THE No.1 MAGAZINE FOR ELECTRONICS TECHNOLOGY & COMPUTER PROJECTS

EVERYDAY

JULY 2001

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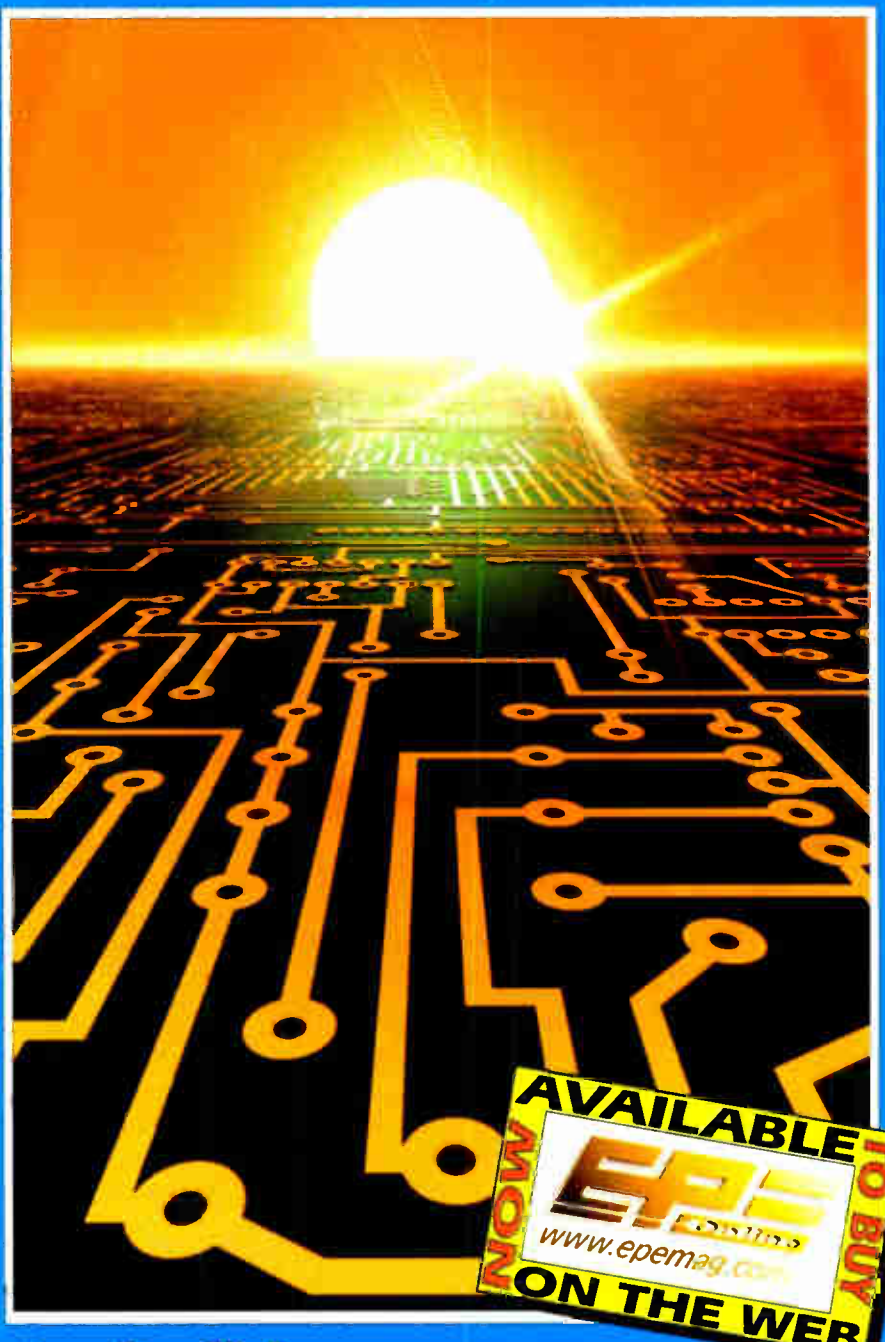

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PIR OPERATED WATER VALVES. These brand new units consist of a control box with integral PIR and a water valve fitted with 15mm compression fittings. The valve is 6V d.c. operation and latches, e.g. 6V pulse will open it, 6V negative pulse will release it. Originally made to control urinals (flush when someone comes in) they have many other uses in cat scarers, automatic watering systems etc. They have built-in adjustable time delays and settings and run quite happily for months on just a 9V battery. The valve alone could have many uses in garden features, solar systems, etc. Current retail price for the complete unit is £120, we can offer them at just £19.95 while stocks last! Ref PIRVAL2.

PIR SECURITY SWITCHES. These brand new swivel mounting PIR units will switch up to 2 kilowatts. Adjustable sensitivity, light level and time delay (9 seconds to 10 minutes), 15m detection range, mains operated, waterproof. £5.95. Ref PIR1PACK or a pack of 5 for £22 Ref PIR5PACK or 10 for £39.95 Ref PIR10PACK

12V 18Ah SEALED LEAD ACID BATTERIES, new and boxed, unused, pack of 4 £44.95, Ref CYC7 or £15.95 each, Ref CYC6.

12V 6·5Ah SEALED LEAD ACID BATTERIES, new and boxed, pack of 5 £34.95, Ref CYC65A, or individually at £8.99, Ref CYC65B.

A new range of 12V to 240V INVERTERS

IV400S (400 watt) £89

IV800S (800 watt) £159

IV1200S (1200 watt) £219

SODIUM LAMP SYSTEMS, £75.70. Complete system with 250W or 400W SON-T Agro bulb, reflector with bulb holder and remote ballast and starter (uncased), all you need is wire. 250W system Ref SLS1, 400W system SLS2.

HYDROPONICS – DO YOU GROW YOUR OWN? Check our web site at **www.bullnet.co.uk**.

PC COMBINED UPS AND PSU. The unit has a total power of 292 watts, standard motherboard connectors and 12 peripheral power leads for drives etc. Inside are three 12V 7·2aH sealed lead acid batteries. Backup time is 8 mins at full load or 30 mins at half load. Made in the UK by Magnum, 110V or 240V a.c. input. +5V at 35A, –5V at 0·5A, +12V at 9A, –12V at 0·5A outputs. 170mm x 260mm x 220mm, new and boxed. £29.95. Ref PCUPS2.

ALTERNATIVE ENERGY CD, PACKED WITH HUNDREDS OF ALTERNATIVE ENERGY RELATED ARTICLES, PLANS AND INFORMATION ETC. £14.50. Ref CD56.

AERIAL PHOTOGRAPHY KIT. This rocket comes with a built-in camera, it flies up to 500 feet (150m), turns over, and takes an aerial photograph of the ground below. The rocket then returns, with its film, via its parachute. Takes 110 film. Supplied complete with everything, including a launch pad and three motors (no film). £29.98. Ref ASTRO.

3HP MAINS MOTORS. Single-phase 240V, brand new, 2-pole, 340mm x 180mm, 2,850 rpm, built-in automatic reset overload protector, keyed shaft (40mm x 16mm). Made by Leeson. £99 each. Ref LEE1.

BUILD YOUR OWN WINDFARM FROM SCRAP. New publication gives step-by-step guide to building wind generators and propellors. Armed with this publication and a good local scrapyard could make you self-sufficient in electricity! £12. Ref LOT81.

MAGNETIC CREDIT CARD READERS AND ENCODING MANUAL, £9.95. Cased with flyleads, designed to read standard credit cards! Complete with control electronics p.c.b. and manual covering everything you could want to know about what's hidden in that magnetic strip on your card! Just £9.95. Ref BAR31.

SOLAR POWER LAB SPECIAL. 2in. x 6in. x 6in., 6V 130mA cells, 4 l.e.d.s, wire, buzzer, switch plus relay or motor. £7.99. Ref SA27.

SOLAR NICAD CHARGERS. 4 x AA-size, £9.99. Ref 6P476. 2 x C-size, £9.99. Ref 6P477.

LOCKPICKS. We sell a full range of lockpicks and lockpicking books on our website: **www.lockpicks.co.uk**.

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Hydrogen fuel cells. Our new Hydrogen fuel cells are 1V at up to 1A output. Hydrogen input, easily driven from a small electrolosis assembly or from a hydrogen source, our demo model uses a solar panel with the output leads in a glass of salt water to produce the hydrogen! Each cell is designed to be completely taken apart, put back together and expanded to whatever capacity you like (up to 10 watts and 12V per assembly). Cells cost £49. Ref HFC11.

PHILIPS VP406 LASER DISC PLAYERS, SALE PRICE JUST £9.95. SCART OUTPUT, JUST PUT YOUR VIDEO DISK IN AND PRESS PLAY. STANDARD AUDIO AND VIDEO OUTPUTS. £9.95. REF VP406.

SMOKE ALARMS. Mains powered, made by the famous Gent company, easy fit next to light fittings, power point. Pack of 5 £15, Ref SS23. Pack of 12 £24. Ref SS24.

SENDER KIT. Contains all components to build a A/V transmitter complete with case. £35. Ref VSXX2.

CCTV CAMERAS FROM £22. Check out our web site at **www.cctvstuff.co.uk**.

MAMOD STEAM ENGINES AND A FULL RANGE OF SPARE PARTS.
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14 WATT SOLAR PANEL. Amorphous silicon panel fitted in an anodised aluminium frame. Panel measures 3ft. by 1ft. with screw terminals for easy connection. 3ft. x 1ft. solar panel £69. Ref MAG45. Unframed 4 pack (3ft. x 1ft.) £69. Ref SOLX.

12V SOLAR POWERED WATER PUMP. Perfect for many 12V d.c. uses, from solar fountains to hydroponics! Small and compact, yet powerful, works direct from our 10 watt solar panel in bright sun. Max hd: 17ft., max flow = 8l.p.m., 1·5A. Ref AC8. £18.99

SOLAR MOTORS. Tiny motors which run quite happily on voltages from 3V-12V d.c. Works on our 6V amorphous 6in. panels, and you can run them from the sun! 32mm dia., 20mm thick. £1.50 each.

WALKIE TALKIES. 1 MILE RANGE. £37/PAIR. REF MAG30.

LIQUID CRYSTAL DISPLAY. Bargain prices. 40-character 1-line 154mm x 16mm. £6.00. Ref SMC4011A.

YOUR HOME COULD BE SELF-SUFFICIENT IN ELECTRICITY. comprehensive plans with loads of info on designing systems, panels, control electronics, etc. £7. Ref PV1.

SOLAR POWER LAB SPECIAL. 2in. x 6in. x 6in., 6V 130mA cells, 4 l.e.d.s, wire, buzzer, switch plus relay or motor. £7.99. Ref SA27.

SOLAR NICAD CHARGERS. 4 x AA-size, £9.99. Ref 6P476. 2 x C-size, £9.99. Ref 6P477.

MINIATURE TOGGLE SWITCHES. These top quality Japanese panel mounting toggle switches measure 35mm x 13mm x 12mm, are 2-pole changeover and will switch 1A at 250V a.c., or 3A at 125V a.c. Complete with mounting washers and nuts. Supplied as a box of 100.

BRAND NEW NATO ISSUE RADIATION DETECTORS, SALE PRICE JUST £39.95. Current NATO issue standard emergency services unit used by most of the world's military personnel. New and boxed. Normal retail price £400. BULL'S bargain price just £99. The PDRM 82M is a portable, lightweight, water resistant gamma radiation survey meter to measure radiological dose rate in the range 0·1 to 300 centigrays per hour in air. The Geiger muller (G.M.) tube detecting unit is energy and polar response corrected. The radiation level is displayed on a Liquid Crystal Display. The microcomputer corrects for the non-linearity of the G.M. tube response. The instrument is powered by three international C-size batteries giving typically 400 hours operation in normal conditions. The dose rate meter PDRM 82M, designed and selected for the United Kingdom Government, has been fully evaluated to satisfy a wide range of environmental conditions and is nuclear hard. The construction enables the instrument to be easily decontaminated. The instrument is designed for radiation surveys for post incident monitoring. Used in a mobile role, either carried by troops or in military vehicles for rapid deployment enabling radiation hot spots to be quickly located. Range 0-300 cGy/h in 0·1 cGylh increments. Over-range to 1500 cGh/h – indicates flashing 300. Accuracy f20% of the true dose rate +1 cGylh, 0-100 cGy/h. f30% of true dose rate, 100-300 cGy/h. Energy Response 0·3 MeV to 3 MeV – within f20% (Ra 226). 80 KeV to 300 KeV – within i40% (Ra 226). Detector Energy compensated Halogen quenched Geiger Muller Tube. Controls combined battery access and ON/OFF switch. Batteries 3 international standard C cells. Weight 560 grams. Operating temperature range 30 deg. C to +60 deg. C. Indications high contrast 4 digit l.c.d. £39. Ref PDRM.

BASIC GUIDE TO BIO DIESEL. HOW TO MAKE DIESEL FUEL FROM USED KITCHEN OIL, £6. REF BIOF.

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30 WATTS OF SOLAR POWER for just £69, 4 panels, each one 3ft. x 1ft. and producing 8W, 13V. Pack of four £69. Ref SOLX.

200 WATT INVERTERS, plugs straight into your car cigarette lighter socket and is fitted with a 13A socket so you can run your mains-operated devices from your car battery. £49.95. Ref SS66.

THE TRUTH MACHINE. Tells if someone is lying by micro tremors in their voice, battery operated, works in general conversation and on the phone and TV as well! £42. Ref TF3.

INFRA-RED FILM. 6in. square piece of flexible infra-red film that will only allow IR light through. Perfect for converting ordinary torches, lights, headlights etc. to infra-red output only using standard light bulbs. Easily cut to shape. £15. Ref IRF2.

33 KILO LIFT MAGNET. Neodynium, 32mm diameter with a fixing bolt on the back for easy mounting. Each magnet will lift 33 kilos, 4 magnets bolted to a plate will lift an incredible 132 kilos! £15. Ref MAG33. Pack of 4 just £39. Ref MAG33AA.

77 KILO LIFT MAGNET. These Samarium magnets measure 57mm x 20mm and have a threaded hole (5/16th UNF) in the centre and a magnetic strength of 2·2 gauss. We have tested these on a steel beam running through the offices and found that they will take more than 170lb (77kg) in weight before being pulled off. Supplied with keeper. £19.95 each. Ref MAG77.

HYDROGEN FUEL CELL PLANS. Loads of information on hydrogen storage and production. Practical plans to build a hydrogen fuel cell (good workshop facilities required). £8 set. Ref FCP1.

STIRLING ENGINE PLANS. Interesting information pack covering all aspects of Stirling engines, pictures of home made engines made from an aerosol can running on a candle! £12. Ref STIR2.

ENERGY SAVER PLUGS. Saves up to 15% electricity when used with fridges, motors up to 2A, light bulbs, soldering irons etc. £9 each. Ref LOT71. 10 pack. £69. Ref LOT72.

12V OPERATED SMOKE BOMBS. Type 3 is a 12V trigger and three smoke cannisters, each cannister will fill a room in a very short space of time! £14.99. Ref SB3. Type 2 is 20 smaller cannisters (suitable for mock equipment fires etc.) and one trigger module for £29. Ref SB2. Type 1 is a 12V trigger and 20 large cannisters. £49. Ref SB1.

HI POWER ZENON VARIABLE STROBES. Useful 12V p.c.b. fitted with hi power strobe tube and control electronics and speed control potentiometer. Perfect for interesting projects etc. 70mm x 55mm 12V d.c. operation. £6 each. Ref FLS1. Pack of 10 £49. Ref FLS2.

HOW TO PRODUCE 35 BOTTLES OF WHISKY FROM A SACK OF POTATOES. Comprehensive 270 page book covers all aspects of spirit production from everyday materials. Includes construction details of simple stills £12. Ref MS3.

NEW HIGH POWER MINI BUG. With a range of up to 800 metres and 3 days use from a PP3 battery this is our top selling bug! Less than 1in. square and a 10m voice pick-up range. £28. Ref LOT102.

IR LAMP KIT. Suitable for CCTV cameras, enables the camera to be used in total darkness! £6. Ref EF138.

INFRA-RED POWER BEAM. Handheld battery powered lamp, 4 inch reflector, gives out powerful pure infra-red light! Perfect for CCTV use, nightsights etc. £29. Ref PB1.

SUPER WIDEBAND RADAR DETECTOR. Whistler 1630. Detects both radar and laser, XK and KA bands, speed cameras, and all known speed detection systems. 360 degree coverage, front and rear waveguides. 1·1in. x 2·7in. x 4·6in., fits on visor or dash. New low price £99. Ref WH1630.
Other models available at **www.radargun.co.uk**.

LOPTX. Made by Samsung for colour TV. £3 each. Ref SS52.

WANT TO MAKE SOME MONEY? STUCK FOR AN IDEA? We have collated 140 business manuals that give you information on setting up different businesses, you peruse these at your leisure using the text editor on your PC. Also included is the certificate enabling you to reproduce (and sell) the manuals as much as you like! £14. Ref EP74.

ELECTRONIC SPEED CONTROLLER KIT. For the above motor is £19. Ref MAG17. Save £5 if you buy them both together, one motor plus speed controller rrp is £41. Offer price £36. Ref MOT5A.

INFRA-RED REMOTE CONTROLS. Made for TVs but may have other uses. Pack of 100 £39. Ref IREM.

RCB UNITS. In-line IEC lead with fitted RC breaker. Installed in seconds. Pack of 3 £9.98. Ref LOT5A.

STEPPER MOTORS. Brand new stepper motors, 4mm fixing holes with 47·14mm fixing centres, 20mm shaft, 6·35mm diameter, 5V/phase, 0·7A/phase, 1·8 deg step (200 step), body 56mm x 36mm. £14.99 each. Ref STEP6. Pack of 4 for £49.95.

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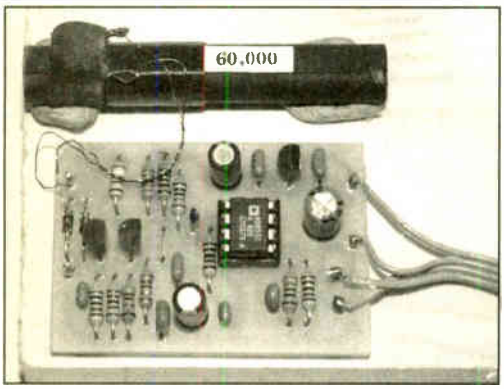

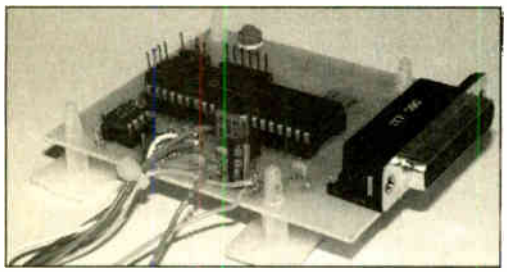

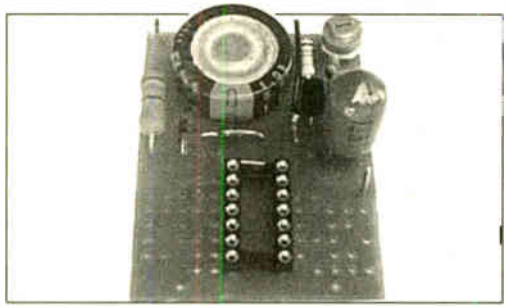

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TELEBOX ST for composite video input type monitors	£36.95
TELEBOX STL as ST but fitted with integral speaker	£39.50
TELEBOX MB Multiband VHF/UHF/Cable/Hyperband tuner	£69.95

For overseas PAL versions state 5.5 or 6 mHz sound specification.
*For cable / hyperband signal reception Telebox MB should be connected to a cable type service. Shipping on all Telebox's, code (B)

NEW State of the art PAL (UK spec) UHF TV tuner module with composite 1V pp video & NICAM hi fi stereo sound outputs. Micro electronics all on one small PCB only 73 x 160 x 52 mm enable full tuning control via a simple 3 wire link to an IBM pc type computer. Supplied complete with simple working program and documentation. Requires +12V & + 5V DC to operate.
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3½" QUANTUM 40S Prodrl ve 42mb SCSI I/F, New RFE	£49.00
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5¼" CDC 94205-51 40mb HH MFM I/F RFE tested	£69.95
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5¼" HP C3010 2 Gbyte SCSI *differential* RFE tested	£195.00
8" NEC D2246 85 Mb SMD interface. *New*	£199.00
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8" FUJITSU M2392K 2 Gb SMD I/F RFE tested	£345.00

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VGA cable for IBM PC included.
External cables for other types of computers available - CALL

Ex demo 17" 0.28 SVGA Mitsubishi Diamond Pro monitors, Full multisync etc. Full 90 day guarantee. Only £199.00 (E)

Just In - Microvitec 20" VGA (800 x 600 res.) colour monitors. Good SH condition - from £299 - CALL for info

PHILIPS HCS35 (same style as CM8833) attractively styled 14" colour monitor with both **RGB and standard composite 15.625 Khz video inputs via SCART socket** and separate phono jacks. Integral audio **power amp and speaker for all audio visual uses.** Will connect direct to **Amiga and Atari** BBC computers. Ideal for **all video monitoring / security applications with direct connection to most colour cameras.** High quality with many features such as front concealed flap controls, VCR correction button etc. Good used condition - fully tested - guaranteed **Only £99.00** (E)
Dimensions: W14" x H12¾" x 15½" D.

PHILIPS HCS31 Ultra compact 9" colour video monitor with **standard composite 15.625 Khz video** input via SCART socket. Ideal for all monitoring / security applications. High quality, ex-equipment fully tested & guaranteed (possible minor screen burns). In attractive square black plastic case measuring W10" x H10" x 13½" D. 240 V AC mains powered.
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KME 10" 15M10009 high definition colour monitors with 0.28" dot pitch. Superb clarity and modern styling. Operates from any 15.625 khz sync RGB video source, with RGB analog and composite sync such as Atari, Commodore Amiga, Acorn Archimedes & BBC. Measures only 13½" x 12" x 11". Good used condition.
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Superbly made UK manufacture. PIL all solid state colour monitors, complete with composite video & *optional* sound input. Attractive teak style case. Perfect for Schools, Shops, Disco, Clubs, etc.In EXCELLENT little used condition with full 90 day guarantee.

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Sony DXC-3000A High quality CCD colour TV camera	£995
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Racal ICR40 dual 40 channel voice recorder system	£3750
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Fujitsu M3041R 600 LPM high speed band printer	£1950
Fujitsu M3041D 600 LPM printer with network interface	£1250
Perkin Elmer 299B Infrared spectrophotometer	£500
Perkin Elmer 597 Infrared spectrophotometer	£3500
VG Electronics 1035 TELETEXT Decoding Margin Meter	£3250
LightBand 60 output high spec 2u rack mount Video VDA's	£495
Sekonic SD 150H 18 channel digital Hybrid chart recorder	£1995
B&K 2633 Microphone pre amp	£300
Taylor Hobson Talysurf amplifier / recorder	£750
ADC SS200 Carbon dioxide gas detector / monitor	£1450
BBC AM20/3 PPM Meter (Ernest Turner) + drive electronics	£75
ANRITSU 9654A Optical DC-2.5G/b waveform monitor	£5650
ANRITSU MS9001B1 0.6-1.7 uM optical spectrum analyser	£POA
ANRITSU ML93A optical power meter	£990
ANRITSU Fibre optic characteristic test set	£POA
R&S FTDZ Dual sound unit	£650
R&S SBUF-E1 Vision modulator	£775
WILTRON 6630B 12.4 / 20GHz RF sweep generator	£5750
TEK 2445 150 MHz 4 trace oscilloscope	£1250
TEK 2465 300 Mhz 300 MHz oscilloscope rack mount	£1955
TEK TDS380 400Mhz digital realtime + disk drive, FFT etc	£2900
TEK TDS524A 500Mhz digital realtime + colour display etc	£5100
HP3585A Opt 907 20Hz to 40 Mhz spectrum analyser	£3950
PHILIPS PW1730/10 60KV XRAY generator & accessories	£POA
CLAUDE LYONS 12A 240V single phase auto volt. regs	£325
CLAUDE LYONS 100A 240/415V 3 phase auto. volt. regs	£2900

19" RACK CABINETS

Superb quality 6 foot 40U
Virtually New, Ultra Smart
Less than Half Price!

Top quality 19" rack cabinets made in UK by **Optima Enclosures Ltd**. Units feature designer, smoked acrylic lockable front door, full height lockable half louvered back door and louvered removable side panels. Fully adjustable internal fixing struts, ready punched for any configuration of equipment mounting ,plus ready mounted integral 12 way 13 amp socket switched mains distribution strip make these racks some of the *most versatile we have ever sold*. Racks may be stacked side by side and therefore require only two side panels to stand singly or in multiple bays. Overall dimensions are: 77½" H x 32½" D x 22" W. **Order as:**

OPT Rack 1 Complete with removable side panels. £345.00 (G)
OPT Rack 2 Rack Less side panels £245.00 (G)

Over 1000 racks, shelves, accessories 19" 22" & 24" wide 3 to 46 U high. Available from stock !!

32U - High Quality - All steel RakCab

Made by **Eurocraft Enclosures Ltd** to the highest possible spec, rack features **all steel construction** with removable side, front and back doors. Front and back doors are **hinged for easy access** and all are lockable with **five secure 5 lever barrel locks.** The front door is constructed of double walled steel with a **'designer style'** smoked acrylic front panel to enable status indicators to be seen through the panel, yet remain unobtrusive. Internally the rack features fully slotted reinforced vertical fixing members to **take the heaviest of 19" rack equipment.** The two movable vertical fixing struts (extras available) are pre punched for standard 'cage nuts'. A **mains distribution panel** internally mounted to the bottom rear, provides 8 x IEC 3 pin Euro sockets and 1 x 13 amp 3 pin **switched utility socket.** Overall ventilation is provided by fully louvered back door and double skinned top section with top and side louvres. The top panel may be removed for fitting of **integral fans** to the sub plate etc. Other features include: fitted castors and floor levelers, prepunched utility panel at lower rear for cable / connector access etc. Supplied in **excellent,** slightly used condition with keys. Colour Royal blue. External dimensions mm=1625H x 635D x 603 W. (64" H x 25" D x 23¾" W)

Sold at LESS than a third of makers price !!

A superb buy at only £245.00 (G)
42U version of the above only £345 - CALL

12V BATTERY SCOOP - 60% off !!

A special bulk purchase from a **cancelled export order** brings you the most **amazing savings** on these ultra high spec 12v DC 14 Ah rechargeable batteries. Made by **Hawker Energy Ltd, type SBS15** featuring **pure lead** plates which offer a far superior shelf & guaranteed 15 year service life. Fully BT & BS6290 approved. Supplied **BRAND NEW** and boxed. Dimensions 200 wide, 137 high, 77 deep. M8 bolt terminals. Fully guaranteed. Current makers price over £70 each ***Our Price £35 each*** (C) ***or 4 for £99*** (E)

RELAYS - 200,000 FROM STOCK

*Save £££'s by choosing your next relay from our **Massive Stocks** covering types such as Military, Octal, Cradle, Hermetically Sealed, Continental, Contactors, Time Delay, Reed, Mercury Wetted, Solid State, Printed Circuit Mounting etc. , CALL or see our web site www.distel.co.uk for more information. Many obsolete types from stock. Save £££'s*

COLOUR CCD CAMERAS

BIG £ SAVER

Undoubtedly a **miracle of modern technology** & our special buying power ! A quality product featuring a fully cased COLOUR CCD camera at a give away price ! Unit features full autolight sensing for **use in low light & high light applications.** A 10 mm fixed focus wide angle lens gives **excellent focus and resolution** from close up to long range. The **composite video** output will connect to any composite monitor or TV (via SCART socket) and most video recorders. Unit runs from 12V DC so ideal for **security & portable applications** where mains power not available. Overall dimensions 66 mm wide x 117 deep x 43 high. Supplied BRAND NEW & fully guaranteed with user data, 100's of applications including Security, Home Video, Web TV, Web Cams etc. etc.

Web ref = LK33 ***ONLY £99.00 or 2 for £180.00*** (B)

SOFTWARE SPECIALS

NT4 WorkStation, complete with service pack 3 and licence - OEM packaged. ***ONLY £89.00*** (B)

ENCARTA 95 - CDROM, Not the latest - But at this price !	£7.95
DOS 5.0 on 3½" disks with concise books c/w QBasic	£14.95
Windows for Workgroups 3.11+ Dos 6.22 on 3.5" disks	£55.00
Wordperfect 6 for DOS supplied on 3½" disks with manual	£24.95

shipping charges for software is code B

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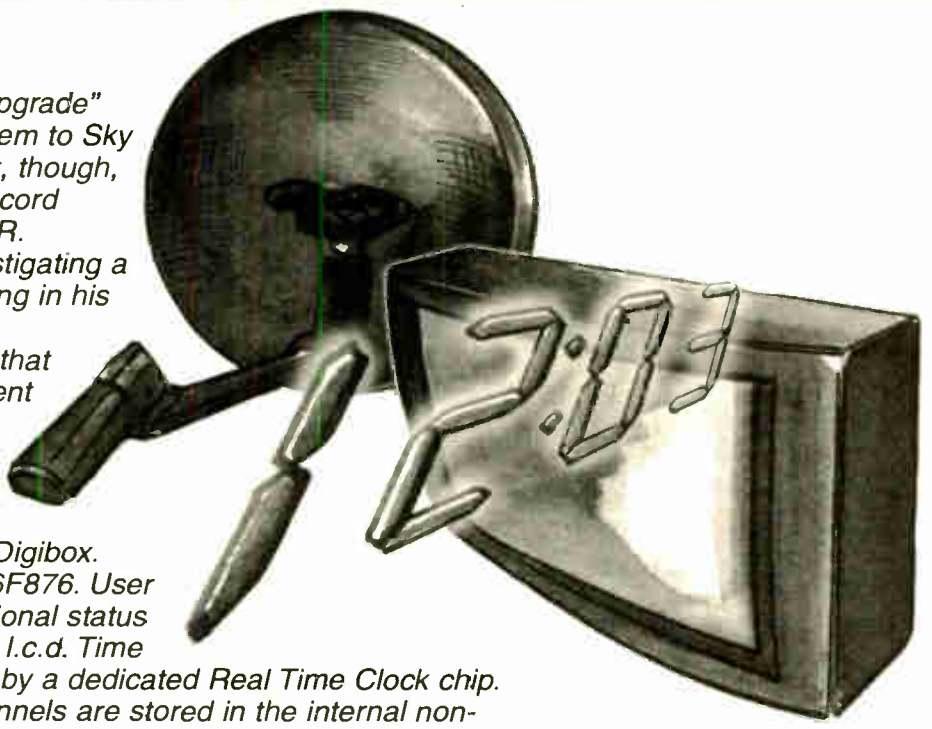
All prices for UK Mainland. UK customers add 17.5% VAT to TOTAL order amount. Minimum order £10. Bona Fide account orders accepted from Government, Schools, Universities and Local Authorities - minimum account order £50. Cheques over £100 are subject to 10 working days clearance. Carriage charges (A)=£3.00, (A1)=£4.00, (B)=£5.50, (C)=£8.50, (C1) £12.50, (D)=£15.00, (E)=£18.00, (F)=£20.00, (G)=CALL. Allow approx 6 days for shipping - faster CALL. All goods supplied to our Standard Conditions of Sale and unless stated guaranteed for 90 days. All guarantees on a return to base basis. All rights reserved to change prices / specifications without prior notice. Orders subject to stock. Discounts for volume. Top CASH prices paid for surplus goods. All trademarks, tradenames etc acknowledged © Display Electronics 1999 E & O E. 07/99.

NEXT MONTH

DIGITIMER



The author was persuaded to "upgrade" his motorised Pace satellite system to Sky Digital. It soon became apparent, though, that its Digibox did not have a record timer feature for use with his VCR. Consequently he set about investigating a suitable external solution, resulting in his Digitimer constructional design.
The concept behind Digitimer is that at a preset time the Digibox is sent a series of remote control commands to change to the desired channel. They can be sent either via infra-red or via r.f. to the Digilink connector on the Digibox. The unit is controlled by a PIC16F876. User input is via a keypad and operational status is displayed on an alphanumeric l.c.d. Time keeping functions are controlled by a dedicated Real Time Clock chip. Timer settings and favourite channels are stored in the internal non-volatile EEPROM.

COMPACT SHORTWAVE LOOP AERIAL

Some readers who constructed the Active Ferrite Loop Aerial *(Sept '00) have asked if its coverage can be extended to the shortwave bands.*
A new circuit has, therefore, been developed for reception between 1·6MHz and 30MHz. Although similar in concept to the medium wave version, plug-in air-cored loops are used, modifications have been made to the tuning and Q-multiplier circuits, and a second buffer stage has been incorporated. In addition to making the operation of the controls smoother at high frequencies, the extra stage also provides signal amplification.
This Q-multiplied loop aerial will deliver as much signal as a long wire and null out local electrical interference. Performance, in terms of signal output and depth of null, is very satisfactory.

PERPETUAL PROJECTS – 2

The Sun can flash an l.e.d. forever! This simple solar-powered flasher could be used as a thief deterrent almost anywhere – maybe on a dummy bell box or in an outbuilding etc. Or use it to mark a switch or keyhole so you can find it at night.
The second project (yes, two next month) is a Double Door Buzzer; not for double-doors, but to give different tones for two doors. Again it will run forever on solar power.

PLUS ALL THE REGULAR FEATURES

NO ONE DOES IT BETTER

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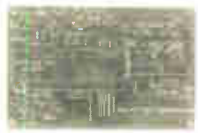
AUGUST 2001 ISSUE ON SALE THURSDAY, JULY 12

'PICALL' PIC Programmer



Kit will program **ALL** 8*, 18*, 28 and 40 pin serial AND parallel programmed PIC micro controllers. Connects to PC parallel port. Supplied with fully functional pre-registered PICALL DOS and WINDOWS AVR software packages, all components and high quality DSPTH PCB. Also programs certain ATMEL AVR, serial EPROM 24C and SCENIX SX devices. New PIC's can be added to the software as they are released. Software shows you where to place your PIC chip on the board for programming. Now has blank chip auto sensing feature for super-fast bulk programming. *A 40 pin wide ZIF socket is required to program 8 & 18 pin devices (available at £15.95).

3117KT	PICALL' PIC Programmer Kit	£59.95
AS3117	Assembled 'PICALL' PIC Programmer	£69.95
AS3117ZIF	Assembled 'PICALL' PIC Programmer c/w ZIF socket	£84.95

ATMEL 89xxxx Programmer

Powerful programmer for Atmel 8051 micro controller family. All fuse and lock bits are programmable. Connects to serial port. Can be used with ANY computer & operating system. 4 LEDs to indicate programming status. Supports 89C1051, 89C2051, 89C4051, 89C51, 89LV51, 89C52, 89LV52, 89C55, 89LV55, 89S8252, 89LS8252, 89S53 & 89LS53 devices. NO special software required – uses any terminal emulator program (built into Windows). **NB ZIF sockets not included.**

3123KT	ATMEL 89xxx Programmer	£32.95
AS3123	Assembled 3123	£47.95

Atmel 89Cx051 and AVR programmers also available.

PC Data Acquisition & Control Unit

With this kit you can use a PC parallel port as a real world interface. Unit can be connected to a mixture of analogue and digital inputs from pressure, temperature, movement, sound, light intensity, weight sensors, etc. (not supplied) to sensing switch and relay states. It can then process the input data and use the information to control up to 11 physical devices such as motors, sirens, other relays, servo motors & two-stepper motors.

FEATURES:

- 8 Digital Outputs: Open collector, 500mA, 33V max.
- 16 Digital Inputs: 20V max. Protection 1K in series, 5·1V Zener to ground.
- 11 Analogue Inputs: 0-5V, 10 bit (5mV/step.)
- 1 Analogue Output: 0-2·5V or 0-10V. 8 bit (20mV/step.)

All components provided including a plastic case (140mm x 110mm x 35mm) with pre-punched and silk screened front/rear panels to give a professional and attractive finish (see photo) with screen printed front & rear panels supplied. Software utilities & programming examples supplied.

3093KT	PC Data Acquisition & Control Unit	£99.95
AS3093	Assembled 3093	£124.95

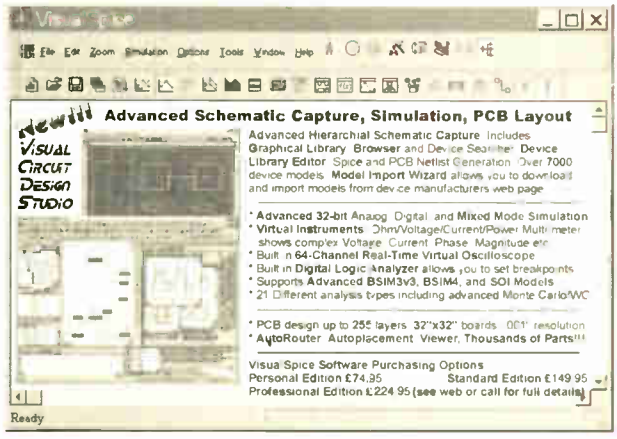
See opposite page for ordering information on these kits

ABC Mini 'Hotchip' Board

Currently learning about microcontrollers? Need to do something more than flash a LED or sound a buzzer? The ABC Mini 'Hotchip' Board is based on Atmel's AVR 8535 RISC technology and will interest both the beginner and expert alike. Beginners will find that they can write and test a simple program, using the BASIC programming language, within an hour or two of connecting it up. Experts will like the power and flexibility of the ATMEL microcontroller, as well as the ease with which the little Hot Chip board can be "designed-in" to a project. The ABC Mini Board 'Starter Pack' includes just about everything you need to get up and experimenting right away. On the hardware side, there's a pre-assembled micro controller PC board with both parallel and serial cables for connection to your PC. Windows software included on CD-ROM features an Assembler, BASIC compiler and in-system programmer The pre-assembled boards only are also available separately.

ABCMINISP	ABC MINI Starter Pack	£64.95
ABCMINIB	ABC MINI Board Only	£39.95

Advanced Schematic Capture and Simulation Software



Serial Port Isolated I/O Controller

Kit provides eight 240VAC/12A (110VAC/15A) rated relay outputs and four optically isolated inputs. Can be used in a variety of control and sensing applications including load switching, external switch input sensing, contact closure and external voltage sensing. Programmed via a computer serial port, it is compatible with ANY computer & operating system. After programming, PC can be disconnected. Serial cable can be up to 35m long, allowing 'remote' control. User can easily write batch file programs to control the kit using simple text commands. NO special software required – uses any terminal emulator program (built into Windows). All components provided including a plastic case with pre-punched and silk screened front/rear panels to give a professional and attractive finish (see photo).

3108KT	Serial Port Isolated I/O Controller Kit	£54.95
AS3108	Assembled Serial Port Isolated I/O Controller	£69.95

£1 BARGAIN PACKS Selected Items

HIVAC NUMICATOR TUBE, Hivac ref XN3. Order Ref: 865.

2IN. ROUND LOUDSPEAKERS. 50Ω coil. Pack of 2. Order Ref: 908.

2IN ROUND LOUDSPEAKERS. 8Ω. Pack of 2. Order Ref: 908/8.

5K POT, standard size with DP switch, good length ¼in. spindle, pack of 2. Order Ref: 11R24.

13A PLUG, fully legal with insulated legs, pack of 3. Order Ref: GR19.

OPTO-SWITCH on p.c.b., size 2in. x 1in., pack of 2. Order Ref: GR21.

1000W FIRE SPIRALS. In addition to repairing fires, these are useful for making high current resistors. Price 4 for £1. Order Ref: 223.

BRASS-ENCASED ELEMENT. Mains working, 80W standard replacement in some fridges but very useful for other heating purposes. Price £1 each. Order Ref: 8.

PEA LAMPS, only 4mm but 14V at 0·04A, wire ended, pack of 4. Order Ref: 7RC28.

HIGH AMP THYRISTOR, normal 2 contacts from top, heavy threaded fixing underneath, think amperage to be at least 25A, pack of 2. Order Ref: 7FC43.

BRIDGE RECTIFIER, ideal for 12V to 24V charger at 5A, pack of 2. Order Ref: 1070.

TEST PRODS FOR MULTIMETER with 4mm sockets. Good length very flexible lead. Order Ref: D86.

LUMINOUS ROCKER SWITCH, approximately 30mm square, pack of 2. Order Ref: D64.

30A PANEL MOUNTING TOGGLE SWITCH. Double-pole. Order Ref: 166.

SUB MIN TOGGLE SWITCHES. Pack of 3. Order Ref: 214.

HIGH POWER 3in. SPEAKER (11W 8ohm). Order Ref: 246.

MEDIUM WAVE PERMEABILITY TUNER. It's almost a complete radio with circuit. Order Ref: 247.

MAINS MOTOR with gearbox giving 1 rev per 24 hours. Order Ref: 89.

ROUND POINTER KNOBS for flatted ¼in. spindles. Pack of 10. Order Ref: 295.

CERAMIC WAVE CHANGE SWITCH. 12-pole, 3-way with ¼in. spindle. Order Ref: 303.

REVERSING SWITCH. 20A double-pole or 40A single pole. Order Ref: 343.

LUMINOUS PUSH-ON PUSH-OFF SWITCHES. Pack of 3. Order Ref: 373.

SLIDE SWITCHES. Single pole changeover. Pack of 10. Order Ref: 1053.

PAXOLIN PANEL. Approximately 12in. x 12in. Order Ref: 1033.

CLOCKWORK MOTOR. Suitable for up to 6 hours. Order Ref: 1038.

TRANSISTOR DRIVER TRANSFORMER. Maker's ref. no. LT44, impedance ratio 20k ohm to 1k ohm; centre tapped, 50p. Order Ref: 1/23R4.

HALL EFFECT DEVICES, mounted on small heatsink, pack of 2. Order Ref: 1022.

12V POLARISED RELAY, 2 changeover contacts. Order Ref: 1032.

PROJECT CASE, 95mm x 66mm x 23mm with removable lid held by 4 screws, pack of 2. Order Ref: 876.

LARGE MICROSWITCHES, 20mm x 6mm x 10mm, changeover contacts, pack of 2. Order Ref: 826.

PIEZO ELECTRIC SOUNDER, also operates efficiently as a microphone. Approximately 30mm diameter, easily mountable, 2 for £1. Order Ref: 1084.

LIQUID CRYSTAL DISPLAY on p.c.b. with i.c.s etc. to drive it to give 2 rows of 8 figures or letters with data. Order Ref: 1085.

8μF 350V ELECTROLYTICS, pack of 2. Order Ref: 987.

WHITE PROJECT BOX, 78mm x 115mm x 35mm. Order Ref: 106.

I.F. TRANSFORMERS, 465kHz, pack of 4. Order Ref: 40.

AIR-SPACED TUNER, 20pF with ¼in. spindle. Order Ref: 182.

PUSH ON TAGS, for ¼in. spades, pack of 100. Order Ref: 217.

FERRITE AERIAL with medium and long wave coils, solder tags and mounting clips. Order Ref: 7/RC18.

LEVER-OPERATED MICROSWITCHES, ex-equipment, batch tested, any faulty would be replaced, pack of 10. Order Ref: 755.

SPECIAL SUMMER OFFER

Here's a lot of buy-one-get-one-free offers for the months of June, July and August, so here's some real bargains not to be missed.

COMPUTER DUST COVER
22in. long, 14in. wide, 6in. deep, nicely boxed, £1. Order Ref: D204.

12V 2A DC POWER SUPPLY
Cased with internal fuse, £6. Order Ref: 6P23.

SAFETY LEADS
Coiled, stretches to 3m, £1. Order Ref: 846.

DITTO but 3-core 13A, stretches to 1m, £1. Order Ref: 847.

POWER SUPPLIES
Cased with D.C. output, 4·5V 150mA, £1. Order Ref: 104.
6V 700mA, cased, £1. Order Ref: 103.
9V 150mA, £1. Order Ref: 733.
9V 200mA, £2. Order Ref: 2P114.
24V 200mA, £2. Order Ref: 2P4.
9·5V 500mA, AC output, £1.50. Order Ref: 1.5P97.

PM LOUDSPEAKER
6in. x 4in., 4ohm, £1. Order Ref: 242.

HORN SPEAKER
8ohm, £3. Order Ref: 3P82.

LOUDSPEAKER CROSSOVER
40W, £1. Order Ref: 23.

1000W FIRE SPIRALS
Pack of 4, £1. Order Ref: 223.

BIG PULL SOLENOID
Mains operated, £1. Order Ref: 871.

BIG PUSH SOLENOID
Main operated, £1. Order Ref: 872.

DYNAMIC MICROPHONE
500ohm, plastic body with black mesh head and on/off switch, £2. Order Ref: 2P220.

FLASHING BEACON
12V for cars, £5. Order Ref: 5P267.

LIGHT ALARM
Warns when cupboard door opens, etc. £3. Order Ref: 3P155.

WATER LEVEL ALARM
For wall mounting over bath, etc., adjustable for water level, £3. Order Ref: 3P156.

SOLAR KIT
To make aeroplane, £7.50. Order Ref: 7.5P2.

FULL-WAVE BRIDGE RECTIFIER
35A 600C, £2. Order Ref: 2P474.

TELEPHONE ANSWERING MACHINE
Complete with power supply, £12. Order Ref: 12P38.

ROTEL HAIR CUTTER AND TRIMMER OUTFIT
Cutter and 8 accessories, £7.50. Order Ref: 7.5P16.

LIGHT DIMMERS
Replace a standard wall switch. One of each: red, yellow, green, blue, £2 each. Order Ref: 2P380.

TELEPHONE EXTENSION LEAD
Plugs into BT socket, £2. Order Ref: 2P338.

ENGINEER'S 13A BENCH PANEL
Accepts 2 x 13A plugs individually switched and illuminated, £2. Order Ref: 2P461.

TIME ON MAINS SWITCH
Can be set anywhere from 0 to 90 mins. and has calibrated knob, £2. Order Ref: 2P90.

QUICK HOOK-UPS
10 leads each with an insulated crocodile clip each end, £2 a set. Order Ref: 2P459.

MINI MAINS MOTOR WITH GEARBOX
1 rev per hour, £1. Order Ref: 500.
1/3 of a rev per minute, mains operated, £2. Order Ref: 2P460.
15 revs per minute, £2. Order Ref: 2P321.

IN-CAR UNIT
12V-6V, plugs into lighter socket, £2. Order Ref: 2P315.

INSTRUMENT LEAD
2m long, white, £1. Order Ref: 8TOP1.

TRANSISTOR AMPLIFIER
By Newmarket, 12V operated, 3V output, £2. Order Ref: 1/26L2.

ULTRASONIC CAR OR HOUSE ALARM
Operates from its own battery. Nicely cased, is reasonably loud or can be coupled to external horn, £10. Order Ref: 10P76.

UNDERDOME BELL
Friedland, transformer or battery operated, £5. Order Ref: 5P232.

MAINS KLAXON TYPE ALARM
Free standing, £5. Order Ref: 5P226.

METAL BOX WITH LID
Slightly sloping, size 8in. x 3in. x 4in. approximately, £1. Order Ref: 209.

CLOCK MODULE
2in. l.c.d. display, requires 1·5V battery, goes back to zero when switched off so ideal for timing operations. Also has panel for other switching operations, £2. Order Ref: 2P307.

BELT-DRIVEN COUNTERS
For tape decks, etc., 2 for £1. Order Ref: 26.

MAINS OPERATED COUNTERS
6 digit, even numbers, £1. Order Ref: 28.

12V AXIAL FAN
Approximately 3in. x 3in., will suck or blow, £4. Order Ref: 4P65.

HEADPHONES
Extra lightweight, stereo, £1 per pair. Order Ref: 898.

W-SHAPED FLUORESCENT TUBE
30W or 40W, ideal to light house name, etc., £2. Order Ref: 2P314.

WAATERPROOF LOUDSPEAKER
3½in., very high power, waterproof construction, £1.50. Order Ref: 1.5P27.

REVERSIBLE MAINS MOTOR
Beautifully made by the Japanese, probably about ½h.p. with a good length spindle, £4. Order Ref: 4P94.

PACK OR 5 ADAPTORS
Each takes 2 x 13A plugs, £2. Order Ref: 2P187.

TIME AND SET SWITCH
15A mains, £2. Order Ref: 2P104.

CLOCKWORK TIME SWITCH
Calibrated, settable up to 90 mins. Will switch 25A, £2. Order Ref: 2P90.

250W WOOFER
10in., beautifully made by Challenger, 4ohm, £29.50. Order Ref: 29P7.

TERMS

Send cash, PO, cheque or quote credit card number – orders under £25 add £4.50 service charge.

J & N FACTORS
Pilgrim Works (Dept.E.E.)
Stairbridge Lane, Bolney
Sussex RH17 5PA
Telephone: 01444 881965
E-mail: jnfactors@aol.com

SIMPLE PIC PROGRAMMER

INCREDIBLE LOW PRICE! **Kit 857 £12.99**

INCLUDES 1-PIC16F84 CHIP SOFTWARE DISK, LEAD CONNECTOR, PROFESSIONAL PC BOARD & INSTRUCTIONS

Power Supply £3.99

EXTRA CHIPS: PIC 16F84 £4.84

Based on February '96 EPE. Magenta designed PCB and kit, PCB with 'Reset' switch, Program switch, 5V regulator and test L.E.D.s, and connection points for access to all A and B port pins.

PIC 16C84 DISPLAY DRIVER

INCLUDES 1-PIC16F84 WITH DEMO PROGRAM SOFTWARE DISK, PCB, INSTRUCTIONS AND 16-CHARACTER 2-LINE **LCD DISPLAY**

Kit 860 £19.99

Power Supply £3.99

FULL PROGRAM SOURCE CODE SUPPLIED – DEVELOP YOUR OWN APPLICATION!

Another super PIC project from Magenta. Supplied with PCB, industry standard 2-LINE x 16-character display, data, all components, and software to include in your own programs. Ideal development base for meters, terminals, calculators, counters, timers – Just waiting for your application!

PIC 16F84 MAINS POWER 4-CHANNEL CONTROLLER & LIGHT CHASER

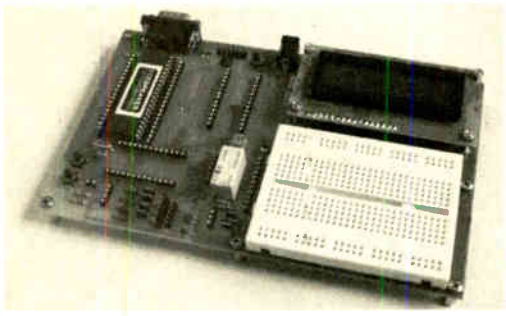
- WITH PROGRAMMED 16F84 AND DISK WITH SOURCE CODE IN MPASM
- ZERO VOLT SWITCHING MULTIPLE CHASE PATTERNS
- OPTO ISOLATED 5 AMP OUTPUTS
- 12 KEYPAD CONTROL
- SPEED/DIMMING POT.
- HARD-FIRED TRIACS

Kit 855 £39.95

Now features full 4-channel chaser software on DISK and pre-programmed PIC16F84 chip. Easily re-programmed for your own applications. Software source code is fully 'commented' so that it can be followed easily.

LOTS OF OTHER APPLICATIONS

ICEBREAKER



PIC Real Time In-Circuit Emulator

- Icebreaker uses PIC16F877 in circuit debugger
- Links to Standard PC **Serial** Port (lead supplied)
- Windows™ (95+) Software included
- Works with MPASM and MPLAB Microchip software
- 16 x 2 L.C.D., Breadboard, Relay, I/O devices and patch leads supplied

As featured in March '00 *EPE*. Ideal for beginners AND advanced users.
Programs can be written, assembled, downloaded into the microcontroller and run at full speed (up to 20MHz), or one step at a time.
Full emulation means that all I/O ports respond exactly and immediately, reading and driving external hardware.
Features include: Reset; Halt on external pulse; Set Breakpoint; Examine and Change registers, EEPROM and program memory; Load program, Single Step with display of Status, W register, Program counter, and user selected 'Watch Window' registers.

KIT 900 . . . £34.99

POWER SUPPLY £3.99 STEPPING MOTOR £5.99

EPE PIC Tutorial

At last! A Real, Practical, Hands-On Series

- **Learn Programming from scrach using PIC16F84**
- **Start by lighting l.e.d.s and do 30 tutorials to Sound Generation, Data Display, and a Security System.**
- **PIC TUTOR Board with Switches, l.e.d.s, and on board programmer**

PIC TUTOR BOARD KIT

Includes: PIC16F84 Chip, TOP Quality PCB printed with Component Layout and all components* (*not ZIF Socket or Displays). Included with the Magenta Kit is a disk with Test and Demonstration routines.

KIT 870 .... £27.95, Built & Tested £42.95

Optional: **Power Supply – £3.99, ZIF Socket – £9.99**
LCD Display ..... £7.99 LED Display £6.99
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PIC TOOLKIT V2

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As featured in Aug./Sept. '99 *EPE*. Full kit with Magenta redesigned PCB – LCD fits directly on board. Use as Data Logger *or* as a test bed for many other 16F877 projects. Kit includes programmed chip, 8 EEPROMs, PCB, case and all components.

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16 Pin DIL 0.3"	£0.11
18 Pin DIL 0.3"	£0.12
20 Pin DIL 0.3"	£0.12
24 Pin DIL 0.6"	£0.12
28 Pin DIL 0.6"	£0.13
40 Pin DIL 0.6"	£0.19

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16 Pin DIL 0.3"	£0.23
18 Pin DIL 0.3"	£0.25
20 Pin DIL 0.3"	£0.28
24 Pin DIL 0.6"	£0.35
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ZIF Sockets

Universal ZIF DIL Sockets	
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26 Way Socket	£0.38
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34 Way 90	£0.81
40 Way 90	£1.17
50 Way 90	£1.14

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40 Way Straight	£0.92
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10 Way 90	£0.46
14 Way 90	£0.48
16 Way 90	£0.54
20 Way 90	£0.59
26 Way 90	£0.81
34 Way 90	£1.03
40 Way 90	£1.23
50 Way 90	£1.41

DIL Headers

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IDC Ribbon Mounting

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15 Way Female Socket	£1.32
25 Way Male Plug	£1.10
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15 Way Female Socket	£0.39
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25 Way Male Plug	£0.48
25 Way Female Socket	£0.51

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9 Way Cover - Black	£0.30
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23 Way Cover - Black	£0.38
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25 Way Cover - Black	£0.37
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9 to 25 Cover / Case	£0.80

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TNC Plug 75Ω Crimp	£1.16
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Extensive range of RF connectors in stock, inc.FME, SMA, Mini UHF & N Type.

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Colours Red, Black, Green, Blue, White or Yellow

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DC Line Socket 2.5mm	£0.68
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DC Chassis Skt 2.5mm	£0.41

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3 Pin IEC Line Plug	£1.78
3 Pin Chassis Socket	£0.55
3 Pin Chassis Plug	£0.72

8 Way Bulgin

8 Pin Line Plug P551	£3.58
8 Pin Chassis Skt P552	£1.28

Toggle Switches

Sub-Miniature

3A 125V 1A 250V

5mm Ø Mounting Hole	
SPST 5 x 10mm	£0.50
SPDT 5 x 10mm	£0.60
SPDT C/Off 5 x 10mm	£0.81
DPDT 9.2 x 10mm	£0.66

Miniature

6A 125V 3A 250V

6.2mm Ø Mounting Hole	
SPST 8 x 13mm	£0.53
SPDT 8 x 13mm	£0.53
SPDT c/off 8 x 13mm	£0.60
SPDT c/o Biased 2 way	£0.97
SPDT c/o Biased 1 way	£1.04
DPDT 12 x 13mm	£0.72
DPDT c/off 12 x 13mm	£0.80
DPDT c/o Biased 2W	£1.28
DPDT c/o Biased 1W	£1.28

Standard

10A 250V Push on terminals

12mm Ø Mounting Hole	
SPST 18 x 30mm	£1.28
SPDT 18 x 30mm	£1.31
SPDT c/off 18 x 30mm	£1.43
DPDT 21 x 30mm	£1.65
DPDT c/off 21 x 30mm	£1.68

Slide Switches

Miniature

300mA 125V

7 x 15mm Mounting Hole	
DPDT 7 x 23mm	£0.18

Standard

1A 125V

5.5 x 12mm Mounting Hole	
DPDT 12 x 35mm	£0.27
DPDT c/o 12 x 35mm	£0.27

Rotary Switches

150mA 250V Make before Break 22mm Ø

9.8mm Ø Mounting Hole	
1 Pole 12 Way	£0.84
2 Pole 6 Way	£0.84
3 Pole 4 Way	£0.84
4 Pole 3 Way	£0.84

Push Switches

Miniature Round

250mA 125V 28 x 10mm
7mm Ø Mounting Hole

Non Latching Push to Make Black, Red, Yellow, Green, Blue or White	£0.23
Non Latching Push to Break Black PTB	£0.24

Standard Square

1A 250V	
39 x 15MM	
12mm Ø Mounting Hole	
Non Latching Push to Make Black, Red, Blue or White	£0.60
Latching -push On push Off Black, Red, Blue or White	£0.65

Rocker Switches Miniature

13 x 19mm Mounting Hole	
SPST 4A 250V	£0.57
SPST 6A Red Neon	£1.65
SPST 3A Red LED	£1.92
SPDT 6A 250V	£0.75
DPST 4A 250V	£0.81
DPST 4A Red Neon	£1.10
DPST 3A Amber Neon	£1.40
DPST 3A Green Neon	£1.32

Standard

10(SP),22(DP) x 30mm Mounting Hole	
SPST 10A 250V	£0.60
SPST 16A 250V	£0.75
SPST 15A Red Neon	£0.90
SPDT 16A 250V	£0.75
DPST 10A 250V	£0.90
DPST 15A Red Neon	£1.18
DPST Amber Neon	£1.25
DPST Green Neon	£1.25
DPDT 10A 250V	£0.90

Relays

PCB Mounting

1A 24Vdc DPDT 5V	£1.38
1A 24Vdc DPDT 12V	£2.00
3A 110V SPDT 6V	£0.58
3A 110V SPDT 12V	£0.58
5A 110V SPDT 6V	£0.72
5A 110V SPDT 12V	£0.72
5A 110V DPDT 6V	£0.93
5A 110V DPDT 12V	£0.93
5A 240V DPDT 6V	£1.76
5A 240V DPDT 12V	£1.76
10A 240V SPDT 6V	£1.20
10A 240V SPDT 12V	£1.44
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9F Gender Changer	£1.73
25M Gender Changer	£2.20
25F Gender Changer	£2.43
9 Male - 25 Female	£1.73
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9F- 6 Mini Din Female	£2.23
5M Din - 6F Mini Din	£1.73
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5A Surge Protector	£5.20
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1.5m Printer Lead	£2.55
2m BD Printer Lead	£2.98
5m BD Printer Lead	£4.98
10m BD Printer Lead	£9.88
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10m IEEE1284 Printer	£16.13
Serial Printer 25M-9F	£4.88
Serial Printer 25M-25F	£4.38

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9 Female - 9 Female	£4.38
25 Female- 25 Female	£6.48
9 Female - 25 Female	£4.38
9&25F to 9&25F	£4.88

Modem Leads

25Male to 9Female	£4.08
25Male to 25Female	£3.78

PC Link Leads

InterLink 25M to 25M	£3.88

Patch Lead

25Male to 25Male	£3.60
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Internal Leads

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Power 5¼-2 x 5¼	£1.50
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Boxes & Cases

Many more sizes available

General Purpose Plastic

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112 x 62 x 31mm	£4.18
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Wire & Cable

Ribbon Cable

Price per 305mm (1ft)

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16 Way Grey Ribbon	£0.17
20 Way Grey Ribbon	£0.24
26 Way Grey Ribbon	£0.29
34 Way Grey Ribbon	£0.38
40 Way Grey Ribbon	£0.49
50 Way Grey Ribbon	£0.52
60 Way Grey Ribbon	£0.64

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Per 50g (2oz) Reel
500g reels available

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18 SWG Enamelled	£0.97
20 SWG Enamelled	£0.97
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24 SWG Enamelled	£1.12
26 SWG Enamelled	£1.14
28 SWG Enamelled	£1.22
30 SWG Enamelled	£1.24
32 SWG Enamelled	£1.25
34 SWG Enamelled	£1.27
36 SWG Enamelled	£1.29
38 SWG Enamelled	£1.55
40 SWG Enamelled	£1.84

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16 SWG Tinned	£0.97
18 SWG Tinned	£0.97
20 SWG Tinned	£1.01
22 SWG Tinned	£1.01
24 SWG Tinned	£1.03
26 SWG Tinned	£1.03
24 SWG Tinned	£1.03

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Solid 1/0.6mm	£2.67
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32.768KHz	£0.39

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3mm Yelow Led	£0.09
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3mm Blue 60mcd	£0.78
3mm Blue 100mcd	£0.96
3mm Blue 550mcd	£0.96
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3mm Tri-Colour	£0.24
5mm Red Led	£0.07
5mm Green Led	£0.08
5mm Yelow Led	£0.08
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6N137 Opto-Coupler	£0.90
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Lens 3.6mm F1.4 >1.9 Lux
Power 12Vdc 50mA
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Lens 3.7mm F1.2 90
Power 12Vdc 120mA
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Miniature + Audio (31 x 31 x 28mm)
Sensor 270k Pixel >7 Lux
Lens 7.8mm F1.2 56
Power 12Vdc 30mA
660-840 £38.61 + vat

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WE'VE GONE

By the time you read this we won't be there! Again? someone asked me the other day. Well it is seven years since we did it last and seven years before that – and seven . . . Yes, it has become repetitive and the interesting thing is that something significant has happened to the magazine roughly every seven years since the birth of *PE* back in 1964. If you care to read *The History of EPE* on our UK web site you will get the full picture.

