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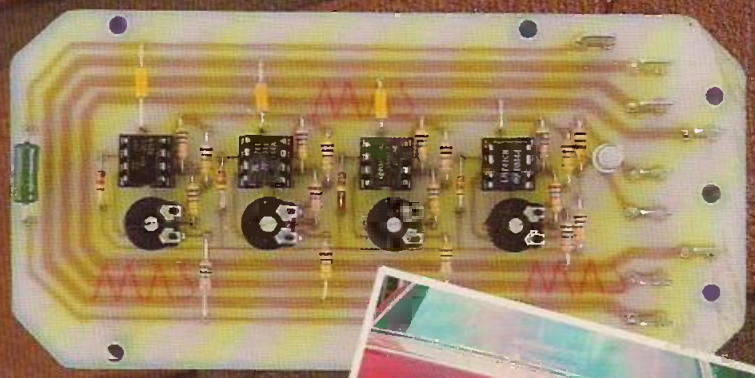

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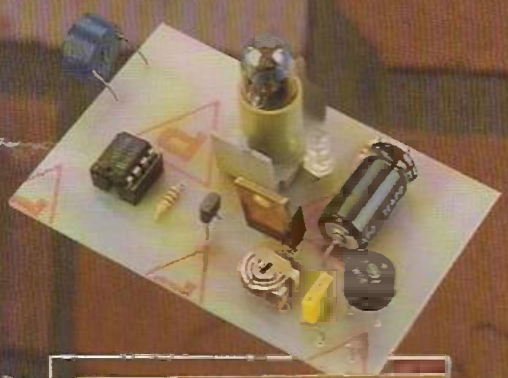
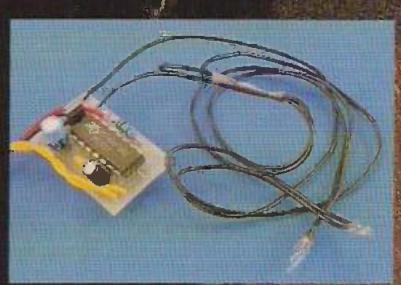
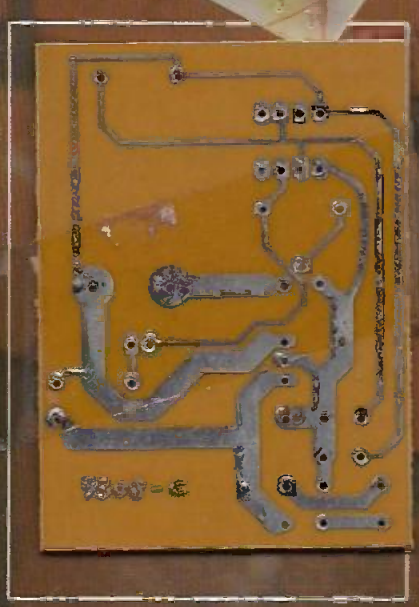




BRAKE LIGHTS FOR RC MODELS



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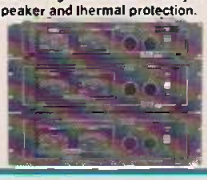

SIZES:- MXF200 W19"xH3½" (2U)xD11"
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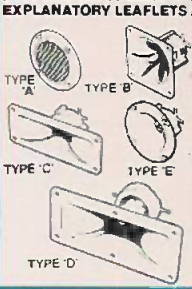

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THOUSANDS OF MODULES PURCHASED BY PROFESSIONAL USERS

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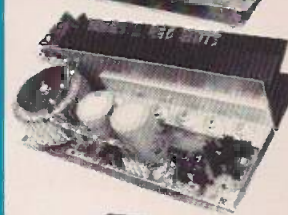
PRICE £40.85 + £3.50 P&P

OMP/MF 200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 50V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 155 x 100mm.
PRICE £64.35 + £4.00 P&P

OMP/MF 300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 60V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 330 x 175 x 100mm.
PRICE £81.75 + £5.00 P&P



OMP/MF 450 Mos-Fet Output power 450 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 385 x 210 x 105mm.
PRICE £132.85 + £5.00 P&P

OMP/MF 1000 Mos-Fet Output power 1000 watts R.M.S. into 2 ohms, 725 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 422 x 300 x 125mm.
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NOTE: MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS: STANDARD - INPUT SENS 500mV, BAND WIDTH 100KHz. PEC (PROFESSIONAL EQUIPMENT COMPATIBLE) - INPUT SENS 775mV, BAND WIDTH 50KHz. ORDER STANDARD OR PEC.

