14.95 each (A1)

BIG £ SAVER

Nickel Cadmium Batteries

Super Ni-Cad Sale!

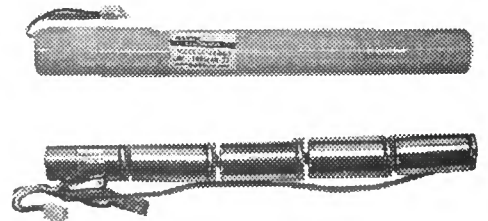
We have been able to obtain quantities of ni-cad battery packs which have been retired from a large user of cellular phones and 2 way radios. The majority have been declared surplus for cosmetic reasons, dents and scratches on the cases and in some cases the demise of a single cell. This makes them no longer usable in the equipment for which they were made. We have tested a cross section and the actual batteries inside seem to have plenty of life left in them. They come in all shapes and sizes, with all types of cells inside. At this price we are unable to select particular sizes or types and they are sold as is.



5 for £9.95 (A) 10 for £16.50 (B)

'C' Size Cells

Sanyo "Cadnica" stick of five standard 'C' size rechargeable nickel cadmium batteries, model number **5N-1800CR**. Designed for **Victor laptop computers**. Nominal voltage 1.25 volts per cell and 6 volts 1.8 amp hours for entire stick. A thermal cutout is incorporated with a temperature sensor strapped to the case of one of the cells. May be used as is or very easily divided into the separate cells as shown in the lower photograph. Measures 26mm diameter and 250mm long.

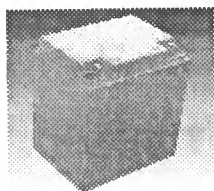
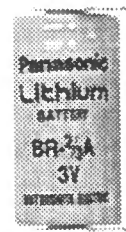


Per bar.....£8.95 each (A)

3 Volt Lithium Backup Batteries

Size 2/3A (33mm long, 16.6mm diameter) **industry standard size** lithium batteries. Used mainly as backup batteries for CMOS memory and clock support in **IBM PC's** and other applications. Rated at 3 volts 1.5 amp/hour. Printed circuit mount or solder to the PC tabs. Brand new, made by Panasonic.

£1.95 each (A) 5/£9.00 (A)



12v 24 Ah Rechargeable Sealed Lead Batteries

A super deal in **BRAND NEW sealed maintenance free** rechargeable lead acid batteries. Rated at 12 vdc at 24 amp hours these compact high energy sources have a wide range of applications including standby power systems, robots, golfcarts, etc etc. Overall dimensions are 4.9" D x 6.5" W x 7.5"H. Supplied complete with nut / bolt connection kit.

£24.95 each (B) 2/£48.00 (C)

Automatic 12 v, Lead Acid Battery Chargers



Specifically designed to charge 12 v DC sealed lead acid batteries (as on special offer above) for an electric golf cart, unfortunately the golf cart company went broke and we bought the entire stock. **Quality made** in an all steel louvered case with dimensions of only 7" W x 4.25" H x 5" D. The unit will completely charge a 12 volt 24 Ah battery in approx 16 hours. The nice feature about this unit is that internal electronics **constantly monitor** the state of the battery so when the charge is complete it switches into a 'trickle' mode just enough to maintain the battery in **peak condition** and for an infinite period, ready for use. Many other types of charger on the market tend to 'cook' sealed lead acid batteries grossly shortening their life. Supplied **BRAND NEW** with maker's instructions and 2 crocodile clips.

Knock Down Price Only £16.95 each (B)

Chloride "Powersafe" High Current - 6 V 100 AH Batteries

Made for BT by Chloride, type 3VB11 specifically for standby power systems where the batteries are trickle charged for long periods of time and therefore have to be particularly reliable. We came across a large quantity of these driving a massive inverter in a London financial institution - all are relatively new and in excellent condition. Batteries are totally enclosed and maintenance free and rated at 100 amp hours, they are also capable of giving an **extremely high current** for short periods of time and therefore all normal safety measures must be taken to **avoid short circuits** which could result in severe burns or a fire. Many uses include standby power systems, high current sources, traction drives etc. Termination is via two threaded lugs. Supplied fully tested with 90 day guarantee and at a current **list price of over £135 each, the Bank's loss is your gain !!!**

£39.95 each (C) 2/£65.00 (D)

Dimensions: 9" H x 8" D x 8" W

4,000,000

IC's, Transistors, Regs,
Diodes, SCR's, Opto
FROM STOCK !!

SAVE 

Apart from a vast range of current product, many
obsolete and discontinued items are listed in the
Display Electronics "Semiconductor HotList"

Send £2.50 for your own personal copy or £7.50 for 3 issues.

THIS MONTH - JUST A SMALL SELECTION FROM OUR VAST RANGE

6802	Central Processing Unit	£2.90 each.	10 for £24.00
68A21	Peripheral Controller	£3.00 each.	10 for £24.00
80C31	CPU with serial I/O	£4.75 each.	10 for £41.00
8085	Central Processing Unit	£3.00 each.	10 for £23.00
Z80BS10-2	Input/Output Controller	£4.50 each.	10 for £39.00
2732	32K EPROM	£1.00 each.	10 for £ 8.00
2764	64K EPROM	£1.20 each.	10 for £ 9.95
27C64	64K EPROM LP *	£1.50 each.	10 for £14.00
27C256	256K EPROM *	£2.90 each.	10 for £22.00
27512	512K EPROM *	£4.90 each.	10 for £45.00
HN27C101G-25	1 meg EPROM (131k x 8. Package=32 pin DIL)	£5.50 each.	10 for £50.00
6264P-15	8K Static memory	£2.35 each.	10 for £22.00

LM7812V

12 Volt positive 1.5 amp regulator
Why pay more ??

38p 10/£3.50

INTEL 486-DX33

33 Mhz CPU IC
with integral math co pro. Heatsink fitted.

£99.00

LM78H05

12 Volt 5 AMP regulator in TO3
CASE Loads Amps - and only

£3.50 10/£32.00

NEC V20-8

The well known NEC speed up CPU *
Speed up your PC!

£12.95

D8271

The disk controller IC necessary to get the BBC
B to use disks. Now obsolete.
Don't get caught out!

£32.00

D8748

Microprocessor with 1K x 8 bit UV
erasable EPROM built in.

£5.95 10/£50

SAA5050

Philips Teletext integrated circuit.
Now obsolete.

£7.00 10/£55

SAA5243/E

Current Philips
Teletext IC

£9.95 10/£80

D8751

MPU With 4k x 8 bit integral EPROM
+Serial UART

£22.00 10/£190

D87C51

CMOS Version of this very versatile
micro, integral 4k x 8 EPROM +
Serial UART

£24.95 10/£220

A80386-16

16 MHz
Ever Popular PC or controller CPU

£12.95

LM1881N

Versatile Video / Sync stripper IC
many uses - 8 pin DIL pack

£2.45 10/£21

Drum

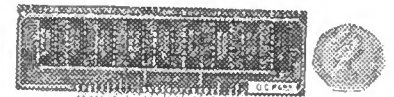
Specials!

4164	64K DRAM	300 nanosecond or better
		200 nanosecond or better
		150 nanosecond or better
		120 nanosecond or better
41256	256K DRAM	150 nanosecond or better
		120 nanosecond or better
411000	1MEG DRAM	120 nanosecond or better
1M X 9	120 ns SIMM modules for IBM PC, XT, AT etc	
1M X 9	80 ns SIMM modules 3 chip for IBM PC, XT, AT etc	
1M X 9	80 ns SIMM modules 9 chip for IBM PC, XT, AT etc	

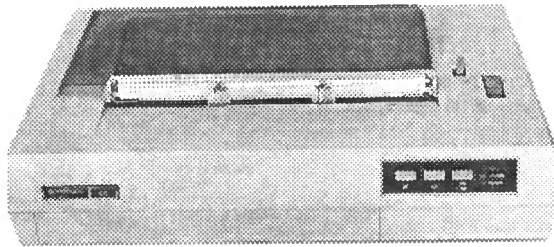
9 for £6 or 18 for £11.50
9 for £10 or 18 for £18.50
9 for £16 or 18 for £29.00
9 for £18 or 18 for £32.00
9 for £20 or 18 for £37.00
9 for £22 or 18 for £40.00
9 for £40 or 18 for £78.00
£19.50 each 2 for £38.00
£23.50 each
£22.50 each

256K RAM SIPPS - Special Offer

These are brand new 256K dynamic RAM SIPPS containing 9 off Texas Instruments TMS 4256 or equivalent and their associated decoupling capacitors. Although the chips are absolutely standard, as used in thousands of computers, these SIPPS were manufactured for a specific application and the pinout of the module is therefore not as per a standard SIPP package. The chips are surface mounted with full length formed leads and may be very easily removed from the PC board. Alternatively the module may be used as is or modified. A very cheap way to buy 256K dynamic RAM!



£9.95 per SIPP (A) 4 for £32 (A)



Inkjet Printer **BLOW OUT**

We bought another **MASSIVE** quantity of these printers at a very advantageous price, we are **passing this price straight on to you**, on a 'we need the space basis'. Therefore, a **massive reduction** brings you this printer for **only £34.95** ! Naturally at this 'No Time To Test Price' all units are 'sold off the pile' un-tested and without guarantee. For those of you who 'smell a bargain' here is the specification of the printer. Mannesmann Tally monochrome inkjet printer **Model MT90**, featuring high speed, high print quality and quiet operation using

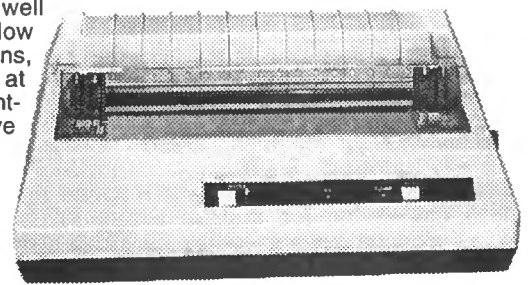
bubble jet technology. Choice of draft or **Near Letter Quality** modes using bidirectional operation in text mode and unidirectional in graphics mode. Printing speed is 220 cps in draft and 110 cps in NLQ. Standard RS-232C serial interface. Paper feed is fanfold, roll or single sheet, ink is via ink cartridge Mannesmann part no 040-858. Print width is 8 inches, normal characters print at 80 column, enlarged at 40 column. Condensed versions of both at 132 and 66. There are **four modes of graphic printing**: 480, 960, 1920 and 1440 bits. Dims: 15¾"L x 11-5/8"W x 4½"H.

WAS £119.00 - Now To Clear £34.95 !! (D)

Another Display Printer Bargain

We seem to be getting quite a name for high quality, brand spanking new printers at well under half price! We sold out of the Hazeltine Esprints and then the Epson MX-80's. Now we have a deal better than both, the Centronics 152 in both parallel and serial versions, shining bright in manufacturer's cartons, original packaging, complete with manuals at a fraction of the original price. The 152 is a full width (5 to 15 inches width paper) printer with a choice of tractor, fan fold or single sheet feed. Both versions of the 152 have the following specifications in common:

Print speed:	150 characters per second
Print format:	10 cpi/16.36 cpi
Printing:	Bidirectional impact
Dot matrix:	9 x 7
Input code:	96 character ASCII
Paper advance:	6 lines /inch. 13 line feeds /second
Print buffer:	768 characters plus one line
Country codes supported:	England, USA, France, Germany, Italy, Denmark, Sweden

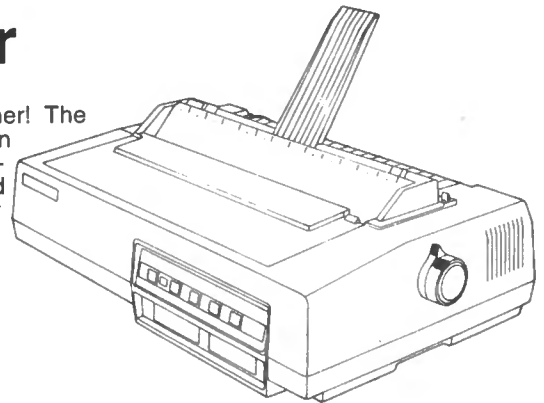


The 152-2 is standard Centronics parallel interface, the 152-4 is standard RS-232C serial. The latter is factory preset for 1 start bit, 7 data bits, 1 even parity bit and 1 stop bit. 8 data bits may also be selected and the parity may be disabled or made odd. Baud rate is switch selectable from 200 to 9600 in the usual steps. Measurements 21"W x 15"D x 7"H.

152-2 or 152-4: £129.00 each. (E)

Superb 24 Pin Printer

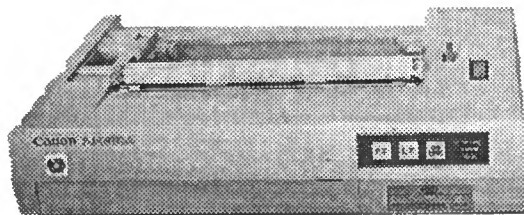
If you need a quality 24 pin Dot Matrix printer that is up to any job then look no further! The NEC P9XL is an advanced printer featuring letter quality printing and high resolution graphics, giving a maximum 360 DPI output. Print speeds range from 140 characters per second Letter Quality to 400 characters per second Draft. Standard Centronics parallel interface. Can also emulate Diablo / IBM. Comes with Feeder as standard. Measurements 24¼"W x 15"D x 14¾"H. A real heavy duty printer. Supplied in good used condition.



Only £199.00 (E)

Colour Inkjet Printers

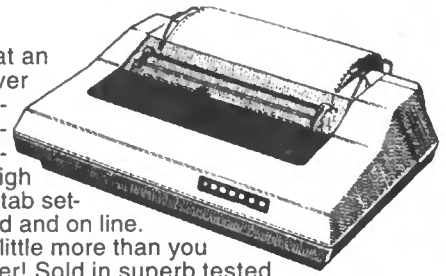
Canon Model PJ-1080A Colour Inkjet printers for high quality, and quiet, print and graphics production. Both standard (80 column) and enlarged (40 column) characters are available. The seven colours are Yellow, Magenta, Cyan, Green, Red, Blue and Black. Uses four nozzles orientated horizontally, the additional three colours are obtained by combining two, for instance, yellow and cyan for green. Characters - full ASCII set plus 64 special - are printed on a 5 x 7 dot matrix for 80 column and 10 x 7 for 40 column. Resolution is 640 dots per line. The PJ-1080A will accept either single sheet up to A4 or roll paper up to 8½" wide, maximum diameter of the roll is 2¾". Also perfect for overhead projection film up to A4 size. Dual cartridge ink supply, tri-colour and black with 3.2 million and 4 million character capacity respectively. In excellent used condition with full 90 day guarantee.



Only £199.00 (D)

Ultra Fast Full Size Printers

The Newbury Data Model 8840 high speed full size (15.5" paper) printer buzzes along at an amazing 240 cps. An excellent buy enables us to bring this printer to you at a saving of over £1000! Newbury products are famous for their quality and the 8840 is no exception. It features an integral fully adjustable paper tractor giving exceptionally fast accurate paper handling and copes with multi-part forms and precision printing with ease. There are 10 selectable built in type fonts providing up to 226 printable characters on a single line. Many high quality printer features are standard including convenient electronic horizontal and vertical tab setting. It has the normal form and line feed buttons on the front panel together with reset, hold and on line. The ribbon cartridge has a 15 million character expected life. RS232 serial interface. For little more than you would normally expect to pay for a desktop, you can buy this full size professional printer! Sold in superb tested condition, with a 90 day guarantee.



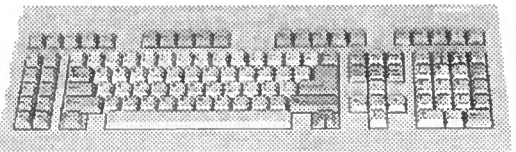
Only **£295.00** (E)



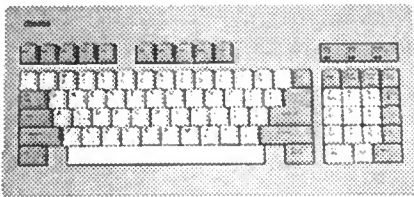
PC-XT/AT Switchable & PC-XT Keyboards

30 Function Key Switchable XT/AT

A very nice brand new and boxed switchable XT/AT enhanced keyboard featuring no less than 30 function keys making 115 keys in all. In AT mode it will power up as a true AT, that is with the Numb Lock on, unless the machine software directs otherwise. This is a UK keyboard with a pound sign as well as a dollar sign. The backslash, ampersand and other keys which sometimes give a placement problem, are all in their correct places for the UK. Good clicky feel with the normal three LED indicators built into the keys.



£49.95 (B)



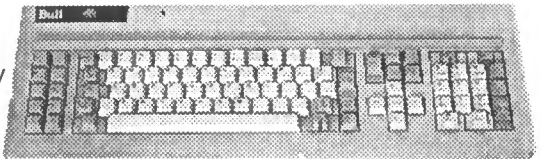
Switchable XT/AT

Brand new and boxed keyboard for use with the PC XT and AT, switch selectable. 85 keys with the usual 3 LED indicators. 10 function keys along the top of the keyboard. Made by NCR. Complete with template for user slogans.

£32.95 (B)

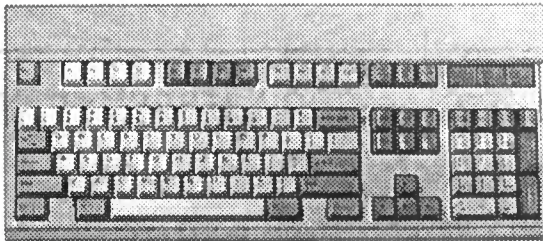
XT Keyboard

Unique keyboards made by Honeywell for Bull. Even though they are enhanced they are still compatible with the XT and compatibles together with the original PC. What's more it comes with an assortment of keys so that you can make it into a UK or US keyboard! It has LED indicators for CAPS and NUMB plus features no less than 94 keys, with the 10 function keys on the left. A handy pencil ledge just above the top line of keys is provided. Nice two tone grey, measures 20" L x 9" D. Normal retractable tilt legs, curly cord and 5 pin DIN plug. Plus the ultimate in convenience: the cord can be exited from the left, centre or right of the rear of the keyboard!!



£29.95 (B)

High Quality - Low Cost XT / AT / PC Keyboard



Made for a major rental user of computer systems, we have the contract to purchase all of their ex-rental equipment. Quite often the equipment is only in use for a few weeks and is returned to us in virtually new condition! One of these 'goodies' is this quality keyboard - fully configurable for all systems via a DIP switch on its underside, it features light pressure double shot moulded keytops, a generous length curly cable terminated with a standard 5 way DIN plug. All keys are standard except for the exception of a key with a UK '£' sign. Supplied fully tested & guaranteed at a snip price of only....

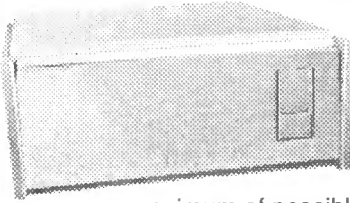
£19.95 (B) **5 \ £85.00** (C)

Educational Keyboards ??

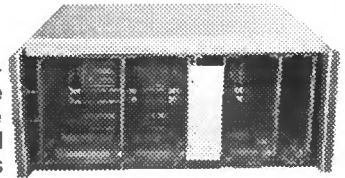
We are often asked to supply keyboards for use in schools and nursery groups. Forward thinking teachers could do no better than to familiarise children with the look and feel of a keyboard - after all its most likely that whatever field of employment or lifestyle they adopt in the future, a keyboard of some description will probably be encountered. Display Electronics have vast stocks of keyboards ideal for this application, quite often brand new or hardly used, but electrically non compatible with the current PC trend. We are able to supply these units as **Educational Keyboards** at a price well below their original cost and ideal for the purpose described.

Order as KB-ED **£5.95 each** (B) **or 5 \ £25.00** (C)

Hi Quality Chassis Box



Built to BT's highest standards this box was made to house a number of printed circuit cards and mains power supply unit, which slide in the front door, which hinges upwards. As supplied there are four 40 way 0.1" card edge connectors at the back, all those used have gold plated contacts. The box is made so that these sockets can be moved and new ones added as required. The probable

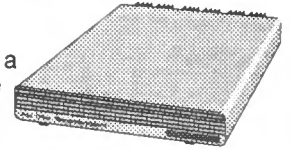


maximum of possible cards is twelve. Complete with power cord and a standard 25 way D female connector. Even a spare D connector male plug is supplied. Dims 16"L x 14.5" W x 6"H. Very ruggedly manufactured and makes a perfect enclosure for hundreds of different projects.

Only £15.95 (C) or 2 for £30.00 (D)

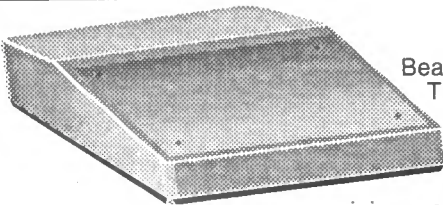
General Purpose Chassis Box

Ex BT general purpose chassis boxes, complete with rectifiers, two 12 volt TO-3 cased regulators and a 2N3055 transistor, all mounted on a large heat sink at the rear of the case. Two 25 way 'D' sockets, one male and one female, also mounted on rear. Internally there are two bays (one optionally divided into two) stretching the length of the case which can be left as is or removed. At the back of the bays are 3 gold plated 40 way edge connector sockets. The front of the case hinges upwards for easy access. Steel chassis with aluminium cover and front panel. Measures 16" x 11½" x 2½".



Only £10.95 (C) or 3/£29.95 (D)

Combination Desk Top Case

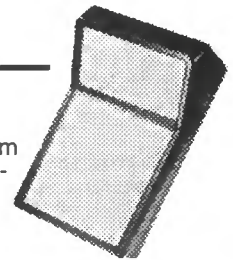


Beautiful desk top enclosures from Vero type 65-5033K suitable for hundreds of different projects. The unit has a sloping front with a removable panel of attractive matt anodised aluminium which comes with a peel-off protective plastic cover. The case itself is made of high impact black and light grey plastic in two parts which screw together. Seven fastening bosses are supplied inside on the base so that chassis or printed circuit boards may be mounted. Dims in mm are 228L x 215W x 76H (at the back 50 mm at the front). The slope of the anodised aluminium panel is 70E, the flat top is 65mm wide and the anodised aluminium panel measures 200mm x 130mm. Fixing hardware is supplied. A super case which will dress up any project.

£9.95 each (A) 3 for £27.00 (B)

Instrument / Keyboard Case

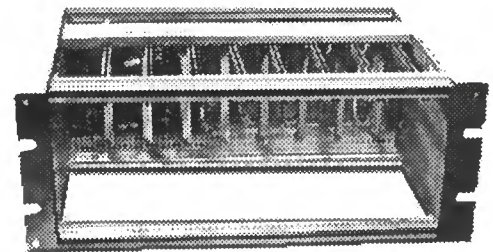
An attractively styled sloping back black moulded case suitable for hundreds of applications. The two aluminium plates are removable for ease of drilling and the case itself is in two parts for simple accessibility. The back aluminium plate slopes at a 45E, the front one is horizontal. Measures 7-3/8" long by 4-1/4" wide. The height at the front is 1-5/8" high and 3¼" at the back. The back aluminium plate is 3¾" x 2¼" and the front 3¾" x 4¼".



£3.95 (A) each or 3 for £11.00 (B)

Half Width Euro Rack

Useful item for constructors of modular PCB equipment. Made from all aluminium extrusion this mini rack lends it's uses to a host of applications. As shipped the unit is fitted with 8 x DIN 4162 64 way socket connectors (half populated) these have long solder spills on so can be re-used or as they are only held in by two screws may be replaced. The connectors are 'Bus Wired' and terminate on to 3 x 24 way connectors on the rear panel. Card guides conform to the standard 100 mm vertical spacing for Eurocards. Overall Dims are mm 355 W x 235 D x 132 H. Supplied in used but in good condition.



Only £14.95 (B)

WANTED

To complete a personnel collection of test equipment manuals, we would very much like to locate the following manufacturers catalogues:

TEXTRONIX Test Equipment catalogues for 1980 & 1989

HEWLETT PACKARD Test Equipment catalogues for 1977 & 1989

Please contact Dave Fisher at Display Electronics

Naturally a suitable reward could be considered.

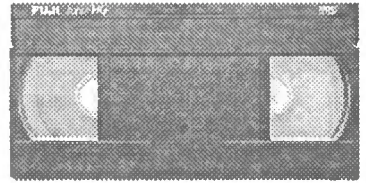
Signal Isolation Transformer



Radio Spares part number 217-826. Miniature double wound transformer specifically made for audio / data transfer. An isolation voltage of 4kv is achieved by the double wound bobbin which is also wound to give a 1-1 ratio with an input and output impedance of 600 ohms. Connection via solder tags. Dim. mm 45 H x 44 D x 46 W Order as RS-IT

Only £3.95 (A)

VHS TAPE CASSETTES!



We had a bit of luck! A certain well known company uses **extra high grade VHS tapes** - mainly 120 minutes, by **Fuji - Super High Grade, BASF, TDK etc.** for a precision film application. Because of the special application they can record them only once. Their loss is your gain. At these prices **you can't even buy such quality** direct from the manufacturers! This is one of the best deals we have ever been able to offer (mail order only) - **first quality at a lowest ever price** - and you don't often see that!

10 for £14 (B) 25 for £33 (C) 50 for £65 (C) 100 for £125 (E)

Very Versatile 'G' Clamps

Extremely versatile because not only may they be used as an ordinary clamp, they have threaded holes on the rear so that they themselves can be attached to other objects. In this way, almost anything can be made capable of being clamped to any protruding surface. Has a jaw height of 2½". Thousands of uses in any workshop or household.



Only £3.45 each (A) 5/£15.95 (A)

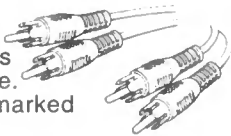
Telescopic Aerial

A standard heavily chromed telescopic aerial for portable radios and other applications. Screw (supplied) fixing at the base. It has 7 sections and the length varies from 4-5/8" to 17". Base diameter is 5/16". Makes a handy pointing tool as well!

3 for £3.95 (A) or 10 for £10 (A1)

High Quality Video Cables

'Gold Dubbing Cable' 6 ft long, ideally suited for connection of two video recorders - features **GOLD** plated phono connectors for ultra low noise. Connectors on each end of cable are clearly marked 'Audio' and 'Video'.



Heavy gauge 3.75 m, 75Ω RG59U video cable assembly fitted with high quality moulded nickel plated connectors terminated one end with **BNC plug and PL259 plug** the other. Black cable. Must have cost a fortune!

General purpose video cable terminated one end with moulded **BNC male connector**, the other end being **Phono / RCA Jack** plug. 1.5 m long in Black finish.



Satellite 'F' to 'F' connector cable 26" long. Industrial grade RG59 75Ω cable terminated at each end with a crimp type 'F' plug as used on most satellite equipment.

£2.25 each or any 3 for £5.99 (A)

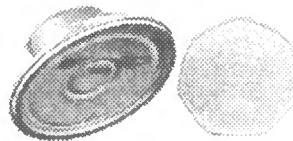
Telescopic Aerial

with Angled Mast

Six section versatile telescopic aerial YOKOWO type 1-300-01. Side bracket fixing and the ability not only to extend to 42" but also to be placed in any angle up to 45 degrees from the vertical. Heavy chrome finish. Closed length is 8.25".

£1.75 (A) each or 5 /£7.75 (A1)

40mm Submin Speaker

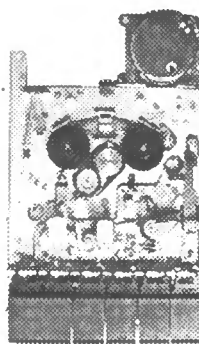


Radio Spares part number 248-476. High quality miniature speaker for general purpose use in audio or tone generator applications, ideal for direct PCB fixing. Solder tag connections. 8 ohm coil rated at 200 mW

Only 99p 10/£7.95 (A)

Audio Cassette Mechanisms

Brand new complete stereo audio cassette mechanisms, including stereo play and electronic erase heads. The motor is 12 vdc. Six piano type control keys for Record, Fast Forward, Rewind, Play, Eject and Pause. First grade well engineered quality on a sturdy metal chassis and heavy duty motor. The assembly is of normal cassette machine size - approximately 7"L x 5"W x 2-½"H. Just needs the electronics and its ready to go! Also very useful for spare parts. Shown with the plastic cover removed for ease of illustration.



£9.95 each (A) 3 for £27.95 (B)

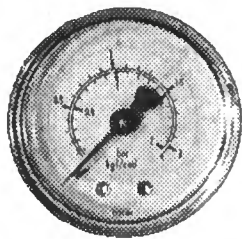
Sticky Number Sheets



One of those useful items that's always handy to have around. A large sheet of 84 very durable PVC permanent self adhesive peel off numbers, numbered 1 to 84. Each number is circular die cut and 5 mm across. Ideal for numbering parts, IC's on prototype boards, stock locations, in fact any numbering job that comes to mind!!

10 Sheets £1.95 (B)

Pressure Gauges



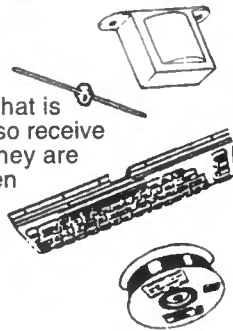
Three different types of pressure gauges to choose from:

- PG-1** Three scales. The red outer 0-30 lbf/in²; the middle black is 0-2 kgf/cm² and the inner black is 0-2 bars. Stainless steel case measuring 1-7/8" diameter by 1 3/4" deep overall. The bushing is 15mm diameter.
- PG-2** Two scales: the inner in red 0-4 bars and the outer in black 0-60 lbs/in². Black metal case with heavily chromed surround. Dims: 2"D x 1 3/4" including the screw bushing connector, which is 10mm diameter.
- PG-3** Two scales both coloured black. The outer 0-4 bars and the inner 0-60 lbs/in². Stainless steel case measuring 2" diameter by 1 3/4" deep including the 10mm diameter bushing.

Any type £4.50 each (A) 3/£12 (B) Mix or match!

Quality Bargain Parcels

Bargain packs or bags are not uncommon in the surplus industry but sometimes they prove to be disappointing when received. Because we know this, we go to a lot of trouble to select quality contents for our parcels and that is why they are different. We make certain that our customers not only get the very best value for their money but also receive real quality material and an excellent mix of parts. The only similarity between our parcels and others is that they are sold by weight. You can buy our parcels with total confidence that you will get a very nice surprise when you open them! They contain hundreds of different types of electronic parts and equipment ranging all the way from semi-conductors and optoelectronics to potentiometers and complete sub-assemblies. The majority of the contents are brand new! We regret that we cannot fill orders for specific parts.



5 kgs £8.95 (B) 10 kgs £14.50 (C) 20 kgs £22.50 (D)

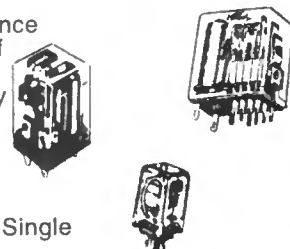
Parts Boards Bargain Parcels

We have thousands of parts boards from all types of equipment - computers, televisions, modems, RF boards, memory banks and so on. Most of them are new spares and some are from, again new, equipment. Rather than sort them all out and prepare data sheets we are selling them in parcels of various numbers of boards for parts stripping. The board sizes vary from about 4" x 6" up to jumbo size. We cannot say what actual sizes are in any parcel but each will have a good mix. The components on the boards are mostly IC's and other semiconductors, relays, DIP switches, connectors etc. The IC's may be socketed or not. The one thing certain is that you can save an awful lot of money in component costs!

5 board parcel £4.95 (A1) 10 board parcel £8.50 (B)

Bundles

"Bundles" are assortments of various types of the same basic component. A bundle of relays for instance would contain the stipulated number of relays, of differing voltages, contacts and sizes. The majority of parts in a bundle are brand new, only a few are ex-equipment and only when they would present an extraordinary value to the customer. Bundles must be distinguished from Grab Bags which might contain any type of part.



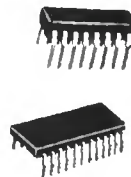
Relays

You never have the right relay at the right time. Stock up at these prices! May be any mounting style. Single and multi pole, DC and AC, high or low voltages. But definitely a good mix !!

10 for £9.95 (B) or 100 for £90 (C)

Integrated Circuits

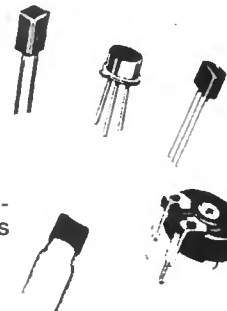
A massive pool of ICs of all types makes this one of our most attractive bundles. Mostly dual in line, plastic and ceramic - digital and analogue, many to military specifications. Op-amps and other linears, CMOS, TTL, LSI and others. Mostly regular types with some house numbers. All fully guaranteed NO FALL OUTS. How can you go wrong at these prices?



Small Semi's

100 for £11 - or - 200 for £20 (B)

This bundle contains small semiconductors of all types. May contain small signal silicon transistors, LEDs of all shapes and sizes, diodes, character readouts and so on. All brand new of course.



Passives

100 for £7.95 - or - 500 for £35 (A)

All types of passive components including pots, PC board mount resistor trimmers, variable and fixed capacitors, chokes, coils and many others. These passives are sold by weight. Very approximately 100 passives is equivalent to a half pound. Added bonus - six microswitches thrown in outside the weight!

1/2 kg for £7.95 or 1 kg for £14 (B)

Crimp Connectors

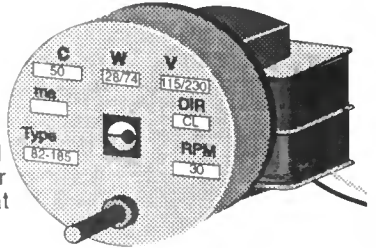
Regular type crimp connectors, solder tags, solder lugs, spades, butt joiners open and closed ended etc - sold by the item in many car accessory shops for around 20p each !!! Our price

200 for £3.25 - or - 400 for £6 (A)



Crouzet Geared and Ungearred Dual Low Speed Synchronous Mains Motors

Type U82265 super precision high quality geared motor from Crouzet which may be used with either 115 or 230 vac as required. It consumes only 12 watts yet gives torque you can hardly hold. The speed is a useful general purpose 30 RPM. The gearbox is precision engineered in bronze and steel with a beautifully smooth working. The shaft is 3/4"L x 1/4"D. The overall dimensions, including the gear box but excluding the shaft are 2-5/8" diameter by 2 1/2"H. A brand new top quality geared motor at a fantastic price - ideal for hundreds of applications.

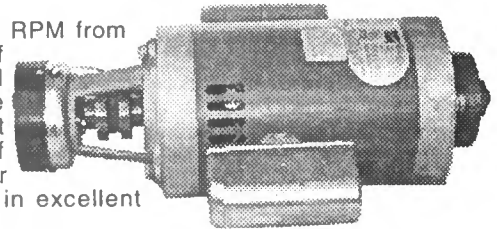


£19.95 each (B) or 3 for £55.00 (C)



Mains 3/4 HP Motor with Brake

Doerr motor Model LR 22132 delivering 3/4 horsepower and 2900 RPM from 220 / 230 vac 50 hz. Rated for continuous operation with a consumption of 4.1 amps. Features automatic thermal protection and pre-lubricated ball bearing action. The motor has a coil operated brake on one end which locks the shaft dead. It requires 12 vdc at 1/2 amp. The drive shaft is 1/2" and comes with a belt drum fitted which may be taken off by unscrewing a couple of Allen screws if required. The diameter of the body is 6" (excluding the thermal trip and capacitor protrusions) and the overall length is 16". Removed from equipment and in excellent condition, fully guaranteed for 90 days.