The last time we moved our UK editorial office it was into larger premises to accommodate our expanding publishing "empire", this time it is for commercial reasons (we will own the building). Of course, the message we need to get across is that even though we are not there anymore it's business as usual, so please note our new address, telephone and fax numbers. Anything sent to the old address will be redirected by the Post Office but, of course, it may be delayed in that process.

WE'RE STAYING

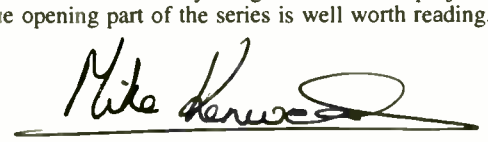
The move does not affect our advertising office so please continue to use the same address and telephone numbers for Peter Mew – our Advertisement Manager. Also all the E-mail and web site addresses remain unchanged, thanks to technology – pity technology won't yet allow us to keep our editorial phone and fax numbers, even though we are only moving about three miles up the road.

PLCs

Programmable Logic Controllers (PLCs) are a subject that readers have occasionally asked us about. They are presently only really of interest to those in industry where they are used to control a vast range of manufacturing processes. Because of this, we do not feel that in-depth articles on these devices are appropriate for *EPE*. However, Owen Bishop's article in this issue gives an overview of what they are, how they work and where they might be used. We hope it helps your understanding.

SUN'S UP

This issue also sees the start of an interesting series of *Perpetual Projects* powered by the sun. The research that the designer has undertaken to reduce circuit power consumption has thrown up some interesting results that could be of use to any designer. Even if the projects themselves are not of interest to you, the opening part of the series is well worth reading. (As if you would not read every page of *EPE* anyway!)



Editor: MIKE KENWARD

Deputy Editor: DAVID BARRINGTON

Technical Editor: JOHN BECKER

Business Manager: DAVID J. LEAVER

Subscriptions: MARILYN GOLDBERG

Administration: FAY KENWARD

Editorial/Admin: (01202) 873872

Advertisement Manager:
PETER J. MEW, Frinton (01255) 861161

Advertisement Copy Controller:
PETER SHERIDAN, (01202) 873872

On-Line Editor: ALAN WINSTANLEY

EPE Online (Internet version) **Editors:**
CLIVE (MAX) MAXFIELD and ALVIN BROWN

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E-mail: techdept@epemag.wimborne.co.uk
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COMPONENT SUPPLIES

We do not supply electronic components or kits for building the projects featured, these can be supplied by advertisers (see *Shoptalk*). We advise readers to check that all parts are still available before commencing any project in a back-dated issue.

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AVAILABILITY

Copies of *EPE* are available on subscription anywhere in the world (see below), from all UK newsagents (distributed by COMAG) and from the following electronic component retailers: Omni Electronics and Yebo Electronics (S. Africa). *EPE* can also be purchased from retail magazine outlets around the world. An Internet on-line version can be purchased and downloaded for just $9.99(US) per year available from **www.epemag.com**

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Binders to hold one volume (12 issues) are available from the above address. These are finished in blue p.v.c., printed with the magazine logo in gold on the spine. Price £5.95 plus £3.50 p&p (for overseas readers the postage is £6.00 to everywhere except Australia and Papua New Guinea which cost £10.50). *Normally sent within seven days but please allow 28 days for delivery – more for overseas.*

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Constructional Project

STEREO/ SURROUND SOUND AMPLIFIER

MAX HORSEY and TOM WEBB

An inexpensive, easy to build, stereo amplifier that can also produce pseudo surround sound when used with an existing stereo amplifier.

Gives a "true" 1W r.m.s. per channel output from a 12V supply

THIS Stereo/Surround Sound Amplifier is a simple system based on a TDA2822M amplifier i.c. and is rated at 1 watt per channel. At first sight this may appear puny, but note that this is a *genuine* watt, in other words it is an r.m.s. measurement. When driven from a 12V supply there will be plenty of sound.

FIGURES AND LIES

There are a number of different ways of measuring the power output from an amplifier. A good Hi-Fi store will only quote r.m.s. figures. These are mathematically based and provide a clear and accurate guide to the output.

Some dealers may prefer to quote "Peak Power". This is higher than r.m.s. power. Another misleading term is "Music Power" (whatever that means), but the most outstanding use of phoney figures must be "Peak Music Power Output (PMPO)".

Many computer speakers with integral amplifiers are quoted in terms of PMPO. When the author bought a pair of computer speakers with internal amplifiers rated at 100W PMPO, the actual r.m.s. power was found to be *less than 1W.*

ANOTHER MYSTERY

Another wattage mystery is how the power output actually affects the loudness of the sound. You may think that 2W (r.m.s.) will be twice as loud as 1W (r.m.s.). This is not the case, since power output needs to be many times higher for an appreciable increase in loudness. So you would need to increase to 10W to notice much difference. Put another way, 1W (r.m.s.) per channel will sound much louder than the figure implies.

SYSTEM DETAILS

The block diagram of the Stereo/ Surround Sound Amplifier system is illustrated in Fig.1. Note that this project only comprises of the parts within the heavy borders. The other blocks represent your existing system.

The amplifier is designed to amplify a stereo Line signal from any standard source such as a CD-player, tuner, video recorder, mini disc player. It does not include a pre-amplifier and is therefore ***not*** suitable for a record deck or microphone.

SURROUND SOUND

If you already have a stereo amplifier, then this 1W amplifier project may be used to extract a *pseudo* surround sound signal, and the p.c.b. includes provision for additional resistors and a capacitor i.e. the Surround Sound Extractor.

The cost of the surround sound components is less than 50p, and should not be confused with Dolby Surround, Dolby Pro-Logic, Dolby Digital, or DTS sound! But the effect – considering the modest cost – is quite convincing.

When hooked up to an existing amplifier, our surround extractor amplifies the difference between the signals applied to the main stereo speakers. If the sound is coming from the centre, the two stereo speakers will be delivering identical signals, and these will not be amplified by the extractor. If the main stereo speakers are 180 degrees out of phase, the sound will be amplified by the extractor and delivered via the rear speakers.

Of course, the sound field will not be as accurate as a fully-fledged surround sound processor, but it will be much better than driving rear speakers in parallel with the front speakers.

Note that this amplifier cannot drive your front and surround speakers at the same time. It is one or the other. If you do not already have a stereo amplifier, you will need to build two amplifier circuits and operate them from separate power supplies.

SWITCHED OPTION

The block diagram of Fig.1 shows how a switch may be employed so that the amplifier circuit can be used as a normal amplifier, or as a surround sound amplifier. When the switch is open the amplifier is in normal stereo mode. Hence if you do not wish to include the surround sound option, the switch and "surround extractor" can be omitted.

When the switch is closed, the "'surround extractor" is selected. Note that the two ordinary left and right stereo inputs are

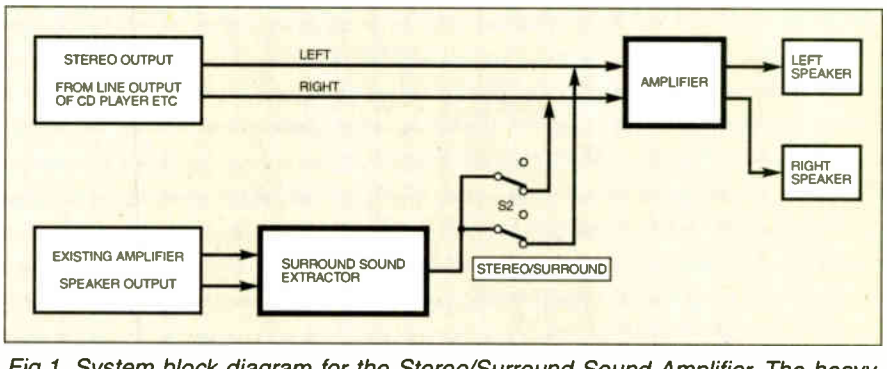


Fig.1. System block diagram for the Stereo/Surround Sound Amplifier. The heavy boxes show what is included in this circuit, plus the selection switch S2.

now joined together. So if you leave the switch in this position and use the amplifier to amplify line signals, they will be combined into a mono signal.

If you only require this circuit as a surround extractor, the switch can be omitted and the connections permanently wired as discussed later.

SUMMING UP

When the switch is open (or omitted) the circuit behaves as an ordinary stereo amplifier for use with signals from the Line outputs of CD players etc. The speakers will be at the front.

When the switch is closed the circuit must be used with an additional amplifier. The *additional* amplifier powers the *front* stereo speakers, and the circuit drives the rear speakers. Both rear speakers will deliver the same "pseudo surround" sounds.

MAIN CIRCUIT

The full circuit diagram for the Stereo/Surround Sound Amplifier is shown in Fig.2. Some people enjoy the challenge of designing a transistor amplifier from first principles, but if you require a system that is inexpensive and reliable, an amplifier based on an integrated circuit (i.c.) is the best option!

The i.c. chosen for this circuit is the TDA2822M. It is particularly unfussy about layout, operates on a supply of between 3V and 15V and provides a genuine 1W r.m.s. per channel.

It only requires six capacitors and two resistors, namely C1 to C6 and R1 and R2. These provide decoupling and stability for IC1. Overall circuit decoupling is provided by electrolytic capacitor C7.

Overall volume control is provided by VR1a and VR1b. This is a stereo-ganged potentiometer so that a single control knob operates both Left and Right channels in unison.

SOUND EXTRACTOR

The Surround Sound Extractor part of the circuit is shown inset in Fig.2, and may be omitted if not required. The "positive" speaker outputs from your additional amplifier are employed. The extractor circuit draws very little current, and will not affect your existing speakers in any way.

One of the positive speaker outputs is connected to 0V in the circuit. The other positive speaker output is connected via a potential divider made from resistors R3 and R4. The potential divider attenuates (reduces) the signal and ensures that the circuit has no effect on the existing amplifier and speaker system.

The signal is now applied to capacitor C8 which removes any d.c. which may be present. The value of C8 is not critical, and although a value of 1μF is suggested, a lower value – down to say 100nF – should be acceptable. The only effect will be to reduce the bass content in the rear speakers, but since bass is less directional this is not likely to be significant. Note that the capacitor must be non-polarised i.e. *do not use an electrolytic type.*

Do not connect anything to the negative speaker terminals of your existing amplifier (apart from your existing speakers of course).

Notice that the signal fed via C8 and switch S2 to the circuit will represent the difference between the positive output terminals of your existing front speakers. So the voice of a singer standing in the middle of the stereo field will not appear through the rear speakers. Sounds completely out

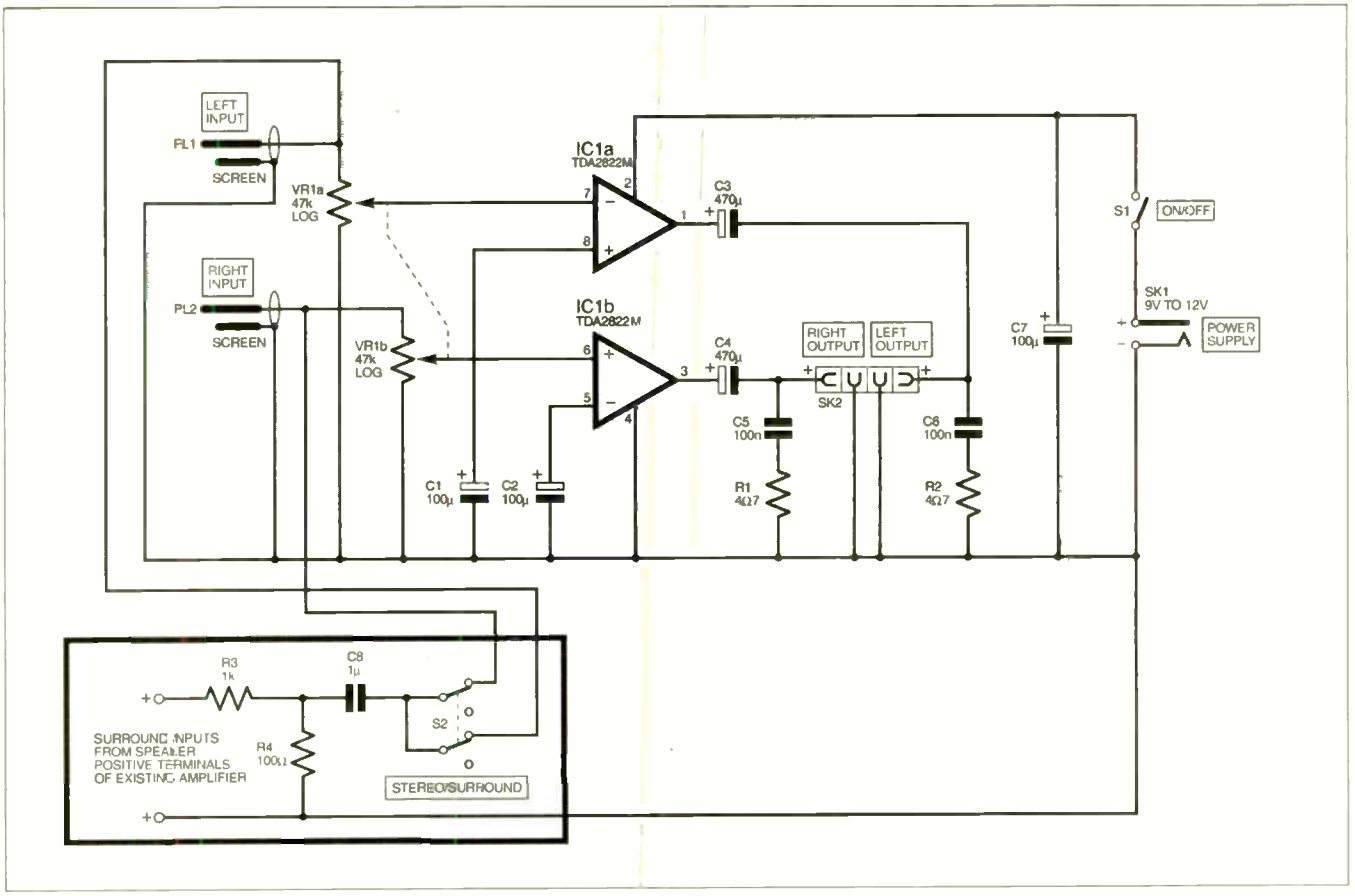


Fig.2. Complete circuit diagram for the Stereo/Surround Sound Amplifier. The surround sound extractor components are those within the boxed area. The "surround" inputs must only be taken from the speaker positive terminals.

of phase via the front speakers will be amplified and directed also through the rear speakers. This will include rear sound effects as used in modern films.

Sounds directed off centre will also appear via the rear speakers and although – strictly speaking – this is an error, in practice it should not present a problem.

OPTIONS

The printed circuit board (p.c.b.) component layout, including the "surround" components, together with a full-size underside copper foil master for the Stereo/Surround Sound Amplifier is shown in Fig.3. This board is available from the *EPE PCB Service*, code 304.

The interwiring details from the circuit board to the off-board components is also shown in Fig.3. If you only require the circuit as an ordinary stereo amplifier, then omit components R3, R4, C8 and switch S2. If you only require the circuit as a surround sound extractor, then omit switch S2 and link the connections as shown in Fig.4.

If you require both options (*remember that you cannot use both at the same time*) then fit all components and selector switch S2. This switch allows you to quickly select between using the circuit as a stereo amplifier, or as a surround extractor for the rear speakers.

CONSTRUCTION

The printed circuit board is designed to take the dual stereo Volume control VR1. Begin construction by checking that the control does fit and that the holes in the p.c.b. are large enough. If the control does not fit, or if you would prefer to use two separate controls for the Left and Right channels then a set of wires may be used to link the p.c.b. with the controls. Either way, do not solder in the control(s) at this stage.

Solder in the smallest components first, such as resistors and the 8-pin d.i.l. socket for IC1. Fit the smallest capacitors C5 and C6 (and C8 if required). These may be fitted either way round. Now fit the larger electrolytic capacitors taking care with their polarity. The negative side of each capacitor should be indicated down the side of its casing and its longer lead usually indicates positive.

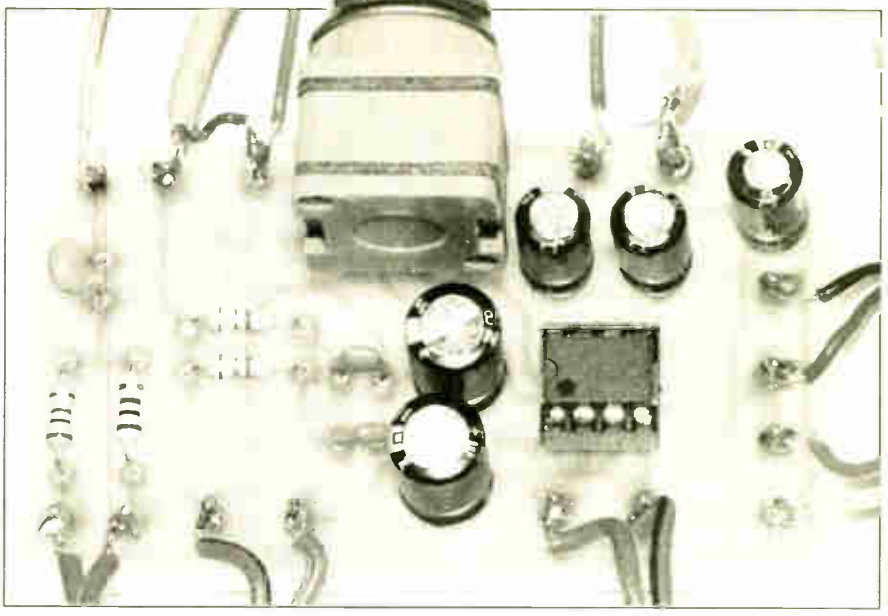
Next solder in position the potentiometer (Volume control), either directly into the p.c.b. or via wires. If you have a potentiometer which will fit directly into the p.c.b., then the circuit board will not require any additional fastening when housed inside a case.

Insert terminal pins for the various "lead-off" wires. The circuit may be connected to the Line output from a CD-player etc. either directly via twin-screened cable, or via plugs and sockets as shown in Fig.3. Ensure that the screen of the cable (i.e. the wire "mesh" which surrounds the inner insulated wire) is connected to the 0V side of the circuit.

The speaker connections can be made via a speaker terminal block, SK2, as shown. Note that this is fitted from the outside of the case, so do not solder it at this stage.

If you are using the circuit to drive rear speakers you will need to link the "surround inputs" to the *positive* speaker terminals of your *existing* amplifier. This can be achieved with ordinary wires.

Completed p.c.b. showing the stereo pot. mounted on the board.



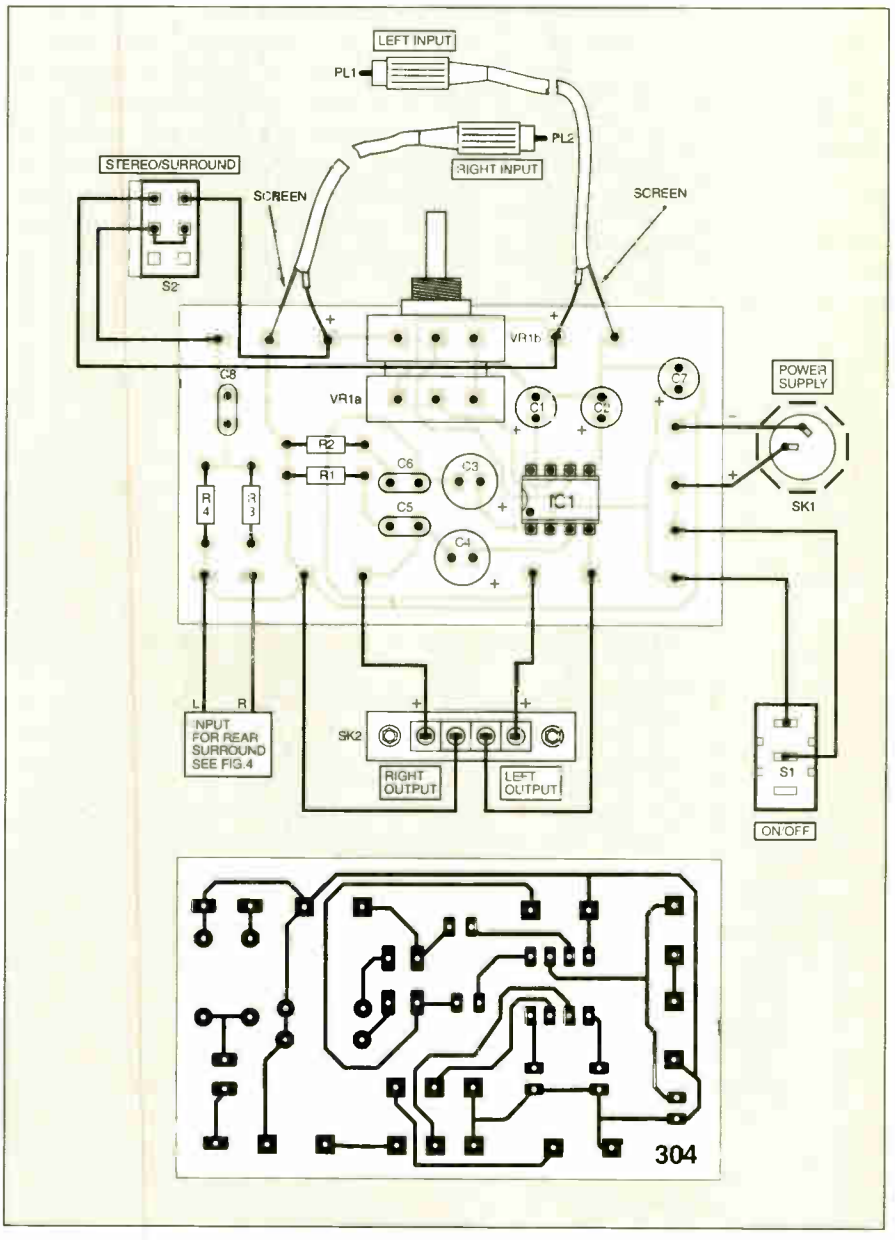
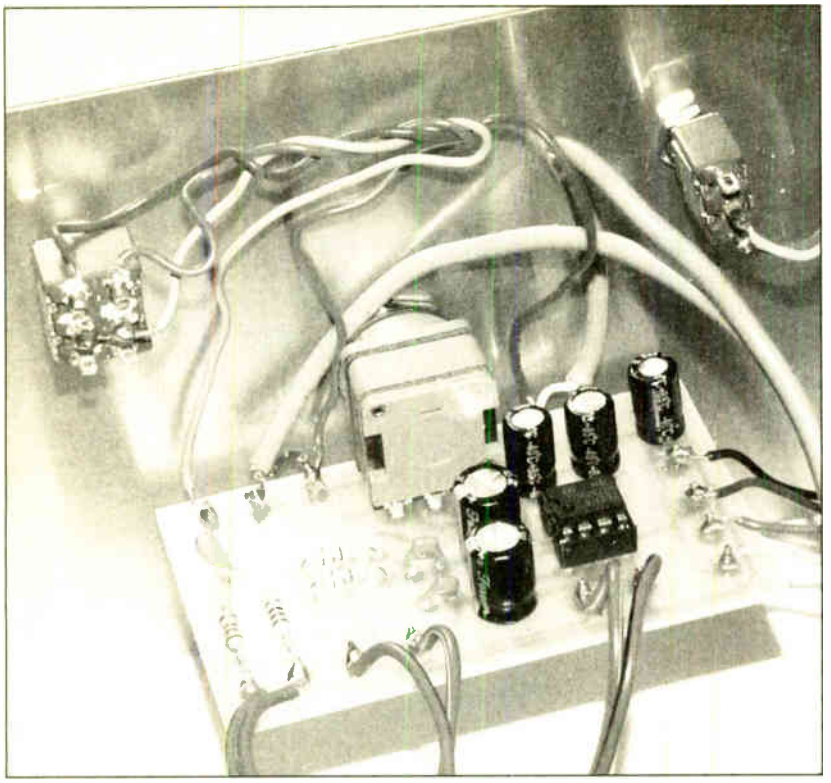
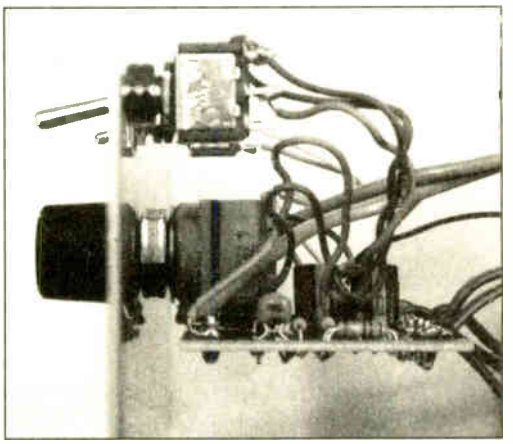


Fig.3. Amplifier printed circuit board topside component layout, wiring and full size copper foil master pattern.



It may not be Dolby Pro-Logic but the effect – considering the modest cost – is quite convincing.



The circuit board is held in position on the front panel by the dual-ganged potentiometer mounting bush and nuts.

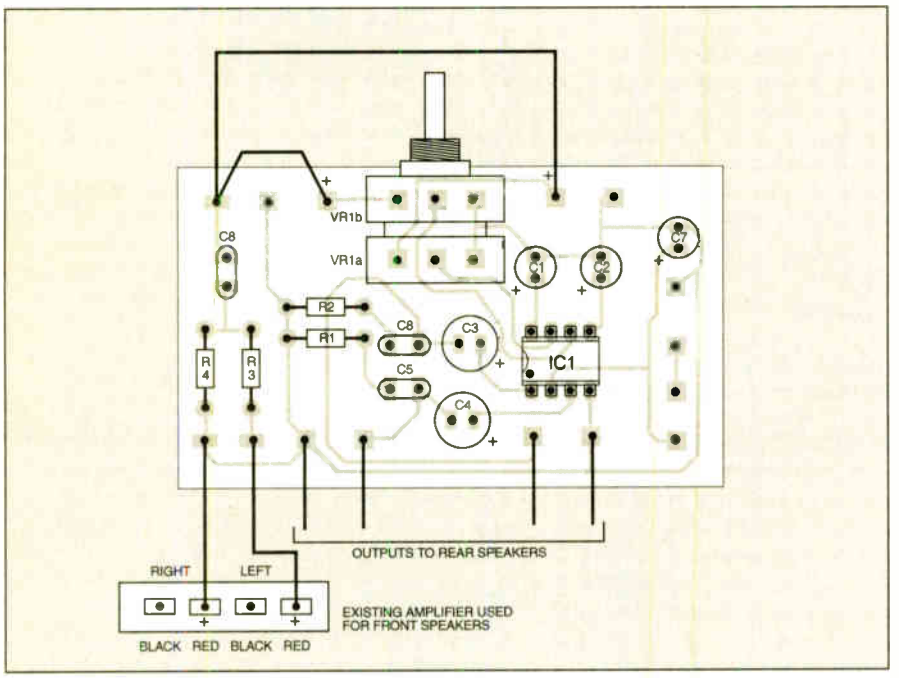


Fig.4. Amplifier used as a surround sound extractor and to drive the rear speakers. Switch S2 is omitted and link wires inserted as shown.

TESTING

Connect some loudspeakers (4 ohm to 8 ohm are ideal) to the amplifier. (Note that – unlike some amplifier designs – it does not matter if a speaker output is left open circuit i.e. not connected).

Stereo

Set switch S2 (if used) to Stereo. Power up the circuit and apply a test signal from a "Walkman" etc. A Line output is ideal, though a headphone output will work if no alternative is available.

Check that all is well and that the two stereo channels are separate. Test this by disconnecting one of the stereo line inputs. The appropriate speaker should go silent. If both speakers continue working, it is likely that the left and right channels are joined somewhere. For example, you may have switch S2 set wrongly.

Surround

Set switch S2 to the Surround position and connect the Surround Inputs to the Red (+) connectors of the Left and Right speakers of your existing amplifier.

Try to test with a recording from a film soundtrack or solo artist. You should notice that sounds (such as dialogue) from the centre of the front stereo field are hardly audible via the rear speakers. But sounds off centre are amplified more, and effects sounds are amplified the most.

COMPONENTS

Resistors

R1, R2	4Ω7 (2 off)
R3	1k
R4	100Ω

All 0·25W 5% carbon film

See SHOP TALK page

Potentiometer

VR1	47k dual-ganged (stereo) rotary carbon, p.c.b. mounting, log.

Capacitors

C1, C2 C7	100μ radial elect. 16V (3 off)
C3, C4	470μ radial elect. 16V (2 off)
C5, C6	100n ceramic (2 off)
C8	1μ any *non*-electrolytic type, such as polylayer

Semiconductors

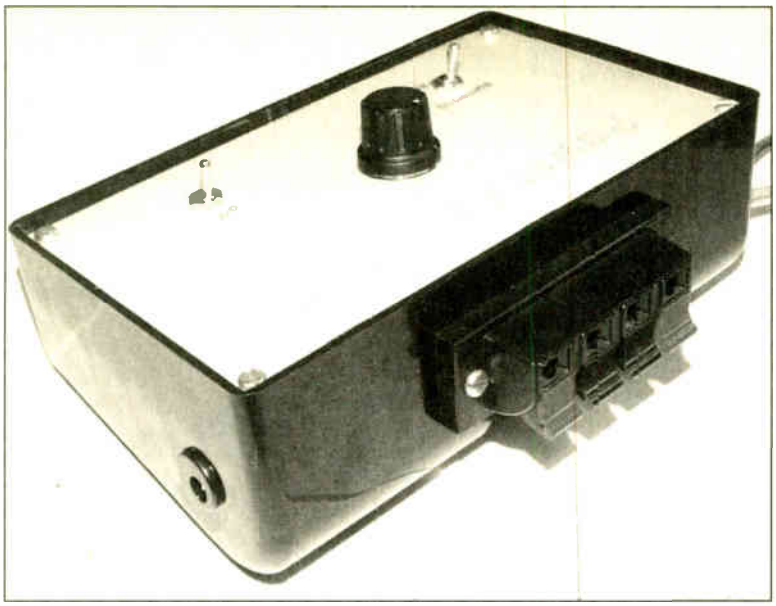
IC1	TDA2822M 1W stereo amp.

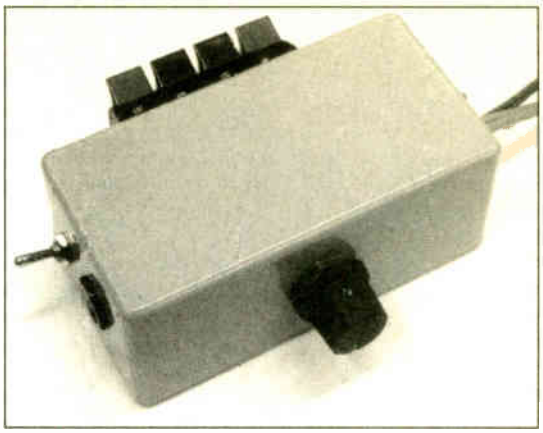
Miscellaneous

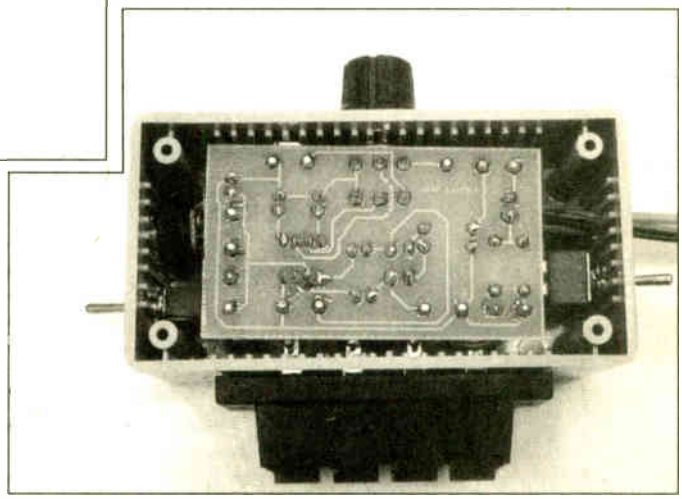
S1	on/off toggle switch
S2	d.p.d.t. toggle switch
SK1	2·5mm d.c. power socket, chassis mounting
SK2	4-way, spring-loaded, loudspeaker connector block
PL1, PL2	phono plug (2 off)

Printed circuit board available from the *EPE PCB Service*, code 304; sloping front case, size 160mm x 100mm x 60mm; 8-pin d.i.l. socket; plastic knob; 9V to 12V battery or regulated mains power supply adaptor (300mA or more); screened cable; multistrand connecting wire; solder pins (15 off); solder etc.

Approx. Cost Guidance Only* £15 *excluding case & batt./p.s.u.







Completed amplifier housed in a sloping-front case and showing the power input socket and the spring-loaded loudspeaker connecting blocks.

(Above right) Completed amplifier housed in a standard plastic case.

(Right) The circuit board is a neat fit in a standard plastic case.

BOXING UP

The prototype unit was housed in a sloping front case measuring approximately 16cm by 10cm and 6cm deep at its highest point. The front panel layout and general positioning of components within the case can be seen in the photographs. The photographs also show how the p.c.b. may be housed in a standard case.

You may wish to use a similar case and front panel layout as shown, in which case you can make up a "dummy" front panel from stiff cardboard (it's easier to cut, drill and modify) to check that the front panel components will fit into the case without clashing with any other side-mounted components. Using the card as a template, place it over the front panel of the case and drill the 3 holes for the switches and potentiometer. (This assumes that you require all the options as described earlier).

Drill suitable holes in the sides of the case for the speaker connector (SK2), power input connector (SK1) and audio input wires. Alternatively you could use connectors for the audio input, in which case drill the appropriate holes for the connectors.

Once you have drilled out the front panel, you can letter it, possibly using "rub-down" transfers, or you can make up a second thin card "overlay" with lettering on it. This can be positioned on the panel, the required holes punched in the card and the switches and potentiometer bolted in place.

Now complete the final wiring from the p.c.b. to the speaker connector and power socket. Ensure that the polarity of the power supply correctly matches the power socket and conduct a final test of the amplifier. □

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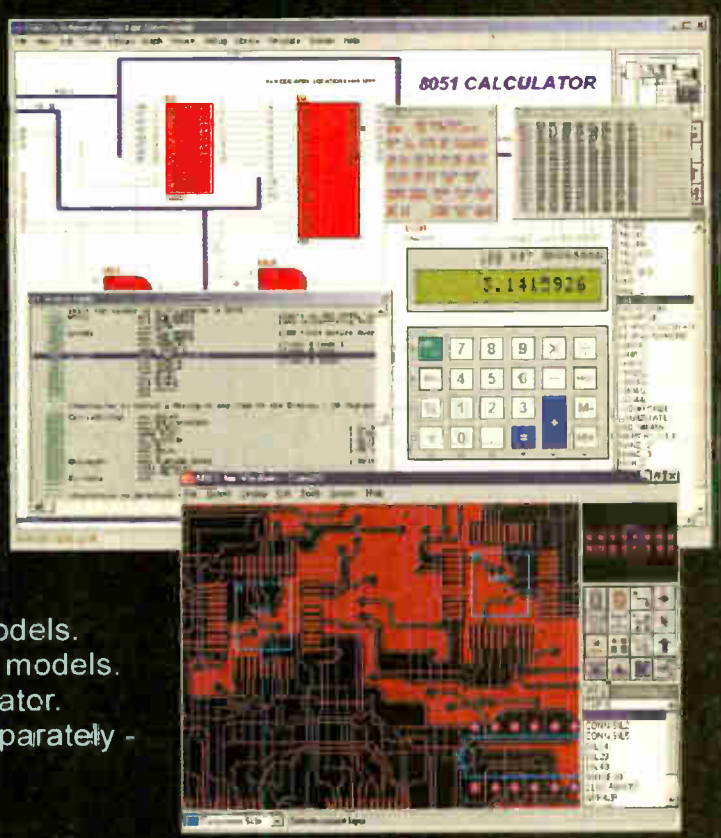

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News . . .

A roundup of the latest Everyday News from the world of electronics

PC USERS CAN HELP MEDICAL RESEARCH

Anyone with a fast PC can use it to analyse medical research data and help discover potential new drugs. Barry Fox reports

FOR most of the time, most PCs are idling. Either they are doing no work at all, or only a fraction of the processor power is being used by wordprocessor, E-mail or database software.

The idea of exploiting this spare capacity dates back at least three years, when SETI, the Search for Extra-Terrestrial Intelligence (once funded by the US Government but now a cash-strapped voluntary League) started using idle computers and obsolete satellite systems to look for recognisable patterns in radio signals received from space. A regular pattern could signify distant intelligence.

Peer-to-peer analysis

United Devices of Austin, Texas, has now joined with chipmaker Intel and the National Foundation for Cancer Research and Department of Chemistry at Oxford University, to use "peer-to-peer" computing for analysing the characteristics of possible new drugs. The challenge is to check hundreds of millions of molecular structures for their ability to match and block the proteins which are critical to the growth of cancers, such as leukaemia.

This is obviously a "good cause" and anyone with a PC can go to **www.intel.com/cure** or **www.ud.com/home.htm** and download a computer program which downloads possible drug structures and runs jigsaw-match checks on them.

The PC runs the program in the background, when it would otherwise be idle – rather like a screen saver. Once the jigsaw check is complete, which should normally take a day or so, the program sends the results back to United Devices Data Centre and requests a new package of data to check. This happens automatically when the user goes onto the Internet to look at any other site.

Virtual supercomputer

Intel predicts that worldwide downloads will eventually involve millions of participants and generate a virtual supercomputer which is ten times more powerful than any of the world's existing super computers.

Because large projects are broken down into smaller tasks, the proprietary drug information should remain secure. Hopefully the involvement of Intel guarantees security against viruses. But does the program slow down a PC by soaking up processing power? No, assures Daven Oswalt of Intel.

"When applications are being used, these peer-to-peer programs stay on the sidelines, so as not to interfere at all with the user's main application processing. It is only at moments when a user is not engaged in processing that the peer-to-peer program computes. This could be when a user steps away to do something else, but leaves the PC on, or when he or she is at the computer but momentarily not using any processing power – not inputting anything that requires a response from the computer, for example.

"Having a more powerful PC not only means faster user application processing, but also faster processing of any peer-to-peer applications that are resident on the PC, such as any philanthropic peer-to-peer program."

United Devices also assures: "The UD Agent will never interfere with your ability to use your own computer. Most computers never use all their resources – it is estimated that up to 90 per cent of the processing power of an individual PC goes unused. The United Devices distributed computing model is based on the ability to utilize this *idle* capacity from individual computers."

But poorly documented

There is no reason to doubt these assurances, but the program is very poorly explained. Users only find out by trial, error and exploration that there are options to tweak the way the program runs, for instance displaying graphics which show the molecules being checked.

The program does not explain what it is doing on the Internet and why it sometimes tries to force a connection and cost the PC owner money on-line while uploading results and downloading more data. This can be very disconcerting for casual users who are worried about viruses. Also, only the highest speed Pentium PCs will be able to plough through the millions of calculations in a reasonable time. Slower PCs will still be at a few per cent of the task after days.

There is no information offered on how to get rid of the agent, but this can be done with the usual Windows Settings, Add and Remove Programs options.

If Intel, United Devices and Oxford University want people to volunteer their resources they should surely pay them the courtesy of offering a better explanation of what the UD Agent software is doing while it lives inside a PC.

UNIVERSAL PROGRAMMER

The LabTool-48 is an "intelligent" universal device programmer which works through your PC's parallel port. It features a 48-pin universal pin driver and an expandable TTL pin driver and supports over 3000 different devices, including memory, logic and single-chip. It can handle *all* of Microchip's PIC series. The literature received states "no adaptor required for any DIL device up to 48 pins – guaranteed".

Device types catered for are PROM, EPROM, EEPROM, Flash, Serial PROM, NVRAM, PAL, GAL, CEPAL, PEEL, CPLD, EPLD, OTP and Flash microcontrollers. Operations include read, blank check, device insertion/contact check, verify, checksum, EEPROM ID check, compare, erase chip, function test, program, memory protect, device configuration setting, device search, edit buffer, mass production mode, modify vector, serialization, H/L byte buffer swap, buffer search.

For more information contact Burn Technology Ltd., Dept EPE, Winfrith Technology Centre, Building C51, Dorchester, Dorset DT2 8DH. Tel: 01305 852090. Fax: 01305 851940. E-mail: sales@burntec.com. Web: www.burntec.com.

PICS ON-SCREEN WEBSITE

SIMON Blake of the BlackBoxCamera Company wants you to know about his company's website and their new product, the PIC16F84-STV5730A On Screen Display (OSD) project board.

He tells us the STV5730A is an OSD i.c. widely used in VCRs for displaying on-screen programming menus. Combining this device with a 16F84 gives it the ability to display text and graphics characters on any TV or video monitor. The product provides the hardware and software to create both simple and complex OSD applications, and the website provides *free* development resources.

For more information contact The BlackBoxCamera Co. Ltd., Dept EPE, Unit U7, Lenton Boulevard, Nottingham NG7 2BY. Tel/Fax: 0700 2522526. E-mail: Simon.Blake@STV5730A.co.uk. Web: www.STV5730A.co.uk.

Greenweld's Bargains

BY the time you read this Greenweld's new 32-page May catalogue should have been published. We know that as usual it will have a good selection of the bargains for which Greenweld are renowned (*Greenweld – Home of Bargains* is the slogan on their last newsletter received).

Greenweld's bargain lists are well-worth obtaining – ask for your copy now! Greenweld Ltd., Dept EPE, PO Box 144, Hoddesdon EN11 0ZG. Tel: 01277 811042. Fax: 01277 812 419.

E-mail: bargains@greenweld.co.uk.

Web: www.greenweld.co.uk.

Voice of the Crystal

QUITE likely many of you will consider Crystal Radio to be an almost forgotten stepping stone on our tortuous route to achieving today's electronics technology. It is, though, a technology that can still be experimented with and rewarding results achieved.

To emphasise the point, we were recently sent a rather delightful book written and illustrated by H. Peter Friedrichs, called *The Voice of the Crystal*. Peter comments that while his book fits into the genre of crystal radio, it goes beyond that and "it's quite unlike any you've seen before". It introduces radio theory in simple layman's terms and then proceeds to demonstrate how to build various radio components completely from scratch. The various components are then linked together to create working radios.

Construction covers building fixed and variable capacitors, a variety of coils including slider, spider and basket-weave types, a plethora of detectors using a veritable rainbow of materials. The book also describes the construction of three different types of home-build headphones, including a piezoelectric design fashioned from the components of a cigarette lighter!

This 185-page book is published in the USA but is readily purchasable online from **www.amazon.com**, who quote a price of US $14.95. No doubt your local good bookseller could also obtain a copy for you, ISBN 0-9671905-0-9.

NATIONAL VALVE MUSEUM

Allan Wyatt of the National Valve Museum has sent us the Museum's remarkable CD-ROM, which contains photographic images and details of many of the world's early valves.

Allan tells us that the museum was founded early in 2000 with the specific aim of providing a first class digital collection of this essential part of our national heritage. The original plans for digital collections were discussed with major museums which, while they completely supported the initiative, had no funding available to do something similar or to help.

The window of opportunity seemed too small to let it drop, so Allan has funded it himself. The core of the project is a publication database with high quality digital pictures, accessed via the Internet or via CD-ROM.

Each indexed term is validated against a master list to maintain accuracy. All of the web pages and indexes are generated from a batch process to make updates fast and easy and the equivalents list is dynamically linked to the exhibit entries each time the process is run.

All software from the database onwards has been designed specifically for the museum project. A physical home is not practical at present, and Allan feels that a close-up picture can convey far more than a cabinet full of valves.

The Museum regularly receives 2,500+ visits to its web site per week.

For more information contact The National Valve Museum, Dept EPE, 75 Millbrook Road, Crowborough. East Sussex TN62SB. Web: www.valve-museum.org

Stamplets to Cure the Spam Deluge?

Barry Fox reports on a proposal for reducing unwanted E-mail messages.

ANYONE who uses E-mail is cursed by spam – unwanted messages that bucket through from the Internet, offering "100% FREE" opportunities to spend money on becoming a millionaire.

Although subscribers to reputable E-mail services who send spam can in theory be stopped, most unsolicited junk E-mail now comes from anonymous senders using untouchable services in far-off lands. China is a prime suspect.

CD-ROMs, costing a few dollars, contain literally millions of E-mail addresses, and can be used to automate E-mail transmission. It takes only four hours to send a million spam E-mails and it costs the sender only an hour in line time.

Filtering Spam

Some Internet service providers now try and filter mail by searching for tell-tale words. But the spammers then avoid those words. Others use the Brightmail system which uses trap accounts to attract spam and then put a network block on everything from the same address or with the same header. But spammers can then change the headers and sender addresses.

Guernsey-based Anodyne Developments thinks it has a better solution, with Stamplets. The E-mail or Internet service provider installs software which interrogates the address list stored in the Internet mail software (e.g. Microsoft Outlook or Netscape Messenger) on the user's PC. It then lets through only those messages which come from known addresses.

All other messages, which may either be unwanted spam, or wanted messages from unknown or new senders, is then held for up to 30 days on the service provider's server. An automated reply is transmitted to the sender, saying that the original message will only be delivered if the sender pays a small fee. This is payable in any of the online credit and debit micro-units used for e-commerce and Internet auctioning. These units are for instance tied to the price of gold, with credit bought in advance at the beginning of each month by credit card.

Anodyne's Stamplets system would let E-mail users give out free credit to people charged for sending wanted E-mails, and set their own price to charge spam senders.

Deterrence

If adopted, the system would certainly deter anyone sending unsolicited messages by the million, because they would face heavy bills to get their messages through. But first the E-mail and Internet service providers must adopt the system and so far there have been no big-name takers. Also some users may not like the idea of wanted E-mails from unknown senders initially being blocked.

MARCONI MUSEUM

The interactive online Marconi Museum has been opened by E-minister Patricia Hewitt. The website coincides with the 100-year anniversary of the world's first transatlantic wireless transmission by Guglielmo Marconi, the pioneer of wireless communication, and captures his extraordinary achievements.

The website features 10,000 web pages containing an historic collection of 500 pieces of ephemera, 426 photographs, 33 sound clips and 10 film clips. The Marconi Online Museum caters for interests of all ages, including students, historians, researchers and wireless enthusiasts, and particularly school children, for whom the content is directly relevant to the National Curriculum.

Visit **www.marconicalling.com**.

New Technology Update

Non-volatile memory based on CD-ROM technology promises smaller, faster devices with a multitude of applications, reports Ian Poole.

In today's electronics technology, memory is being used in increasing quantities. PCs usually have a hundred or more megabytes of RAM, whereas only ten or fifteen years ago a few kilobytes was standard. This increase has become necessary due to the development and use of far more sophisticated computer software. However, technology has had to advance to enable memory to be sufficiently compact and cheap to be used in this way. It is often said that memory is cheap and this is quite true. It only costs a few tens of pounds to put more memory in a PC.

To meet the ever-growing requirements for memory, new technologies are being developed. In one development ST Microelectronics is to start work on a joint development project with the US based company, Ovonyx. The aim is to build non-volatile memory based around the techniques used in rewritable CDs.

The new memory is named phase change or amorphous memory and the basic technology has been developed by Ovonyx, a company that has come out of Energy Conversion Devices Inc. The memory is based on an alloy that can be converted from an amorphous to a crystalline state and back again by using an electric current. The two phases or states of the material have quite different resistances enabling it to be used to store information.

ST have obtained a licence from Ovonyx that will let them build this memory technology into microcontrollers, system-on-chip, and bulk memory devices as well as reconfigurable logic devices.

Technology

The technology uses unique thin film materials to store information in a very compact manner. The memory is based around a phase change chalcogenide alloy similar to that used to store information on commercial rewritable CDs and DVD RAM.

Optical disks use light from a laser to convert small spots on the disk from the amorphous state with a disordered structure to a crystalline state with a regular atomic structure. In this way the digital data can be stored because the amorphous state is non-reflective and has a high resistance whereas the crystalline state is reflective and has a low resistance.

The phase change memory operates in a very similar manner but uses an electric current to change the state of the material. To read the data, a voltage is applied to the storage area and the state of the cell is detected by the amount of current that flows. The system is particularly efficient and can store data in a much smaller area than its optical counterpart. Furthermore, data can be read and written at a much greater speed and there are cost advantages over more conventional forms of memory, including DRAM and Flash. This results from the very small active storage area and the simple manufacturing process required. In fact the manufacturing process deviates only a little from the standard CMOS flow line, making it very attractive for manufacturers who would not have to invest large sums in new plant.

Basic concept

The material that has been most widely used in amorphous semicondictor memories to date has been a composition based on germanium and tellurium (GeTe). Small quantities of other dopants such as antimony can be added to improve the conductivity for the low resistance phase. In addition to this selenium is often added to improve the switching performance.

The crucial aspect of the device is in switching the memory element between the high and low resistance states. In fact both conversions are implemented by heating the data storage element itself with a high current pulse. The current pulse is sufficient to melt the storage element and on cooling down it crystallises so that the atomic structure is ordered and the material can conduct an electric current through a low resistance.

To reverse the change and erase the data a higher current pulse is applied. Typically this will be about ten times that of the original write pulse and will have much faster rise and fall times. The effect of this is that when the molten material cools down it changes to its amorphous state with a high resistance.

Device structure

Details of the actual device structures in use at the moment are not very clear as little information has been released. One structure that may be in use is shown in Fig.1. Here the data storage region is filled with the chalcogenide. When in the crystalline state current can flow from the upper electrode to the resistive element. Obviously when in the amorphous state it will exhibit a high resistance and significant current will not be able to flow.

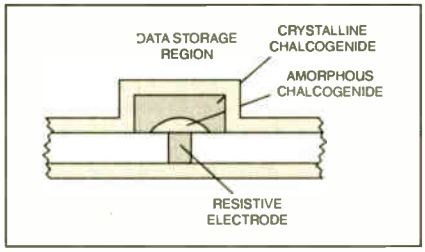

Fig.1. Planar form of an amorphous memory

Performance

The memory has many advantages. It is non-volatile allowing the information to be retained even when the power is removed. Currently Flash is the most widely used form of non-volatile memory. This has the disadvantage that it has to be erased in blocks. In addition to this the memory only has a limited number of read/write cycles. Today's devices typically withstand about 100,000 write cycles.

Amorphous memory does not suffer from either of these problems, having a virtually unlimited lifetime and each cell can be individually addressed for both read and write. This enables it to be used in ordinary memory applications as well as those that would normally have been serviced by Flash memory.

A further advantage is that no power is required to maintain the memory even when in standby "operation". Other forms of memory use considerable amounts of current and as a result this will give amorphous memory a significant advantage, especially for portable applications where battery size and lifetime are primary considerations.

Future

The small size, flat topology and the low voltage operation make the memory very suitable for migration to smaller geometries than those that are being used today. In fact the performance of individual cells improves if they are scaled down in size. Interestingly, the reverse is true for memories such as Flash where the amount of charge stored is dependent upon the surface area of the electrodes within the cell. If the amount of charge stored is too small then the performance of the memory will be impaired.

The advantages of amorphous memory mean that it should find uses in a wide variety of applications. Laptop and palmtop computers will be a particularly suited. In addition to this the new multimedia third generation mobile phones will have a far greater requirement for memory and they should find many uses in this arena. Apart from the portable applications where their low power consumption is of particular interest they should find widespread use in virtually all types of electronics where memory is required. Obviously this will include the run of the mill computer applications where there is a truly vast market.

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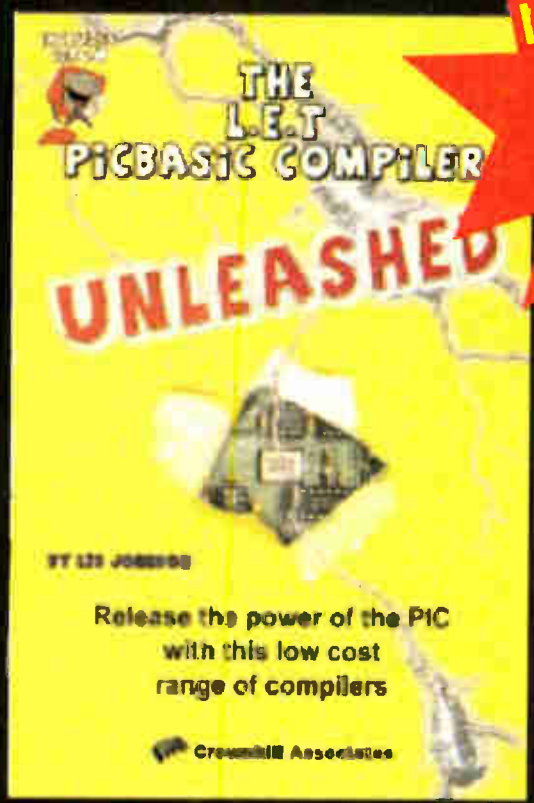

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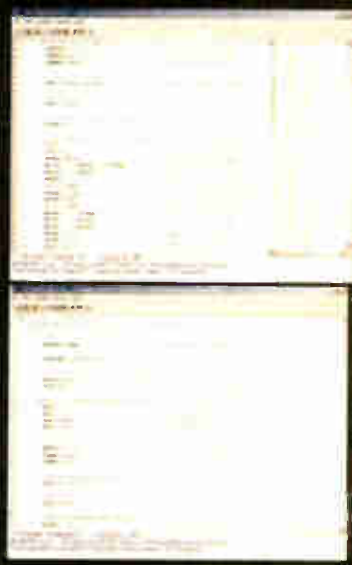

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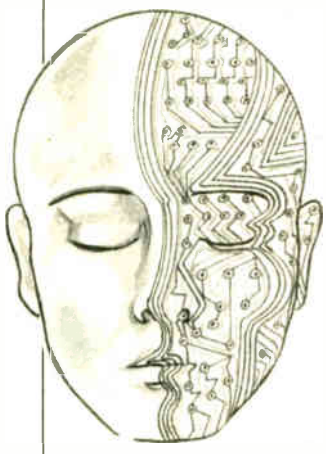

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Zener Diode Tester – Service Check

HAVING amassed a large collection of surplus Zener diodes, some using type numbers and codes which are obsolete, others having lost their markings altogether, the circuit diagram shown in Fig. 1 was developed to check their polarity and voltage. It supplies a constant current to the device under test and a digital voltmeter (DVM) then reads the Zener "breakdown voltage" across the device. The constant current source ensures the Zener is unlikely to be damaged.

In the circuit, transistor TR2 forms a constant current source in conjunction with diodes D1, D2 and resistors R1 and R2, to provide a test current of approximately 7mA into TR2's collector. With no test diode connected, the meter reads the supply voltage, either 33V or 6V depending on which positive test terminal is used. This indicates the off-load battery voltage.

When the test diode is connected current flows through it to 0V via resistor R3. Transistor TR2 is turned off at this time as its base current, via resistor R1, is blocked by TR1. Provided current through the test diode exceeds about 7μA then the voltage developed across R3 is sufficient to turn on transistor TR3.

The base current of transistor TR3 is limited by resistor R5 to a safe level under all conditions, and capacitor C1 decouples TR3 base. The transistor's collector current is drawn from the +33V supply via transistor TR1's base emitter junction, turning TR1 on. Resistor R4 prevents TR1 being spuriously turned on by any leakage in TR3 whilst capacitor C2 decouples TR1 base.

With transistor TR1 turned on, this provides the base current for TR2 via R1, enabling the constant current source to be used for measuring the test diode's Zener voltage. As soon as the test diode is removed the circuit returns to its quiescent state. If the polarity of the device is unknown, connecting it the wrong way round will give a reading of 0·6V to 0·7V on the DVM as a Zener behaves like an ordinary silicon diode in the forward direction. Should the device be a short-circuit then 0V will be read on the DVM.

Devices other than Zener diodes could be checked by the circuit. By using three 9V PP3 type batteries (B1 to B3) in series with four "AA" cells (B4 to B7) as shown, l.e.d.s. could be safely checked for operation and polarity. Note that using the 6V tap for testing will not risk reverse breakdown (usually quoted as 5·1V for an l.e.d.) if the device is accidentally reversed when testing. If the l.e.d. is serviceable and correctly polarised the 7mA test current gives a visible light.

This principle could be extended to safely sorting the pinouts of unknown 7-segment displays.

J.A. Morton,
Sowerby Bridge, W. Yorks.

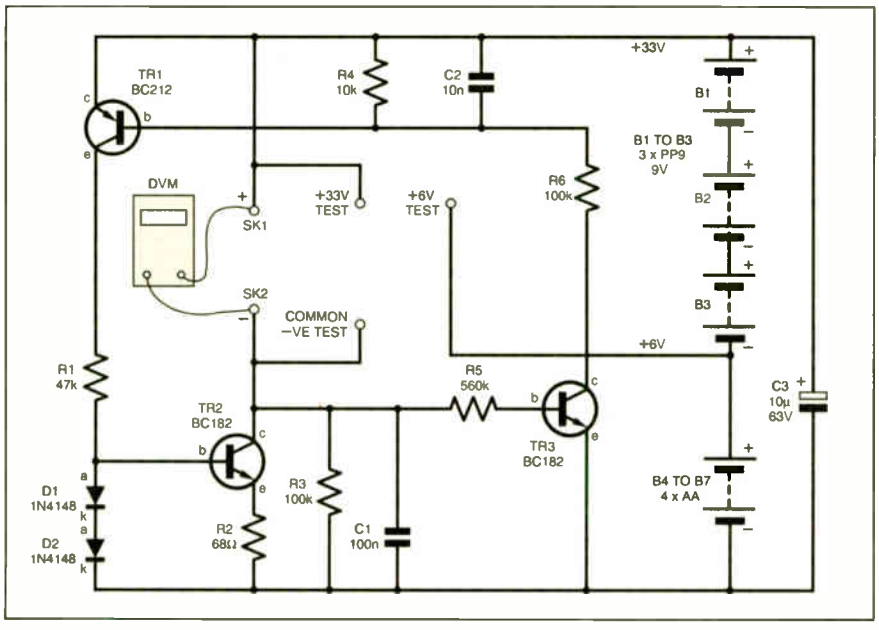

Fig. 1. Circuit diagram for a simple Zener Diode Tester. Note that capacitors C1 and C2 are disc ceramic types.

WHY NOT SEND US YOUR CIRCUIT IDEA? Earn some extra cash and possibly a prize!

Cupboard Door Monitor – Shut That Door

THE circuit diagram of Fig.2 emits a beep (more like a wail) every time a cupboard (closet) door is opened. It sounds somewhat like a cat's "miaow" – which is an ideal warning noise for a cat-hater *(You beast! Ed)*!

The circuit is very simple, and is based on a CMOS 4069 hex-inverter chip, IC1. Gates IC1a and IC1b form an oscillator at about 700Hz, which is buffered by gates IC1c to IC1e. Gate IC1f is unused, so pin 1 is tied to the positive supply to prevent it from floating.

Microswitch S1 is mounted on the cupboard such that it changes over whenever the door is opened. When it does so, capacitor C3 charges up from battery B1, thus powering the circuit for about five seconds.

As C3 charges and the voltage across it rises, the voltage left to the rest of the circuit falls, so generating a falling, diminishing tone. The capacitor is discharged when the door is closed; resistor R3 protecting the switch contacts from damage caused by the charge accumulated on C3.

The piezo disc X1 is driven with two signals of opposite polarity in order to double the amplitude of the signal, so making it louder. If the piezo disc is mounted rigidly on the wood of a cupboard, this acts like a resonator which will amplify the tone.

Battery life is excellent, as the circuit only consumes power when it is actually sounding. If the door is left either closed, or open, no appreciable current flows.

Richard Neill,
Cookham Dean, Berks.