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LARGE SELECTION OF SPECIALIST LOUDSPEAKERS AVAILABLE, INCLUDING CABINET FITTINGS, SPEAKER GRILLES, CROSS-OVERS AND HIGH POWER, HIGH FREQUENCY BULLETS AND HORNS, LARGE (A4) S.A.E. (60p STAMPED) FOR COMPLETE LIST.

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ALL EMINENCE UNITS 8 OHMS IMPEDANCE

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10" 100 WATT R.M.S. ME10-100 GUITAR, VOCAL, KEYBOARD, OISCO, EXCELLENT MID.
RES. FREQ. 71Hz, FREQ. RESP. TO 7KHz, SENS97dB. **PRICE £33.74 + £2.50 P&P**

10" 200 WATT R.M.S. ME10-200 GUITAR, KEYB'D, DISCO, VOCAL. EXCELLENT HIGH POWER MID.
RES. FREQ. 65Hz, FREQ. RESP. TO 3.5KHz, SENS 99dB. **PRICE £43.47 + £2.50 P&P**

12" 100 WATT R.M.S. ME12-100LE GEN. PURPOSE, LEAD GUITAR, DISCO, STAGE MONITOR.
RES.FREQ. 49Hz, FREO. RESP. TO 6KHz, SENS 100dB. **PRICE £35.64 + £3.50 P&P**

12" 100 WATT R.M.S. ME12-100LT (TWIN CONE) WIDE RESPONSE, P.A., VOCAL, STAGE MONITOR. RES. FREQ 42Hz, FREQ. RESP. TO 10KHz, SENS 98dB. **PRICE £36.67 + £3.50 P&P**

12" 200 WATT R.M.S. ME12-200 GEN. PURPOSE, GUITAR, DISCO, VOCAL, EXCELLENT MID.
RES. FREQ. 58Hz, FREQ. RESP. TO 6KHz, SENS 98dB. **PRICE £46.71 + £3.50 P&P**

12" 300 WATT R.M.S ME12-300GP HIGH POWER BASS, LEAD GUITAR, KEYBOARD, DISCO ETC.
RES. FREQ. 47Hz, FREQ. RESP. TO 5KHz, SENS 103dB. **PRICE £70.19 + £3.50 P&P**

15" 200 WATT R.M.S. ME15-200 GEN. PURPOSE BASS, INCLUDING BASS GUITAR.
RES. FREQ. 46Hz, FREQ. RESP. TO 5KHz, SENS 99dB. **PRICE £50.72 + £4.00 P&P**

15" 300 WATT R.M.S. ME15-300 HIGH POWER BASS, INCLUDING BASS GUITAR.
RES. FREQ. 39Hz, FREQ. RESP. TO 3KHz, SENS 103dB. **PRICE £73.34 + £4.00 P&P**

EARBENDERS:- HI-FI, STUDIO, IN-CAR, ETC

ALL EARBENDER UNITS 8 OHMS (Except EB8-50 & EB10-50 which are dual impedance tapped @ 4 & 8 ohm)

BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED SURROUND

8" 50watt EB8-50 DUAL IMPEDENCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR.
RES. FREQ. 40Hz, FREQ. RESP. TO 7KHz SENS 97dB. **PRICE £8.90 + £2.00 P&P**

10" 50WATT EB10-50 DUAL IMPEDENCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR.
RES. FREQ. 40Hz, FREQ. RESP. TO 5KHz, SENS. 99dB. **PRICE £13.65 + £2.50 P&P**

10" 100WATT EB10-100 BASS, HI-FI, STUDIO.
RES. FREQ. 35Hz, FREQ. RESP. TO 3KHz, SENS 96dB. **PRICE £30.39 + £3.50 P&P**

12" 100WATT EB12-100 BASS, STUDIO. HI-FI, EXCELLENT DISCO.
RES. FREQ. 26Hz, FREQ. RESP. TO 3 KHz, SENS 93dB. **PRICE £42.12 + £3.50 P&P**

FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND

5¼" 60WATT EB5-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC.
RES. FREQ. 63Hz, FREQ. RESP. TO 20KHz, SENS 92dB. **PRICE £9.99 + £1.50 P&P**

6½" 60WATT EB6-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC.
RES. FREQ. 38Hz, FREQ. RESP. TO 20KHz, SENS 94dB. **PRICE £10.99 + 1.50 P&P**

8" 60WATT EB8-60TC (TWIN CONE) HI-FI, MILTI-ARRAY DISCO ETC.
RES. FREQ. 40Hz, FREQ. RESP. TO 18KHz, SENS 89dB. **PRICE £12.99 + £1.50 P&P**

10" 60WATT EB10-60TC (TWIN CONE) HI-FI, MULTI ARRAY DISCO ETC.
RES. FREQ. 35Hz, FREQ. RESP. TO 12KHz, SENS 98dB. **PRICE £16.49 + £2.00 P&P**

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PRICE £8.80 + £1.00 P&P

PHOTO: 3W FM TRANSMITTER

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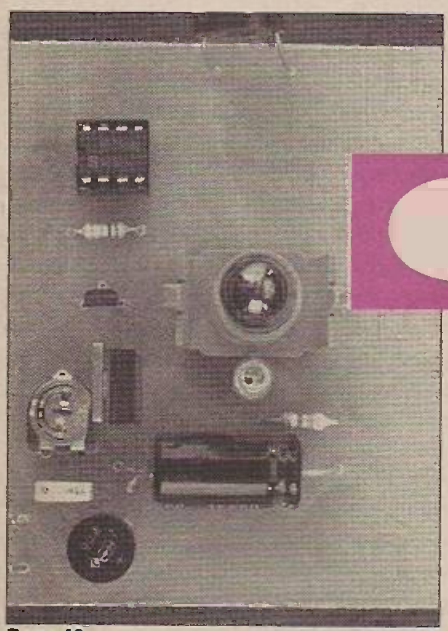

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Features & Projects

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Regulars

Editorial

by Paul Freeman

With joint venture co-operation from the multinationals breaking out all over the place these days, it seems that complete market domination is their aim.

IBM and BT have been collaborating on a project to make the videophone a standard appliance by the end of the century, IBM providing the software and BT the communication technology.

As most people now have Windows on their computer screens and a separate telephone, the videophone will just become another integrated part of the system. Using digital ISDN lines, costing no more than an ordinary phone call a good colour image appears on screen. Improving the moving image is just a case of using two lines instead of one. Multiway link-ups or video conferencing should also become common place. The two giants see this situation as an inevitability, as they already have companies beating on their doors for the technology. The reasons are clear - cutting down travel time and saving costs would appeal to any company.

The technology is here and the videophone described will be available from around October. Whether there will be intense advertising pressure to make the consumer believe they cannot do without one, or whether computer buffs will want the latest gadget irrespective, remains to be seen.

OPEN CHANNEL

Any doubts anyone has ever had about the long-term viability and popularity of satellite television must surely be quashed with British Telecom's recent move into the telecommunications consumer sales arena. By the end of the year, BT will be selling satellite receivers and dishes (Astra-based, of course) from its 90 shops around the country.

Astra's operator, the Societe Européene des Satellites, is not in the least surprised. Other household names are expected to follow BT's lead over the next year or so, as sales in general ramp up and more people take advantage of the wide range of high quality programmes now on offer from the Astra series of satellites.

There are now two Astra satellites in service, while a third - Astra 1C - was successfully launched aboard Arianespace flight number 56 during the early hours of May 12 this year. Indeed, as you read this, Astra 1C will be in the engineering process of being made operational, and several transmissions may already have started from it. Three satellites co-located at the Astra position of 19.2' east of south means that some 50 television channels (16 on each of Astras 1A and 1B, and 18 from Astra 1C) are now possible, along with hundreds of radio channels, and all can now be received from just one dish pointed at the satellites' single position.