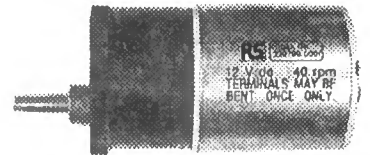
Only £49.95 each (F)




Fantastic Miniature DC Motor Selection

High Torque 40 RPM DC Geared Motor


Radio Spares part number 330-799. Quality totally enclosed reversible 6 to 12V DC steel geared, high torque motors - try and hold the shaft and it will take your fingers off! 40 revs per minute at 12 volts, 30 revs at 10 volts. Draws 15 ma at 12 volts, no load. 6 mm diameter drive shaft 15 mm long. Length including shaft is 90 mm, diameter at widest point is 40 mm. Front flange mounting via 4 fixing holes. Brand new and high quality for continuous duty. Order as MHT-2.




RS Price £40!! Our price only £19.95 (A1)

 Crouzet type 82/180. This is the same motor as above without gears. The shaft is 1/8" diameter by 3/4" long. The overall diameter is 2-5/8" and the height without the shaft is 1 1/2".


MM-1 £3.90 or 4 / £10 (A)

 We call this the Pancake motor because of its ultra slim 9 mm thickness. Precision made by the Japanese NAMIKI Co. this motor was made to direct drive tape cassette reel hubs in high quality digital tape decks. The motor features RARE EARTH magnets giving it incredible power for it's small size - so powerful that it is virtually impossible to stop the 1.5 x 6mm spindle with your fingers when run on only 6v!! Nominal speed on 6v DC 1200 rpm. Dim 9 x 42 m

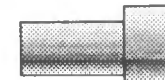
MM-2 £1.99 or 3 / £5 (A)

 Heavy Duty 6-24 v DC Computer Tape deck reel motor dimensions 15 x 8.1 cm. Fully enclosed construction with front flange mount and 30 x 8 mm spindle. High torque with typical no load speeds of 2400 rpm @ 24v and 1200 rpm @ 12v. Continuously rated, even under stalled condition. Complete with flange mounting plate. RFE.


MM-3 £10.95 each 3/£29.95 (B)

 6 to 12v dc motor with integral gearbox very high torque. Runs down to 2 vdc. Revs range from 60 to 240 rpm from 2 to 12 v dc. 4.5 x 3.5cm with 15 x 3 mm drive shaft. IDEAL MODELS ETC.


MM-4 £6.55 each (A)

 Miniature Swiss precision DC motor and gearbox by ESCAP type C11.210-5. Undoubtedly one of the best quality geared motors ever to come our way. Completely tubular measuring only 53mm long by 24 mm diam. Unit features a 12 stage gearbox giving a final speed on the 2.7 x 6 mm drive shaft of 90 rpm @ 6v and 180 rpm @ 12v. VERY HIGH TORQUE. Ideal models, lens control, robotics etc. At a current manufacturers price of £55 each, these motors should not be missed.

MM-5 £14.95 each (A)

 This is a little jewel of a precision geared motor ideal for all applications where real "Swiss Made" quality and precision is needed. The torque has to be seen to be believed and it fairly sings as it goes! It needs 12v DC to give about 1500 rpm and it gives proportionately lower RPM voltages down to about 6 volts. Dims. only 3L x 2.5Dcm. The gear may be removed from the shaft if required leaving 1/4"L x 1/16" shaft for any application! A beautiful piece of craftsmanship - must normally sell for around £50!

MM-6 £6.95 each (A)

 A nice little general purpose motor running at 3750 RPM at 12 vdc with very high torque. It has lower revs at 6vdc but we recommend this motor for 12 volt applications. The motor is reversible with the same strong torque. Measures 1-1/4" diameter by 1" deep. The shaft is 1/16" diameter by 1/2" long.

MM-7 £3.95 or 3 / £10 (A)

BIG £ SAVER

High Reliability Printer Mechanisms

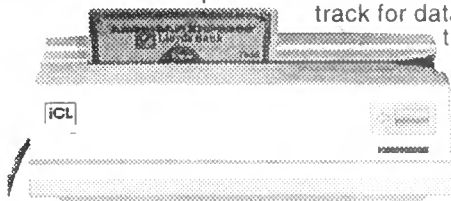
Star model DP824-12-F miniature high speed matrix printer mechanisms for normal paper. Brand new and boxed. Uses standard ribbons, friction feed paper and 7 pin head. Full 40 character per line width on normal 114mm (4") paper. Fast ten lines per second paper feed and one line per second print speed. Requires 12 vdc and driver electronics. Built for high reliability applications and sold at a fraction of its normal price.



Only £49.95 each (B) 3/£139 (C)

Credit Card Swipe Reader System

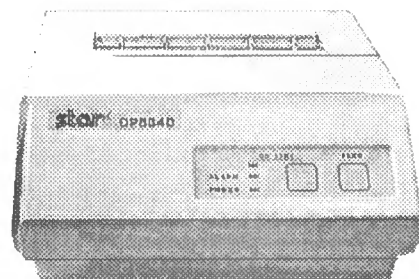
Now's your chance to see what is *actually* on your credit card !! ICL 136720/01 compact stand alone card reader features all internal electronics to output a decoded TTL level serial data stream containing all the data recorded on track 2 which is the industry standard track for data on credit cards etc. To complement this unit our engineers have written a BASIC program to run on a standard PC - when coupled to the reader via the serial port, each time a card is 'swiped' the number is displayed on the screen in ASCII and HEX. Hundreds of other applications include security, entry control systems, Point of Sale data capture etc. Supplied tested, in as new condition, complete with Full Data sheet & Basic program. Requires +5 & +- 12v DC.



Limited Quantity - Only £49.95 (B)

Star DP8340 40 Column Point of Sale Slip Receipt Printer

Star stand alone printer type DP8340 RM. Manufactured for use as a receipt label or ticket printer for a host of applications. **Totally enclosed** unit with standard RS232 serial interface with selectable baud rates from 150 to 9600. Printer accepts plain paper rolls fed from the rear from its own roll holder. Internal micro processor electronics control the **9 needle head** to give an **exceptionally high throughput** of approx **2 lines per second**. Many other features, too numerous to list here are fully covered in the 50 page manual. A few of this printers outstanding points are: 40 column printing, **block graphics**, two colour ribbon, software controlled peripheral output to drive cash draw, paper cutter, software handshake, etc. An exceptionally well built device which will provide long term service and reliability. Requires 12 V DC power at approx 2 amps. Supplied **BRAND NEW** with full manual. Manufacturers **current price is over £200**. Our price only



Only £145.00 (B)

Multicore Cable Bargain

BICC type H6900 cable assembly- one end terminated with a 15 way 'D' type plug, the other with a 15 way 'D' socket. Each connector is moulded on in heavy duty plastic and there are 9 pins connected. Remove these connectors if not required and you are left with a profusely screened multicore cable in a bright blue outer colour. Cable length is 6.5 mtrs long and with overall outer diameter off 11 mm. The inner is composed of 4 twisted pairs of individually coloured 7/0.2 mm cables. Each pair is individually screened with an aluminium foil wrap and all 4 pairs are overall screened by a heavy woven tin copper braid. A separate 7/02 mm bare screen or drain wire runs up the centre core. Ideal for all low voltage applications where extremely good screening, quality and durability is required.

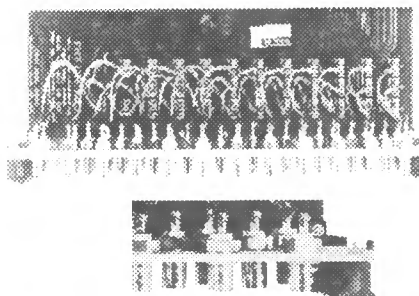
Only £5.95 (A) 10/ £48.00 (A1)

BIG £ SAVER

BACK IN STOCK AGAIN!!

Isolated BNC Connector Boards

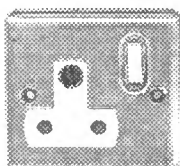
This is a front panel for a distribution board and contains 34 high quality female BNC connectors. They are chassis isolated, that is to say the outer shell is insulated from the mounting hardware and chassis. Panel measures 15½" x 2". You won't buy them anywhere else at under 20p each! As a matter of fact they are normally £1.57 each!



Only £7.95 each (A)

15 Amp Solid Brass Switch Sockets

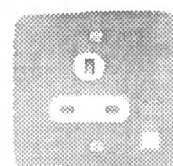
Top quality product from one of Britain's best electrical accessory makers, MK Ltd. **Rated at 15 Amps 240 V** to accept the heavy duty round pin 15 amp un-fused type plug. **Solid brass brushed front panel** with white switch and trim - **must cost a fortune !!** Order as MK15.



Only £3.50 (A) 5/£15.00 (B)

13 amp Quality Switch Sockets

Stainless steel front plate, High Grade 13 amp switch socket. UK made by Dorman and Smith for the MOD, so best quality. Removable front plate therefore ideal for flush or surface mount with additional backbox.



Only £2.25 (A) 5/£9.95 (B)

BT Approved Push Button Phones By Philips

BT approved push button telephone - an improved version of the standard BT "Statesman" with "Recall" button. Two tone brown colour with a matte stout plastic finish rather than the shiny lighter weight plastic of the "Statesman". Built to a high specification by Philips. Complete with a standard telephone plug on a long 3 metre cord ready to plug into your wall socket. Tested good used condition. 90 day guarantee.



Order as PHDP for pulse dial or PHMF for tone dial.

Only £12.95 each (A)

5/£59 (B) 10/£99 (C)

Quality Aerosol Electrical Products

AE-1 Freezer. A rapidly cooling chemical, ideal for locating those frustrating intermittent components and testing thermo sensitive devices. Nett weight 228 grams.

£1.35 (A)

AE-2 Switch cleaning lubricant. A special formulation for cleaning contacts and commutators and leaving a thin film of oil to reduce contact wear. Nett weight 226 grams.

£0.99 (A)

AE-3 Solvent degreaser. A fast and efficient solvent for general purpose cleaning including PC boards, tape heads, relays and most plastics and paint surfaces.

£0.99 (A)

AE-4 This is The famous Ambersil anti-static foaming cleanser, versatile deep cleaning formula for virtually all electronic equipment, plastics and cabinets. Removes grime and grease as you have never seen before !!

£2.50 (A)



DIN Rail Components

An international standard defines a metal strip (honest it's true), called a 'DIN' rail. This metal strip is normally bolted onto a chassis or into an enclosed box. On this strip can be mounted (usually clipped) a virtual host of electronic / electrical devices and connectors. The whole concept is to provide a logical, quick and easy method to build / modify or service control panels and electronic systems. We have some large quantities of these devices as follows:

Klippon SAK 16/35 terminal connector rated at up to 600v at 35 amps, upto 16mm² cable entry.



Only £6.50 for 10 (A1)



Klippon SAK S3/32 in line cartridge fuse holder with clamping lugs. Rated upto 440v at 15 amps.

Only £12.50 for 10 (A1)

Quality Handtools for Electronics

SC-1 High quality US made diagonal side cutters by Hunter for electronic applications made of extra high quality semi-polished steel. 3/4" blade length with 3-1/2" insulated handles. Maximum jaw width at tips is 3/4".

£7.95 each (A)

SC-2 Exactly the same as the above but miniature. 5/16" blade length with 2-1/2" insulated handles. Maximum jaw width at tips is 5/8". The nose is more tapered than SC-1.

£9.95 each (A)

SD-1 US made quality slot head screwdriver from Challenger. High grade chrome plated steel round blade with flared tip. Yellow plastic grooved handle 3/4" diameter for a solid grip. The blade is 3-1/2" long.

£1.00 each (A)

CT-1 Heavy duty precision hand tool for crimping 50 and 75 ohm connectors to RG-58/U, RG-59/U and RG-62/U coaxial cables. Manufactured from high grade steel with one movable and one fixed jaw plus ratchet release for ease of use. Normal distributor price for this precision tool is £60!

£29.95 each (A)

Air Valves & Switches

Two different types of air flow valves from Martonair, types S/666 and S/560. The first, shown in the left hand photograph, is a low profile push button switch type with a firm spring return. There are three apertures, an inlet port, a cylinder port and an exhaust port. At the rest position the inlet port is sealed and the cylinder port is connected to the exhaust. When the button is pressed, and for as long as it remains pressed the inlet port is connected to the cylinder port, sealing the exhaust. In electrical terms it is a normally closed momentary operation single changeover switch. The valve body measures 2"H x 1-1/4"W x 3/4"T. The panel hole required is 1-1/8". Type S/560 (right hand photograph) also has three ports as described above but the changeover is controlled by air pressure at two pilot ports, one at each end of the valve. A momentary air pressure at one pilot port whilst the other is evacuated changes the valve over where it stays until a momentary pressure is applied at the other, whilst the first is evacuated. A single changeover toggle switch. The air supply pressure rating for both switches is 10-100 psi and all ports are 1/8" B.S.P. Air pressure on the pilot ports of S/560 is 30 psi minimum to ensure changeover and it measures 2-1/2" long by 1-1/4" square. These valves are brand new and packaged in the manufacturers original boxes and S/560 is supplied complete with mounting bracket and screws. S/666 is panel mounted and is supplied with shrouding and mounting nuts.

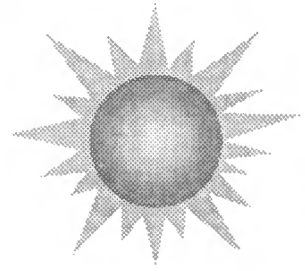
S/666: £8.95 each or 3 for £24.95 (A)

S/560: £17.95 each or 3 for £49.95 (A)

BIG £ SAVER



Cooling Fans For Every Application!



Axial Cooling Fans

Please specify 110 or 240v for AC fans

Size	Model	Description	Price
60 mm	MMF06D12	DC 12V 0.84 watts. 25mm thick. Mitsubishi	£6.95 (B)
80 mm	AT300	AC 38 mm thick	£ 8.50 (B)
80 mm	126LF/8850	AC38 mm thick	£ 8.50 (B)
80 mm	MMF08C12	DC 12V Mitsubishi 2.04 watts. 25mm thick	£8.95 (B)
80 mm	8978	AC 240v Papst Slimline 25 mm thick. Low noise	£ 9.95 (B)
92 mm	MMF09B12	DC 12V Mitsubishi 2.64 watts. 25mm thick	£5.95 (B)
93 mm	99 XU	AC ETRI Slimline - only 25 mm thick	£ 9.95 (B)
120 mm	2984	AC dual voltage 110/240v. 38 mm thick	£10.95 (B)
120 mm	WR341	AC 38 mm thick	£ 9.95 (B)
120 mm	Var.	As above RFE and fully tested	£ 4.95 (B)
120mm	AT500	115 volts AC. 38 mm thick	£ 9.95 (B)
60 mm	812/814	DC Slimline 25 mm thick. Order no.812 for 6/12v or 814 for 24v	£15.95 (A)
80 mm	8312	DC Slimline 30 mm thick. Papst 6-15 vdc. 1.8 watts	£12.95 (A)
120 mm	FB-12C12H	DC 12v 12 watts. 38 mm thick. High throughput	£12.50 (B)
120 mm	CUDC24K4	DC 24v 8 watts. 25 mm thick	£14.50 (B)
120 mm	4124X	DC 28v 5.5 watts. 38 mm thick	£10.95 (B)



Brand new Mitsubishi 60 X 25 mm Fan Scoop

Attention all manufacturers using 60mm 12 volt DC fans! We have a **HUGE** quantity of these brand new fans, Model MMF06D12. Specifications : 12v DC, 0.84 watts input. 11.6 CFM at 24dB(A). Measures 60mm square by 25mm. Buy now before they all go!

Large Quantity Available - Call for pricing



Only £4.95 each (A) 3/£13 (A) 10/£42 (C) 100/£400 (E) 1000+/CALL

Special Offer

A beautiful little ultra slimline from Densitron model DPF92B012 high performance 12 vdc 3.12 watt axial fan. It uses an electronically commutated brushless motor to give long life, very low noise and extra high efficiency operation. Measures only 92 mm square by an incredible 18 mm thin!

An incredible buy at only..... £8.95 (A)

2 for £16 (B) 10 for £75 (C) 100 for £590 (G)

Exactly the same physically as the above Densitron ultra slimline but Model DPF92B230FS for 230/240 vac mains voltage at 8 watts.

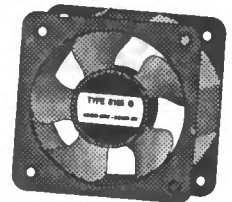


Only £9.25 each (A) 2/£18 (A) 10/£85 (C) 100 for £620 (F)

5 VDC 3 Watt Papst Fans

Super fans for all applications where only a 5 volt rail is available - not necessary to have a separate fan power supply! Papst System model 8105 G. Measures only 80 mm square by 38 mm thick. RFE in almost new test-ed condition - only

£9.95 each (A) 2/£18.00 (B) 10/£85 (C)



6 inch Round Fans For High Air Flow

Papst type 7450 230 volt AC round fan for extra high air flow. Has high size/air flow ratio with 5 large fan blades. 6" diameter (6-3/8" mounting hole to mounting hole) by 2-1/8" thick.



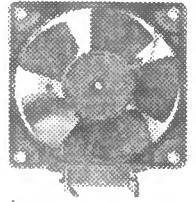
£12.95 each (B) or 3/£33.00 (C)

Fan guard grilles for standard 4 1/2" fans. 4 1/2" between mounting holes horizontally and vertically, 5 13/16" diagonal. Made of hardened plastic in black matte. **£1.25 each or 10 for £9.95 (A)**

Mains Voltage Shaded Pole Motor Fan

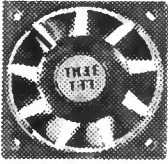
Gould type **JB-3AR**, this fan has all the advantages of being driven by a 220/240 vac shaded pole motor, **rf and tv interference free**. The fan blade diameter is 3" and overall depth is 2-1/2". Height is 3 1/2". Connection is by two flying leads terminated in push on connectors. A nice brand new **exceptionally quiet efficient fan** for all mains applications, at a give away price!

£4.95 each (A) or 3 for £12.95 (B)



Similar to the above with five unenclosed 4" diameter blades. Attachment is by way of 4 stout chromium plated spider legs. The mounting holes are at the corners of a 4" square. Rated at 230 vac 14 watts. Made by Howard Industries model number 3-90-8449.

£6.95 each (A) or 3 for £19.95 (B)



Brushless 12 vdc Miniature Fan

Buhler brushless fan model MF-55. These miniature fans are designed for optimum air flow and aerodynamic rating together with a small size coupled with very low electrical and magnetic interference, which is achieved by a match box size controller supplied with the fan. The pack is nominally 12 vdc input. The operational range is 8 to 16 vdc with a pro-rata fan speed. The rotation direction is reversible with reduced performance ratings. The MF-55 measures only 2-1/2" square and has nine blades. The power pack measures 2" x 1-1/2" x 1/2".

£4.95 each (A) 5 for £19.95 (B)



Superb Sub-Miniature Fans

Sanyo Pico Ace 25 Model 109PO6125S402 - a beautiful little sub-miniature fan with an amazing volume of air flow. Runs on 12 volts DC @ 0.21 amps. Measures only 2-3/8" square and 1" thick.

£7.95 each (A) or 3/£22.00 (B)

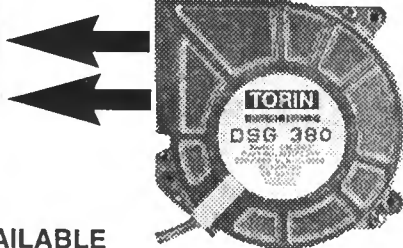
And Even Smaller!!



Would you believe it - only 1 1/2" square yet with seven blades and it moves that air! Made by Omron for Epson type DO412. Rated at 12 vDC at 150 ma. Mounting holes are 1/4" apart square and it is only 3/4" thick. Ideal for all miniature work, model making, trains etc.

£8.95 each (A) or 3/£25.00 (B)

NEW COMPACT SIDE BLOWER



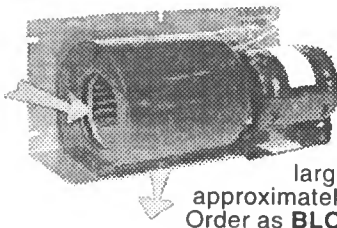
LARGE QTY AVAILABLE

TORIN 4" x 1.5" Side Blower

Just the job for those compact units that require a good blast of air. Torin type **DSG380** features a very compact unit - the air intake to the blower is on the large flat side with the output (see arrow) on the thin side. The air output aperture measures 30 x 64 mm and can be left as supplied or coupled to hosing etc. Quality made in ABS plastic on a cast alloy chassis. Three hole fixing with flying lead connections **240 v AC 20 watts**. Overall dim 125 mm square x 40 mm thick.

Only £12.95 (B) or 3/£33.00 (B)

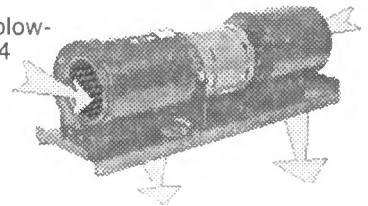
High Density Snail Blowers



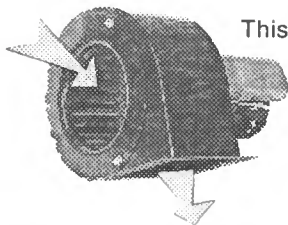
Four inch diameter blower powered by a high quality 220 volts AC motor by Fasco Industries (Torin) type U62 B1, complete with integral starter capacitor. Draws 0.36/0.44 amps. RPM 2770/3350. 1/20 HP class B. Features thermal protection and sealed ball bearing. Brand new surplus made for IBM. Perfect for applications requiring the high speed movement of air, particularly for cooling medium to larger items of equipment. Overall measurements: 11"L x 5"D x 5"H. Outlet duct: 3 1/2" x 2". Motor shaft: approximately 3" long and 5/16" diameter. At these prices they are worth buying for the motor alone!
Order as **BLOW 1**

£22.95 (D) 3 for £66.00 (E)

This is similar to the above but the motor has its shaft extended from both ends and it drives two blowers. 220/240 volts AC at 0.6 amps. RPM 2825/3350, 1/20 HP. Thermally protected. Requires a 4 mfd capacitor. Model number JF1E007N. Measures 16"L x 5"D x 5"H. Outlet ducts: 4" x 2 1/2" each. Ideal for applications where the ratio of air movement to power consumed needs to be very high.
Order as **BLOW 2**



£24.95 (D) 2 for £48.00 (E)

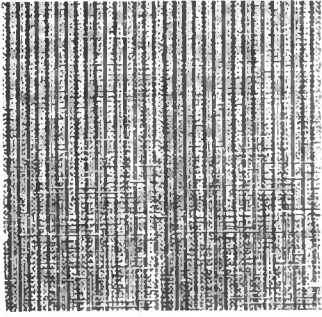


This is an extra high capacity snail blower by McLean Engineering 7162-1254 Type U62, for 220 volts AC at 0.9 amps. Has integral starting capacitor so you can just plug in and go. It also features thermal protection, quality ball bearing construction and it is rated for continuous duty. RPM is 2850/3400. CSA and Underwriters Laboratories approved - of course. A really nice blower capable of moving an enormous amount of air for those critical jobs. Order as **BLOW 3**

Only £29.95 each (D) 2 for £55.00 (E)

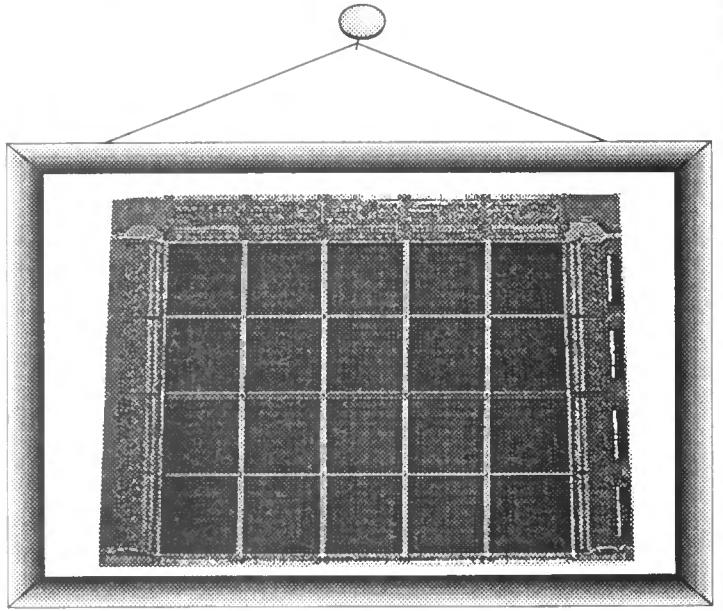
Cor...

MEMORY PANELS



Magnification of one "square" in photo opposite.

The world of electronics has many facets. Components, in particular, have been used for many things other than their intended function. Jewellery made from IC silicon wafers, discrete parts made into intricate sculptures and now core memory panels for you to frame! A long (!) time ago, core memory came not in the form of silicon chips but in panels containing miles of copper wire almost as fine as human hair. This wire was weaved into a criss-cross pattern forming a matrix of horizontal and vertical wires. Where each wire crosses another, they pass through a tiny ferrite ring, so small that a microscope is needed to see it. It is, or rather was, the charge existing at this point which was either "on" or "off" constituted one bit (not byte!) of memory. The combination of the colour of the woven wire and beads, plus the fact that gold plated connectors are used makes for a beautiful piece of memorabilia from the early days of computers, which if framed, will form a talking point at many a party! Originally four are concertinad together to give about 256K. We have separated the individual panels which measure 19" x 14" each.



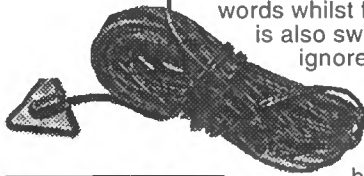
One panel £19.95 (B)

Four (still connected) £59.95 (C)



Digital Thermometer and Clock

Here's a prime piece of surplus to take advantage of! A brand new and packaged indoor/outdoor digital Thermoclock - a thermometer and clock combined which may be used inside or outside, complete with a self-adhesive water resistant thermoprobe for outside use, on a 3 metre lead. The Thermoclock may be switched for either function and whilst in one mode a button may be depressed to display the other. In other words whilst functioning as a clock, pressing the button will give a temperature reading. Inside and outside use is also switch selectable. When inside is chosen an internal thermosensor is used and the external probe is ignored. Features a jumbo sized liquid crystal display (3/4" high) for high legibility even at a distance. A 12 hour clock is displayed, complete with AM/PM readout. An extremely wide temperature range of -50EC (-58EF) to +70EC (+158EF) is available. The Thermoclock is powered by a standard LR44 (or equivalent) button cell which is easily replaced in a slide compartment. Measures only 3 1/4"L x 2 1/4"H x 5/8"T and comes complete with a foldaway back stand for desk use. Ideal for household, car, office, greenhouse and almost everywhere else!



Water Resistant Outside

Only £11.95 each (A)

£ £ £ £

**SURPLUS WANTED
TOP CASH WAITING!**

£ £ £ £

Display Electronics has a constant requirement for quantities of surplus / obsolete and redundant stocks. All kinds of electronic / computer / test equipment / power supplies / components / connectors / semiconductors / IC's / printed circuit boards / radio equipment / motors / racks / relays etc. always wanted. We are able to give a fast quote on lists of items available, or by viewing 'that pile in the corner'. We are also happy to negotiate a 'Confidential Reward' for any information leading to a purchase. Distance or quantity no problem - Fax or call Dave Fisher or Gavin Mac for further information now!!

Miniature Portable Frequency Counters



Brand new Kaise frequency counters models SK-6710 (frequencies to 250 Mhz) and SK-6720 (frequencies to 1 GHz) which literally are pocket sized and are powered by either six AA batteries (not supplied) or a mains adaptor. Either of the 9 vDC adaptors shown on page 18 of *Display News* Issue No.11 would be fine. The readout on both models is by way of bright 7mm red LED displays, the SK-6710 has 5 digits (99999) and the 6720 has 4½ (19999). Both have overflow indicators and an internal frequency standard of 3.2768 Mhz. The Gate Time (the gate inputs the frequency to be measured and the standard frequency and outputs to the counter) is front panel switchable between 0.01 sec and 1 sec. The front panel also houses the range selector. They have a foldaway support as shown in the photograph and with it retracted measure 5"L x 4-3/8"W x 1½"H. The sturdy case is of steel and brushed aluminium. Both are supplied with a shielded input lead with a BNC plug to fit the socket on the counter at one end with two crocodile clips at the other.

SK-6710			
Ranges	Gate Time	Resolution	Accuracy
Lo range 1Hz to 2MHz	1 s	1 Hz	± 50 ppm ± 1 count
	0.01s	100 Hz	
Hi range 1 Mhz to 250MHz	1 s	100 Hz	
	0.01 s	10 KHz	

SK-6720			
Ranges	Gate Time	Resolution	Accuracy
1 M range 1Hz to 2MHz	1 s	1 Hz	± 50 ppm ± 1 count
	0.01s	100 Hz	
100 M range 1 Mhz to 160MHz	1 s	100 Hz	
	0.01 s	10 KHz	
1 GHz range 100Mhz to 1GHz	1 s	1 KHz	
	0.01 s	100 KHz	

Note: Input sensitivities vary slightly over the various ranges but lay between 30 mV rms and 50 mV rms for them all.

SK-6710 - £89.95 (B) SK-6720 - £125.00 (B)

MS - DOS

- MS-DOS version 4.01 on 3½" 720K floppies **£9.95 (B)**
- MS-DOS version 4.01 on 5¼" 360K floppies **£8.95 (B)**
- MS-DOS version 5.0 on 3½" 720K floppies **£14.95 (B)**
- MS-DOS version 6.0 on 3½" 1.44Mb floppies **£22.95 (B)**

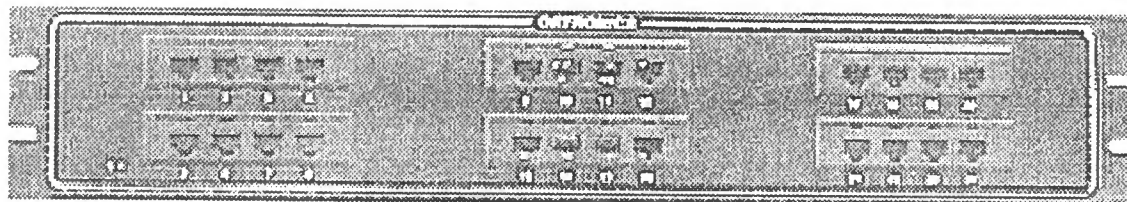
Notes: All of the above versions support large hard drive partitions - unlike 3.x and earlier. They also all include the important utilities which usually come with MS-DOS such as CHKDSK, SMARTDRV, FORMAT and so on. However MS-DOS used by OEM's can differ in small respects as to content. For instance the 5¼" above includes GW-BASIC, the 3½" do not. If any of the OEM optional utilities are critical for you please call to check before ordering. All are brand new, sealed and un-registered, so presumably can be updated to new versions of MS-DOS when released.

IBM PC Card Mount / Blanking Plates

Often hard to find item. Plated pressed steel with two right angled tapped mounting holes which may be used for mounting a custom PCB or hardware to be secured by the card guide frame on all types of PC, AT or XT computers. May also be used as blanking plate to ensure correct operation of your computers cooling system when unused cards are removed, thus causing incorrect airflow and possible overheating. Don't be without them - Overheating can be VERY costly!

**£1.25 each
or 6 for £5.00 (A)**

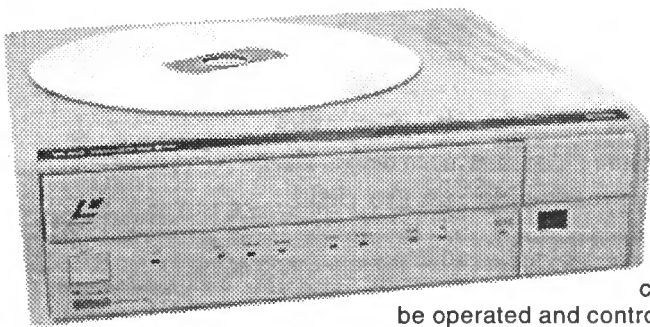
19" 24 Port Network / Comms Distribution Panels



**BIG £
SAVER**

Professional USA made by ORTRONICS # OR-811044521 24 port 8 wire 'Quad' frame patch panel on 19" 2 U rack mount panel made for network or signal distribution patching, all 8 way RJ45 8 way sockets are pre wired to Krone strips on the rear of the panel for use of simple IDC connection techniques. Each krone strip has write on panels on for clear cable pair identification. Fully UL & CSA approved product. Typical current price of this unit is around £125. Surplus buying brings this to you BRAND NEW.

Only £85.00 (B)



Computer Controlled Laser Video Disk Player

BIG £ SAVER

One of the most amazing surplus deals that we ever been able to offer our customers! The Philips VP410 LaserVision player, in a used / tested condition, which plays disks which are, in effect, 12" CD's. The VP410 may be operated and controlled in two different ways. Firstly by an infra red remote control, obtainable from Philips part number either VP131 or VP410 and secondly by computer via a standard RS-232 port. It will play entertainment disks with startling visual and audio quality in two channel stereo or mono, or when controlled by a computer, it may also be used as a versatile high quality storage/retrieval medium. It will play back either LaserVision CAV (active play) or CLV (Long Play) discs (which covers all commercially available video discs). With the former, special LongVision effects may be used, such as still, slow-motion, reverse play, fast forward, fast reverse and goto picture or chapter number. The disk has a maximum capacity of 54,000 pictures per side (approximately 36 minutes of play at 25 pictures per second). The CLV disc offers continuous forward play only but with time and chapter search, plus the added advantage of increased playing time of 1 hour per side. Here is a brief list of the major features of this incredible machine:

- **RGB output/PAL-RGB decoder:** Employs a specially designed PAL-RGB decoder for incredible picture quality - even in non-standard playing modes, such as still and slow-motion. A full 5 Mhz video bandwidth is supplied in all playing modes making high resolution pictures such as maps and small text crystal clear.
- **Sync Pulse Generator:** An internal sync pulse generator is employed so that freshly generated line and field sync pulses are available at the player's output at all times for a rock steady and shimmer free picture.
- **Genlock:** A feature which enables the field and line sync pulses from the player output to be synchronised with an external reference signal. It ensures correct overlay of video signals.
- **CVBS output/RGB-PAL encoder:** The VP410 contains an RGB-PAL encoder. This takes the RGB output from the player and encodes it into a CVBS signal, using fresh sync pulses from the internal generator described above. The signal at the CVBS output is therefore totally stable.
- **Electronic Timebase Corrector:** A charge coupled device timebase corrector is employed to provide timing correction. This replaces the more usual mechanical methods providing a far superior optical system.
- **Instant Jump:** The radial mirror which points the laser beam at the correct track to be read is so manipulated that a search for a required picture can be virtually instantaneous. Very useful when one picture "connects" with another - rather like the pages of the A - Z map!
- **Fast Random Access:** Special circuitry results in phenomenal access times, that is to find any particular point on the disc. Typical times to search an entire disc are 1 second for CAV discs and 5 seconds for CLV.
- **Wired Remote Control:** If an infra red remote is being used, it may be that the player is located out of the necessary line of site and a control computer is not available. For such circumstances provision is made to hard wire the remote to the player.