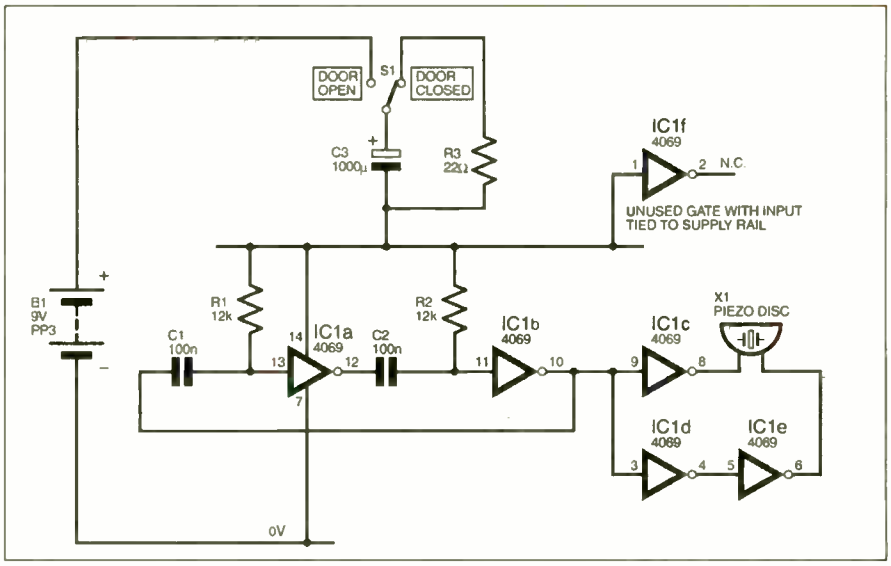

Fig.2. Circuit diagram for the Cupboard Door Monitor.

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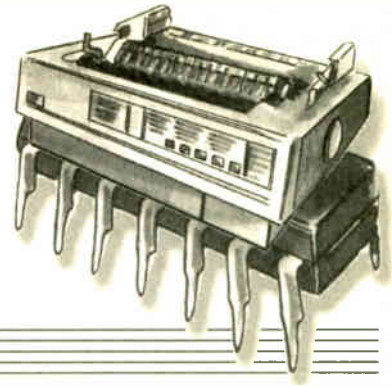
Constructional Project

PIC TO PRINTER INTERFACE



JOHN BECKER

Demonstrates PIC control of Epson dot-matrix printers, and offers a long-term hard-copy data logger.

EPE reader Andy Daw had a letter published in *Readout* March '01. To precis it, he said:

I read with interest the UFO Detector/Recorder *in the January '01 issue. The ingenuity of Raymond Haigh's chart recorder is inspiring. Having once refurbished a chart recorder for recording auroras I know that hard copy recording of analogue events is hard work. What is needed is a cheap and easy method.*

Some people have bought new colour printers and their old dot matrix printers are just sitting in the loft. It would be nice for EPE *to do a PIC-based analogue interface to dot-matrix printers – Z-fold paper for week-long recording, A4 for shorter periods, variable "chart" speed, date stamp and grid lines.*

What a good idea it seemed! And described here is one way of doing it. In fact, it is not at all difficult.

EPSON PRINTERS

A good ten years ago the author investigated Epson printers and how they could be instructed, through GW-Basic and QuickBasic, to print graphics data recorded in connection with a weather centre and other DOS-based designs. Those designs basically output data to the PC's screen and to disk, but the facility to also output screen displays to a printer was deemed to be worthwhile.

Consequently, the author obtained Epson's ESC/P reference manual, a massive tome that details how all the functions of Epson's printers can be controlled. Through it, the desired graphics printout facilities were added (long before the days of Screen Dumps through Windows!).

The introduction to the manual says that:

When Epson created the ESC/P printer control language, the industry standard for sophisticated, efficient operation of dot matrix printers was born.

To ensure that the features on all Epson printers are used to their fullest, this reference manual was created as an aid in creating programs and drivers. In addition, information is included on features and options available on all dot-matrix printers produced by Epson for the American, European and non-Japanese Pacific markets.

The manual is applicable to the full Epson range, including ESC/P2 and ESC/P 24-pin printers, and ESC/P 9-pin printers. The latest version, actually dated December 1997, was downloaded free from Epson's web site by the author in February 2001 (see later).

It is to this edition that certain page references are made within this article. The commands used are those which the manual states are backwards compatible with all ESC/P and ESC/P2 models.

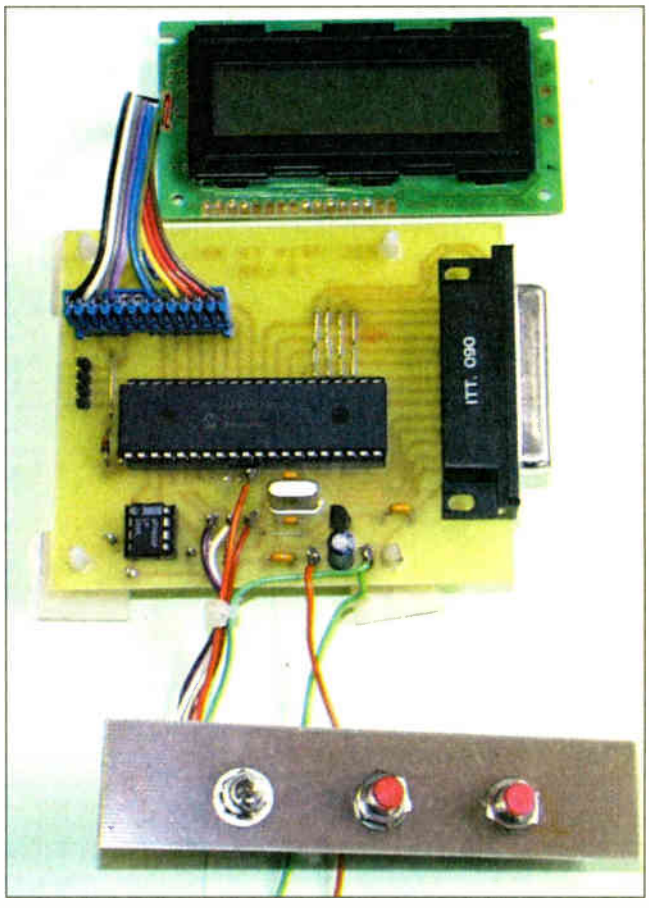
Consequently, it would appear that the interface described here can be used with *any* Epson-compatible dot-matrix printer. As the author has proved, the manual's data is applicable to *some* inkjet colour printers as well. It has been proved with the dot-matrix LQ-550 and LQ-570 and with the inkjet Photo 600 and Stylus Photo 750. A third inkjet printer, though, a Photo 650 purchased in Feb '01, would not respond to the graphics commands from the experimental board, although it did respond to the text commands.

However, the "brief" of this design, as set by Andy Daw, was to show how dot-matrix printers could be controlled. The fact that it can control some inkjets is therefore a bonus!

It is only the simplest of commands that are demonstrated here, showing how text and graphics can be printed under PIC control. The information presented, though, should allow readers to add their own additional printing features according to Epson's commands as listed in their manual, including text font selection (lettering size and style) and enhanced graphics printing.

COMING NEXT

This article first examines how Epson printers are controlled, and then as a practical example, describes the construction of a simple data logger. The logger inputs analogue data having a level between 0V and +5V d.c., converts



Test model that interfaces an external d.c. signal source to a PIC microcontroller which prints it as a graph to an Epson dot-matrix printer.

it to digital and then plots it as a graph on the printer.

The logger has pushbutton-selectable sampling periods, ranging from once per second to once every 255 seconds (4¼ minutes). Data is plotted from the top of the paper downwards, allowing Z-fold (fan-fold) or cut-sheet paper (e.g. A4) to be used.

An hours-minutes-seconds clock facility is built into the controlling software. It starts at zero when sampling is started and the elapsed time is printed to paper after every eight samples. Signal amplitude graph lines (rule lines) are plotted at zero, ¼, ½, ¾ and maximum amplitude intervals.

A non-inverting unity-gain d.c.-coupled op.amp is included on the printed circuit board. It is left to users to add signal amplification or attenuation stages of their own design. These must provide a d.c. output voltage lying between 0V and +5V. Since sampling is intentionally at very slow rates, a.c. coupling of signals seems impractical.

Readers are encouraged to modify the basic PIC software to suit their own needs in other designs. To repeat an earlier statement, the design described here should be regarded as a demonstration of PIC to printer interfacing, but which also has a practical application.

PRINTER TIMINGS

The simplest function that can be performed on a printer is that of printing text, taking advantage of the printer's own character generators. The operation is to output each text character as its ASCII value (the Data), and pulse the printer's Strobe line down and then up. When all characters have been output for a given text line, a "carriage return" command is sent, followed by a "line feed" command.

The order of operations for a single data item is shown in Fig.1.

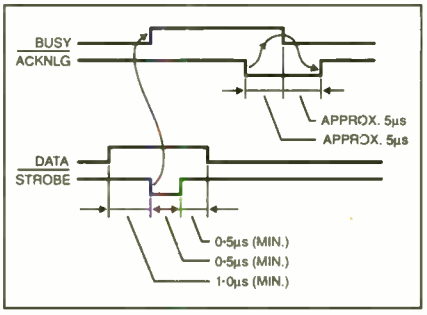


Fig.1. Typical Epson dot-matrix printer control waveforms.

It will be seen in Fig.1 that as well as Data and Strobe, there are two other control waveforms, those for the Busy and Acknowledge lines. The Busy line goes from low (logic 0) to high (logic 1) when the Strobe line goes low. It returns low shortly after the Strobe line returns high. Busy must always return low before the next command is sent.

As shown, there are minimum timing and signal order requirements for the Data, Strobe and Busy lines. The values given in Fig.1 are the "worst case" values quoted in Epson's data; some printers respond more quickly than is indicated. However, it is probably best if you regard the longer timings as the minimum required. That is, send Data, wait 1.0µs, take Strobe low for 0·5µs, wait a further 0.5µs, and then poll the Busy line until it is found to have returned low, after which the next command can be sent.

In simple printing operations the fourth line, Acknowledge, can be ignored. Its timing values are shown for the sake of completeness. However, as will be seen, it can be used to determine whether the printer is switched on and if its cable is connected.

LISTING 1. Send text to printer directly via parallel printer port

```
PORT = &H378:                          ' or &H278 or &H3BC – basic Port address
OUTDATA = PORT:                        ' Data output register (e.g. H378)
INDATA = PORT + 1:                     ' Data input register (e.g. H379)
CTLDATA = PORT + 2:                    ' Control data register (e.g. H37A)
OUT CTLDATA, 254:                      ' binary 11111110 – i.e. bit 0 (Strobe) = 0
A$ = "This is a printer test line":    ' line to be sent to printer
FOR A = 1 TO LEN(A$):                  ' for length of the test line (A$)
D = ASC(MID$(A$, A, 1)):               ' get ASCII value of each character in turn
GOSUB PRINTDATA:                       ' send the value to the printer
NEXT:                                  ' repeat until all done
D = 13:                                ' send carriage return (ASCII 13) to printer
GOSUB PRINTDATA
D = 10:                                ' send line feed command (ASCII 10) to printer
GOSUB PRINTDATA
STOP:                                  ' end of routine

PRINTDATA:                             ' sub-routine in which data is sent to printer
B = INP(INDATA) AND 128                ' read status of Busy line (bit 7)
IF B = 0 THEN GOTO PRINTDATA:          ' wait until bit 7 goes high (= 128)
OUT OUTDATA, D:                        ' send data to printer
OUT CTLDATA, 255:                      ' binary 11111111 – i.e. bit 0 (Strobe) = 1
OUT CTLDATA, 254:                      ' binary 11111110 – i.e. bit 0 (Strobe) = 0
RETURN:                                ' exit sub-routine
```

BASIC DEMONSTRATION

It is easiest, perhaps, to demonstrate the operation of sending text to the printer simply by directly accessing the parallel printer port from the QBasic/QuickBASIC program in Listing 1.

If you have one of these two Basic dialects on your PC, it is suggested that you experiment with the routines in Listing 1 before you spend money on purchasing components for the PIC to Printer Interface, to prove that your printer can be controlled as discussed.

In Listing 1, the first command, PORT = &H378, sets the printer port register address. Register H378 (hex 378) is the one normally encountered on most PCs, but, as regularly highlighted by Robert Penfold in his *Interface* articles, addresses H278 and H3BC may be required by some PCs. If yours does not respond with H378, substitute one of the other addresses as the PORT value until you find which one your machine is set for.

You can also establish the Port register via Windows (95/98), using the path:

My Computer/Control Panel/System/ Device Manager/Ports.

The PORT address (at H378, for instance) is the address of the register used to *output* data to the parallel printer port, which is named as OUTDATA in Listing 1.

Handshaking and other return lines from the printer port are input to the second register address, which is the next address up from the first (e.g. &H379). In Listing 1 this is named INDATA. Control data is sent to the printer by the second address following the first (e.g. H37A), named CTLDATA in Listing 1.

It should be noted that the PC inverts the Strobe line output, hence the apparent contradiction between the Strobe value in Listing 1 and the Strobe value shown in the timing graph of Fig.1.

In Listing 1 it will be seen that Strobe is only pulsed for the duration of one command. With the 120MHz PC on which this routine was tested, the delay between the two commands that toggle Strobe was measured to be about 5µs, more than enough to comply with the timing requirements shown in Fig.1. With PCs having a much faster clock it may be necessary to put a delay between each of the output commands, for example:

```
OUT OUTDATA, D
FOR E = 1 TO DELAY: NEXT
OUT CTLDATA, 255
FOR E = 1 TO DELAY: NEXT
OUT CTLDATA, 254
```

where DELAY might, perhaps, be given a value of 10 (or even much more) in order to extend the Strobe pulse length.

Try Listing 1 on your PC, with the DELAY included until you know whether or not you need it. It will be necessary, of course, to check which PORT value you need to use, as commented earlier.

Immediately on running the program you should hear the printer respond, and then stop. Winding the paper forward a bit you should see that the test message has been printed.

Experiment with sending other messages instead, of differing lengths. If you are feeling adventurous, write a program that sends several lines of text to the printer.

When normally using Basic to print text to a printer, you would simply issue the command LPRINT, A$. What Listing 1 does is to completely bypass the computer's own printing procedure, directly

accessing the printer via the printer port registers.

PRINTER PIN DIRECT ACCESS

For graphics output to the printer, the procedure is just a bit more complicated, but not a lot.

First the printer has to be told that it is to accept a batch of data that it is to treat as its pin-activating (graphics) data. Epson have allocated specific series of ASCII values as command groups that tells the printer it is to treat the next lot of data in a different way than if it were to receive text data (Epson manual pages C-2 to C-8 – Command Lists).

Note that all values from hereon are quoted in decimal unless stated otherwise.

The first control command is ASCII 27, which is also known as the ESCAPE command, ESC for short. It is, perhaps, after this command name that Epson's printers are known as ESC/P and ESC/P2. It is a command that has to precede any group of control commands.

To put the printer into its "command" mode, the ESC command (27) is sent to the printer in the same way that text data was sent in Listing 1:

```
D = 27: GOSUB PRINTDATA
```

Next the ASCII value 42 (the asterisk symbol) is sent, telling the printer that it is being put into one of its graphics modes (Select Bit Image, page C-176).

```
D = 42: GOSUB PRINTDATA
```

DOT DENSITY

It is now necessary to tell the printer the dot density required and the number of graphics data bytes that will follow.

In the Epson manual (C-177/8 – Dot Density), tables give the value that should be sent to set the required density. The value used by the author with his 24-pin printers is 6. This sets the horizontal density at 90 dots per inch (dpi), a vertical density of 60 dpi, with adjacent dot printing, 8 dots per column, and 1 byte per column. (For a 9-pin ESC/P printer this value would produce the same results for all parameters except vertical density, which would become 72 dpi.) The density setting is thus sent as:

```
D = 6: GOSUB PRINTDATA
```

The number of graphics data bytes to be sent will vary with what we want to send to the printer. Let's suppose we want to send 300 bytes.

The quantity value is sent as two 8-bit bytes (page C-176), first LSB (least significant byte) followed by MSB (most significant byte). The MSB is obtained by dividing the quantity by 256 and ignoring the remaining fraction. In this case the MSB is 300/256 = 1. The LSB is simply 300 minus the MSB times 256, which is 300 – (1 × 256) = 44.

In Basic, the calculation can be done as:

```
MSB = 300\256: LSB = 300 – (MSB * 256)
```

where the backslash ("\") division command automatically tells Basic that the MSB is to be an integer. Another way of doing it would be to use the integer command (INT) with the forward slash division command ("/") and say: MSB = INT(300/256). You could alternatively use the MOD (modulo) command to obtain the LSB, i.e. LSB = 300 MOD 256.

The number of data bytes that will follow is thus sent as:

```
D = LSB: GOSUB PRINTDATA
D = MSB: GOSUB PRINTDATA
```

Now the next 300 data bytes will be treated as instructions to the printer that it is to activate its pins according to the binary representation of the data value received. The printer head automatically moves across the paper by one position for each data byte received. The amount of forward movement is according to the horizontal density value previously set.

GRAPHICS IMAGE

To understand how a graphics image can be printed, imagine that an 8-pin print head has its pins numbered as follows:

Pin 7 (top)	= 128 (binary bit 7)
Pin 6	= 64 (binary bit 6)
Pin 5	= 32 (binary bit 5)
Pin 4	= 16 (binary bit 4)
Pin 3	= 8 (binary bit 3)
Pin 2	= 4 (binary bit 2)
Pin 1	= 2 (binary bit 1)
Pin 0 (bottom)	= 1 (binary bit 0)

To activate the topmost pin (pin 7), you would simply send a decimal value of 128. To activate pins 5 and 3 together you would send (32 + 8 = 40). To activate them all together you would send 255 (the total of all bit values).

For example, you could send 300 bytes of data that would activate the pins in a strict incrementing sequence from 0 to 255, roll over to zero and then continue upwards again until all 300 bytes had been sent.

Such a sequence, following the sending of the data quantity LSB/MSB, would be sent as:

```
D = 0
FOR A = 1 to 300
GOSUB PRINTDATA
D = (D + 1) AND 255
NEXT
D = 13: ' carriage return
GOSUB PRINTDATA
D = 10: ' line feed (optional)
GOSUB PRINTDATA
```

where D is incremented by one each time round the loop, with the AND 255 statement limiting D to a maximum value of 255, after which it repeats incrementing again from zero. Try it, and observe the pattern created on the paper.

Note that after the full batch of data has been sent for any line, a carriage return command (ASCII 13) must always be sent. It may often be desirable (but not essential) to follow it by sending a line feed command (ASCII 10). The latter depends on whether or not you actually want the paper to move upwards by one step.

EQUALITY

It is important to note that if the amount of data sent does not correspond to the amount that the printer is expecting (as advised by sending the LSB/MSB earlier), the printer will not respond correctly.

If too little data is sent, the printer will wait until more is received, probably not having actually printed any data to the paper yet. If too much is sent, the printer is likely to consider the excess data as text characters, and some strange symbols may well be printed.

Always send the same amount of graphics data as is expected, and follow that data by a carriage return. (It is not necessary to tell the printer how many *text* characters are to be sent.)

It is necessary to always precede any batch of graphics data bytes with the commands discussed, i.e.:

```
D = 27:  GOSUB PRINTDATA
D = 42:  GOSUB PRINTDATA
D = 6:  GOSUB PRINTDATA (or value
        selected from C-176/8)
D = LSB: GOSUB PRINTDATA
D = MSB: GOSUB PRINTDATA
(Now send all graphics values as required)
D = 13:  GOSUB PRINTDATA
```

PRINTER INITIALISING

All the foregoing has been carried out on the assumption that the printer is freshly switched on and has not been used in any other way. In other words, it is still in its Reset mode, as is actioned at the time of switch on.

However, such might not be the case – the printer may already have had other commands sent to it by another program, commands which may not apply to the way in which you wish to use the printer.

Consequently, prior to sending data to the printer, it is preferable that you ensure it is in the mode required. The first set of commands to be sent, therefore, is a pair of Reset commands. These take the following form (page C-199 – Initialize Printer):

```
D = 27: GOSUB PRINTDATA: ' ESC
D = 64: GOSUB PRINTDATA: ' @ symbol
```

It is then desirable (but not always necessary) that you set the line spacing that the printer will increment by each time the line feed command is given. For the PIC interface to be described later, an increment of 24/180-inch has been selected to suit the graph to be drawn. The manual shows the requirements on page C-55 (Set N/180 Inch Line Spacing).

```
D = 27: GOSUB PRINTDATA: ' ESC
D = 51: GOSUB PRINTDATA: ' ASCII
value for symbol "3"
N = 24: D = N: GOSUB PRINTDATA:
' where N sets the spacing
```

All five commands should be sent before sending other data.

PIC EQUIVALENT CODE

Let's now show how the Basic codings are translated to PIC. There's actually not a lot difference! For instance:

```
MOVLW 27
CALL PRINTIT
```

is the PIC equivalent of the Basic:

```
D = 27: GOSUB PRINTDATA
```

LISTING 2. Printer Initialisation

```
INITPRINTER:    ;
   MOVLW 27     ; ESC
   CALL PRINTIT ; send to printer
   MOVLW 64     ; @
   CALL PRINTIT ; send to printer
   RETURN
```

LISTING 3. Set n/180 line spacing

```
SETLINE:          ;
   MOVLW 27       ; ESC
   CALL PRINTIT
   MOVLW 51       ; 3
   CALL PRINTIT
   MOVLW 24       ; n = 24
   CALL PRINTIT
   RETURN
```

The essential command routines are shown in Listings 2 to 7.

In these listings, the PIC's Port addresses and their order of pin-to-function allocation have been set previously to suit the layout on the printed circuit board, more on which later.

It is worth noting that different Port and pin allocations can be used to suit other applications of your own design, with the software amended accordingly.

The NOP pauses in the PRINTIT routine provide a delay of about 1μs when the PIC is controlled by a 4MHz crystal. The pause will be somewhat longer when a 3·2768MHz crystal is used, as it is in the accompanying circuit design.

LISTING 4. Send data to printer

```
PRINTIT:  MOVWF PORTD          ; output data val held in W
   NOP                         ; 1 cycle pause – about 1 microsecond
   MOVLW STROBELO              ;
   MOVWF PORTC                 ; output STROBE low to printer
   NOP                         ; 1 cycle pause – about 1 microsecond
   MOVLW STROBEHI              ;
   MOVWF PORTC                 ; output STROBE high to printer
   NOP                         ; 1 cycle pause – about 1 microsecond
WAITBUSY: BTFSC PORTC,BUSY     ; wait till BUSY goes low
   GOTO WAITBUSY
   RETURN
```

Believe it or not, that is basically all there is to sending data to the printer from a PIC. However, one other principle aspect will be discussed later: how to plot a continuous graph to paper when data logging.

First, though, a practical circuit design for PIC-controlling an Epson dot-matrix printer is described.

INTERFACE CIRCUIT DIAGRAM

A PIC16F877 microcontroller was chosen as the base through which PIC to printer interfacing could be demonstrated. The circuit diagram is shown in Fig.2.

In brief, IC2 is the PIC microcontroller, which is operated at 3·2768MHz as set by crystal X1. Op.amp IC1a is configured as a d.c. unity gain buffer whose output is fed to one of IC2's analogue-to-digital conversion (ADC) pins, RA0/AN0.

LISTING 5.
Carriage return command

```
CARRIAGE:
   MOVLW 13    ; cause carriage return
   CALL PRINTIT
   RETURN
```

LISTING 6. Line feed command

```
LINEFEED:
   MOVLW 10          ; line feed
   CALL PRINTIT
   RETURN
```

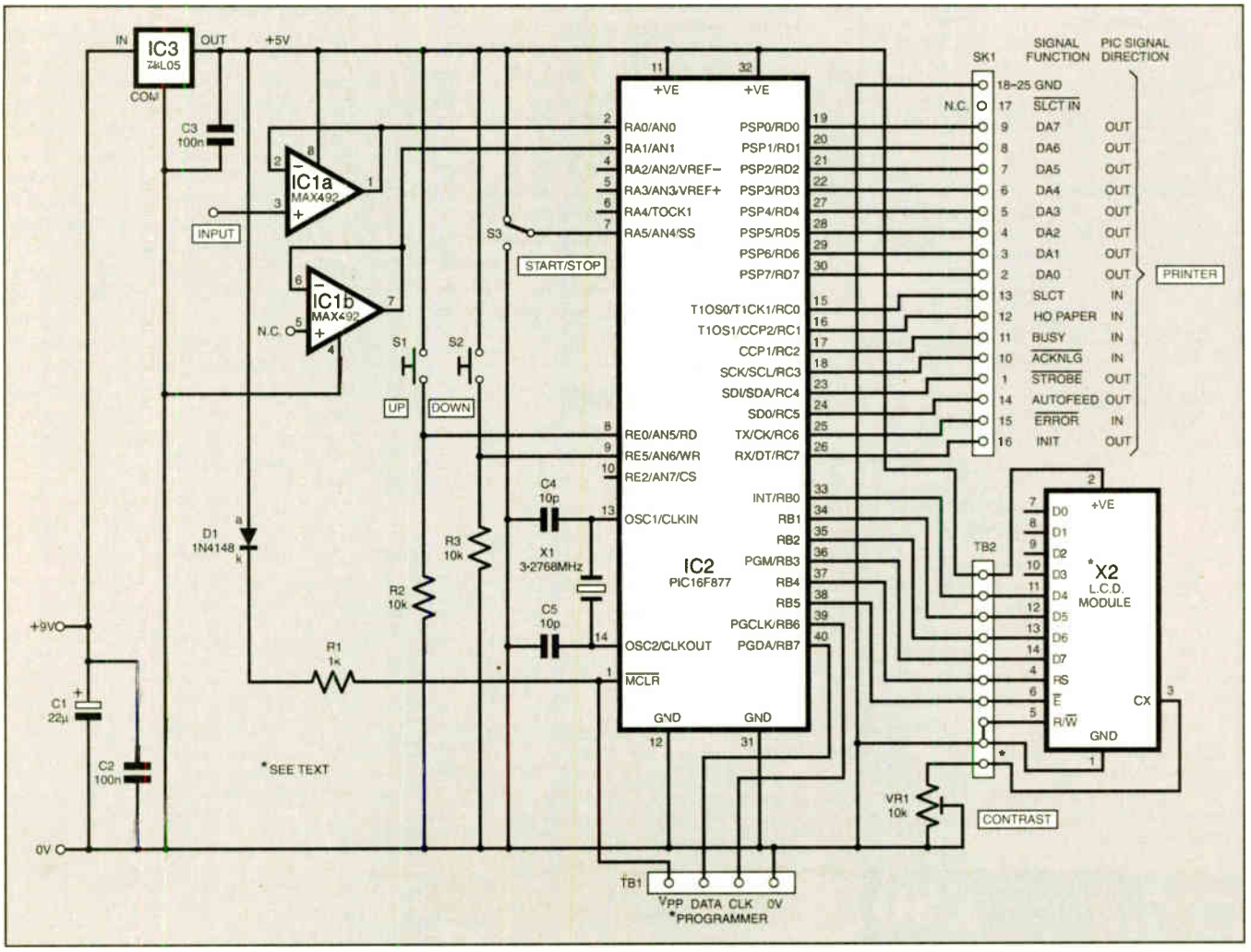


Fig.2. Complete circuit diagram for the PIC to printer data logging interface.

LISTING 7.

Set line length command

```
LINELENGTH:
   MOVF LSB,W   ; get LSB, set previously
   CALL PRINTIT ; send LSB
   MOVF MSB,W   ; get MSB, set previously
   CALL PRINTIT ; send MSB
   RETURN
```

A second op.amp buffer, IC1b, is shown but it is not actually used in this design. You might find it useful if writing your own software for some other application.

Pushbutton switches S1 and S2 allow the PIC's data sampling rate to be set up or down (range one sample every 1 to 255 seconds). Switch S3 causes the PIC to start or stop sampling and printing.

Liquid crystal display module X2 provides visual readout for various messages to help in your use of the design as a data logger. Its connections and controlling software are the same as has become traditional for this author's PIC-based designs that use alphanumeric l.c.d.s. Preset potentiometer VR1 sets the l.c.d.'s contrast.

COMPONENTS

See SHOP TALK page

Resistors

R1	1k
R2, R3	10k (2 off)

All 0·25W 5% carbon film

Potentiometer

VR1	10k preset, min. round

Capacitors

C1	22μ radial elect. 16V
C2, C3	100n min. ceramic (2 off)
C4, C5	10p min. ceramic

Semiconductors

D1	1N4148 signal diode
IC1	MAX492 dual rail-to-rail op.amp (or similar)
IC2	PIC16F877 PIC microcontroller (see text)
IC3	78L05 +5V voltage regulator

Miscellaneous

S1, S2	s.p. min. push-to-make switch (2 off)
S3	s.p.d.t. min. toggle switch
SK1	25-way Centronics connector, female, right-angled, p.c.b. mounting
X1	3·2768MHz crystal
X2	2-line 16-character (per line) alphanumeric display
TB1	4-way pin-header strip
TB2	4-way + 6-way pin-header strips

Printed circuit board, available from the *EPE PCB Service*, code 308; case to suit (see text); 8-pin d.i.l. socket; 40-pin d.i.l. socket; p.c.b. supports (4 off); connectors to suit TB1 and TB2; connecting wire; solder, etc.

Approx. Cost Guidance Only **£30** *excluding case.*

TABLE 1. Printer Connector Pin Functions

Pin	Signal	Direction	Function
1	STROBE	In	STROBE pulse for printer to read incoming data. Pulse width must be more than 0.5μs.
2 to 9	DATA 1 to 8	In	These signals present information of bits1 to 8 of parallel data, respectively. Bit1 = LSB, Bit 8 = MSB. Logic 1 = High, Logic 0 = Low.
10	ACKNLG	Out	About an 11μs pulse. Low indicates that data has been received and that the printer is ready to accept more data.
11	BUSY	Out	A High signal indicates that the printer cannot receive data. The signal goes High in the following cases: 1. During data entry 2. During printing 3. When off-line 4. During printer error state
12	PAPER	Out	A High signal indicates that the printer is out of paper.
13	SELCT	Out	Pulled up to +5V through a 3k3 resistance.
14	AUTO FEED	In	When this signal is Low, the paper is automatically fed 1 line after printing.
15	NC		Not used
16	GND		Logic ground level
17	CHASSIS GND		Printer's chassis ground which is isolated from the logic ground.
18	NC		Not used
19 to 30	GND		Twisted pair return signal ground level.
31	INIT	In	When this becomes Low, the printer controller is reset to its power-up state and the printer buffer is cleared. This level is normally High. Its pulse width must be more that 50μs.
32	ERROR	Out	This level becomes Low when the printer is: in paper out state; off-line; in error state.
33	GND		Same as for pins 19 to 30
34	NC		Not used
35	–	Out	Pulled up to +5V through a 3k3 resistance.
36	SLCT IN	In	The level of this signal is factory-set to Low (see Epson manual).

PROGRAMMING

The PIC can be programmed on-board via the TB1 connector pins, which are in the author's standard order. *PIC Toolkit Mk2* is a suitable unit for programming the software into the PIC. Diode D1 and resistor R1 prevent distress to the circuit's 5V supply when programming is in progress.

The circuit may be used with a d.c. power supply of between about 7V and 15V. IC3 regulates the input voltage down to the 5V supply required by the circuit. *This 5V voltage level must not be significantly exceeded for fear of damaging the PIC, l.c.d. and printer.* A deviation of about 10 per cent (but no more) is permissible.

PRINTER CONNECTIONS

Refer now to Fig.3 and to Table 1. Fig.3 shows the connections at the printer (36 pins) and at what is normally the computer end of the setup (25 pins). Table 1 shows the pin assignments for the standard 36-way Centronics parallel interface connector, as used at the printer end.

The demo p.c.b. uses a 25-pin connector so that a standard Centronics printer cable can be used between the unit and the printer. If you have a printer you should already have this cable!

CONNECTION FUNCTIONS

In the earlier discussions, we examined the functions for the DATA, BUSY and ACKNLG lines. It seems unlikely that the PAPER, ERROR, AUTO FEED and INIT functions listed in Table 1 will find use in a PIC-controlled printer interface.

For the first two functions, the reading of the BUSY line provides the answer to whether or not the PIC is to send more data. Line Feed and Initialisation (INIT) functions can be performed through software. Functions SLCT and SLCT IN are probably only of use when several printers are chained. See the Epson manual for details of the functions not discussed.

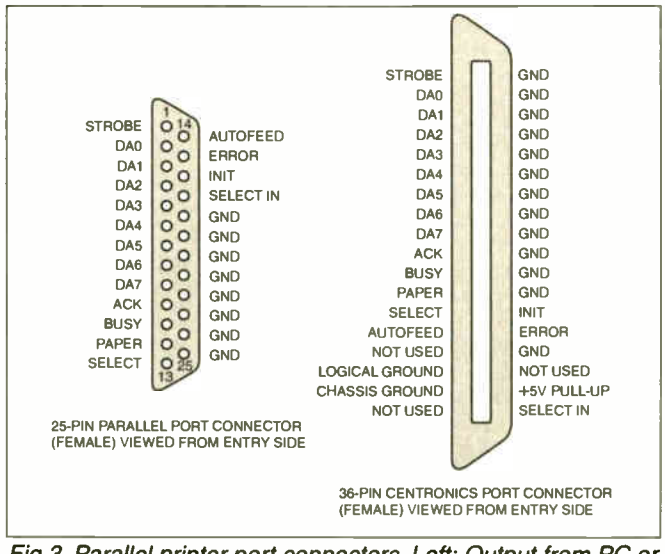


Fig.3. Parallel printer port connectors. Left: Output from PC or PIC to printer interface. Right: Input to dot-matrix printer.

Although some functions are not implemented through the demo software, the p.c.b. provides connections between the PIC and all function lines except SLCT IN.

Data lines are connected to PIC PORTD, and Control lines to PORTC. If you are designing a board for another circuit of your own invention, you could probably omit the PIC connections for the SLCT, PAPER, ACKNLG, AUTO FEED, ERROR and INIT functions. This would allow you to control the printer via only 10 lines, DATA × 8, STROBE and BUSY.

Consequently, if the ADC and l.c.d. readout facilities are not needed, you could actually control the printer from a PIC16F84. This would leave three pins for other purposes. The use of the DATA lines could also be multiplexed between the printer and other external circuits.

It would seem desirable to connect a resistor between the printer's unused *inputs* and 0V or +5V (see Table 1 for which power level is appropriate for which pin). A suggested resistor value is 3k3 – as used by Epson on a couple of lines as shown in Table 1).

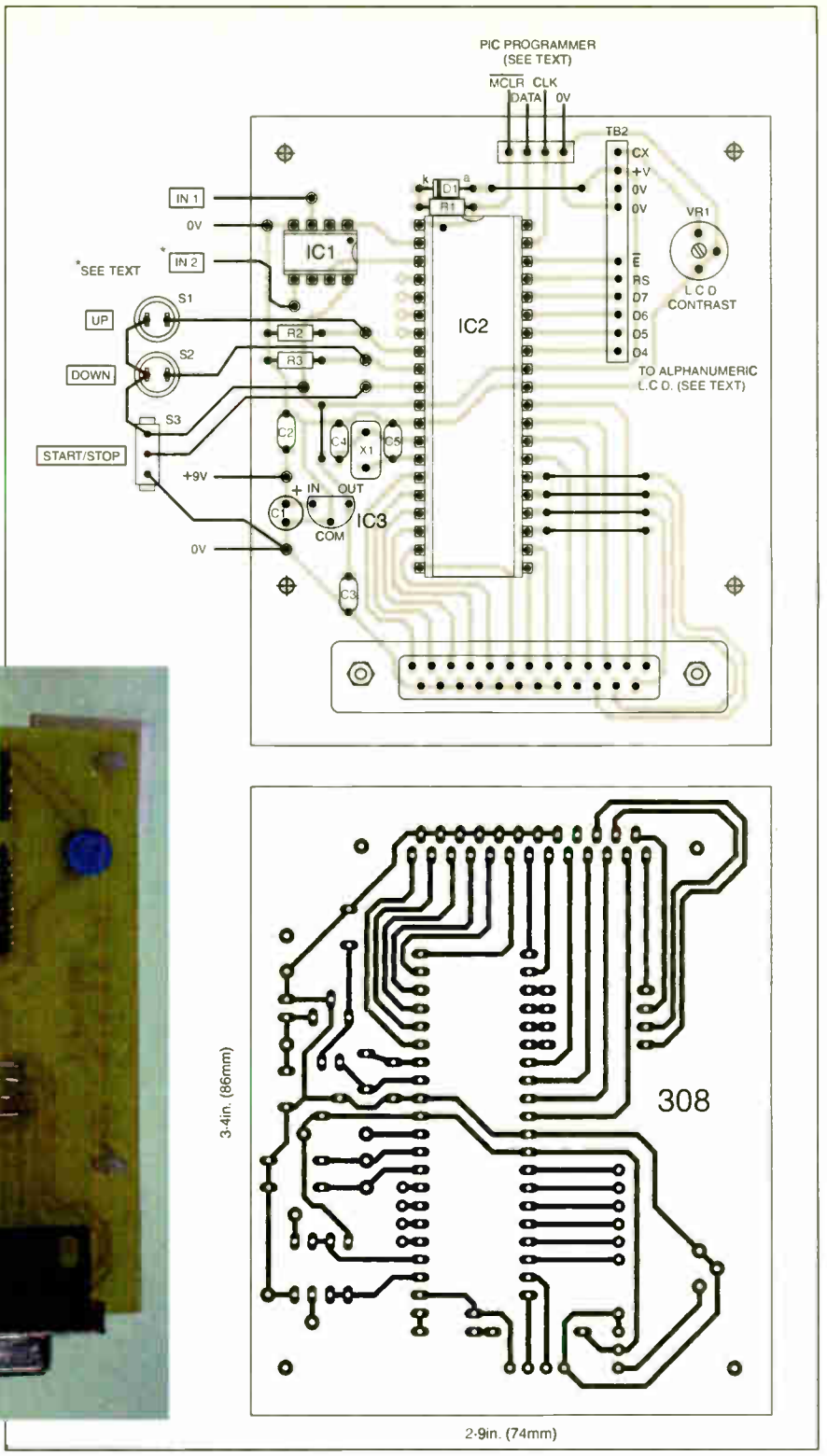


Fig.4. Printed circuit board component layout and full-size master track pattern.

CONSTRUCTION

The printed circuit board component and track layouts for this interface are shown in Fig.4. The board is available from the *EPE PCB Service*, code 308.

First insert and solder the few wire links, then the two d.i.l. i.c. sockets, followed by the remaining small electronic components. Conclude with connectors TB1, TB2 and SK1, and then wire up the switches and power supply.

As seen in the photographs, the prototype was not mounted in a case and the choice of style for this is left to you.

Do not insert IC1 and IC2 or connect the l.c.d. until you have ascertained that the power supply is being correctly regulated down to +5V by IC3.

The PIC microcontroller can be programmed on-board via the TB1 connector, a function which can be performed by *Toolkit Mk2*. The software is available as stated later.

If you intend to use the design simply as a data logger with printer output, you may prefer to use a pre-programmed PIC – they are available as stated in *Shoptalk*.

Before running the unit, first switch S3 to the Stop position. On power-up the programmed PIC will cause a opening message to be displayed on the l.c.d. screen:

SET RATE PRD= 2 on line 1. and WAITING START on line 2.

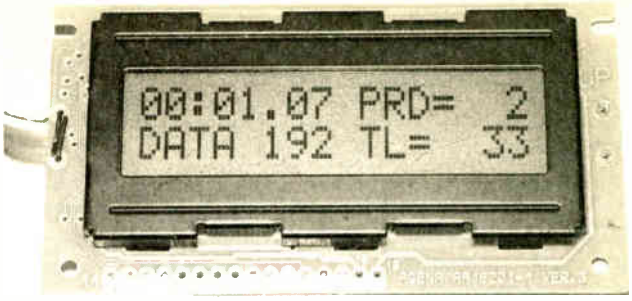
The value of PRD= 2 shows that the sampling rate is set for taking samples once every two seconds. The period may be increased, up to once every 255 seconds, by pressing and holding down pushbutton switch S1. The value increments at a rate of twice per second. After 255 has been reached, the sample rate rolls over to 1 (second per sample), omitting the zero step.

Switch S2 allows the rate to be decremented, rolling over to 255 following 1. The sampling rate can only be set prior to switching on S3.

OVER-ACTIVE

It may, incidentally, be found that some printers seem a bit over-active if a

L.C.D. screen prior to printing data to printer.



Typical l.c.d. screen during printing.

sampling rate of once per second is chosen, hence the default value of 2. This was the case for the author's inkjet colour printer, although once per second did not make his dot-matrix printers seem over-active.

When S3 is switched, the message on the screen changes to just show the period (PRD) value on line 1, whilst line 2 changes to state WAITING PRINTER. If the printer is not ready (not switched on, cable omitted, paper out, etc), the screen will remain in this mode until the printer is ready.

The printer's status is first determined by reading its ACK line, with the statements:

```
WAITACK:  BTFSS PORTC,ACK
.         GOTO WAITACK
```

This causes the program to wait until the ACK line goes high, which is its normal status when the printer is switched on.

Then, once ACK is high, and as part of the sending data process, the BUSY line is read to determine if it is low, as discussed earlier.

CLOCKING-UP

When the printer is ready the l.c.d. top line will display an hour-minutes-seconds clock counter, counting upwards from zero. The clock counts in seconds intervals, irrespective of the sampling rate selected. Note that it will stop counting if the printer detects an error condition (paper out, etc). It will not detect if the printer is switched off since BUSY will automatically go low in this instance, or if the cable is disconnected.

Line two shows the value of the last sample that the PIC has taken via its analogue input, RA0, ranging between 0 (0V) and 255 (+5V approximately – actually the line voltage value at which the PIC is being powered).

If no signal input is applied to the op.amp, IC1a, the PIC's RA0 input will see a voltage midway between the two power voltages, about 2·5V, resulting in a DATA value of around 127.

At the right of line 2, a counter keeps track of the number of samples taken since printing commenced, e.g. TL= 9. TL can reach 9999, after which it rolls over to zero and starts counting upwards again.

When the printer starts running following S3 being switched on, a text line is printed first, confirming the sampling rate, e.g.:

SAMPLING SET FOR ONCE PER 10 SECONDS

A second line is then printed which corresponds with graph lines that are printed while samples are plotted. The intervals are 0, ¼, ½, ¾ and MAX.

From then on, sampling clock time is printed at the left of paper, once every eight samples. The printer then prints a series of dots between the value of the previous sample and the current one, so drawing what is effectively a continuous graph line.

It is up to you to actually write on the paper the actual date and time that printing commences.

The full graph sweep is from 0 to 255. If a sample has the same value as the previous one, a single dot is placed beside the last one (as one would expect, of course!).

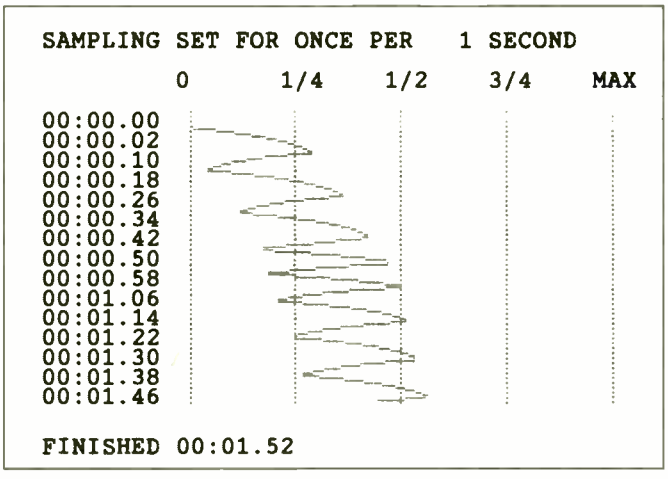


Fig.5. Example printout of waveform received by the PIC to Printer Interface.

TERMINATING

Sampling and printing may be terminated at any time by switching off S3. The printer responds by printing the finishing time (elapsed time since printing began). Then follow two line feeds, and the printer stops. The l.c.d. screen reverts to showing WAITING START (etc) when S3 is switched off.

Note that the printer may actually continue to print for a short while after S3 has been switched off, emptying its buffer memory of any remaining data.

Also be aware that S3 being switched off will not be responded to if the printer is in an error condition. To terminate the PIC sampling routine in such an instance, the error condition must either be removed, or the PIC's power supply switched off. No harm can come to the PIC while it is held "in limbo" by a printer error, it simply sits in a holding loop until the BUSY line goes low.

To test the unit, it suggested that you first leave the input to IC1a unconnected, causing a midway-value trace to be plotted by the printer. Next, using a meter lead perhaps, connect IC1's input to 0V for a while, after which connect it to the 5V rail for a further period. The printed graph should show all three sampling voltage levels, min, mid and max.

DATA REVERSAL

The software uses variations on the control routines discussed earlier in the article. There are two aspects, though, that deserve further discussion. First, a "reversal" of the data sent to the printer:

The printed circuit board has been configured so that connections to the 25-pin socket are made in the most convenient order, without lots of cross-over links. This has meant that the pinouts from DATA PORTD are in the opposite order in relation to the DATA pins of connecter SK1.

Consequently, on entry to the PRINTIT routine a data byte reversal routine is first called (REVERSE – see Listing 8) which rearranges the binary logic to the correct bit order. For instance, binary 10101010 becomes 01010101.

RASTERFAREAN

The second aspect concerns the way in which adjacent sampling values are plotted:

LISTING 8. Reverse order of bits to suit p.c.b. layout

```
REVERSE:  MOVWF STORE1     ; store data val brought in on W
          MOVLW 8          ; set loop val for 8 bits to reverse
          MOVWF LOOPA
REV1:     RRF STORE1,F     ; rotate right STORE1 into Carry
          RLF STORE2,F     ; rotate left Carry into STORE2
          DECFSZ LOOPA,F   ; decrement loop until all 8 bits done
          GOTO REV1
          MOVF STORE2,W    ; call STORE2 into W as reversed order val
          RETURN
```

Each sample value is compared against the previous one. From this the start and end points for the printing of the graph dots for one "raster" line are determined.

From a zero position (beyond the "time stamp"), the printer is fed with a series of zero values, until the dots-start position is reached. Then the dots sequence is commenced, in which just one printer head pin is activated. After this sequence, further zero values are fed to the printer, until a total of 256 printing commands have been issued for that line.

During the 256 commands sequence, the software automatically activates four printer pins at the graph line positions, creating the dotted graph reference lines.

PIN HEAD CYCLE

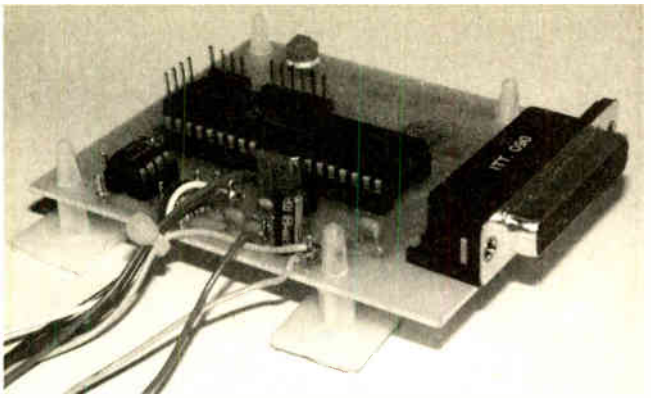
When writing the software, the author recognised two ways in which adjacent printing lines could be kept close, either by shifting the line feed by a very small value, or by changing the pin number activated between adjacent lines. It is this latter technique that is employed.

Track is kept of the number lines being printed. Pins are activated in relation to this count value, on a cycle of eight (effectively, the software establishes the "modulo-8" value of the count).

On the modulo value equalling 0, only pin 7 (value = 128, see earlier) is the one activated for that line. On the next line, pin 6 becomes the only active one (= 64). And so on until pin 0 (= 1), after which the next pin number will again become 7.

Each time the modulo value equals zero, a line feed command is issued, which moves the paper forward by an amount that keeps all line groups equally spaced. Immediately following this, the next elapsed time value is printed.

It is worth noting that the author's *inkjet* printer appears to shift the print head across the paper three times for each sample. This may be a situation for which a prohibitive command might be available, but the author has not investigated it. It is of no significance to the printed results.



CONCLUSION

So there we have it – how a PIC can be interfaced to an Epson-compatible dot-matrix printer, and how you can use this facility as a hard-copy, time stamped, data logger and plotter. Thank you Andy Daw for making the suggestion, the author enjoyed implementing it!

It is hoped that you now feel encouraged to experiment with the many other printer commands described in Epson's reference manual.

RESOURCES

The software for this project was written in TASM and is available as source code, HEX code and OBJ code on 3·5-inch floppy disk from the *EPE* Editorial Office (a nominal handling charge applies). It is also available for free download from the *EPE* ftp site. For more details of both methods, see *Shoptalk* elsewhere in this issue, or the *EPE PCB Service page*.

Epson's web site, from where you can download the free Acrobat-based reference manual, is at **www.epson.com**. There are several files involved. The one that includes all Epson's commands is the first one, **EpsonPart1(1).pdf**, and includes all the "C-" referenced pages mentioned during this article.

It is well worth downloading the other Epson manual files as well, since many other printer control aspects are covered in them, some of which relate to specific models of printer.

All commands discussed earlier are believed to be available on all Epson dot-matrix models.

Incidentally, the software for this PIC to Printer Interface was developed on the author's new *Toolkit TK3 For Windows (Toolkit Mk3)*, which will be published in the October 2001 edition. *TK3* has full stand-alone operation and has *many* functions available, including Internet and MPASM access. □

PERPETUAL PROJECTS

THOMAS SCARBOROUGH

● Solar-Powered – No batteries ● Uses a common – Uniboard – p.c.b.
● Will run indefinitely, without attention ● Ideal for the novice.

A series on "solar powered" projects that will run unattended for months – in fact, for years or even centuries!

THIS four-part series includes eight "*perpetual*" projects, all of which will continue to run indefinitely without attention. All are based on one small p.c.b. called a "*Uniboard*". Each project is powered around the clock – perpetually – by a one Farad "Goldcap" capacitor (memory backup) and a small solar cell (no battery). Each is designed for continuous operation with a maximum of thirty minutes sunlight a day – in fact just *five minutes sunlight* with the specified 300mW solar panel.

In Conception

The concept in itself is a simple one, however it required considerable experimentation, and a little ingenuity, to obtain around-the-clock operation for every project in the series. A number of "micropower" i.c.s were at first tested for suitability, but virtually all fell short – some consuming 60µA, some 100µA, some even 500µA when in use. This was not nearly good enough to see a "Goldcap" through a long night.

Finally, a veteran among i.c.s delivered a nice surprise – the 4093 quad 2-input NAND Schmitt trigger showed that it was capable (for instance) of perpetually flashing an l.e.d. (light-emitting diode) with just 15µA power consumption when the Motorola version (MC14093BCP) was used.

To put this in perspective, the typical power requirements of one of these Perpetual Projects is more than *one thousand times* less than the requirements of an ordinary l.e.d., and *thirty times* less than those of the "efficient" LM3909 l.e.d. flasher i.c.

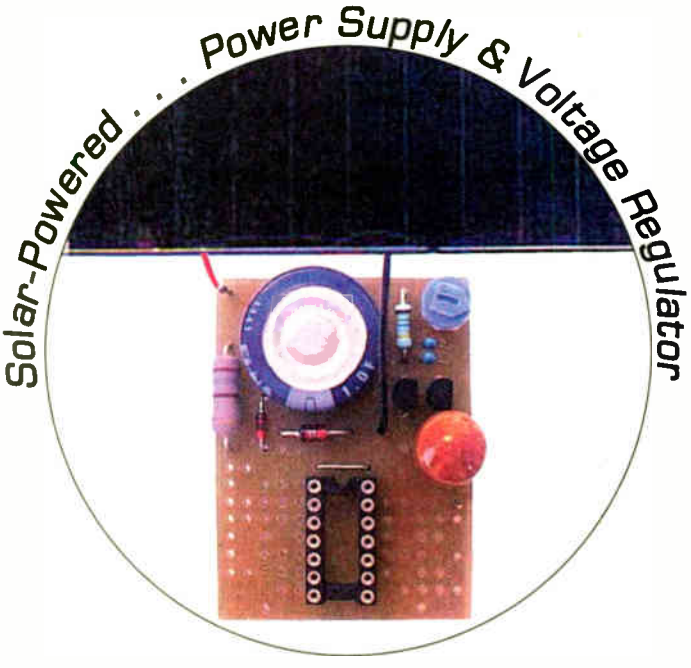
Projects at a glance:

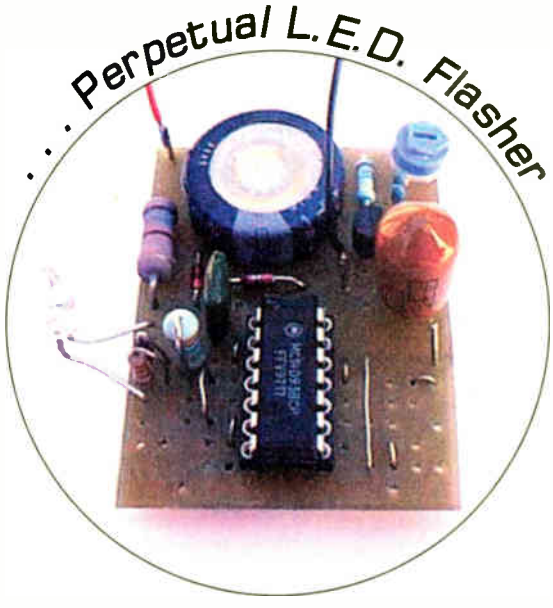
- ☆ ***L.E.D. Flasher***
- ☆ ***Loop Burglar Alarm***
- ☆ ***Double Door-Buzzer***
- ☆ ***Door-Light***
- ☆ ***Rain Alarm***
- ☆ ***Gate Sentinel***
- ☆ ***Bird Scarer***
- ☆ ***Register***

Besides the projects listed here, the series includes nine suggestions for modifications. These include a Single Door-Buzzer, a Broken Beam Beeper, a Power Failure Alarm, a Soil Moisture Monitor, a Thermistor, a Timer, a Liquid-Level Alarm, a Wake-Up Alarm, and a Break Contact Alarm.

Design Considerations

The "all-purpose" 4093 quad 2-input NAND Schmitt trigger i.c. has a great many potential applications. It may even be used as the heart of radio receivers and metal detectors. However, only projects thought to be *practical* perpetual projects have been selected.





A decision was made early on to limit the designs to a single active component, namely the 4093 CMOS i.c. (regulator components excepted). No additional i.c.s or transistors are employed. Thus – it might be said – we have here a series of *pocketable* practical perpetual projects!

Some circuits which seemed to be candidates for the series at first needed to be omitted from the main line-up because they were not strictly "perpetual". Due to higher current consumption, they would have shut down some time before sunrise. Nonetheless, some of them would have been very useful, and are therefore included in the series under "Suggestions".

In particular, those circuits which teetered too long on the edge of triggering (that is, which involved slow-moving analogue signals, such as a thermistor or soil moisture monitor) did not meet the necessary power requirements. If gates are held at a level close to triggering, the 4093 i.c. will consume 60µA at 3V (some makes will consume up to 200µA), although this may be reduced a little with a simple trick.

Under normal circumstances, such power consumption would be negligible – however, power consumption must average 20µA or less to see one of these *Perpetual Projects* around the clock.

It was decided to use *touch switches* throughout the series, since the symbolism of the "perpetual" might be compromised if any mechanical switches were included – particularly if these would interrupt the power supply. The *option* of mechanical switches is included, since touch switches may become troublesome in a wet or damp environment.

Conservation

An important design consideration throughout the series is that, as far as possible, no oscillator should run "in the background" – that is, oscillate while a piezo disc or l.e.d. is disabled. It is possible, for instance, to silence a piezo sounder by switching off a buffer, while the oscillator behind it remains active.

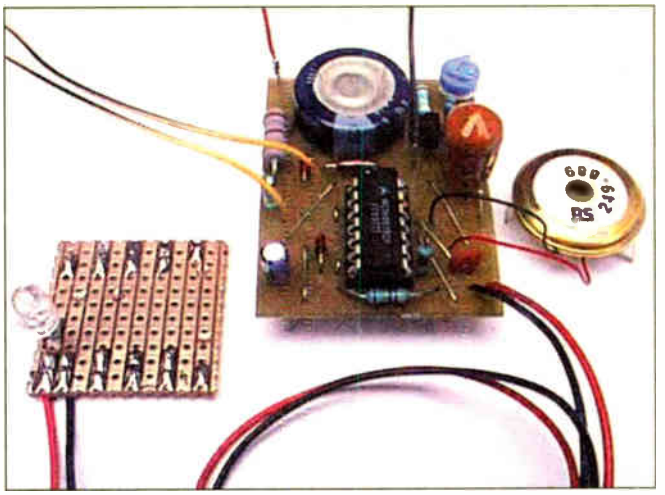
In order to conserve power, each oscillator needs to be shut down when not in use. In some of the projects, such "background" oscillation (if it were permitted) would exhaust the "Goldcap" capacitor well before it could go around the clock.

But first we must turn our attention to the most distinctive aspects of this series – the solar-powered power supply and voltage regulator for all these projects.

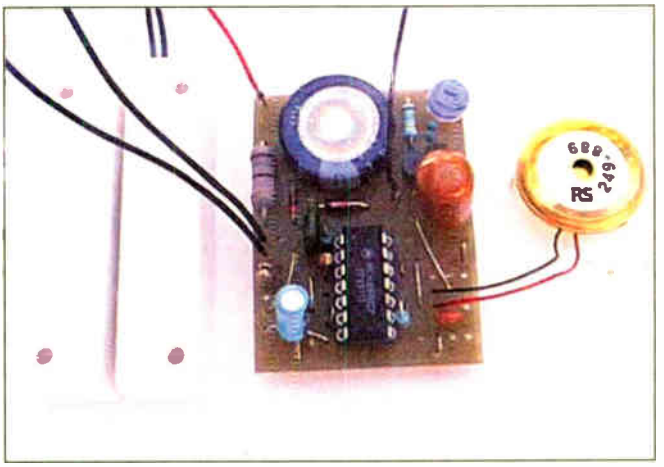
It might be worth noting at this stage that the biggest outlay for the Perpetual Projects lies in the power supply and regulator components. Once these have been purchased, the cost of the projects which follow will be well below £10 each.

It now only remains for you to choose the Perpetual Project that appeals to you and await its publication. Better still, to avoid missing that particular issue, why not place a regular order for *EPE* at your local Newsagent (or take out a Subscription) and experiment with *all* these forthcoming Solar-Powered projects?

. . . Rain Alarm

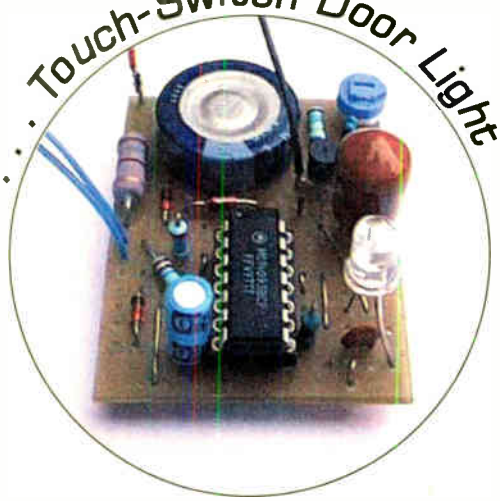


. . . Gate Sentinel

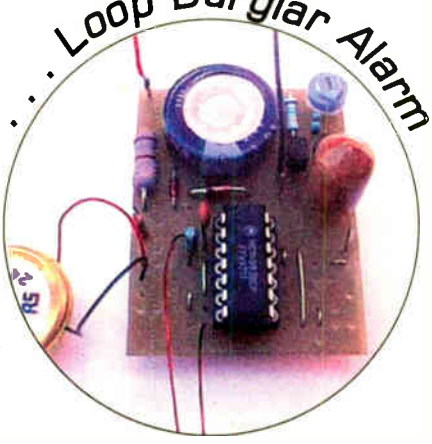


TURN OVER FOR FIRST PROJECT

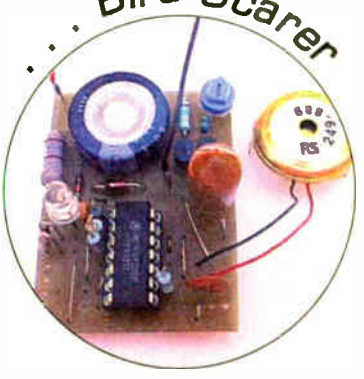
. . . Touch-Switch Door Light



. . . Loop Burglar Alarm



. . . Bird Scarer



Perpetual Project – 1

SOLAR-POWERED POWER SUPPLY & VOLTAGE REGULATOR

THOMAS SCARBOROUGH

Free power for your projects!

BEFORE we undertake the construction of the first practical circuit of our Perpetual Projects for this series (next month) we must consider the power supply requirements and construct a suitable unit that will cater for all the various circuit designs. All the projects are built on a low-cost Uniboard (printed circuit board – one required for each project, unless you are expert at desoldering!), which also includes the Solar-Powered Power Supply and Voltage Regulator circuit described here.