BT has simply seen the writing on the wall, of course - or probably more to the point, the dishes on the walls - with this move to act as a retail outlet, but it does signal a general change in attitude towards satellite television reception. Just a few years ago, the only satellite dishes around were large multi-satellite affairs in the occasional enthusiast's gardens. While these are still around (and indeed, have become more popular due to Astra's involvements) the norm is now to see dishes on house walls pointed towards Astra. In these few short years, satellite television has changed from being a novelty and an amusement to neighbours, into being almost the norm.

By retailing receivers and dishes, BT has simply underlined the general and growing acceptance of satellite television reception and, thus, can only be good for the already flourishing market. In a few year's time, it may be to the amusement of neighbours if a house doesn't have a satellite dish on its wall.

Virtually reality

It's not often that a new product or service comes along which I think could be a winner. Five years ago, the birth of reasonable satellite television suggested one such service. And now look at it.

The latest development to look promising in my eyes is a service called virtual private networking (OK, if you have to have an acronym - VPN). Actually, the service has been around in one form or another since 1984, but it's only recently that world-wide moves have been made to make it of interest outside of pure data communications fields among restricted groups in the United States. Things are changing, as more users see its potential.

A virtual private network is a method of allowing data communications between distributed sites, such that each data user on the network appears - via a computer - to be directly connected to the other users, despite the distance between them. So, it works in much the same way as local area networks, such as LocalTalk or Ethernet, around a single office, in that data can be freely routed between users and users can communicate equally freely. It's just that distances of many thousands of miles might be involved, rather than the few metres within an office.

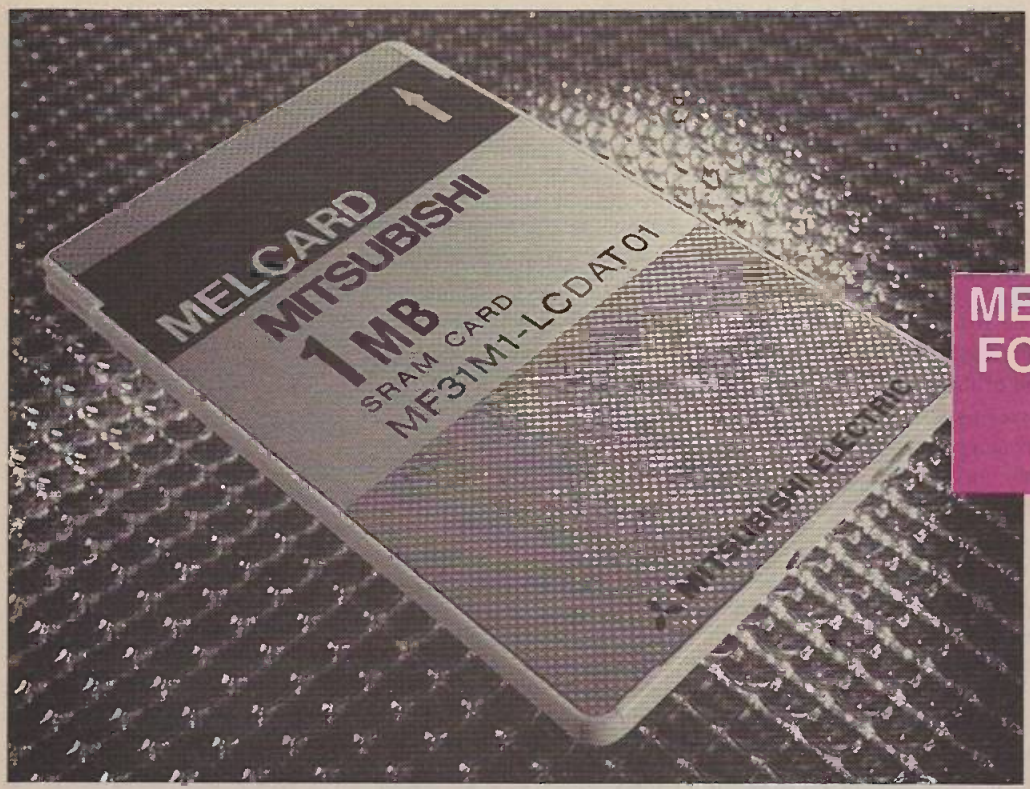
There's nothing new in principle here - after all, a few modems can be interlinked over standard 'phone lines to give a similar, if not the same effect. The trick is to do it all so that each user appears to be directly connected to the others, as if a private long distance network of cables between sites had been set-up.