The VP410 will drive either RGB or CVBS monitors. Output for RGB is via a Scart socket (which also outputs an additional CVBS signal), CVBS is via a BNC. BNC's are also used for other signals such as syncs; audio in and out is via phono sockets and the RS-232 via a standard 25 way D female socket. Baud rates for the RS-232 are set at 1200, 2400, 4800 or 9600 by way of a DIP switch on the back panel.

One of the most attractive features of the VP410 is the ease with which it is computer controlled. Virtually any language may be used to write a short control programme, it lends itself particularly to friendly interface high level languages such as Quick Basic, Visual Basic and so on. Communication is by way of an integral "instruction set" called F code. F code commands when received from the computer produce a reaction similar to the receipt of an infra red signal from the remote control. All the software has to do therefore is to send an F code down the RS-232. If a user friendly environment is not needed then a program would not be required. Any software that is capable of sending user definable code and receive acknowledgments back would do. There are about 40 commands in the F code set, the decimal, character and hex values of each are listed in the data supplied, together with a full description. Outstanding clarity and quality of both picture and sound plus choice of either computer or remote control (neither supplied!) adds up to one of the best deals we have ever been able to bring you. We don't anticipate being able to get another buy like this one so we seriously recommend that you buy as quickly as possible if you are interested.

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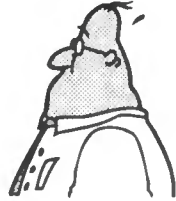


AMPEX 1/4" Audio Mastering Tape

Still one of the best and un-complicated mediums on which to record high quality audio, try and edit sound cuts on a cassette! **AMPEX Pro Grade type 407 mastering tape** - polyester based, the best of the cream as used by many studios and discerning audiophiles. You don't have to be one of them to use this tape - only the difference is, that they are probably paying twice the price than you can buy here!! Complete with library case.

7" Spool, 1800' Only £4.75 (A) or 5 / £21 (B)

Modems



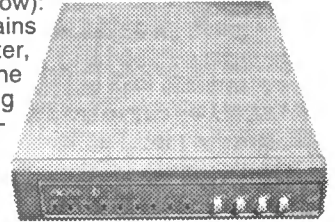
Free!

With all modems - ProComm communications software. Very extensive doc on the disk!



A deluxe top of the line modem from Acer Model 2424, V22 1200/2400 baud asynchronous full duplex. Stand alone external, totally Hayes compatible and complete with internal speaker. Front panel switches for selecting: Talk/Data, Originate Answer, 1200/2400 and Normal/Test. Features MNP Level 4 error control. Front panel LED indicators (see below): EF, HS, AA, CD, OH, RD, SD, TR and MR. Auto answer and auto dial facilities. The back panel contains a configuration switch, an RS-232 25 way female connector to link to the serial port of the host computer, RJ11C female jack to go to the line and the same for your phone should you wish to run your telephone through the modem, rather than use a "Y" connector on the wall jack. A cable is supplied for connecting the modem to the line wall jack. Unlike some (very annoying) modems, a power switch is also located on the back panel. Very attractive styled metal case in light beige, to match the standard PC colouring. , with ribbed decor and offset front panel. Measures 10"L x 6 3/4"W x 1 3/4"H. Brand new and boxed.

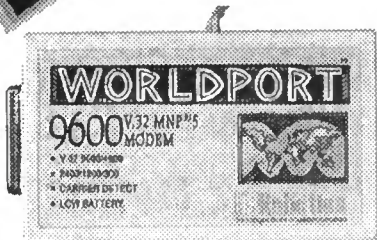
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BIG £ SAVER

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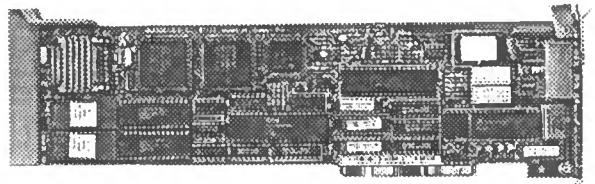


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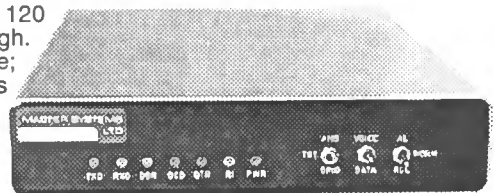


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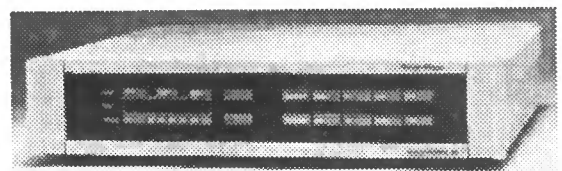
Only £49.00 (C)



Racal-Milgo "OMNIMODE" 96 Pro High Speed Modem

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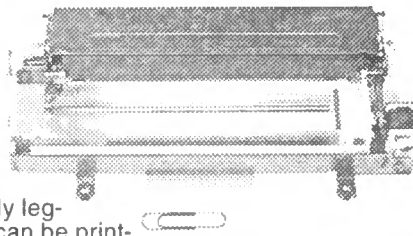
Industrial specification modem designed for synchronous data use at speeds of up to 9600 baud (CCITT V29) over a dedicated 4 wire leased line circuit. Fully compatible with MPS9601 & MPS9629 modems and protocols. Many features (to many to mention here !!) are included in the 90 page manual, eg: soft strapping, continuous duty, full local and remote test, non volatile set up storage etc. etc. Original cost over £700 each. Supplied **BRAND NEW** and boxed.



BRAND NEW SURPLUS Only £169.00 (C)

Ball Point Pen Printer/Plotters

This is a full 40 character per line ball point pen printer/plotter using standard 114mm wide paper. It is a high quality mechanism from Alps/DED Ltd and comes complete with an 8 page data pack which includes the circuit diagrams for the simple electronics used to drive the stepper motors and pen control solenoid. It has two stepper motors to accurately control both paper and pen movement in either forward or backward directions enabling graphics and plotting to a resolution of 1/5th of a millimetre! Text printing is achieved by the mechanism lowering and raising the pen onto the paper then drawing lines in 0.2mm steps, giving extremely legible characters. Again this is carried out by the two stepper motors. Condensed characters can be printed at twice the number of characters per line giving 80 characters per line on paper only 4-1/2" wide!



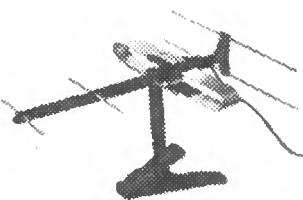
Scaled enlarged characters are printed in a similar way. An additional feature of this model is that an integral sensor detects when the pen is at the carriage return position and closes a normally open switch, the contacts of which are available for external use. Typical print speed is 12 characters per second and plotting speed is 52mm per second in both horizontal and vertical mode. Along a 45 degree vector the speed is 73 mm per second. Paper feed is approximately 6 lines per second. A single +5v DC is used for power, using under 1/2 amp.

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Pens: Box of 4 for £5.50 (A)

Hi-Gain Indoor TV Aerials

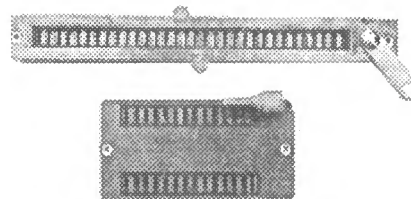


Brand new and boxed indoor TV aerials for both colour and black and white receivers covering all UHF TV channels. British made by Mercury Telecraft - model STO2 - with many de-luxe features. The aerial may be adjusted for either horizontal (as shown) or vertical orientation. A wide loop dipole is used for extra gain and a double alloy reflector for anti-ghosting. Extremely light in weight, which is useful if used with a portable or hand held receiver, yet of sturdy construction with a one and a half metre co-axial cable terminated in a normal TV aerial plug. Overall measurements are 13"L x 11"W x 8"H.

Only £4.99 (A) each 3/£14.50 (B)

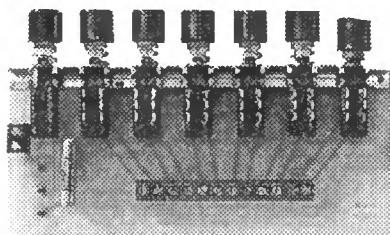
Zero Insertion Force Sockets

Zero insertion force sockets from Texttool. Socket action is controlled by a lever: when open the IC or other device may be dropped into the socket, when the lever is flipped the leads are firmly gripped. Z-28 is a 28 pin IC socket and has pretinned leads. Z-32 is for 32 pin in line boards or devices with .1" spacing. Ideal for speed testing or wherever permanent contact is not required.



Either type: £5.95 each or 5 for £27 (A)

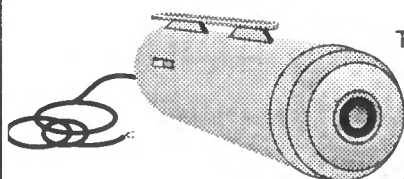
Latching Push Switch Banks



These are two types of latching push button banks. The first (SWB-1) contains 7 DPDT switches, one of which is a dummy, to release the others. All are mounted on a PC board as shown. At the back of the board is a 12 way terminal block and on the side is a 2 way block. The switches are wired so that one terminal of the side block is routed to any one terminal on the back when the switch controlling that terminal is pressed. At rest, there is a similar arrangement but the routing is through a capacitor, which can be shorted out if required. The mounting of the switches on the board provides a very versatile and adaptable arrangement as 3 other terminals are provided in addition to the blocks, so almost any arrangement can be used. The second bank (SWB-2) is not on a PC board and is a simple bank of 4 DPDT switches. Both types have black plastic push buttons, the first round, the second square.

SWB-1: 2/£2.50 (A) 5/£5 10/£9 (B)

Handy Portable Vacuum Cleaner



This is an extremely useful portable 220 vac vacuum cleaner for service engineers, jobs around the house, car, garden and even the computer! Quality made by / for IBM, and supplied to their service engineers for cleaning laser printers and photostat machines - so it has to be good quality. It has a beefy 175 watt motor which gives very strong suction and has a re-usable and washable filter. Uses a standard 1" diameter hose (not supplied). Measures 11" long by 5" diameter at its widest part. Comes complete with a generous 3 metre long two core (UK coloured) mains cable.

Only £19.95 each (B) or 3 for £58 (D)

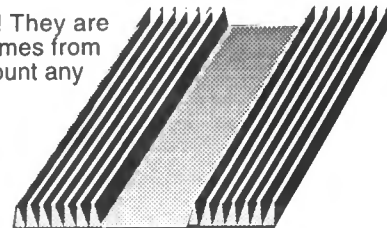
Perspex Sheets

Two useful sheets of Perspex. PS-1 measures 12"L x 4-3/4"W x 1/8"T, has square corners and is very slightly black tinted. Two of the corners of PS-2 are rounded and the other two have small indents and drilled holes, obviously to fit hinge pins. There is a larger hole (probably a fingerhole) drilled towards the rounded corner side; the sheet was probably made as a hinged flapdoor for some equipment. PS-2 measures 9"L x 5"W x 1/4"T.

Either sheet: 2 for £1.50 (A) 10 for £6.00 (B)

Low Profile High Dissipation Black Anodised Heat Sinks

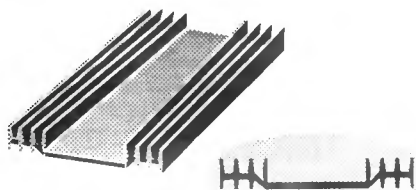
BLANK Super low profile black anodised heat sinks with a lot of dissipation yet only 1/2" high! They are undrilled so that you can make it fit your own particular application. The high dissipation rate comes from the large number of fins, 14 in all with 7 on each side. The blank area is 6" x 1-1/2" on which to mount any case size of semiconductor. Overall measurements are 6"L x 3-5/8"W x 1/2"H. Order as **BHS-1**.



£3.95 (A) each or 3 for £10.95 (B)

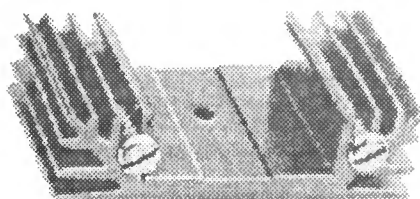
Space limitations this issue of Display News prevented us from printing our 2 page listing of power supplies, **We have over 10,000 power supplies** of all types ex stock - call our sales line for more information or a full list.

Low Profile Heatsink



Very nice brand new blank heat sinks. The unique design provides double fins and also a large area of flush contact with the mounting base. RS Components Ltd stock number 401-497. Measures 4"L x 2-1/2"W x 1/2"H. Blank mounting area is 4" x 1-1/4".

£1.49 each (A) 5/6.95 (A) 10/£13 (B)



TO-220 High Dissipation Heat Sinks

Extruded black anodised sinks for TO220 or similar cases. May be mounted horizontally by the devices mounting screw or vertically with self tapping screws (not supplied) as shown. This is an excellent quality sink from Redpoint. Dims: 2-3/8"L x 1-1/4"W x 5/8"H. Order HS-220-1. The same as the above but without self tapping screw holes. Order HS-220-2.

75p each (A) or 3 for £1.99 (A) 50 for £26 (A1)

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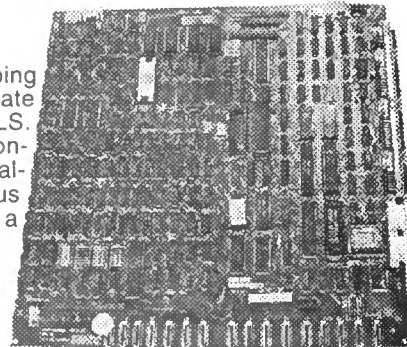
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Parts Boards

The most efficient and easiest way to have an **instant range of electronic components** at your disposal for a **fraction of their normal costs** - not even considering the inconvenience factor of not having that crucial part - **just when you want it !!**

The following boards contain an **exceptionally good mix** of all types of analogue and digital components, keep them handy and you will using them for years to come !!

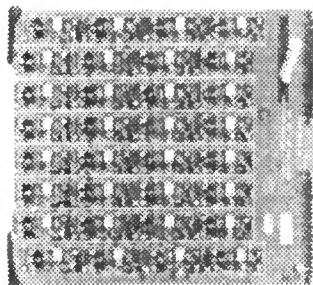
Jumbo Parts Board

This is the entire brain of the 16 bit 8088 system from Future Computers. It measures a whopping 14 inches square! We have no data so it is sold as a parts board and is not guaranteed to operate as a computer board or to be fully populated. It contains about 200 ICs. The logic is TTL-LS. Included are eighteen 64K RAM chips, which are scarce nowadays! and a NEC D765A disk controller and 7220 graphics IC plus normal support LSI packages. A ni-cad battery is provided for calendar support and a nice low profile relay. Three crystals of 24, 25 and 8mhz are included plus a buzzer. We believe that these boards are ex working equipment so if you can get it going its a gift but anyway its a gift for the parts!



Only £9.95 each (B) 3 for £25.50 (B)

Massive Discretes Board

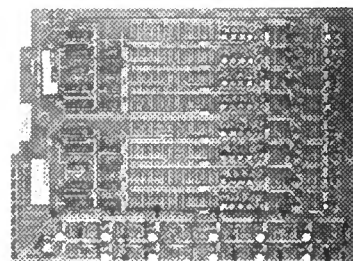


This is a video distribution board and consists of 32 individual circuits on the same board - yielding a massive parts count as follows: 96 off Tantalum bead capacitors 47mfd @ 16v. 32 each of: Bourns trimpot 100 W; transistor NPN 45v 200ma BC183; transistor PNP 45v 200ma BC213; transistor NPN 40v 500ma BSX20. Plus hundreds of resistors and capacitors, not listed. Note that the two complementary transistors may be matched pairs and should be removed from the board accordingly. There are also 32 hard to get plastic shrouded linking clips as used on disk drives and other equipment. The board measures 12" x 9".

Only £6.95 each (B) 3 for £19.95 (B)

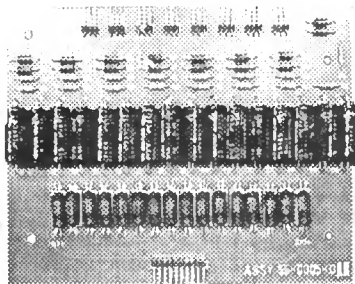
General Purpose Parts Mix!

This one is a real mixture and includes close to 100 transistors some of which are complementary pairs; Bourns trimpots, 18 ICs - all 74LS series, tantalum bead capacitors and hundreds of resistors. The reverse side of the board to that shown, holds 5 edge connector sockets. The transistors are BC183, BC213, BFY50 and BSX20's. The ICs include 6 off 74LS244 octal 3 state buffers. The board measures 12" x 8-1/2".



£5.95 (A) 3 for £16.95 (B)

Super Opto-Coupler Parts Board

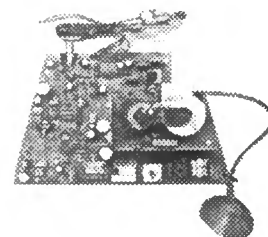


What a tremendous buy for those of you who want some very high isolation voltage opto-couplers! These boards hold 16 off OPI 110's which have an isolation voltage of 10,000 volts. Input is to a photo emitter diode, output from a phototransistor - all in the same case of course. Ratings for the output are maximum 30 volts and 40 ma. The diode's input ratings are 1.5 volts and 20 ma. Rise time is 2 ms and overall package dissipation is 100 mw. In addition to the opto-couplers the board has 16 off 47 mfd @ 63 vdc electrolytics, 16 off BY206 diodes and various resistors.

£4.95 (B) per board 3/£13.00 (B)

Complete Monitor Board Made by Weir Electronics

Although we sell this board for the parts it contains, it is in fact a complete board from a 12" working monochrome monitor based around the well known TDA1170S and TDA1180 IC's, with a BUV48 as the line output transistor. Complete with video input stage and BNC connector, amplification and driver stages and line output with EHT tube connector. A CRT octal base socket is also provided on flying leads. The board tapers from front to back but the overall measurements are 8-1/2" x 8". We have no data - but it should not be hard for you to sort it out or strip for parts!



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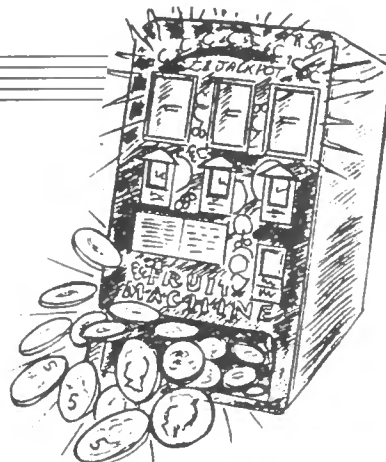


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EPE FRUIT MACHINE

BRETT GOSSAGE and JULYAN ILETT ≡ Part 2 ≡

A coin operated fruit machine that really pays out!

OPERATING principles of fruit machines and the design approach adopted for the *EPE Fruit Machine* were discussed last month. Also, the full circuit description and construction of the circuit board were covered. This month we conclude with the mechanical construction, checking and operation.

MECHANICAL CONSTRUCTION

Building the coin detector and payout mechanisms is not difficult, but should be carried out with reasonable accuracy to ensure reliable operation. Most of the parts are simple rectangles which can be cut from the plastic sheet using a Stanley knife or large modelling knife.

Score the plastic down to about half its depth, then simply snap the plastic apart by

bending. Be extremely careful as these knives are very dangerous. NEVER cut towards your fingers. Don't use the knife to cut the pipe, use a junior hacksaw, and clean up with emery paper.

A number of circular holes have to be cut. For the small holes, a drill can be used. For the larger holes, start by drilling a 3mm to 4mm pilot hole, then use a reamer to take the hole out to a larger diameter, and finally, for best results, use a Q-max hole cutter.

This project needs only one hole cutter, size 20mm, but they are rather expensive. The 21mm holes can be punched initially to 20mm and then enlarged using fine emery paper, but care should be taken not to let the hole become eccentric.

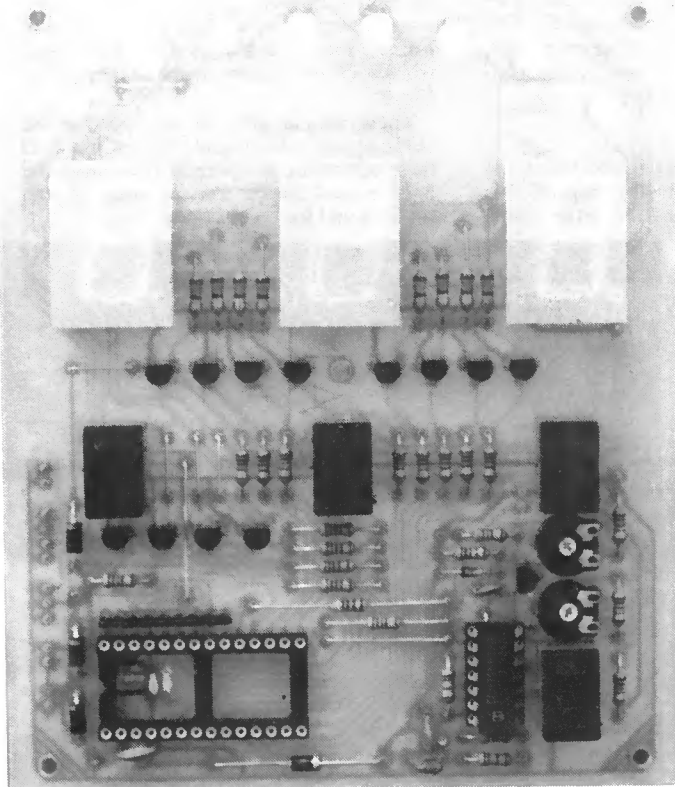
The plastic parts should be glued together using "Plastic Weld" or a similar

solvent glue. This substance isn't really glue at all, it dissolves the plastic, welding it together. It was found best to apply plenty of glue using a fine paint brush then hold the parts together for several seconds until the plastic starts to re-set.

It takes much longer, however, for the plastic to set hard, hours rather than seconds. It may be a good idea to experiment with the glue and a few offcuts of plastic, in order to establish a good technique for making these welds. The author's first attempts resulted in some rather fragile joints!

All the plastic parts required are detailed in Fig. 5, Fig. 7 and Fig. 12. Check the details carefully as although most parts are made from 80 thou' white plastic sheet, there are a few exceptions.

Side and underside views of each of the mechanisms are shown in Fig. 6 and Fig. 8. The letters can be used to cross-reference the drawings with the parts in Fig. 5, Fig. 7 and Fig. 12. These figures should be used in conjunction with the photographs when fitting the various parts together.



The completed circuit board, minus the controller i.c. The link J1, used when "testing", is positioned just left of the Hold switch.

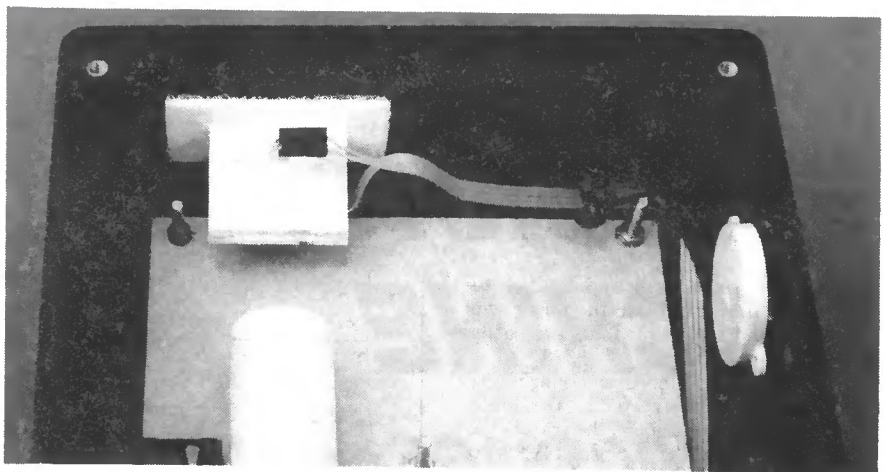


COIN DETECTOR

Glue together all parts of the coin detector mechanism, then glue the infra-red l.e.d. and phototransistor (TR14) into the small plastic pipe pieces. Unfortunately, these two devices look identical, although the l.e.d. may have much longer legs than the transistor. Check carefully the wiring from these devices to the 4-pin connector (SK4), details are given in Fig. 11. Solder wires to the legs of the devices and insulate with heatshrink sleeving.

PAYOUT MECHANISM

Glue together all parts of the coin payout mechanism. The specified Futaba servo motor comes with rubber mounting blocks which are first pressed into the holes on the servo chassis. M3 bolts should be used with suitable length spacers to mount the servo onto the payout mechanism base-plate.



The completed coin detector mechanism is glued behind the coin cutout slot in the top of the case. Ribbon cable is used to connect the infra-red l.e.d. and phototransistor back to the p.c.b. – see Fig. 11.

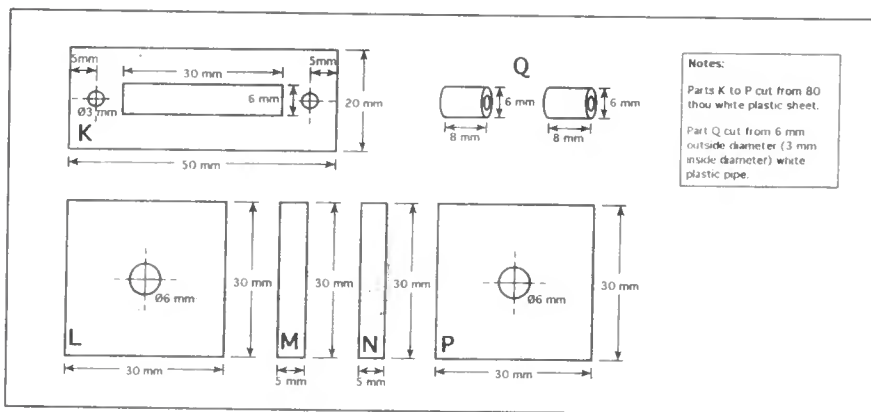


Fig. 5. Plastic parts for the coin detector mechanism.

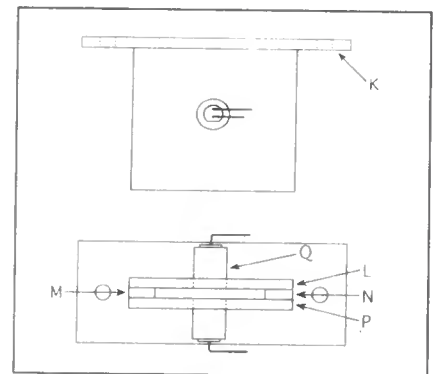


Fig. 6. Coin detector mechanism. The infra-red l.e.d. and phototransistor are glued in the small tubes either side of the coin slot.

The connecting link which connects the coin slide to the servo actuator arm requires special consideration. The actuator is initially supplied with four arms, three of which should be cut off as shown in Fig. 8. The arm should then be used to find the mid-position of the servo shaft's full range of travel.

Leaving the servo shaft in its mid-position, remove the arm from the shaft. Link the coin slide and the arm with the metal link and then press the arm onto the splines of the servo shaft so that it is perpendicular

to the direction of travel of the coin slide as shown in Fig. 8.

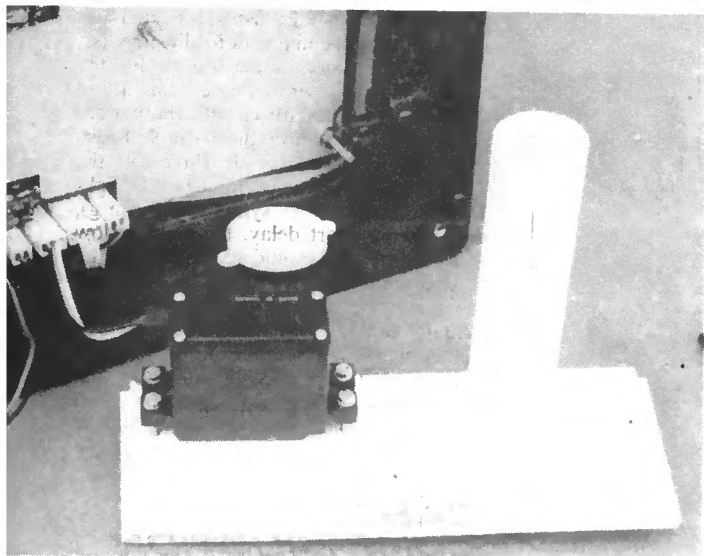
The coin slide should now be half way between its extremes of movement. This alignment is necessary to ensure the best possible range of travel of the coin slide. Finally, screw the arm firmly to the servo shaft using the screw provided.

TESTING

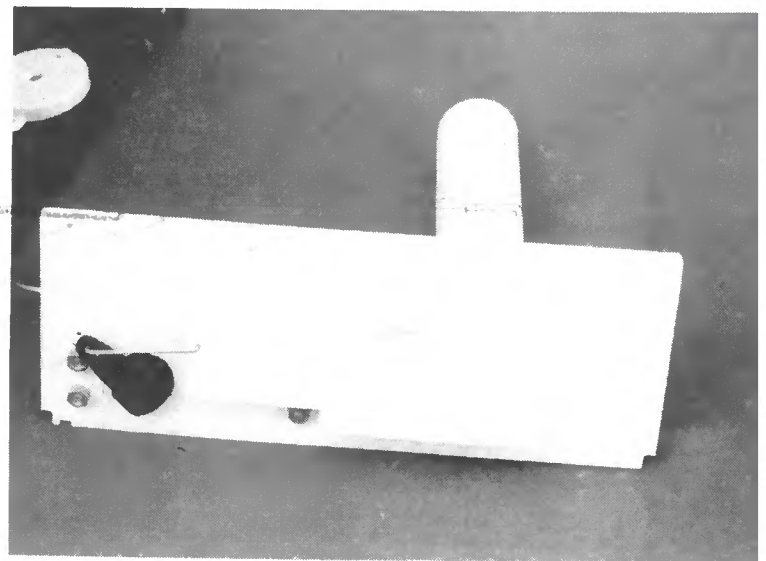
Turning now to the p.c.b. and servo, ensure that the microcontroller chip (IC1) is NOT fitted. Connect just the battery pack

to the p.c.b. (PL1), and link the two pins of PL2 (on/off switch connector). If possible use an oscilloscope to check for the servo control waveform on IC2b pin 9. (See *a* in Fig. 9). Fit the link J1 and the servo control waveform should change to that of *b* in Fig. 9.

There should also be an approximate 50Hz square wave signal at IC2a pin 5. If these signals are not present, disconnect the battery and check the polarity of the supplies and the connections.



The payout mechanism showing the coin collection tube and the servo motor plugged into the p.c.b. connector.



Underside of the servo mechanism base-plate showing the modified servo actuator arm and coin slide linkage.

The mechanical adjustment of the servo position needs to be quite accurate so that coins are dispensed correctly. With the coin mechanism disconnected from the rest of the unit, and the servo link (paper clip) fitted to the coin slide of the payout mechanism, manually push the servo arm round to both end limits, and check for smooth movement of the slide.

Next, fill the coin tube as much as possible (by now you should have saved lots of 5p pieces!) and holding the mechanism approximately upright, rotate the servo arm to and fro and see if the coins are easily dispensed.

Empty the coin tube and connect the battery and servo to the p.c.b. The servo should move to one end of the travel, the "payout" position. Adjust preset VR1 so that the hole cut-out in the slider has moved about one millimetre further than necessary to "payout" the coin.

Fit the link J1. Now adjust preset VR2 so that the same condition occurs with the other fixed hole cut-out at the bottom of the coin stack tube. This is the "collect"

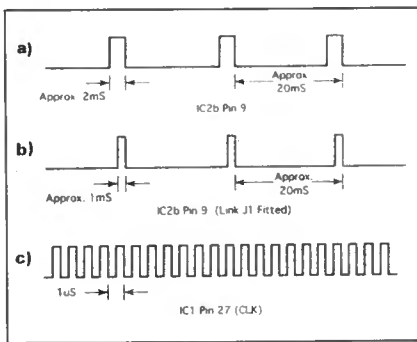


Fig. 9. Servo control waveforms.

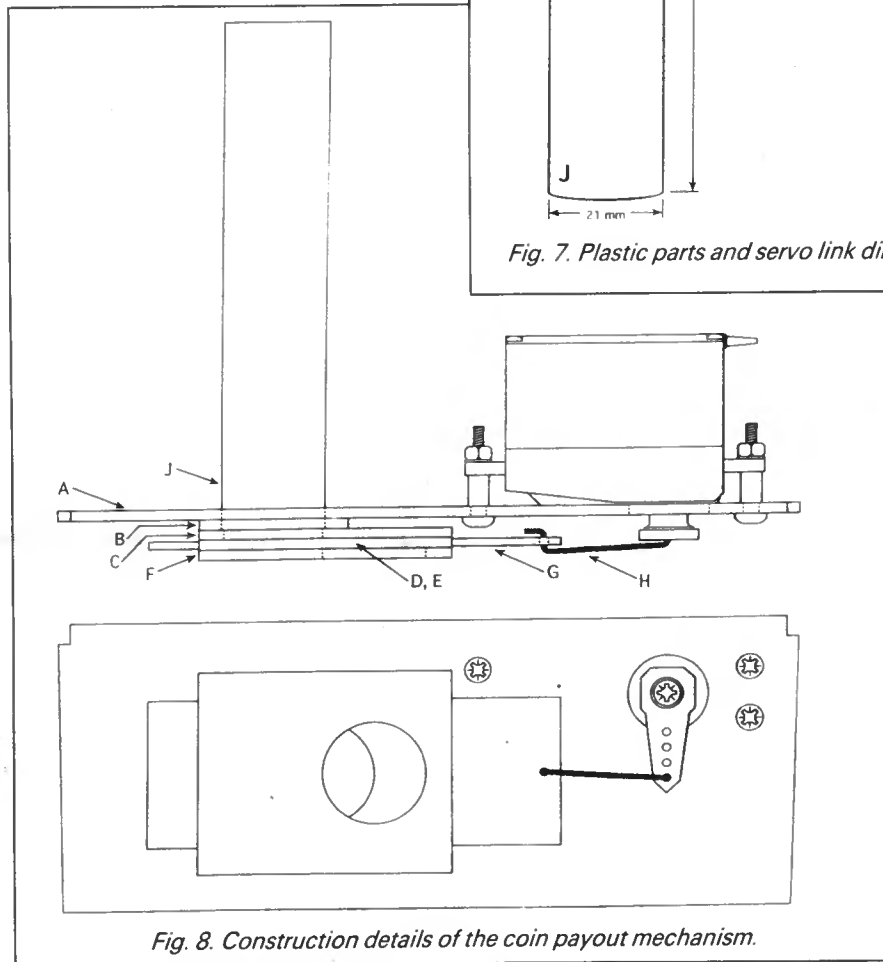


Fig. 8. Construction details of the coin payout mechanism.