The Solar-Powered supply section is only required once, unless you wish to build and keep all the projects as separate modules. Once the power supply and regulator components have been purchased, the cost of the other projects which follow is in the region of £5 each (excluding p.c.b.).

POWER SUPPLY

The full circuit diagram for the Solar-Powered Power Supply and Voltage Regulator is shown in Fig.1. Capacitor C1 is charged by means of the solar cell X1, which provides 6V to 12V, and 10mA upwards – that is, a relatively small solar cell will provide adequate charge.

Note that 12V should be the maximum actual unloaded output of the solar cell in full sunlight – therefore one having a load voltage rating of 6V or 7·5V will most likely suit. A higher voltage solar panel could be used, but the value of resistor R1 would need to be adjusted so that $V_{MAX}/R<75mA$.

The voltage from the solar cell is regulated by Zener diode D1. Resistor R1 ensures that D1 and rectifier diode D2 are never overloaded. Diode D2 prevents reverse leakage of current, and its inclusion (with solar cell disconnected) extends the charge holding time of C1 more than ten-fold.

Diode D2 drops about 0·7V, therefore the highest voltage that will be found across capacitor C1 is 4·9V. This ensures far better regulation than if C1 were charged to capacity – in fact, a fully charged C1 does not confer much more life on the circuit. Note that capacitor C1 should never be *directly* attached to the solar cell, since its maximum rating is 5·5V. It is easily damaged, as well as expensive, and needs to be treated with care.

Capacitor C1 is quickly charged in full sunlight. With a small 6V 10mA solar cell receiving full sunlight, it will be fully charged within 30 minutes. A 12V 100mA solar cell will charge C1 *in less than a minute*.

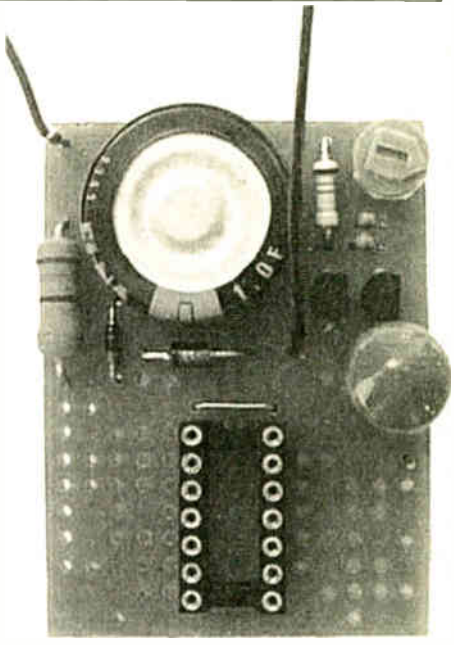
Capacitor C1 cannot be over-charged, nor can the solar cell overload any of the projects, so long as its maximum output is an *actual* 6V to 12V.

VOLTAGE REGULATION

A capacitor behaves very differently to a battery, in that a battery's voltage goes into gradual decline as it discharges, while a capacitor's voltage generally goes into a "free-fall", then levels out as it reaches a fraction of its starting-point.

Therefore, the secret to obtaining any useful long-term service from a capacitor is to *regulate* its rapidly falling voltage. In this case, this is achieved with the help of bipolar transistor TR1 and f.e.t. TR2.

Field effect transistor (f.e.t.) TR2 is employed in such a way that its conductance is automatically adjusted to keep a constant voltage across capacitor C2 as the voltage across C1 falls. A f.e.t. was chosen for this purpose since its conductance is voltage- (or field effect) controlled, and it therefore draws only a minute current – a very necessary feature in this application.



The control voltage is provided at the collector (c) of bipolar transistor TR1, which forms part of a variable potential divider, through preset VR1 and thermistors R3 and R4. As the voltage across C1 decreases, so the conductance of TR1 decreases, and the potential at TR1's collector rises. This in turn increases the conductance of TR2.

During the testing of the *Perpetual L.E.D. Flasher* project (next month), the voltage across capacitor C2 held steady for 20 hours before beginning to slip, and had fallen only 5 per cent after 26 hours.

A bipolar transistor with high or medium gain does not serve well in the position of TR1, and a very low gain transistor, the TIPP31C

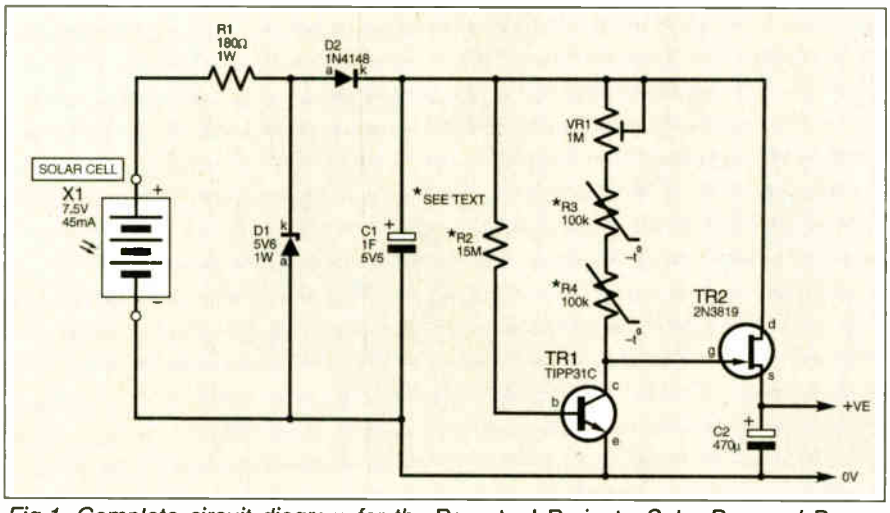


Fig.1. Complete circuit diagram for the Perpetual Projects *Solar-Powered Power Supply and Voltage Regulator.*

(nominal gain 25) is employed. The TIPP31 and TIPP31B (but *not* the TIPP31A) were also tested successfully. Other equivalents should be chosen with great care.

The f.e.t. regulator consumes around 5µA. A low leakage capacitor should be chosen for C2, since higher leakage can significantly reduce the life of the power supply.

Several types of regulator were tried, but all except two fell short – chiefly because of excessive current drain, or because the voltage across C2 dropped too fast. The present regulator has proved to be the best so far, but it does, however, have one drawback. The more efficient the circuit (the efficiency being determined by resistor R2, thermistors R3, R4, and preset VR1), the more sensitive it becomes to temperature variations.

Therefore, thermistors R3 and R4 are inserted in the variable potential divider incorporating TR1 and VR1. This largely balances the effects of temperature on transistor TR1. The thermistors should be "common" types designed for use between –25°C and +125°C (plus or minus 25°C) – not "industrial" types that might take molten lead in their stride!

IN COMPARISON

An interesting (but very approximate) comparison is made in Table 1 between C1 (a 1 farad memory retention capacitor) and an AA nickel-cadmium rechargeable battery. This also gives a rule of thumb for determining the length of service of any particular project in this series.

The anticipated hours of service of any given Perpetual Project are calculated by dividing capacity (mAh) by actual current consumption (mA).

CONSTRUCTION

Construction of the Solar-Powered Power Supply and Voltage Regulator, which lies at the heart of the series, is fairly straightforward and once the regulator has been constructed, it is over to you to choose which specific project you would like to add to your Uniboard.

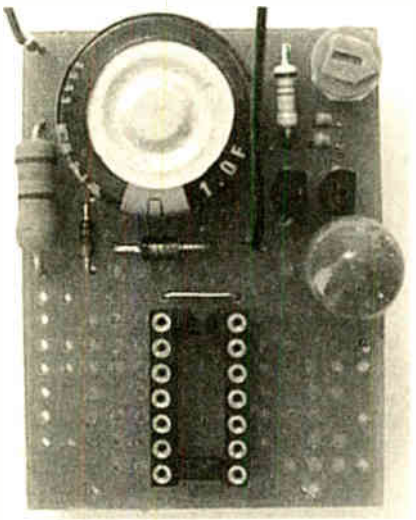
Note that all the projects may also be run off batteries. In this case, the solar cell and "GoldCap" capacitor (C1) may be omitted during construction, as well as R1, D1, and D2. A 4·5V battery supply (three AA batteries in series) is connected in place of C1. Be sure to observe the correct polarity.

Table 1: Comparison between an AA type NiCad and the 1 farad ("GoldCap") capacitor, with f.e.t. regulator

AA nickel-cadmium (rechargeable)		*One farad capacitor with regulator*	
Nominal Voltage:	1·2V	Nominal Voltage:	3V
Nominal Capacity:	500mAh	Nominal Capacity:	0·5mAh
Average Life:	1000 cycles	Average Life:	"Infinite" cycles
Average Charge Time:	14 hours	Average Charge Time:	5 minutes
Shelf Life:	1 year	Shelf Life:	1 day

Most of the Uniboard projects will continue for the shelf life of the batteries (five years in the case of quality alkaline batteries). However, this will inevitably involve the bother (too much for the author!) of replacing batteries every so many years – not to mention that your descendants will need to replace them, too!

The regulator circuit is built up on a small, single-sided, printed circuit board (p.c.b.) and the topside component layout, wiring and details of the underside full-size copper foil master are shown in Fig.2. This board is available from the *EPE PCB Service*, code 305. If you are going to make your own p.c.b., it is so designed that it may be drilled using a piece of 0·1in. matrix stripboard as a template.



Completed power supply board. Note the miniature thermistors, top right, and the 14-pin i.c. socket.

All the components should fit into place without too much difficulty. Start construction by soldering the solder pins and link wire in position, then the resistors, thermistors, and preset VR1, continuing with the diodes, capacitors and transistors. Also insert and solder the dual-in-line socket if you wish to build any of the projects on the same p.c.b. as the Power Supply – they all use the same 14-pin i.c. The leads of the solar cell are taken to the solder pins as shown in Fig.2.

If a single high-value resistor for R2 is unobtainable, you may insert 10 megohm and 4·7 megohm resistors in series to make up the required value. Also, if 100 kilohms at 25°C n.t.c. thermistors are unobtainable,

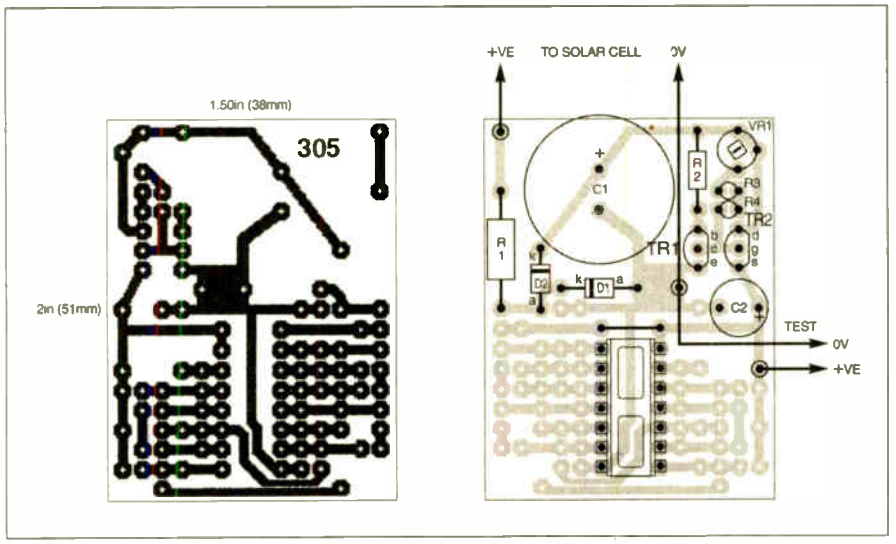


Fig.2. Uniboard Power Supply and Voltage Regulator component layout and full-size copper foil master. Not all the holes/pads are used.

COMPONENTS

POWER SUPPLY/REGULATOR

Resistors

R1	180Ω carbon film, 1W
R2	15M metal film 0·25W (see text)
R3, R4	n.t.c. thermistor, 100k at 25°C (see text) 2 off

Potentiometers

VR1	1M min. cermet trimmer, single turn (6mm) 300mW

See SHOP TALK page

Capacitors

C1	1F 5·5V d.c. low-profile memory back-up, ("GoldCap") radial elect. 5mm lead pitch
C2	470µ radial resin dipped aluminium elect. 6·3V

Semiconductors

D1	5·6V Zener diode, 1W
D2	1N4148 signal diode
TR1	TIPP31C *npn* silicon transistor
TR2	2N3819 *n*-channel field effect transistor (f.e.t.)

Miscellaneous

X1	6V to 12V solar panel, 10mW upwards (see text)

Printed circuit board (Uniboard) available from the *EPE PCB Service*, code 305; 14-pin d.i.l. socket; multistrand connecting wire; link wire (component lead off-cut); solder pins; solder etc.

Approx. Cost Guidance Only **£20** *excl. solar panel*

use other values in series to make up about 200 kilohms in all.

Be sure to observe the correct polarity of the solar cell and the two capacitors, and the correct orientation of diodes D1, D2, transistors TR1 and TR2. The cathode (k) ends of D1 and D2 are banded.

SETTING UP

Before we commence the calibration, you should give the p.c.b. one final inspection for any wiring faults, such as "bridged" solder tracks, or wrongly positioned components (particularly as not all the holes/pads are used with each project). If all appears to be correct, you can now leave the solar cell (but not the p.c.b., which should be protected from wide temperature swings) in direct sunlight to charge up capacitor C1.

Give the circuit half an hour in full sunlight to be certain that C1 has fully charged (five minutes if the specified solar panel is used). Then temporarily connect a 180 kilohms resistor (a load resistor) across capacitor C2, and measure the voltage across it. Solder pins are provided for this purpose at both sides of C2.

Turn preset potentiometer VR1 across its full range – this should give you readings from about 2·5V to 4·7V (this may vary according to component tolerances). In the various Uniboard projects, a supply of either 3V or 3·6V will be required. If the voltages measured do not fall within these parameters, experiment with the value of resistor R2 – a higher value for higher voltages, and vice versa.

Note that capacitor C2 causes a delay to any adjustments that are made to the voltage – the circuit does not respond to adjustment of preset VR1 immediately. This means that you will need to allow half a minute or so for the voltage to settle at any particular setting of VR1.

LONG TERM

Since there is plenty of time until next month, why not test the long-term stability of the power supply in the meantime?

Temporarily connect the 180 kilohm load resistor across capacitor C2. Adjust the voltage across C2 to 3V. The current passing through the resistor at 3V will be about 17µA (*V/R=I*), which is a little more than the required current for the *Perpetual L.E.D. Flasher* (next month).

All being well, this voltage should hold steady for 18 hours and more before beginning to slip – if not rising slightly in between.

GOING ACTIVE

Having built and "tested" the Solar-Powered Power Supply and Voltage Regulator, we can now proceed with a general introduction to the Perpetual Projects' single most active component (regulator components excepted), which is IC1 – a 4093 quad 2-input NAND Schmitt trigger.

There are various manufacturers of the 4093 i.c., and the make used in this series is the Motorola MC14093BCP. This does make a difference – the make significantly affects both the power consumption and characteristics of the 4093 i.c. For instance, the GD4093B i.c. roughly doubles the power consumption. Therefore, other 4093 i.c.s may be used as a stop-gap measure, but are likely to perform inadequately.

Each of IC1's gates (of which there are four – see Fig.3) switches, or triggers, very decisively between high and low states (logic 1 and logic 0) at its output terminal. Such switching is crucial to these applications – ordinary NAND gates fail to function at all.

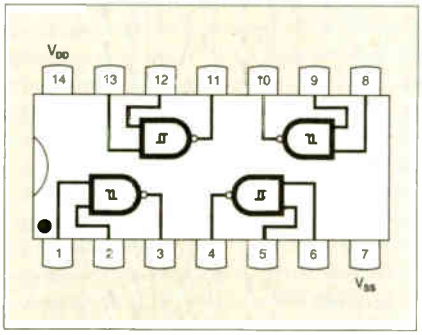


Fig.3. Pinout details for the 4093 quad 2-input NAND Schmitt trigger i.c.

The four 2-input gates of IC1 employ, of course, NAND logic. To explain this in the simplest terms, if *both* the inputs of a NAND gate are taken high (to positive), the output is low (or negative). All other combinations of inputs give a high output.

Wires may be taken directly from inputs to the positive or negative rails – or they may be taken high or low *through* a resistor. This also means that *potential dividers* may be used at the inputs, which will be described in more detail as the series progresses.

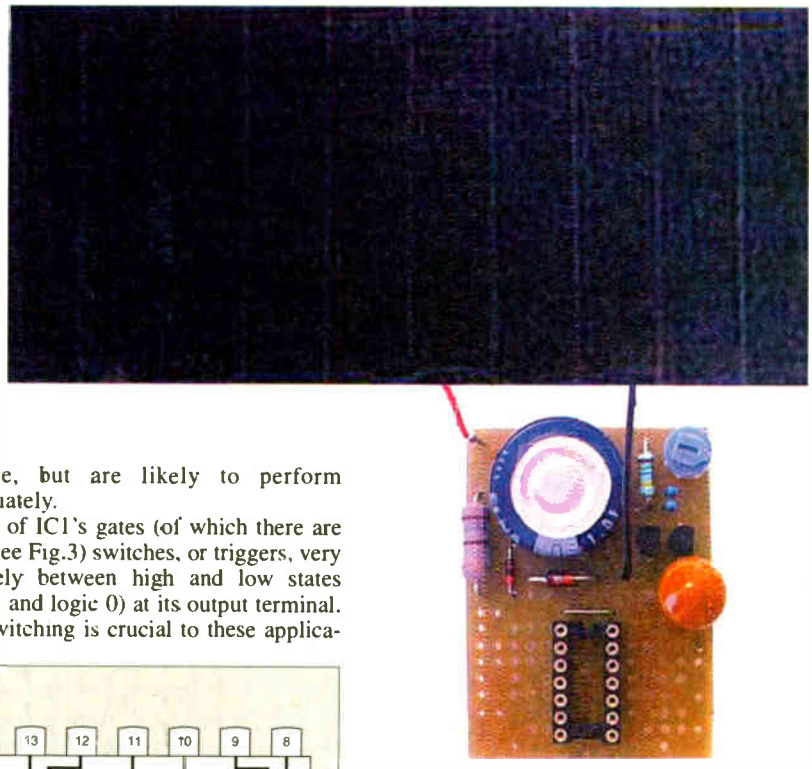
Inputs should not be left "floating" (unconnected), otherwise an input may not know what to do, and is likely to behave erratically. By "tying inputs high", a significant amount of power (as much as one third) is conserved in the projects which follow.

DELAYED ACTION

One more important aspect of IC1 is that the transition of an input from a low to a high state or vice versa may be *delayed*.

If, for instance, a capacitor (C_X - see Fig.4) is wired between the negative rail (0V) and an Input B, and a resistor (R_X) is wired between Input B and the positive rail, a certain amount of time passes before the capacitor charges, and therefore the transition from a high to a low state is delayed at the output terminal.

Not only this, but as soon as the capacitor's charge reaches two thirds of the supply voltage (assuming that Input A is high as well), the gate conducts, and the capacitor is discharged. This sequence begins again once the capacitor's charge has dropped to one third of the supply voltage.



The solar panel wired to the completed power supply circuit board.

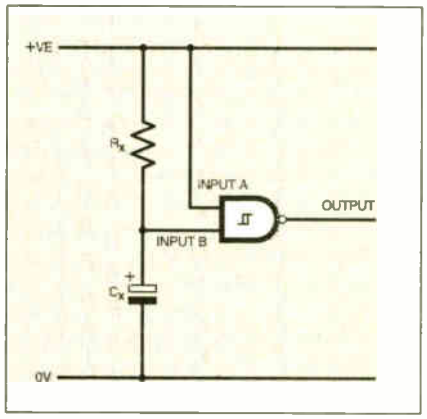


Fig.4. Delayed transition from output high to output low.

Armed with this knowledge, you should be able to understand (almost!) all the workings of the projects in this series and even develop further circuits of your own.

Next month: *L.E.D. Flasher, Double Door-Buzzer*, and *Single Door-Buzzer*.

THE MAINLINE FLYER

Issue 3

OVER 500 NEW PRODUCTS

Here is the third Surplus flyer catalogue. .

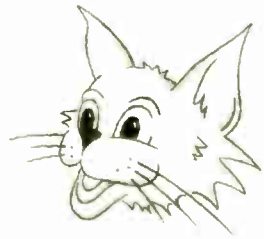
We have tons of surplus electronic components that we want to sell at the lowest possible prices. Please remember that many of the items are surplus and are impossible to repeat. So get your orders in early!

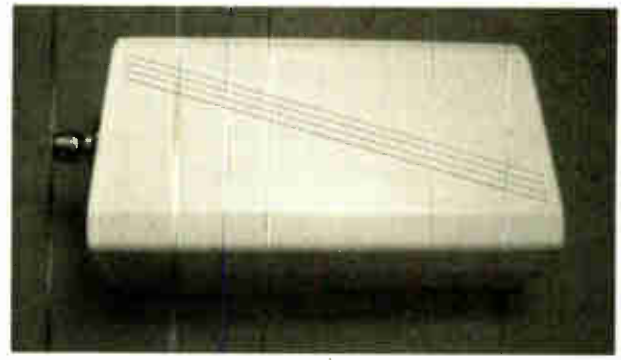
Our cat (Chester) has a habit of sleeping in the warehouse. If you see him in this catalogue he always tends to find the best bargains. You can even E-mail him if you want at chattothecat@mainlinegroup.co.uk. **Good reading! ...The Crew at Surplus Sales**

A booster amplifier for the 1800 meg band.

Operating supply	10.8v – 14v
Current consumption	
Receiving	approx. 170mA
Transmitting	approx. 300 mA
Standby (with expired time after 14 h)	<0.1 mA
Frequency range	
Receiving	1805 MHz-1785 MHz
Transmitting	1710 MHz-1785 MHz
Output power	1 w max. (30 dBm) at antenna
Sensitivity as per DCS spec. at antenna base	<-100 dBm (no deterioration of handset sensitivity!)
Temperature range	-25 C to +70 C
Attenuation equalization in transit and receive direction	each 11 dB
Dimensions	110 mm x 80 mm x 28 mm
Weight	approx 280g
Order no 99-1100	£20 Each

Although part of the Mainline Group of companies, we have no physical connection with Mainline Electronics. Please do not mix orders between companies.





1710-1880MHZ PCN base aerial 7DBI gain with wall fitting 3in x 5.5in.
Order no 99-1066 £14.00

PLEASE NOTE

The surplus flyer sells top quality components at low cost prices. Please forgive us but in order to stay competitive, we have purely a sales desk with no technical sales support. Catalogues are produced when we have enough surplus items to fill them.

Mainline Surplus Sales
PO BOX 5783 Leicester LE3 2QL England
Tel: 0870 241 0810 Fax: 0116 289 6633 Intl: +44

Fantastic speaker offers

We have been very lucky to obtain direct from the manufacturers 19 tons of top quality loudspeakers, in various sizes , shapes and power ratings. The parcel also includes many different types of cabinet fixings to assist constructors in building speaker enclosures.
We have good stocks of each line but at these prices demand will be high. We have listed the obvious speaker specifications but a more comprehensive data sheet is available on most items.

Man No YD80-0803R60B

Order No 21- 0681

Diameter 3in
Fixing centres 3.5 x3.5 in
Depth 1.5in
Ohm 8
Watts 10 £3.50
70-18 Khz
Foam edge RF =150Hz

Man No YD80-0805R60B

Order No 21-0682

Diameter 3in
Fixing centres 3.5 x 3.5in
Depth 1.5in
Ohm 8
Watts 10 £3.90
70-18 Khz
Foamed edge

Man No YD80-0804R60B

Order No 21-0683

Diameter 3in
Fixing centres 3.5 x 3.5 in
Depth 1.5 in
Ohm 8
Watts 10 £3.90
70-18 Khz
Foam edge RF = 100Hz

Man No YD100-2001R13A

Order No 21-0684

Diameter 4in
Depth 1.5 in
Ohm 32
Watts 3
180-15 Khz £1.50

Man No YD100-5305R76B

Order No 21-0677

Diameter 4in
Fixing centres 4.5 x 4.5 in
Depth 2in
Ohm 8
Watts 10
70-15 Khz £4.00

Man No YD100-5303R76B

Order No 21-0678

Diameter 4in
Fixing centres 4.5 x 4.5 in
Depth 2in
Ohm 8
Watts 10
70-18 Khz
Foam edge £4.00

Man No YD100-5304R76B

Order No 21-0679

Diameter 4in
Fixing centres 4.5 x 4.5 in
Depth 2in
Ohm 8
Watts 10
80-15 Khz
Foam edged P.P Cone £4.00

Man No YB100-2804545B

Order No 21-0680

Diameter 4in
Fixing centres 4.5 x4.5 in
Depth 2in
Ohm 4
Watts 15
70-18 Khz £4.00

Man No YB0813-0401T45B

Diameter 3x5in
Fixing centres 2.5x3.5in
Depth 2.5 in
Ohm 16
Watts 35 Order No 21-0685
100-5 Khz
Foam edge £2.50

Man No YD 200-9-8
Order No 21-0746

Diameter 4in
Fixing Centres 4.5x4.5 in
Ohm 8
Watts 60
70-4 Khz
Foam edge £4.80

Man No YD130-1604R80B

Order No 21-0673

Diameter 5in
Fixing centres 5.5 x 5.5 in
Depth 2.5 in
Ohm 8
Watts 15
70-5 Khz
Foam edged P.P cone £5.00

Man No YD130-1605R80B

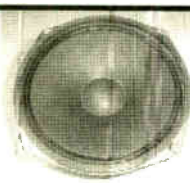
Order No 21-0674

Diameter 5 in
Fixing centres 5.5 x 5.5 in
Depth 2.5 in
Ohm 8
Watts 15
50-5 Khz
Rubber edge £5.00

Man No YD130-1603R80B

Order No 21-0676

Diameter 5in
Fixing centres 5.5 x 5.5 in
Depth 2.5 in
Ohm 8
Watts 15
70-5 Khz
Foam edged £5.00



Man No YD156-0116S60B

Order No 21-0687

Diameter 6 in
Fixing centres
Depth 2.5 in
Ohm 6
Watts 40
70-9 Khz £3.00

Man No YD165-1210R80B

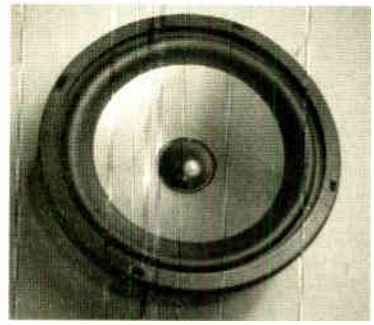
Order No 21-0675

Diameter 6.5 in
Fixing centres 6.5 x 6.5 in
Depth 3in
Ohm 8
Watts 30
65-6 Khz £5.50

Man No YD165 - 1208R80B

Order No 21-0672

Diameter 6.5 in
Fixing centres 6.5 x 6.5 in
Depth 3in
Ohm 8
Watts 30
70-6 Khz
Foamed edge £5.50



These arrived from a different supplier and we only have limited data. We feel they were used in car Hi Fi applications probably for a Bass Tube or mounted on the rear parcel shelf. At a guess they will be 50-3 Khz with a power of 50 watts they have a solid poly cone and rubber edge.

Diameter 7in
Fixing Centres 7.5x 7.5 in
Depth 4in
Ohm 4 Order No 21-0747 £6.00
Ohm 8 Order No 21-0747 £6.00

Man No YD200-3611R100B

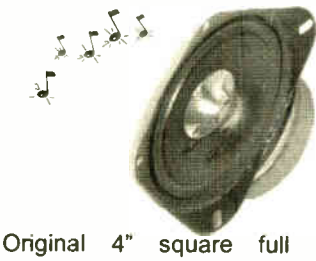
Order No 21-0670

Diameter 8in
Fixing centre 8.5 x 8.5 in
Depth 3.5 in
OHM 8
Watts 60
45-5 Khz £7.00

Man No YD165-120PR80B

Order No 21-0671

Diameter 8in
Fixing centres 8.5 x 8.5 in
Depth 3.5 in
Ohm 8
Watts 60
45-5 Khz £6.50



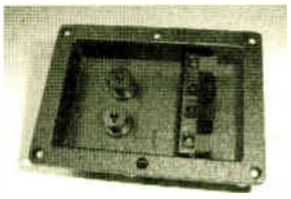
Original 4" square full range speaker used in Vauxhall and Ford cars. Rated 40w, 4ohm.
Order No 21-0047 **£3.50**

P.P = Polypropelene/ Foam Edge generally gives a better all round sound and is more suited to hi-fi Applications, rubber edge

All prices include VAT

Mainline Surplus Sales
PO BOX 5783 Leicester LE3 2QL England
Tel: 0870 241 0810 Fax: 0116 289 6633 Intl: +44

For speaker constructors we can offer a range of terminals for the rear of the speaker enclosures. Although surplus we have bought them direct from the manufacturer and for volume users we could probably supply continually if required.



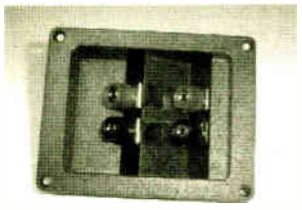
Man No DPT 14L

Order No 21-0688

STAR BUY

We have two types in stock of this size. The SPT14L (21-0686) is as per illustration. The DPT14L (21-0680) Has the same fixing centres and physical size but has one side of terminal replaced by two standard Speaker (din) sockets. In both cases all of the terminals are fully isolated from each other so can be configured in different ways. (139.2 x 60.5 x25.3mm)

SPT 14L	8 Terminal	21-0686	£2.50
DPT 14L	4 Terminal	21-0688	£2.50



Order No 21-0691

120 x 81 x 24mm

This range all have the same dimensional sizes 21-0691 and 21-0689 both have shorting bars which can be removed if required and identical connections, 21-0689 has gold connections where as 21-0691 has a nickel finish.

21-0691	Nickel finish	£2.20
21-0689	Gold finish	£2.50

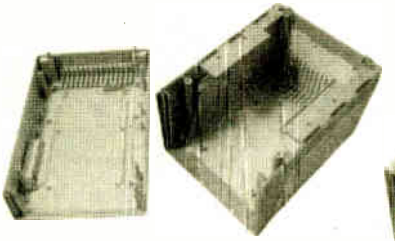
Order No 21– 0690

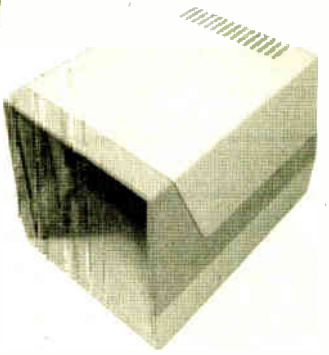
Similar in size to 21-0691 this connection is without the shorting links and has Gold plated 4mm sockets (2 pairs)

21-0690	Gold finish	£2.50

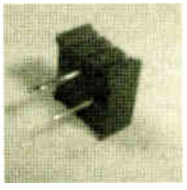
Remote access answer machine BT approved can be turned on from a distance. Using a touch tone phone uses a micro cassette so you don`t sound like a darlek.

Order No 99-0596 Bargain £10.00





Nice two tone plastic case.
Size: 23 x 17 x 13.8cm approx.
Order No 211-0570
£4.00



Top Adjust cermet preset 200 Ohm`s
Order No 02-0717
3 for £1.00

9 pin male plug to 25 way D female socket. Probably modem mouse adaptor on serial port on PC.
72-0602 £1.00

Standard 220 Ohm preset enclosed .
Order No 02-0705
10 for £1.00

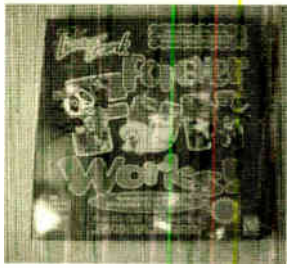
Big chunky magnets.
75mm dia 30mm inner diameter.
Order No 21-0600
£1.00

Nice big slide switch DPDT new.
Order No 05-0708
£0.80

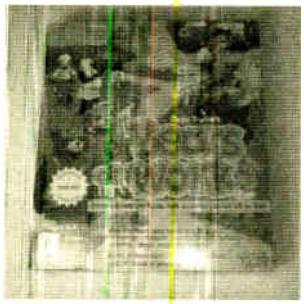
All prices include VAT

We obtained a huge quantity of software at deeply discounted prices, we appreciate that they are designed for older machines But we find the older software to be more reliable than some of the latest graphics hungry programs. They offer good value for money some of the family tree software contains USA listings for contacting lost relatives etc, which may not apply in the UK.

KIDS CORNER



A drawing program for girls over 5 years. This program allows you to make templates for masks, magnets, hats, T-shirts, crowns etc. Over 100 templates available just pick a project add a design then print and paint yourself.
CD rom only operates on Windows 95/98
Order No 73-0695 £3.50



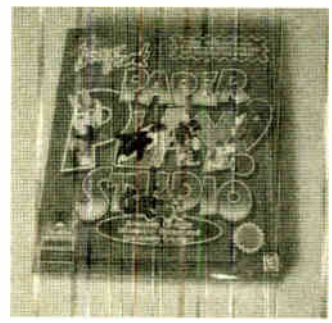
An interactive storybook and activity centre, based around a fun house. Kids can print play music, make sounds with different instruments. Also has an introduction to the world wide web Hours of fun, ages 3-8 years
Win 3.1, Win 95 etc and MAC
Order No 73-0696 £3.50

Hidden Pictures workshop is designed for kids 5 years and up and is primarily a drawing program with puzzles and various paint palletts, print pictures out in black and white to save a fortune on colouring Books
Win 3.1/95/98 & Mac

Order No 73-0697 £3.50

Wishbone is probably Americas best known doggy presenter. Wishbone 3-1 contains 3 software titles in 1. The activity zone has loads of stuff to do (games etc) . The Odyssey takes you through Homers famous tales but in a doggy fashion; Wishbone print tricks allows you to make just about anything from a greetings card to posters with good old Wishbone helping you along. Ages 5 and up.
Windows 3.1, 95 etc and mac
Order No 73-0658 £8.00

This is the stand alone print section of the wishbone trilogy for producing greetings cards certificates etc. Hundreds of templates are included. Hosted by Emmy award winning dog.
WIN 3.1 windows 95 & Mac
Order No 73-0657 £4.00



Another Girls drawing program, ages 5 years and up. This software contains over 100 different templates and a wider range of pallets and text and the ability to E-mail your work to your friends etc. All written by Lisa Frank who is famous in the USA for Girls art and design, some decorations included. Win 95& 98
Order No 73-0664 £4.00

This is the add on program for the Duke Nukem series of blast everything that moves software and needs Duke Nukem 3D to work, also hundreds more blasting scenes. Order No 73-0698 £3.00

PARODY`S

This a range of totally unofficial software that is designed to extract the fun part out of other very well known titles and lighten them up a bit.

This is a parody of Star Wars Titles. With blast the Ewok, U don`t know Jedi,tell you will I, it was written by two slightly warped fans you can have hours of fun, don,t forget to put your favourite characters in the time machine (Baby Yoda!). Very funny.
Win 3.1, 95 etc Pentium or above
Order No 73-0699 £5.00

Another humourous lampooning on the X-files, play beam up the cows, ditch the alien, conspiracy theory etc. This parady is not authorised by Twentieth Century Fox and so is very funny. Join Mully and Scudder and find out the real truth.
Ages 13 & up Win 3.1, 95 etc 486 & above & mac

Order No 73-0668 £8.00

Mainline Surplus Sales
PO BOX 5783 Leicester LE3 2QL England
Tel: 0870 241 0810 Fax: 0116 289 6633 Intl: +44

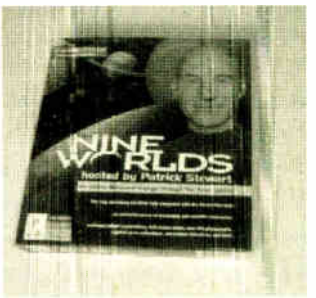
All prices include VAT

This is a Parody on Windows 98, play splat the bug, feeds the Billagotchy (Bill Gates). You know the company, you know the software, you know the man now have some fun and vent your frustrations, visit the microshaft campus
Aged 13 & up Windows 95 or Mac

Order No 73-0656 £6.00

This software allows you to upgrade to windows 98 from windows 3.1 or 95 without losing your original setting, so if when you upgrade your machine it all freezes don't panic, just switch back to your original os then sort the bugs out later.

Order No 73-0667 £6.00



Hosted by Patrick Stewart this CD rom takes you through our solar system and travels back in time to take a tour through its History and discoveries.
This CD will answer just about any planetary exploration questions you may have. Good value for money
Win 3.1 as above 486/66 as above

Order No 73-0665 £8.00

A take of off one of the bestselling CD rom games of all time, get out of those places you have got stuck in time and time again. Great graphics includes a www interface to send electronic postcards etc, it's funny even if you don't remember the original .
Win 3.1 or above & Mac

Order No 73-0700 £4.00

An interesting poker training game software package .Welcome to the cowboy casino where you can interact with real gamblers using video footage, watch out or they will con you.
386 or better ,Win 3.1 or above

Order No 73-0663 £15.00

This software is designed to emulate the power of thought into rationalising the design process and allows you to operate a 'what if' type of problem. The clever bit is it can interface with most databases, so you can use it to get answers without hours of programming. This is very highbrow software that I am still trying to figure out, if it does what it says on the box then it could appear that you can add the power of reasoning to your P.C
Win 95 NT or above

Order No 73-0702 £12.00

Tired of playing the standard windows solitaire, this software has over 200 different versions of solitaire, with this you can stay single forever, or move your PC into the potting shed and escape normality for a few hours at least .
Win 95 etc

Order No 73-0701 £8.00

An 18 years adults only CD. Play Poker/Blackjack in a virtual Las Vegas casino, spend your winnings with the naughty lassies definitely not a CD for the family, X-rated ,very naughty.

Order No 73-0669 £6.50

This is top quality photo manipulation software that allows you to take images correct colour, resize even go crazy with the s-t-r-e-t-c-h feature. Templates are included to make t-shirts, flyers etc etc. Sometimes this software from other manufacturers is ten times the price.

Order No 73– 0666 £10.00

FAMILY TREE SOFTWARE

This make of software is the USA`s best selling genelogy software and is normally an arm and a leg and comes in many different versions. These titles are nearly all current or can be upgraded to later versions in the UK. They may include sophisticated search data bases for the USA which may not apply in Europe.

This is the ultimate family tree software in its basic version only, it allows you to enter everything you know about your family in a clean logical manner, you can import photos, news clips, birth certificates etc. The unit includes a built in word processor and search tools to help you uncover what you want to know.
Compatible with many other genealogy software titles.
Order No 73-0660 £12.00

This is the ultimate family tree with all the latest gadgets that contains English and Welsh records . Produce reports , import documents, change fonts, even manipulate images. This software is very expensive and has been awarded much praise. This is the ultimate genealogy program. Win 3.1 on above Win 95 Pentium recommended

Order No 73-0659 £35.00

This looks like an older version of the two titles 73-0660-661 but allows a web site to be built.
Works on win 3.1 386 on win 95 & 486 as above. Perhaps a good start if your interested in a basic software package.

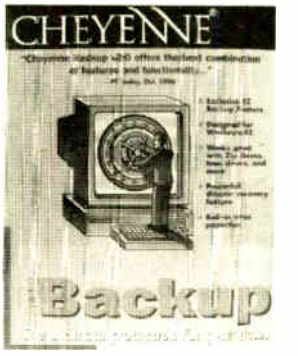
Order No 73-0661 £8.00

This is an addition to 73-0660 and covers more extensive searching mainly in the USA. However there is a lot of interesting material including much topical information from old news reports and papers from 1833 and 1853. This also includes the complete listing guide to genealogy which gives many tips that apply in Europe, interesting reading.

Order No 73-0662 £6.50

Designed to complement the Family Tree software. This title allows you to create beautiful memory books and family scrapbooks of outings, holidays, Birthdays Etc. These can be converted from digital images from any source you can even create family web sites with this software
Windows 95/98

Order No 73-0655 £16.00



I've tried to use the Dos/ Windows backup programme, but it never seems to work right, the latest versions of other manufacturers software make my head spin whilst in the USA I found this software by Cheyenne for Win 95 nice and simple, it does exactly what it says on the box with graphics you can understand.
Order No 73-0610 £10.00

Earlier versions of the translator software for Win 3.1 –95– NT. This version only has 3 languages Spanish/ French/ German runs on 386 machines or higher.

Order No 73-0609 £14.00

Translation software for Windows 95 or NT complete with 15 user capability translate in real time English into Spanish/ French/German/Italian text, E mails even web pages.
Needs 486/66 or higher Win 95 62 MB if fully installed CD rom.

Order No 73-0608 £16.00

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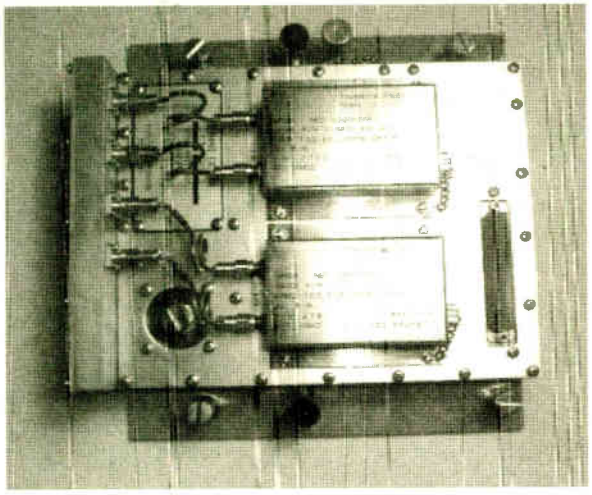
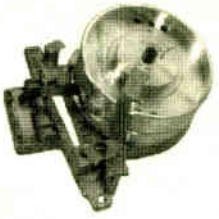
Tel: 0870 241 0810 Fax: 0116 289 6633 Intl: +44



This is a C band exciter made by NEC no data available but it looks to have two very high spec TCXOS +mixers etc.
Must have cost thousands only a few in stock, New.
Order No 99-0720 £75.00

Original varnished cambric tape, 36 yards long x 1 inch made by 3m.
Order No 83-0745
£6.50



Video head assembly from Samsung + other equipment. Part No. SESC/CV970812027 (0149) Spec: CX5-S2N
Order No 99-0569 £4.00

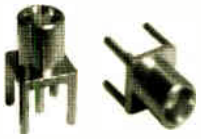
BT plug to 4 way connector on 0.1 pitch.
Order No 72-0565
2 for £1.00

Washable glue especially made for children non toxic in two sizes.
Order No 83-0603
225ml glue £1.50
Order No 83-0744
36ml glue £0.40

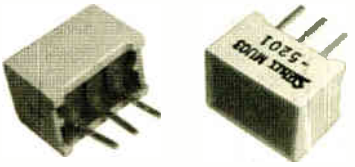
The photo does not do justice to what is the biggest non releaseable cable tie I've seen, length 35in width 0.5in. Just think of the fun you can have with them, (big grin!)
Order No 83-0597 £0.95

370V AC 50/60Hz 3UF 3 terminal (has written on side 25/3UF) motor run capacitor. Size: 10 x 5cm diam.
Order No 01-0568
£1.50 each

Very high quality fan and heatsink. Size 2in W x 2in L x 1.25in D with two 4 way power sockets 1 male, 1 female made by AAVID for 486/586 processors. Not to be confused with the cheaper styles, obviously can be used in other applications.
Order No 36-0693 £6.50

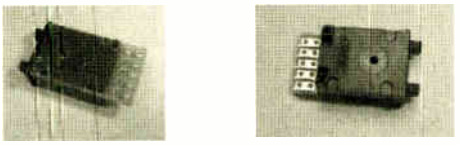


Standard Pcb mounted Mcx sockets
50 OHMS
Order No 71-0601
£0.85 each

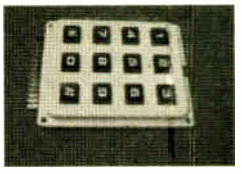


Joint LED's in two colours size 10 x 6 x 7 mm. In a rectangular brick .
Order No 18-0566 Red Part No. MU03-22
2 for £1.00
Order No 18-0567 Green Part No. MU03-5201

High quality microphone and holder designed to stick to the front of the PC or other work surface. Terminates in a 3.5mm stereo plug.
Microphone probably electret high Impedence.
Order No 21-0725
£2.50

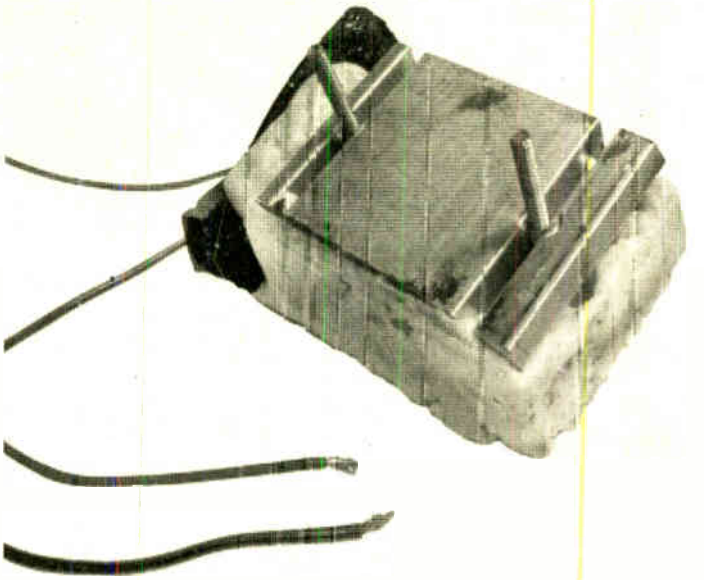


Mini 9+0 cherry selector switch only 5 connections on rear so probably Hex/Binary.40mm L x10mm W x7mm D
No end cheeks lovely switch.
Order No 05-0727 £1. 00 each
6 for £5.00



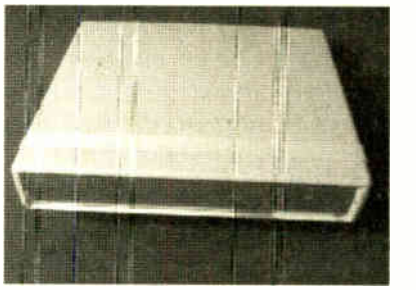
Standard keyboard used for telecom and security applications. 14 connections (only 13 connected) so looks like common earth cover white.
Order no 05-0730 £3.50

All prices include VAT



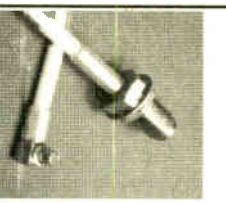
We have obtained a quantity of these large 12 volt peltier devices originally used in caravan coolers one side gets hot, the other gets really cold, needs to be mounted on a heat sink. Approx size 3.5in L x 2in W x 1.5in D. Likely to be very popular so early purchase recommended. Order No 20-0605 £9.50

Drawing pen 0.45mm line width waterproof black.
Order no 83-0724 £1.00



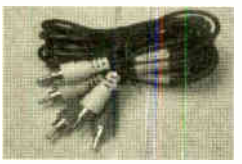
A quality plastic enclosure with aluminium front and back panels, size 7in L x 6in W x 1.5in D colour grey.
Order No 82-0694 £2.00

Rogers duroid 5880A Teflon PCB double sided this is the 1/16 size and so has to be scaled from the more popular 1/32 size which is nearly £100 per sheet.
Size A 8 x 5in
Order No 81-0719 £11
Size B 10 x 8in
Order No 81-0732 £20

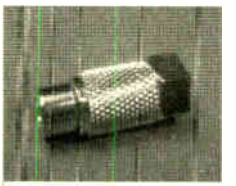


Small SMA flying socket. To approx 10cm of cable then what looks a very tiny mcx/tv style connection only 3mm across.
Order no 72-0721 £1.40

Slightly larger than normal, preset vertical 1 MEG LIN probably used in TV`s looks like 7.5mm pitch.
Order No 02-0706
4 for £1.00

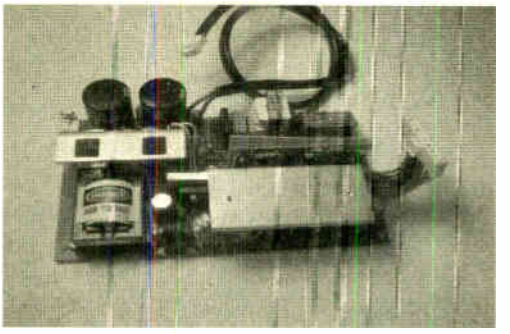


Set of 3 gold plated phono plugs in red/white/yellow to suit most audio visual applications.
Order No 73-0737 £1.80



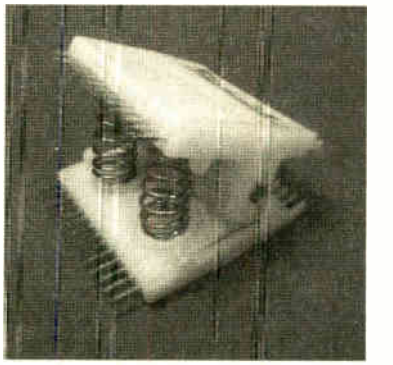
Standard phono socket to F plug adaptor.
Order No 71-0741
£0.75

Standard 3.5mm mono jack socket.
Order No 71-0722
£0.18 or 6 for £1.00



Lovely switch made P.S.U 100/120V or 200/240V AC input +5v 8amps DC and +12v 8 amps (12 volt peak).
Size 7L x 4W x 2D in

Order No 99-0731 £8.00



A range of test clips for testing the popular DIL IC`s all types are gold plated and spring loaded.
Order No`s

84-0738	16 pin DIL	£4.00
84-0734	24 pin DIL	£4.80
84-0739	28-pin DIL (wide)	£5.00
84-0733	40 pin DIL (wide)	£6.50

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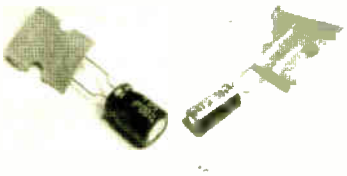
Tel: 0870 241 0810 Fax: 0116 289 6633 Intl: +44

All prices include VAT

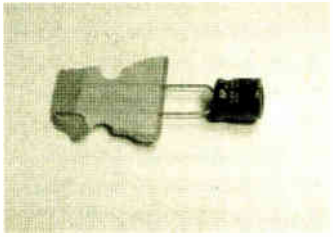
Standard radial Electroytic caps in small case styles



Value	Voltage	10+	100+	stock No
4.7 UF	50V	0.25	1.50	01-0778
10UF	50V	0.30	2.00	01-0779
47UF	50V	0.35	2.40	01-0780
100UF	50V	0.44	3.20	01-0781

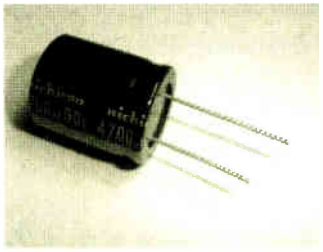
Stock up while you can at these prices.

Sub minature Electroytics.



100UF 16V Pitch 2.5mm (spaced to 5mm), lovely size for projects.
Stock No 01-0782 10 for 50p

Large radial Electroytics

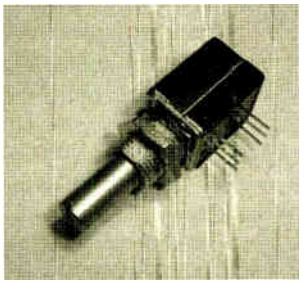


Lovely 4700 UF 50V Radial electrolytic nice size 50mm x 40mm pitch 20mm
Order No 01-0783 £1.00

400 Volt 220 UF Electrolytic capacitor, dimensions 80mm x 60mm pitch 22mm.
Order No 01-0784
£3.00

250K High quality pots with 4mm shaft made by Spectrol, Lovely.
Order No 02-0749
£2.00

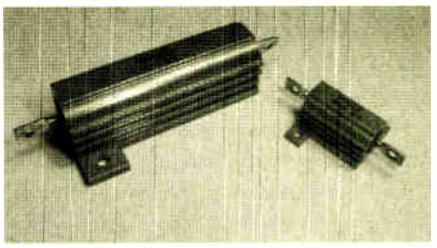
Bourns precision multiturn pot, 500 Ohm's shaft size 6mm.
Order No 02-0751 £4.00



Dual precision 1K pot very unusual lovely quality only few in stock.
Order No 02-0750
£2.00

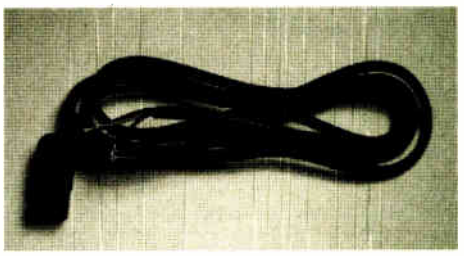
1000 uF capacitors.
25 volts: 21 x 13mm diam with 4mm pitch.
63 volts: 32 x 16mm diam with 8mm pitch.

01-0571 1000 uF 25 volts **15 for £1.00**
01-0572 1000 uF 63 volts **8 for £1.00**



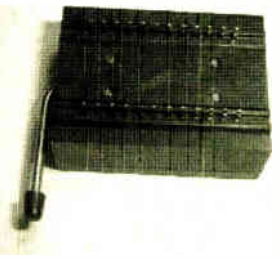
Power resisters.
A range of metal clad power resisters in the following values.

0.33 OHM	10 Watt	Order 02-0768	£0.50
0.39 OHM	10 Watt	Order 02-0767	£0.50
300 OHM	25 Watt	Order 02-0766	£1.00
10 OHM	50 Watt	Order 02-0765	£1.80



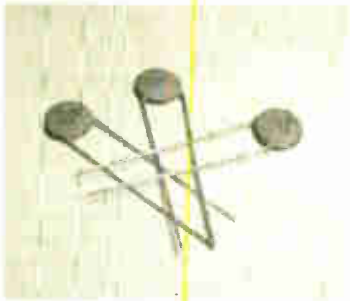
Right angled IEC socket lead 80in long.
Order No 71-0755 £1.00

40 way IDC plug right angled with lugs.
Order No 71-0764 £1.00 for 2



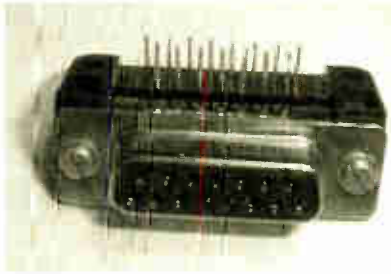
24 way wide spaced IC Test socket with gold pins. Made by Harwin.
Order No 71-0754 £3.50

CERAMIC CAPACITORS



Standard 5mm 50V 100 N plate ceramic used everywhere, better for RF than multi-layer styles.
Stock No 01-0775 50 for £1.50

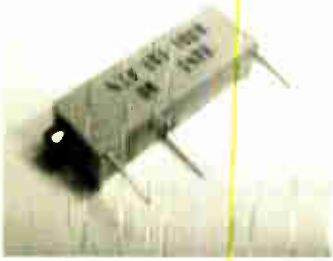
Small plate ceramics
27 pf Plate ceramic 10 for 25p
Stock no 01-0776
470 pf Plate ceramic 10 for 25p
Stock No 01-0777



Right angled 15 way D socket for PCB mounting.
Order No 71-0753 £0.75

IEC plug to IEC line socket length 82in.

Order No 71-0774
£2.00



Spectrol precision trimmers. Available in the following value

10 OHM`s	Order No 02-0771	£0.80
20 OHM`s	Order No 02-0772	£0.80
100 OHM`s	Order No 02-0770	£0.80
200 K	Order No 02-0773	£0.80 2
Meg	Order No 02-0769	£0.80

Standard micro switch, SPDT 250 Volt rated spade lugs.
Order No 80-0752
£1.00

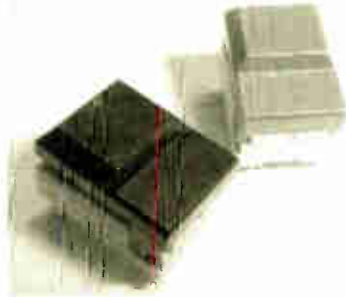
SWITCHES

Small push switch SPST green non latching, size of rear 15mm x 13mm. Only few in stock.
Order No 80-0759 £1.00

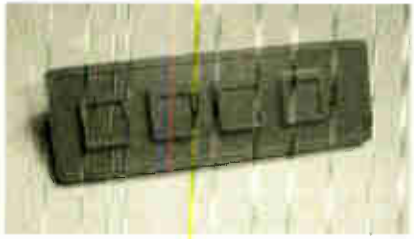
80-0786

80-0785

Illumunated small rocker switch, red, size30mm x 20mm x 15mm SPST.
Order No 80-0785 £0.95p
Order No 80-0756 £1.00



Lovely DPST push switches
Size 10mm 17mm in two colours.
Red Stock No 80-0760 £1.00
Black Stock No 80-0761 £1.00



Very unusual purchase made by Storm This is a 4 way rugged sealed switch. Illuminated size 30mm x 95mm. Must have cost a packet, full data available.
Order No 85-0763 £5.00

Small rocker switches.
Order No 80-0757 30mm x 20mm x 25mm SPDT £0.60
Order No 80-0758 30mm x 20mm x 20mm DPST £0.70

Same size rear as above but switch physically bigger with a red and green Led in cased in a black switch.
Stock No 80-0762 £1.50

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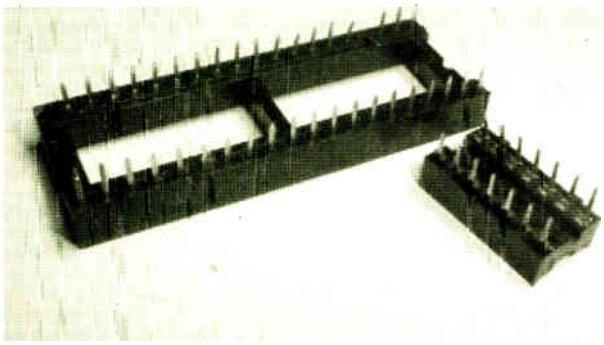
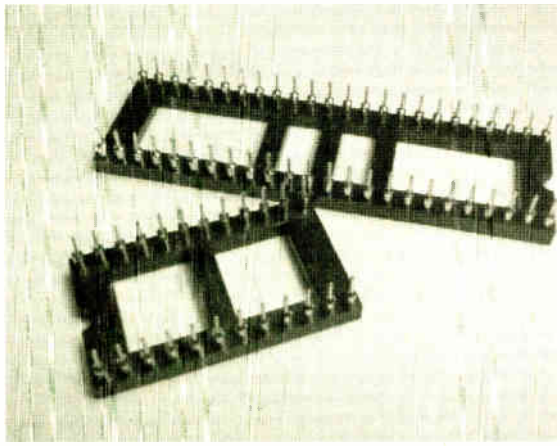
IC SOCKETS



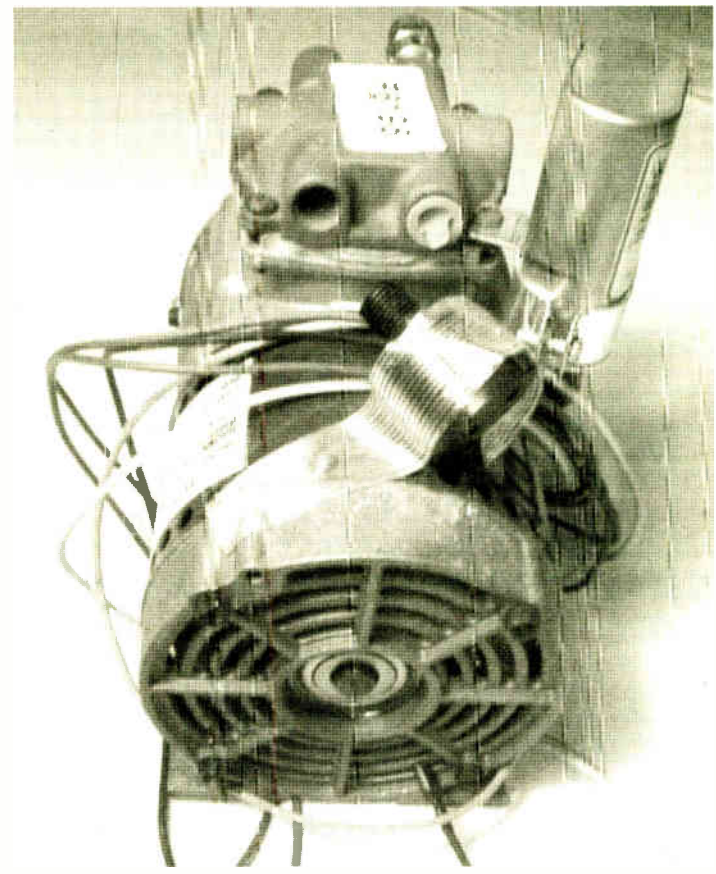
We have finally got around to listing some of the IC sockets we have in stock. This is by no means all we have but it's a start.