The advantage to users, over a true private network, is in cost - private networks are very expensive. Merely using the 'phone network to interconnect users as and when required is cheaper and, potentially, much cheaper. Private networks are expensive to install (lots of cables) and run, while telephone lines are already there and are already being run. Private networks require expensive hardware, which inevitably has to be paid for directly by the users, while virtual private networks only require additional software in the switching exchanges which set-up the required links over the existing 'phone network. Effectively, this software simply has to set-up a predefined linkage, in a very similar way to that in which standard 'phone calls are set-up.

To date, the only obstacle in the way of decent and world-wide virtual private networks has been the disparity between telephone network operators. The services which one operator, in one part of the world, provides may be somewhat - if not totally - different to the services provided by another elsewhere. So, what looks to be a good thing, has been held back by lack of standardisation.

Fortunately, things appear to be changing. Telephone operators around the world (some 25 so far) have joined forces to define standard features which should be offered and to fix a seamless method of integrating world-wide services. This is just the start. Once virtual private networks become more common (which they will - simply because of this standardisation and cost benefit) price cuts are inevitable. It's foreseeable that the long-awaited and much-vaunted revolution in teleworking (i.e., working at home, instead of in an office and simply linking to the office computer by 'phone line) will be able to finally happen. Virtual private networks will allow this easily and, what's more, at an ever decreasing cost.

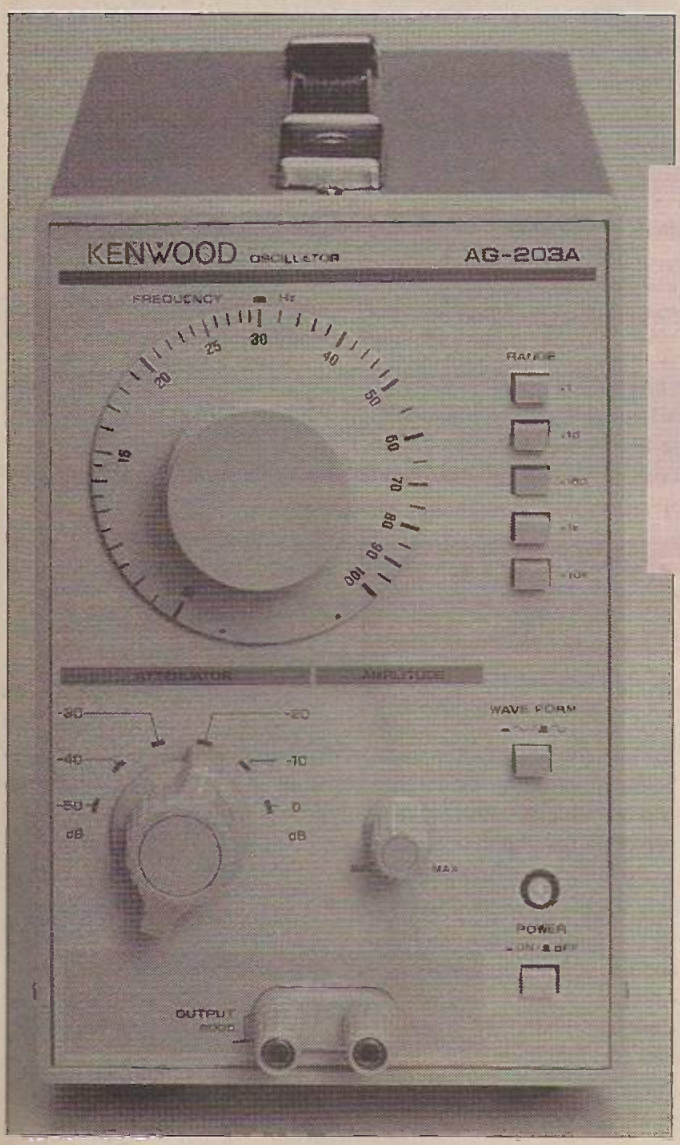
Keith Brindley



MEMORY CARDS FOR PERSONAL DIGITAL ASSISTANT

Mitsubishi has announced the release of its JEIDA and PCMCIA Standard SRAM memory cards, the first to be approved by Amstrad for use with the computer company's new personal digital assistant. The memory cards are used by the computer to provide additional memory for storing text, names, addresses and notes, and 128k, 256k, 512k, 1M, and 2M versions are now available from Amstrad Spares & Service Division at Brentwood. A 4Mb SRAM card is also available from Mitsubishi.