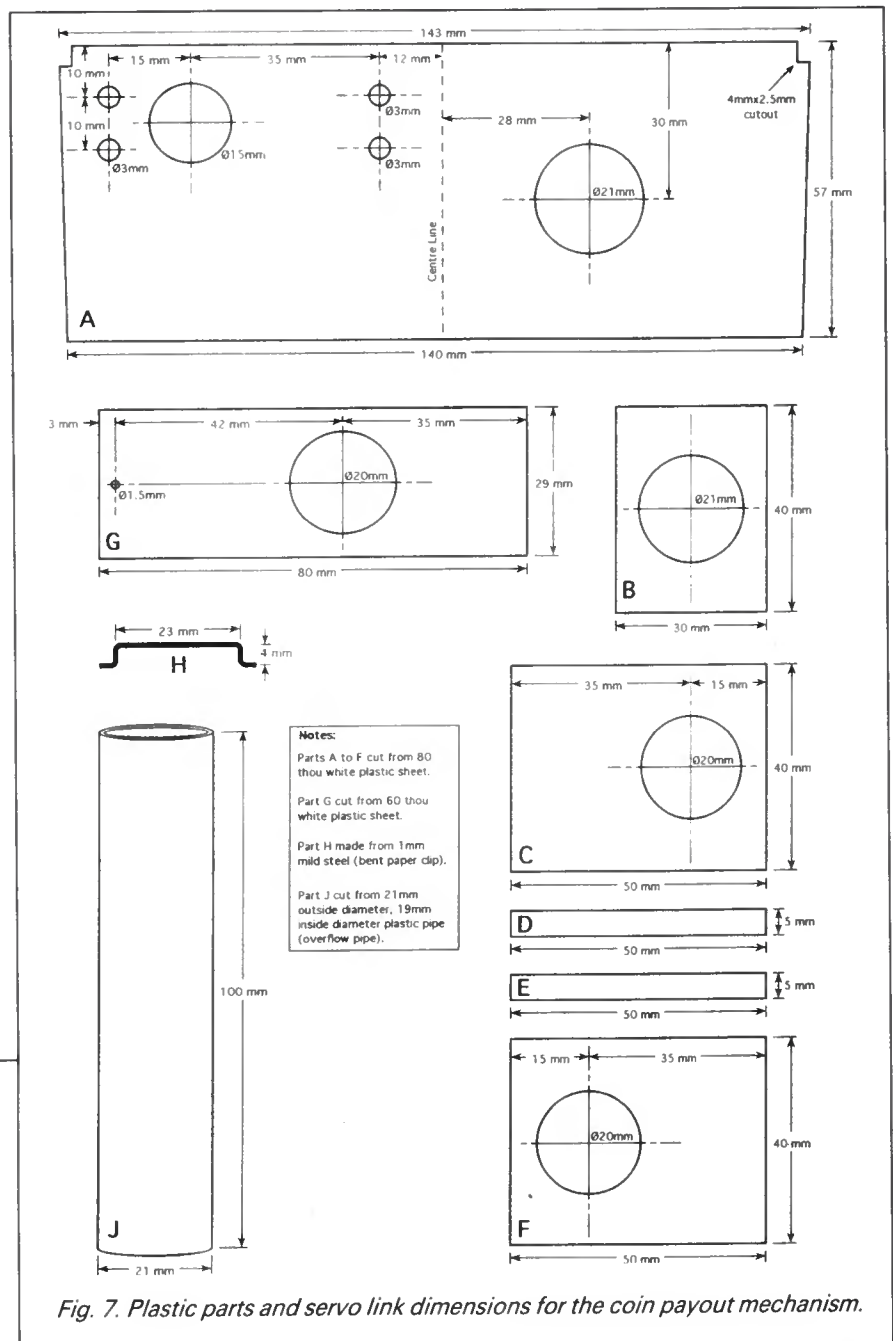


Fig. 7. Plastic parts and servo link dimensions for the coin payout mechanism.

position. Preset VR1 must be adjusted first as it affects both end position adjustments.

Finally, place some coins in the mechanism and operate the servo by fitting and removing the link J1 with the battery connected. Disconnect the battery. Insert IC1 and switch on, all three of the 7-segment displays should instantly light with the BAR or "—" symbol (segment g), and, after a short delay, the eight yellow "Feature" i.e.d.s should sequence through a repeating flashing pattern. If this is not the case, check the CLK signal to IC1 pin 27, and see that it matches c in Fig. 19, i.e. a clock signal of 1MHz.

The first sign of battery failure is when the displays become dim, and the servo does not operate. This will not really be noticed until a win is achieved during "play."

CASE CONSTRUCTION

The basic cutouts required for the case of the Fruit Machine are shown in Fig. 10. These are mostly made in the front of the

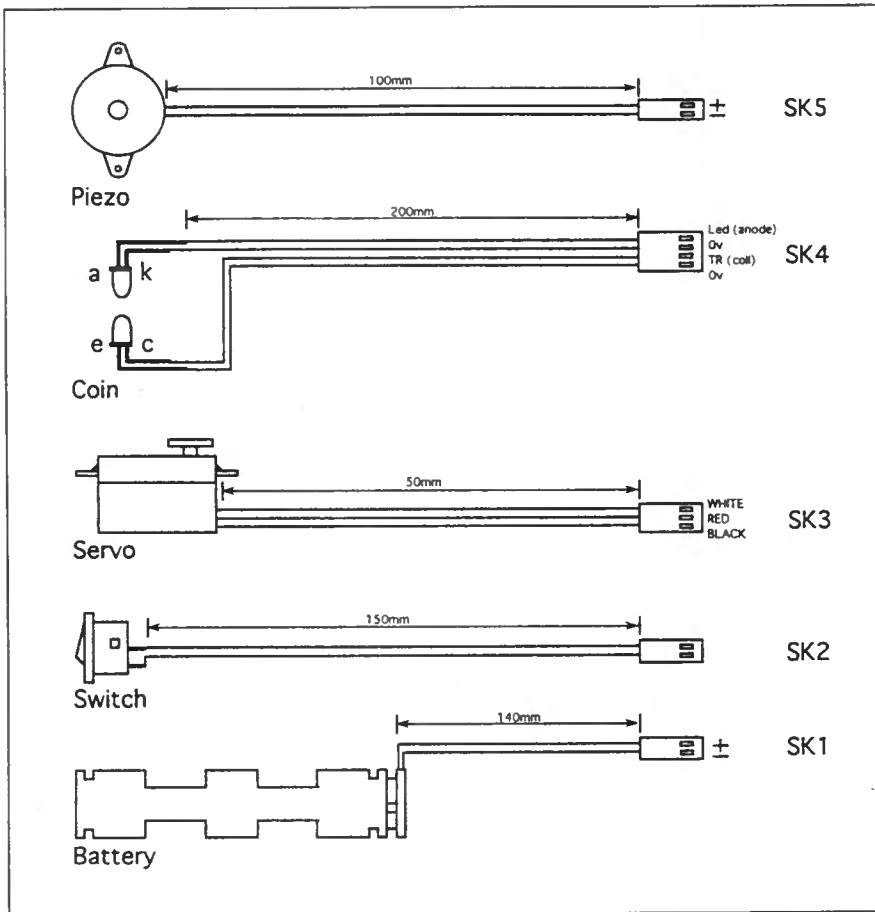


Fig. 11. Interwiring ribbon cable runs from the piezo sounder (top), coin detector, coin payout servo mechanism, on/off switch and battery holder (bottom) to the printed circuit board connector plugs.

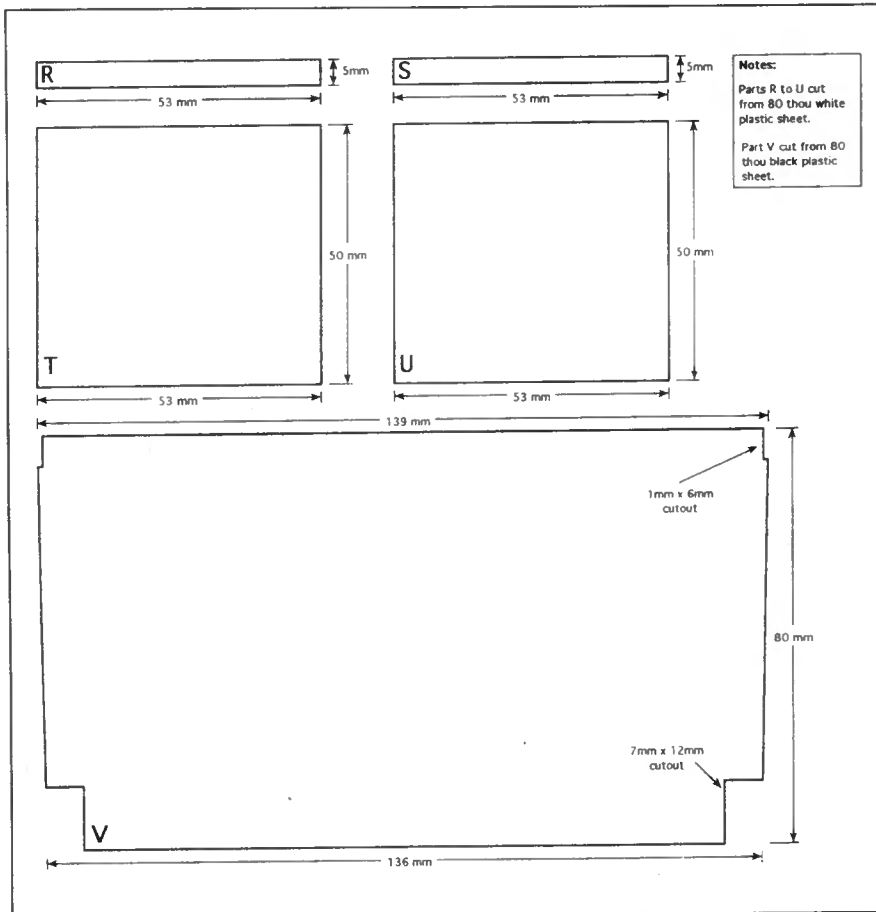
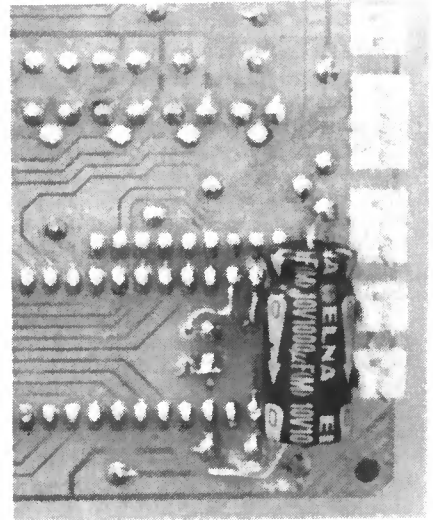


Fig. 12. Plastic parts and dimensions for the coin chute/battery compartment and coin mechanism support.



The p.c.b. connectors mounted on the track side.

FINAL ASSEMBLY

A guard for the back of the p.c.b. will be needed to protect it from damage or short circuits caused by coins dropping into the "money-box" portion of the machine (if the coin stack overflows). This can be made out of cardboard or stiff paper.

First cut out a piece the size of the p.c.b. and then make cutouts for the holes, capacitors and connectors. Mount the p.c.b. in the empty case with the guard flush to it, not forgetting positioning of the red display filter. This can either be glued to the inside of the finished box, or glued to the p.c.b. assembly.

Now make up the five wiring assemblies as shown in Fig 11. Glue the coin detector to the inside top of the box, in line with the cutout slot for the coin, and make sure that the "trailing" cable runs out of the way of any coins. The coin detector may be attached with two screws for easy removal, for instance, if there is a problem with the infra-red l.e.d. or opto-transistor.

Fit and connect the on/off switch, and the connector to the battery pack. Glue the piezo sounder to the upper middle right hand side of the box, and connect it to the uppermost connector on the p.c.b. (PL5).

Place, or glue the two square pieces of plastic "T" & "U" (See Fig. 12) as low as possible, into the bottom sides of the box, ensuring correct orientation (50mm high, 53mm deep). These hold up the coin mechanism at the sides. Glue the two runners "R" & "S" above the pieces just fitted, allowing a 2mm gap for the coin mechanism to slide in between them. Connect the servo to the p.c.b. and slide the completed coin mechanism into these slots.

Finally, push the black coin tray slide (V) into place at an approximate 45 degree angle, into the space below the coin mechanism. When the lid is fitted to the box, the angle of this slide is fixed, and it also holds up the coin mechanism at its centre, giving the construction extra rigidity.

Fit the battery pack into the area at the base of the box with Velcro or double-sided sticky pads, and connect it to the battery clip. Cut a little slot into the right hand side of the black coin slide, to accommodate the wires for the battery clip, so that the lid does not trap them when fitted.

Note that the coin mechanism can be easily removed for inspection at any time by removing the lid, then the tray slide, and then sliding the mechanism out.

MECHANICAL CHECKS

The electronic part of the fruit machine operation should be fault free, however the mechanical parts do have their limitations.

The first and perhaps most obvious, is that this fruit machine can only be operated in an approximate upright position, purely due to the coin stacking and payout mechanism. It works well if hand held in a slightly tilted position away from the operator.

If the coins inserted in the slot do not pass the coin sensor within a specific time, then a credit will not be accepted, and the credit l.e.d. will not light. This is a software implemented "tamper" fail-safe, so don't try poking lolly sticks into the slot!

There is the possibility of over filling. As the machine has a estimated payout of about 80 per cent, there will be a net gain by the machine over a long period of playing. Eventually the coin stack will fill up (about 65 coins) and then it will overflow. Any more coins inserted will still be registered as credits, but they will fall into the enclosed space around the coin stack within the machine.

This is acceptable, as there are no moving parts to jam in this area. This is considered to be the "money box" area of the machine, as these coins can never be paid out by the mechanism. Eventually, this area will also fill up, and if the coin sensor continually fails to register credits, or is blocked, then remove the back panel of the machine, and clear out any excess coins.

During testing, the payout mechanism was found to be very reliable, but if coin jams occur in the coin mechanism, check the servo operation and try resetting the start and end points of the servo travel with presets VR1 and VR2 (see "Testing").

OPERATION

The operation and features of this fruit machine have been made to mimic commercial gaming machines as much as possible, and those of you that are familiar with the operation of these machines will already know a lot of the following, but read on anyway!

SWITCHING ON

When the unit is first switched on, the 7-segment displays will all show the BAR symbol. (Something had to be picked, so why not the jackpot!) The eight yellow l.e.d.s in an arc above the main display are the "Feature" l.e.d.s, and they will flash in a set sequence repeatedly, luring you to put a coin in the slot. When you have done this, these l.e.d.s will go off (with the exception of the left hand l.e.d. showing one credit) and the green start l.e.d. should light.

CREDITS

If you decide to be ambitious with your investment and put in further coins, you can do this! The first eight credits will be registered by lighting up the arc of l.e.d.s above the main display from the left hand side to the right, except during a WIN sequence. Further coins can be inserted up to a total of 255 (£12.75), and the total will be stored in the microcontroller memory. Any further coins inserted will be "lost" credits.

After each "play" the credit count will be reduced by one. When the credit count falls below eight, the l.e.d.s above the main display will go out from the right to the left, warning you of the last few credits available.

Finally, after the last "play" has finished, the green start l.e.d. will go off, the feature l.e.d.s will start sequencing, and pressing the start button with no credits will have no effect! You can insert coins at any time, even when the machine is paying out.

START BUTTON

Insert a coin and press the start button. Each of the three "reels" will cycle through a sequence of letters and symbols (six in all), which correspond to the "fruits". This cycle will slow down and stop with each reel from the left to the right.

WINNING AND PAYOUT

A WIN sequence starts with the "Feature" l.e.d.s flashing through a short pattern with the piezo sounding, and ends after paying out coins with the green start l.e.d. coming on. (If you have remaining credits, that is.) A small win is achieved if the first two "reels" (left and middle), have the same "fruit" displayed on them when the "play" has finished. In all six cases, this win is two coins or 10p (i.e. double the stake and is similar to some commercial gaming machines).

If the third reel has the same "fruit" as the first two reels, a larger win results. This time, it is dependent on the fruit concerned, and this is listed in the Odds and Wins table in Fig. 13. The "jackpot" or highest win corresponds to the three dashes or "bars", and this combination pays out 20 coins (£1).

HOLD FEATURE

The hold feature has been included to make the "play" more interesting, and is incorporated on virtually all fruit machines. It shifts the odds of winning in your favour by keeping reels the same as they were in the previous "play". If you

have a hold, the three red l.e.d.s in the switches underneath the reels will flash. If you wish to hold any reel (i.e. keep the current "fruit" on the selected reel), press the appropriate hold button, and the l.e.d. will stay on continuously.

If you decide to change your mind, pressing the hold button again will cancel the hold, and the l.e.d. will flash again. After you have decided on what hold you require, press the start button and only those reels that have not been held will change.

Remember, you may have a hold after a win! In this case, if it is a win where only the first two reels are the same, these two reels can be held to guarantee a two coin win, and possibly a higher win if the third reel is also the same after the next "game". Holding all three reels is wasteful (unless after a winning combination) but this is a valid option.

Another point to remember is that if you have no credits left, you do not know if you have a hold on the next game. Only by inserting another coin, will the credit l.e.d. will come on and if you have a hold, the hold l.e.d.s will flash. This feature does

Low wins			High wins			
--	--	ANY	10p	--	--	£1.00 (Jackpot)
BAR	BAR	ANY	10p	BAR	BAR	50p
L	L	ANY	10p	L	L	40p
O	O	ANY	10p	O	O	30p
P	P	ANY	10p	P	P	20p
C	C	ANY	10p	C	C	20p

Fig. 13. Payout odds and possible win combinations.

come up at random, but has been set in the software to happen about every one in three "plays".

GAMBLE FEATURE

An added bonus is that after each of the higher wins (three "fruits" the same), the

A "Jackpot" win is indicated by a row of dashes appearing in the reel windows.



gamble feature is implemented. Here, the green *start* l.e.d. and the red *hold* l.e.d. above it will flash. Now the player can *gamble* by pressing the *start* button, or he can collect the displayed win by pressing the right hand *hold* button which is marked "collect".

If the *gamble* is taken, the three reels will either "step up" to the next highest win, or they will step down to the next lowest win. Because of this, the *gamble* feature does not happen on the highest win, the three bar jackpot.

If the *gamble* is lost, the three reels will step down to the next lowest win and the machine will pay out this amount. If this happens on the lowest value "fruit" i.e. three cherries, then the game is lost.

If the *gamble* is won, the three reels will step up to the next highest win and then there will be a further opportunity to *gamble* again, in which case, the entire process is repeated. This may continue right up to the three bar jackpot if you are lucky! The highest number of successful *gambles* is five, starting at three cherries, and gambling up to the jackpot.

ODDS AND WINS

The format of the winning combinations is shown in Fig. 13. There are six fruits per reel: "-" = BAR; "A" = APPLE; "L" = LEMON; "O" = ORANGE; "P" = PLUM and "C" = CHERRY. This amounts to 216 different combinations that can come up on the three reels ($6 \times 6 \times 6 = 216$).

Only 36 of these are winning combinations. Of these winning combinations 30 occur when only the first and second "reels" are the same, paying two coins,

PLEASE TAKE NOTE – Part 1

The component designations for the p.c.b. connectors listed in the "Components List" were incorrectly given. Although the actual types and quantity required are correct they should be designated as follows:

Plugs: PL1, PL2 and PL5 2-way. PL3 3-way. PL4 4-way.
Sockets: SK1, SK2 and SK5 2-way. SK3 3-way. SK4 4-way.

In the Fruit Machine circuit diagram Fig. 3, the electrolytic capacitors C6, C7 and C8 should, of course, be connected the other way round i.e. the negative side of the capacitors should go to the 0V line, the p.c.b. layout is correct.

The Futaba servo motor should be type **FB. S148**.

Finally, a change of address should be noted when sending for the ready programmed PIC microcontroller, self-adhesive front panel and a set of three 7-segment displays. The new address to write to can be found by turning to the *Shoptalk* page.

or twice the stake. This occurs 30/216 times, or once in approximately every seven games.

If all 216 different conditions happen in the same number of "plays" (the theoretical average), then 112 coins will be paid out during these 216 games. This amounts to one of each of the six "high" wins, $20 + 10 + 8 + 6 + 4 + 4 = 52$ coins, and together with the 30 "low" wins, $30 \times 2 = 60$ coins, give a total of 112 coins.

This means that the payout percentage is 112/216 or about 52 per cent. This value is raised dramatically by the introduction of the *hold* and *gamble* features. The precise maths involved using these features is beyond the scope of this article (and the author's brains!), but after extensive tests, the actual payout percentage was found to be around 80 per cent, a similar amount to real gaming machines.

There may appear to be a curious effect where *wins* and *holds* do not seem to occur at random, but happen in groups. After playing many fruit machines, this is

actually quite normal! Quite often a high *win* may quickly follow a previous high *win*, and then it will *hold*!

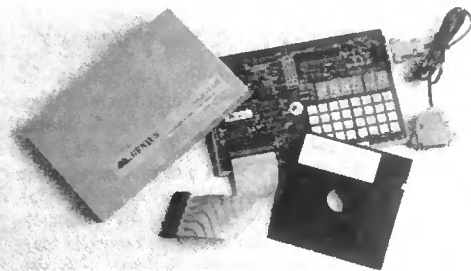
This can be quite disconcerting to a player who has had a long run of losing, and the next player captures all the winnings, but this is all part of the fun! There is a small amount of strategy and skill involved to get the maximum possible wins from the machine, but it was thought best to leave the constructor or player to find these out!

The *hold* feature occurs at random 33 per cent of the time after a game, (one game in three) and the *gamble* feature occurs when there is a *win* line of three similar "fruits". (When a *gamble* is won, the feature repeats until either the *gamble* is lost, or the *win* is collected). □

Brett and Julyan would like to give special thanks to Mandy Harding for producing the front panel artwork.

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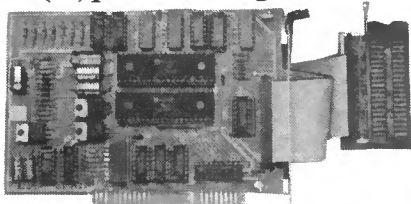


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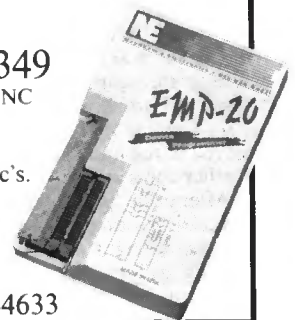
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CHECKING TRANSISTORS

ANDY FLIND

Highlighting an unusual problem, and how to easily check for it.



FOLLOWING publication of the *TENS* projects (*EPE* May/June '94), a few readers have experienced problems with the lead connections of the transistors used in this circuit. Those used in the prototype had the classic "ebc" lead arrangement, but it seems that this is not always the case with transistors obtained from different suppliers and worse, there is sometimes no indication of the particular arrangement used. Less experienced constructors can easily be caught out by this. Once in circuit, the apparent fault can be difficult to locate even for the experienced, not least because the cause is unsuspected.

This problem first surfaced with a letter from a constructor of the *Advanced TENS* project. All apparently went well until a fairly late stage in testing when the unit began consuming large amounts of current and the multiplier's high voltage output failed to appear. Following investigation it was found that the 2N5551 transistors had the alternative "ecb" lead arrangement. Strangely, the complementary 2N5401s from the same supplier used the "ebc" arrangement.

Subsequently another reader described similar problems with the BC327 and BC337 transistors and, following some research, discovered at least twelve variants of BC337 and six of BC327. All of this points to the fact that where doubt exists, discrete transistors should be checked carefully before use.

GENERIC TYPES

Semiconductors tend to vary according to manufacturer. Transistors of the same generic type may have different gains and lead connections. Often this will be indicated by a suffix, such as the BC109, where the letter A, B or C indicates the gain group. Epoxy-cased transistors sometimes have a suffix for their lead positions, such as the BC184L and BC214L, where the "L" indicates leads in the "ecb" positions.

Versions of these without this letter usually have their leads arranged as "ebc". The 2N5551s which caused the first reader's difficulties had no such suffix however, and it took some time to determine the exact cause of the problem.

TESTING TRANSISTORS

For a full check of a transistor there is no substitute for a good transistor tester, either commercially manufactured or home constructed. Many of these have appeared as projects over the years, including at least one by the present author. (The most recent one was the *Transistor Checker* in the Jan '92 issue - Ed.) A good tester will indicate polarity (*npn* or *pnp*), warn of faults such as open or short circuits or excessive leakage, and measure gain.

However, it may be that some readers do not have sufficient use for such an instrument to warrant buying or even constructing one. Where this is the case, simple transistor checking can be carried out with an ordinary multimeter, either analogue or digital, using the "ohms" range. Where doubt exists about a transistor's condition or connections, this can save a lot of trouble and perhaps expense.

The principle of testing with a meter is quite simple. From the point of view of meter measurements, a bipolar transistor consists of two diodes, back-to-back as shown in Fig. 1a and Fig. 1b. It can be seen that the direction of these diodes depends on the polarity of the transistor; in an *npn* they both point away from the base, in a *pnp* they both point towards it. It follows that current can flow in one direction only from both emitter and collector to the base, but not between emitter and collector so long as there is no base connection. This allows the use of a meter to determine the transistor's base connection and type.

Before testing a transistor, it is useful to check the response of the meter to a

semiconductor junction and also to determine which probe lead is "positive". The lowest "ohms" range will normally be the most suitable where an analogue meter is used as this usually operates with a 1.5V or 3V battery. Ranges for higher resistance sometimes use a higher voltage which could cause "Zener breakdown" of a reverse-biased emitter-base junction.

A simple check with a small silicon diode, such as a 1N4148 or one of the "4000" series, such as a 1N4001, will demonstrate the meter's response. Usually it will indicate about half-scale, not because the diode has internal resistance, but because it exhibits a forward voltage drop of about 0.6V when conducting. The important thing is that a clear reading is obtained in one direction, with no indication at all in the other.

The position of the probes for the "forward" indication should be noted. Analogue meters often have reversed probe polarity when measuring resistance, so that the black "negative" probe becomes the "positive" source. To avoid confusion it might be worth swapping the probes for transistor testing, so long as it is remembered to swap them back again afterwards.

DIGITAL METERS

With digital meters the position is different. Generally, the probe polarity of these is correct, but the voltage used for resistance measurement is often lower than the 0.6V forward voltage drop of a diode, resulting in an open-circuit measurement in both directions. To overcome this, most digital meters have a diode symbol displayed over at least one resistance range to indicate a higher testing voltage, making this particular range

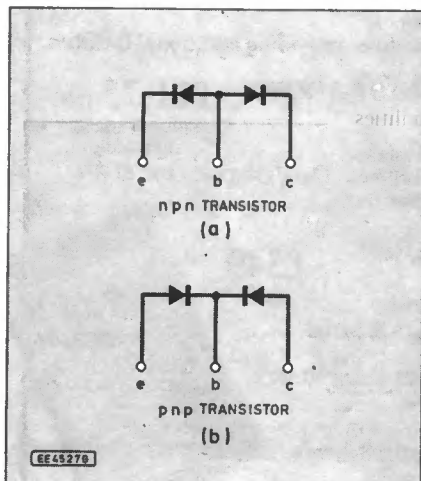


Fig. 1. Elements of a transistor.

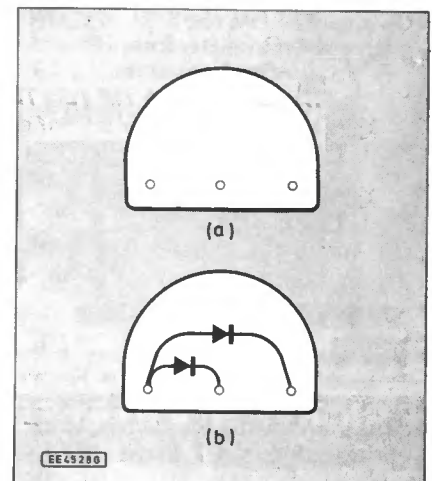


Fig. 2. Locating the base.

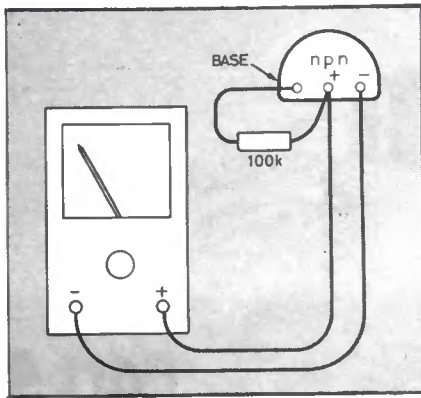


Fig. 3. Finding the emitter and collector.

suitable for diode and transistor testing. Again, simple testing with a small diode will demonstrate the response.

POLARITIES

To check a transistor then, the polarity of the probes and the response of the meter should first be checked. Then a quick sketch of the pins of the transistor can be made as shown in Fig. 2a. A meter probe should be clipped to one lead of the transistor and the other probe used to test each of the other two leads in turn, noting any "diodes" found as in Fig. 2b. This can be done for all three leads in both directions, a maximum of six tests which will take only a few seconds, and should clearly identify the base connection and polarity. In Fig. 2b this is an npn type with the base on the left.

Determining the functions of the other two leads can be slightly more difficult, as many small bipolar transistors actually exhibit some gain when these are swapped! At least, with the base clearly identified, there are just two to choose from. An initial

check should be made to ensure that no current flows between them with the base open-circuit, in either direction. If it does, then the device is either not a bipolar transistor or is highly suspect. Otherwise, the testing can continue with the injection of a small bias current into the base from the supposed "collector" which will be the positive probe for an npn or the negative one for a pnp.

This can sometimes be done with a finger placed across the two leads, but more often a resistor will be needed to apply sufficient current. The amount needed depends on the gain of the transistor, but resistor values between 10k and 100k should usually produce the desired result. Fig. 3 shows the way to do this, the connections producing the highest reading being (probably!) the one in which the probes are correctly connected to the emitter and collector.

GAIN TEST

If a full functional test is required with a value for the gain, the simple circuit shown in Fig. 4 may be used. Here, resistor R1 supplies base current, whilst the meter, on a 10mA current range, measures collector current. Resistor R2 limits current to protect the meter if a short circuit is present, otherwise it has little effect.

With a nine-volt supply, a value of 420k for R1 will give a "gain" scale of 0 to 500 on the meter. Resistor R1 can consist of 150k and 270k in series to give 420k. If the gain of the transistor is lower than 100, an 82k resistor for R1 will alter the scale to approximately 0 to 100. The circuit shown is for testing an npn transistor, for a pnp type the battery and meter polarities should be reversed.

These testing techniques can be applied to just about any small bipolar transistor

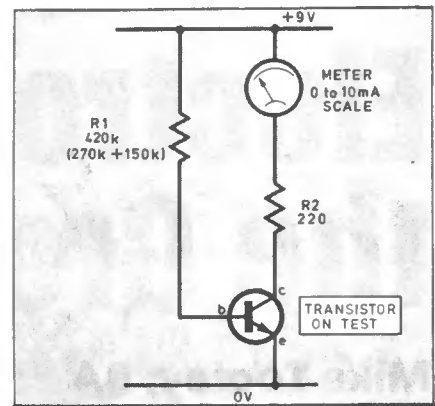


Fig. 4. Checking the current gain (nnp).

and may save a lot of time and trouble where a problem is suspected. They are also useful to some extent with power transistors, though gain readings obtained may be misleading with the small collector currents used. The lower current gain of most power transistors will require the use of a lower value of resistance for the test shown in Fig. 3; a 2N3055 tried by the author required 1k for a positive result. It is not usually possible to test "Darlington" transistors with these methods due to their very high gain and the fact that there are effectively two "diodes" between some leads.

CONFORMITY

In our experience, the occurrence of incorrectly marked transistors is unusual. Readers should not feel undue concern when purchasing components from suppliers who can vouch for the source of manufacture and conformity of the product. Ed.

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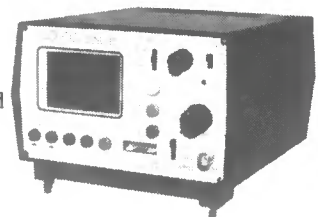
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Electronics from the Ground Up

Mike Tooley, BA

Part 4

ELECTRONICS from the Ground Up is designed to provide you with a comprehensive and up-to-date introduction to the world of electronics. The series is based on *Electronics Workbench*, a remarkable new software package that lets you use your PC to build and test a wide range of circuits. Back issues of earlier parts of this series are available – see Back Issues page.

In this fourth part we introduce transistors. We describe the action of *npn* and *pnp* bipolar junction devices and introduce the concept of current gain and amplification. We also introduce the three basic circuit configurations used for transistor amplifiers and the use of characteristic graphs as a means of predicting amplifier performance. We round off this month's instalment with a practical investigation of single and two-stage transistor amplifiers.

TRANSISTORS

Like diodes, transistors are fabricated from semiconductor material. Unlike diodes, a second junction and a third electrode is present. Transistors can be either unipolar or bipolar depending upon the types of charge carrier present. Unipolar transistors use a single type of charge carrier, either electrons (negative charge carriers) or holes (positive charge carriers). Bipolar transistors, on the other hand, employ both types of charge carrier (i.e., both electrons and holes). In *Electronics from the Ground Up* we shall only consider the operation of bipolar transistors. Readers with the full *Electronics Workbench* package will be able to experiment with both types of device.

Fig. 4.1 and Fig. 4.2 show the basic construction of *npn* and *pnp* bipolar transistors. Each type of device has three connections (emitter, base, and collector) and two junctions (collector-base and base-emitter). The *p*-type material contains free holes whilst the *n*-type material has a quantity of free electrons. In normal operation, the collector-base junction is reverse

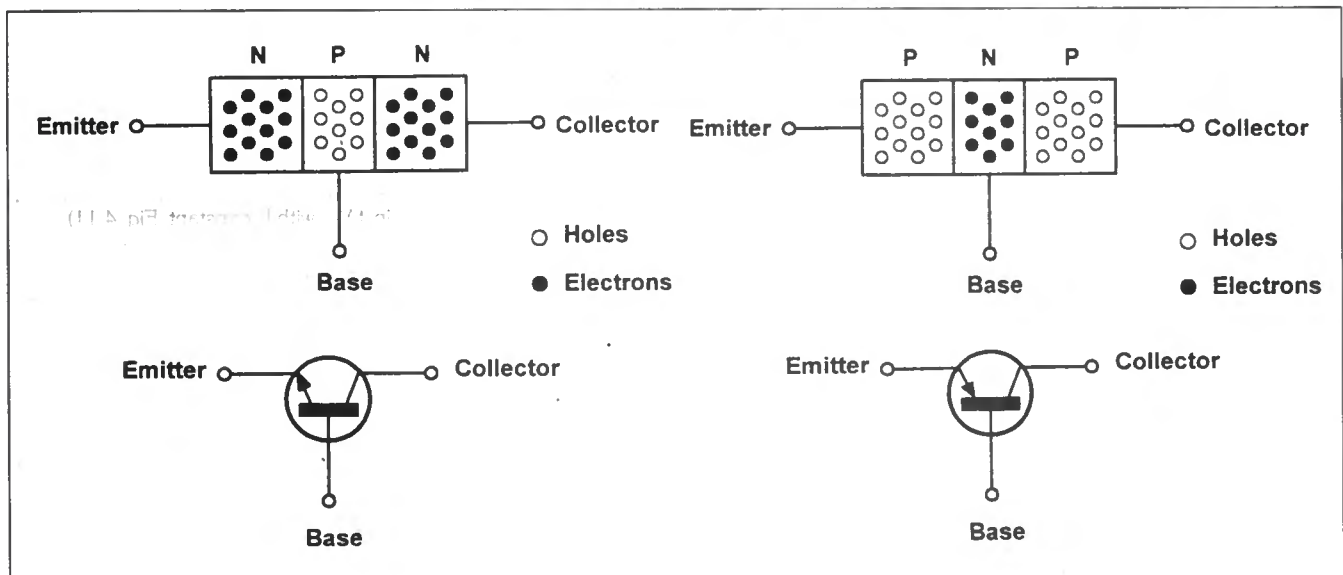
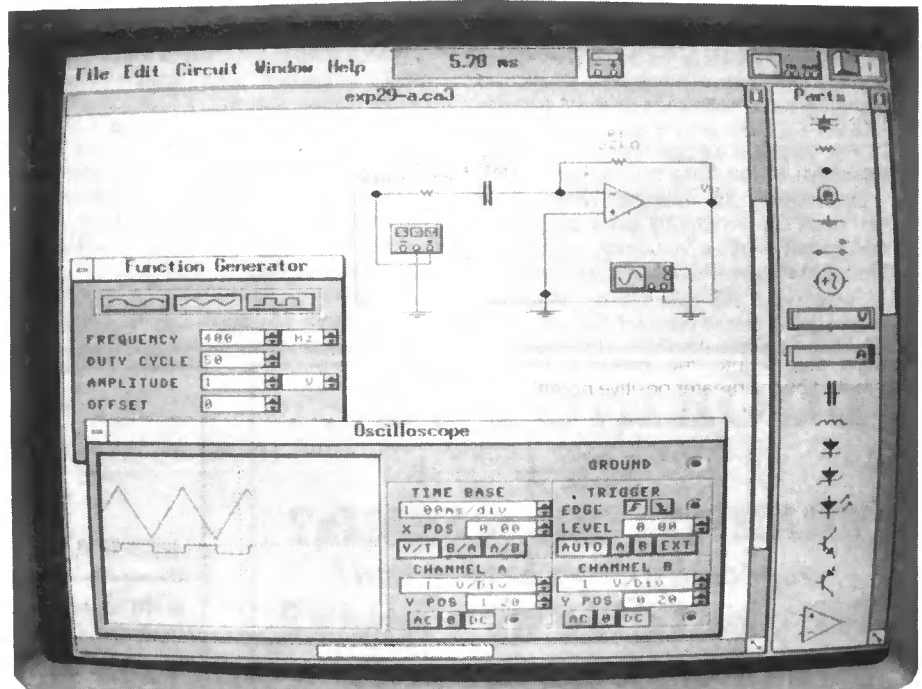


Fig. 4.1 Simplified construction and symbol for an npn transistor.