NO OF PINS	LENGTH	WIDTH	STOCK NO	PRICE 1	25	100
	10mm	10mm	71-1019	3p	2p	1p
14	18mm	10mm	71-1020	4p	3p	2p
16	20mm	10mm	71-1021	5p	3p	2p
20	25mm	10mm	71-1022	6p	4p	3p
22	28mm	10mm	71-1023	7p	5p	4p
24	30mm	10mm	71-1024	8p	6p	5p
24	30mm	18mm	71-1025	8p	6p	5p
28	36mm	18mm	71-1026	8p	6p	5p
40	50mm	18mm	71-1027	10p	8p	6p



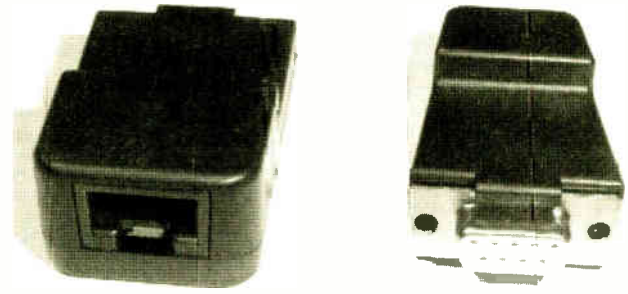
These are the higher specification turned pin styles.

NO OF PINS	LENGTH	WIDTH	STOCK NO	PRICE 1	25	100
8	10mm	10mm	71-1028	7p	5p	4p
14	18mm	10mm	71-1029	12p	8p	6p
16	20mm	10mm	71-1030	14p	10p	8p
18	23mm	10mm	71-1031	15p	11p	9p
20	25mm	10mm	71-1032	17p	12p	10p
22	28mm	12mm	71-1033	19p	14p	12p
24	30mm	18mm	71-1034	20p	15p	13p
28	36mm	18mm	71-1035	23p	17p	15p
32	40mm	18mm	71-1036	27p	20p	18p
40	50mm	18mm	71-1037	34p	32p	18p
48	60mm	18mm	71-1038	30p	28p	20p
50	64mm	25mm	71-1039	30p	28p	22p
64	80mm	25mm	71-1040	30p	28p	24p
32	80mm	SIL	71-1041	27p	20p	18p



A 115v/230v heavy duty compresser made for Marconi. The unit can provide a constant pressure of 50 psi continuous. Current consumption at 240 volts 2.5 amps.
Order no 99-2004 £120

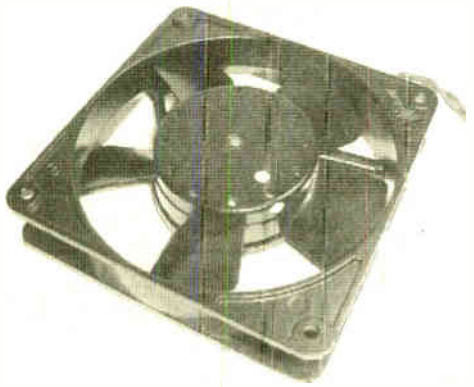
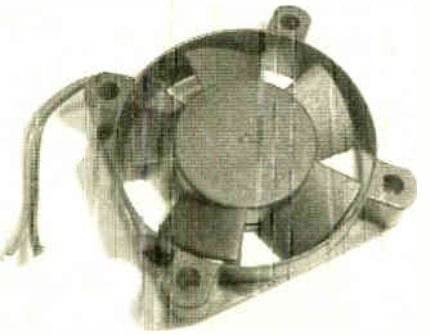
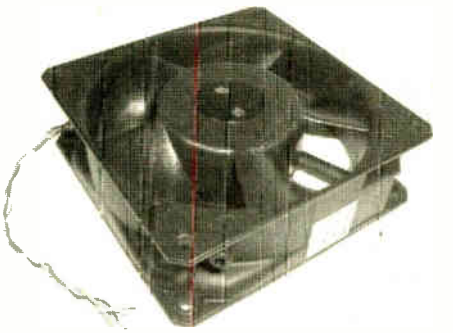
Curly BT telephone lead to 2mm push on terminals.
Order no 71-0910
£0.50



9 way female D socket to Cat 5 computer, probably for connecting comport to network.
Order no 71-0916 £1.00

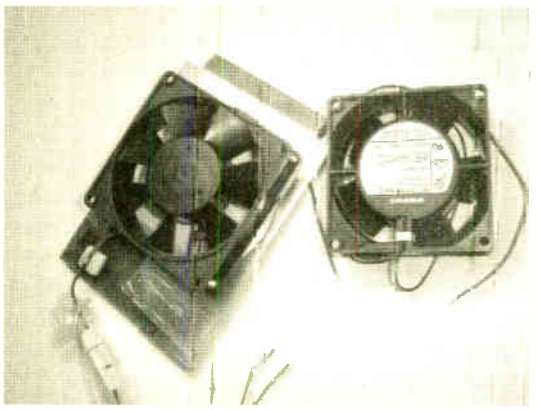
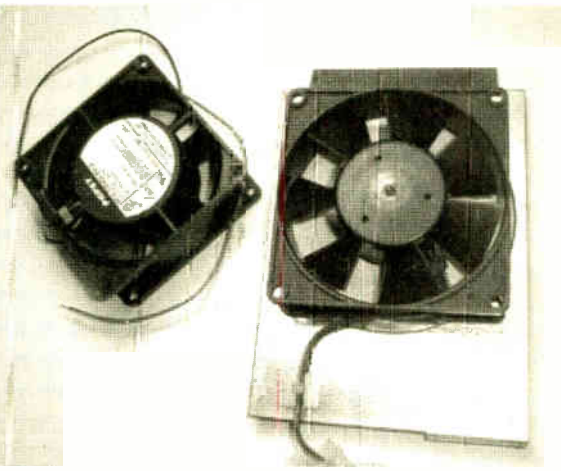
FANS AND BLOWERS

Fans proves to be our most popular sellers in the last catalogue, so we have listed all of the types we have in stock. New deliveries arrive every day.

SIZE	WIDTH	FORMAT	VOLTAGE	POL	POWER	CONSTR	STOCK NO	PRICE	NOTES
120mm	38mm	square	12v	DC	0.45A	plastic	36-0891	£2.50	made by Panaflo
60mm	25mm	square	24v	DC	0.1A	plastic	36-0934	£2.50	made by Panaflo
40mm	10mm	square	12v	DC	0.9W	plastic	36-0098	£2.50	made by Sunon
40mm	20mm	square	12v	DC	0.9W	plastic	36-0930	£2.50	made by Sunon
126mm	39mm	square	12v	DC	5.9W	metal	36-0235	£5.50	made by EBM
80mm	20mm	square	12v	DC	0.2A	plastic	36-0337	£2.50	made by Shicoh
80mm	25mm	square	12v	DC	0.15A	plastic	36-0338	£3.50	made by Nidec
120mm	25mm	square	220/230	AC		metal	36-0339	£6.00	made by Tobishi
80mm	36mm	square	110/120v	AC	12W	metal	36-1011	£6.00	

PAPST FANS

Many people demand fans manufactured by the Papst company. These have a good reputation for quality and a long service life. We have listed these seperatly although still surplus and at surplus prices. If you have a requirement for a special Papst fan we may be able to supply it directly from the manufacturer.

SIZE	WIDTH	FORMAT	VOLTAGE	MIN/MAX	POL	CONSTR	PAPST NO	STOCK NO	PRICE
171mm	50mm	circle	100-120v		AC	metal	TYP6008S	36-1012	£8.50
171mm	50mm	circle	115v		AC	metal	TYP6300S	36-1013	£8.50
118mm	42mm	square	48v	(38-56)	DC	metal	TYP4148XP	36-1014	£5.00
80mm	38mm	square	5v		DC	metal	TYP8105G	36-1015	£5.00
80mm	32mm	square	12v	(6-15)	DC	plastic	multifan8312	36-1016	£3.00
118mm	38mm	square	115v		AC	metal	TYP4600N	36-1017	£3.00
90mm	38mm	square	24v	(12-28v)	DC	plastic on metal tray	TYP3414	36-0236	£3.00

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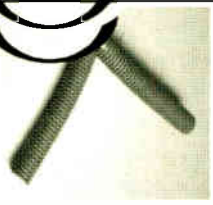
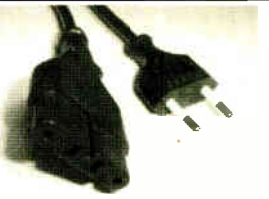


20mm conduit
5 metres long.
Order no 71-0813
£3.00

250 V 1-30 PF trimmers By tekelec
Order No 05-0821
£3.50

Small push switch size 5mm x 5mm
Order No 80-0814
£1 for 2

Very big terminal inner
diameter 15mm
Order No 71-0816
£1.00 for three



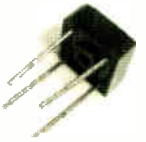
EEC mains lead to chunky socket used for TV`s etc.
Order No 71-0824
£0.40

Heavy duty push switch DPDT non latching.
Order No 71-0815
£1.50

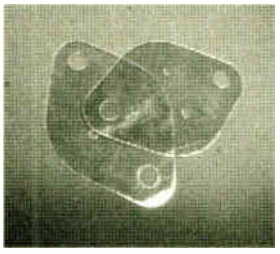
Small crimp terminal red.
Order No
71-0817
25 for £1.00

Right angle 10 amp IEC connector (kettle type) for hand wiring.
Order No 71-0962
£1.50

24 volt DC buzzer
1in x 1in.
Order No 21-0828
£0.80 each



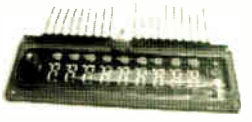
Small bridge size 10mm x 10mm, no data but probably 3 amp 100 volts.
Order No 17-0830
£0.80 for 2



Standard TO3 silicon washers.
Order No 83-0831 Pack of 20 £0.50

Those annoying TO220 mica washers that you can never find when you want them. Order No 83-0873
40 for £1.00

10 amp 250 volt otled relax SPDT 12volt coil.
Order No 80-0826
£1.00 for 2



Small florescent display height of characters approx 5mm, no data hence priced to clear.
Order No 18-0829
£1.00

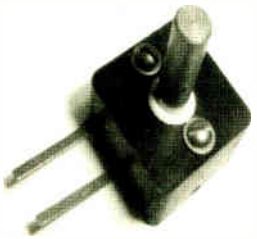
Screening can size 15 mm x 15 mm x 30 mm For S18 coils and others made in UK by Neosid.
Order No 83-0883
3 for £1

Heatsink for the older T066 devices
Order No 83-0886
£1 for 2

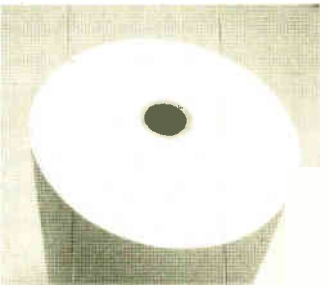
Large 3 amp 25 uh choke size 4.5 in long by 10 mm wide.
Order No 38-0882
3 for £1

Small 12V battery meter HO6 fixings 15mm apart.
Order No 18-0832
£2.00

BNC straight coupler 50 OHM female to female.
Order No 71-0827 £1.00



High quality British made Dilimin 500pf variable capacitor for radio sets etc. Spindle 1/4 in x 5/8 in long, made believe or not in the UK.
Order No 01-0833 £2.00



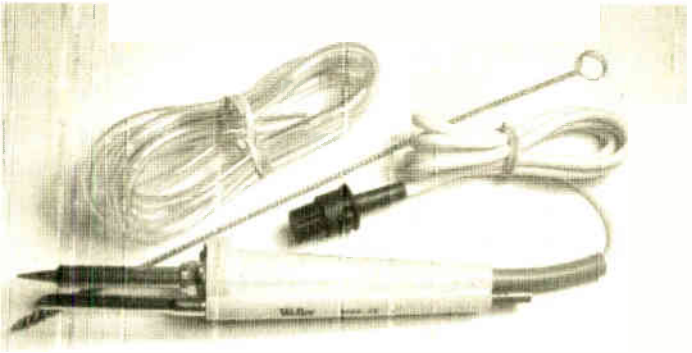
Paper roll size 5 x 3in
Order No 99-0957 £1.00

Small sub minature SMB socket do not confuse with standard SMB, this is only about 2.5mm wide.
Small straight sub SMB socket, 50 OHM`s
Straight order no 71-0819 £0.70
Right angled order no 71-0820 £1.00

E-mail Chester with your comments and suggestions at: chattothecat@mainlinegroup.co.uk

WELLER SPARES

We have obtained a small quantity of various Weller spares. To save some space we have listed the Weller spare part number which you can cross reference in the big component



SPARE BITS FOR WELLER IRONS

Complete fume extraction iron part no TCP3 FE 24 volt DC. Thermostatically controlled with plastic tube and pipe cleaner. Fits standard PSU units.
Order No 83-0838 £35.00

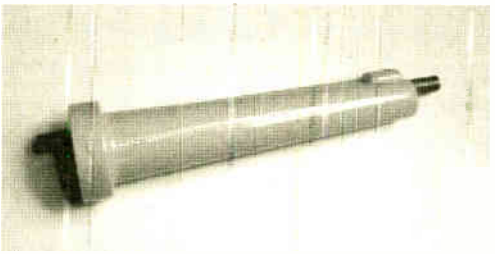
WELLER NO	QTY IN STOCK	PART NO	PRICE
PTC5	18	83-0839	£2.00
CT6C	10	83-0841	£6.00
PTDD9	50	83-0842	£6.00
PTK5	16	83-0843	£2.00
PTBB9	16	83-0844	£2.00
PTE5	70	83-0845	£2.00
PTC7	40	83-0846	£2.00
PTR6	16	83-0840	£2.00
PTL6	10	83-0847	£2.00
PTK8	60	83-0848	£2.00
PTAA9	12	83-0849	£2.00
PTK7	65	83-0850	£2.00
PTP5	18	83-0851	£2.00
PTDD6	35	83-0852	£2.00
PTM7	17	83-0853	£2.00
PTH6	20	83-0854	£2.00
PTH5	12	83-0855	£2.00
MT8	15	83-0856	£1.00

Replacement nozzle for fume extraction soldering irons, FEN-11.
Order No 83-0835
£1.50

Weller nozzle for Weller desober pumps part no PSN20.
Order No 83-0834
£2.00

We may be able to obtain other Weller spare parts but the pricing on new items may be different.

Standard Weller 3 way housing. Only for TCP units.
Order No 83-0836 £4.00



Standard 3 hole fixing TCP handle with fume extraction pipe we think the part number would be FEH.
Order No 83-0837 £7.00

We buy surplus electronic components and other items. Being one of the largest surplus dealers in the UK we can pay more. Send us lists of your excess.

To avoid confusion with the other Mainline companies, if you see items in the flyer that you want to order call only the 0870 241 0810 number. Calls are just charged at the normal national rate. Callers are welcome to visit us. Please ask for details.

Mainline Surplus Sales
PO BOX 5783 Leicester LE3 2QL England
Tel: 0870 241 0810 Fax: 0116 289 6633 Intl: +44

The silver solution, chemically silverplates through a unique process that beautifies and protects, it also cleans polishes and retards tarnishing better than conventional polishes.
Order No 99-0859 £3.50

4 phono sockets mounted in a metal panel with right angled connections for PCB mounting.
Order No 05-0865
£0.50

21in Flyback transformer 10 pin bale VDE Reg no 5266 made by samsung. Their part no FTN21A001
Order No 91-0822
£5.00

Small PCB DIL bridge normally rated at 0.8 amps 300 volts.
Order No 17-0866
£1 for 3

Really nice size 1500UF cap size25mmx20 mm Legs10mm apart.
Order no 01-0863
3 for £1.00

Nice keypad from the front of alarm panels 10 connections so probably Binary/hex.
Order No 05-0823 £1.00

Nice chunky wire wound 330R probably 8 watts.
Order No 02-0861 5 for £1.00

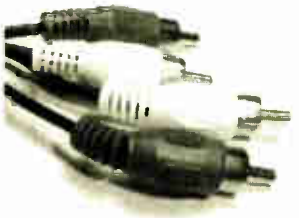
Standard 7.5 amp spade fuse for car (brown) Bargain.
Order No 81-0874
10 for 1.00

50 OHM panel mount BNC socket crimp fixing for RG58 style cable.
Order no 71-0868 £1.00

Small cable clamp for 2/3mm cable HO6 size approx 9-10mm
Order No 71-0860
10 for £1.00

2.5mm Mono plug.
Order No 71-0862
7 for £1.00

Red and black phono plugs to 3.5 mm stereo plug.
Order No 71-0857
£1.20



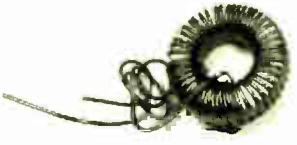
Pair of phono leads red and black, bargain.
Order No 71-0867 £1

Nice heatsink for T03 plastic devices 2in.
Order No 83-0887
£0.50

3.5mm chassis plug.
Order No 71-0858
7 for £1.00

Phono female to PL259 plug adaptor.
Order No 71-0869
2 for £1.00

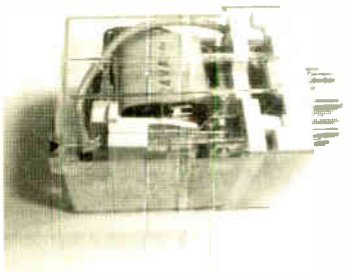
Small blue toroid ring with winding probably low frequency size.
Order No 38-0870
£1 for 3



Pre wound toroid on an amidon toroid (probably T130-26) for LF uses.
Order No 38-0871
£1.00 for 2

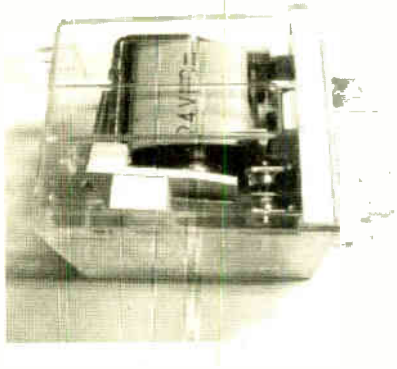
All prices include VAT

POWER RELAYS



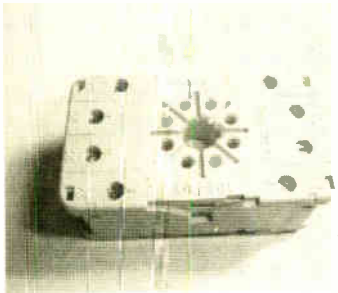
Large plug in relays 8 pin widely used in electronic controllers etc which may need to be changed quickly. We have the following types in stock. Pin assignmentis coil Pins 2-7 commons Pins 1-8 NCPins 4-5 No Pins 3-6, all types are DPDT and can switch 10 amps at 240 V.

24 V AC	orange coil	37-0875	£3.50
12 V DC	blue coil	37-0878	£3.50



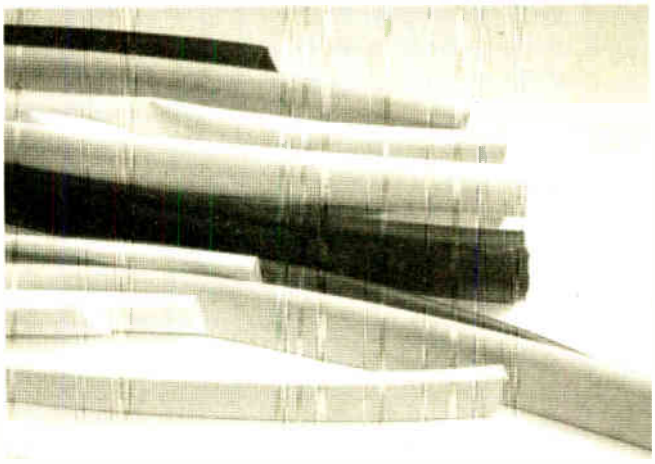
Similar to above but with spade terminals. This I think 20 amp mains relay SPST one paddle across two sets of contacts gives the power rating.

24 VDC	Blue coil	37-0876	£4.00



High quality relax base for 8 pin relax all terminals are brought out to screw connectors.
Order No 37-0877 £1.80

HEATSHRINK PACKS



We have tons of heatshrink material in stock in all sorts of colours and sizes. Its just to difficult to list so we have sorted the stock into 3 packs. These offer great value so buy while you can.

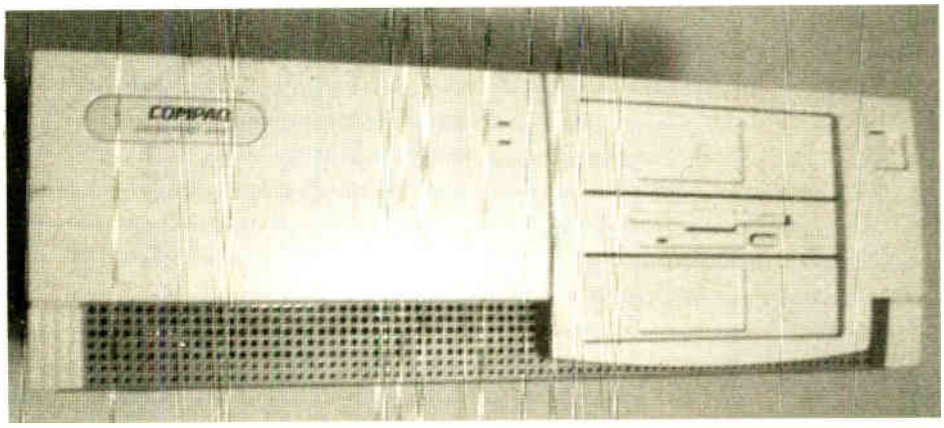
PACK A = 10 x 1 metre lengths of heatshrink (at least 4 different sizes) All under 1cm.
Stock No 81-0879 Price £1.50

PACK B = 6 x 1 metre lengths of heatshrink (at least 4 different sizes) between 1cm and 2 cm
Stock No 81-0880 Price £2.00

PACK C = 6 x 1 metre lenghts of heatshrink, above 2cm.
Stock No 81-0881 Price £2.50

All sizes quotes are approximate before shrinkage.

COMPAQ BASE UNITS



We had a big delivery of 486 DX66 base units. They comprise of a 2/300 meg hard drive 8 megs of ram and video on board. They have a 1.44 mb floppy and psu and just need os and keyboard and a vga monitor to work.
These are ideal for entry level systems or someone that just wants to type letters.

486 Base units	Order no 99-0912	£20.00
486 Base units with extra 8 meg ram	Order no 99-0913	£25.00

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E-mail Chester with your comments and suggestions at: chattothecat@mainlinegroup.co.uk

Nice looking push switch red cap size 20mm diameter.
Order No 80-0889
2 for £1

Small cable grommet.
For 8mm hole /4mm cable approx
Order No 81-0885
8 for £1

RF Toroid Kit
A small kit of popular Toroids by Amidon.
Kit includes -2 =500 khz-15khz
-6 =5-50mhz

T 37-2 x 5
T 37-6 x 5
T 50-2 x 5
T 50-6 x 5
T 68-2 x 2
T 68-6 x 2

Total 24 toroids in all
£10 the lot
Order No 38-0884

Small gear belt 14 in
Order No 81-0894
£1 each-

Cable clamp 20 mm
5 for £1
Order No 81-0892

Great big cable grommet for panels entry 15mm.
Order No 81-0893
£1

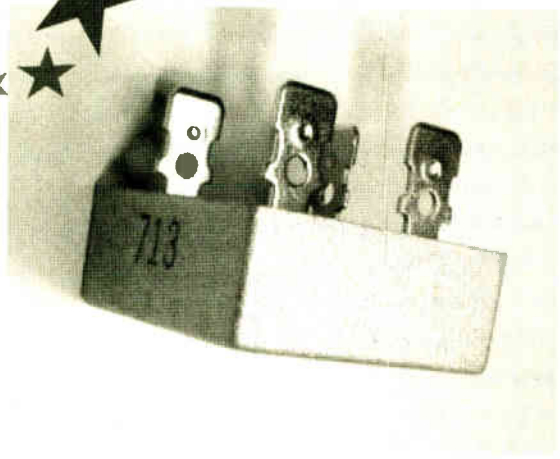
Standard spade terminals.
Order No 81-0897
25 for £1

50 ohm panel mounted bulkhead BNC socket for RG 58 cable.
Macom part no B35H45JB10X99
Order No 71-0898
£1.40

High quality 12 or 24 volt DC power plug for car or lorry. Made in Germany.
Order No 62-0948
£1.00 for two

High quality 12 volt DC adaptor lead with LED.
Order No 62-0961
£1.25

Anode lead for TV length 15in.
Order No 62-0956
£0.50



35 amp 600 volt all metal clad bridge rectifers. With spade terminals size 30mm x 20mm.
Order No 18-0890 £2.00 each 3 for £5
Stock up whilst you can.

Big cable tie metal with adjuster approx size 39 cm long.
Order No 81-0896
£1.00

Really big cable termination approx size of
Entry 20mm
Order No 81-0895
£1.00

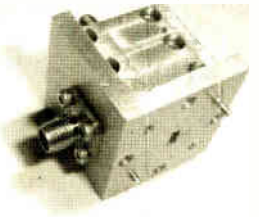
Resonators for use in simple applications 5 types are available from stock.
3.58 mhz, Order no 20-0937
6.00mhz, Order no 20-0938
12.00 mhz, Order no 20-0939
455 khz, Order no 20-0940
512 khz. Order No 20-0941
3 of one type for £1.00

All prices include VAT

This is an unusual adaptor to allow the user to plug earthed USA appliances into none earthed sockets with a wire to allow you to connect to an earthed pin.
Order NO 71-0944 £1.00

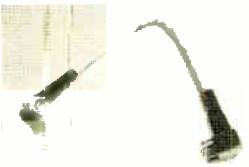
Unusual Nicad cell. Looks like an AA but longer 70mm long no nipple. Probably high capacity industrial type.
Order No 31-0945 £1.25

Not quite sure about this it looks like a fused mains terminal strip for panel or bus mounting.
Order No 71-0951 £1.00



We believe this to be a very small filter maybe even a mixer unit comprising of 3 ports 1 has An SMA socket 1 has a sub-SMA socket and one looks like it`s wave guide entry. I would say the frequency is very high as the wave guide entry is only about 6mm long.
Limit 1 per customer.
Order No 99-0953
£10.00

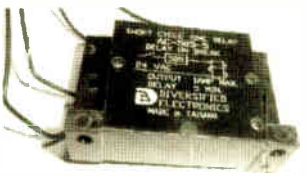
Unusual adaptor lead semi-rigid cable 50 OHM SMA plug to what looks like another SMA plug but smaller (sub sma?) length 3.5 in.
Order No 72-0959 £2.00

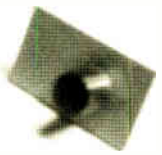


SMC plug 50 OHM`s to PCB connector for fixed use length 5in.
Order No 72-0958
£1.80

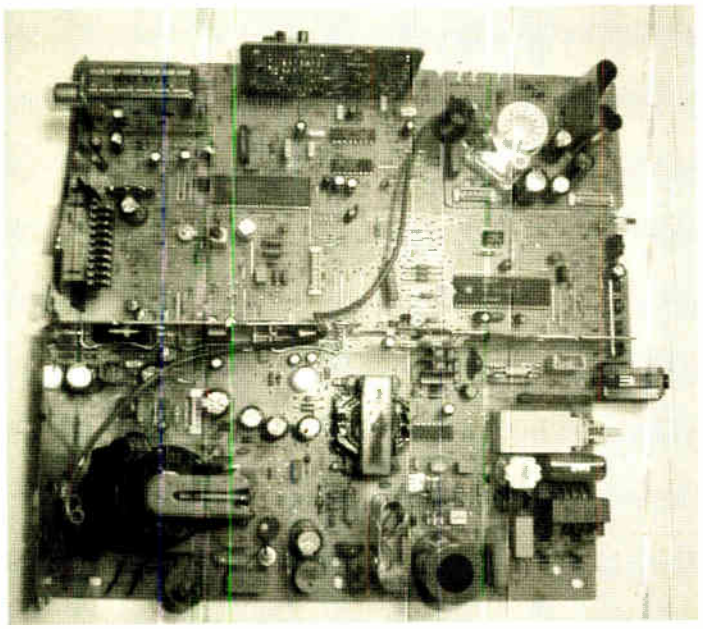
SMC fly lead length 8 in about 50 mm has been stripped back to coax braid at the bottom for PCB mounting 50 OHM.
Order No 72-0960
£1.40

New NIMH cell probably 500-600 mah or higher.
Order No 31-0947
£1.00 for two





Time delay relay all in cased in plastic resin 24 vac 1 amp. Delay or break 5 mins.
Order No 37-0949 £4.50

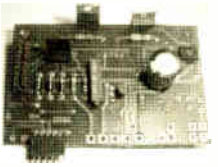


Very modern TV chassis made by ONWA in Newcastle for major brand names. These are not tested but are brand new and are sold for parts only. They contain a tuner, flyback unit + TDA8326A + SDA5254 CHIPS. I think you could just add a tube and hardware and you would have a new TV.
Absolute bargain at £6.95
Order No 99-0963

Small unpacked anti-clockwise isolators (3rd port terminated). Frequency 11.85-13.65 GHZ. I would guess a few 100 MW.
Order No 99-0946
£2.00 each

Made by Legrand this is hand wired European plug in white. It`s worth keeping a few of these in the suitcase as they are cheaper than a load of travel adaptors.
Order No 71-0950 £0.80

Right angled 9 pin D socket with long gold pins very high quality for PCB mounting..
Order No 71-0955
£0.80 for two



Small charger PCB contains 2 x LM317T +a 7805 regulator and small bridge.
Order No 99-0952 £2.00

All prices include VAT

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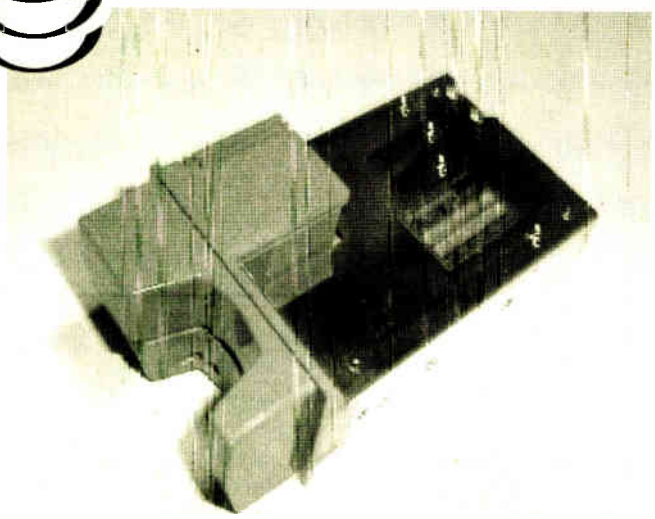
All prices include VAT



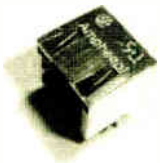
Panasonic cards reader model no ZU93123TE
Order no 99-2022 £10.00

Stereo adaptor plug . converts mini stereo plug to standard size.
Order No 71-0921
£0.80

Molded adaptor from 3,5mm minature plug to standard jack plug.
Order No 71-0922 £0.80

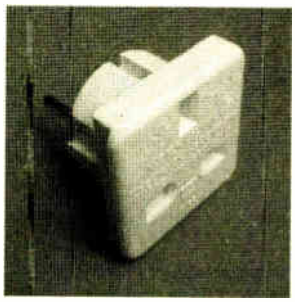
A stereo adaptor allows the use of two mini stereo headphones in a single mimi headphone jack.
Order No 71-0925 £1.20

3.5mm minature plug.
Order No 71-0924
5 fo £1.00



8 way + 2 led cable pcb connector for cat 5 applications, nice .
Order No 71-0918
£1.20

N connector Nickel plated 3 way 50 OHM N female T-piece.
Order No 71-0923
£1.00



UK adapter plug for use in Europe or as a shaver socket, buy one now or be stung at the airport.
Order No 1042
£1.35

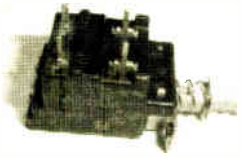
Looks like a 75 OHM type 43 termination.
Order No 71-0929
£1.50

Small isolator, without data size 25mm x 25mm x 10mm. I would say it would be around or above 500 mhz but I cannot be certain.
Order No 99-0917 £1.50

Some sort of filter limit one per customer .
Order No 99-0920 FREE

Made by Sagem model no 10MS56-07-02. It calls itself a one axis Gyro sensor. Must have been an expensive item. No data , limit one per customer.
Order No 99-0909 £20.00

Anti static wrist band and cable terminates in 4mm plug, good quality.
Order No 0914 £2.50



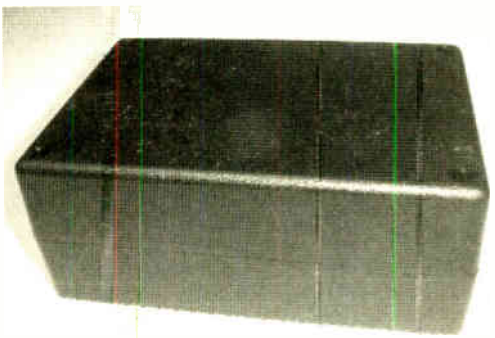
DPST mains switch on bracket like that used in Televisions, good click movement.
Order No 05-0906 £1.00

All prices include VAT

LARGE MULTI-PURPOSE BOXES WITH LIDS

These boxes are moulded in ABS to give maximum strength, but can be easily punched or drilled for individual requirements and to produce a professional looking product. They are available in black as standard but other colours may be available on request. PCB slots are provided on certain styles to allow for ease of manufacture.

Order no	Dimensions	Nominal Wall thickness	Rib spacing side A	side B	Each
88-2005	79 x 61 x 40	1.5	20	20	£1.50
88-2006	100 x 76 x 41	1.5	20	20	£1.80
88-2007	165 x 122 x 36	1.5	23	23	£2.50
88-2008	165 x 122 x 55	2.5	20	32	£2.95
88-2009	177 x 120 x 83	2.5	23	40	£3.75
88-2010	150 x 80 x 50	2.5	20	23	£2.50
88-2015	165 x 122 x 74	2.5			£2.50

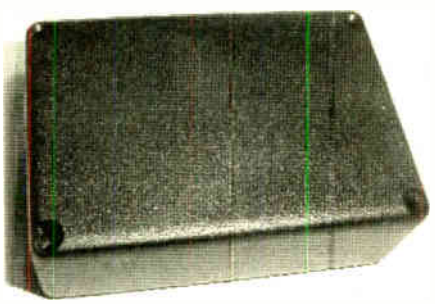


These have a matt finish and the lids are retained by 6 x M3.5 screws into brass inserts.

Order no	Dimensions	wall thickness	each
88-2011	216 x 130 x 85	4.0	£5.90
88-2012	220 x 150 x 64	3.0	£4.50

SMALL MULTI– PURPOSE BOXES WITH LIDS

These boxes are moulded in ABS to give maximum strength, but can be easily punched or drilled for individual requirements and to produce a professional looking product. They are available in black as standard . Lids are retained by countersunk self-tapping screws.



Order no	Dimensions	wall thickness	Each
88-2013	73.5 x 51 x 25.5	1.75	£0.90
88-2014	75 x 56 x 25	1.5	£0.90
88-2016	111x 57 x 25	2.5	£1.11

MINATURE SLOPING MODULE CASE

A highly adaptable minature case ergonomically designed for desk, dashboard, pocket, etc. and can be used either way up for the desired application.
Manufactured from high impact black or white ABS with single self-tapping screw fixing with a matt finish on all surfaces except for a polished recessed panel on the largest flat surface.
A cable knock-out is provided for flying lead applications.

Order no	Dimensions (mm) A	B	C	D	E	Nominal wall thickness	colour	Each
88-2017	71	44	28	22	17	2.0	black	£0.69

2 PART ABS BOXES WITH LIDS

These are general, all purpose, rugged boxes are made in ABS with a white polished finish.
The lid is retained by 4 x 3.5 countersunk plated screws into brass inserts. PCB slots are provided in the base of 88-2020 and in both halves of 88-2021

Order no	Dimensions A	B	C	Nominal wall thickness	Each
88-2019	82	62	46	3.0	£2.07
88-2020	84	65	32	3.0	£2.55

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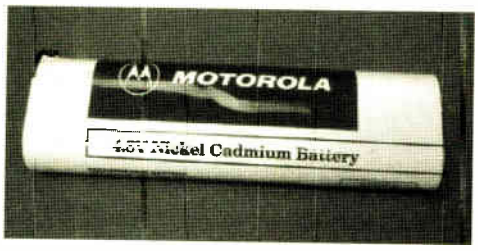
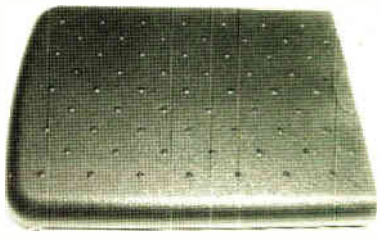
CELLULAR PHONE BATTERIES



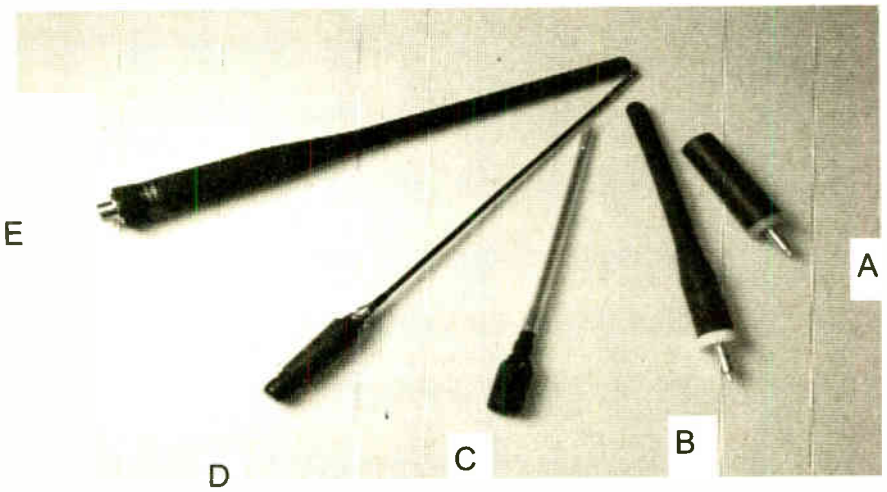


MODEL	TECHOLOGY	CAPACITY	STOCK NO	PRICE	NOTES
Aeg/matra 9/2020	nicad	450mah/6v	31-0964	£2.00	
Aeg/matra 9/2020	nicad	700mah/6v	31-0965	£2.50	
Aeg/matra 9/2020	nicad	1200mah/6v	31-0966	£2.90	
Aeg/matra 9/2020	nimh	600mah/6v	31-0967	£2.20	
Alcatel (group j)	nimh	600mah/3.6v	31-0968	£2.50	
Alcatel (group j)	nimh	1200mah/3.6v	31-0969	£3.50	
Bt amber/cmh 500	nimh	1200mah/6v	31-0970	£3.50	
Bosch (group d)	nimh	650mah/4.8v	31-0971	£2.50	
Dancell (group f)	nicad	400mah/6v	31-0972	£2.00	
Dancell (group f)	nimh	850mah/6v	31-0973	£4.00	
Ericsson (group I)	nimh	550mah/4.8v	31-0974	£6.50	
Ericsson (group I)	nimh	1200mah/4.8v	31-0975	£9.00	
Ericsson (group h)	nimh	1200mah/6v	31-0976	£6.00	ericsson
Ericsson (group h)	nicad	550mah/6v	31-0977	£2.50	
Ericsson (group g)	nimh	800mah/6v	31-0978	£4.50	ericsson
Ericsson (group g)	nimh	1200mah/6v	31-0979	£6.50	ericsson
Maxon amber/cmh400	nicad	1200mah/6v	31-0980	£3.00	
Mitsubushi mt30/35	nimh	800mah	31-0981	£2.50	
Motorola (group e)	nicad	400mah/6v	31-0982	£2.00	slim
Motorola (group e)	nicad	700mah/6v	31-0983	£3.80	mot
Mororola (group e)	nicad	700mah/6v	31-0984	£2.80	
Motorola (group e)	nimh	900mah/6v	31-0985	£3.00	slim
Motorola (group e)	nimh	1200mah/6v	31-0986	£5.00	mot
Motorola (group e)	nimh	1200mah/6v	31-0987	£3.50	
Motorola (group e)	nimh	2200mah/6v	31-0988	£6.75	
Motorola (group b)	nimh	550mah/3.6v	31-0989	£5.00	
Motorola (group b)	nimh	/3.6v//	31-0990	£4.00	
Motorola (group b)	lion	/3.6v	31-0991	£5.50	
Motorola modulo	nicad	720mah/4.8v	31-0992	£4.00	mot(1)
Nokia2110 (group a)	nicad	450mah/6v	31-0993	£2.00	slim
Nokia2110 (group a)	nimh	550mah/6v	31-0994	£2.50	slim
Nokia2110 (group a)	nimh	700mah/6v	31-0995	£3.50	slim
Nokia2110 (group a)	nicad	700mah/6v	31-0996	£2.50	
Nokia2110 (group a)	nimh	1800mah/6v	31-0997	£4.80	
Nokia3110	lion	400mah/7.2v	31-0998	£3.00	nokblj-1
Nokia8110/I/8148/I	lion	800mah/7.2v	31-0999	£6.50	
Nokia909	nimh	1200ma	31-1000	£3.00	
Orbitel pc902	nimh	1100mah/6v	31-1001	£3.00	
Panasonic 2827	nimh	600mah/4.8v	31-1002	£3.00	
Panasonic eu2000/1	nicad	700mah/6v	31-1003	£3.00	
Phillips (group c)	nimh	600mah/4.8v	31-1004	£2.00	slim
Phillips (group c)	nimh	600mah/4.8v	31-1005	£5.50	sl/vibrate
Phillips (group c)	nimh	900mah/4.8v	31-1006	£2.80	
Phillips (group c)	nimh	1200mah/4.8v	31-1007	£3.50	
Siemens s6 e10	lion	1000mah/3.6v	31-1008	£3.00	siemens
Samsung sh7/810 815	nicad	1200mah/4.8v	31-1009	£3.50	
Siemens c25	nimh	650mah/3.6v	31-1010	£3.50	

CELLULAR PHONE BATTERIES CONTINUED

*specially extended model
(1) this is a 4 cell pack there is a slightly thinner pack than for certain uk phones please check before ordering this pack.
Group a consists of nokia 2110/2140/2110/2140 and orange 5.1 and orange one to one / 2146
Group b consists of startac 70/85 and orange mr501/mr701
Group c consists of phillips diga/spark/twist orange ph301
Group d consists of bosch/gsm com 607/608 dual com/738/world 718 gsm719world
Group e consists of all the microtac range of early flips mot/omnitel 5200/6200/7200/8200/8400/8700/8800 bosch 214/354/406/554/714 pioneer pcc 730/740/750 gold vip flare/one2one m300/301/400 bt pearl/diamond 4 one2one m750/760 mot d460/470
Group f consists of dancall hp2711/hp2613 e plus/handy/dance orange dc 1
Group g consists of ah,dh,cf,ch,df,pd 237/8/300/310/320/337/338/337/338/338vi/318/318vi/338/343/353/368 368vi/328/398 and ge models ct700/750/800/dt3325 3500
Group h is all phones in group g but not ah210/220/230/318/218
Group I consists of ga628/gh688/sh888
Group j consists of alcatel one touch/pro hc 400/600/800

REPLACEMENT CELL PHONE AERIALS



A range of replacement aerials to suit most phones, we have listed the types where knpwn but in many cases some aerials are used to replace other manufactureres types. We have listed all the information we have at this time.

Code	model no	length	stock no	price	notes
D	samsung SCH 250	140mm	99-1043	£3.00	retractable
C	nokia pt11nf a39	100mm	99-1044	£3.00	retractable
C	alcatel hc800	100mm	99-1045	£3.00	retractable
A	nokia 1610/1611	30mm	99-1046	£3.00	
C	nokia 100/101/121	100mm	99-1047	£3.00	retractable
A	as above fixed stubby	40mm	99-1048	£3.00	
D	motorola slimlite	150mm	99-1049	£3.00	retractable
B	panasonic f bt ebony	75mm	99-1050	£3.00	
B	siemens sl	80mm	99-1051	£3.00	
D	panasonic g400	140mm	99-1052	£3.00	retractable
A	ericsson ga628/gh88 and model a1018	45mm	99-1053	£3.00	
C	bt2140	90mm	99-1054	£3.00	retractable
A	bra14	35mm	99-1055	£3.00	
C	phillips genie	100mm	99-1056	£3.00	retractable
E	necp100/p3 and bt jade and jet	155mm	99-1057	£3.00	
B	nokia/orange 121/2146	85mm	99-1058	£3.00	
B	ericsson brs3	90mm	99-1059	£3.00	
C	phillips spark	90mm	99-1060	£3.00	retractable
D	BTMT9	150mm	99-1061	£3.00	retractable
B	unkn/aerial	155mm	99-1062	£3.00	retractable
B	aerial brp6	85mm	99-1063	£3.00	

PLEASE NOTE
The code`s ABCDE Are just an indication of the type /size of aerial. The exact fitting may change between aerials in the same group, refer to the table to be certain.

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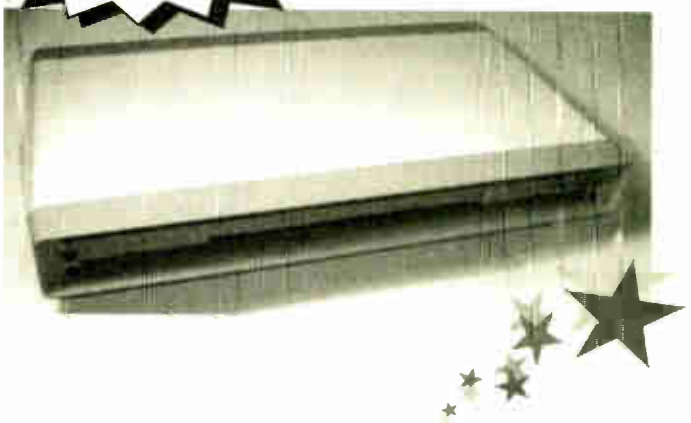
SIGNAL PLUS CONVERTERS

These are essentially adapters to allow your cell phone to adapt to the normal uhf fitting found on the end of most car phone earials and other phone accessories, such as boosters hands freekits etc etc.

Model	suitable for	Order no
Ac9020	aeg9020/matra2020/mercury121 m150	0901
Acmot8200	motorola 8200/8400/8700	0903
Ac1610	nokia 1610/1611/1630	0904
Ac5200	all microtacs mot/orange etc etc	0905
Acdan 100	dancall orange dc1/121 m600 samsung sgh 100 okgt1	0907
Eric337	ericsson gh337	0911

JUST ARRIVED



These are absolutely beautiful 10 high 19 inch cases in cream and taupe. Total length 12 in width 20 in deptn 2 in. I completely guarantee that you will be happy with the quality and value for money of them. These were purchased from an English company that made equipment for very proffessional applications. I am limiting purchases to a maximum of two cases so that everyone can have the chance to buy these otherwise someone would buy the lot. Normally they cost over £80 each in hundred of quantities.
Order no 99-2023 10 case £25

DATA TRANSMISSION CARDS

We have obtained a range of pcmcia data cards that are used to interface notebook computers to mobile telephones, in brief these cards plug into a free slot on your notebook and with the software supplied and a suitable cable also supplied, they plug into the mobile phone.
The software normally allows data and fax transmission and sometimes sms and file transfer over the gsm network.
Sometimes the datacards have standard modem type connectors so other companies cables may interface with the units where we might not have the interface cables, we have noted this where possible.
Speeds normally are 9600bps over the gsm network although some of the units use data compression technolgy so speeds up tp 19200 seem achieveable although it largely depends on the type of data that is actually being passed thru the unit, for example a zipped file shows virtually no speed improvements in actual data transmissions.

Mitsubishi pcmcia data/fax kit for mt30/ mt230/ mt430/mt-d30/mt35/mt401.
Kit includes cable software modem model no ombn1302.
Motorola 8400 8700 d460 kit
Order no 99-0927 £20
Nokia 2110 and all compatibles
Order no 99-0926 £20
Nokia 5110 6110 5130 6130 6190 and orange nk702 compatibles
Order no 99-0936 £35

We have smaller quantities of many other types if you have a phone and require a data kit please send us the make and model number and we will do our best to find a suitable unit for you, prices vary from £20 to £100 it just depends on the model and how current it is.

All prices include VAT

POWER LEADS FOR CELLULAR PHONES

We have a mountain of these in stock we have listed the types we can readily identify, we have just about every phone version available so please call if you require a type that is not listed.

Alcatel hc400/600/800 alcp4	Order no 71-1067
Bosch gsm com 607/608 dual com/738/world 718 gsm719world	Order no 71-1068
Bosch 908	Order no 71-1069
Dancell dc 1 one 2 one m600 samsung sgh 100	
oki gt 1 amstrad gsm audio vox	Order no 71-1070
Ericsson for 200 300 series337	Order no 71-1071
Ericsson for ah600-700 series	Order no 71-1072
Maxon cmh400 bt amber talkland t12 amh400	Order no 71-1073
Mitsubishi mtd30/mt30	Order no 71-1074
Motorola early flip 5200 7200 one to one m300/1 etc motcp5	Order no 71-1075
Motorola as above but has a fixed cradle to mount on dashboard	Order no 71-1076
Motorola tri band time port motcpst mr501/mr701	Order no 71-1077
Motorola a130/d160/d170 motcp130	Order no 71-1078
Motorola a130/d160/d170 motcp130rf *see note 1	Order no 71-1079
Motorola microtac motcp1 mr30/20 8200/8400/8700/8800	Order no 71-1080
Orbitel pc902	Order no 71-1081
Orbitel ppu903/5/7 ericsson go118	Order no 71-1082
Necp7 p8 p800 bt jade2 and elan neccp7	Order no 71-1083
Nec g8 g9	Order no 71-1084
Necp100 bt jade bt jet	Order no 71-1085
Nokia 2110 series ctnok2	Order no 71-1086
Nokia 2110 series nokcp2rf *see note 1	Order no 71-1087
Nokia 5110/6100 series	Order no 71-1088
Nokia 8110 *see note 1	Order no 71-1089
Panasonic g350/400/450/500 pancp4	Order no 71-1090
Phillips spark/diga/twist	Order no 71-1091
Siemans s6	Order no 71-1092
Sagem 715/730 sacp730 phlcps	Order no 71-1093
Sony cm-dx 1000 and siemans s4 *see note 1	Order no 71-1094
Sony cm-h333 snycp333	Order no 71-1095
Sony cm r111	Order no 71-1096

NOTES 1/ These 12 volt leads also include an rf connector to allow an external aerial to be used.

TRAVEL TALK IN CAR HANDS FREE KIT

This is a clever idea to quickly add a hands free facility to your mobile phone and allow use in the car without the complication of drilling holes etc..
Kits normally include a plug in charger/speaker unit connections to the phone and a self contained microphone unit, we have the following complete kits in stock.

Ericsson 628/688	Order no 99-1097
Nokia 5110/6110 series	Order no 99-1098
Nokia 8110i or orange nk502	Order no 99-1099
Siemans s6	Order no 99-2000
Microtac mr20/30 8200/8400/8700/8800	Order no 99-2001
	All £15.00 each

Call 0870 241 0810
All phone calls are charged at standard national rates.

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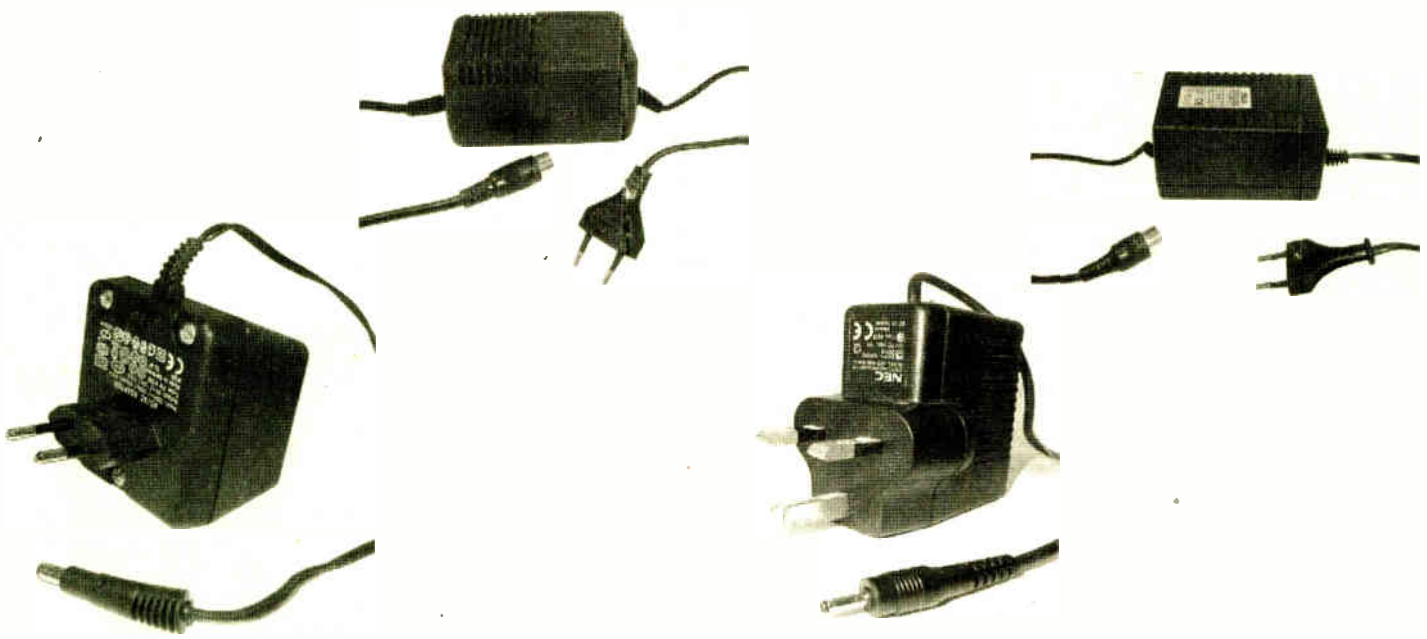
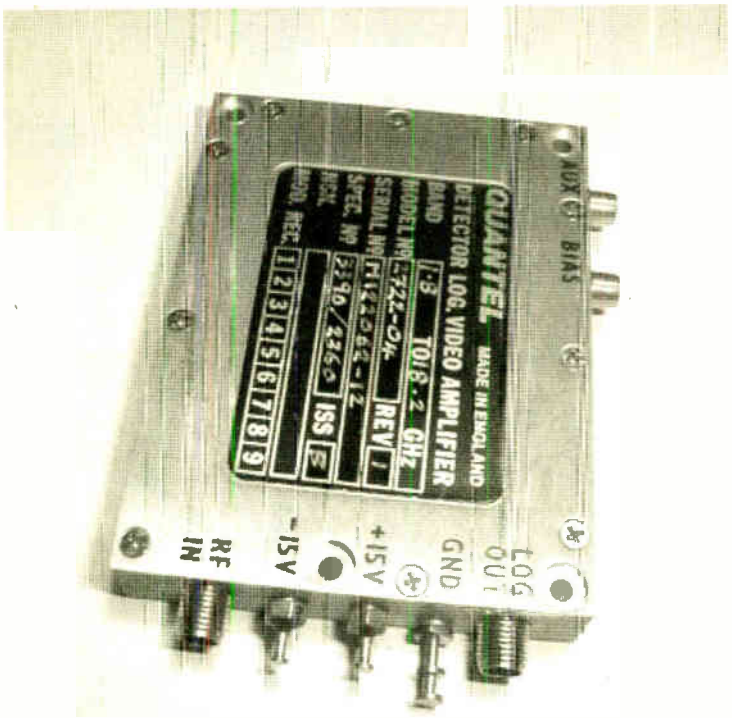
WALL ADAPTORS AND CHARGERS

We have received nearly a million "wall warts" in the past few months. Stock is constantly changing, we have bulk listed the following for ease of reference.

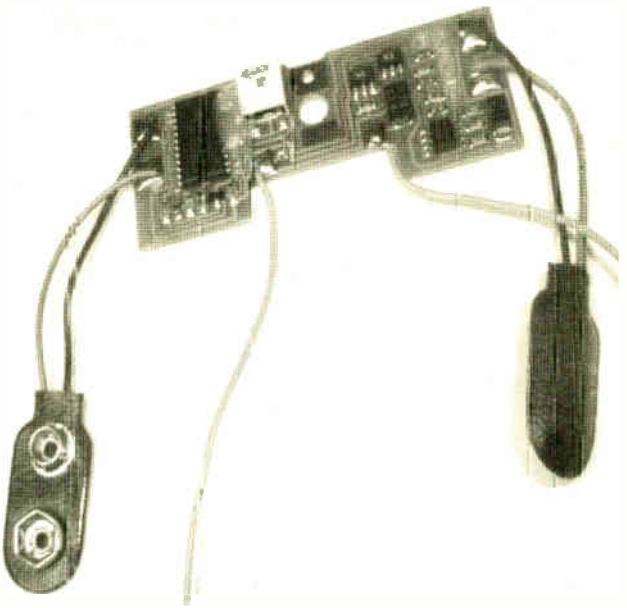


VOLTAGE IN	VOLTAGE OUT	POL	POWER	TECHNO	REG	TERMINALS IN	TERMINALS OUT	TYPE	PARTS NO	PRICE	NOTE
240	12	AC	1900MA	LINEAR	NO	EEC		WALL	71-0555	£1.40	
220	5/12	DC	400/6MA	LINEAR	YES	EEC	DIN	TABLE	32-0448	£3.00	12V +/-
240	9	DC	1200MA	LINEAR	NO	UK	2.1	WALL	32-0786	£2.50	
230	10.7	DC	350MA	LINEAR	YES	EEC	BT43	WALL	32-0787	£1.50	
230	9	AC	105MA	LINEAR	NO	EEC	2.5MM	WALL	32-0788	£2.00	
230	12	DC	580MA	LINEAR	YES	UK	2.5MM	WALL	32-0789	£1.50	
230	7	DC	67MA	LINEAR	YES	UK	UNKNOWN	WALL	32-0790	£1.50	
240	12	DC	1.2AMP	LINEAR	NO	?	3.5MM	WALL	32-0791	£2.00	
120	12	DC	120MA	LINEAR	YES	USA	2.1	TABLE	32-0792	£1.80	
240	12	DC	300MA	LINEAR	NO	UK	2.1	WALL	32-0793	£1.80	
120	10.2	DC	3200MA	LINEAR	NO	USA	UNKNOWN	TABLE	32-0794	£3.50	
220	5/12	DC	1A/250MA	LINEAR	YES	EEC	DIN	WALL	32-0795	£2.50	12V +/-
230	10	DC	500MA	LINEAR	NO	UK	2.1	TABLE	32-0796	£2.00	
240	9	DC	200MA	LINEAR	YES	UK	2.1	WALL	32-0797	£1.75	
220	12	DC	1200MA	LINEAR	YES	USA	3.5PLG	TABLE	32-0798	£2.00	
240	9	DC	680MA	LINEAR	YES	UK	2.1MM	WALL	32-0799	£2.00	
220	12/6	DC	?	LINEAR	?	EEC	DIN	TABLE	32-0449	£3.00	
230	12	DC	250MA	SWITCH	YES	UK	1.5MM	WALL	32-0130	£2.00	JOHN
240	7.8	AC	1000MA	SWITCH	YES	UK	SPC	WALL	32-0800	£3.00	M SPMO 98410
230	6.5	DC	700MA	SWITCH	?	EEC	1.0	WALL	32-0801	£3.00	
230	13	DC	800MA	LINEAR	NO	EEC	2.5	WALL	32-0802	£3.00	
240	12	DC	1200MA	LINEAR	NO	UK	2.1	WALL	32-0803	£3.00	
240	13	DC	1000MA	SWITCH	YES	UK	1.0	WALL	32-0804	£3.00	
240	12	DC	1200MA	LINEAR	NO	UK	2.5	WALL	32-0805	£3.00	
230	12	DC	1200MA	LINEAR	NO	EEC	2.1	WALL	32-0806	£3.00	
230	9.4	DC	550MA	SWITCH	?	EEC	SP	WALL	32-0807	£3.00	BOSCH COMP
230	7.5	DC	500MA	SWITCH	YES	EEC	SP	WALL	32-0808	£3.00	PANA G400/500
240	8.2	DC	840MA	SWITCH	YES	UK	1.3	WALL	32-0809	£3.00	
240	8.2	DC	840MA	SWITCH	YES	EEC	1.3F	WALL	32-0810	£3.00	PHIL PH301
240	8.5	DC	750MA	SWITCH	YES	UK	SPC	WALL	32-0811	£3.00	ERIC 337/388
230	9.3	DC	550MA	SWITCH	YES	EEC	1.3	WALL	32-0812	£3.00	

All prices include VAT



This is a detector log video amp 1-8 to 18.2 GHZ. I have no idea on the gain but the box must have cost £50 at least, made by Quantel in USA model no 2722-04
Order No 99-0919 £40 each
LIMIT ONE PER CUSTOMER



Interesting built PCB when the unit is connected to 2 9 volt batteries and a speaker (grey wires). The unit says "emergency emergency call the police". A suitable switch is required to short the middle terminals together otherwise the unit is complete.
Order no 99-0736 £2.40

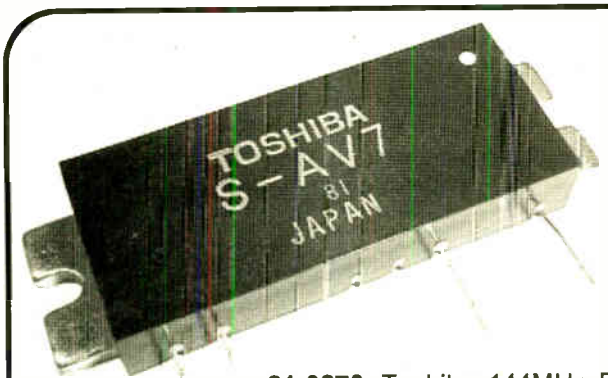
Crimp 50 OHM line SMC socket, in gold looks like for 2mm cable entry.
Order no 71-0933
£1.25

Crimp on right angled type 43 connector for 5mm cable.
Order no 71-0928
£1.50

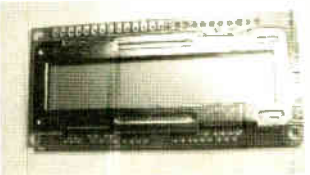
Small Board mounted high quality MCX socket in gold.
Order no 71-0932
£1.00

Mixture of 4 low frequency Toroids for RFI suppression.
4 for £1.00
Order no 38-0902

SMA square socket gold 50 OHM`s to pin connection for thru board mounting.
Order no 71-0931 £2.00



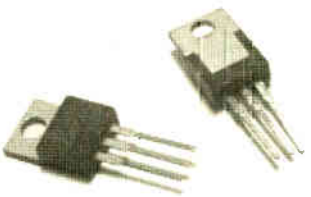
21-0270 Toshiba 144MHz FM power amplifier 300mW input gives you 28 watts RF output. Data included Toshiba part number S-AV7. **£20 each or 2 for £30**



Lovely Epson LCD part number EAD20025ER display area 80 x 18 2 by 20 character.
Order no 18-0900 £3.50

15 amp terminal block.
Order no 71-2003 £0.80

Voltage Regulators: 4 for £1



Voltage Regulators.
Standard positive types in a T0 220 case.
17-0051: type 7815: **4 for £1**
17-0238: type 7812: **4 for £1**
17-0239: type 7805: **4 for £1**
17-0486: type 7808: **4 for £1**
17-0487: type 7905: **4 for £1**
17-0488: type 7912: **4 for £1**

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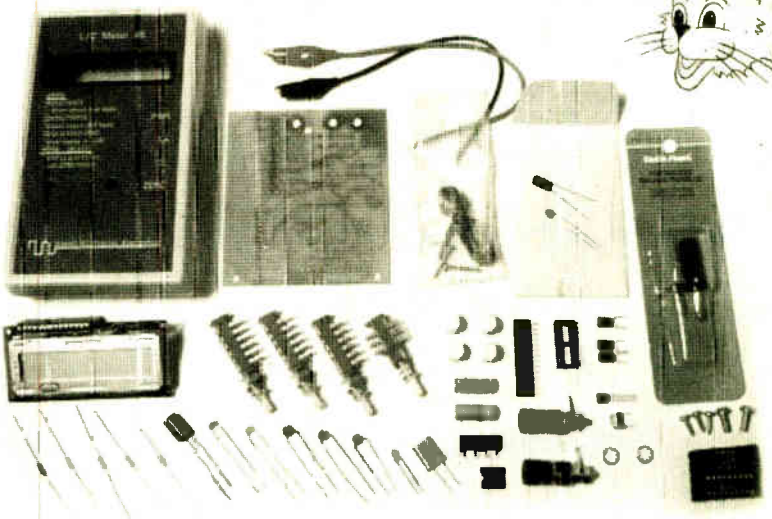
Chester's Choice...

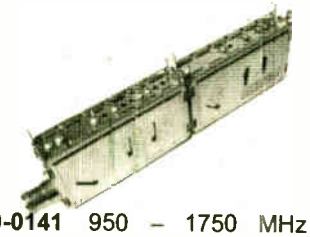
01-0314 This LC meter measures inductance and a capacitance. The problem is that units which read lower value parts are very expensive – this unit changes all that. The specifications are as follows:

0.001 uH (1 mH) to 100 mH (most units measure to 150 mH)

0.010 pF to 1 uF (most units measure to 1 uF)

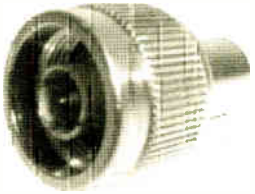


Great for constructors who experience difficulty in identifying those oddly marked components such as trimmers, air spaced, gangs and for winding P.A. coils. Very interesting and useful to build. Box size: 14.5 x 3.4 x 9cm **£79.00**

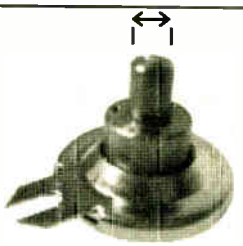


99-0141 950 – 1750 MHz tuner. Widely used in satellite / amateur TV use with pin out data. Output baseband or 479MHz. **£5.00**

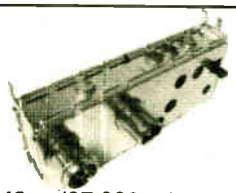
72-0118 An odd connector lead used on cellular base stations. May be a 7/16 type. **£3.00**



71-0115 (1100 in stock approx.) 50 ohm N dummy load made by Sunher. Top quality. Power rating probably half a watt, 2GHz. **£2.00**



81-0224 6 – 1 Ball drive. Custom made but customer cancelled order, hence the price: **£2.50 each**

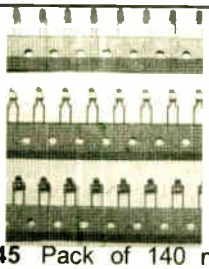


99-0142 (37,000 in stock approx.) Switchable setup TV modulator for UK PAL. Better quality than most. Made by Mitsumi. **£1.50 each or 5 for £5.00**

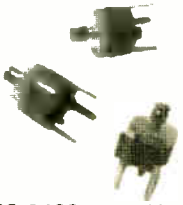
83-0175 Solder Wick. Used for desoldering PCBs the 'old fashioned' way. Length: 5 feet. **£0.95**

Nice 10 amp rocker switch
Size 55mm x 25mm x 35mm SPST
Order No 71-0888
£1.50
99-0888

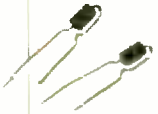
82-0039 Eddystone diecast 7134P box. Probably the most popular size: 110 x 60 x 31mm. **£2.40**



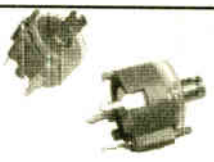
00-0145 Pack of 140 mixed 3mm LED's. All colours plus high brightness types. **£5.00 a pack**



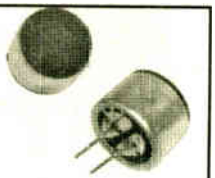
02-0183 Philips 40pf trimmer. Violet, unusual value in the smaller size. 3 for **£1.00**



38-0054 Ferrite beads on leads. Ideal for screening or putting in power supply feeds. **20 for £1.00**

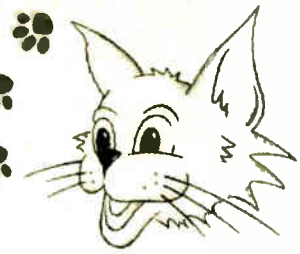


01-0056 Mullard / Philips 1.5 – 6pf Grey foil trimmers. (Not seized up) Good to uhf. **5 for £1.00**



21-0057 2 lead Electret condenser mikes. Made by Panasonic. **2 for £1.40 or 10 for £5.00**

Chester's Choice...

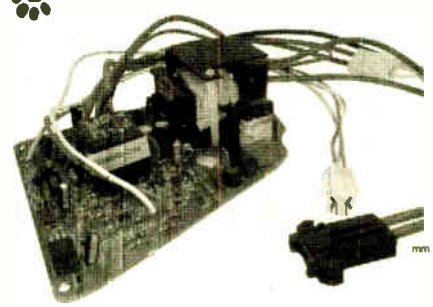


AMAZING PRICE: £12.50

31-0229 Made by KIEL. We have obtained 1000 of these 12 volt, 18AH batteries, they are the sealed lead acid type so you need a lead acid charger (normal household car chargers are no good). These were past the sell by date, but all the ones we have tested are okay. New, not second hand. 180 x 167 x 75mm.

HUNDREDS SOLD

JUST ARRIVED!



91-0594 Charger PCB for use with our 18AH batteries. No data right now but looks straightforward with flying leads for connections. Probably needs a heatsink. **£7.00**

BEST SELLERS FROM LAST CATALOGUE

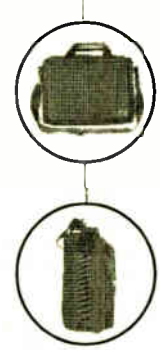
Ideal for Playstations

ELONEX Laptop cases

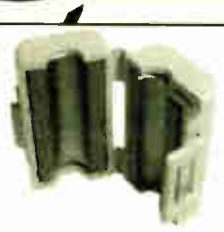
Only £5.75

Also great for gents overnight bags!

82-0013 ELONEX Laptop cases. Very good quality. Complete with handle and adjustable shoulder strap. Includes disk and accessory pockets with lock. Thousands sold. Approx. size: 32cm x 14cm x 24cm.

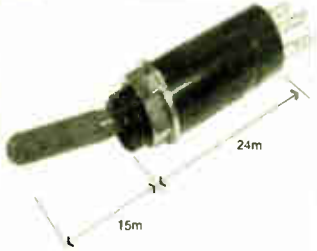


Mainline Surplus Sales
PO BOX 5783 Leicester LE3 2QL England
Tel: 0870 241 0810 Fax: 0116 289 6633 Intl: +44



38-0034 Small ferrite clamp, 22 x 12 x 12mm. For use internally or externally. Okay for 4mm cable. **5 for £3.00**

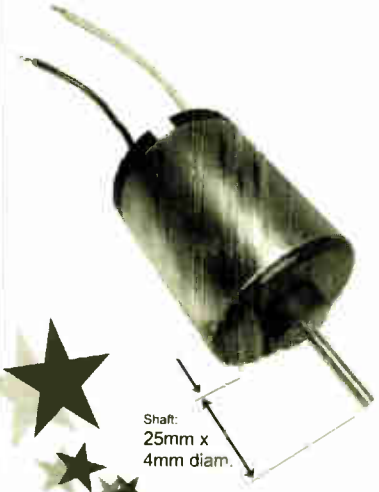
72-0140 9" N plug to N plug, 50 ohm patch lead. **£2.50**



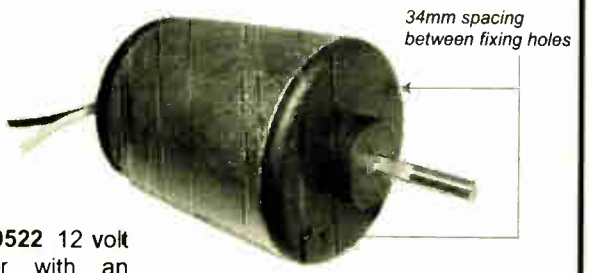
30-0574 Small toggle switch. **2 for £1.00**

MOTOR MANIA!

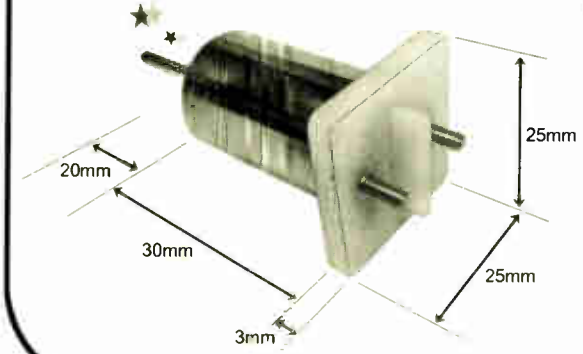
We have obtained a parcel of nearly 100,000 motors at an exceptional price. These motors have wide applications in electronics and modelling...

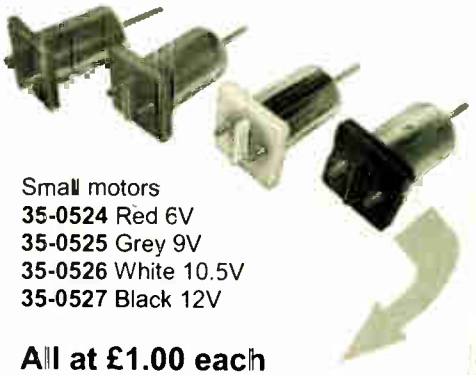


35-0522 12 volt motor with an RPM of 11000. Quite a large motor: 60mm x 47mm diam. Shaft: 25mm x 4mm diam. **£3.00**



35-0523 12 volt motor with fixing holes. Approximately 4000 RPM. Size: 60mm x 48mm diam. Shaft: 20mm x 4mm diam. **£3.50**





Small motors
35-0524 Red 6V
35-0525 Grey 9V
35-0526 White 10.5V
35-0527 Black 12V

All at £1.00 each
or 6 (of one type) for £5.00

Ceramic Heaters

99-0002 A really unusual item. These are 125 watt mains ceramic heaters that are used in base stations for cable TV. Very efficient, put one on a thermostat in the loft, under the tank, in the porch, in the garage etc.

Unbelievable price at:

£6.50 each
2 for £10.00

71-0074 50 ohm BNC female. Bulkhead socket, back to back. **2 for £1.00**

IEC Inlet as standard but 10 amp rated.
Order No 71-0954 £4.00

71-0072 SMA to SMA female. Coupled in gold. Made by SUNHER. **£1.50**

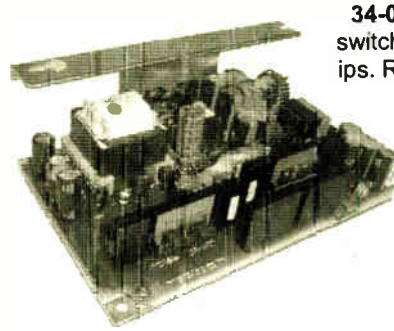
71-0071 SMB PCB Skt, 50 ohm, gold. **£1.00**

71-0080 SMA female socket with mini pin output for-thru printed circuit applications. **£1.00**

All prices include VAT

STAR BUY BATTERIES

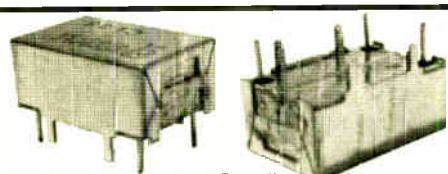
31-0343 AAA batteries.
6 for £1.00 or 35 for £5.00



34-0561 Brand new top quality switch mode PSU made by philips. Rated at DC in: 10-32 volts, 140 watts. DC out:
5V at 3.5 amps
15V at 1.7 amps
28V at 1.4 amps
-5 at 0.5 amps
-15 at 0.25 amps
-48 at 0.15 amps
Overall size: 20.5 x 12.5 x 7.2cm. **£5.00**

01-0285 10,000uf 63v Philips capacitor. Length: 75mm, Diameter: 40mm, Pitch: 14mm. New. **£2.00**

31-0082 (30,000 in stock approx.) Huge parcel of AAA Nicads. Probably 180-220mAH PCB mntg (44mm pitch) but tags can be removed. These have the nipple on unlike normal types so okay for home use etc.
£1.00 each
20 for £10.00
80 for £32.00

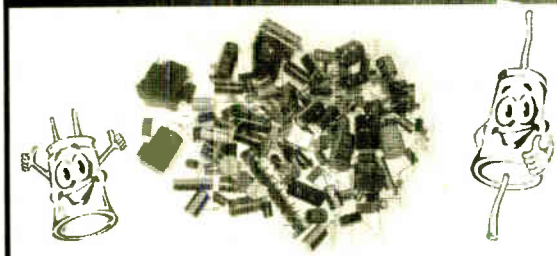


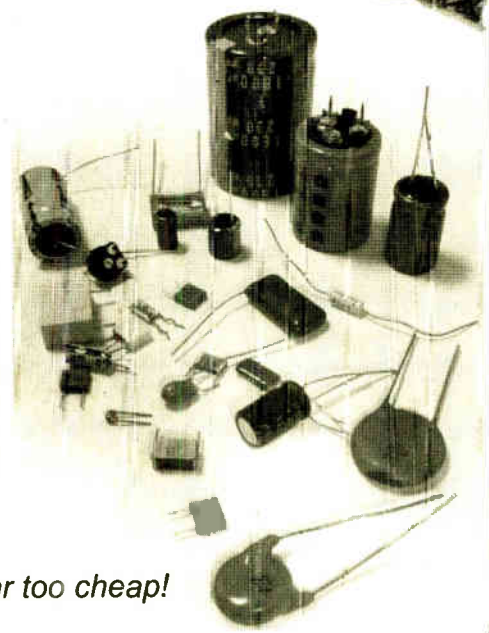
99-0399 900 MHz VCO / Transmitters used widely in cellular phones. No pinout but normally Earth = Can, Dot = Output. Other two pins are normally 5-12 volt Dc input and the other is normally 5-20 volt for varying frequency. Thousands of applications. (I cheat and put a Varicap on the tuning voltage and hey presto a bug!) **£1.50 each or 10 for £10.00**

The electret microphones have been very popular so we have introduced two smaller types (one with leads on).

21-0515 Small mike insert. 6 x 5mm diam. **2 for £1.20 or 10 for £6.00**
21-0517 Very small mike insert with leads. 3 x 5mm diam with 25mm leads. **2 for £1.40 or 10 for £6.00**

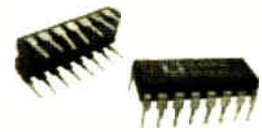
AMAZING VALUE CAPACITOR BAGS!!!





01-0543 Capacitor bags. We were just about to make up some mixed capacitor bags when another dealer offered us some already made up. After looking at his bags, they put ours to shame so we bought all he had. These capacitor bags represent the best value for money I've seen in years. The bag is crammed full of lots of large electrolytics in the 200 – 400 volt ranges, plus smaller types as well. One of the capacitors costs more than the whole bag. Total weight is approximately 1.5 KG.

I'm very tempted to break these down as they are *far too cheap!*
ONLY £5.00



12-0274 SL6440CDP complete radio IF chip. Now discontinued by PLESSEY. Get them while you still can with data. **2 for £5.00**

71-0558 Standard fused IEC inlet. Good quality. **£1.00 each or 6 for £5.00**

ORDER FORM

Please send your order to:

e-mail us at: surplus@mainlinegroup.co.uk

All prices are VAT inclusive

Order Code	Qty	No. of packs	Description	Price	£ p

Postage & Packaging (UK)	£3.00
Sub Total	£
Deduct credit	£
TOTAL	£

Goods normally dispatched within 72 hours by parcel post. Parcel post can take 4 – 5 days to reach you. For urgent orders contact sales for details of carrier options...Thank you for your order.

Overseas customers please contact sales

Postman: If undelivered please return to:

Mainline Surplus Sales
PO BOX 5783
Leicester
LE3 2QL
England
Tel: 0870 241 0810
Fax: 0116 289 6633 Intl: +44

PLEASE WRITE CLEARLY AS THIS FORM WILL BE USED FOR THE DELIVERY OF YOUR GOODS:

Name:

Address:

Postcode:

Daytime telephone number *(in case of query)*:

e-mail:

If your address is incorrect, or you no longer wish to receive mailings from us, please let us know so we can update our records. Many thanks.

Please advise if you want this order:

☐Sent as soon as possible with a credit note for any parts out of stock.
☐Sent as soon as possible with out of stock items to follow (only if value 'to follow' items exceed £10)
☐To save the inconvenience of low value credit notes (under £2), please list alternative goods (or we will include popular items up to this value) for any items not available, unless you tick box.

Please tick method of payment: ☐Credit / Debit card Visa/Access/Connect/Switch; ☐Cheque ; ☐Postal order ; (made payable to MAINLINE SURPLUS SALES); ☐Cash

If paying by card, only goods supplied will be charged on the day of dispatch
CREDIT NOTES ARE A PAIN TO EVERYBODY – PLEASE USE YOUR PLASTIC!

Credit/Debit card number*..

*Please Note: With switch the number we require is the long one across the middle of the card

Exp. Date.......................... Issue Number (SWITCH only)........................

Signed..

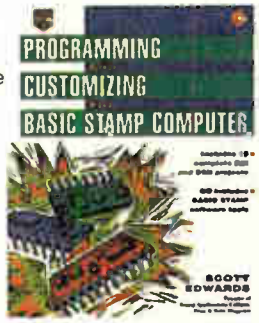
Vat No. 565713426

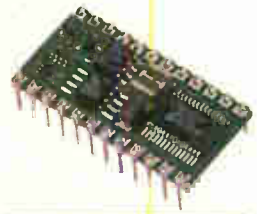
CONTROL & ROBOTICS

Milford Instruments

BASIC Stamp Microcontrollers

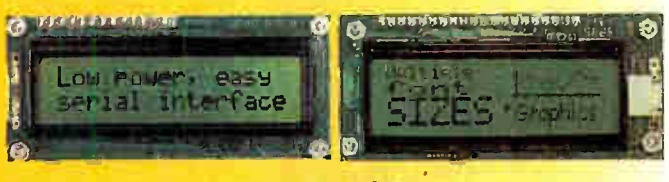
Still the simplest and easiest way to get your project or development work done. BASIC Stamps are small computers that run BASIC programmes. With either 8 or 16 Input-Output pins they may be connected directly to push-buttons, LEDs, speakers, potentiometers and integrated circuits such as digital thermometers, real-time clocks and analog-digital converters. BASIC Stamps are programmed using an ordinary PC running DOS or Windows. The language has familiar, easy-to-read instructions such as FOR...NEXT, IF...THEN and GOTO. Built-in syntax make it easy to measure and generate pulses, read push-buttons, send/receive serial data etc. Stamps from **£25** (single quantities), Full development kits from **£79**





Full information on using BASIC Stamps plus lots of worked projects and practical electronics help. CD-ROM also includes 30+ past magazine articles and Stamp software.
£29.95

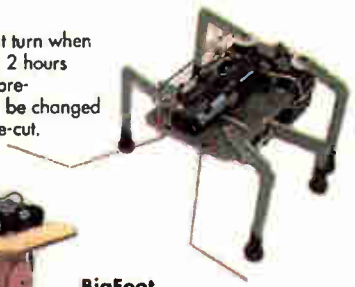
New to PICs or just wanting to learn more tricks?
We stock the excellent PIC primer books from David Benson- suitable for the complete beginner to the advanced user.



SERIAL LCDs
Bannish the hassle of interfacing to LCD displays.
We stock a comprehensive range of alphanumeric and Graphic LCDs - all with an easy-to-use standard RS232 serial Interface. Sizes from 2x16 to 4x40 plus 128x64 graphic panels.
Prices start at **£25** (single quantity)

Stamp2 based 3-axis machine
Stepper drive to X, Y and Z axes with 0.1mm (4thou) resolution.
Kit conains pre-machined frame components.
Complete with Windows software for drilling pcbs.
Full kit at £249, Part kit at £189

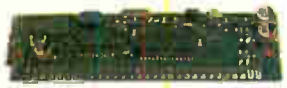
StampBug
Stamp1 based walking insect
Forwards,backwards and left/right turn when feelers detect object in path. Up to 2 hours roving from 4xAA Nicads. Chips pre-programmed but programme may be changed (software supplied). Body parts pre-cut.
Full kit £68



TecArm4
New range of robotic arms for educational and hobbyist use with super powerful servos. Controlled from PC (Windows freeware provided) or from optional keypad. Stands about 450mm high when fully extended.
Kit includes all pre-cut body parts, servo controller board, servos and software. Requires 9v Dc. Kits start at **£189**

BigFoot
Stamp1 based walking humanoid
Walks forwards/backwards with left and right turn when detects obstacles. Electronics pcb pre-built and tested. Programme pre-loaded but may be changed with supplied software.
Full kit £68

Alex- Animated Head
Stamp2 based controller with voice record-playback capability, PIR input and/or random playback. 4-servo actions are recorded/edited one track at a time. May also be controlled from PC.
Head kits start at £29. Cantrollers from £29



On Screen Display
Superimpose text onto standard CCTV from simple RS232 serial line.
Ready built/tested at **£59**

IR Decoder Board
Control your project using a standord domestic IR remote.
7 Output lines (5v @ 20mA) may be set to momentary or toggle action.
Simple teaching routine. Requires 9-12vDC
Supplied built and tested.
£29 single quantity

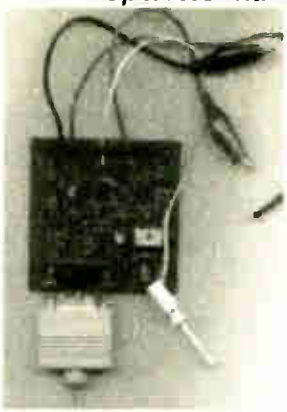
Servo Driver Board
Control up to 8 standard hobby servos from an RS232 serial data line using this controller board. Simple command structure holds servos in position until update is received.
Fully built and tested- requires 9vDC and servos. Supplied with Windows freeware.
£29 single quantity. Optional keypad available.

All prices exclude VAT and shipping.
BASIC Stamp is the registered trademark of Parallax Inc. For further details on the above and other interesting products, please see our web site-
www.milinst.demon.co.uk

Milford Instruments
120 High Street, South Milford, LEEDS LS25 5AQ
Tel: 01977 683665 Fax: 01977 681465

NEW From FED – In Circuit Debugging for PIC 16F87x series

Operates with all FED PIC Development applications (PIXIE, WIZPIC, PICDESIM, C Compiler)



In Circuit Debugger Board

What is In-Circuit Debugging (ICD) ?

In Circuit Debugging is a technique where a monitor program runs on the PIC in the application circuit. The ICD board connects to the PIC and to the PC. From any of our applications it is then possible to set breakpoints on the PIC, run code, single step, examine registers on the real device and change their values. The ICD makes debugging real time applications faster, easier and more accurate than simulation tools available for the PIC.

Features

- Allows real hardware to be examined & programs to be debugged and to be *run in real time* on your application
- *Powered* from the application circuit (3 3V to 5V)
- The FED ICD requires only *one data* I/O pin on the PIC which can be chosen from any of ports B, C or D.
- Can *program and re-program applications* in circuit
- Up to *3 breakpoints*
- Run, single step and step over, run to cursor line, set PC to any value in the program
- Trace execution in the original C or Assembler source files
- *Animate* operation to trace variables at breakpoints or watch the program executing
- Auto Run application if ICD not connected
- *View and change values* of PIC special function and general purpose registers, W and the ports.
- Uses a standard (3 wire) serial interface to a PC

Prices

In Circuit Debugger Board - £30.00

You will also need a copy of PICDESIM, WIZPIC, our C Compiler, or PIXIE, all of which operate with the ICD board.

PIXIE

Visual Development for the FED PIC C Compiler

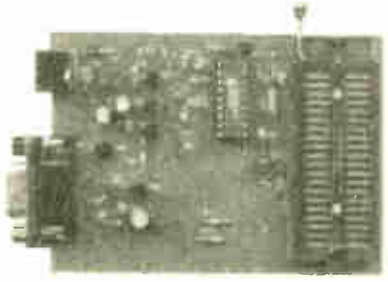
- An application designer for the FED PIC C Compiler FULLY including the PIC C Compiler
- Drag a software component on to your design & set up the parameters using check boxes, drop down boxes and edit boxes (see shot right).
- Connect the component to the PIC pins using the mouse
- Select your own C functions to be triggered when events occur (e.g. Byte received, timer overflow etc.)
- Simulate, Trace at up to 10x the speed of MPLAB
- Generate the base application automatically and then add your own functional code in C or assembler
- Supports 14/16 bit core PICS - **16F87x,16C55x,16C6x, 16F8x, 16C7xx 18Cxx**
- C Compiler designed to ANSI C Standards

Prices

PIXIE with Introductory manual (C Manuals on CD) - **£70**

PIXIE with WIZPIC, Serial Programmer, or Development Board **£50.00** CD-ROM

PIC & AVR Programmers



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READOUT

E-mail: editorial@epemag.wimborne.co.uk

John Becker addresses some of the general points readers have raised. Have you anything interesting to say? Drop us a line!

WIN A DIGITAL MULTIMETER

A 3½ digit pocket-sized l.c.d. multimeter which measures a.c. and d.c. voltage, d.c. current and resistance. It can also test diodes and bipolar transistors.

Every month we will give a Digital Multimeter to the author of the best *Readout* letter.

★ LETTER OF THE MONTH ★

DOCTOR'S ORDERS

Dear EPE,

Just to let you know that your magazine has been a saviour to me. Having subscribed to it for a number of years without embarking on any of the fine constructional projects published because of pressure of work, I dropped the subscription last year, definitely a mistake on my part!

Some five months ago, I was signed off from work so the medical profession could investigate my ongoing health problem. However, instead of sitting around, doing nowt, I started to browse my old copies of *EPE* and my eye was taken by a number of articles which I could get stuck into and time would pass by in productive mode.

I also decided that learning QBasic would enhance my understanding of *Toolkit Mk2* and programming of the PIC16F877. As a result, the last several weeks has proved to be very interesting indeed, my Wife has become a Computer/Electronics Widow and I have built my own skeleton version of the *TK* software and successfully Programmed a PIC16F877 with TKTEST4.

Next step is to get hold of a Graphic LCD and continue with the Feb '01 supplement.

I have renewed my subscription and look forward to further interesting projects, especially *TK Mk3*, to keep me going. *EPE* has saved me from boredom and for that I thank all your staff and wish them well for the future.

Nick Biggs, via the Net

Welcome back Nick. We wish you every success.

KEYPADS

Dear EPE,

I recently added a keypad interface to a 6502 note-collecting unit and found your *Using PICs and Keypads* article (Jan '01) very interesting although I had a sinking feeling when I noticed the extra resistors R1 to R4 (which I haven't used). However, my prototypes haven't blown the 74LS139 column driver, presumably because in normal use the keyboard is continuously scanned so that each column can only be short circuited for a short time.

In order to understand your routine I converted it into C, without global variables and with a multidimensional array, which makes converting row and column into the correct character more obvious. I used the CCS PCM compiler.

I have also read your *PIC V-Scope* article: it seems quite a slow scope: I wondered if it could be speeded up by running the PIC at its full 20MHz and using external ADCs on the pseudo data/address bus used by the RAM with a few of the spare port lines used as chip selects.

When reading this January's *Elektor Electronics*, I noticed that one of the PIC projects was written in CVSAM which is a sort of macro assembler that maps standard type microprocessor mnemonics to PIC mnemonics. The web address is:

http://www.tech-tools.com/cvasm16.htm.

Alan Bradley, via the Net

Thanks for your interesting comments Alan. Yes, PIC V-Scope *could run faster as you suggest, although it fulfils my original intentions for a really simple PIC-only unit. One day I might try the route you suggest, with enough encouragement from you all. Do you all want one?*

Thanks for the useful Elektor *info, too. (In case readers wonder about us acknowledging the existence of other mags, we are quite happy to mention them when appropriate, in the belief that the market benefits by having several rival publications devoted to the same subject. We are the best, though!)*

DOOR BELL SLAVE

Dear EPE,

I see *IU* is suffering from a lack of material (*Editorial*, Mar '01). Whilst I am unable to submit any circuits, I suggest that a reader might consider offering a solution to the following problem:

I have a wireless chime with a range of 30 metres, which is three metres too short to reach my workshed from the front door. How can I use a second unit as a "slave-relay" to increase the range?

The *Door Bell Extender* of March '01 is unsuitable as the earthing system in Ireland is different to that in the UK. In Ireland an earth does not come in with the supply, rather the Neutral is earthed by taking a wire back out and driving an earth rod into the ground.

M. Guthrie,
Loughrea,
Co. Galway, Ireland

Well, anyone? (The colleague who suggested moving the house nearer the shed has been severely rebuked!)

YES TO USB

Dear EPE,

In response to *Readout* May '01, I think you should definitely look into using the USB ports on computers. I think they should be quite easy to use and there is plenty of info out there about them. Check the following website:

http://www.lvr.com/usb.htm

With their potential speed of 480Mb/s you could do an oscilloscope project, like the one in the May issue, but just using a fast ADC and the USB port then get the PC to do the rest . . . you could end up with very cheap single channel 50Msamples/sec scope!

Matt Lee,
via the Net

Thank you Matt. The LVR site is also useful for a whole raft of other info too, including Visual Basic subjects.

USING USB

Dear EPE,

I feel there should be more mention of USB with regards to the possibility of amateur constructors using it to interface with computers. I have a 300+ page document of the official USB V1.1 specification and after reading through it, there seem to be three points to consider:

1. Hardware/electrical: neither is much of a problem here, the connectors can be purchased, or taken from a cheap USB extension cable, and the interface circuit is no more than a few buffer gates and associated resistors and capacitors.

2. Interface signals: more complicated – USB has two modes of operation, high speed at 12MHz and low speed at 1·5MHz. While this low speed mode might just about be usable on fast PICs, I doubt 12MHz is achievable on even a 20MHz PIC. However, there is rumour that Microchip are planning a PIC with USB support.

The signal itself is not much more than a souped-up RS232 communication; it has start and stop bits, and the usual signals that an asynchronous communications protocol has. The communication uses an NRZI differential signal with bit stuffing after six non-changes.

However, USB is different to RS232 in one key aspect; it is a multi-connection protocol. Whereas RS232 only has to consider one channel of information, and so communicates individual characters, USB works by a different principle, similar to TCP/IP or other packet-switching networks.

Each USB device establishes a number of virtual pipes with the host controller (i.e. PC), and all communications occur through them. To send a packet requires quite a bit of processing, so perhaps more than one PIC is required, one to act as a special-purpose UART, and the other to provide the actual data. Note that allowance must be made for mixed byte lengths in a row as not all the USB message fields are eight bits long.

3. Software Drivers: the operating system does not give access to the USB port like it does to serial, but only to the end data used by these virtual device numbers. When the host controller detects a new device on the bus, it queries it for its device number (unique to model, for example, a particular make of USB mouse), and loads the appropriate driver. This driver is then allowed to communicate to the device which it knows only by the virtual port number.

Paul Evans, 1st year Maths & Computing,
Cambridge, via the Net

Many thanks Paul for your enlightening comments (and for the other helpful information in your E-mail, but which we do not have space to include).

SOLDERING QUESTIONS

Dear EPE,

I recently came across Alan Winstanley's very informative soldering/ desoldering "tutorial" and have two questions. First, would there ever be any reason someone might choose a 25W iron over say a 50W iron? Many higher priced soldering stations seem to provide the option of choosing a lower wattage iron on even higher power stations, such as a 20W or 40W iron on an 80W station.

Your soldering tutorial seemed to explain that the power rating of the iron was primarily an indication of its resilience to heat loss when working on "larger jobs" or quickly working one joint after another. It confuses me that lower power irons can achieve the same temperature as the higher power irons.

My other question is regarding Weller soldering stations. The choice seems to become the WES50 running at about $100 US and the WS80 at about twice that. The WS series offers a substantial amount of more features, but which I am unsure if I need. The former being a 50W station and the latter an 80W seems to be the only "issue" I can think of.

Can you offer guidance to someone who will solder quite regularly but does not need the exacting control of a high-priced iron. I consistently work with CMOS electronics.

Arthur W. Green, via the Net

Alan replies to Arthur:

It's true that irons will reach the same temperature (soldering stations have a variable control), but one with a higher wattage has more power (heat) in reserve. This only becomes apparent when soldering larger joints, or when performing many joints in rapid succession. Here's why . . .

The lower-wattage iron will struggle to keep heated up, with the result that heat can be drawn out of it faster than it can be replaced by the element. So the joints will not be formed correctly. At a minimum, the user must wait for the iron to regain its operating temperature in between making joints.

If you tried to solder a copper water heating cylinder with such an iron, the copper tank would draw out all the heat from the element, and the tip would never reach the melting point of solder. The tip would be stone cold.

A higher wattage (25W-40W) is able to keep heating the tip such that heat is replaced as quickly it's taken away by larger joints. It's a bit like a moving conveyor belt, with heat being pumped in at one end and taken out at the other. A higher wattage allows the conveyor belt to keep up!

On basic irons, the tip temperature is thermally balanced, and the iron is designed so that the element warms it up approximately as quickly as heat is lost to the ambient air. As I said in the guide, consider a higher wattage iron as more "unstoppable".

A 25W iron is fine for general hobby use, a 40W temperature controlled iron includes a "thermostat" for closer temperature control and is a better bet.

Regarding your other question, a 50 watt iron should be more than enough, with ample in reserve for almost all routine soldering of discrete and integrated components. A temperature controlled soldering station would be ideal, if you can afford to spoil yourself then that is what I would buy. But it may be overkill, and you could instead practice your skill on a cheaper iron before deciding to upgrade.

A fixed temp-controlled iron will be fine though, and Weller have plenty of spares, tips, handles, etc. and are extremely popular. You won't go wrong with a Weller. Skilled engineers I know use a 40W Weller and are very happy. Here in the UK I'd expect to pay say £40 ($60 US) for a good iron.

PIC PROGRAM EDITOR

Dear EPE,

I have just built the board for your *PIC Tutorial* (Mar-May '98) and have my first l.e.d.s flashing. What excitement! Having found a Windows editor called PFE by Allen Phillips that I prefer over the Microsoft one, I managed to get your program to use it instead.

I open PFE, edit or write a program and then launch your programmer from there, continually hopping between the two, but having to "re-maximise" each time. I read with interest that you will be making a Windows version. Maybe you can have your new programmer running from an editor designed specifically with your projects in mind.

You are the leaders in this field and I have decided, after following your articles from way back when, that you are now the electronics "guru", surpassing even Bob Grossblatt of *Radio Electronics* fame.

Mike MacLeod,
Mossel Bay, South Africa, via the Net

Flattery is always welcome! In fact, Mike, Toolkit for Windows *(TK3) provides access to any text editor of the user's choice. We are aiming at publishing in the October '01 issue.*

CLOCKING CLOCKS

Dear EPE,

Referring to Chris Betts' letter (*Synchronous Motors, Readout* Apr '01), some time ago I solved a similar problem by locking a 300Hz oscillator to the 50Hz UK mains supply. I then locked a 60Hz oscillator to this 300Hz source and fed the result through a small step-up transformer driven by a switching transistor. A second small transformer stepped down the 50Hz mains and a half-wave rectifier provided the d.c. power required. No crystals or stabilised supplies were needed, and the solution was cheap!

Les Williams, Stourport on Severn, Worcs

Interesting, thank you Les.

REVAMPING IDEAS

Dear EPE,

It is noticeable that old ideas get revamped every so often, mostly disguised by the use of a PIC or some other processor type device. I suppose there are only so many circuits to go around.

I have a large collection of older magazines, if I find a good circuit that can't be built as originally intended would it be possible to send in the idea for an updated article?

There are some ideas that are timeless in concept but require reworking to achieve a practical design – that is, finding updated devices or a new way to invent the wheel.

Ian Johnson, Kidderminster, Worcs

Yes, Ian, there are some basic concepts that deserve updating from time to time for the sake of those who have newly entered electronics or when more advanced techniques allow them to be implemented more simply.

If any reader has an idea which he would like to recommend as a possible EPE *article we will be pleased to consider it. Whilst as a magazine we do not actually design circuits, we have many enterprising contributors who delight in plying their designing/authoring skills and who could well be interested to follow up suggestions.*

PIC TRICKS

In response to my request in Readout *May '01 for short snippets of interesting PIC codes,* ***Harry Purves of Newcastle-upon-Tyne*** *sent a lengthy E-mail about some definition tricks he finds useful. It is too long to quote in full but the summary is that he defines the Status flags and the actions to be taken following certain function tests (which can otherwise get him confused!). Examples are:*

```
#define carry status,0
#define dcarry status,1
#define zero status,2
#define ifzero btfsc zero
#define ifnotzero btfss zero
#define ifequal btfsc zero
#define ifnotequal btfss zero
#define ifcarry btfsc carry
#define ifnotcarry btfss carry
#define ifnegative btfss carry
#define ifpositive btfsc carry
```

As an example of the use of the latter he quotes:

```
subwf count,w
ifpositive
goto positive_result
return
```

which causes a jump to the stated destination if indeed the result is positive.

He keeps the definitions in header files so that they are always available for each project by simply "including" them at the start of the source file. For example:

include "C:\Picprog\Projects\header\l6f84.h"

Thank you Harry for sharing this info with us.

BASIC IS EASIER

Dear EPE,

To add to the discussion as to which language to use, I speak from about 25 years experience as a computer hardware engineer. My excursions into programming have ranged intermittently from machine code (in binary, octal or hexadecimal as required), assembler of various varieties, Algol, Fortran and Basic etc. Whatever the merits of any of these for a particular task I can assure you that for *intermittent* use, M. Bradbury in the May issue is spot on. You cannot beat Basic for ease of re-learning.

Any language is relatively easy to use when you know how. The trouble is that if you go away and do something else for six months, it takes a long time to pick it up again. By far the easiest to pick up again is Basic in one of its various flavours.

In common with most of your readers, I suspect, while I am interested in PICs, their use and programming, it is not something that I do all the time. For instance, I followed your *PIC Tutorial* without difficulty and built and used the *Toolkit Mk1* programmer. However, now I am considering a new project and find that I have forgotten it all so I will have to re-learn it. The easy bit will be relearning any Basic required.

Roger Warrington, via the Net

Indeed so Roger. As familiar as I am with several programming languages, if I have a difficult bit of logical code to write, I will often first write it in Basic, and translate that to the equivalent code in PIC or whatever.

One big advantage of Basic is that it can have intercepts easily placed at strategic points at which intermediate data can be displayed on screen, and for new variables and sub-routines to be temporarily introduced without having to recompile to machine code. This makes tricky development much easier.

ELECTRONICS TUTORIALS

Dear EPE,

I have recently started buying *EPE* again regularly. I like *Circuit Surgery, Ingenuity Unlimited, Network, New Technology Update* and of course series such as *Teach-In* and the specials like the recent *Schmitt Trigger* series. I think I ought to do something with PICs. Just a suspicion . . .

I also check the web for info and interest from time to time. One thing that I have come across, amongst the many "home pages" that amateur radio and electronics hobbyists publish is the one produced by Ian Purdy (VK2TIP) from Australia. I think it's a good source of info and practical examples for anybody new or old to radio and electronics.

You need to have a look at the extent of the site to gauge how much effort he puts in, and I think it's worth a "plug" in *EPE*. I have absolutely nothing to do with Ian in a business or personal sense, apart from admiring what he's got on his site. As a pensioner and a radio amateur, I regard what he has done as an excellent job in propagating knowledge and interest in a fine hobby. His web address is:

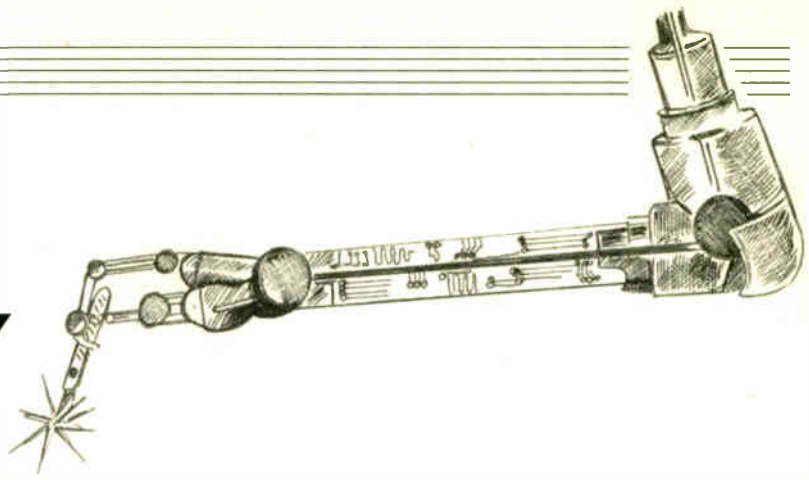
www.electronics-tutorials.com

Bill Jones, via the Net

Yes Bill, I've had a look at Ian's site, it does seem good and I commend it to other readers. I have also added it to TK3's list of recommended sites. Thank you for all your kind comments.

Regular Clinic

CIRCUIT SURGERY



ALAN WINSTANLEY and IAN BELL

Logic families and component voltage ratings come under scrutiny in our regular column answering readers' problems.

Keep it in the logic family

OUR thanks to reader **Richard Black** who E-mailed us about logic families:

After four years, I've suddenly found the time to take up electronics as a hobby again. On designing my first project I have discovered that I can't remember the differences between 74LS, 74HC and 4000 series ICs.

For example, what's the difference between the following: 7400 quad 2-input NAND, 74HC00 quad 2-input NAND, 74HCT00 quad 2-input NAND, 74LS00 quad 2-input NAND? Hope this isn't a daft question!

This is not a daft question at all – there is a bewildering number of "logic families", i.e. types of circuitry and technology for implementing discrete digital systems. The first commercially available logic family was resistor-transistor logic (RTL), introduced in 1962. This was followed by diode-transistor logic (DTL) and then the *transistor-transistor logic* (TTL) of the classic 7400 series. All these are based on the bipolar junction transistor (bjt), with TTL using a "multiple emitter" transistor at logic gate inputs.

New versions of TTL have continued to be introduced which provide higher operating speed and/or lower power dissipation, for example Advanced Schottky TTL (ASTTL). Another type of bipolar logic is Emitter-Coupled Logic (ECL) which provides a very high speed of operation.

Going MOS

In addition to these bipolar logic families, there are a number of MOSFET-based families. MOS logic may be implemented using *n*-type or *p*-type transistors alone (NMOS and PMOS), or both together (CMOS). NMOS provides higher performance than PMOS, but the advantages of CMOS mean that most MOS logic is now CMOS.

The classic CMOS logic family is the 4000 series, but just to confuse you even more, CMOS versions of the "TTL" 7400 series are also available (74HC00 and others). MOS and bipolar transistors can be used together to exploit the advantages of both, in Bi-CMOS, the 74ABTC series for instance.

CMOS 4000 series are susceptible to damage by static electricity (so handle with care), can operate on +3V to +15V supplies, and may behave unpredictably if inputs are left unconnected. Compare this with the original 7400 and other TTL series, which must have a supply of +5V (±0·5V), are not static sensitive and have inputs that behave as logic 1 when left floating.

The 4000 series provides some multiplexers that can be used for switching and selecting analogue signals, but there are no analogue functions in the TTL 7400 series. Other series have different properties, for example 74LVC00 is a CMOS series operating on a 3·3V supply. Not all functions are available in all families though.

Table 1: Some 74 series variations

7400	Standard bipolar TTL, the originals!
74LS00	Early TTL "low-power Schottky" improvement over basic 7400 series
74ALS00	Higher speed, lower power TTL than LS
74F00	High speed "Fast" TTL improvement on LS
74HCT	Direct CMOS equivalents to LSTTL. +4·5V to +5·5V supply
74AC00	CMOS, with CMOS logic levels
74ACT00	CMOS, with TTL logic levels
74FCT00	CMOS. Low power than 74F, by virtue of CMOS technology
74HC00	Basic high speed CMOS, similar to TTL. 2V to 6V supply
74LV00	CMOS 3·3V supply
74LVC00	CMOS 3·3V supply, faster, improved output over LV.

Example of a 4072 CMOS digital i.c.

When designing with discrete logic it is important to be aware of the general differences in the behaviour of the different logic types (CMOS, TTL, ECL etc) and the individual specifications of the logic family you are using, such as the allowable supply voltage range, power consumption, and typical propagation delays. The "maximum fanout", logic levels and drive currents are also worth checking. Maximum fanout is the number of inputs that a single output will drive and still give good logic levels.

Variation in logic levels and drive capabilities mean that you cannot necessarily connect the output from a device from one logic family, directly to the input of one from a different family. Some conversion devices are available to help with this problem. The ability of logic outputs to drive non-logic loads such as l.e.d.s. also varies between families.

To find out these details consult a databook for the series, or a datasheet for one of the devices. If you do a lot of logic design it is a good idea to get hold of the appropriate manufacturers' data books or CD-ROMs as these contain sections covering the general characteristics of the devices in the series and design guidelines, as well as all the individual datasheets. This data is also available on-line from the semiconductor manufacturers' web sites.

A summary of just some of the 74 series variations is shown in Table 1. Often you will be able to manage with LS or HCT families for most project or experimental work. These parts are widely available by mail order from all the usual vendors. *I.M.B.*

Capacitors, Resistors and Voltages

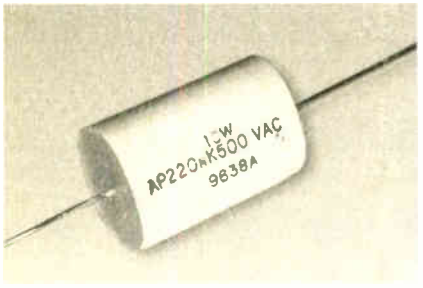
I need to get some parts for a schematic which requires a 9V battery. What voltage should the resistors and capacitors be? Some of the parts sold have a rating of 100V, I guess I can't use those, or can I? Thanks, ***Ilya, via E-mail.***

There's no problem using components that have a higher voltage rating in your 9V circuit. The value is simply the maximum voltage rating they can sustain

without damage. Polyester or ceramic capacitors have typical voltage ratings of 63V, 100V, 200V or even 500V or more. Any of these values can be used in your 9V circuit, no problem at all except for physical size, perhaps.

Some types, notably polypropylene capacitors, are specially designed for higher voltages or for direct use with mains a.c. voltages, when it is critical that the correct voltage rating is observed. Furthermore, in the UK capacitors which are intended for mains voltage use are further classified according to their ability to withstand peak voltages.

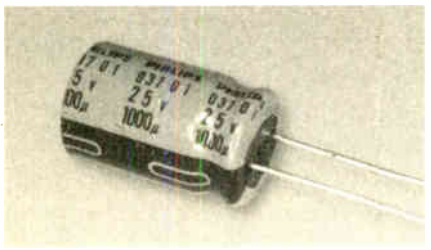
Devices with an "X" class rating can be connected directly across the mains, e.g. as a suppressor. According to the handy reference book *Newnes Electronics Toolkit* by Geoff Phillips (ISBN 0-7506-0929X) a Class X1 type can withstand transients (spikes) exceeding 1·2kV; a Class X2 can cope with



Example of a high voltage polypropylene capacitor.

transients less than or equal to 1·2kV.

The book also explains that a Class Y capacitor is intended for connection as a suppressor to ground (earth). These are specially designated for earthing connections as they have a guaranteed maximum leakage current, so that no electric shock hazard will arise. Such aspects are of critical importance in medical equipment



Electrolytic capacitors show their maximum working voltage rating which should not be exceeded.

applications.

One component which does require special consideration is the polarised *electrolytic capacitor*. For general electronic circuits, these are seldom seen with voltages higher than 63V or 100V d.c. It is perfectly safe to use a higher-voltage rated capacitor in a low voltage circuit; it is however *very unwise* to greatly *exceed* the capacitor's voltage rating, and it can be *dangerous* to reverse-polarise an electrolytic by a substantial amount for any length of time.

Resistor Voltages

Turning to resistor values, again there would be no problem using any type in the reader's 9V circuit. For example, the popular Philips CR25 is rated at 250V which would be just fine for the project.

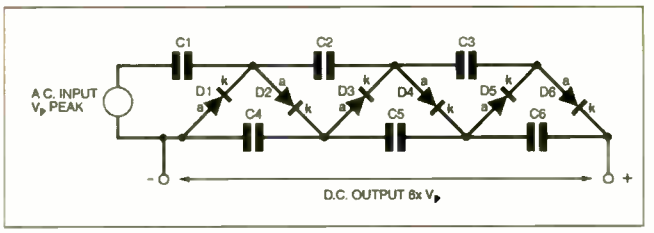


Fig. 1. Cockroft-Walton voltage multiplier producing six times the a.c. peak input voltage.

Sometimes you *do* need to pay more attention to resistor voltages though – in fact, resistor voltage ratings can be an area of some confusion.

The Philips product catalogue specifies the voltage rating as "U_{max}" (V_{max}) which we take to mean the maximum voltage across the resistor. However some sources mention "250V r.m.s." for this value, which implies a *peak* voltage rating of more like 350V. There seem to be no hard and fast rules concerning whether maximum voltages are r.m.s. or peak, so this aspect would need confirming where necessary. Sometimes, several resistors are wired in series just to ensure that individual voltage ratings are not exceeded.

There are several interesting aspects of resistor ratings which are worth bearing in mind. Using the formula $P = V^2/R$, placing 500V across a 1M resistor means that the resistor would dissipate 0·25Watts. Whilst this is within the *power rating* of a typical small carbon film resistor, it would exceed typical *voltage* ratings. Manufacturers sometimes quote a voltage rating and a "maximum overload voltage" or even a parameter known as the "limiting element voltage" that you see in many data sheets.

For example, a data sheet for carbon resistors, downloaded from the web site of manufacturer Kamaya Ohm, defines the rated voltage as:

Rated voltage (Vd.c. or a.c. r.m.s.) =

$$\sqrt{(Rated Dissipation) \times (Rated\ Resistance)}$$

Here the *rated voltage* is clearly derived from the power rating using the formula $P = V^2/R$. But in case you think you can apply any voltage across the resistor provided the power dissipation is not exceeded, there are more factors to bear in mind!

On the Limits

Another resistor voltage rating sometimes quoted is the limiting element voltage which, Kamaya states, can only be applied to resistors where the resistance value is equal to or higher than the "critical resistance value". I presume this latter term is the minimum resistor value permissible to ensure that the resistor's power rating is not exceeded at any given voltage; so at 250V d.c. voltage drop, the "critical resistance value" of a 0·25W resistor must be 250 kilohms or more; at 9V d.c. it would be just 330 ohms.

Depending on the resistor type, the limiting element voltage is typically 200V to 350V d.c. or V a.c. r.m.s. All resistors have a maximum overload voltage, but if the limiting element voltage is quoted instead, you can take this to mean the maximum voltage allowed across the resistor provided its power rating is not exceeded.

Note that if the overload voltage *is* exceeded then the resistor's insulation may break down, even if the resistor is dissipating hardly any power. *A.R.W.*

More on Multipliers

Gregory O'Kelly E-mailed in response our article on voltage multipliers in January 2001:

In your January 2001 edition, on page 36, you show a voltage multiplier that allegedly increases the voltage by a multiple of six of peak input voltage. I find that it is more like 2 to the sixth power, with each electrode acting almost like a doubler. I have hooked this up to the output from a 555 timer in an attempt to get something like an ignition coil, but the current flow is extremely low.

I want to use the pulsed d.c. to produce electrochemical pulses, and I need greater current flow. Could you tell me how to go about doing this? Do I increase the capacitance? Since I want merely to multiply the output voltage from the 555 timer by a multiple of 6 or eight, not 64, should I just use three capacitors of a high faradic rating?

We repeat the schematic to which Gregory refers in Fig. 1. Although the circuit is called a voltage "multiplier" the action is really additive. The capacitors add up the peak voltage of the a.c. waveform. One stage of the multiplier does not multiply the output from the previous stage – it just adds more multiples of the input voltage.

We mentioned in the original article that the Cockroft-Walton voltage multiplier did not readily provide high current outputs, and that the voltage would tend to drop in response to sudden changes in loading. Unfortunately, the circuit is not good at high currents because it takes several a.c. cycles to recharge the multiplier, also the capacitors are effectively in series, reducing their effective capacitance. Thus the output ripple is high and the regulation is poor.

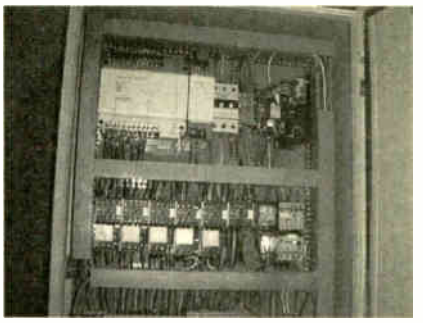
In order to get a higher current output you first need to make sure that the source (a.c. input) is capable of supplying the required current at the low voltage end of the multiplier. This may include some demanding current transients to charge the capacitors quickly and we strongly doubt that a simple 555 would be up to the job.

Using high quality, suitable components, and high quality construction will help reduce losses in the circuit. Larger capacitors will allow the circuit to provide larger transient energy to the output, but if this is to be sustained the source has to be up to the job of constantly "recharging" the multiplier. Furthermore, high current demand from the load may still result in large voltage drops and high ripple.

We're not sure there is a simple solution for what you're trying to achieve, namely a source of high voltage, high current pulses for (we guess) laboratory experiments. *I.M.B.*

Special Feature

THE WORLD OF PLCs



OWEN BISHOP

In industrial manufacturing processes, Programmable Logic Controllers (PLCs) offer many advantages over standard digital logic or computer control.

IN *EPE* June 2001, we looked at how electronics played an important role at Jodrell Bank. That article was the first of an occasional series looking at how electronics is used to control various industrial and research applications.

During the industrial visits made for this series it has become clear that PLCs, or Programmable Logic Controllers to give them their full name, are currently the most popular devices used for electronic control. In this article we look at PLCs in general and describe a number of examples of their application in various industries.

RELAY LOGIC

Before we consider PLCs, it is interesting to look at two earlier but related techniques, the older of which is relay logic control. In many instances this gave way to hardwired logic integrated circuit control. Relay logic is still used by several companies for controlling processes that do not demand the more complex programming achievable with PLCs.

The simple example shown in Fig.1 (see also Panel 1) shows only the relay contacts, and omits the circuits associated with the various sensors which provide input to the system. It also omits any interfacing there might be to deliver sufficient electrical power to the solenoids or motor.

Although a well-designed and proven relay logic system can give years of trouble-free service, it has several drawbacks.

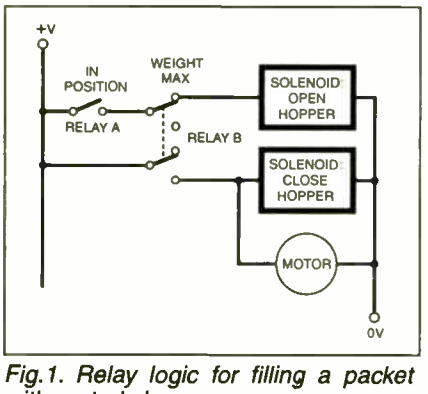
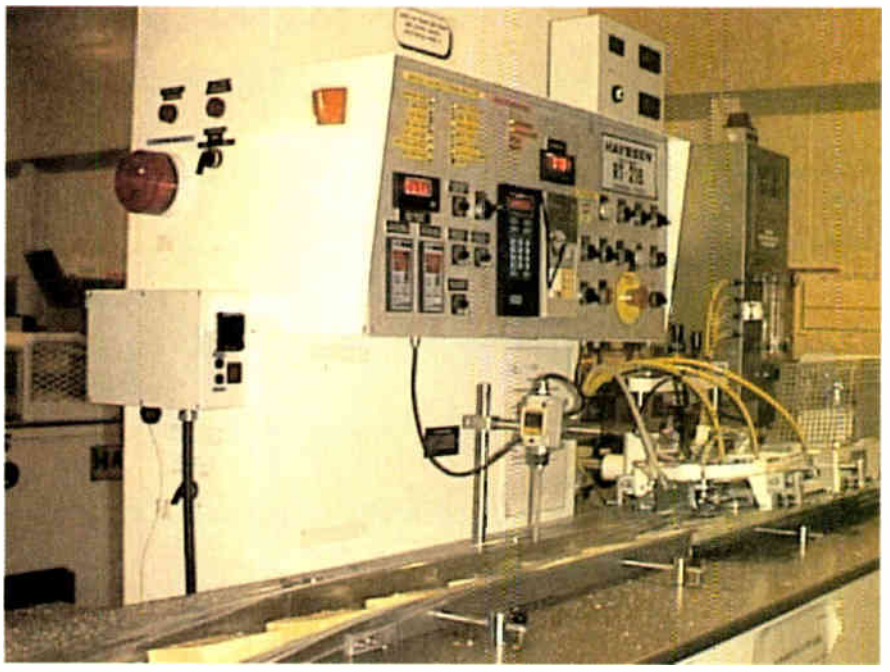


Fig.1. Relay logic for filling a packet with grated cheese.



Automatic cheese packaging line at Glanbia Foods Ltd.

One of these is that relays take up a lot of board space and even a relatively simple process such as filling a packet with cheese requires many relays. Partly compensating for this is the advantage that, given the schematic, it is easy to understand how it works.