Fig. 4.2 Simplified construction and symbol for a pnp transistor.

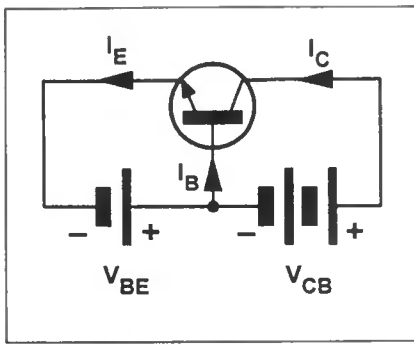


Fig. 4.3 Bias and current flow for an npn transistor.

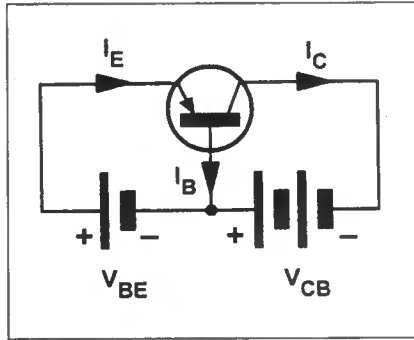


Fig. 4.4 Bias and current flow for a pnp transistor.

biased whilst the base-emitter junction is forward biased (see Fig. 4.3 and Fig. 4.4).

When the base-emitter junction is forward biased a large number of electrons travel from the emitter into the base region. A small number of electrons recombine with vacant holes within the narrow base region. However, the vast majority are swept across into the collector region, attracted by the greater positive potential.

Regardless of whether the transistor is *npn* or *pnp*, the three electrode currents are related by the expression:

$$I_E = I_B + I_C$$

where I_E is the emitter current, I_B is the base current, and I_C is the collector current.

Note that in *Electronics from the Ground Up* we have adopted the convention that an upper case subscript repre-

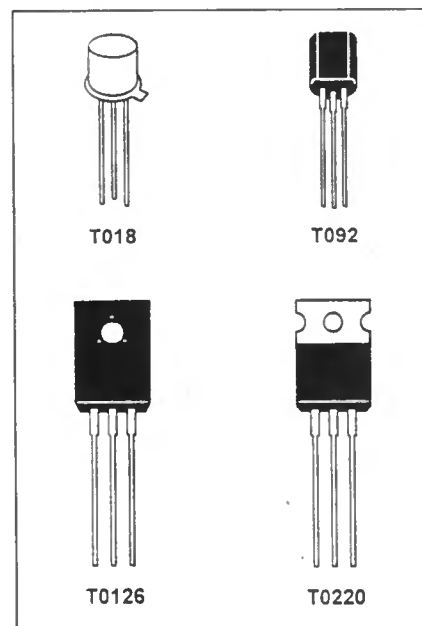
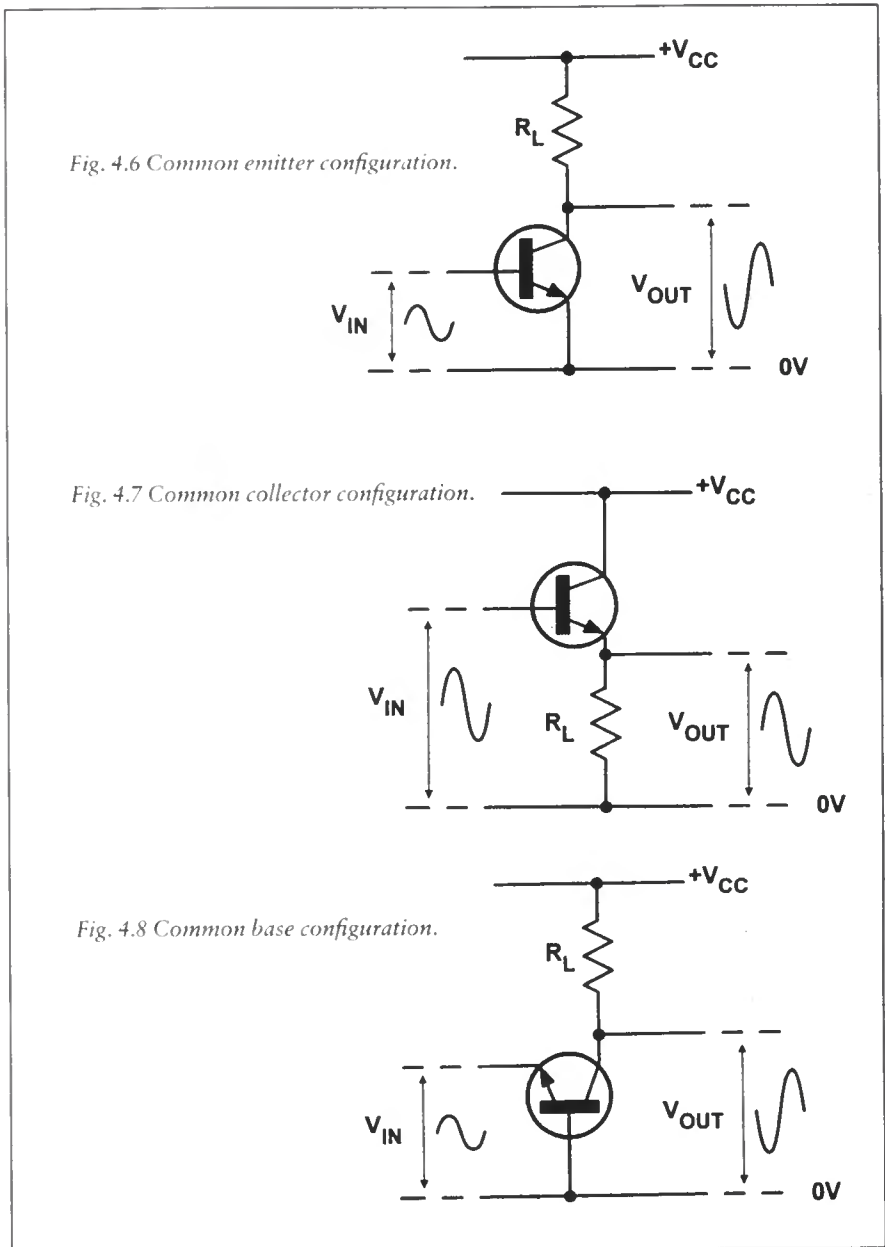


Fig. 4.5 Some common transistor packages.



sents a large signal (d.c.) value whilst a lower case subscript denotes a small change, increment or small a.c. value. This is an important point as we shall see later.

Some common transistor packages are shown in Fig. 4.5.

TRANSISTOR CIRCUIT CONFIGURATIONS

Regardless of what type of transistor is employed, three basic circuit configurations are used. These three circuit configurations depend upon which one of the three transistor connections is made common to both the input and the output. In the case of bipolar transistors, the configurations are known as *common emitter*, *common collector* (or *emitter follower*), and *common base*. See Fig. 4.6 to Fig. 4.8, respectively.

The three basic circuit configurations exhibit quite different performance characteristics as shown in the Table 4.1 (typical values are given in brackets).

TRANSISTOR CHARACTERISTICS

A number of characteristic graphs (showing the relationship between electrode voltage and current) can be used to predict

the performance of practical transistor circuits. In order to keep things simple (and to avoid confusion) we shall confine our study to the common emitter mode. Similar sets of characteristics can be obtained for the other modes.

In common emitter mode the three most useful characteristic graphs are:

- the input characteristic (I_B plotted against V_{BE} with V_{CE} constant, Fig. 4.9).
- the transfer characteristic (I_C plotted against I_B with V_{CE} constant, Fig. 4.10).
- the output characteristic (I_C plotted against V_{CE} with I_B constant, Fig. 4.11).

The input characteristic shown in Fig. 4.9 is similar to that of a forward biased diode. This, of course, should not be too surprising since the base-emitter junction acts just like a *p-n* junction diode. As with a conventional silicon diode, the junction does not begin to pass current until a forward voltage of approximately 0.7V is reached. The collector-emitter voltage (V_{CE}) has remarkably little effect on the shape of the characteristic and thus only a single curve is drawn for a fixed value of V_{CE} .

In contrast, the transfer characteristic shown in Fig. 4.10 takes the form of an almost straight line. This shows that, as the base current is increased, the collector

Table 4.1 Transistor circuit configurations

Parameter	Mode of operation		
	Common emitter (Fig. 4.6)	Common collector (Fig. 4.7)	Common base (Fig. 4.8)
Voltage gain	medium/high (40)	unity (1)	high (200)
Current gain	high (200)	high (200)	unity (1)
Power gain	very high (8000)	high (200)	high (200)
Input resistance	medium (2k Ω)	high (100k Ω)	low (200 Ω)
Output resistance	medium/high (20k Ω)	low (100 Ω)	high (100k Ω)
Phase shift	180°	0°	0°
Typical applications	General purpose, a.f. and r.f. amplifiers	Impedance matching, input and output stages	r.f. and v.h.f. amplifiers

current will increase in direct proportion (i.e., doubling the base current will produce a twofold increase in the collector current, and so on). Once again, the collector-emitter voltage (V_{CE}) has only a minor effect on the shape of the characteristic and again we can make use of a single curve keeping V_{CE} constant.

A set of output characteristics is shown in Fig. 4.11. This set of curves results from the fact that I_C will increase both as I_B increases and as V_{CE} increases. Note that we must usually construct a family of curves for increasing values of I_B . It is also worth noting that the output characteristics have a pronounced bend (or "knee") for values of V_{CE} below 2V. Above this value, I_C will rise only very slowly as V_{CE} increases. We refer to the shape of this part of the graph (above $V_{CE} = 2V$) as a "constant current" characteristic.

Input resistance

The input resistance of an amplifier is the resistance that is effectively "seen" between its input terminals. As such, it is the ratio of the voltage between the input

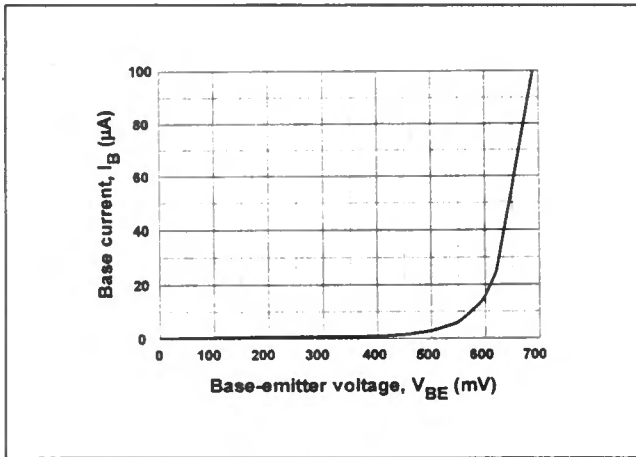


Fig. 4.9 Input characteristic (I_B plotted against V_{BE} with V_{CE} constant).

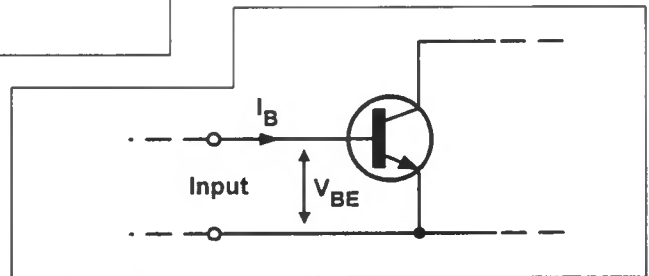


Fig. 4.12 Current and voltage at the input of a common emitter amplifier stage.

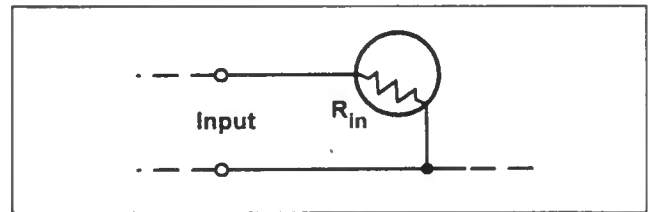


Fig. 4.13 Input resistance of a common emitter amplifier stage.

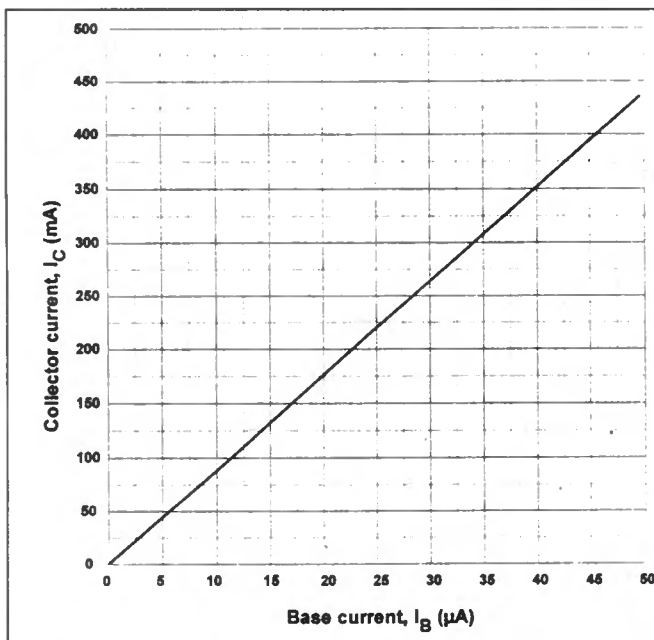


Fig. 4.10 Transfer characteristic (I_C plotted against I_B with V_{CE} constant).

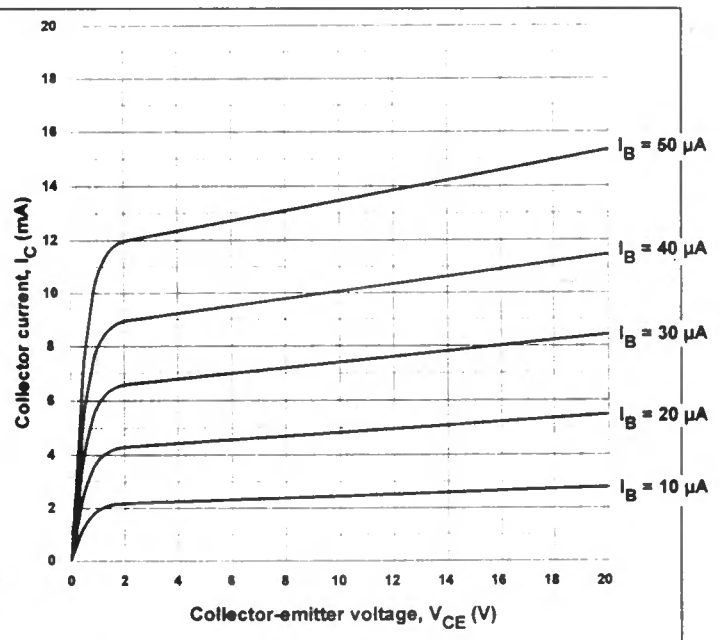


Fig. 4.11 Output characteristic (I_C plotted against V_{CE} with I_B constant).

terminals to the current flowing into the input. In the case of a transistor operating in common emitter mode, the input voltage is the voltage developed between the base and emitter, V_{BE} , whilst the input current is the current supplied to the base, I_B .

Fig. 4.12 shows the current and voltage at the input of a common emitter amplifier stage, whilst Fig. 4.13 shows how the input resistance, R_{in} , appears between the base and emitter. Note that R_{in} is not a discrete component - it is *inside* the transistor.

From the foregoing we can deduce that:

$$R_{in} = \frac{V_{BE}}{I_B}$$

The transistor's input characteristic can be used to predict the input resistance of a transistor amplifier stage. Since the input characteristic is non-linear (recall that very little happens until the base-emitter voltage exceeds about 0.7V), the value of input resistance will be very much dependent on the exact point on the graph at which the transistor is being operated.

Furthermore, we might expect quite different values of resistance according to whether we are dealing with larger, d.c. values or smaller incremental changes (a.c. values). Since this can be a rather difficult concept, it is worth expanding on it.

Fig. 4.14 shows a typical input characteristic in which the transistor is operated with a base current, I_B , of $50\mu\text{A}$. This current produces a base-emitter voltage, V_{BE} , of 0.7V. The input resistance corresponding to these steady (d.c.) values will be given by:

$$R_{in} = \frac{V_{BE}}{I_B} = \frac{0.7\text{V}}{50\mu\text{A}} = 14\text{k}\Omega$$

Now, suppose that we apply a steady bias current of, say, $70\mu\text{A}$ and superimpose on this a signal that varies above and below this value, swinging through a total change of $100\mu\text{A}$ (i.e., from $20\mu\text{A}$ to $120\mu\text{A}$). Fig. 4.15 shows that this produces a base-emitter voltage change of 0.05V.

The input resistance seen by this small-signal input current is given by:

$$R_{in} = \frac{\text{change in } V_{BE}}{\text{change in } I_B} = \frac{V_{be}}{I_b}$$

$$= \frac{0.05\text{V}}{100\mu\text{A}} = 500\Omega$$

It is worth comparing this value with the previous value. The appreciable difference is entirely attributable to the shape of the input characteristic!

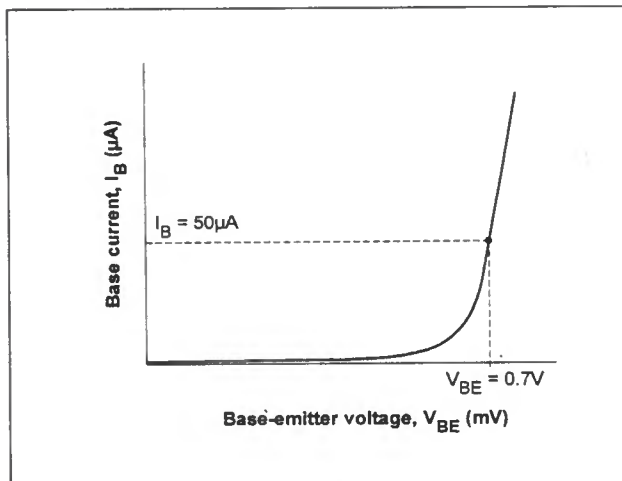


Fig. 4.14 Using the input characteristic to determine the large signal (d.c.) input resistance of a transistor connected in common emitter mode.

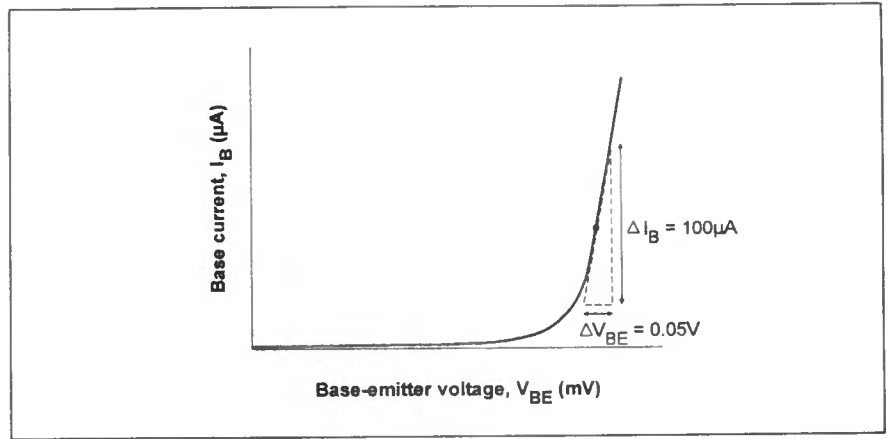


Fig. 4.15 Using the input characteristic to determine the small signal (a.c.) input resistance of a transistor connected in common emitter mode.

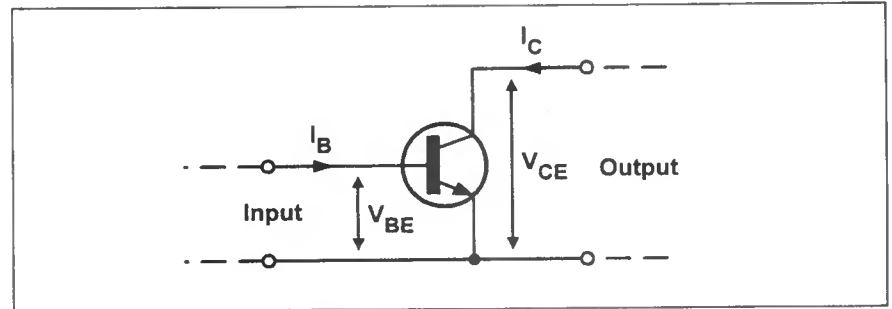


Fig. 4.16 Input and output currents and voltages in a common emitter amplifier stage.

CURRENT GAIN

The current gain produced by an amplifier is the ratio of output current to input current. In the case of a transistor operating in common emitter mode, the input current is the base current, I_B , whilst the output current is the collector current, I_C .

Fig. 4.16 shows the input and output currents and voltages for a common emitter amplifier stage. The magnitude of the current produced at the output of the transistor is equal to the current gain, A_i , multiplied by the applied base current, I_B . Since the output current is the current flowing in the collector, I_C , we can deduce that:

$$I_C = A_i \times I_B$$

Fig. 4.17 shows how this current source appears between the collector and emitter. Once

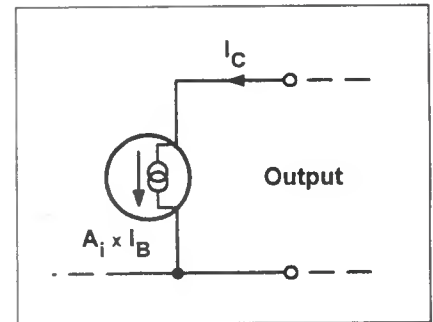


Fig. 4.17 Equivalent output current source in a common emitter amplifier stage.

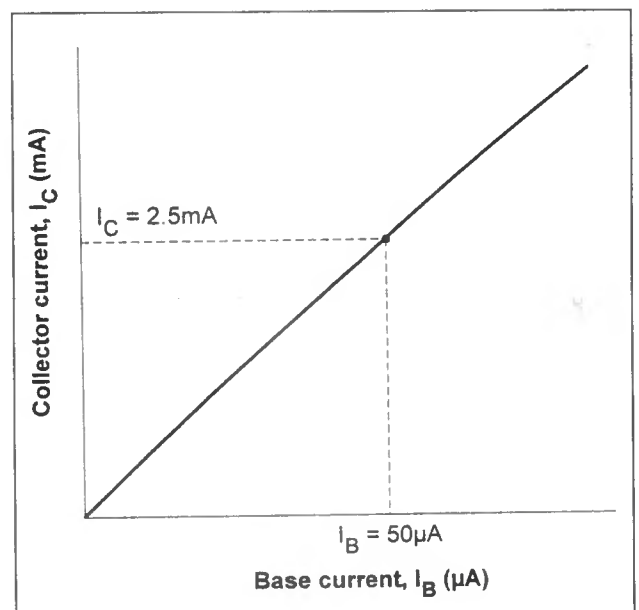


Fig. 4.18 Using the transistor's transfer characteristic to determine the large signal (d.c.) current gain produced by a transistor connected in common emitter mode.

again, the current source is not a discrete component – it appears *inside* the transistor.

The transistor's transfer characteristic can be used to predict the current gain of a transistor amplifier stage. Since the transfer characteristic is linear, the current gain remains reasonably constant over a range of collector current.

Fig. 4.18 shows a typical transfer characteristic in which the transistor is operated with a base current, I_B , of $50\mu\text{A}$. This current produces a collector current, I_C , of 2.5mA . The current gain corresponding to these steady (d.c.) values will be given by:

$$A_i = \frac{I_C}{I_B} = \frac{2.5\text{mA}}{50\mu\text{A}} = 50$$

Now, suppose that we apply a steady bias current of, say, $50\mu\text{A}$ and superimpose on this a signal that varies above and below this value, swinging through a total change of $40\mu\text{A}$ (i.e., from $30\mu\text{A}$ to $70\mu\text{A}$). Fig. 4.19 shows that this produces a collector current swing of 2mA .

The small-signal a.c. current gain is given by:

$$A_i = \frac{\text{change in } I_C}{\text{change in } I_B} = \frac{I_C}{I_b} = \frac{2\text{mA}}{40\mu\text{A}} = 50$$

Note that this value is the same as the large-signal (d.c.) value.

Practical assignment 4.1: Transistor characteristics

In this practical assignment, using *Electronics Workbench*, you will investigate the input and transfer characteristics of a typical silicon transistor.

Objectives:

- 4.1.1 To plot the input characteristic graph for a silicon transistor when connected in common emitter configuration.
- 4.1.2 To plot the transfer characteristic graph for a silicon transistor when connected in common emitter configuration.
- 4.1.3 To determine the large and small signal input resistance and current gain for a silicon transistor operating in common emitter configuration.

Instructions:

1. Connect the circuit shown in Fig. 4.20 using a 0.6V battery to supply base voltage to the transistor.

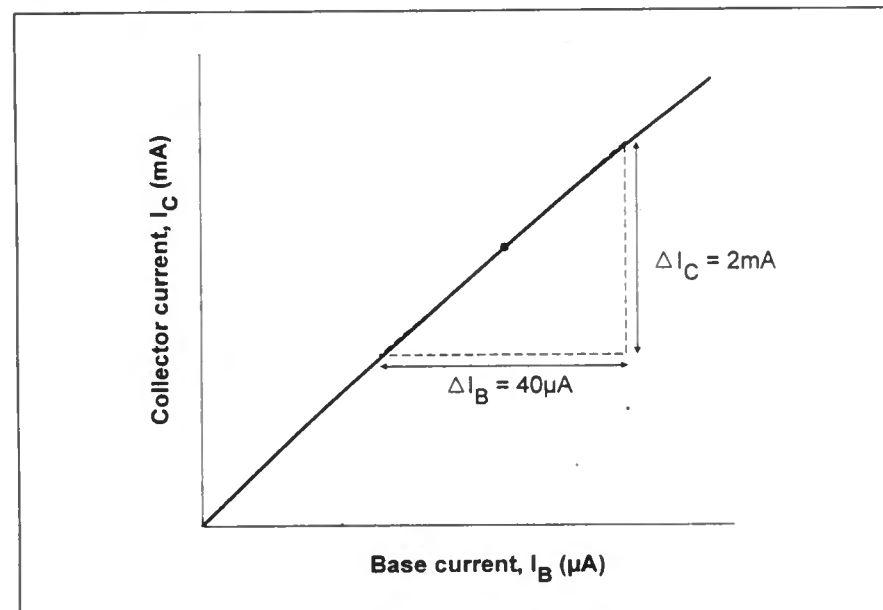


Fig. 4.19 Using the transistor's transfer characteristic to determine the small signal (a.c.) current gain produced by a transistor connected in common emitter mode.

Table 4.2 Measured values for Assignment 4.1.1

V_{BE} (V)	0V	0.5V	0.6V	0.65V	0.7V	0.75V	0.8V	0.85V
I_B (mA)	0							

2. Switch on the power to your circuit and measure the base current flowing. Record the value of base current in Table 4.2.
3. Repeat steps 1 and 2 using battery voltages of 0.625V , 0.65V , 0.675V , 0.7V , 0.725V and 0.75V . Measure and record the collector current for each value of applied base-emitter voltage.

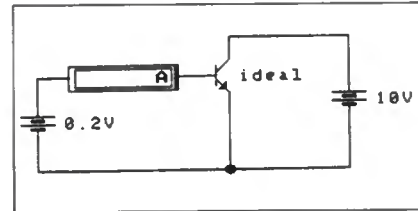


Fig. 4.20 Circuit for Assignment 4.1.1 (input characteristic).

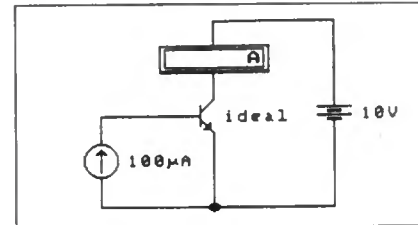


Fig. 4.21 Circuit for Assignment 4.1.2 (transfer characteristic).

Table 4.3 Measured values for Assignment 4.1.2

I_B (μA)	0	100	200	300	400	500	600
I_C (mA)	0						

4. Use the results from Table 4.2 to plot a graph showing base current (I_B) plotted against base-emitter voltage (V_{BE}).
5. Use the graph to determine the large signal (d.c.) input resistance of the transistor (V_{BE}/I_B) when V_{BE} is 0.7V .
6. Use the graph to determine the small signal (a.c.) input resistance of the transistor ($\Delta V_{BE}/\Delta I_B$ or V_{be}/I_b) when V_{BE} is 0.7V .
7. Connect the circuit shown in Fig. 4.21 using a $100\mu\text{A}$ d.c. current source to supply base current to the transistor.
8. Switch on the power to your circuit and measure the collector current flowing. Record the value of collector current in Table 4.3.
9. Repeat steps 7 and 8 using source currents of $200\mu\text{A}$, $300\mu\text{A}$, $400\mu\text{A}$, $500\mu\text{A}$, and $600\mu\text{A}$. Measure and record the collector current for each value of applied base current.
10. Use the results from Table 4.3 to plot a graph showing collector current (I_C) plotted against base current (I_B).
11. Use the graph to determine the large signal (d.c.) current gain of the transistor (I_C/I_B) when I_C is 50mA .
12. Use the graph to determine the small signal (a.c.) current gain of the transistor ($\Delta I_C/\Delta I_B = I_c/I_b$) when I_C is 50mA .

Conclusions:

To what extent have the objectives for this assignment been met? Comment on

the shape of the graphs. Are these what you would have expected? If not, why not? Comment on the large and small signal values of input resistance. Are the values similar? What range of base input current would be sensible for this device (assuming linear operation)? Comment on the large and small signal values of current gain. Are the values similar?

TRANSISTORS AS SWITCHES

Conventional electromechanical switches and electromagnetic relays will only operate at relatively slow speeds. In practice most electronic circuits demand switching speeds that are many orders of magnitude faster than can be achieved with these types of switch. Before going further, it is worth considering the properties that we would require an "ideal" switch to have.

PROPERTIES OF AN IDEAL SWITCH

An ideal switch would operate instantaneously, changing from its "off" state to its "on" state in zero time. In its "off" state,

Table 4.4 Typical characteristics of switching devices

Characteristic	Ideal	Relay (electromagnetic)	Transistor (solid state)
Switching time (off-on and on-off)	zero	20ms	10ns
Maximum switching rate (operations per second)	infinite	50Hz	10MHz
"On" state resistance	zero	0.05Ω	0.5Ω
"Off" state resistance	infinite	>100MΩ	>1MΩ
Maximum "off" state voltage	infinite	500V	150V
Maximum "on" current	infinite	2A	5A

the switch should have an infinite resistance and be capable of withstanding an infinite voltage applied to the open switch contacts without breakdown. In its "on" state, the switch should have zero resistance and be capable of passing an infinite current.

Whilst these characteristics may sound impossible to achieve, solid-state devices do go a long way towards satisfying even the most demanding of practical requirements (see Table 4.4).

SATURATION AND CUT-OFF

Before we take a look at a simple transistor switching circuit it is worth considering two extreme cases of transistor switching operation; *saturation* and *cut-off*.

Fig. 4.22 shows a simple transistor switching circuit. The input current is applied to the base (via resistor R1) and the output (i.e., the switched current) flows in the collector (via resistor R2). Provided the current gain is sufficient, the transistor will be driven into *saturation* when a relatively small base current is applied. In this condition, the collector-emitter voltage (V_{CE}) will fall to virtually 0V (in practice the saturated collector-emitter voltage, $V_{CE(sat)}$, for a typical silicon transistor will be of the order of 200mV). Almost the entire supply voltage (V_{CC}) will then appear dropped across resistor R2.

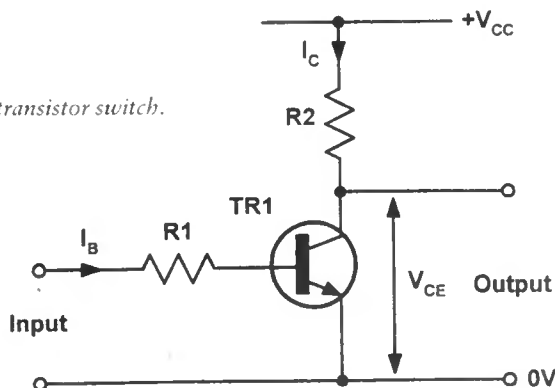


Fig. 4.22 A simple transistor switch.

Conversely, when no base current is applied (e.g., when the base itself is connected to ground) the transistor will not pass any collector current. In this condition the transistor is said to be *cut-off* and the collector-emitter voltage (V_{CE}) will rise to approximately the same as the supply voltage (V_{CC}). Almost no voltage will then be dropped across resistor R2.

The action of this circuit is thus equivalent to that of a switch connected between the collector and emitter. When the switch is "closed", the transistor is saturated and all of the supply voltage appears dropped across resistor R2. When the switch is "open", the transistor is "cut-off" and no voltage is dropped across resistor R2. The transistor switch is operated by a small current (typically less than 1mA).

Practical assignment 4.2: The transistor as a switch

In this practical assignment you will investigate the behaviour of a simple transistor switching circuit.

Objectives:

- 4.2.1 To investigate the switching action of a transistor.
- 4.2.2 To demonstrate the use of an l.e.d. (light emitting diode) indicator.

Instructions:

1. Connect the circuit shown in Fig. 4.23.
2. Switch on the power to your circuit. Measure and record the current flowing with the switch ("1" on your keyboard) in both positions.
3. Connect the circuit shown in Fig. 4.24. In this circuit, the ammeter is replaced by a light emitting diode connected in series with a 470Ω resistor.
4. Switch on the power to your circuit. Observe the l.e.d. with the switch in both positions (note that the diode symbol will appear darker when illuminated).

Conclusions:

To what extent have the objectives for this assignment been met? Can you explain the action of the circuit in your own words (remember that collector current will only flow when base current is applied)? In a practical application, the keyboard operated switch would be replaced by circuitry that either produces a small current or does not produce any current. With this in mind, can you suggest a practical application for the circuit?