A third point about relay logic is that it is hard-wired. This makes it easy for an engineer to test its action with a multimeter and to service it and make any adjustments that may be necessary. But it takes appreciable time to design, assemble and wire up the board. Once built, it may be very inconvenient and costly to alter it to correct errors in design or to modify or extend its action. Very often the easiest solution is to scrap the entire board and start again.

LOGIC GATES

Hardwired logic control makes use of the large range of logic i.c.s of the TTL, CMOS and other families. The function of Fig.1 can be performed by logic gate i.c.s.

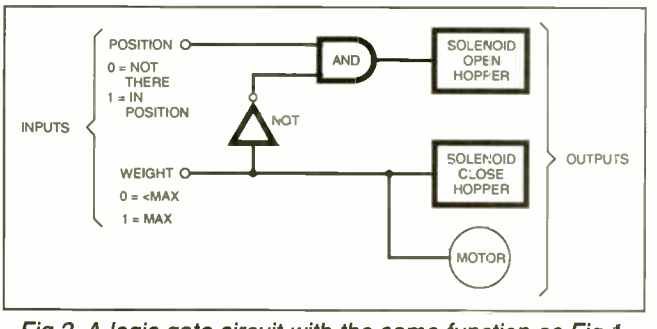


Fig.2. A logic gate circuit with the same function as Fig.1.

as in Fig.2, supplemented by interfacing not shown.

One obvious advantage of i.c.s is that they take up far less board space and require far less power to drive them. But, because they are hardwired, any alterations to the existing circuit can be difficult or even impossible. Furthermore, the average electrical (as opposed to electronic) engineer is likely to find them more difficult to install and service.

This brings us to PLCs, which are intended to provide a wide range of control functions based on (though not restricted to) the principles of relay logic.

PLC SYSTEMS

The main parts of a PLC system are illustrated in Fig.3 and, as an example, the photograph below shows the contents of a PLC cabinet that controls one of the packaging lines at Glanbia Foods Ltd.

At the centre of the system is a controller unit. This is where all the logical operations take place and where programs and data are stored. The controller is the large white box at top left. To its right is another smaller box, which is an extension unit to allow more inputs and outputs to be connected.

Although the controller is based on a CPU, the manufacturers play down its importance. In the world of PLCs there seems to be no equivalent of the "Intel Inside" sticker found on so many PCs.

Looking through the literature and data sheets one rarely comes across any mention of what kind of i.c. is doing all the work. Instead the specification concentrates on how many inputs and outputs the controller has, the maximum number of steps in its program and the time taken to execute a single step.

These facts are the main ones of interest to an engineer designing and building a PLC system. For the rest, the system is regarded as a "black box".

PLC PROGRAMMING

The inputs and outputs (I/O) of a PLC are much more numerous than those of an ordinary desktop computer. A PLC does not necessarily have a keyboard, a disk drive or a monitor but it may have several hundred inputs and outputs. In the PLC world, I/O is of supreme importance.

The I/O is in the lower section of the photograph below and the leads connecting this to the control unit can be seen.

Since the system does not usually have a keyboard or monitor, it is normally programmed by attaching a special programmer to it. This is needed only when setting up the system or occasionally when making changes to its operating routines.

Some manufacturers produce a special purpose programming computer, similar to a PC, but often having a keyboard with keys dedicated to keying in PLC programs. Other systems use a regular desktop or laptop PC running specialised programming software.

A PLC system usually has its own power supply, separate from the supply to the sensors and actuators of the system. This prevents electrical noise from passing into and disrupting the action of the processor. Most PLC units operate on 24V d.c.

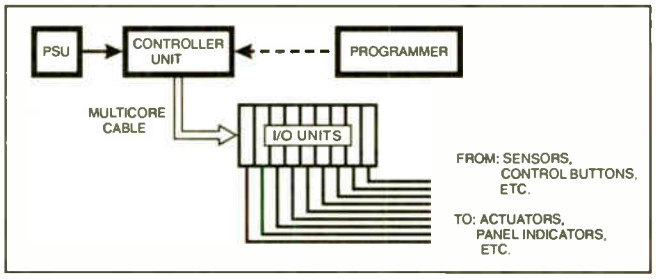


Fig.3. The essentials of a PLC system.

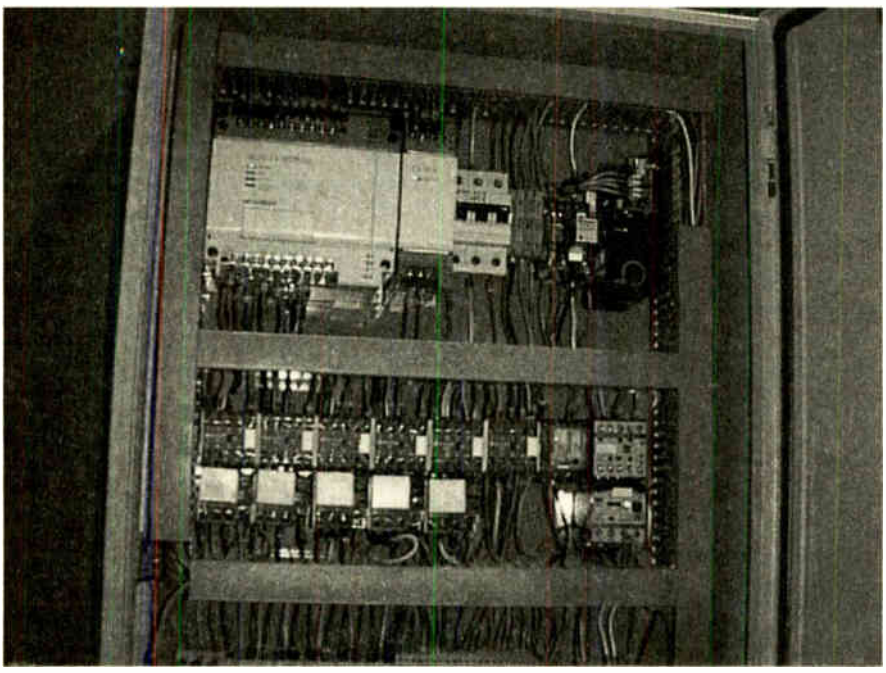
PLC units are manufactured by a number of specialist companies who produce the controllers, compatible I/O units, PSUs and other units with a wide range of specifications so that a designer can pick out just that combination of units which best suits the requirements of the plant.

It is also a feature of PLC systems that the individual I/O units are relatively inexpensive so that a few additional ones can be included in the system when it is first put together. This allows for subsequent expansion to cope with initial design faults, afterthoughts, process modifications and expansion. In this way PLCs are superior to hard-wired relay and logic systems.

The advantages of PLCs have become so widely appreciated that a number of manufacturers are now producing PLC systems suited for small-scale control such as thermostat and door opening systems. It is even suggested that the model railway enthusiast could find many ways of using these small-scale PLCs.

INPUT/OUTPUT OPTIONS

An I/O device usually consists of a rack-mounted circuit card bearing a number of identical interface circuits. Each card has its address in the memory map of the controller, and on that card there are usually several (typically eight) individually addressable I/O circuits.



Detail of the PLC system at Glanbia Foods Ltd.

PANEL 1. Relay Logic

A simplified control system for filling packets with grated cheese is shown in Fig.1. The cheese is supplied by a hopper that can be opened or closed by solenoids that operate in opposite directions. A sensor (perhaps optical) detects when a packet is in position to receive the cheese. A signal from the sensor energises the coil of relay A if a packet is in position. The packet is on a platform (a segment of a conveyor belt) supported by a load cell, which measures the weight of the packet and the cheese, if any, it contains.

A signal from the load cell energises relay B if the weight is at its maximum value (packet full). Relay B has two contacts, the upper one being closed when the packet is not full. So, a solenoid opens the hopper if the packet is in position AND the packet is NOT full.

The lower part of the circuit controls what happens when the packet becomes full. Relay B is energised, turning off the "open" solenoid and turning on the "close" solenoid. This stops the flow of cheese into the packet. The change in relay B also starts the motor that moves the conveyor belt to take away the full packet and replace it with an empty one.

The circuit is a gross over-simplification of what is usually needed to control such an operation. There would normally be sensors such as microswitches to confirm that the hopper is actually open, or closed. Input from these sensors would be used to activate additional relays to be wired in series with relays A and B.

There would be sensors to confirm that the packet had actually been taken away. There would also be a delay between closing the hopper and moving the packet. A relay with a non-ferrous slug on its core could be used to produce such a delay.

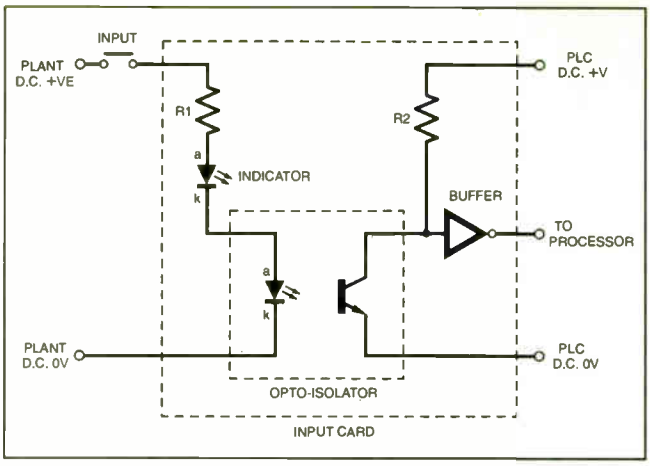


Fig.4. A d.c. input card, one channel.

In Fig.4 is shown one circuit (or channel) on a typical d.c. input card. This is intended to receive a d.c. signal (usually a logic high or low) from the plant and to send an identical signal on to the processor. The plant and processor do not necessarily operate on the same d.c. levels but this is taken care of in the circuitry.

The circuit includes an opto-isolator to protect the processor from any high voltages that may find their way to the card from the plant. There is usually an indicator l.e.d. on the card (often a row of l.e.d.s on the edge of the card, one for each channel). The output side of the card is powered from the controller's d.c. supply.

Usually the input side of a system is made up of a mix of d.c. and a.c. cards. The system designer can select from various type of card of either sort, adding a few spares in case of a change of design at a later stage.

A.C. INTERFACING

The typical a.c. input card circuit in Fig.5 has a full-wave bridge rectifier. An indicator lamp (not an l.e.d.) across the input connections lights when a signal is being received (the a.c. signal is either on or off).

The rectified signal goes to an opto-isolator to protect the system from excess voltages. Since the input signal is often at mains voltage this precaution is essential. Beyond the opto-isolator the circuit is powered from the system power supply and a buffer sends a logic-level replica of the input signal to the processor.

Output cards also incorporate opto-isolators. In a typical d.c. output card (Fig.6) logic-level signals from the processor are sent to a transistor which switches the current through the photodiode of the opto-isolator. The phototransistor is in the base circuit of a power transistor which has its collector connected to the plant d.c. supply. This may often be at 24V d.c.

The load is in the transistor's collector circuit. Connected across the load is an indicator l.e.d. located on the card to show the state of the output. Also there is a diode to protect the circuit from the voltage spikes that occur if the load is inductive, as it often is, for solenoids and motors are very common actuators in industrial systems.

As an alternative to the transistor output of the d.c. card, some types of card have relay outputs. The coil of the relay replaces the load shown in Fig.6. It can be situated on the card and powered from the system supply. Using a relay means that a wide range of plant voltages, d.c. or a.c., can be used to drive the load.

In an a.c. output card, useful for controlling motors, the plant a.c. is rectified to provide a d.c. potential across the phototransistor of the opto-isolator (Fig.7). When a signal is present, the phototransistor conducts and this produces a pulse to trigger the triac. The triac then conducts, and an alternating current passes through the indicator lamp and the load.

Most cards deal with digital signals, those that are on or off, high or low. There are also cards for analogue signals, often incorporating analogue-to-digital converters for converting analogue input to digital form to send to the processor.

PROGRAM OPERATION

Apart from the read only memory (ROM) used for storing the operating system, the memory map includes the regions shown in Fig.8. The major part of this is PROM (programmable ROM), used for storing the program fed into it by the programming computer.

The PROM may extend to only a few kilobytes, which is sufficient for storing the program steps that the controller requires. In addition, there is an area of random access memory (RAM).

The way in which a typical PLC operates its program is usually very different from the operation of a PC programmed in machine code or one of the high-level languages. In a typical PC program, the processor starts at the beginning, after which it may jump about indefinitely from one routine to another, depending on the input (from its keyboard, disk drives and elsewhere) that it receives at various stages.

It skips around the program from routine to routine, sometimes waiting for input and at other times producing output (continually updating the monitor, for example, or sending data to a modem). There may be some routines (such as updating the monitor, or waiting for input from the keyboard) that it returns to frequently. It may visit these routines several times a second. Other routines may be run very rarely, perhaps only when something goes wrong.

PLC SCANNING

While some of the more sophisticated PLCs do allow for conditional jumps and other features commonly available in PC programs, a typical PLC program is simply a series of steps taken in order from beginning to end, and repeated from beginning to end for as long as the PLC is operating. This is called scanning the program and a scan takes about 2ms to 5ms per kilobyte of program, depending on the processor.

In a typical control system a scan takes between 10ms and 50ms, depending upon the number of steps in the program. Before

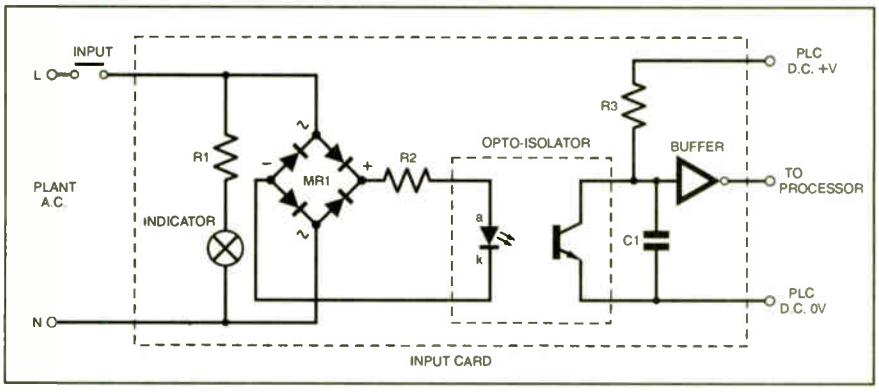


Fig.5. An a.c. input card, one channel.

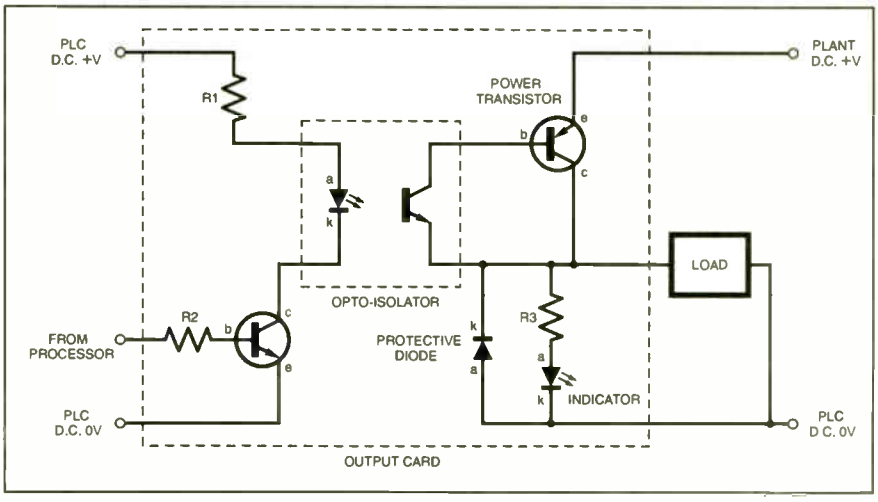


Fig.6. A d.c. output card with transistor-controlled output, one channel.

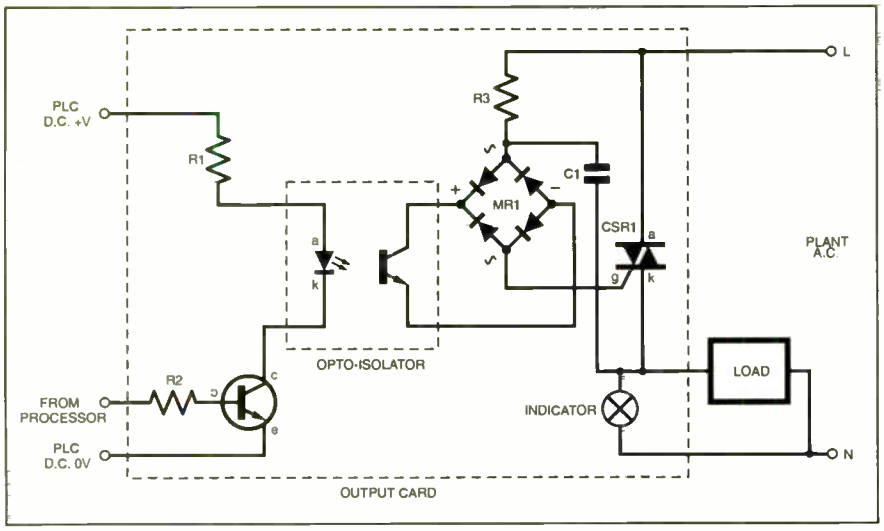


Fig.7. An a.c. output card with triac-controlled output, one channel.

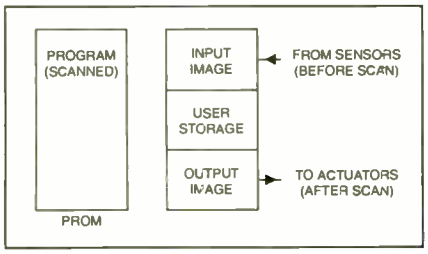


Fig.8. A map of the memory of a typical controller.

each scan, the processor reads in the state of all the sensors in the system. The data is stored in the area of RAM known as the input image, either as single bits (flags) or as analogue data in digital form.

Then the scan begins, using the recently acquired data of the input image. Decisions are taken and, if there are any changes to be made in the operation of the actuators, the control signals to be sent to the actuators are stored in RAM as the output image.

Signals are not actually sent to the actuators until the scan is complete. The remaining area of memory is used for temporary storage of intermediate data produced by calculations.

Once the scan is finished, the actuators are turned on or off according to data now present in the output image. This almost inevitably produces changes in the state of the system and these changes affect the sensors. Data is read from the sensors, stored as the input image and the next scan begins.

In this way the state of the system is read every few tens of milliseconds and appropriate action is taken. This gives a degree of control sufficiently tight for most industrial processes.

PROGRAMMING TECHNIQUES

There are three techniques for programming the PLC, of which one method appears to be far more popular than the others. This is known as "ladder logic" and derives its form from the relay logic used in the earliest control systems. It is a way of setting up a virtual relay system, without the bulky, space-consuming relays and the more-or-less permanent hard wiring.

Being based on the principles of relays means that the system can be understood (and therefore maintained) without the need for a specialist electronic engineer. Returning to the examples of Fig.2 and Fig.3, the equivalent in ladder logic is shown in Fig.9, which represents the controls for filling a packet with a quantity of (in this instance) grated cheese.

In programming the system, a diagram such as this is drawn on the screen of the programmer or PC, the software converts this to the equivalent machine code, which is then downloaded into the PROM of the controller.

The symbols used in this diagram are derived from the symbols used in the USA for representing relays in schematics. A relay with normally-open contacts looks rather like the symbol for a capacitor.

The relay contacts are open until the packet is in position ready for filling. When the sensor detects that the packet is in position, the corresponding bit in the input image is set to logic 1. The slanting line across the next symbol in the top row of the diagram indicates normally-closed contacts. The contacts are closed unless the given condition is true. The "weight" bit in RAM stays at logic 0 until the packet reaches the required weight.

Viewing the diagram as a pair of relay contacts in series, a current flows from the left through the two pairs of contacts and activates the "open hopper" solenoid when both relays are closed. That is, when the packet is in position and it is *not* full.

During a program scan the processor reads the state of the two bits and, if one is logic 1 and the other is logic 0 it stores an "open hopper" bit in the output image. At the end of the scan an output is sent to the solenoid to activate it (or continue its state of activation), to keep the hopper open, delivering grated cheese to the packet.

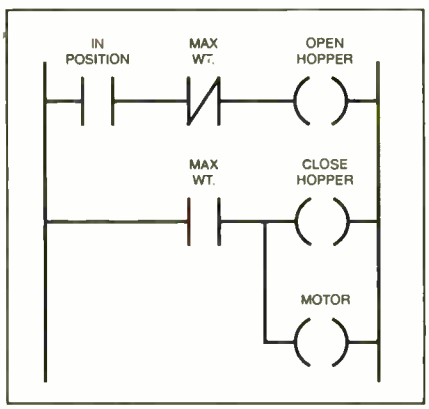


Fig.9. The equivalent of Fig.2 and Fig.3 in ladder logic.

The controller then scans to the second row of the program. Here the position of the packet is not important. If the packet has reached full weight, the output image must be changed to switch on the solenoid to close the hopper, and to start the motor to carry the packet away to be sealed. In this row the processor reads the weight bit again and, if it is logic 1, sets the bits to initiate appropriate action.

LADDER LOGIC

The schematic in Fig.9 illustrates only two steps in a program that might be 100 or more steps long. The complete program has vertical lines down each side, cross-connected by the row of symbols describing the logic. The appearance of the diagram of a complete program strongly resembles a ladder, which is why this form of representation has become known as ladder logic.

When we examine such programs it becomes obvious that even an apparently simple task requires a considerable number of inputs and outputs, perhaps several hundred on one machine.

Most systems suitable for controlling with PLCs also provide for the program to be entered as a drawing of a logical system. Here the programming is similar to that of the earlier control systems based on TTL or CMOS i.c.s. Logic symbols such as AND and OR gates are assembled on the screen of the programmer and connected by "wires". Then the software generates the corresponding machine code to be downloaded into PROM.

A third method of programming a PLC is by a text-only statement list. The logic of the system is keyed in, in standardised form, as a table of instructions to the processor.

The ladder logic described so far provides for logical operations such as AND (relays in series on a single rung), and OR (relays in parallel on branching rungs). The use of normally-closed relays introduces NOT, which provides for NAND and NOR operations.

Even when programming with ladder logic it is possible in the more advanced PLC systems to call on routines which provide the equivalent of flip-flops, counters and timers.

PLCs IN ACTION

To illustrate the versatility of PLCs this article concludes with a few examples taken from Glanvia's plant.

The photograph on the next page shows a section of the belt that carries packages of cheese from the wrapping section, which is off to the left of the photograph.

The package then passes on to a short length of belt, on a platform that is mounted on a load cell. This weighs the package as it passes across the section. Although one associates load cells with weighing massive objects such as fully-laden trucks, sensitive load cells are frequently used in packaging plants for objects weighing only a few hundred grammes.

Readout of the weight takes only a fraction of a second and is displayed on the

control panel. If the weight is outside the preset limits the next section of the belt tips downward, as shown in the photograph (below), and the rejected package falls into a receptacle below the line.

When a package of acceptable weight comes along, it continues along the main line to the right, where a vendor's label is printed with its weight and is applied to the package. The system also calculates the price of the piece and prints this on the label together with the bar code.

All this is done within a fraction of a second as the packages stream along the production line. The system keeps a full record of the number of packages passed and also the number rejected for being over or under weight.

SAFETY

Food safety is of paramount importance so special precautions are taken to detect metallic objects that might be embedded in the cut blocks of cheese. At one point there is a large coil around the conveyor belt and an oscillating signal is applied to this coil. Close above the line is an inductive proximity detector. This consists of a core wound with a coil and connected to a frequency-sensitive circuit.

If there is any metal object in the cheese there is a phase delay which is detected by the circuit. The PLC registers this change. The timing of the program is such that just as that block reaches a point 40cm further along the line, a rejection lever is actuated to push the block off the line. Alternatively, a photo-reflective detector further along the line may detect the arrival of the suspect block and operate the reject arm.

SIMPLICITY PAYS

The process is simple and well illustrates the nature of most applications of PLCs. Textbooks on electronic control systems lay great emphasis on negative feedback, proportional control, integral control and other sophisticated aspects of control systems, but these do not feature in the majority of practical systems.

PANEL 2. Chemical Plant Sensors

Most of the processing at chemical manufacturers Rhone-Poulenc Ltd. involves liquids, so the main measurements required are temperature, pressure, level and flow. The reactants are normally inside an enclosed system, but there must be points at which probes are allowed to enter the system. In the case of tanks, the probes are inserted through sealed openings at the top. This minimises leakage should the seal deteriorate.

Very often the activity at different parts of the system is monitored in more than one way using different types of sensor. One measurement is a back-up of the other and, if the two fail to agree, an alert is signalled on the control panel.

An ingenious way of measuring flow is the MicroMotion sensor, which depends on the detection of Coriolis forces. This is the force which makes the water spin in a clockwise direction as it drains from the bath (anti-clockwise in the Southern Hemisphere).

The fluid is made to flow in an omega-shaped tube and the force distorts the tube slightly. Distortion is measured using a strain gauge or an electromagnetic pickup and from this the rate of flow can be calculated. The liquid is completely enclosed in the tube and there are no vanes or other moving parts to be sealed in (and eventually leak).

Liquid level may be measured by a tuning fork level sensor (Fig.10). A crystal oscillator in the base of the fork vibrates the fork at 30kHz. However, when the tines of the fork are partly covered by liquid, this shifts the frequency of the system. The resulting frequency is measured and this is related to the liquid level.

Another method of level measurement involves capacitance. In effect the sensor of Fig.11 is a capacitor. If the liquid is an electrical conductor, the pin and the casing (plus liquid) act as plates and the PTFE sleeve is the dielectric. If the liquid is a non-conductor, the sleeving is omitted and the liquid acts as dielectric.

In either case, capacitance increases with liquid level. The sensing circuit measures the capacitance by measuring the frequency of an oscillating circuit containing the sensor. Changes of frequency are interpreted in terms of liquid level.

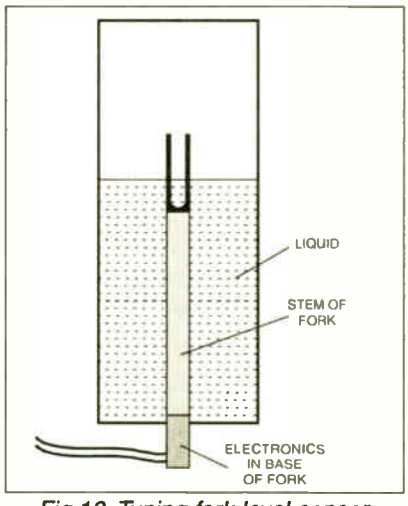


Fig.10. Tuning fork level sensor.

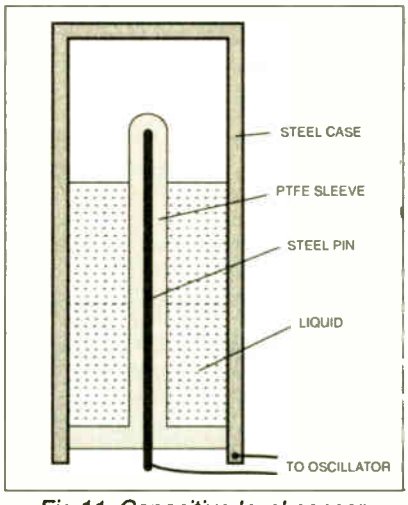
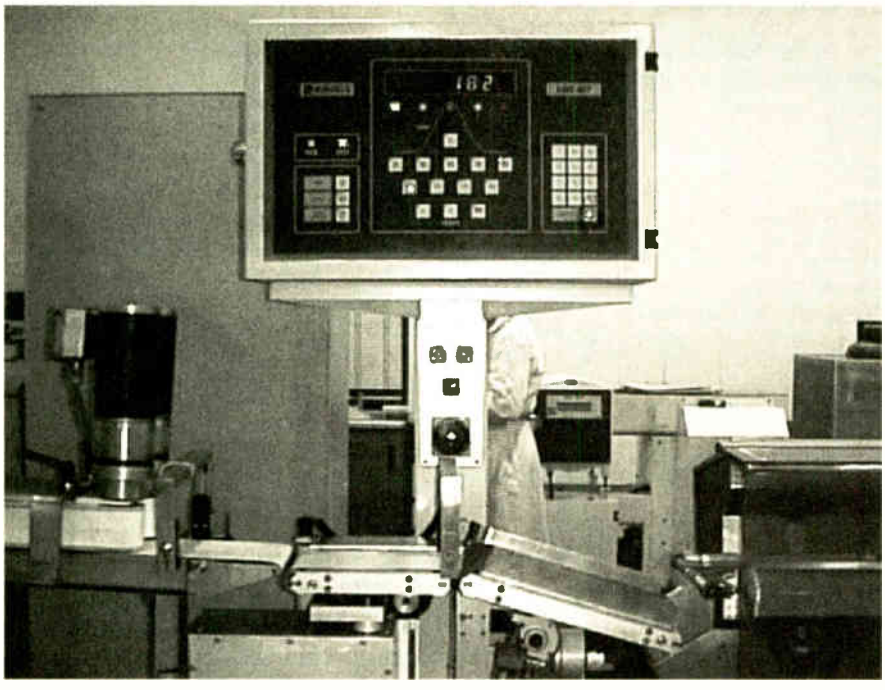


Fig.11. Capacitive level sensor.



Cheese weight monitoring system at Glanbia Foods Ltd.

It would be possible to devise a system by which the filling of, say, grated cheese bags would be monitored as it is occurring, bringing the weight up to the required level. Such a system would be more complicated, possibly slower, and certainly more expensive to build and maintain than the simple accept/reject system.

In practical and economic terms, the simpler (and cheaper) the system the better. This does not necessarily apply to all manufacturing processes, but it applies to most. It is cheaper to omit the fine adjustments and simply reject the occasional item that is out of range. On the shop floor, economics rules over control theory and PLCs are usually the best means for controlling systems at this level.

In practice, most control systems have a simple on-off binary nature. Only a small range of instructions is needed for such a system. The situation is akin to that which has lead to the development of RISC (reduced instruction set) computers.

Research has shown that although a typical microprocessor may have several hundred instructions in its set, 80 per cent of a typical program makes use of only 20 per cent of the instructions. Now, microcontrollers are being manufactured

with as few as 30 instructions. This makes it very easy to learn the programming language.

SPECIAL PRECAUTIONS

Certain industries pose special problems that can be solved by PLCs, but which need attention to various precautions. The Rhone-Poulenc plant (see Panel 2), for example, manufactures agricultural products, such as herbicides, and intermediate products for the pharmaceutical industry.

It produces these chemicals on the large scale and their production often involves highly flammable liquids such as toluene, methanol and xylene. For this reason there must be no combustion or sparks in the areas where chemicals are processed and stored. Obviously there is no place for relays and other spark-producing equipment on the plant. There are risks when any electrical components are present, for a faulty device or cable might soon overheat to the point at which it could ignite a flammable vapour.

Each production rig has its own enclosed control room, keeping the operating staff well away from the scene of chemical reactions. Whereas the PLC cabinet is usually located beside the plant, mainly in order to keep electrical connections as short as possible, the PLCs at Rhone-Poulenc are situated in a special room adjacent to the control room.

The PLCs drive pneumatic actuators, so that communication between the PLC cabinets and the plant is exclusively by air lines. This eliminates the risk of fire or explosions caused by sparks or overheating.

The design philosophy of the system is that the consequences of failures are so potentially catastrophic that no chances can be taken. Consequently the sensors and actuators are all simple in principle and have proven reliability.

Also, there are many of them, monitoring every stage of production. This means that a system may have up to 1000 input/output connections and a correspondingly long (but well-tried and tested) program. The system designers have no intention of trying to lead the way in the chemical industry!

SUMMING UP

The industrial popularity of PLCs is attributable to their many advantageous features:

- At the design stage there is no need for a really detailed description of the proposed system. The size of the processor and the number of cards of each kind is easy to estimate within limits, allowing a little spare capacity for future modifications.
- At the construction stage the system is easily assembled from a wide range of standard units, most of which are relatively inexpensive.
- At the installation stage it is possible to make use of pre-built units to cover certain aspects of control.
- At the commissioning stage it is easy to modify the system if changes or extensions to the original design are thought necessary. As explained earlier, this is definitely not the case with relay logic and other early systems in which any changes made at this stage may be prohibitively expensive.
- At the operational stage PLC systems are easy to check and maintain. Later changes to the system are simple to effect.

PANEL 3. Resin Production using PLCs

Chipboard is made by mixing wood chips with a bonding resin, and rolling the mixture out into a sheet. At the Chirk works of Kronospan Ltd the resin is prepared in large kettles. Formerly, control of the process was wholly manual but, recently, it has been automated, using PLCs.

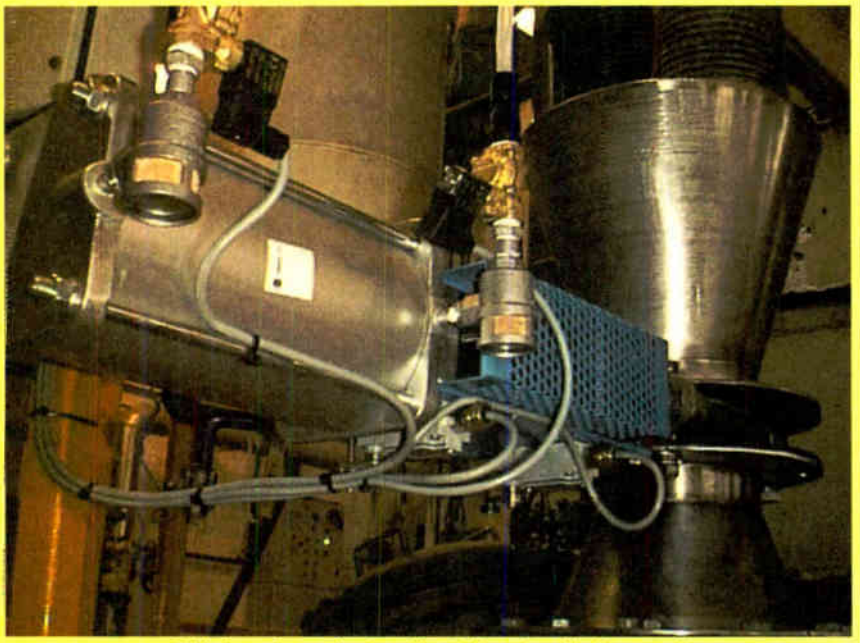
With either method of control the kettle is first loaded with formaldehyde and then urea is run in, using a screw feeder. The reaction is exothermic (generates heat), so the process can be started from cold, although materials may be warmed first to 60°C.

The heat produced by the reaction is such that the mixture has to be cooled by a cold water jacket around the kettle. Precise control is necessary at this stage because the reaction can soon run away, with the risk of an explosion. For this reason the reaction is carefully controlled and the temperature is never allowed to rise above 98°C.

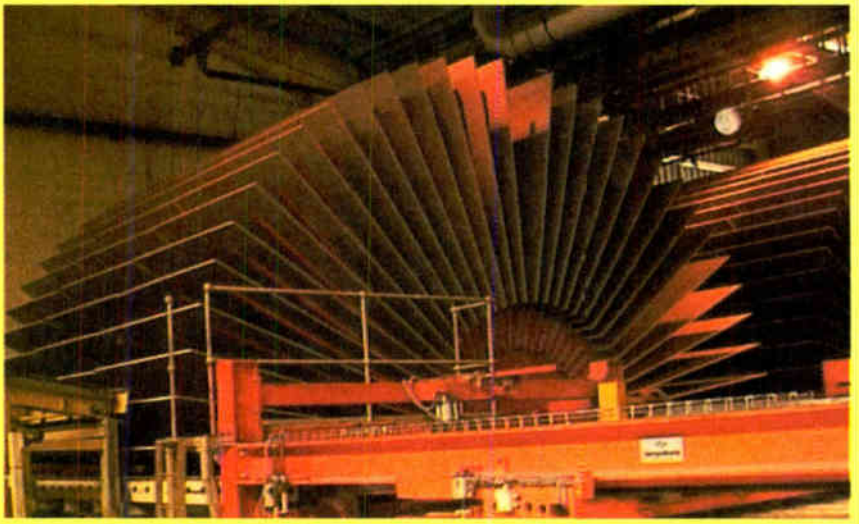
The reaction rate is maintained at the correct level by controlling three parameters: the initial temperature, the rate of adding urea, and the circulation of the cooling water.

The PLC system developed at Kronospan is programmed in 32 stages, with a target rate of addition and temperature for each stage. The targets are stored as a look-up table in the ROM of the controller. At each stage the kettle is weighed using load cells and the weight of its contents compared with the weight specified in the lookup table. The rate of feed of urea is then adjusted proportionately.

At the same time the temperature is measured and compared with its lookup table, and appropriate adjustments made to the flow rate of the cooling water. If the temperature is more than 2°C above the prescribed level, the feed of urea is cut off completely.



Chipboard production "kettle" under PLC control.



No, it's not a giant finned heatsink, it's chipboard being dried!

ACKNOWLEDGEMENTS

The author thanks the following for their help in providing the information upon which this article is based: Glanbia Foods Ltd, Oswestry; Rhone-Poulenc Ltd, Norwich; Kronospan Ltd, Chirk. □

SHOP TALK
with David Barrington

MSF Signal Repeater and Indicator

The main items of concern when ordering components for the *MSF Signal Repeater and Indicator* will be the AD8532 rail-to-rail, high speed op.amp and the prealigned 60kHz ferrite, LC tuned, antenna assembly.

Unfortunately, the Analog Devices AD8532 op.amp has been dropped by the original supplier and readers may have difficulty finding a local source. However, it is listed by **Farnell** (☎ ***0113 263 6311*** or ***www.farnell.com***), code 314-5888, and we understand they currently carry stocks.

We found the pre-aligned 60kHz ferrite antenna assembly under Maplin's "Modules" (sub-section "Clocks") and "Projects" sections. It can be ordered from them (☎ ***0870 264 6000*** or ***www.maplin.co.uk***) and is listed as code MK72P. The latest news we have is that it is currently out of stock, Maplin are expecting new deliveries but could not give a delivery date at the time of going to press.

The BC184L transistor has a different pinout arrangement to most BC184s, so it would be wise to emphasise the suffix L when purchasing this part. The choice of 100μA f.s.d. meter is left to the individual constructor, but most of our component advertisers should be able to offer one at a reasonable price.

The two printed circuit boards are available from the *EPE PCB Service*, codes 306 (Repeater) and 307 (Meter), see page 529.

Perpetual Projects – Solar Powered Power Supply and Voltage Regulator

First appearances would suggest that parts for the *Perpetual Projects* series should be readily available and not cause any buying problems. But some of the components called up for the *Solar-Powered Power Supply and Voltage Regulator*, which is the "driving force" behind all projects in this series, need to be chosen carefully and may not be available from your local supplier.

Working to the prototype unit, the solar cell "load voltage" rating is quoted as 7·5V 45mA and is an RS component which was purchased through **Electromail** (☎ ***01536 204555*** or ***http://rswww.com***), their mail order outlet, code 194-098. They also supplied the following items: 100k resistance/temperature matched n.t.c. thermistor, code 151-243; 1F 5·5V d.c. "GoldCap" memory backup electrolytic (code 107-690) and the 470μF 6·3V resin dipped aluminium electrolytic (code 221-8433) capacitor; single-turn cermet trimmer preset potentiometer, code 187-595. Note that the preset and the aluminium electrolytic are only sold on a minimum order quantity of 5 off.

Once again Maplin have discontinued stocking the required transistor – this time the TIPP31C – and cannot offer an alternative device. We have found that **Cricklewood** (☎ ***020 8452 0161***) currently have stocks and enquiries should be made to them. They carry a large range of semiconductor devices and can usually find those "rare" devices. The TIPP31C is also listed by Electromail (see above), code 638-532.

The small "Uniboard" printed circuit board (the basis for all the *Perpetual Projects*) is obtainable from the *EPE PCB Service*, code 305 (see page 529).

Stereo/Surround Sound Amplifier

Picking out the most likely components to cause concern when putting together the items needed to build the *Stereo/Surround Sound Amplifier* highlighted the stereo amplifier i.c., the stereo potentiometer and the sloping front case.

Taking the TDA2822M 1W stereo amp., again **Maplin** (☎ ***0870 264 6000***) are currently "out of stock" but expecting delivery very soon. In the meantime, try **Rapid Electronics** (☎ ***01206 751166***) code 82-0672, who do have some in stock.

The sloping front case is not critical and most of our component advertisers should be able to come up with a suitable alternative, even if the dimensions do not exactly match the prototype (Maplin code LH63T), provided they are greater than specified. The neat, chassis mounting, d.c. power socket came from Rapid (see above), code 20-0985.

If you wish to use and mount the 16mm dual-gauged stereo potentiometer directly on the p.c.b., as shown in the article, this came from Maplin, code VQ35Q. The printed circuit board is available from the *EPE PCB Service*, code 304.

PIC To Printer Interface

Nearly all the components used in the *PIC To Printer Interface* prototype are RS parts and any *bona fide* stockist, including some of our advertisers, will be able to obtain them for readers. If difficulties are experienced in obtaining the MAX492 dual rail-to-rail op.amp, it can be ordered through **Electromail** (☎ ***01536 204555*** or ***http://rswww.com***), code 182-2738.

A ready-programmed PIC16F877 microcontroller can be purchased from **Magenta Electronics** (☎ ***01283 565435*** or ***www.magenta2000.co.uk***) for the inclusive price of £10 (overseas add £1 p&p). They also supplied the alphanumeric display module and you should specify that you want one with a pin connector attached.

The printed circuit board (code 308) and the software is available from the *EPE PCB Service*, see page 529. The software is available on a 3·5in. PC-compatible disk (*EPE* Disk 4) for the sum of £3 (UK), to cover admin costs (for overseas, see page 529). It is also available *Free* from the EPE web site at:

ftp://ftp.epemag.wimborne.co.uk/pubs/PICS/PICprinter.

SURVEILLANCE

Electronic Surveillance Equipment Kits from the UK's No.1 Supplier

SUMA DESIGNS has been supplying professional quality electronic surveillance equipment kits for over 20 years. Whether your requirement is hobbyist, amateur or professional you can be sure that you are buying from a company that knows the business. We ONLY sell surveillance products, no alarms, disco lights or computer bits. All of our kits are designed for self assembly and are well tried, tested and proven. All kits are supplied complete with top grade components, fibreglass PCB, full instructions, circuit diagrams and assembly details. Unless otherwise stated all transmitter kits are tuneable and can be received using an ordinary VHF FM radio.

UTX Ultra-miniature Room Transmitter
At less than 1/2 the size of a postage stamp the UTX is the smallest room transmitter kit in the world! Incredible 10mm x 20mm including microphone, 3-12V operation. Range up to 500m **£13.95**

MTX Micro-miniature Room Transmitter
Our best selling room transmitter kit. Just 17mm x 17mm including mic. Extremely sensitive. 3-12V operation. Range up to 1000m. .. **£14.95**

STX High-performance Room Transmitter
High performance transmitter with buffered output for greater stability and range. Measures just 22mm x 22mm including mic. 6-12V operation. Range up to 1500m. **£16.95**

VT500 High-power Room Transmitter
Our most powerful room transmitter with around 250mW of output power. Excellent range and penetration. Size 20mm x 40mm, 6-12V operation. Range up to 3000m. **£17.95**

VXT Voice-activated Room Transmitter
Triggers only when sounds are detected by on-board mic. Variable trigger sensitivity and on-time with LED trigger indicator. Very low standby current. Size 20mm x 67mm, 9V operation, range up to 1000m. **£21.95**

HVX400 Mains Powered Room Transmitter
Connects directly to 240V AC supply. Ideal for long-term monitoring. Size 30mm x 35mm, range up to 500m. **£21.95**

SCRX Subcarrier Scrambled Room Transmitter
To increase the security of the transmission the audio is subcarrier modulated. Receiver now requires the decoder module (SCDM) connected to allow monitoring. Size 20mm x 67mm, 9V operation, up to 1000m range. **£24.95**

SCDM Subcarrier Decoder for SCRX
Connects to earphone socket on receiver and provides decoded audio output to headphones. Size 32mm x 70mm, 9-12V operation. .. **£27.95**

UTLX Ultra-miniature Telephone Transmitter
Smallest kit available. Connects onto telephone line, switches on and off automatically as phone is used. All conversations transmitted. Size 10mm x 20mm, powered from line, up to 500m range. **£13.95**

TLX700 Micro-miniature Telephone Transmitter
Best selling kit. Performance as UTLX but easier to assemble as PCB is 20mm x 20mm. **£14.95**

STLX High-performance Telephone Transmitter
High-performance transmitter with buffered output for greater stability and range. Connects onto telephone line and switches on and off automatically as phone is used. Both sides of conversation transmitted up to 1000m. Powered from line. Size 22mm x 22mm. **£16.95**

PTS7 Automatic Telephone Recording Interface
Connects between telephone line (anywhere) and normal cassette recorder. Automatically switches recorder on and off as phone is used. Both sides of any conversation recorded. 9V operation, size 20mm x 67mm. **£21.95**

CD400 Pocket Size Bug Detector/Locator
LED and piezo bleeper pulse slowly. Pulse rate and tone pitch increase as signal source is approached. Variable sensitivity allows pinpointing of signal source. 9V operation, size 45mm x 54mm. **£34.95**

CD600 Professional Bug Detector/Locator
Multicolour bargraph LED readout of signal strength with variable rate bleeper and variable sensitivity allows pinpointing of any signal source. When found, unit is switched into AUDIO CONFIRM mode to distinguish between bugging devices and legitimate signals such as pagers, cellphones etc. Size 70mm x 100mm. 9V operation. **£59.95**

QTX180 Crystal Controlled Room Transmitter
Narrow band FM crystal transmitter for ultimate in privacy. Output frequency 173.225 MHz. Designed for use with QRX180 receiver unit. Size 20mm x 67mm, 9V operation, range up to 1000m **£44.95**

QLX180 Crystal Controlled Telephone Transmitter
Specifications as per QTX180 but connects onto telephone line to allow monitoring of both sides of conversations. **£44.95**

QSX180 Line Powered Crystal Telephone Transmitter
Connects onto telephone line, switches on and off as phone is used. Power is drawn from line. Output frequency 173.225 MHz. Designed for use with QRX180 receiver. Size 32mm x 37mm. Range up to 500m. **£39.95**

QRX180 Crystal Controlled FM Receiver
Specifically designed for use with any of the SUMA 'O' range kits. High sensitivity design. Complex RF front end section supplied as pre-built and aligned sub-assembly so no difficult setting up. Headphone output. PCB size 60mm x 75mm. 9V operation. **£69.95**

TKX900 Signalling/Tracking Transmitter
Transmits a continuous stream of audio bleeps. Variable pitch and bleep rate. Ideal for signalling, alarm or basic tracking uses. High power output. Size 25mm x 63mm, 9-12V operation, up to 2000m range. **£23.95**

MBX-1 Hi-Fi Micro Broadcaster
Connects to headphone socket of CD player, Walkman or Hi-Fi and broadcasts your favourite music around house and garden up to 250m. Size 27mm x 60mm, 9V operation. **£22.95**

DLTX/RX Radio Remote Switch System
Two kits, transmitter sends a coded signal (256 selectable codes) when button pressed. Receiver detects signal, checks code and activates relay. Can be set to be momentary or toggle (on/off) operation. Range up to 100m, 9V operation on both units. TX 45mm x 45mm, RX 35mm x 90mm. **£44.95**

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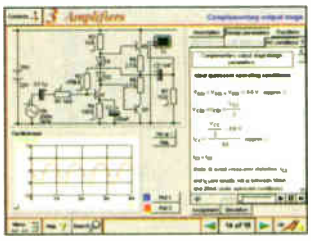
ELECTRONICS CD-ROMS

ELECTRONICS PROJECTS

Logic Probe testing

Electronic Projects is split into two main sections: **Building Electronic Projects** contains comprehensive information about the components, tools and techniques used in developing projects from initial concept through to final circuit board production. Extensive use is made of video presentations showing soldering and construction techniques. The second section contains a set of ten projects for students to build, ranging from simple sensor circuits through to power amplifiers. A shareware version of Matrix's CADPACK **schematic capture**, **circuit simulation** and **p.c.b. design** software is included.
The projects on the CD-ROM are: Logic Probe; Light, Heat and Moisture Sensor; NE555 Timer; Egg Timer; Dice Machine; Bike Alarm; Stereo Mixer; Power Amplifier; Sound Activated Switch; Reaction Tester. Full parts lists, schematics and p.c.b. layouts are included on the CD-ROM.

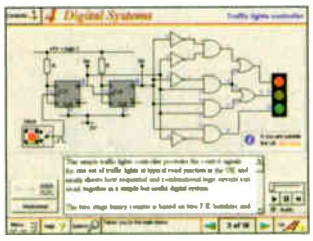
ANALOGUE ELECTRONICS



Complimentary output stage

Analogue Electronics is a complete learning resource for this most difficult branch of electronics. The CD-ROM includes a host of virtual laboratories, animations, diagrams, photographs and text as well as a SPICE electronic circuit simulator with over 50 pre-designed circuits. Sections on the CD-ROM include: **Fundamentals** – Analogue Signals (5 sections),Transistors (4 sections), Waveshaping Circuits (6 sections). **Op.Amps** – 17 sections covering everything from Symbols and Signal Connections to Differentiators. **Amplifiers** – Single Stage Amplifiers (8 sections), Multi-stage Amplifiers (3 sections). **Filters** – Passive Filters (10 sections), Phase Shifting Networks (4 sections), Active Filters (6 sections). **Oscillators** – 6 sections from Positive Feedback to Crystal Oscillators. **Systems** – 12 sections from Audio Pre-Amplifiers to 8-Bit ADC plus a gallery showing representative p.c.b. photos.

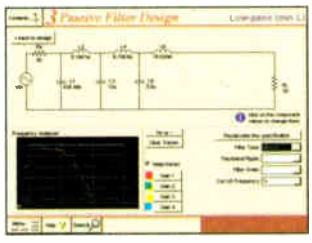
DIGITAL ELECTRONICS



Virtual laboratory – Traffic Lights

Digital Electronics builds on the knowledge of logic gates covered in *Electronic Circuits & Components* (opposite), and takes users through the subject of digital electronics up to the operation and architecture of microprocessors. The virtual laboratories allow users to operate many circuits on screen.
Covers binary and hexadecimal numbering systems, ASCII, basic logic gates, monostable action and circuits, and bistables – including JK and D-type flip-flops. Multiple gate circuits, equivalent logic functions and specialised logic functions. Introduces sequential logic including clocks and clock circuitry, counters, binary coded decimal and shift registers. A/D and D/A converters, traffic light controllers, memories and microprocessors – architecture, bus systems and their arithmetic logic units.

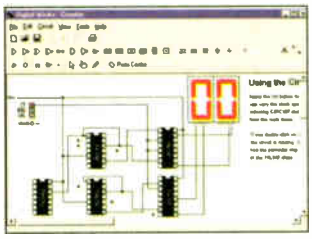
FILTERS



Filter synthesis

Filters is a complete course in designing active and passive filters that makes use of highly interactive virtual laboratories and simulations to explain how filters are designed. It is split into five chapters: **Revision** which provides underpinning knowledge required for those who need to design filters. **Filter Basics** which is a course in terminology and filter characterization, important classes of filter, filter order, filter impedance and impedance matching, and effects of different filter types. **Advanced Theory** which covers the use of filter tables, mathematics behind filter design, and an explanation of the design of active filters. **Passive Filter Design** which includes an expert system and filter synthesis tool for the design of low-pass, high-pass, band-pass, and band-stop Bessel, Butterworth and Chebyshev ladder filters. **Active Filter Design** which includes an expert system and filter synthesis tool for the design of low-pass, high-pass, band-pass, and band-stop Bessel, Butterworth and Chebyshev op.amp filters.

DIGITAL WORKS 3.0

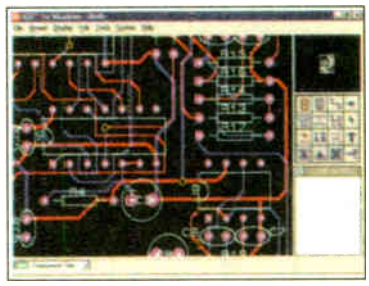


Counter project

Digital Works Version 3.0 is a graphical design tool that enables you to construct digital logic circuits and analyze their behaviour. It is so simple to use that it will take you less than 10 minutes to make your first digital design. It is so powerful that you will never outgrow its capability.

- Software for simulating digital logic circuits
- Create your own macros – highly scalable
- Create your own circuits, components, and i.c.s
- Easy-to-use digital interface
- Animation brings circuits to life
- Vast library of logic macros and 74 series i.c.s with data sheets
- Powerful tool for designing and learning

ELECTRONICS CAD PACK



PCB Layout

Electronics CADPACK allows users to design complex circuit schematics, to view circuit animations using a unique SPICE-based simulation tool, and to design printed circuit boards. CADPACK is made up of three separate software modules: **ISIS Lite** which provides full schematic drawing features including full control of drawing appearance, automatic wire routing, and over 6,000 parts. **PROSPICE Lite** (integrated into ISIS Lite) which uses unique animation to show the operation of any circuit with mouse-operated switches, pots. etc. The animation is compiled using a full mixed mode SPICE simulator. **ARES Lite** PCB layout software allows professional quality PCBs to be designed and includes advanced features such as 16-layer boards, SMT components, and even a **fully functional autorouter**.

"C" FOR PICMICRO MICROCONTROLLERS

C for PICmicro Microcontrollers is designed for students and professionals who need to learn how to use C to program embedded microcontrollers. This product contains a complete course in C that makes use of a virtual C PICmicro which allows students to see code execution step-by-step. Tutorials, exercises and practical projects are included to allow students to test their C programming capabilities. Also includes a complete Integrated Development Environment, a full C compiler, Arizona Microchip's MPLAB assembler, and software that will program a PIC16F84 via the parallel printer port on your PC. (Can be used with the *PICtutor* hardware – see opposite.)
Although the course focuses on the use of the PICmicro series of microcontrollers, this product will provide a relevant background in C programming for any microcontroller.

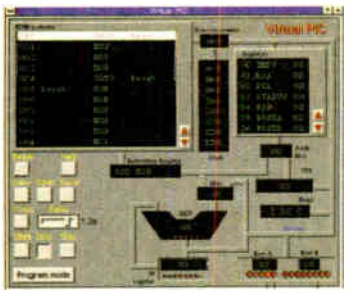
PRICES

Prices for each of the CD-ROMs above are:

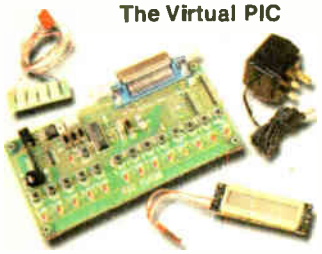
Hobbyist/Student .....£45 inc VAT
Institutional (Schools/HE/FE/Industry).....£99 *plus* VAT
Institutional 10 user (Network Licence) .....£199 *plus* VAT

(UK and EU customers add VAT at 17.5% to "plus VAT" prices)

Interested in programming PIC microcontrollers? Learn with PICtutor by John Becker



The Virtual PIC



Deluxe PICtutor Hardware

This highly acclaimed CD-ROM, together with the PICtutor experimental and development board, will teach you how to use PIC microcontrollers with special emphasis on the PIC16x84 devices. The board will also act as a development test bed and programmer for future projects as your programming skills develop. This interactive presentation uses the specially developed **Virtual PIC Simulator** to show exactly what is happening as you run, or step through, a program. In this way the CD provides the easiest and best ever introduction to the subject.
Nearly 40 Tutorials cover virtually every aspect of PIC programming in an easy to follow logical sequence.

HARDWARE
Whilst the CD-ROM can be used on its own, the physical demonstration provided by the **PICtutor Development Kit**, plus the ability to program and test your own PIC16x84s, really reinforces the lessons learned. The hardware will also be an invaluable development and programming tool for future work.
Two levels of PICtutor hardware are available – Standard and Deluxe. The **Standard** unit comes with a battery holder, a reduced number of switches and no displays. This version will allow users to complete 25 of the 39 Tutorials. The **Deluxe** Development Kit is supplied with a plug-top power supply (the **Export** Version has a battery holder), all switches for both PIC ports plus l.c.d. and 4-digit 7-segment l.e.d. displays. It allows users to program and control all functions and both ports of the PIC. All hardware is supplied **fully built and tested** and includes a PIC16F84.

PICtutor CD-ROM

Hobbyist/Student	£45 inc. VAT
Institutional (Schools/HE/FE Industry)	£99 *plus* VAT
Institutional 10 user (Network Licence)	£199 *plus* VAT

HARDWARE

Standard PICtutor Development Kit	£47 inc. VAT
Deluxe PICtutor Development Kit	£99 *plus* VAT
Deluxe Export Version	£96 *plus* VAT

(UK and EU customers add VAT at 17.5% to "plus VAT" prices)

ELECTRONIC COMPONENTS PHOTOS

A nigh quality selection of over 200 JPG images of electronic components. This selection of high resolution photos can be used to enhance projects and presentations or to help with training and educational material. They are royalty free for use in commercial or personal printed projects, and can also be used royalty free in books, catalogues, magazine articles as well as worldwide web pages (subject to restrictions – see licence for full details). Also contains a **FREE** 30-day evaluation of Paint Shop Pro 6 – Paint Shop Pro image editing tips and on-line help included!

Price £19.95 inc. VAT

ELECTRONIC CIRCUITS & COMPONENTS + THE PARTS GALLERY

Provides an introduction to the principles and application of the most common types of electronic components and shows how they are used to form complete circuits. The virtual laboratories, worked examples and pre-designed circuits allow students to learn, experiment and check their understanding. Sections include: ***Fundamentals:*** units & multiples, electricity. electric circuits, alternating circuits. ***Passive Components:*** resistors, capacitors, inductors, transformers. ***Semiconductors:*** diodes, transistors, op.amps, logic gates. ***Passive Circuits . Active Circuits***

The Parts Gallery will help students to recognise common electronic components and their corresponding symbols in circuit diagrams. Selections include: ***Components, Components Quiz, Symbols, Symbols Quiz, Circuit Technology***

Hobbyist/Student	£34 inc VAT
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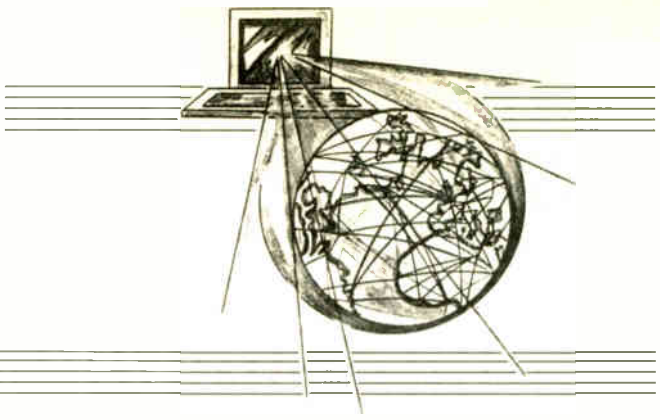

Google Rocks!

IN LAST month's *Net Work* we discussed the Open Directory Project (ODP) available at **www.dmoz.org** which is claimed to be the largest human-edited web search resource on the Internet. It has a clean front end with none of the usual portal-type distractions.

Today, the other best-known search engine has to be Google (**www.google.com**). The author considers this resource to be so significant that this month we return to the Google web site once again – this time to look at Usenet and the advanced features Google's downloadable toolbar offers to make life easier.

The author strongly recommends installing the Google toolbar into Internet Explorer 5 or higher, so that a search box and other options are always to hand. Google's Internet Explorer toolbar has many useful benefits which soon become apparent in use: for example you can Highlight any search phrase "hits" (useful on long or complex pages – multiple terms are highlighted in different colours), and using Word Find you can scroll from one search hit on a page to the next one.

Deja View

There are more handy options in the Google toolbar which regular web users will soon appreciate. One of the most significant is the direct link to Usenet (newsgroups). Many old hands on the Internet mourned the loss of ***Deja News***, the best-known archive of newsgroup postings established in 1995. It's all very well searching the world-wide web for answers, but if you wanted to know what your peers think – perhaps you had a particular software or hardware problem and wondered if anyone else had overcome that same problem – then the savvy net user would head over to Deja News to trawl through the Usenet archives.

These archives contain some 500 million messages and are considered by many to be public property, which is why there was an outcry when Deja folded and the archives, trademarks and Deja's domain names landed in Google's lap. In fact it could be a marriage made in Heaven, because there is nothing Google likes better than the challenge of searching through a terabyte of data – fast. Even on a 56K dialup connection, results are returned virtually instantaneously.

Usenet Googlified

During the first half of 2001 Google has therefore busied itself with Usenet, and the result is that a powerful beta version of ***Google News*** is online at **http://groups.google.com**. Happily, Google Groups is easily accessible via the Explorer toolbar where installed, and the archive did an eerily efficient job of pulling up many of my own posts dating back to the mid 1990s! A Search Usenet button is also available in the Google Toolbar – excellent!

If you don't have the toolbar, you should still bookmark Google Groups and become familiar with its features; more than once I have resolved some thorny problems by searching Usenet archives; in fact I have just received an E-mail from someone who searched Google and found one of my posts dated 1997 which he wanted to discuss with me! Now you have half a decade of human conversation at your fingertips.

You can now also post onto Usenet using Google, and the way to ensure that your post is **not** archived, if required, is to add the line *X-No-Archive: yes* into the header of your message. Furthermore, as many old hands will know, posting into Usenet means that your E-mail address will quickly be scooped up by spammers (junk E-mailers) so you should *never* use your regular daytime E-mail address anywhere in your Usenet message.

For those using other operating systems or browsers, Google does offer a search function restricted to Linux or BSD users. Macintosh users can see the Options page ("Googlify your browser") for details of the Sherlock plug-in for Apple Macs.

There's yet more! The Google toolbar has an optional "Search Directory" button which combines the Open Directory Project (see last month) together with Google's own PageRank feature. This indicates how importantly Google's highly complex algorithms have rated a web page hit for relevance. Last of all, the toolbar's drag and drop feature allows you to drop any text or URL from the main browser into the toolbar to start a search.

All in all, Google could be your first port of call when hunting for answers on the Internet. Even so, it is still possible that Google may not always return very many suitable hits, especially if you are looking for obscure information (remember to trawl through newsgroups too). It is worth having a second search engine up your sleeve.

Alta Vista (**www.altavista.com**) is another search engine which appears to be re-inventing itself as . . . a search engine. Its portal content has been stripped away leaving a leaner page that harks back to the mid 90's, and it incorporates Babel Fish, which enables both text and web sites to be translated between a number of languages.

Alta Vista was originally created by the computer manufacturer Digital Equipment as a living testimony to the power of its own systems (see *Net Work*, March 2000) before the engine was catapulted into commercialisation when DEC sold out. Many others use Yahoo or Ask Jeeves instead.

A Word from Our Sponsors

Many portal sites rely on good old advertising for their revenue, in spite of the mounting evidence of the decreasing effectiveness of on-line advertising, specifically banner adverts. Predictably, users have acquired the ability to focus on the content and block out banner adverts altogether, so the click-through ratios of typical banners are very low indeed.

Banner adverts are a standard size, usually 468 × 60 pixels. Most users will not wait for a banner to download and instead they will start to read the page as soon as it starts to download. Hence we recognise the "start" of a banner ad and we block it out. Indeed software is available which will block out adverts or will prevent time-consuming animated gifs from downloading at all.

One of the latest trends in on-screen advertising is the use of *superstitial, interstitial* and *transitional* adverts. Superstitials load in the background at "quiet" times and only start to play when fully loaded. Interstitials are more irritating – they are often in the form of pop-up windows that open immediately, followed by a delay while the advert loads. Unlike banner adverts, you cannot help but notice – because you usually have to close the window to dismiss it. Last of all, the *transitional* advert runs when fully downloaded, and will play in the main browser window for a few seconds when the next page is being loaded.

Payback Time

As the revenue from traditional banner advertising falls, and businesses have to start to pay several hundred dollars to be registered on major search engines, it seems that payback time is dawning on the Internet. Users have always enjoyed a vast amount of free content paid for by advertising, but now there are signs that online advertising will become a lot less subtle and a lot more "in your face".

That's it for this month, so as Babel Fish would say in Spanish, *las gracias por leer esto, le consideran próximo el mes!* My E-mail address is **alan@epemag.co.uk**.

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Constructional Project

MSF SIGNAL REPEATER AND INDICATOR

ANDY FLIND

How to receive MSF radio clock signals in a "shielded" building.

In common with the author's *Multi-channel Transmission System* featured in the May and June 2000 issues, this project began with a request from the local Hospital Radio group.

The group use radio-controlled clocks working from the 60kHz MSF signals transmitted from Rugby to assist with the synchronisation of some of their broadcast items. They soon discovered that these clocks were unable to receive the signal in their new studio, which is located in the interior of a large steel-framed building.

TO THE RESCUE!

A way of overcoming this problem was required so once again the author's services were called upon. Clearly the simplest approach would be to place a receiving antenna somewhere close to the edge of the building or even outside it, conduct the signal to the studio through a screened cable and then re-radiate it close to the clocks.

Small ferrite antenna assemblies are readily available complete with capacitors tuned to the Rugby MSF signal so they'd tried simply attaching one to each end of a length of 75 ohm UHF TV co-axial cable, but it didn't work! "The signal seemed to get lost in the cable", was their comment.

In retrospect, the probable cause of the failure was the cable's capacitance which would have shifted both antenna centre frequencies a long way from the required 60kHz. A circuit to buffer and amplify the signal at the receiving end seemed the most promising solution and ultimately led to the development of this project. It seems likely that the problem of MSF clocks failing to work in steel-framed buildings may be quite common since many office and factory premises use this form of construction, so this circuit may find plenty of applications.

There may also be electronics enthusiasts who would like to work with the signal and would appreciate its availability at an easily usable level and source impedance on the workbench, although where only the demodulated data signal is required a complete receiver module is available at low cost. More details of this can be found in the November '97 issue where it was used in John Becker's excellent *EPE Time Machine*. However, for more basic experiments this design may be useful, especially as it features a simple add-on circuit to indicate the relative incoming signal strength.

REPEATER CIRCUIT

The circuit of the repeater part of the project is shown in Fig.1. The antenna is a small ferrite rod supplied pre-wound with an enamelled copper wire coil and fitted with a parallel tuning capacitor, with a rubber sleeve to hold it in place.

Like all parallel-tuned resonant circuits it should only be connected to a high impedance since resistive or capacitive loading will tend to de-tune it and adversely affect performance. For this reason it is first buffered by the field effect transistor (f.e.t.) TR1, which does not amplify the signal voltage but greatly reduces its impedance. The output from TR1 is taken from the source (s) connection.

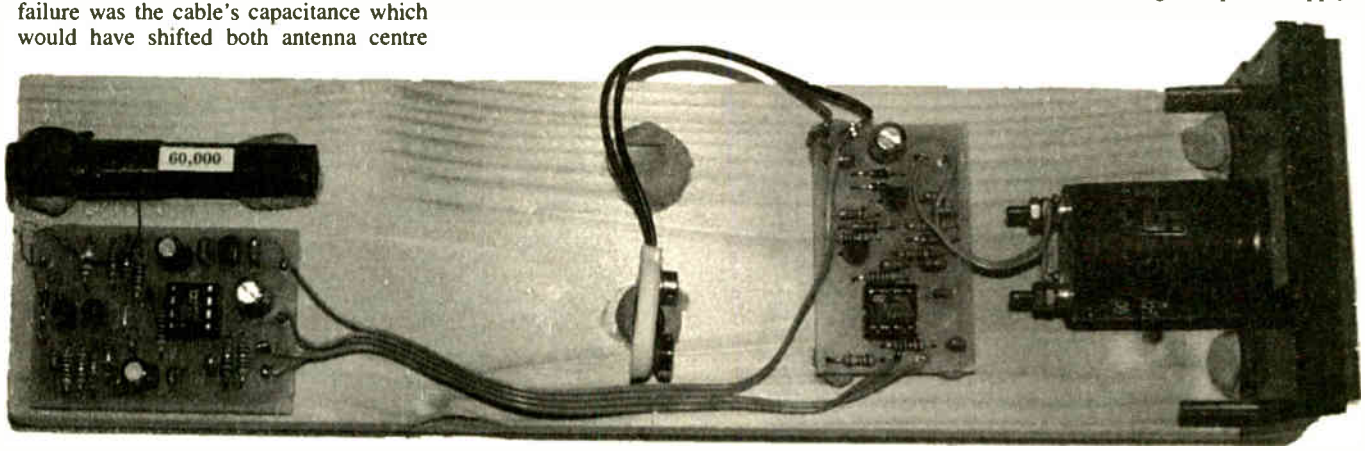
Diodes D1 and D2 protect TR1 from excessively high signal levels should these be encountered. Transistor TR2 provides a voltage gain of about 20, set by the values of resistors R4 and R5.

An AD8532 dual op.amp, IC1, was selected for its features of high speed, rail-to-rail outputs, good output current capability and ability to operate from a 5V supply. The first amplifier IC1a provides further voltage gain of about 10 and incorporates some upper and lower frequency response tailoring with capacitors C6 and C7.

Finally, the signal passes through a passive low-pass filter comprised of resistor R10 and capacitor C8 to the second amplifier, IC1b, which is used as a unity-gain buffer. Resistor R11 protects the output from accidental short circuits.

BE POSITIVE

A problem with high-gain circuits is unwanted positive feedback which can cause instability. Often the path taken by such feedback is through the power supply



rails. Two measures have been taken in this circuit to prevent this occurring.

The first is the use of the local supply voltage regulator IC2 to provide a constant 5V supply. Together with decoupling capacitors C9 and C10, this virtually eliminates signal frequency fluctuations in the supply and also allows the circuit to operate from a wide supply voltage range, including 12V, which is readily available from the Hospital Radio group's equipment.

from Rugby using a 100 per cent modulation system, meaning that the signal is either on or off.

A concern during the design of this project was that the high *Q* of the tuned ferrite aerials would cause long rise and fall times in the re-transmitted signal which might in turn render it unrecognisable by the clocks. However, in practice this has not proved to be a problem. Two clocks of very different types were placed next to the output antenna and both synchronised correctly to its signal with no difficulty whatsoever.

REPEATER CONSTRUCTION

The components for the repeater part of the project are all mounted on a small printed circuit board as shown in Fig.2. This board is available from the *EPE PCB Service*, code 306.

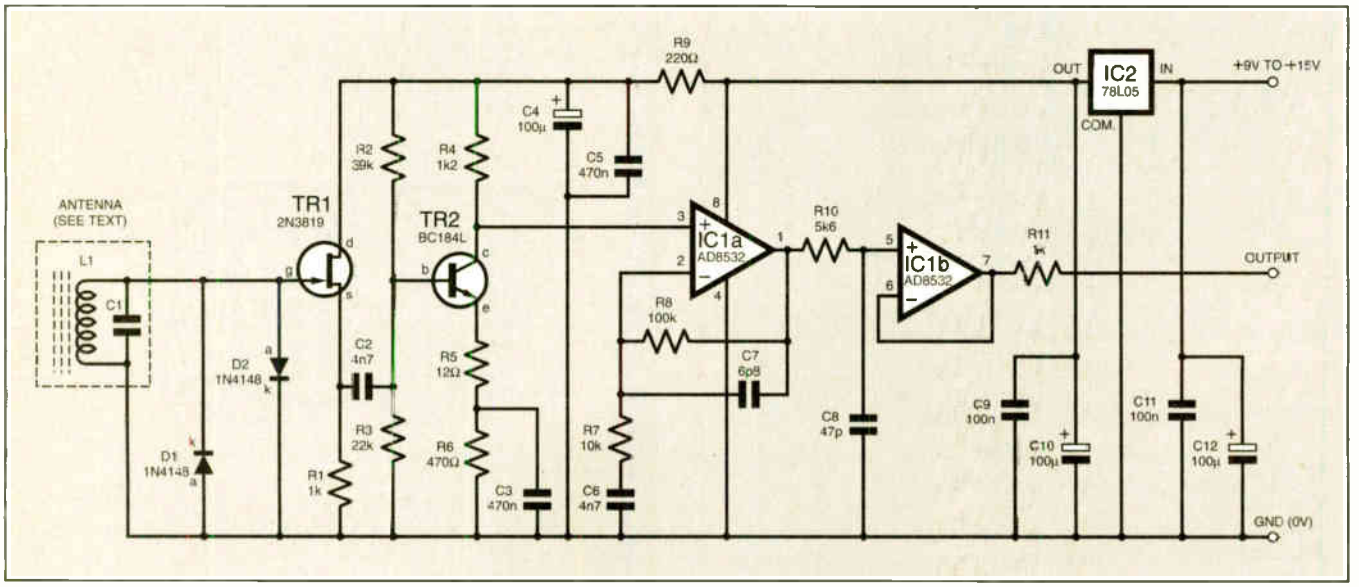


Fig.1. Circuit diagram for the MSF Signal Amplifier and Repeater.

The second measure is the use of some additional supply decoupling for the two transistors, applied with resistor R9 and capacitors C4 and C5.

BANDWIDTH

The complete circuit has an overall bandwidth extending from 20kHz to 200kHz with the maximum voltage gain of about 200 centred around 60kHz, which covers the required frequency and helps to reject noise at higher and lower frequencies. At the author's location, about 130 miles from the Rugby transmitter, the output level is about 45mV peak-to-peak, which is easily displayed on an oscilloscope. The signal is not constant of course: it pulses slowly with a format corresponding to the data being transmitted, which in itself is quite interesting to watch.

The output from the circuit is transferred to the required location by ordinary 75 ohm UHF TV co-axial cable, with the screen connected to ground (0V) to minimise problems of signal leakage. Close to the clock, another resonant ferrite antenna assembly is connected to it in series with a 10nF ceramic capacitor and a 10kΩ resistor (see Fig.3). The resistor provides adequate drive whilst minimising capacitive and resistive loading of the tuned circuit.

LOCAL TIME

In practice this was found to produce a strong but localised signal field which is exactly what is required. If more than one clock has to operate from this arrangement it should be possible to connect several extra tuned circuits to the cable, each with a 10nF capacitor and a 10kΩ resistor in series as with the first. Data is transmitted

COMPONENTS

Approx. Cost Guidance Only £26 excluding case and meter.

Main Repeater Unit

Resistors

R1, R11	1k (2 off)
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R5	12Ω
R6	470Ω
R7	10k
R8	100k
R9	220Ω
R10	5k6

All 1% 0·6W metal film.

See SHOP TALK page

Capacitors

C1	part of antenna assembly (see text)
C2, C6	4n7 resin-dipped ceramic (2 off)
C3, C5	470n resin-dipped ceramic (2 off)
C4, C10	100µ radial elect. 10V (2 off)
C7	6p8 ceramic plate
C8	47p resin-dipped ceramic
C9, C11	100n resin-dipped ceramic (2 off)
C12	100µ radial elect. 25V

Semiconductors

D1, D2	1N4148 signal diode (2 off)
TR1	2N3819 *n*-channel f.e.t.
TR2	BC184L *npn* transistor
IC1	AD8532 dual op.amp
IC2	78L05 +5V 100mA voltage regulator

Miscellaneous

L1/C1	60kHz ferrite antenna assembly
TB1	4-way screw terminal block, p.c.b. mounting

Printed circuit board, available from the *EPE PCB Service*, code 306; 8-pin d.i.l. socket; solder pins; solder, etc.

Signal Strength Meter

Resistors

R1	10k
R2	39k
R3	1k
R4	22k
R5	1k5
R6	1k8
R7	120k
R8	4k7
R9	2k2

All 1% 0.6W metal film.

Capacitors

C1, C3	10n resin-dipped ceramic (2 off)
C2, C5 to C7	100n resin-dipped ceramic (4 off)
C4	470n resin-dipped ceramic
C8	100µ radial elect. 25V

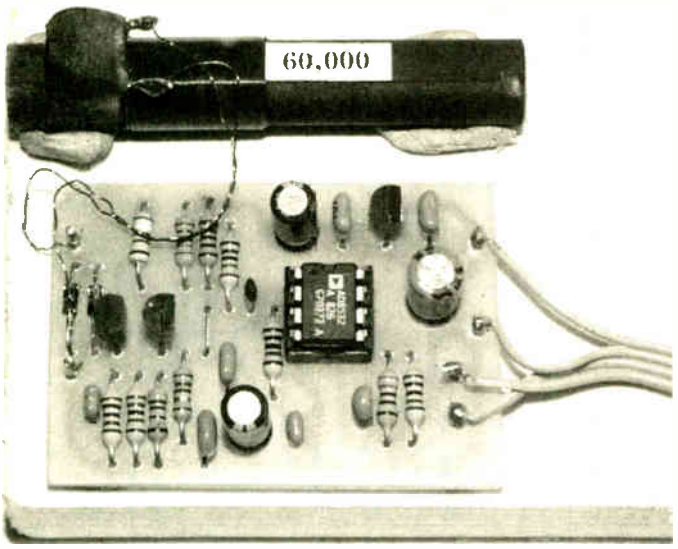
Semiconductors

D1, D2	1N4148 signal diode (2 off)
TR1, TR2	BC184L *npn* transistor (2 off)
IC1	TL071 f.e.t. op.amp

Miscellaneous

ME1	100µA f.s.d. moving-coil meter

Printed circuit board, available from the *EPE PCB Service*, code 307; 8-pin d.i.l. socket; solder pins; solder, etc.



Completed prototype repeater circuit board.

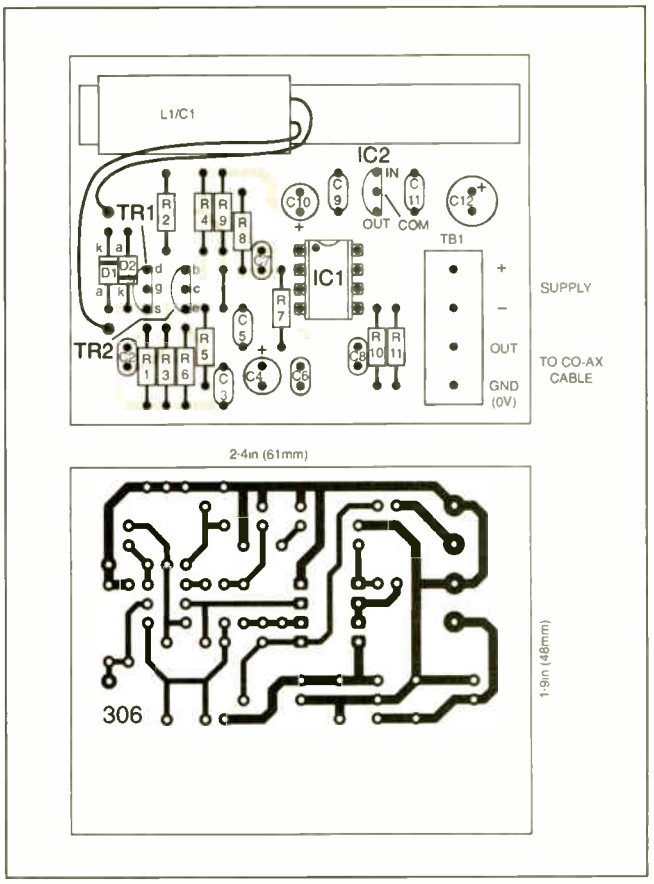


Fig.2 (right). Printed circuit board topside component layout and full-size copper foil master for the Repeater circuit.

Construction should begin with the fitting of all resistors, the two diodes, the small ceramic capacitors, a d.i.l. (dual-in-line) socket for IC1, the three electrolytic capacitors and the regulator IC2. The terminal block TB1 may also be fitted at this point and a pair of solder pins can be provided for connections to the antenna coil.

A supply of between 9V and 15V should be applied, and the regulated 5V supply should be checked as present and correct.

The two transistors may be fitted next. A temporary short circuit link wire should be connected between the input and the 0V line, and power re-applied. If all is well, the collector (c) of TR2 should have a d.c. voltage of about 2·2V and the supply voltage to the transistors, measured at the top of R2 (as seen in Fig.2), should be about 4·4V. If this appears correct, IC1 can be inserted and the circuit powered again.

The two outputs of IC1, pin 1 and pin 7, should both show d.c. voltages of about 2·2V and the total supply current should be about 6·3mA. If so, the board is probably OK so it can be completed by fitting and connecting the ferrite antenna, L1.

TRANSMISSION TESTS

The antenna may be attached to the board with a couple of blobs of Blu-Tack, which seems to increase in strength over time and has proved more than adequate in the prototype. Further testing will require test equipment (or a steel-framed building and a clock!) or the signal strength indicator unit which will be described next.

If an oscilloscope is available it may be used to display the output of the board, which will vary according to the range from the transmitter, but will probably be a few tens of millivolts. It should appear as a 60kHz sinewave, pulsing on and off at around 1Hz or slightly faster.

This part of the project can be fitted into a case if necessary, but any housing used should be made of plastic with no large metal components close to the antenna. In areas of poor signal strength it may be best to use a weatherproof housing and site the unit outside to obtain a better signal. The method of connecting the re-radiating antenna to the unit is shown in Fig.3.

This may also be housed in a small plastic case for a neat appearance, though in some cases it may be possible to simply hide it behind the clock. The negative supply should be earthed at some point to keep signal radiation from the screened output cable to a minimum.

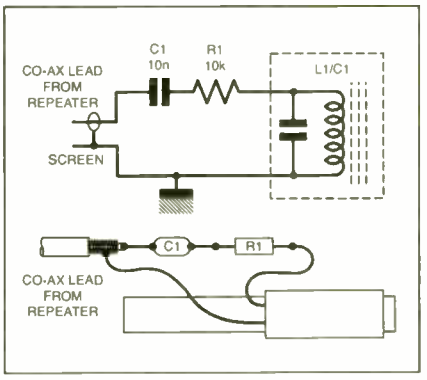


Fig.3. Re-radiating antenna circuit and connection.

SIGNAL METER

During the design of the repeater amplifier it was decided that a portable signal strength indicator would be useful as it might assist in finding the best spot to place the receiving antenna, in orientating it for the strongest signal, and in checking the output field strength at the point where it was re-radiated.

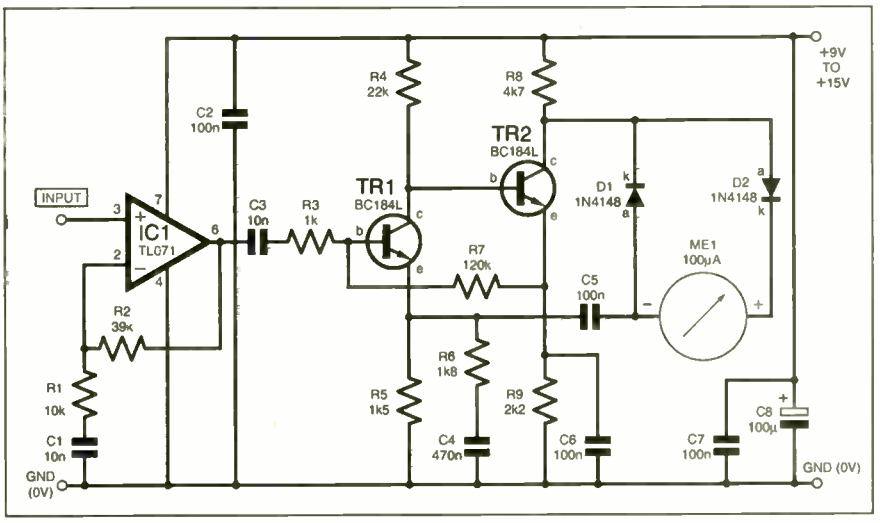


Fig.4. Complete circuit diagram for the MSF Signal Strength meter.

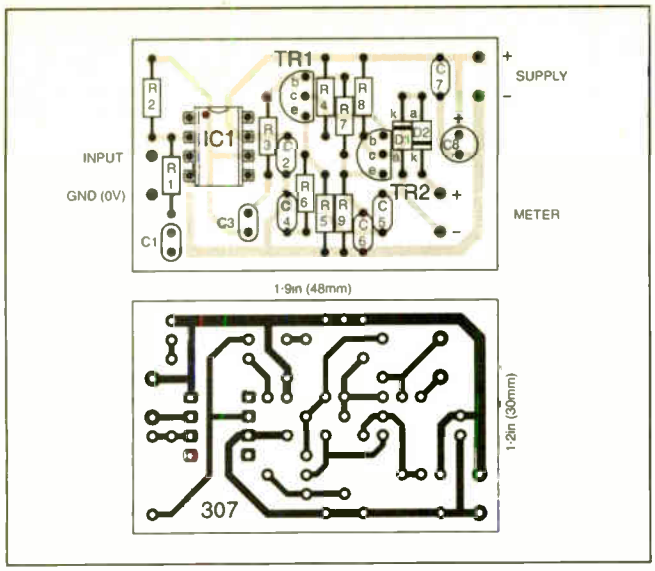
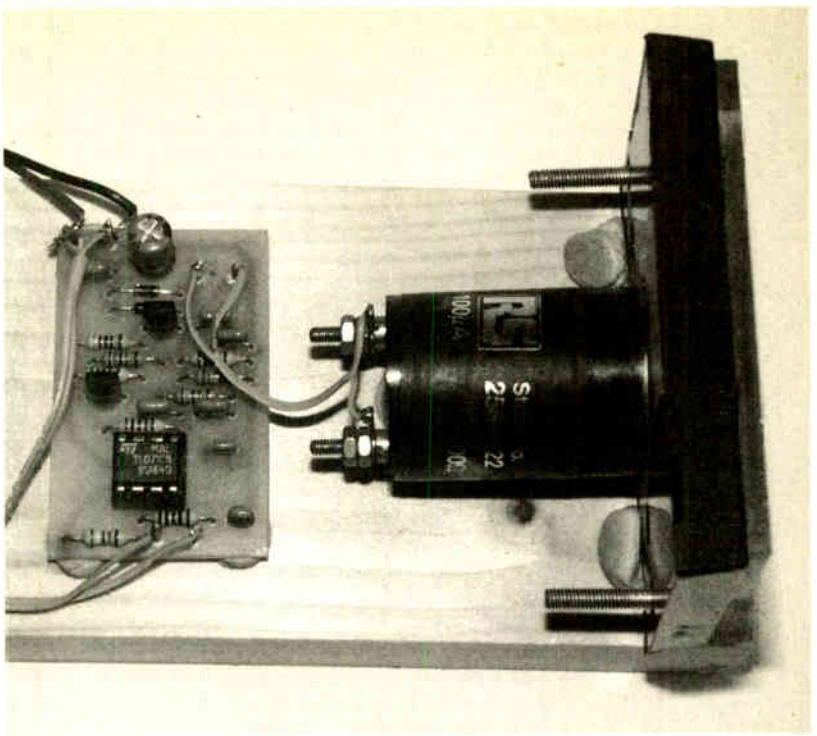


Fig.5. Printed circuit board component layout and full-size foil master for the MSF Signal Strength Meter. The prototype board, wired to the meter, is shown opposite.



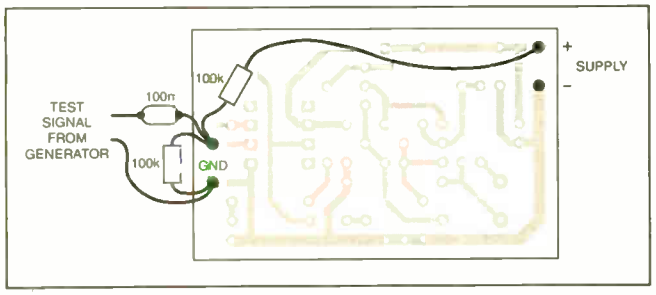
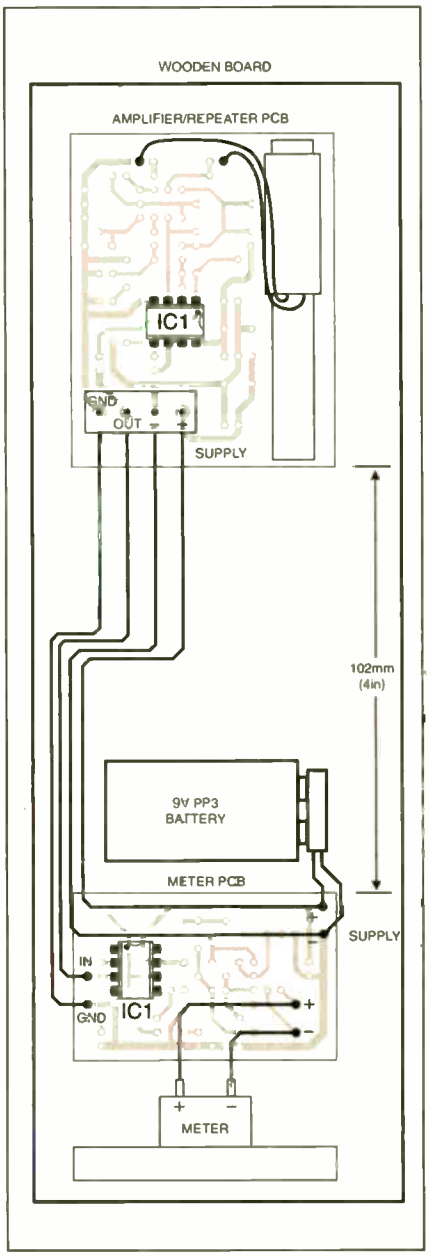


Fig.6. Set up for testing the signal strength board with a signal generator.

Fig.7 (right). Prototype layout and wiring details for the field strength indicator.



The simplest way of doing this was to construct another amplifier and use it with an a.c. millivoltmeter. The workshop multimeter's a.c. performance was a bit depleted at 60kHz so another circuit was designed as an add-on for the task. This is shown in Fig.4.

In this circuit, IC1 is a TL071 op.amp used to buffer the input and provide a small amount of extra gain. Its output drives an a.c. millivoltmeter circuit built around transistors TR1 and TR2, which compensate for the forward voltage drops of diodes D1 and D2, whilst driving the 100μA meter, ME1.

The various capacitor values have been chosen to reduce response at low frequencies whilst maintaining it at 60kHz. In fact, the response begins to fall off at around 5kHz but at the other end is still flat to beyond 200kHz. The sensitivity is set by the values of resistors R2 and R6 and, with the values shown, is 100mV peak-to-peak, or about 35mV r.m.s. for a sinewave input.

The meter is a 100μA moving coil type. Capacitors C2, C7 and C8 are local supply decouplers to help maintain stability. The supply voltage for this circuit may be anywhere between about 7V and 15V, so a 9V PP3 battery may be used for portability. Construction of this part of the circuit consists of assembling the components on the p.c.b. as shown in Fig.5. This board is available from the *EPE PCB Service*, code 307.

METERING CONSTRUCTION

Begin assembly with the resistors, then the diodes, small capacitors, a d.i.l. socket for IC1, and finally the transistors and electrolytic capacitor.

Solder pins are used to make external connections to this part of the project. If the meter is attached to the circuit and power applied it should initially read zero, but touching pin 6 (output) of the socket of IC1 will probably result in a small reading.

Next IC1 can be fitted. Note that this op.amp has no input bias voltage circuit as it will obtain a d.c. bias from the voltage present at the output of the first board.

If it is desired to test the circuit on its own using a signal generator, it will be necessary to provide input biasing. This can be done with a couple of 100kΩ resistors and a 100nF coupling capacitor as shown in Fig.6. The complete circuit should draw a supply current of about 2·5mA.

INTERCONNECTIONS

Connecting the unit to the first board requires some care. If the two boards are too close to each other, feedback will take place between them and cause false high meter readings, so they should be kept a reasonable distance apart and the wiring between them and the meter should be kept short and tidy.

The layout shown in Fig.7 works well and, as can be seen from the photograph, the prototype was assembled on a piece of wood with some Blu-Tack! Well, it was never intended to be more than a lash-up for spot checks on location and it performed that function very well indeed.

ENCLOSURES

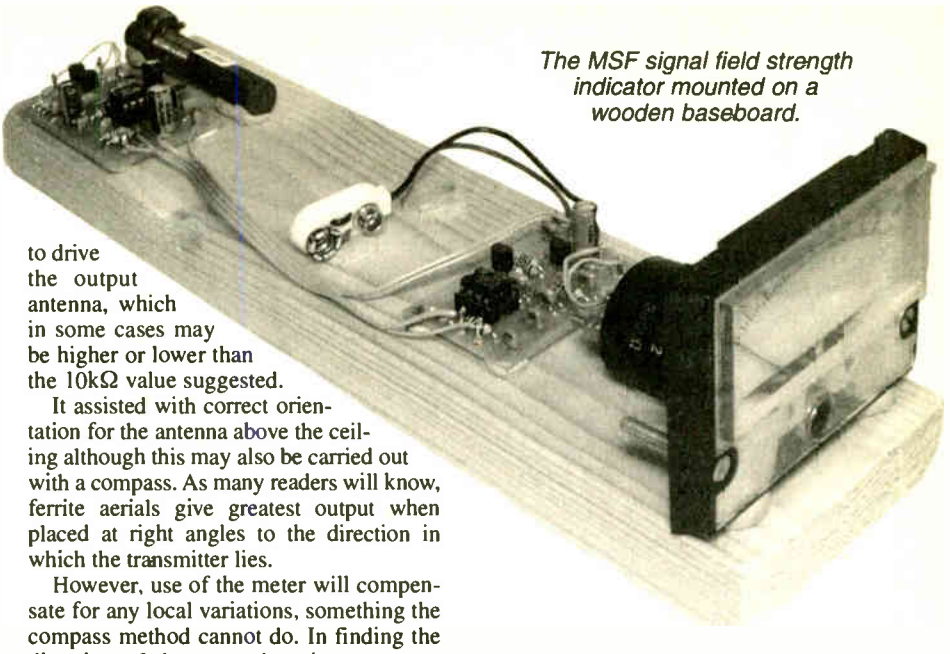
If a more professional job is required, a plastic case can be used instead with a similar layout, but it is suggested that the layout is tested before cutting any holes in the case. It was also found that providing a Ground connection by touching the circuit's negative supply rail approximately doubled the meter reading, and that simply resting a finger on the metal case of the battery achieves a similar effect.

If a plastic case is used a small metal touch-plate connected to the negative supply could be provided for this contact. *A metal case **must not** be used, of course, as this would prevent the signal from reaching the antenna.*

INSTALLATION

In use, it has been found that strong signal sources such as computers can "block" the repeater unit, but apart from this limitation it works well. It certainly proved possible to demonstrate a complete lack of signal within the metal-framed hospital building and to locate a spot above a false ceiling adjacent to an outside wall where an adequate signal was available.

It also showed the strong but short-ranged nature of the output signal close to the clock, and allowed the selection of a suitable value for the series resistor used to drive the output antenna, which in some cases may be higher or lower than the 10kΩ value suggested.



The MSF signal field strength indicator mounted on a wooden baseboard.

It assisted with correct orientation for the antenna above the ceiling although this may also be carried out with a compass. As many readers will know, ferrite aerials give greatest output when placed at right angles to the direction in which the transmitter lies.

However, use of the meter will compensate for any local variations, something the compass method cannot do. In finding the direction of the transmitter it may prove easier to find the "null" or smallest signal orientation due to the pulsed nature of the transmission and then place the receiving antenna at right angles to this.

TRANSMITTER MAINTENANCE

Finally, it should be noted that the Rugby transmitter is occasionally switched off for maintenance, so if no signals are visible, it is worth checking this out first before assuming there may be a fault in the project.

There is a quarterly maintenance period which normally takes place on the first Tuesday of each January, April, July and October from 1000 to 1400 hours GMT (1100 to 1500 BST in summer time).

An annual maintenance period takes place over a two week period in the summer, with the signal being absent during the daytime but restored overnight (although this is not guaranteed). The period for 2001 is from 1300 BST Monday 16 July to 1300 BST Monday 30 July.

More details about the MSF transmissions can be obtained from the National Physical Laboratory (NPL), Teddington, Middx TW11 0LW. Tel: 0208 977 3222.

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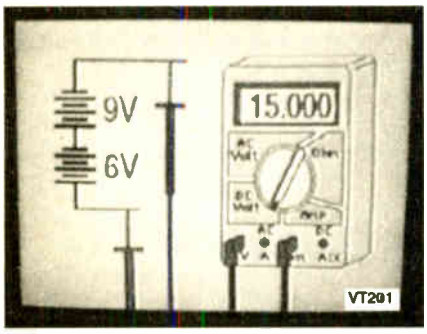

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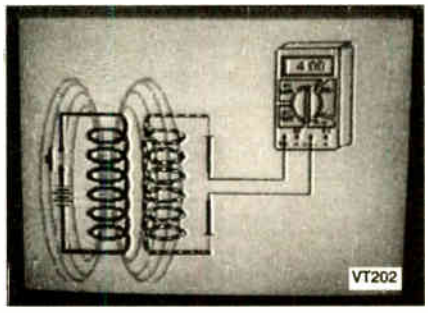

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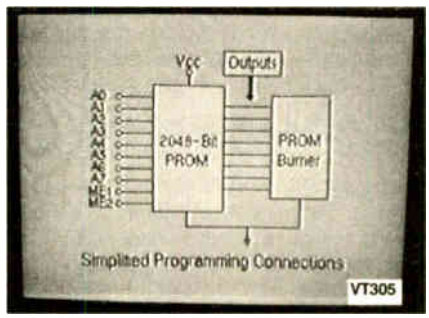

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The contents include an Overview of State-of-the-Art Robots; Robotic Locomotion; Motors and Power Controllers; All Types of Sensors; Tilt; Bump; Road and Wall Detection; Light; Speech and Sound Recognition; Robotic Intelligence (Expert Type) Using a Single-Board Computer Programmed in BASIC; Robotic Intelligence (Neutral Type) Using Simple Neural Networks (Insect Intelligence); Making a Lifelike Android Hand; A Computer-Controlled Robotic Insect Programmed in BASIC; Telepresence Robots With Actual Arcade and Virtual Reality Applications; A Computer-Controlled Robotic Arm; Animated Robots and Androids; Real-World Robotic Applications.

224 pages **Order code MGH1** **£22.99**

Radio

BASIC RADIO PRINCIPLES AND TECHNOLOGY
Ian Poole
Radio technology is becoming increasingly important in today's high technology society. There are the traditional uses of radio which include broadcasting and point to point radio as well as the new technologies of satellites and cellular phones. All of these developments mean there is a growing need for radio engineers at all levels.

Assuming a basic knowledge of electronics, this book provides an easy to understand grounding in the topic.

Chapters in the book: Radio Today, Yesterday, and Tomorrow; Radio Waves and Propagation; Capacitors, Inductors, and Filters; Modulation; Receivers; Transmitters; Antenna Systems; Broadcasting; Satellites; Personal Communications; Appendix – Basic Calculations.

263 pages **Order code NE30** **£15.99**

PROJECTS FOR RADIO AMATEURS AND S.W.L.S.
R. A. Penfold
This book describes a number of electronic circuits, most of which are quite simple, which can be used to enhance the performance of most short wave radio systems.

The circuits covered include: An aerial tuning unit; A simple active aerial; An add-on b.f.o. for portable sets; A wavetrap to combat signals on spurious responses; An audio notch filter; A parametric equaliser; C.W. and S.S.B. audio filters; Simple noise limiters; A speech processor; A volume expander.

Other useful circuits include a crystal oscillator, and RTTY/C.W. tone decoder, and a RTTY serial to parallel converter. A full range of interesting and useful circuits for short wave enthusiasts.

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AN INTRODUCTION TO AMATEUR RADIO
I. D. Poole
Amateur radio is a unique and fascinating hobby which has attracted thousands of people since it began at the turn of the century. This book gives the newcomer a comprehensive and easy to understand guide through the subject so that the reader can gain the most from the hobby. It then remains an essential reference volume to be used time and again. Topics covered include the basic aspects of the hobby, such as operating procedures, jargon and setting up a station. Technical topics covered include propagation, receivers, transmitters and aerials etc.

150 pages **Order code BP257** **£5.49**

SIMPLE SHORT WAVE RECEIVER CONSTRUCTION
R. A. Penfold
Short wave radio is a fascinating hobby, but one that seems to be regarded by many as an expensive pastime these days. In fact it is possible to pursue this hobby for a minimal monetary outlay if you are prepared to undertake a bit of d.i.y., and the receivers described in this book can all be built at low cost. All the sets are easy to construct, full wiring diagrams etc. are provided, and they are suitable for complete beginners. The receivers only require simple aerials, and do not need any complex alignment or other difficult setting up procedures.

The topics covered in this book include: The broadcast bands and their characteristics; The amateur bands and their characteristics; The propagation of radio signals; Simple aerials; Making an earth connection; Short wave crystal set; Simple t.r.f. receivers; Single sideband reception; Direct conversion receiver. Contains everything you need to know in order to get started in this absorbing hobby.

88 pages **Order code BP275** **£4.45**

Computers and Computing

MULTIMEDIA ON THE PC
Ian R. Sinclair
In this book, you'll find out what a CD ROM is, how it works, and why it is such a perfect add-on for a PC, allowing you to buy programmes, text, graphics and sound on a CD. It also describes the installation of a CD ROM drive and a sound card, pointing out the common problems that arise, and then shows how to use them to create a complete multimedia presentation that contains text, photos, a soundtrack with your own voice recorded as a commentary, even animation and edited video footage.

184 pages **Order code PC112** **£12.95**

HOW TO BUILD YOUR OWN PC
Morris Rosenthal
More and more people are building the own PCs. They get more value for their money, they create exactly the machine they want, and the work is highly satisfying and actually fun. That is, if they have a unique beginner's guide like this one, which visually demonstrates how to construct a state-of-the-art computer from start to finish.

Through 150 crisp photographs and clear but minimal text, readers will confidently absorb the concepts of computer building. The extra-big format makes it easy to see what's going on in the pictures. For non-specialists, there's even a graphical glossary that clearly illustrates technical terms. The author goes "under the hood" and shows step-by-step how to create a socket 7 (Pentium and non-Intel chipsets) and a Slot 1 (Pentium II) computer covering: What first-time builders need to know; How to select and purchase parts; How to assemble the PC; How to install Windows 98. The few existing books on this subject, although badly outdated, are in steady demand. This one delivers the expertise and new technology that fledgling computer builders are eagerly looking for.

224 pages – large format **Order code MGH2** **£21.99**

UNDERSTANDING PC SPECIFICATIONS
R. A. Penfold (Revised Edition)
If you require a microcomputer for business applications, or a high quality home computer, an IBM PC or compatible is often the obvious choice. They are competitively priced, and are backed up by an enormous range of applications programs, hardware add-ons, etc. The main difficulty for the uninitiated is deciding on the specification that will best suit his or her needs. PCs range from simple systems of limited capabilities up to complex systems that can happily run applications that would have been considered beyond the abilities of a microcomputer not so long ago. It would be very easy to choose a PC system that is inadequate to run your applications efficiently, or one which goes beyond your needs and consequently represents poor value for money.

This book explains PC specifications in detail, and the subjects covered include the following: Differences between types of PC (XT, AT, 80386, etc); Maths co-processors; Input devices (keyboards, mice, and digitisers); Memory, including both expanded (EMS) and extended RAM; RAM disks and disk caches; Floppy disk drive formats and compatibility; Hard disk drives (including interleave factors and access times); Display adaptors, including all standard PC types (CGA, Hercules, Super VGA, etc); Contains everything you need to know if you can't tell your EMS from your EGA!

128 pages **Order code BP282** **£5.45**

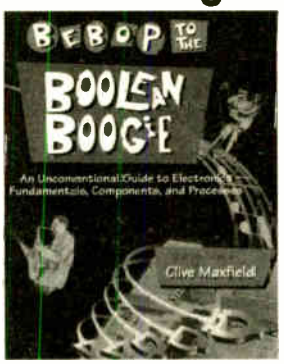
Theory and Reference

Bebop To The Boolean Boogie

By Clive (call me Max) Maxfield

Specially imported by *EPE* – *Excellent value*

An Unconventional Guide to Electronics Fundamentals, Components and Processes



This book gives the "big picture" of digital electronics. This indepth, highly readable, up-to-the-minute guide shows you how electronic devices work and how they're made. You'll discover how transistors operate, how printed circuit boards are fabricated, and what the innards of memory ICs look like. You'll also gain a working knowledge of Boolean Algebra and Karnaugh Maps, and understand what Reed-Muller logic is and how it's used. And there's much, MUCH more (including a recipe for a truly great seafood gumbo!). Hundreds of carefully drawn illustrations clearly show the important points of each topic. The author's tongue-in-cheek British humor makes it a delight to read, but this is a REAL technical book, extremely detailed and accurate. A great reference for your own shelf, and also an ideal gift for a friend or family member who wants to understand what it is you do all day. . . .

470 pages – large format **Order code BEB1** **£26.95**

DIGITAL ELECTRONICS – A PRACTICAL APPROACH
With FREE Software: Number One Systems – EASY-PC Professional XM and Pulsar (Limited Functionality) FREE SOFTWARE
Richard Monk

Covers binary arithmetic, Boolean algebra and logic gates, combination logic, sequential logic including the design and construction of asynchronous and synchronous circuits and register circuits. Together with a considerable practical content plus the additional attraction of its close association with computer aided design including the FREE software.

There is a 'blow-by-blow' guide to the use of EASY-PC Professional XM (a schematic drawing and printed circuit board design computer package). The guide also conducts the reader through logic circuit simulation using Pulsar software. Chapters on p.c.b. physics and p.c.b. production techniques make the book unique, and with its host of project ideas make it an ideal companion for the integrative assignment and common skills components required by BTEC and the key skills demanded by GNVQ. The principal aim of the book is to provide a straightforward approach to the understanding of digital electronics.

Those who prefer the 'Teach-In' approach or would rather experiment with some simple circuits should find the book's final chapters on printed circuit board production and project ideas especially useful.

250 pages **Order code NE28** **£17.99**

Bebop Bytes Back

FREE CD-ROM

By Clive "Max" Maxfield and Alvin Brown

Specially imported by *EPE* – *Excellent value*

An Unconventional Guide To Computers

Plus **FREE CD-ROM** which includes: Fully Functional Internet-Ready Virtual Computer with Interactive Labs

This follow-on to *Bebop to the Boolean Boogie* is a multimedia extravaganza of information about how computers work. It picks up where "Bebop I" left off, guiding you through the fascinating world of computer design. . . and you'll have a few chuckles, if not belly laughs, along the way. In addition to over 200 megabytes of mega-cool multimedia, the accompanying CD-ROM (for Windows 95 machines only) contains a virtual microcomputer, simulating the motherboard and standard computer peripherals in an extremely realistic manner. In addition to a wealth of technical information, myriad nuggets of trivia, and hundreds of carefully drawn illustrations, the book contains a set of lab experiments for the virtual microcomputer that let you recreate the experiences of early computer pioneers.

Over 500 pages – large format **Order code BEB2** **£31.95**

DIGITAL GATES AND FLIP-FLOPS
Ian R. Sinclair

This book, intended for enthusiasts, students and technicians, seeks to establish a firm foundation in digital electronics by treating the topics of gates and flip-flops thoroughly and from the beginning.

Topics such as Boolean algebra and Karnaugh mapping are explained, demonstrated and used extensively, and more attention is paid to the subject of synchronous counters than to the simple but less important ripple counters.

No background other than a basic knowledge of electronics is assumed, and the more theoretical topics are explained from the beginning, as also are many working practices. The book concludes with an explanation of microprocessor techniques as applied to digital logic.

200 pages **Order code PC106** **£9.95**

Music, Audio and Video

AN INTRODUCTION TO LOUDSPEAKERS AND ENCLOSURE DESIGN
V. Capel

This book explores the various features, good points and snags of speaker designs. It examines the whys and wherefores so that the reader can understand the principles involved and so make an informed choice of design, or even design loudspeaker enclosures for him – or herself. Crossover units are also explained, the various types, how they work, the distortions they produce and how to avoid them. Finally there is a step-by-step description of the construction of the *Kapellmeister* loudspeaker enclosure.

148 pages **Temporarily out of print**

ELECTRONIC MUSIC AND MIDI PROJECTS
R. A. Penfold

Whether you wish to save money, boldly go where no musician has gone before, rekindle the pioneering spirit, or simply have fun building some electronic music gadgets, the designs featured in this book should suit your needs. The projects are all easy to build, and some are so simple that even complete beginners at electronic project construction can tackle them with ease. Stripboard layouts are provided for every project, together with a wiring diagram. The mechanical side of construction has largely been left to individual constructors to sort out, simply because the vast majority of project builders prefer to do their own thing in this respect.

None of the designs requires the use of any test equipment in order to get them set up properly. Where any setting up is required, the procedures are very straightforward, and they are described in detail.

Projects covered: Simple MIDI tester, Message grabber, Byte grabber, THRU box, MIDI auto switcher, Auto/manual switcher, Manual switcher, MIDI patchbay, MIDI controlled switcher, MIDI lead tester, Program change pedal, Improved program change pedal, Basic mixer, Stereo mixer, Electronic swell pedal, Metronome, Analogue echo unit.

138 pages **Order code PC116** **£10.95**

VIDEO PROJECTS FOR THE ELECTRONICS CONSTRUCTOR
R. A. Penfold

Written by highly respected author R. A. Penfold, this book contains a collection of electronic projects specially designed for video enthusiasts. All the projects can be simply constructed, and most are suitable for the newcomer to project construction, as they are assembled on stripboard.

There are faders, wipers and effects units which will add sparkle and originality to your video recordings, an audio mixer and noise reducer to enhance your soundtracks and a basic computer control interface. Also, there's a useful selection on basic video production techniques to get you started.

Complete with explanations of how the circuit works, shopping lists of components, advice on construction, and guidance on setting up and using the projects, this invaluable book will save you a small fortune.

Circuits include: video enhancer, improved video enhancer, video fader, horizontal wiper, improved video wiper, negative video unit, fade to grey unit, black and white keyer, vertical wiper, audio mixer, stereo headphone amplifier, dynamic noise reducer, automatic fader, pushbutton fader, computer control interface, 12 volt mains power supply.

124 pages **Order code PC115** **£10.95**

COMPUTERS AND MUSIC – AN INTRODUCTION
R. A. Penfold

Computers are playing an increasingly important part in the world of music, and the days when computerised music was strictly for the fanatical few are long gone.

If you are more used to the black and white keys of a synth keyboard than the QWERTY keyboard of a computer, you may be understandably confused by the jargon and terminology bandied about by computer buffs. But fear not, setting up and using a computer-based music making system is not as difficult as you might think.

This book will help you learn the basics of computing, running applications programs, wiring up a MIDI system and using the system to good effect, in fact just about everything you need to know about hardware and the programs, with no previous knowledge of computing needed or assumed. This book will help you to choose the right components for a system to suit your personal needs, and equip you to exploit that system fully.

174 pages **Temporarily out of print**

THE INVENTOR OF STEREO – THE LIFE AND WORKS OF ALAN DOWER BLUMLEIN
Robert Charles Alexander

This book is the definitive study of the life and works of one of Britain's most important inventors who, due to a cruel set of circumstances, has all but been overlooked by history.

Alan Dower Blumlein led an extraordinary life in which his inventive output rate easily surpassed that of Edison, but whose early death during the darkest days of World War Two led to a shroud of secrecy which has covered his life and achievements ever since.

His 1931 Patent for a Binaural Recording System was so revolutionary that most of his contemporaries regarded it as more than 20 years ahead of its time. Even years after his death, the full magnitude of its detail had not been fully utilized. Among his 128 patents are the principal electronic circuits critical to the development of the world's first electronic television system. During his short working life, Blumlein produced patent after patent breaking entirely new ground in electronic and audio engineering.

During the Second World War, Alan Blumlein was deeply engaged in the very secret work of radar development and contributed enormously to the system eventually to become 'H2S' – blind-bombing radar. Tragically, during an experimental H2S flight in June 1942, the Halifax bomber in which Blumlein and several colleagues were flying, crashed and all aboard were killed. He was just days short of his thirty-ninth birthday.

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HIGH POWER AUDIO AMPLIFIER CONSTRUCTION
R. A. Penfold

Practical construction details of how to build a number of audio power amplifiers ranging from about 50 to 300/400 watts r.m.s. includes MOSFET and bipolar transistor designs.

96 pages **Order code BP277** **£4.49**

Circuits, Data and Design

PRACTICAL ELECTRONIC FILTERS
Owen Bishop
This book deals with the subject in a non-mathematical way. It reviews the main types of filter, explaining in simple terms how each type works and how it is used.
The book also presents a dozen filter-based projects with applications in and around the home or in the constructor's workshop. These include a number of audio projects such as a rythm sequencer and a multi-voiced electronic organ.
Concluding the book is a practical step-by-step guide to designing simple filters for a wide range of purposes, with circuit diagrams and worked examples.
88 pages **Order code BP299** **£5.49**

ELECTRONIC HOBBYISTS DATA BOOK
R. A. Penfold
This book should tell you everything you are ever likely to want to know about hobby electronics, but did not know where to ask or refer. Comprehensive contents pages makes it easy to quickly locate the data you require.
The subjects covered include: Common circuits, and related data (including helpful graphs and tables of values); Colour codes for resistors, capacitors and inductors; Pinout details for a wide range of CMOS and TTL devices, plus basic data on the various logic families; Pinout details and basic data for a wide range of operational amplifiers; Data and leadout information for a wide range of transistors, FETs, power FETs, triacs, thyristors, diodes, etc; General data including MIDI message coding, radio data, ASCII/Baudot coding, decibel ratios, etc.
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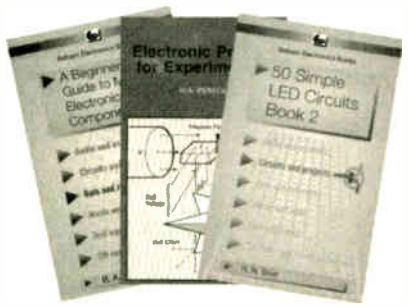

50 SIMPLE LED CIRCUITS
R. N. Soar
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components – the light-emitting diode (LED). Also includes circuits for the 707 common anode display.
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CIRCUIT SOURCE BOOK 1
A. Penfold
Written to help you create and experiment with your own electronic designs by combining and using the various standard "building block" circuits provided. Where applicable, advice on how to alter the circuit parameters is given.
The circuits covered in this book are mainly concerned with analogue signal processing and include: Audio amplifiers (op.amp and bipolar transistors); audio power amplifiers; d.c. amplifiers; highpass, lowpass, bandpass and notch filters; tone controls; voltage controlled amplifiers and filters; triggers and voltage comparators; gates and electronic switching; bargraphs; mixers; phase shifters, current mirrors, hold circuits, etc.
Over 150 circuits are provided, which it is hoped will be useful to all those involved in circuit design and application, be they professionals, students or hobbyists.
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A BEGINNER'S GUIDE TO TTL DIGITAL ICs
R. A. Penfold
This book first covers the basics of simple logic circuits in general, and then progresses to specific TTL logic integrated circuits. The devices covered include gates, oscillators, timers, flip/flops, dividers, and decoder circuits. Some practical circuits are used to illustrate the use of TTL devices in the "real world".
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CIRCUIT SOURCE BOOK 2
R. A. Penfold
This book will help you to create and experiment with your own electronic designs by combining and using the various standard "building blocks" circuits provided. Where applicable, advice on how to alter the circuit parameters is provided.
The circuits covered are mainly concerned with signal generation, power supplies, and digital electronics.
The topics covered in this book include: 555 oscillators; sinewave oscillators; function generators; CMOS oscillators; voltage controlled oscillators; radio frequency oscillators; 555 monostables; CMOS monostables; TTL monostables; precision long timers; power supply and regulator circuits; negative supply generators and voltage boosters; digital dividers; decoders, etc; counters and display drivers; D/A and A/D converters; opto-isolators, flip/flops, noise generators, tone decoders, etc.
Over 170 circuits are provided, which it is hoped will be useful to all those involved in circuit design and application, be they professionals, students or hobbyists.
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ELECTRONIC PROJECTS FOR EXPERIMENTERS
R. A. Penfold
Many electronic hobbyists who have been pursuing their hobby for a number of years seem to suffer from the dreaded "seen it all before" syndrome. This book is fairly and squarely aimed at sufferers of this complaint, plus any other electronics enthusiasts who yearn to try something a bit different. No doubt many of the projects featured here have practical applications, but they are all worth a try for their interest value alone.
The subjects covered include:- Magnetic field detector, Basic Hall effect compass, Hall effect audio isolator, Voice scrambler/descrambler, Bat detector, Bat style echo location, Noise cancelling, LED stroboscope, Infra-red "torch", Electronic breeze detector, Class D power amplifier, Strain gauge amplifier, Super hearing aid.
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PRACTICAL FIBRE-OPTIC PROJECTS
R. A. Penfold
While fibre-optic cables may have potential advantages over ordinary electric cables, for the electronics enthusiast it is probably their novelty value that makes them worthy of exploration. Fibre-optic cables provide an innovative interesting alternative to electric cables, but in most cases they also represent a practical approach to the problem. This book provides a number of tried and tested circuits for projects that utilize fibre-optic cables.
The projects include:- Simple audio links, F.M. audio link, P.W.M. audio links, Simple d.c. links, P.W.M. d.c. link, P.W.M. motor speed control, RS232C data links, MIDI link, Loop alarms, R.P.M. meter.
All the components used in these designs are readily available, none of them require the constructor to take out a second mortgage.
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ELECTRONIC PROJECT BUILDING FOR BEGINNERS
R. A. Penfold
This book is for complete beginners to electronic project building. It provides a complete introduction to the practical side of this fascinating hobby, including the following topics:
Component identification, and buying the right parts; resistor colour codes, capacitor value markings, etc; advice on buying the right tools for the job; soldering; making easy work of the hard wiring; construction methods, including stripboard, custom printed circuit boards, plain matrix boards, surface mount boards and wire-wrapping; finishing off, and adding panel labels; getting "problem" projects to work, including simple methods of fault-finding.
In fact everything you need to know in order to get started in this absorbing and creative hobby.
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R. A. Penfold
The purpose of this book is to provide practical information to help the reader sort out the bewildering array of components currently on offer. An advanced knowledge of the theory of electronics is not needed, and this book is not intended to be a course in electronic theory. The main aim is to explain the differences between components of the same basic type (e.g. carbon, carbon film, metal film, and wire-wound resistors) so that the right component for a given application can be selected. A wide range of components are included, with the emphasis firmly on those components that are used a great deal in projects for the home constructor.
166 pages **Temporarily out of print**

HOW TO USE OSCILLOSCOPES AND OTHER TEST EQUIPMENT
R. A. Penfold
This book explains the basic function of an oscilloscope, gives a detailed explanation of all the standard controls, and provides advice on buying. A separate chapter deals with using an oscilloscope for fault finding on linear and logic circuits, plenty of example waveforms help to illustrate the control functions and the effects of various fault conditions. The function and use of various other pieces of test equipment are also covered, including signal generators, logic probes, logic pulsers, and crystal calibrators.
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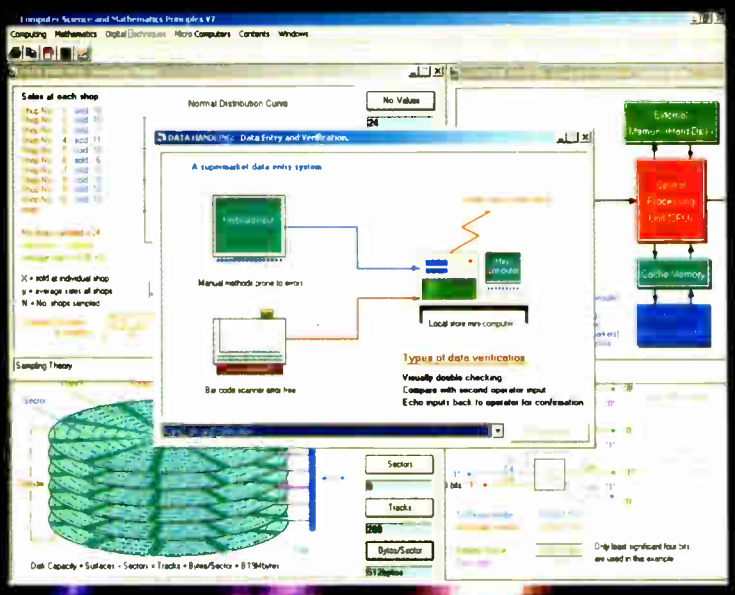

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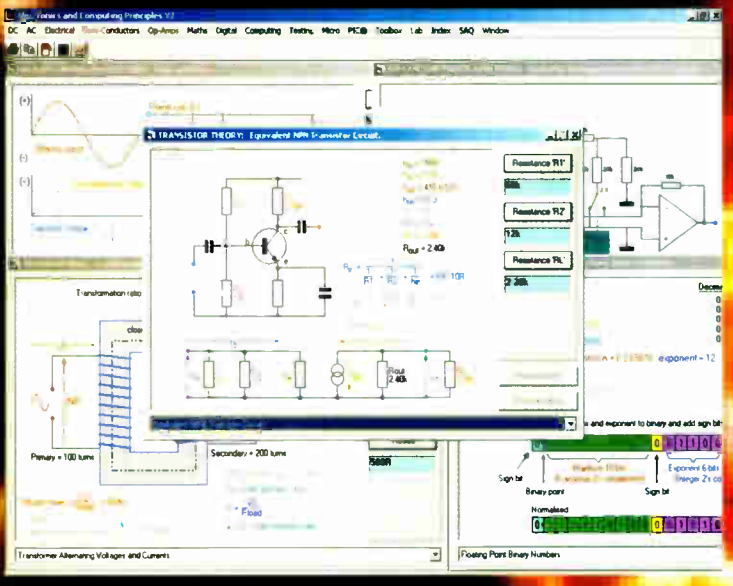

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