AMPLIFIERS

Many different types of amplifier are found in electronic circuits. Before we explain the action of simple transistor amplifiers in detail, it is worth introducing some of the terminology applied to amplifier circuits in general:

A.C. coupled amplifiers

In a.c. coupled amplifiers, stages are coupled together in such a way that d.c. levels are isolated and only the a.c. components of a signal are transferred from stage to stage.

D.C. coupled amplifiers

In d.c. (or direct) coupled amplifiers, stages are coupled together in such a way that stages are not isolated from d.c.

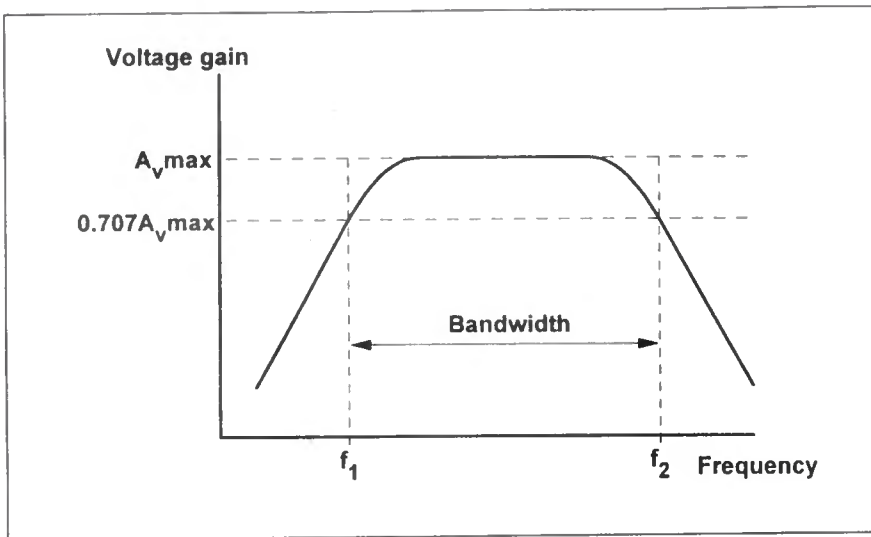


Fig. 4.25 Amplifier frequency response.

potentials. Both a.c. and d.c. signal components are transferred from stage to stage.

Large-signal amplifiers

Large signal amplifiers are designed to cater for appreciable voltage and/or current levels (typically from 1V to 100V, or more).

Small-signal amplifiers

Small signal amplifiers are designed to cater for low level signals (normally less than 1V and often much smaller).

Wideband amplifiers

Wideband amplifiers are capable of amplifying a very wide range of frequencies, typically from a few tens of Hz to several MHz.

Low-noise amplifiers

Low-noise amplifiers are designed so that they contribute negligible noise (signal disturbance) to the signal being amplified. These amplifiers are usually designed for use with very small signal levels (usually less than 10mV, or so).

Gain

One of the most important parameters of an amplifier is the amount of amplification or *gain* that it provides. Gain is simply the ratio of output voltage to input voltage, output current to input current, or output power to input power. These three ratios give, respectively, the voltage gain, current gain, and power gain. Thus:

$$\text{voltage gain} = \frac{V_{out}}{V_{in}}$$

$$\text{current gain} = \frac{I_{out}}{I_{in}}$$

$$\text{and power gain} = \frac{P_{out}}{P_{in}}$$

Input impedance

Input impedance is the ratio of input voltage to input current and it is expressed in ohms. The input of an amplifier is normally purely resistive (i.e., the reactive component is negligible) in the middle of its working frequency range (i.e., the mid-band) and hence, in such cases, input impedance is synonymous with input resistance.

Output impedance

Output impedance is the ratio of open-circuit output voltage to short-circuit output

current and is measured in ohms. Note that this impedance is internal to the amplifier and should not be confused with the impedance of the load.

Frequency response

Frequency response is usually specified in terms of the upper and lower cut-off frequencies of the amplifier. These frequencies are those at which the output power has dropped to 50 per cent (otherwise known as the -3 dB points) or where the voltage gain has dropped to 70.7 per cent of its mid-band value. Fig. 4.25 shows the typical frequency response of an a.c. coupled amplifier. The upper and lower cut-off frequencies are f_2 and f_1 respectively.

Bandwidth

The bandwidth of an amplifier is usually taken as the difference between the upper and lower cut-off frequencies (see Fig. 4.25).

Phase shift

Phase shift is the phase angle between the input and output voltages measured in degrees. The measurement is usually carried out in the mid-band where, for most amplifiers, the phase shift remains relatively constant.

BIAS AND LINEARITY

A requirement of most amplifiers is that the output signal should be a faithful copy of the input signal, albeit somewhat larger in amplitude. Other types of amplifier are "non-linear", in which case their input and output waveforms will not necessarily be similar. In practice, the de-

gree of linearity provided by an amplifier can be affected by a number of factors including the amount of bias applied and the amplitude of the input signal.

It is also worth noting that a linear amplifier will become non-linear when the applied input signal exceeds a threshold value. Beyond this value the amplifier is said to be "over-driven" and the output will become increasingly distorted if the input signal is further increased.

In general, the optimum value of bias for a linear amplifier is that value which ensures that the active devices are operated at the mid-point of their transfer characteristics. In practice, this means that a static value of collector current will flow even when there is no signal present.

Furthermore, the collector current will flow throughout the complete cycle of an input signal (i.e., conduction takes place over an angle of 360°). At no stage will the transistor be saturated nor will it be cut-off (see earlier).

This mode of operation is referred to as "Class-A". Other classes of operation ("B" and "C") offer improved efficiency but at the risk of significantly increased distortion. In *Electronics from the Ground Up*, we shall restrict our investigation of amplifier circuits to Class-A stages.

TRANSISTOR AMPLIFIER CIRCUITS

Fig. 4.26 shows a simple Class-A common emitter amplifier circuit. The signal is applied to the base terminal of the transistor via a coupling capacitor, C1. This capacitor removes the d.c. component of any signal applied to the input terminals and ensures that the base bias current delivered by resistor R1 is unaffected by any device connected to the input. Resistor R2 forms the collector load for the amplifier stage and feeds d.c. current to the collector of the transistor. Capacitor C2 couples the signal out of the stage and also prevents d.c. current flow from appearing at the output terminals. The stage offers a modest voltage gain (80 to 120 typical) with an input impedance of approximately $1k\Omega$ and an output impedance of around $20k\Omega$.

In order to stabilise the operating conditions for the stage and compensate for variations in transistor parameters, base bias current for the transistor can be derived from the voltage at the collector (see Fig. 4.27). This voltage is dependent on the collector current which, in turn, depends upon the base current. A negative feedback loop thus exists in which there is

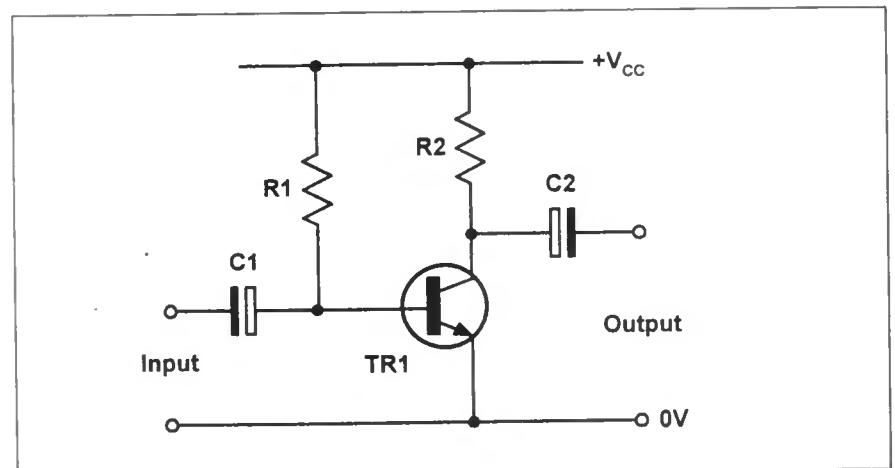


Fig. 4.26 Basic Class-A common emitter amplifier stage.

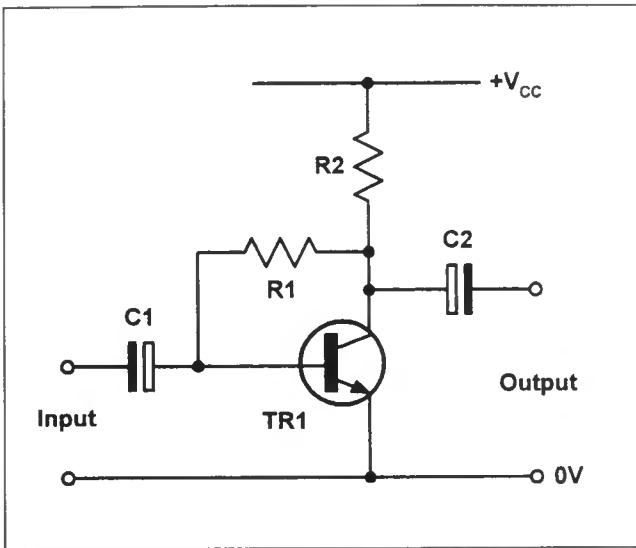


Fig. 4.27 A practical common emitter transistor amplifier.

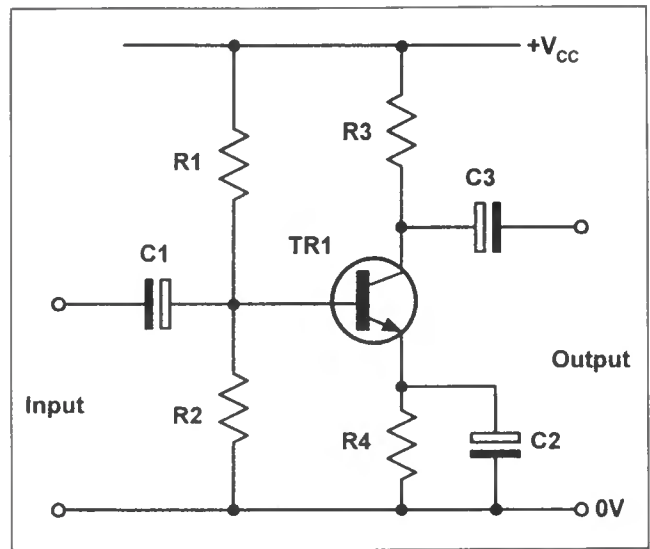


Fig. 4.29 An improved common emitter amplifier stage.

a degree of self-regulation. If the collector current increases, the collector voltage will fall and the base current will be reduced.

The reduction in base current will produce a corresponding reduction in collector current to offset the original change. Conversely, if the collector current falls, the collector voltage will rise and the base current will increase. This, in turn, will produce a corresponding increase in collector current to offset the original change.

The negative feedback path in Fig. 4.27 provides feedback that involves an a.c. (signal) component as well as the d.c. bias. As a result of the a.c. feedback, there is a slight reduction in signal gain. The signal gain can be increased by removing the a.c. signal component from the feedback path so that only the d.c. bias component is present. This can be achieved with the aid of a bypass capacitor as shown in Fig. 4.28.

The value of bypass capacitor, C2, is chosen so that the component exhibits a very low reactance at the lowest signal frequency when compared with the series base bias resistance, R2. The result of this potential divider arrangement is that the a.c. signal component is effectively bypassed to ground.

Fig. 4.29 shows an improved form of transistor amplifier in which d.c. negative feedback is used to stabilize the stage and compensate for variations in transistor parameters, component values and tem-

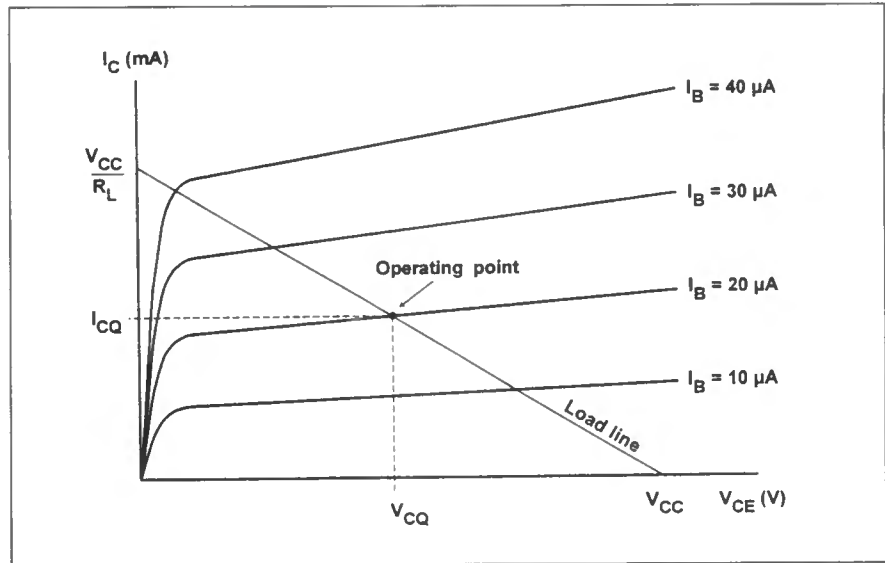


Fig. 4.30 Operating point and quiescent values shown on the load line for a bipolar transistor operating in common emitter mode.

perature changes. Resistors R1 and R2 form a potential divider that determines the d.c. base potential, V_B . The base-emitter voltage (V_{BE}) is the difference between the potentials present at the base (V_B) and emitter (V_E). The potential at the emitter is governed by the emitter current (I_E). If this current increases, the emitter voltage (V_E)

will increase and, as a consequence V_{BE} will fall. This, in turn, produces a reduction in emitter current which largely offsets the original change. Conversely, if the emitter current decreases, the emitter voltage (V_E) will decrease and V_{BE} will increase (remember that V_B remains constant). The increase in bias results in an increase in emitter current compensating for the original change.

PREDICTING PERFORMANCE

The a.c. performance of an amplifier stage can be predicted using a load line superimposed on the relevant set of output characteristics. For a bipolar transistor operating in common emitter mode the required characteristics are I_C plotted against V_{CE} . One end of the load line corresponds to the supply voltage (V_{CC}) whilst the other end corresponds to the value of collector or drain current that would flow with the device totally saturated. In this condition;

$$I_C = \frac{V_{CC}}{R_L}$$

where R_L is the value of collector or drain load resistance.

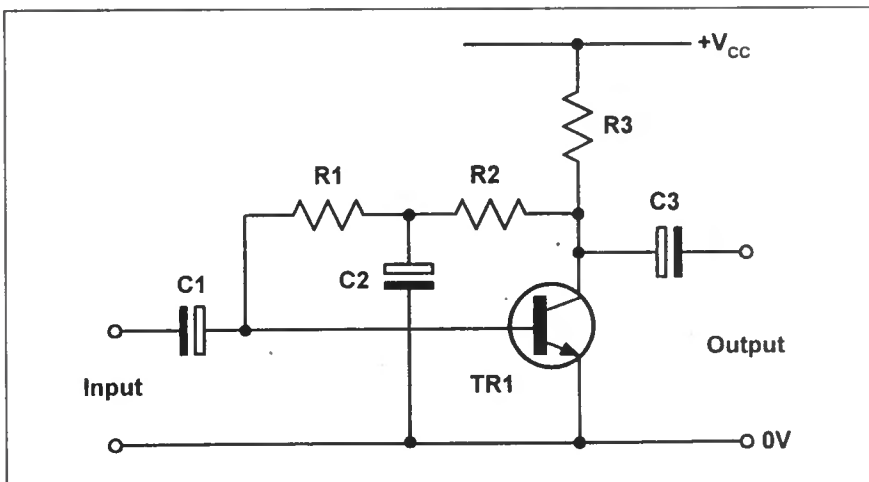


Fig. 4.28 Improved version of Fig. 4.27.

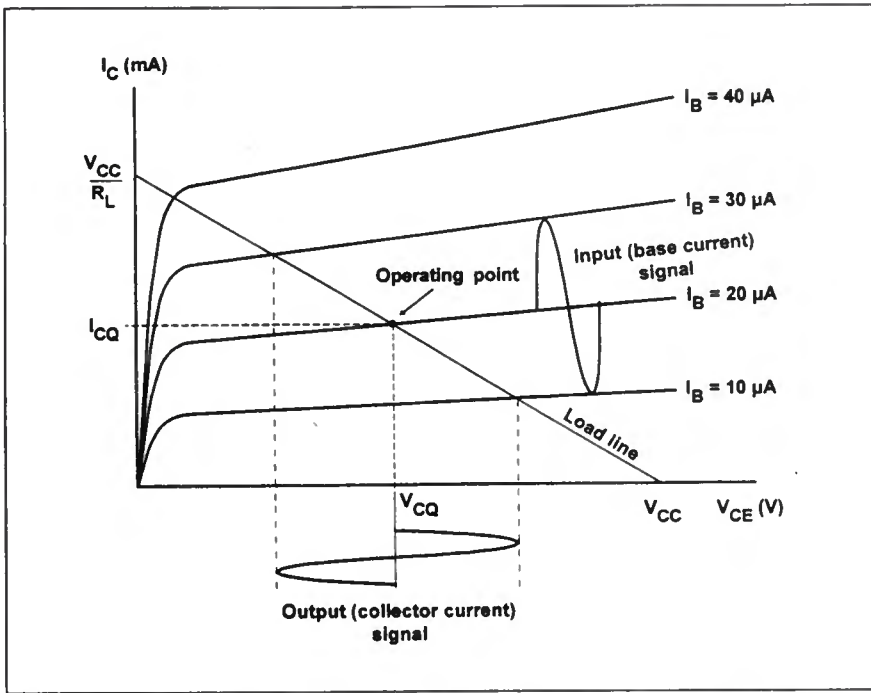


Fig. 4.31 Input (base current) and output (collector current) waveforms superimposed on Fig. 4.30.

Fig. 4.30 shows a load line superimposed on a set of output characteristics for a bipolar transistor operating in common emitter mode. The quiescent point (or operating point) is the point on the load line that corresponds to the conditions that exist when no-signal is applied to the stage. In Fig. 4.30, the base bias current is set at $20 \mu A$ so that the quiescent point effectively sits roughly half-way along the load line. This position ensures that the collector voltage can swing both positively (above) and negatively (below) its quiescent value (V_{CEQ}).

Fig. 4.31 shows the effect of superimposing an alternating base current (of $20 \mu A$ peak-peak) to the d.c. bias current (of $20 \mu A$). The corresponding collector current signal can be determined by simply moving up and down the load line (as shown).

Practical assignment 4.3: Single-stage amplifier

In this assignment you will investigate the behaviour of a single-stage Class-A common emitter amplifier.

Objectives:

- 4.3.1 To investigate the action of a single-stage Class-A common emitter amplifier.
- 4.3.2 To determine the d.c. operating conditions for a single-stage Class-A common emitter amplifier.
- 4.3.3 To use an oscilloscope to obtain waveforms for a single-stage Class-A common emitter amplifier.

Table 4.5 D.C. operating conditions in Assignment 4.3.

Measured value of base-emitter voltage, V_{BE} (volts)	
Measured value of collector-emitter voltage, V_{CE} (volts)	
Calculated value of base current, I_B (μA)	
Calculated value of collector current, I_C (mA)	

- 4.3.4 To measure the voltage gain and phase shift produced by a single-stage Class-A common emitter amplifier.
- 4.3.5 To observe the effect of over-driving an amplifier stage.

Instructions:

1. Connect the circuit shown in Fig. 4.32. The voltmeter is to be connected so that it will indicate the base-emitter voltage (V_{BE}) for the transistor.
2. Measure and record the base-emitter voltage (V_{BE}) in Table 4.5.
3. Connect the circuit shown in Fig. 4.33. The voltmeter is to be connected so that it will indicate the collector-emitter voltage (V_{CE}) for the transistor.
4. Measure and record the collector-emitter voltage (V_{CE}) in Table 4.5.
5. Use the measured values of V_{BE} and V_{CE} to calculate the values of base current (I_B) and collector current (I_C). (Remember that I_B and I_C flow in the $100k\Omega$ and $1k\Omega$ resistors, respectively. You can apply Ohm's Law to determine the current. The voltage dropped across the $100k\Omega$ resistor will be $10V$ minus V_{BE} whilst that dropped across the $1k\Omega$ resistor will be $10V$ minus V_{CE} (from Kirchhoff's Voltage Law).
6. Connect the circuit shown in Fig. 4.34. Set the waveform generator and oscilloscope controls as shown in Fig. 4.35.

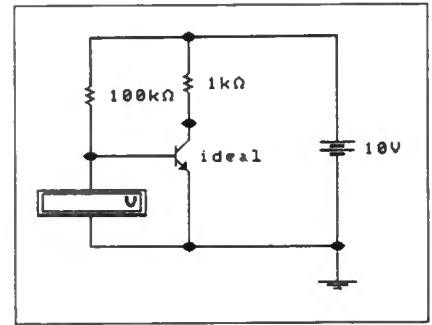


Fig. 4.32 Circuit for Assignment 4.3 with the voltmeter connected to read the value of V_{BE} .

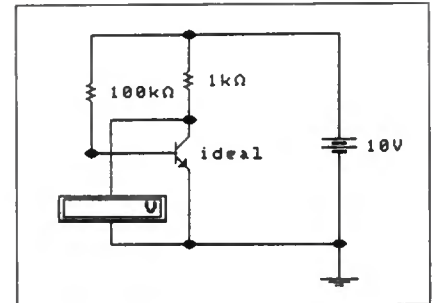


Fig. 4.33 Circuit for Assignment 4.3 with the voltmeter connected to read the value of V_{CE} .

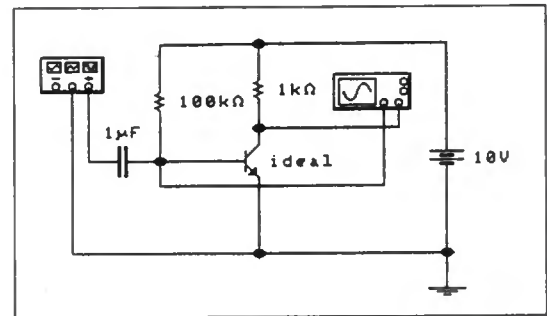


Fig. 4.34 Single-stage Class-A common emitter amplifier (Assignment 4.3).

- 7. Display the input and output waveforms on a common time scale (you might like to sketch these). Determine the phase difference (in degrees) between the input and output signals (remember that a complete cycle is equivalent to a phase shift of 360°).

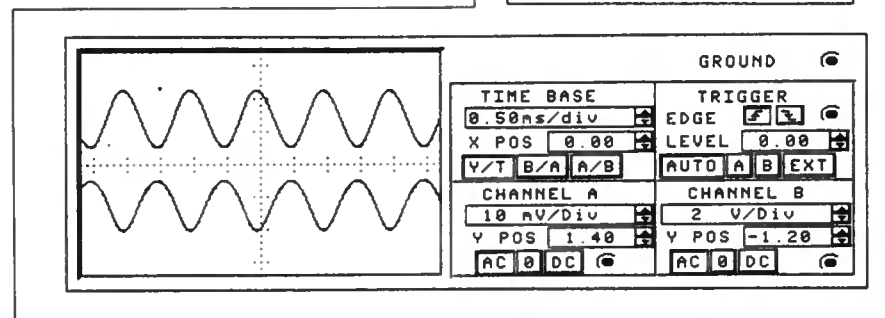
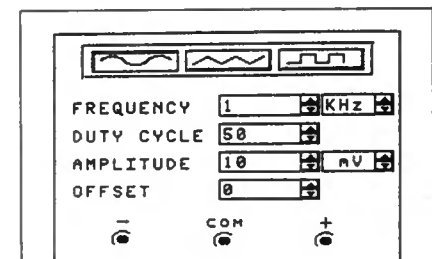


Fig. 4.35 Waveform generator and oscilloscope settings for Assignment 4.3.

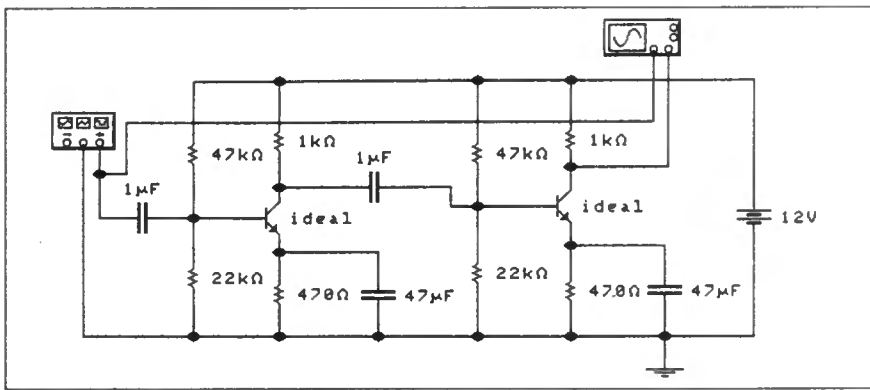


Fig. 4.36 Two-stage Class-A common emitter amplifier (Assignment 4.4).

for the stage? Can you explain why the output signal becomes distorted when this value of input is exceeded? How could the distortion be reduced?

MULTISTAGE AMPLIFIERS

Multistage amplifiers can be used to provide significantly higher values of voltage gain. Signals can be coupled from

Fig. 4.37 Waveform generator and oscilloscope settings for Assignment 4.4.

8. Use the oscilloscope to measure the peak-peak values of the input and output waveforms. Hence determine the voltage gain of the stage.
9. Try increasing the amplitude of the input signal until the output waveform becomes noticeably distorted. You might like to sketch the resulting output waveform.

Conclusions:

To what extent have the objectives for this assignment been met? Can you explain, in your own words, how the circuit works? Comment on the d.c. operating conditions. Are these what you would expect? Comment on the voltage gain produced by the stage. Can you explain why the stage produces a phase shift of 180°? What would you consider should be the maximum input signal

stage to stage (the output of one stage feeding the input of the next) using capacitors or transformers (the former being more common). Stages are effectively connected in tandem (one stage after another) using common supply (V_{CC}) and ground (0V) connections. Note that in practical circuits it is usually necessary to decouple the supply rail in order to avoid unwanted feedback of signals carried on the supply rail. A suitably large value of capacitor connected from V_{CC} to ground usually satisfies this requirement.

Practical assignment 4.4: Two-stage amplifier

In this assignment you will investigate the behaviour of a two-stage Class-A common emitter amplifier.

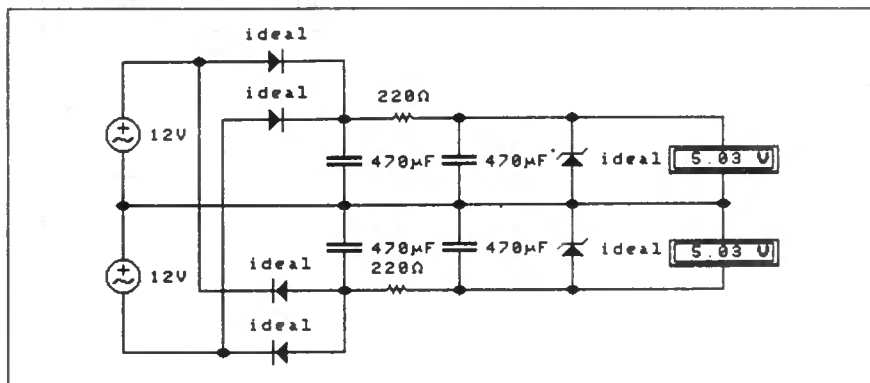


Fig. 4.38 Solution to last month's brain teaser.

Objectives:

- 4.4.1 To investigate the action of a two-stage Class-A common emitter amplifier.
- 4.4.2 To determine the d.c. voltages (under driven conditions) for a two-stage Class-A common emitter amplifier.
- 4.4.3 To use an oscilloscope to obtain waveforms for a two-stage Class-A common emitter amplifier.
- 4.4.4 To measure the voltage gain and phase shift produced by a two-stage Class-A common emitter amplifier.

Instructions:

1. Connect the circuit shown in Fig. 4.36. Set the waveform generator and oscilloscope controls as shown in Fig. 4.37.
2. Use the voltmeter to measure and record the voltages (under driven conditions) at the collector and emitter of each transistor relative to ground.
3. Display the input and output waveforms on a common time scale (you might like to sketch these). Determine the phase difference (in degrees) between the input and output signals (remember that a complete cycle is equivalent to a phase shift of 360°).
4. Use the oscilloscope to measure the peak-peak values of the input and output waveforms. Hence determine the voltage gain of the stage.

Conclusions:

To what extent have the objectives for this assignment been met? Comment on the d.c. voltages. Are these what you would expect? Are they identical for each stage? Comment on the voltage gain produced by the circuit. How does this compare with the voltage gain for a single-stage amplifier? Can you explain why the stage produces a phase shift of 360° (or 0°)?

BRAIN TEASER

This month's challenge for those of you who are using the full *Electronics Workbench* package is to design an a.c. coupled Class-A common emitter amplifier with the following specifications:

$$\begin{aligned} \text{Voltage gain} &= 2 \\ \text{Overall phase shift} &= 180^\circ \\ \text{Supply voltage} &= 10\text{V} \end{aligned}$$

Hint: use the circuit shown in Fig. 4.29. In this circuit, if capacitor C2 is omitted, the voltage gain will be approximately given by the ratio of resistors R3 to R4. Operate the transistor TR1 with $I_C = 2\text{mA}$ and choose values for resistors R1 and R2 that will produce a voltage of between 1.7V and 2V at the base of TR1.

Test your solution using *Electronics Workbench*.

Answer to last month's Brain Teaser

Last month's Brain Teaser involved the design of a full-wave power supply that provides equal but opposite output voltages with a common earth (0V) connection. The circuit should incorporate smoothing and each output voltage is to be stabilised using a parallel-connected 5V Zener diode. Fig. 4.38 shows one solution arrived at using the full version of *Electronics Workbench*.

CAPTOR-VATED!

TERRY de VAUX-BALBIRNIE

Don't cough and choke - remove those harmful fumes. Terry extracts the truth about the benefits of using a fume captor when carrying out soldering operations.

ALMOST anyone constructing electronic circuits will need to solder at times. Unfortunately, those who do this *regularly* may breathe in excessive amounts of fumes. Both solder and flux produce various chemical substances when heated - either in the form of gases or as suspended solid particles - and several of these can be harmful to health. Good ventilation will help but will not completely solve the problem.

Those who solder professionally - that is, people employed in commercial premises - are protected by the COSHH (Control of Substances Hazardous to Health) regulations (1988). These place a duty on the employer to ensure that any exposure of employees to harmful substances is prevented or at least adequately controlled.

All soldering irons installed in most commercial premises will therefore be fitted with fume extraction equipment. This normally consists of a rigid tube attached to the side of the soldering iron connected through a flexible tube to a filter and air pump.

JUST A MINUTE

It would be ideal for the amateur to have this type of equipment available at home. It would also prevent the whole house smelling of "electronics". However, it is generally beyond the means of the average amateur - a self-contained fume extraction soldering station would cost several hundred pounds. I was given the opportunity to try an inexpensive alternative - the Solder Fume Captor from Light Soldering Developments in Croydon.

The Solder Fume Captor is a free-standing mains-operated unit containing a fan which draws air through an activated-carbon filter at the rate of 2.64 cu.m/min. The idea is to place the device close (30cm or less) to the work. The filter traps the solid particles and absorbs the gases so, providing it is replaced regularly, the air emerging from the rear is almost totally free of tarry deposits and odour.

The carbon filter is replaced by first removing the front cover. This is held by two fixings which need to be turned slightly using a coin. The old filter is discarded and a new one placed in position. The cover is then replaced - a one-minute job.

BREATHTAKING

I try to hold my breath while making a soldered joint - especially when doing close work. If I don't, the fumes can make me cough and choke for hours afterwards.

I found that with the Captor running, I could work continuously and comfortably. Moreover, the house did not smell of fumes afterwards. The Solder Fume Captor differs from fan-driven domestic devices in actually *removing* the fumes rather than simply covering them up with a pleasant smell.

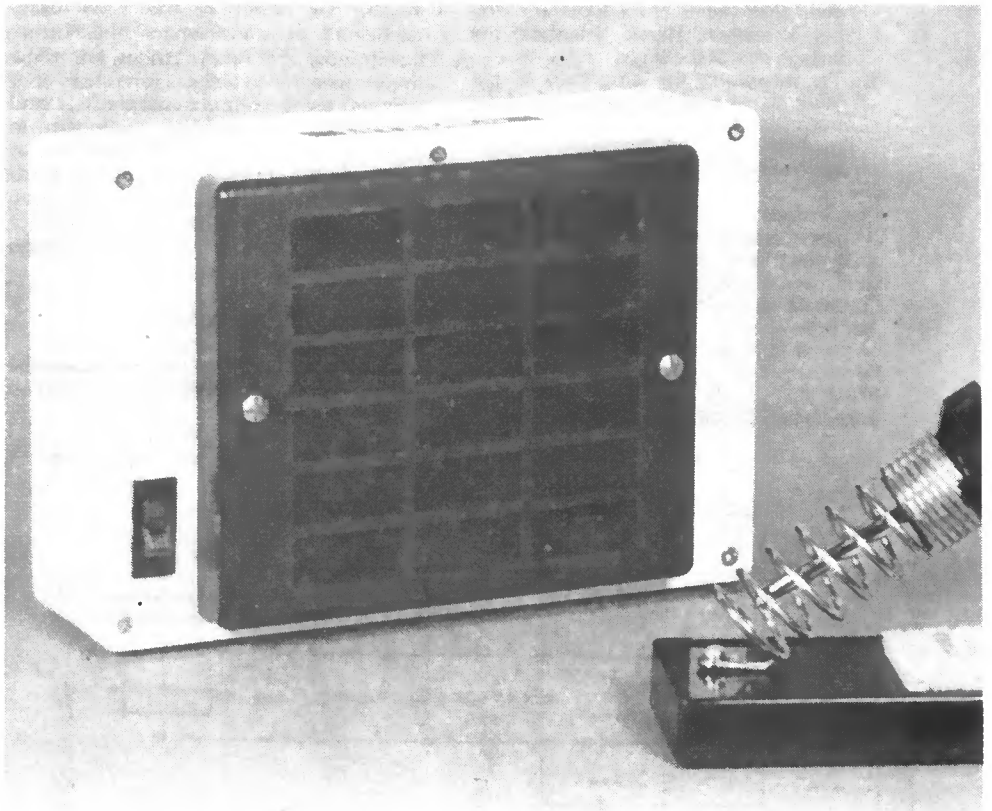
The Captor is effective, runs quietly and consumes only 18W of power. Overseas readers may like to know that it is also

available in a 115V version. I would recommend it to any amateur - especially one who finds soldering fumes irritating or who does a lot of work.

People suffering from asthma, bronchitis and other breathing problems will find it of particular benefit. It would also be useful to schools and colleges - a dozen soldering irons all operating at once can be extremely unpleasant. Possibly two students could share one unit.

At the time of writing, the Solder Fume Captor costs £54.94 plus VAT. This includes three spare filters. Additional filters cost £9.92 for a pack of five. These are all available direct from the manufacturer on a cheque-with-order basis. Carriage is charged for at cost - it would be wise to telephone for the latest prices before ordering.

For more information contact:
Light Soldering Developments Ltd.,
Dept EPE, Spencer Place, 97-99
Gloucester Road, Croydon, Surrey,
CR0 2DN. Tel: 0181-689 0574. Fax:
0181-689 0090.



Solder Fume Captor from Light Soldering Developments.

VIDEOS ON ELECTRONICS

A range of videos designed to provide instruction on electronics theory. Each video gives a sound introduction and grounding in a specialised area of the subject. The tapes make learning both easier and more enjoyable than pure textbook or magazine study. They are proving particularly useful in schools, colleges, training departments and electronics clubs as well as to general hobbyists and those following distance learning courses etc.

VT201 to VT206 is a basic electronics course and is designed to be used as a complete series, if required.

VT201 55 minutes. Part One; **D.C. Circuits.** This video is an absolute must for the beginner. Series circuits, parallel circuits, Ohms law, how to use the digital multimeter and much more. **Order Code VT201**

VT202 62 minutes. Part Two; **A.C. Circuits.** This is your next step in understanding the basics of electronics. You will learn about how coils, transformers, capacitors, etc are used in common circuits. **Order Code VT202**

VT203 57 minutes. Part Three; **Semiconductors.** Gives you an exciting look into the world of semiconductors. With basic semiconductor theory. Plus 15 different semiconductor devices explained. **Order Code VT203**

VT204 56 minutes. Part Four; **Power Supplies.** Guides you step by step through different sections of a power supply. **Order Code VT204**

VT205 57 minutes. Part Five; **Amplifiers.** Shows you how amplifiers work as you have never seen them before. Class A, class B, class C, op.amps. etc. **Order Code VT205**

VT206 54 minutes. Part Six; **Oscillators.** Oscillators are found in both linear and digital circuits. Gives a good basic background in oscillator circuits. **Order Code VT206**

By the time you have completed VT206 you have completed the basic electronics course and should have a good understanding of the operation of basic circuit elements.

VCR MAINTENANCE

VT102 84 minutes: Introduction to VCR Repair. Warning, not for the beginner. Through the use of block diagrams this video will take you through the various circuits found in the NTSC VHS system. You will follow the signal from the input to the audio/video heads then from the heads back to the output. **Order Code VT102**

VT103 32 minutes: A step-by-step easy to follow procedure for professionally cleaning the tape path and replacing many of the belts in most VHS VCR's. The viewer will also become familiar with the various parts found in the tape path. **Order Code VT103**

Each video uses a mixture of animated current flow in circuits plus text, plus cartoon instruction etc., and a very full commentary to get the points across. The tapes are imported by us and originate from VCR Educational Products Co, an American supplier.
(All videos are to the UK PAL standard on VHS tapes)

Now for the digital series of six videos. This series is designed to provide a good grounding in computer technology.

VT301 54 minutes. Digital One; **Gates** begins with the basics as you learn about seven of the most common gates which are used in almost every digital circuit, plus Binary notation. **Order Code VT301**

VT302 55 minutes. Digital Two; **Flip Flops** will further enhance your knowledge of digital basics. You will learn about Octal and Hexadecimal notation groups, flip-flops, counters, etc. **Order Code VT302**

VT303 54 minutes. Digital Three; **Registers and Displays** is your next step in obtaining a solid understanding of the basic circuits found in today's digital design. Gets into multiplexers, registers, display devices, etc. **Order Code VT303**

VT304 59 minutes. Digital Four; **DAC and ADC** shows you how the computer is able to communicate with the real world. You will learn about digital to analogue and analogue to digital converter circuits. **Order Code VT304**

VT305 56 minutes. Digital Five; **Memory Devices** introduces you to the technology used in many of today's memory devices. You will learn all about ROM devices and then proceed into PROM, EPROM, EEPROM, SRAM, DRAM, and MBM devices. **Order Code VT305**

VT306 56 minutes. Digital Six; **The CPU** gives you a thorough understanding in the basics of the central processing unit and the input/output circuits used to make the system work. **Order Code VT306**

By now you should have a good understanding of computer technology and what makes computers work. This series is also invaluable to the computer technician to understand the basics and thus aid troubleshooting.

VT401 61 minutes. **A.M. Radio Theory.** The most complete video ever produced on a.m. radio. Begins with the basics of a.m. transmission and proceeds to the five major stages of a.m. reception. Learn how the signal is detected, converted and reproduced. Also covers the Motorola C-QUAM a.m. stereo system. **Order Code VT401**

VT402 58 minutes. **F.M. Radio 1.** F.M. basics including the functional blocks of a receiver. Plus r.f. amplifier, mixer oscillator, i.f. amplifier, limiter and f.m. decoder stages of a typical f.m. receiver. **Order Code VT402**

VT403 58 minutes. **F.M. Radio Part 2.** A continuation of f.m. technology from Part 1. Begins with the detector stage output, proceeds to the 19kHz amplifier, frequency doubler, stereo demultiplexer and audio amplifier stages. Also covers RDS digital data encoding and decoding. **Order Code VT403**

VT501 58 minutes. **Fibre Optics.** From the fundamentals of fibre optic technology through cable manufacture to connectors, transmitters and receivers. **Order Code VT501**

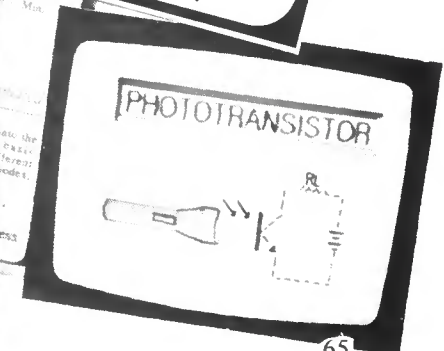
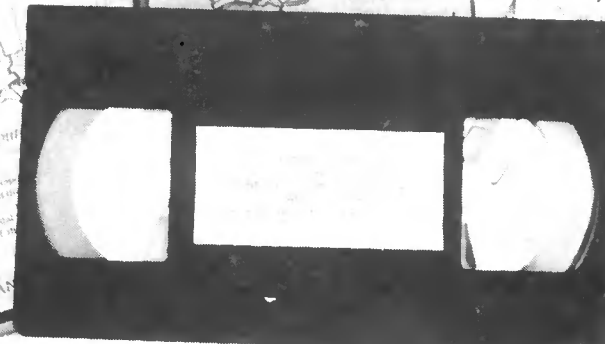
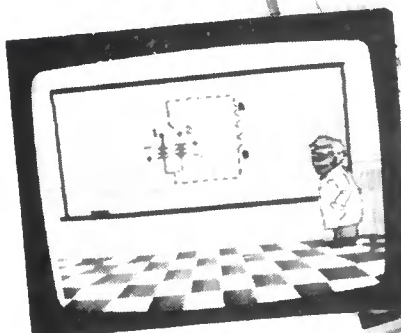
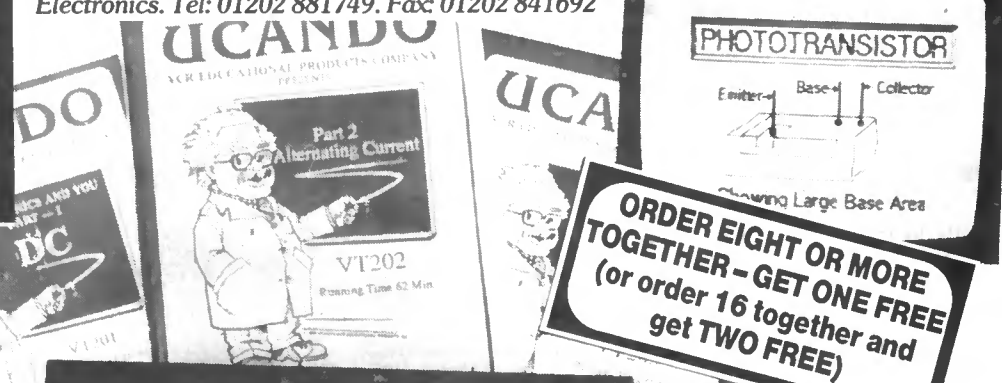
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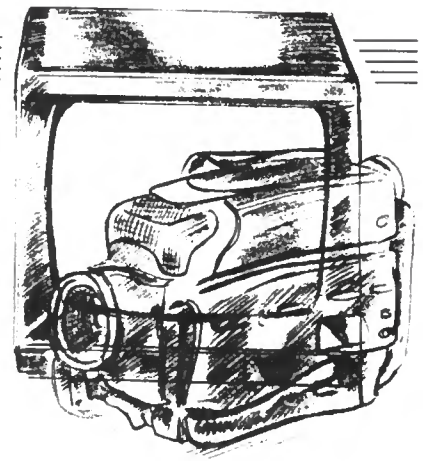
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VIDEO MODULES DYNAMIC NOISE LIMITER



ROBERT PENFOLD Part Three

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WE ROUND-OFF this short series on the design and construction of a selection of Video Modules for editing home videos with details for building a Dynamic Noise Limiter. We also include details for a Simple Mains Power Supply for driving the Modules.

The audio quality of camcorders and video recorders varies considerably. Some have monophonic sound with a rather limited bandwidth and modest signal-to-noise ratio, while others have hi-fi stereo sound.

The lower quality sound systems can certainly benefit from the use of a dynamic noise limiter. This improves the apparent signal-to-noise ratio using dynamic lowpass filtering.

A system of this type relies on the fact that the background "hiss" is masked by the main signal at high volume levels. It is only at low volume levels that the noise becomes intrusive. At high volumes it will probably not be audible at all.

The basic idea is to have quite strong lowpass filtering at low volume levels. This gives some loss of audio quality, but because the tape "hiss" has a strong high frequency content, it gives a large reduction in the background noise level. At

higher volume levels the lowpass filtering is steadily reduced, and at the highest volume levels it is removed altogether.

A fixed amount of lowpass filtering would tend to give crescendos that were lacking in impact due to the lack of treble content. Dynamic filtering gives what is subjectively an equal amount of noise reduction, but with the full bandwidth provided at high volume levels the reproduced sound has much more "sparkle" and impact.

SYSTEM OPERATION

The block diagram for the Dynamic Noise Limiter (D.N.L.) is illustrated in Fig. 20. The input signal is applied to a buffer amplifier, and from here the signal is split two ways. The main route is through a voltage controlled lowpass filter (v.c.f.), and then to the output via another buffer amplifier.

The voltage controlled filter has a control which permits the minimum cut-off frequency to be set by the user. This effectively operates as a noise reduction control. The lower the cut-off frequency is positioned, the greater the degree of noise reduction.

Of course, using a lot of noise reduction also gives a large loss of audio quality at low volumes. This control therefore has to be set for a frequency that gives the best compromise between high noise reduction on the one hand, and loss of audio quality on the other.

A side chain is used to generate the control voltage which raises the cut-off frequency of the v.c.f. at high volume levels. The first stage in the side chain is a high-pass filter. The high frequency "hiss" is masked more readily by high frequency signals than by low or middle frequency signals.

It is therefore necessary to make the unit respond much more readily to treble signals than to bass or middle frequency signals. This avoids having strong bass signals raise the cut-off frequency, producing noticeable increases in the background noise level.

If we did not do this, it would produce some very odd sounds known as "breathing" effects. The highpass filtering makes the unit very insensitive to low frequency input signals, and eliminates the risk of "breathing" effects.

The next stage in the side chain is an amplifier which boosts the signal to an adequate level to drive the subsequent stage correctly. This is a rectifier and smoothing circuit which produces a positive d.c. output voltage that is roughly proportional to the amplitude of the audio input signal.

This voltage is amplified slightly, and then applied to the control input of the v.c.f. Here it provides the required raising and lowering of the cut-off frequency in sympathy with changes in the input level.

CIRCUIT OPERATION

The full circuit diagram for the Dynamic Noise Limiter appears in Fig. 21. IC1 is used as the input buffer stage, and this is a simple operational amplifier voltage follower circuit.

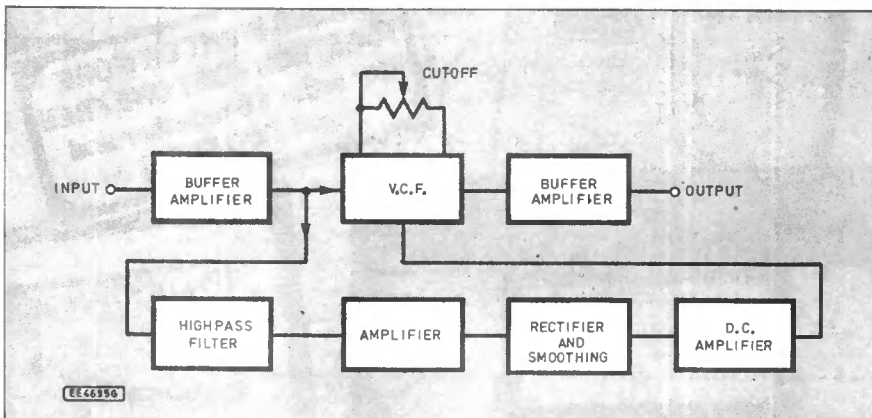


Fig. 20. Block diagram for the Dynamic Noise Limiter (DNL).

A dual transconductance operational amplifier (IC2) is used as the basis of the voltage controlled lowpass filter. The configuration used is actually a form of state variable filter, but in this case it is only the lowpass filtering at the output of IC2b which is utilized. This is a two stage filter giving an attenuation rate of 12dB per octave.

Each section of IC2 has a built-in emitter follower buffer amplifier. Resistors R10 and R16 are the load resistors for these buffer stages.

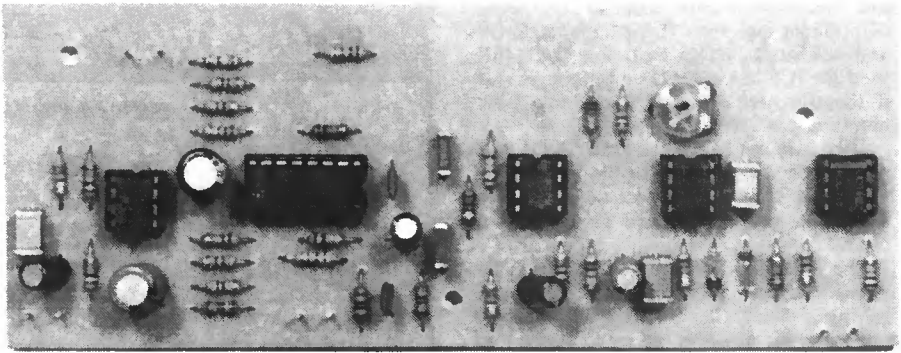
Strictly speaking the filter is current rather than voltage controlled. However, simply adding a resistor (R26) in series with the control input gives a current flow that is roughly proportional to the input voltage, and gives normal voltage control of the filter. Rotary control VR1 provides a variable bias current to the control input of the filter, and the minimum cut-off frequency can therefore be varied by means of VR1.

HIGHPASS FILTER

The highpass filter is a simple second order (12dB per octave) active type based on IC3. It has the cut-off frequency at a little over 2kHz. The output signal from IC3 is amplified by an inverting mode amplifier based on IC4.

Preset potentiometer VR2 enables the closed loop voltage gain of IC4 to be varied from just under three (9dB) at minimum resistance, to a little over 10 (20dB) at maximum resistance. This enables the unit to operate properly with a reasonable range of input levels.

The rectifier circuit is a simple half-wave type based on diodes D1 and D2.



Component layout on the completed Dynamic Noise Limiter p.c.b.

Germanium diodes are used here because they have lower forward voltage drops than silicon types. Resistor R24 and capacitor C13 are the smoothing network. The attack time of the circuit is very short, and although the decay time is much longer it is still quite short.

The decay time has to be something of a compromise. It needs to be short enough to ensure that the unit responds rapidly to changes in the input level, so that short bursts of "hiss" are not produced during very brief pauses in the input signal. On the other hand, it must not be so short that the input signal modulates itself and generates significant amounts of distortion. R24 and C13 have a time constant of approximately 5mS, which gives excellent results.

D.C. AMPLIFIER

The d.c. amplifier stage is built around IC5 and the closed loop voltage gain of this non-inverting amplifier is only two (6dB); its main purpose is to act as a buffer

amplifier. Note that the CA3140E specified for IC5 is an operational amplifier that will work properly as a single supply d.c. amplifier. Most other operational amplifiers need dual balanced supplies for d.c. operation, and will not work properly in the IC5 position of this circuit.

For stereo operation the two channels are normally processed separately. Therefore, if a stereo version of the unit is required it is merely necessary to build two noise limiter boards, one for use in each stereo channel. The current consumption of one Dynamic Noise Limiter circuit is approximately 8mA.

CONSTRUCTION

Details of the Dynamic Noise Limiter printed circuit board component layout and full size copper foil master are provided in Fig. 22. This board is available from the EPE PCB Service, code 919.

On the prototype an LM13600N transconductance op.amp i.c. was used,

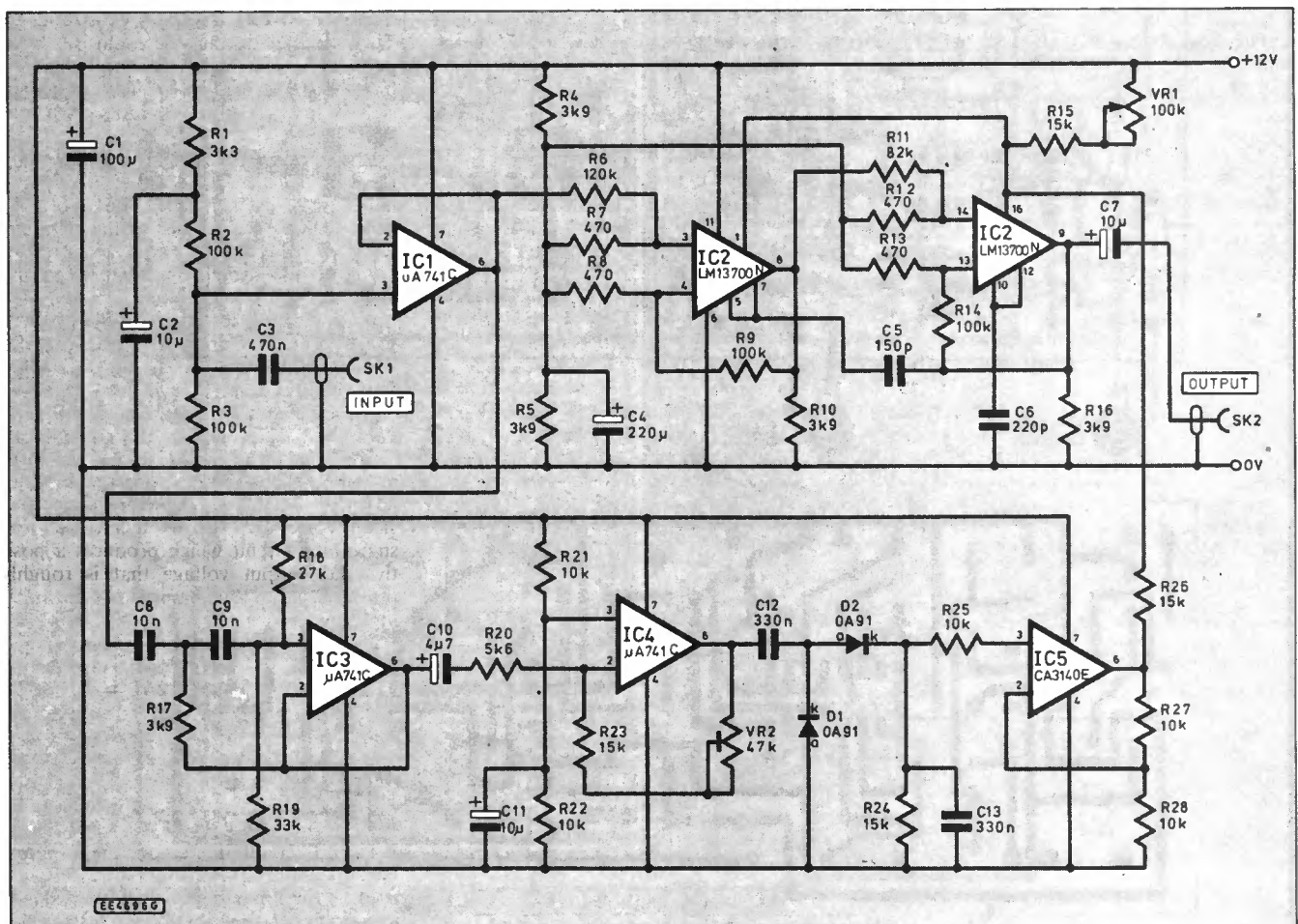


Fig. 21. Complete circuit diagram for the Dynamic Noise Limiter (DNL) module.

but the LM13700N stocked by some component suppliers is virtually identical and will work just as well. The CA3140E used for IC5 has a PMOS input stage, and it therefore requires the usual anti-static handling precautions.

Take care not to overheat diodes D1 and D2 when soldering them to the board. The OA91 is a germanium device which is more vulnerable to heat damage than a silicon diode.

The polyester capacitors should be printed circuit (p.c.b.) mounting types having 7.5mm (0.3 inch) lead spacing. Other types will not fit easily into this component layout.

The hard wiring is also included in Fig. 22, and this is very straightforward. Phono sockets are used for SK1 and SK2 on the prototype, but either or both of these can be changed to a different type if it will fit in better with your equipment.

ADJUSTMENT

When initially testing the unit it should be connected between a suitably "hissy" signal source and an amplifier/speaker so that you can monitor the quality of the output signal. Preset VR2 should be set for minimum resistance (fully clockwise) initially. The front panel potentiometer VR1

COMPONENTS

Approx cost
guidance only

£16

DYNAMIC NOISE LIMITER

Resistors

R1	3k3
R2, R3, R9, R14	100k (4 off)
R4, R5, R10, R16, R17	3k9 (5 off)
R6	120k
R7, R8, R12, R13	470 (4 off)
R11	82k
R15, R23, R24, R26	15k (4 off)
R18	27k
R19	33k
R20	5k6
R21, R22, R25, R27, R28	10k (5 off)
All 0.25W 5% carbon film	

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C3	470n polyester
C4	220µ radial elect. 10V
C5	150p ceramic plate
C6	220p ceramic plate
C8, C9	10n polyester (2 off)
C10	47µ radial elect. 63V
C12, C13	330n polyester (2 off)

Semiconductors

D1, D2	OA91 germanium signal diode (2 off)
IC1, IC3, IC4	µA741C op.amp (3 off)
IC2	LM13700N or LM13600N transconductance op.amp
IC5	CA3140E op.amp

Potentiometers

VR1	100k rotary carbon, log.
VR2	47k min. preset, horizontal

Capacitors

C1	100µ radial elect. 16V
C2, C7, C11	10µ radial elect. 25V (3 off)

Miscellaneous

SK1, SK2 Phono socket (2 off)
Printed circuit board available from the EPE PCB Service, code 919; 8-pin i.c. holder (4 off); 16-pin i.c. holder; control knob; connecting wire; single-sided solder pins; solder etc.

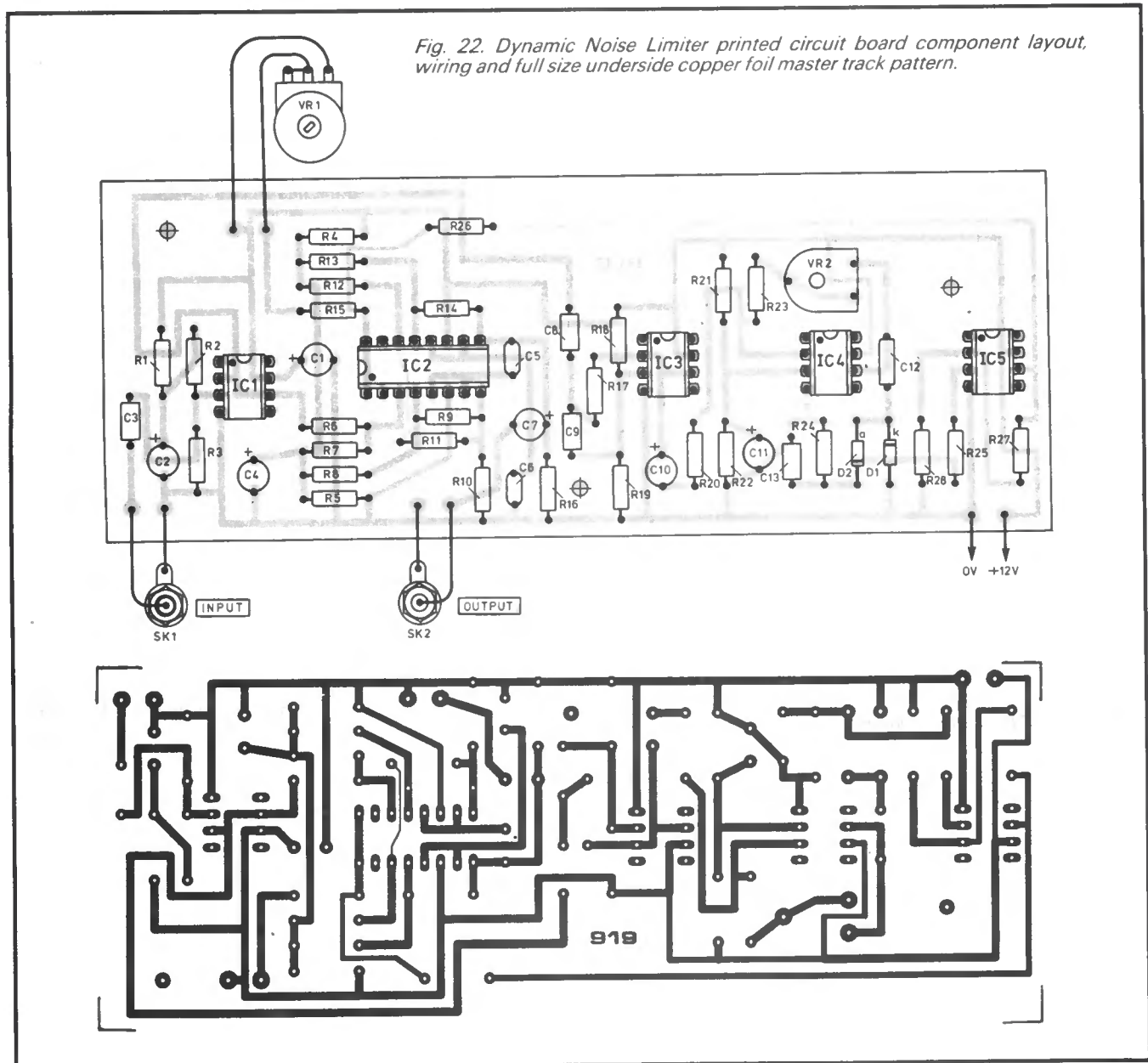


Fig. 22. Dynamic Noise Limiter printed circuit board component layout, wiring and full size underside copper foil master track pattern.

should act rather like a treble tone control, giving considerable control over the background noise level.

The amount of treble cut used is entirely up to the user, but it is probably best to settle for a relatively modest amount if the programme source is mainly music. With other sources a large amount of treble cut might be preferred.

Although one might think that a high degree of treble cut on low level signals would make the action of the dynamic noise limiter fairly obvious, in reality this does not happen. Although human hearing is very good at detecting imperfections in sounds, it seems to be unable to detect the widely varying cut-off frequency of a

dynamic noise limiter. It is therefore quite acceptable to use a large amount of noise reduction provided the loss of treble at low volume levels is deemed acceptable.

With VR2 at minimum resistance it is unlikely that the treble cut will be lifted properly at high volume levels. Adjusting VR2 in a counter-clockwise direction should improve matters, giving a "brighter" sound during the high volume passages.

Using an excessive resistance will result in the treble cut being lifted too readily, giving a lot of "hiss" during quiet passages. The optimum setting for VR2 is the highest resistance that maintains the noise reduction during quiet passages.

IN USE

A Dynamic Noise Limiter is *only* used during final playback. In a video context this means that it will normally be connected between the audio output of the video recorder and the audio input of the television set or monitor. It should *NOT* be used between a camcorder and a video recorder, or at any stage during the editing of a tape.

A dynamic noise limiter is used during final playback since this is where there is the most noise to deal with, and the noise limiter can have the greatest effect. The unit should work with any "hissy" signal source, such as a cassette deck playing old recordings.

MAINS POWER SUPPLY

Power the Video Modules with this simple stabilised 12V d.c. output design.

THESE video and audio processing circuits can be powered from a 12V battery, such as eight HP7 size cells in a plastic holder. This is not a particularly cheap way of powering the circuits though, even if only one or two are constructed. It would be quite an expensive means of powering a Video Controller incorporating several of the modules featured here.

The simple Mains Power Supply circuit of Fig. 23 is a better way of powering the circuits. This provides a well stabilised and smoothed output at currents of up to several hundred milliamps. It can, therefore, supply a full set of these video modules, plus stereo versions of the Dynamic Noise Limiter and Audio Mixer, and still have something in reserve for the possible addition of further circuits at a later date.

The circuit has full-wave rectification of the push-pull variety, with smoothing supplied by capacitor C1. IC1 is a monolithic voltage regulator which provides regulation and electronic smoothing.

The circuit has full-wave rectification of the push-pull variety, with smoothing supplied by capacitor C1. IC1 is a monolithic voltage regulator which provides regulation and electronic smoothing.

Power supply board and mains transformer installed in a Video Controller case and wired to one of the Fader modules.

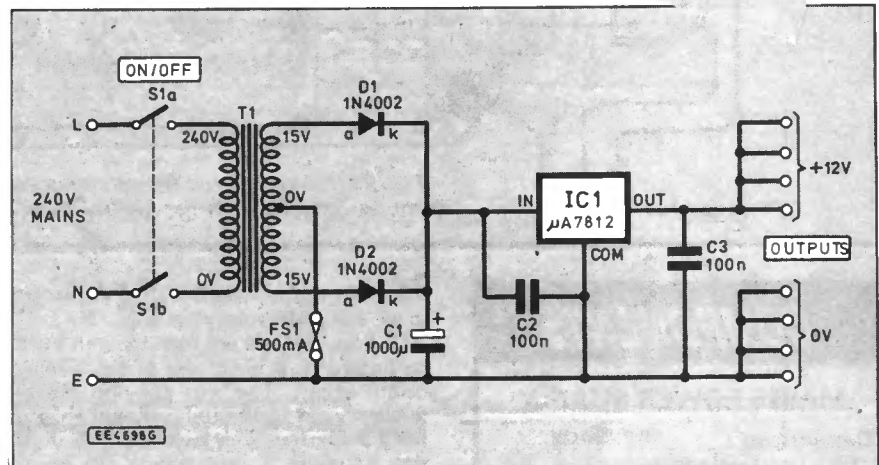
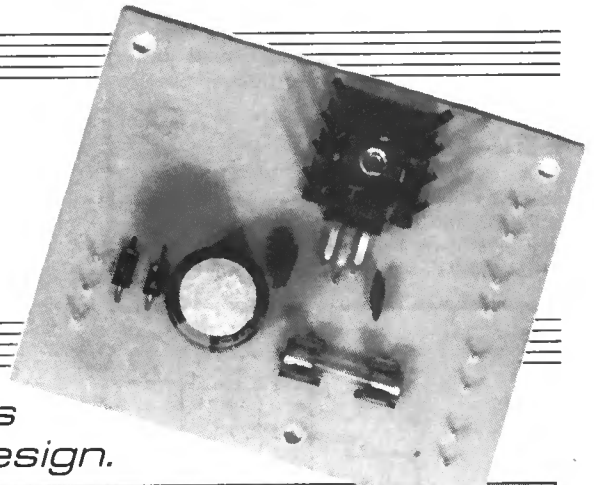
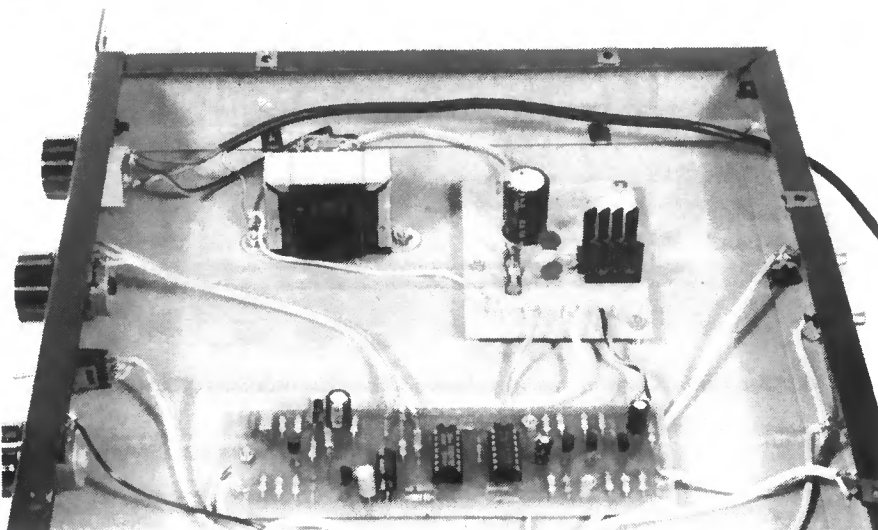


Fig. 23. Suggested Mains Power Supply circuit. It is capable of driving a full set of Video Modules.

None of the modules require a particularly well stabilised supply, but in most cases a well smoothed supply is needed.

The electronic smoothing provided by IC1 is therefore of greater importance than the accurate regulation of the output voltage. C2 and C3 are decoupling capacitors. Their main purpose is to prevent IC1 from becoming unstable.

CONSTRUCTION

Full details of the Mains Power Supply printed circuit board and wiring are provided in Fig. 24. This board is available from the *EPE PCB Service*, code 920.

An anti-surge fuse is used for FS1 and not the more common "quickblow" variety (which would tend to "blow" at switch-on as electrolytic capacitor C1 charged up). FS1 is mounted on the board via a pair of 20 millimetre fuse clips.

The voltage regulator IC1 is bolted to the board using an M3 or 4BA screw and fixing nut. If the supply is only used to power two or three modules it should not be necessary to fit IC1 with a heatsink. If it

is used to power more than three modules it would be advisable to fit IC1 with a small finned heatsink.

Be careful to avoid errors when wiring up the power supply, particularly when dealing with the dangerous mains wiring. *If you are in any doubt about tackling the mains wiring you must seek the advice of a professionally qualified person.*

A solder tag fitted under one of T1's mounting bolts provides an Earthing point on the case, which must be of all-metal construction. It should also be a case which has a screw fitting lid, not a clip-on type. All the normal safety precautions should be observed when dealing with the power supply unit.

There are four pairs of output pins, but there should be no difficulty in connecting each set of pins to two or more modules if the supply is used to power more than four modules. *Make sure that each module is connected to the supply board with the correct polarity.*

FINALLY

The mechanical aspect of construction must be varied to suit the particular modules used, and personal preferences. Probably most users will prefer slider controls for the "Wipe" and "Fade" controls, while

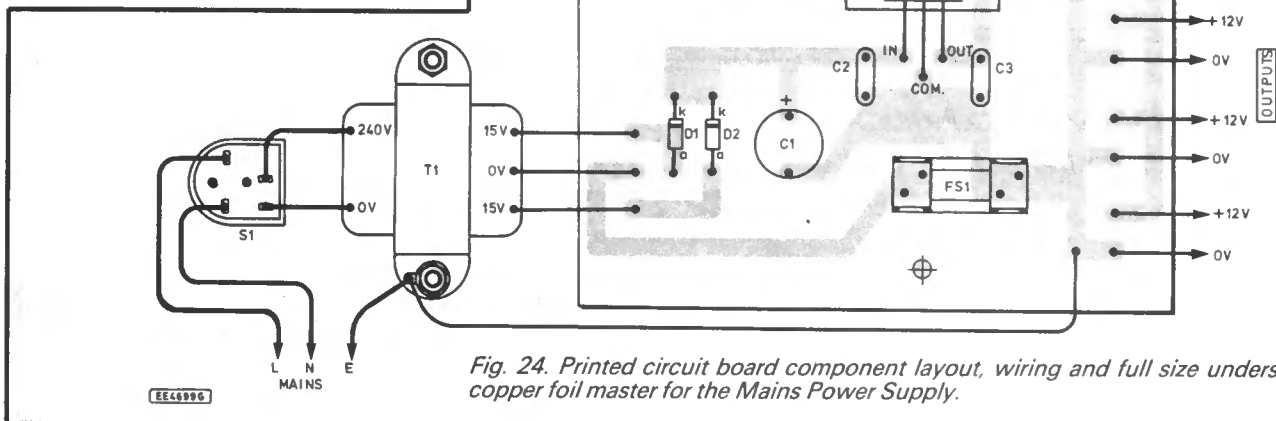


Fig. 24. Printed circuit board component layout, wiring and full size underside copper foil master for the Mains Power Supply.

COMPONENTS

MAINS POWER SUPPLY

Capacitors

- C1 1000 μ radial elect. 25V
C2, C3 100n ceramic (2 off)

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Semiconductors

- D1, D2 1N4002 1A 100V rectifier diode (2 off)
IC1 μ A7812 1A 12V positive voltage regulator

Miscellaneous

- T1 15VA mains transformer: 240V a.c. primary; 15V-0V-15V secondary
S1 rotary double-pole mains switch
FS1 20mm 500mA anti-surge fuse

Printed circuit board available from the EPE PCB Service, code 920; control knob; pair of 20mm fuse clips; small finned heatsink; connecting wire; single-sided solder pins; solder etc.

Approx cost
guidance only

£15

others (myself included) find these difficult to use and prefer rotary controls.

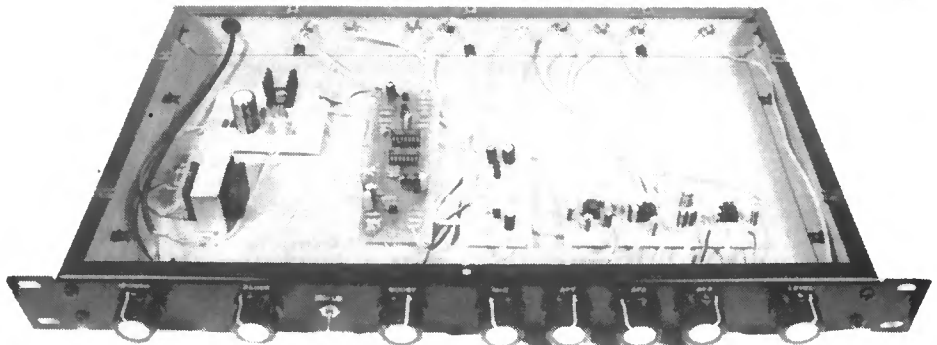
If slider controls are used the unit must be housed in a large case of the sloping front variety. The slits for the potentiometers can be carefully cut and shaped using needle files. This job needs to be done very carefully if neat results are to be produced.

If rotary potentiometers are preferred it will still be necessary to opt for a fairly large case. A typical Video Controller having something like a Fader, a Wiper, and an Audio Mixer will require a large amount of panel space in order to accommodate the controls and sockets. A low-

profile 19 inch rack-mount case is just about ideal, if not particularly cheap – see photographs.

In theory it is possible to wire several of the video boards in series, and then operate any required "Fader", "Wiper", or whatever. In practice this is not a good way of working.

Feeding the video signal through a chain of video boards results in the signal passing through numerous stages, and inevitably degrades the signal to a significant extent. It is better if each unit is "patched-in" only when it is actually going to be used, so that the video signal is only processed by one board at a time. □



A Video Controller unit made up from some of the modules described.

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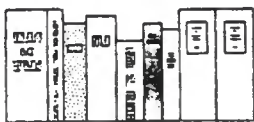
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TROUBLESHOOTING ANALOG CIRCUITS

Author Robert A Pease
Price £14.95 paperback edition 1993 (see note below)
Publisher Newnes-Butterworth ISBN 0 706 1632 6

Most readers of *EPE* will know just how few electronics books are available between the "100 Best Projects for Beginners" variety and the heavyweight mathematical tomes more suited to university-educated professionals. Any publication which helps to fill this gap is therefore most welcome, especially when it contains the wealth of solid practical information contained in this book.

Author Robert Pease is a senior engineer of vast experience with National Semiconductor Corporation, and has been designing i.c.s and circuits and trouble-shooting customers' problems for many years. With so much of his life spent at the "sharp end" of the business, you name the problem and he's seen it, and here he passes on his wealth of knowledge for the rest of us.

There are chapters covering the various kinds of components, both active and passive, in fascinating detail. The advantages and shortcomings of each are clearly explained. Various causes and cures of real problems encountered through design and manufacture are discussed in depth, many of these being surprising and far from obvious. Other chapters include working with test equipment and useful design and testing techniques, often with helpful practical circuits.

With so much information, you might think this book would be "heavy" and loaded with difficult maths. Not so, there is hardly a formula to be seen, and the author's humorous style makes this a book you can even enjoy reading at bedtime! Numerous points are illustrated with photographs, often with amusing captions. "Use a big enough heatsink", he advises beneath one showing a power transistor bolted to a motorcycle cylinder head. "Spice printouts are almost always good for something", suggests another in which he is lining the bottom of a birdcage!

His distrust of computers is illustrated with a picture of him hurling a particularly troublesome one from the third floor of a car park. Incidentally, have you heard about the ultimate solar-powered night-light? Seems it doesn't need a battery, just a 12,000 mile extension lead!

This book is much more than just a guide to trouble-shooting. Fascinating and fun to read, it will prove invaluable to beginners and experts alike and should be in the library of every enthusiast. If you've ever designed or built a circuit that failed to perform as expected and you couldn't see why, the answer is probably here. In the unlikely event that it isn't, you'll still have a most enjoyable read and your understanding of electronics and its problems will undoubtedly be enhanced.

ANDY FLIND

Note: We are advised by the publisher that only the earlier edition at £22.95 (paperback) is now available – ISBN 0 705 6 9499 8 – Ed.

THE CYBERSPACE LEXICON

Author Bob Cotton and Richard Oliver
Price £19.99
Publisher Phaidon Press ISBN 0 7148 2826 2

The new Cyberspace Lexicon just brought out by Phaidon Press is a book for all seasons. The word "lexicon" and its sub-title "An illustration of terms from Multimedia to Virtual Reality" could well indicate yet another drab reference book to sit besides the dictionary on the bookshelf, but the reality is very different.

This is an intensely exciting and stimulating book for anyone remotely interested or involved in today's technology, and a valuable introduction to multimedia for a novice. Excitingly illustrated in striking colours and stylishly written with wit and erudition, it could soon find a place on coffee tables as well as being a valuable addition to the bookshelf of anyone who keeps in touch with the rapid advances in science today.

Just what is Cyberspace? Herbert Marshall McLuhan foresaw it all in 1964:

"Men are suddenly nomadic gatherers of knowledge, nomadic as never before, informed as never before, free from fragmentary specialism as never before – but also involved in the total social process as never before: since with electricity we extend our central nervous system globally, instantly interrelating every human experience."

The book takes us through the "information explosion" that has taken place this century and looks ahead to an even more powerful technological and commercial drive to perfect systems that will bring the means of receiving and transmitting information into every home "and even into every pocket".

Observing that a large proportion of the planet's business is focused on the development of new cyberspace markets, the two authors set out to provide a guide through the maze of these new and emerging technologies.

"As media and telecommunications converge with computing and with consumer electronics to create the cyberspace infrastructure, as concepts collide and catalyse, so the vocabulary needed to deal with this phenomenon becomes polygot, even pidgin." Hence the Lexicon – a key to this new vocabulary and to the new medium of hypermedia and concept of cyberspace.

Arranged conveniently in alphabetical sequence, so that it is easy to refer instantly to anything the reader needs to know, the Lexicon lifts its appeal right out of the dictionary class by adding excellent editorial features on the more interesting technological items in each alphabetical section, backed up by outstanding illustrations in wonderful colours. It gives much space to graphic design technology which has in itself contributed much to the production of this handsome book.

The range of technology covered is impressive; the contents are likely to have as much appeal to the science professor as to the schoolboy hobbyist fascinated by "Cyberpunk" and Nintendo – (the latter neatly sub-titled "Gameboy of the Western World".) The reader can learn all about such things as Anamorphic Projection and Hyperspatial devices, Fractal Compression, Remote Sensing and Multi-spectral scanners, as well as Augmented Reality and Ray Tracing.

Amongst the short features which give the book that "Can't-put-it-down" factor are a description of the Dynabook ("the 25-year-old blueprint of the future") and the Media Lab ("as much a metaphor for the worldwide media situation as it is a particular building in Massachusetts.") We are told this has been called the Bauhaus of the late 20th century because, just as Bauhaus used the new industrial technologies of plastic, steel and electricity, so the Media Lab fuses the new information technologies of AI, silicon chip microprocessors and fibre-optics.

There is a distinctly new slant on Interactive Broadcast TV with its witty sub-heading "Nerd vs Couch Potato", and a fascinating feature on Datagloves and Powergloves – sub-headed "Hands on in Cyberspace" with particularly arresting photographs. Surrogate Travel has another engaging subhead "Around the world in 80 nanoseconds."

Space is found for a feature on "Virtual Sex", a US Government-funded experiment which is described in some detail, although the piece records the fact that funding was withdrawn when the US Government realised the process could threaten the institution of marriage and encourage "virtual promiscuity" on a large scale. Read all about it in the Lexicon.

Photographic enthusiasts will enjoy the striking photographs in "Virtual Reality" and "Music Plus" sections. Keen readers will be interested in Xanadu, an experimental hypermedia/storage management system to provide users with Hypertext links to all the books in the world's libraries and museums "and make you part of a new electronic literature and art, where you can get all your questions answered."

The book's authors conclude with an answer to critics who attack the new "smart" media because it threatens accepted standards of literacy and numeracy, destroys our ability to think, and usurps accepted practices of education. The authors reply that there is no real conflict between the older media and the new.

"In the world of Cyberspace people will still read books printed on paper, listen to music in concert halls, and look at paintings and sculptures in galleries. But they will have a further choice: to become active participators in a worldwide matrix of media and telecommunications, to become "nomadic gatherers of knowledge", or just enjoy the new experiences of the largest entertainment and education machine yet devised."

HAZEL CAVENDISH

EVERYDAY WITH PRACTICAL ELECTRONICS BACK ISSUES

We can supply back issues of *EPE* by post, most issues from the past five years are available. An index for each year is also available – see order form. Alternatively, indexes are published in the December issue for that year. Where we are unable to provide a back issue a photostat of any *one article* (or *one part* of a series) can be purchased for the same price.

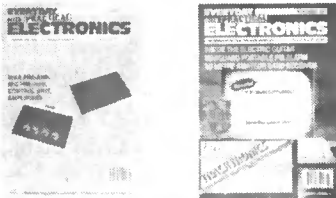
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SEPT. '93

PROJECTS ● Sound Activated Camera Trigger ● Lightwork (trailer light checker) ● Charge – 15 (NiCad charger) ● Amstrad PCW – 8 Channel ADC, Part 2.
FEATURES ● Audio Amplifier Design, Engineering or Alchemy, Part 2 ● Teach-In '93 Part 11 ● Chicago Consumer Show ● Special Review Tracktronics ● Working it Out.

OCT. '93

PROJECTS ● Multi-Purpose Audio System, Part 1 ● Magic Socket ● Linear Power Supply ● Fake Car Alarm ● Kettle Alert ● L.E.D. Sandglass.
FEATURES ● Audio Amplifier Design, Engineering or Alchemy, Part 3 ● Teach-In '93, Part 12 ● Becoming a Radio Amateur.



NOV. '93

PROJECTS ● Portable Miniguard (PIR alarm) ● Tracktronics Projects (Thyristor Latched L.E.D. Display, Night Light, Twin Input Status Indicator) ● 20 Metre Direct Conversion Receiver ● Inside the Electric Guitar ● Multi Purpose Audio System, Part 2.
FEATURES ● Velleman View ● Electronics Principles, Special Software Supplement.

DEC. '93

PROJECTS ● Three-Way Christmas Tree Lights Flasher ● Auto Alarm ● 250W/600W Inverter and Uninterruptable Power Supply, Part 1 ● Multi-Purpose Audio System, Part 3 ● Waterproof Delay Switch.
FEATURES ● Safety First, Part 1 ● Index for Volume 22.

JAN. '94

PROJECTS ● Autolight (automatic nightlight) ● Timer and NiCad Capacity Checker ● 250W/600W Inverter and Uninterruptable Power Supply, Part 2 ● Multi-Purpose Audio System, Part 4 ● Pond Heater Thermostat.
FEATURES ● Safety First, Part 2 ● Calculation Corner, Part 1 ● Electronics Testing and Fault Diagnosis, Course Review.

FEB. '94

PROJECTS ● Whistle Controlled Light Switch ● Reviving the Valve Sound (rebuilding the Quad II power amp) ● Introduction to Microcontrollers – Timeout ● Battery To Mains Inverter and Uninterruptable Power Supply, Part 3 ● Multi-Purpose Audio System, Part 5.
FEATURES ● Calculation Corner, Part 2 ● Safety First, Part 3 ● European International Audio & Video Fair.

MARCH '94

PROJECTS ● Smart-Key Immobiliser ● Audio/R.F. Monitor ● CCD TV Camera, Part 1 ● Visual Doorbell ● Three-Phase Generator.
FEATURES ● Safety First, Part 4 ● Calculation Corner, Part 3 ● Free Wall Chart – Electronics Formulae 1.

APRIL '94

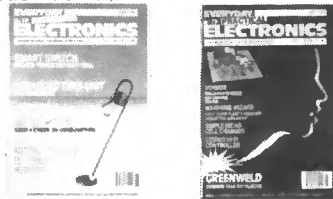
PROJECTS ● MOSFET Variable Bench Power Supply ● *EPE* Soundac (PC sound output board) ● CCD TV Camera, Part 2/Frame Grab ● Impulse Clock Master Unit ● Telephone Ring Detector.
FEATURES ● Best of British, Part 1 ● Calculation Corner, Part 4 ● Electronics Workbench Review ● Free Wall Chart – Electronics Formulae 2.

MAY '94

PROJECTS ● Simple TENS Unit (transcutaneous pain relief) ● Capacitance/Inductance Meter ● L.E.D. Matrix Message Display, Part 1 ● Stereo Noise Gate ● Dual Stepping Motor Driver for PCs.
FEATURES ● Calculation Corner, Part 5 ● Best of British, Part 2.

JUNE '94

PROJECTS ● Microcontroller P.I. Treasure Hunter ● Digital Water Meter ● Microprocessor Smart Switch ● Advanced TENS Unit (transcutaneous pain relief) ● L.E.D. Matrix Message Display, Part 2.
FEATURES ● Best of British, Part 3 ● Calculation Corner, Part 6



JULY '94

PROJECTS ● Voxbox Voice Recording Board ● Simple NiCad Charger ● Watering Wizard (automatic garden watering) ● Pocket Print Timer ● Stereo HiFi Controller, Part 1.
FEATURES ● Best of British, Part 4 ● Calculation Corner, Part 7.

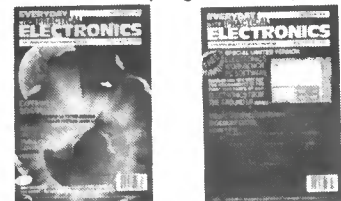
AUG. '94

PROJECTS ● Experimental Noise Cancelling Unit ● Dancing Fountains, Part 1

● Charged-Up (PC battery tip) ● 6802 Development Board ● TV Camera Update ● Stereo HiFi Controller, Part 2.
FEATURES ● Calculation Corner, Part 8 ● Best of British, Part 5 ● I'll Be Seeing You (multimedia communications)

SEPT. '94

PROJECTS ● Protector Plus Car Alarm ● Greenhouse Watering System ● Experimental Seismograph, Part 1 ● Three-Channel Lamp Controller ● Dancing Fountains, Part 2.
FEATURES ● Calculation Corner, Part 9 ● The Invisible Force (magnetic force).



OCT. '94

PROJECTS ● Digilogue Clock ● Visual/Audio Guitar Tuner ● Hobby Power Supply ● Audio Auxilexer ● Experimental Seismograph, Part 2.
FEATURES ● Electronics from the Ground Up, Part 1 with Free PC Software ● Calculation Corner, Part 10.

NOV. '94

PROJECTS ● 1000V/500V Insulation Tester ● Video Modules, Part 1 (Simple Fader, Improved Fader, Video Enhancer) ● Active Guitar Tone Control ● Power Controller ● TV Off-er.
FEATURES ● Electronics from the Ground Up, Part 2 ● Consumer Electronics Show.

DEC. '94

PROJECTS ● Spacewriter Wand ● *EPE* Fruit Machine ● Universal Digital Code Lock ● Video Modules, Part 2 (Horizontal Wiper, Vertical Wiper, Audio Mixer) ● Rodent Repeller.
FEATURES ● Electronics from the Ground Up, Part 2 ● Embedded Controllers ● Index for Volume 23.

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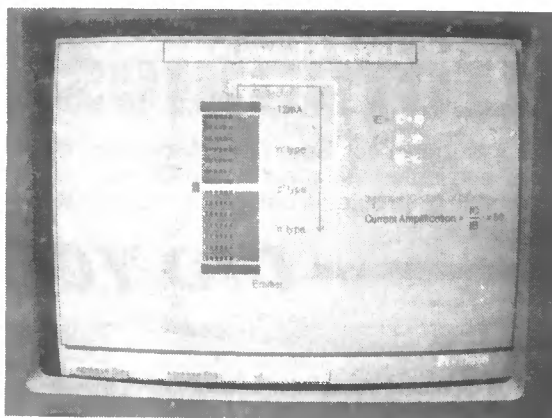
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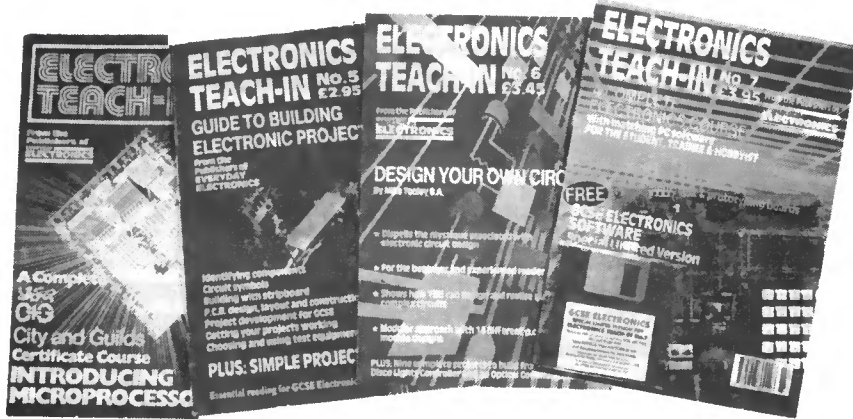
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TESTING, THEORY AND REFERENCE

PRACTICAL ELECTRONICS HANDBOOK - Third Edition
Ian Sinclair

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R. A. Penfold

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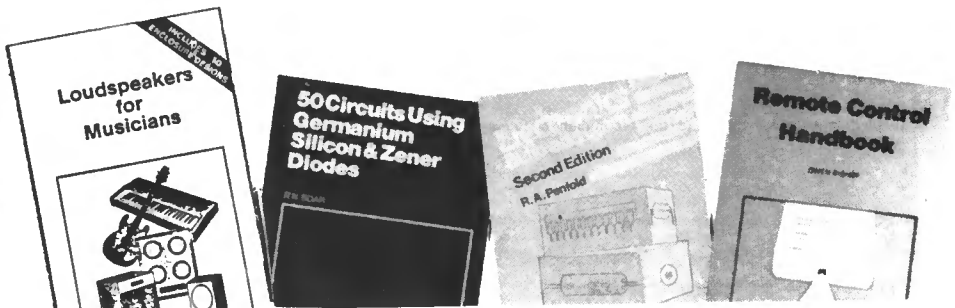
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DATA

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Owen Bishop

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PCB SERVICE

Printed circuit boards for certain EPE 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 with Practical Electronics, Allen House, East Borough, Wimborne, Dorset BH21 1PF.** Cheques should be crossed and made payable to *Everyday with Practical 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.

Back numbers or photostats of articles are available if required - see the **Back Numbers** page for details.

Please check price and availability in the latest issue.

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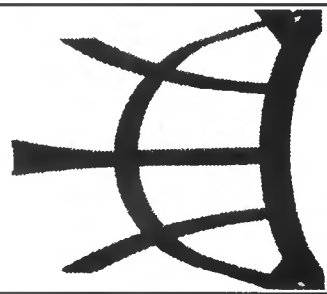
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REPORTING

AMATEUR RADIO



Tony Smith G4FAI

EPE ON ATV

Jim Atherfold, G0FZB, recently asked if he could read and transmit items from this column, and other parts of *EPE*, on Amateur Television (ATV) in the Brighton to Chichester area. After consulting the Editor, I gave Jim the go-ahead and at the same time asked him for more information about his activities.

He replied: "Amateur television is an extension of amateur radio so that as well as talking to each other we can also see each other. We can show each other our constructional projects as well as discuss them.

"To do this, we use another radio frequency as a talkback channel. It is usual for one operator to have his camera, with microphone working, showing himself or his video pictures on 1318MHz while the talkback would be on the 2-metres or 70cms bands; i.e., 144-750MHz or 432-750MHz in my area.

"The Worthing & District Video Repeater Group have built and successfully run GB3VR, a Television Repeater on the Brighton Race Hill, for many years.

"Some very interesting pictures can be seen of radio amateurs operating club stations, or their own stations; Scouts during Jamboree-on-the-Air; Guides and Brownies during Thinking Day. Computer designed callsigns and graphics to rival the BBC are popular.

"One station has been redirecting pictures from French amateurs. He also transmitted, direct from Bognor Pier last summer, pictures of the Birdmen's annual flying attempts while I did the talkback on 70cms.

"ATV can be watched using a satellite TV receiver costing about £20 to £40 at amateur rallies, providing it will tune to 1318 + 6 MHz for the sound, while an antenna can easily be made from a BBC yagi."

The national organisation for this branch of amateur radio is the British Amateur Television Club. For those interested in taking up ATV, they have a new publication, *An Introduction to Amateur TV* which can be obtained from Ian Pawson G81QU, 14 Lilac Avenue, Leicester LE5 1FN, price £5.00 including postage (cheques payable to BATC). He will send details of the club at the same time. Tell him you read about BATC in *EPE*!

ISWL NEW PUBLICATIONS

The International Short Wave League has published a useful booklet containing all amateur radio callsign prefixes worldwide, listed alphabetically by country and alpha-numerically by prefix.

It contains two separate listings in this format. The first is the official DXCC list, showing all countries with which contacts qualify for the prestigious DX Century Club Awards administered by the

American Radio Relay League (ARRL). Many awards issued by other organisations are also based on this list.

The second is intended for those who participate in the monthly ISWL contests. This expands on the DXCC list and includes the call areas of countries such as Australia, Canada, and the USA, plus many islands and other locations.

While this publication will be particularly useful for DXers and contest participants, it will also be helpful for other licensed amateurs or short wave listeners, enabling them to identify the country of origin (and sometimes the particular part of that country) where an amateur station worked or heard is located.

The price of the booklet is £2.50 or four IRCs (International Reply Coupons), post paid. Postage stamps are also acceptable. It can be obtained from the International Short Wave League (Ref: *EPE*), 10 Clyde Crescent, Wharton, Winsford, Cheshire CW7 3LA.

Also available from the same address is the "Guide to English Language Short Wave Broadcasts to Europe (Winter Schedules 1994)". This twice-yearly publication is invaluable in finding a choice of English language short wave transmissions at any time of day and night and costs only £1.50 or three IRCs.

NOVICE ROUTE TO SUCCESS

The Young Amateur of the Year, 1994, is 17-year old Robert Aley G7SRR, from March, Cambridgeshire. The runner-up is 16-year old Stephen Conner GM0TET, from Glasgow, and both started in amateur radio by obtaining Novice licences.

There are now over 1,000 registered Novice Licence Instructors in the UK. Anyone interested in entering amateur radio through the Novice scheme should contact the RSGB, Lambda House, Cranborne Road, Potters Bar, Herts EN6 3JE, for further information, including details of their nearest voluntary instructor.

Unlike the full licence, there is no minimum age for Novices, and the only drawback, until recently, has been that a keen youngster under 14 holding a Novice licence was unable to progress to a full licence until he or she became 14.

The Radiocommunications Agency, however, has just announced a change in the rules. With immediate effect, Novices between the ages of 10 and 14 who have held their licences (Novice A or Novice B) for at least one year may now obtain full amateur licences, Class A or Class B (after passing the appropriate examinations), without having to wait until they are 14 to receive their licences.

HAPPY BIRTHDAY G-QRP!

The G-QRP Club celebrated its 20th birthday recently. QRP is defined as low

power operating using not more than five watts input or ten watts output, while many enthusiasts achieve worldwide contacts with considerably less power, sometimes milliwatts!

George Dobbs, G3RJV, Secretary and Founder, says in the Autumn 1994 issue of the club's journal *SPRAT*, "We began as a small minority group in amateur radio and have grown to be a respected voice for the true nature of the hobby".

If you like constructing radio equipment, the club has a lot to offer. *SPRAT* is full of projects, and includes many useful tips and ideas for constructors.

The current membership fee (for SWLs as well as licensed amateurs) is £6.00 a year. For more information, including a sample copy of *SPRAT*, send a first class stamp to The Rev. George Dobbs, G3RJV, St. Aidan's Vicarage, 498 Manchester Road, Rochdale OL1 3HE. Tell him you read about the club in this column. I'm a member myself and like to keep in with the guvnor!

RARE

Radio Amateur Relief Expeditions is an organisation dedicated to using skills learnt through amateur radio for overseas relief work. Their Hon. Sec., Don Sunderland, G6FHM, tells me that in the last year they have provided teams for Summer Camps for children learning English in Romania, giving them an opportunity to learn about amateur radio and to communicate with people in other countries.

Teams have also been in Turnu Severin in the Mehedinti region of Romania, delivering aid to the county hospital which RARE has pledged to support. They also surveyed an Ear, Nose and Throat Hospital which has not yet received any aid, and which they hope to help in some way. Another team went to an orphanage to deal with an infestation of mosquitoes.

Future plans include the installation of radio communications in ambulances in Romania. Don says, "We are still a young organisation and are progressing slowly but steadily. Training, development and fund raising are important issues under discussion for the future. We welcome publicity to make our organisation more widely known to both potential members and User Organisations."

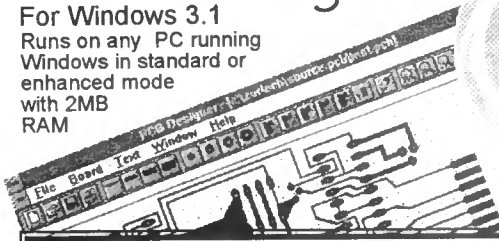
RARE became a registered charity last May and it is looking for more members to enable it to expand its activities. They also need funds to further their aim to provide communications and aid in disaster and emergency situations overseas.

If you are interested in their work, or would like to send a donation, write to Don Sunderland G6FHM, 1 Allfield Cottages, Condover, Shrewsbury, SY5 7AP, mentioning that you read about RARE in *EPE*.

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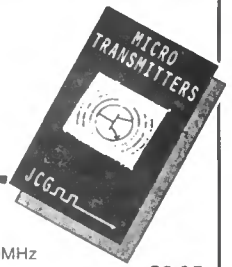
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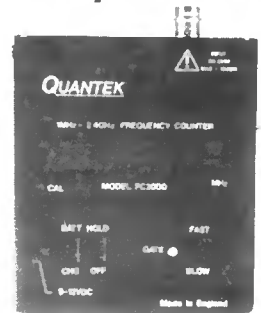
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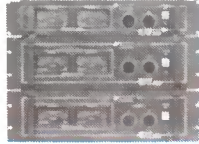
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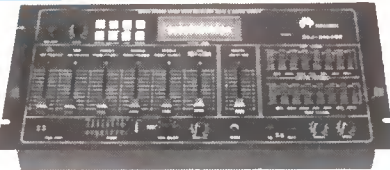


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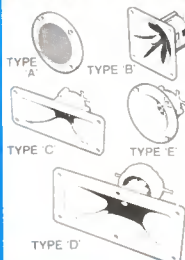


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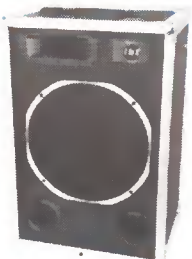
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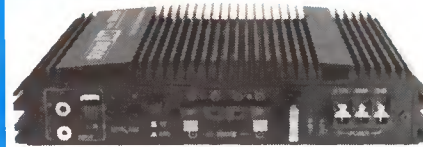
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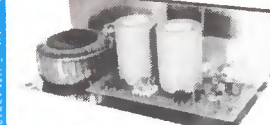
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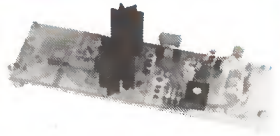


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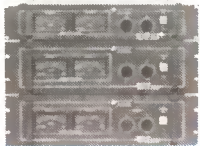
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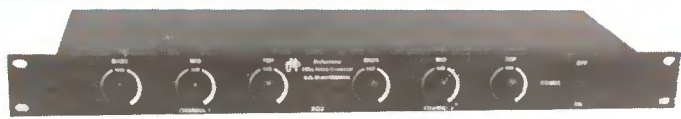
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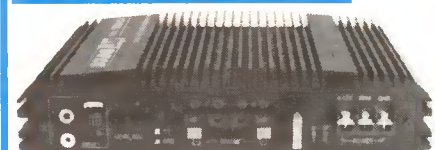
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These modules now enjoy a world-wide reputation for quality, reliability and performance at a realistic price. Four models are available to suit the needs of the professional and hobby market i.e. Industry, Leisure, Instrumental and Hi-Fi etc. When comparing prices, NOTE that all models include toroidal power supply, integral heat sink, glass fibre P.C.B. and drive circuits to power a compatible Vu meter. All models are open and short circuit proof.

THOUSANDS OF MODULES PURCHASED BY PROFESSIONAL USERS



OMP/MF 100 Mos-Fet Output power 110 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 45V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 123 x 60mm.
PRICE £40.85 + £3.50 P&P



OMP/MF 200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 50V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 155 x 100mm.
PRICE £64.35 + £4.00 P&P



OMP/MF 300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 330 x 175 x 100mm.
PRICE £81.75 + £5.00 P&P



OMP/MF 450 Mos-Fet Output power 450 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 385 x 210 x 105mm.
PRICE £132.85 + £5.00 P&P



OMP/MF 1000 Mos-Fet Output power 1000 watts R.M.S. into 2 ohms, 725 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 422 x 300 x 125mm.
PRICE £259.00 + £12.00 P&P

NOTE: MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS: STANDARD - INPUT SENS 500mV, BAND WIDTH 100KHz. PEC (PROFESSIONAL EQUIPMENT COMPATIBLE) - INPUT SENS 775mV, BAND WIDTH 50KHz. ORDER STANDARD OR PEC.

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- 8" 100 WATT R.M.S. ME8-100 GEN. PURPOSE, LEAD GUITAR, EXCELLENT MID, DISCO. RES. FREQ. 72Hz. FREQ. RESP. TO 4KHz, SENS 97dB. **PRICE £32.71 + £2.00 P&P**
- 10" 100 WATT R.M.S. ME10-100 GUITAR, VOCAL, KEYBOARD, DISCO, EXCELLENT MID. RES. FREQ. 71Hz. FREQ. RESP. TO 7KHz, SENS 97dB. **PRICE £33.74 + £2.50 P&P**
- 10" 200 WATT R.M.S. ME10-200 GUITAR, KEYB'D. DISCO, VOCAL, EXCELLENT HIGH POWER MID. RES. FREQ. 65Hz. FREQ. RESP. TO 3.5KHz, SENS 99dB. **PRICE £43.47 + £2.50 P&P**
- 12" 100 WATT R.M.S. ME12-100LE GEN. PURPOSE, LEAD GUITAR, DISCO, STAGE MONITOR. RES. FREQ. 49Hz. FREQ. RESP. TO 6KHz, SENS 100dB. **PRICE £35.64 + £3.50 P&P**
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- 12" 200 WATT R.M.S. ME12-200 GEN. PURPOSE, GUITAR, DISCO, VOCAL, EXCELLENT MID. RES. FREQ. 58Hz. FREQ. RESP. TO 6KHz, SENS 98dB. **PRICE £46.71 + £3.50 P&P**
- 12" 300 WATT R.M.S. ME12-300GP HIGH POWER BASS, LEAD GUITAR, KEYBOARD, DISCO ETC. RES. FREQ. 47Hz. FREQ. RESP. TO 5KHz, SENS 103dB. **PRICE £70.19 + £3.50 P&P**
- 15" 200 WATT R.M.S. ME15-200 GEN. PURPOSE BASS, INCLUDING BASS GUITAR. RES. FREQ. 46Hz. FREQ. RESP. TO 5KHz, SENS 99dB. **PRICE £50.72 + £4.00 P&P**
- 15" 300 WATT R.M.S. ME15-300 HIGH POWER BASS, INCLUDING BASS GUITAR. RES. FREQ. 39Hz. FREQ. RESP. TO 3KHz, SENS 103dB. **PRICE £73.34 + £4.00 P&P**

EARBENDERS:- HI-FI, STUDIO, IN-CAR, ETC

- ALL EARBENDER UNITS 8 OHMS (Except EB8-50 & EB10-50 which are dual impedance tapped @ 4 & 8 ohm)**
- BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED SURROUND**
- 8" 50watt EB8-50 DUAL IMPEDANCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR. RES. FREQ. 40Hz. FREQ. RESP. TO 7KHz SENS 97dB. **PRICE £8.90 + £2.00 P&P**
- 10" 50watt EB10-50 DUAL IMPEDANCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR. RES. FREQ. 40Hz. FREQ. RESP. TO 5KHz, SENS 99dB. **PRICE £13.65 + £2.50 P&P**
- 10" 100watt EB10-100 BASS, HI-FI, STUDIO. RES. FREQ. 35Hz. FREQ. RESP. TO 3KHz, SENS 96dB. **PRICE £30.39 + £3.50 P&P**
- 12" 100watt EB12-100 BASS, STUDIO, HI-FI, EXCELLENT DISCO. RES. FREQ. 26Hz. FREQ. RESP. TO 3KHz, SENS 93dB. **PRICE £42.12 + £3.50 P&P**
- FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND**
- 5 1/2" 60watt EB5-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 63Hz. FREQ. RESP. TO 20KHz, SENS 92dB. **PRICE £9.99 + £1.50 P&P**
- 6 1/2" 60watt EB6-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 38Hz. FREQ. RESP. TO 20KHz, SENS 94dB. **PRICE £10.99 + 1.50 P&P**
- 8" 60watt EB8-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 40Hz. FREQ. RESP. TO 18KHz, SENS 99dB. **PRICE £12.99 + £1.50 P&P**
- 10" 60watt EB10-60TC (TWIN CONE) HI-FI, MULTI ARRAY DISCO ETC. RES. FREQ. 35Hz. FREQ. RESP. TO 12KHz, SENS 98dB. **PRICE £16.49 + £2.00 P&P**

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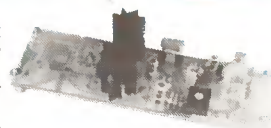


PHOTO: 3W FM TRANSMITTER

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