The SRAM memory cards come in JEIDA and PCMCIA 68 pin format. A double battery backed SRAM version to JEIDA Standards can also be supplied.



LOW DISTORTION SIG GEN

Trio-Kenwood has introduced the AG 203a audio oscillator, which produces low distortion sine and square waveforms with the frequency range of 10Hz to 1MHz.

The sine wave signal is typically better than 0.1% distortion with an output flatness of +0.5dB. The square wave signal has a maximum rise time of 200ns with a duty cycle of 45-55 at 1kHz.

Frequency is selected by a series of range switches with fine adjustment by a rotary vernier control. An output attenuator provides up to -50dB reduction from a maximum output level of 7V RMS. The output impedance is 600R.

The AG 203a is priced at £155.00 + VAT.

60 YEARS OF INNOVATION

Dr William Percival, a prolific inventor with over 120 patents to his name, is this year celebrating sixty years furthering British science and technology in the field of electronics. At 89 years old, he is still heavily involved in technological innovation as a consultant and adviser at Central Research Laboratories Ltd (CRL) - formerly the research development centre of THORN EMI plc - where he has been employed as a scientist since 1933.

Dr. Percival's route into electronics began during the early days of radio with research in crystal detection and technical journalism for Wireless Weekly, Wireless Construction and Modern Wireless. On joining EMI's research laboratories, Dr Percival became a member of the celebrated 'Blumlein' research team, working alongside one of the most influential scientists of this century, A. D. Blumlein, on the first public TV broadcast system at Alexandra Palace in 1936.

Following the success of the first broadcasts, television circuitry became very popular. The 'hook' phenomenon which caused a television picture to drop away

was solved by Dr Percival using frame pulses as line pulses.

During World War II, Dr Percival worked on the world's first RADAR systems and developed particular expertise in aerials for 3cm and 10cm RADAR. Percival explains RADAR's origins: "We noticed that every time a plane flew overhead, the picture quality on the television was affected. We deduced that if we analysed the variation in picture quality, we would detect the presence of a plane. Distance and direction could then be gauged measuring the time it took for the signal to travel from a plane to receptors and by using directional equipment such as rotating aerials."

Another past project was the creation of high power transmitters for TV via distributed amplifier and transversal (Kalman) filters. These were used in early transmitters to broaden bandwidth and allow more information. Dr Percival also completed mathematical analysis to assess the imaging techniques incorporated into the original X-ray scanner, for which CRL's Sir Godfrey Hounsfield won the Nobel prize in 1979.

Some of Dr Percival's most recent achievements have focused on audio broadcast technologies including ICE, the first system to inaudibly embed security data into music. ICE enables the identity of broadcast music to be monitored off-air automatically and is set to become the industry standard for music identification.

DESOLDERING STATION

With the ever increasing complexities in the Electronics industry, one of the growing problems is removing devices with a large number of pins. The days of removing these devices with a hand desolder pump are getting further and further away. Boards with line tracks are easily damaged with excess heat from the soldering iron or by slipping with the hand desolder pump.

With the cost of integrated circuits rising, it is important to remove components so that no damage is done, either to it or the printed circuit board and it was with this in mind that the RA100 Desoldering Station was designed by AK Electronics of Edgware. It was intended to produce a low cost unit, with low maintenance and inexpensive spares, but still with a good vacuum. The vane pump used for this operation develops 15in of mercury vacuum and should cleanly remove solder from plated through boards. The wiring loom was specifically designed with push on crimp connectors to enable the user to carry out repairs on site, without the need to return the unit for repair.

The RA100 was designed around the Weller DS3102 magnastat iron, which was perceived to offer a good all round performance and replacement parts at modest cost. The desolder bits are easily removed and do not bond themselves to the iron. Three bits, DS 112: DS 113 and DS 114, are all that is required to cope with most desolder operations but there is also a range of surface mount desoldering attachments available. For further info contact

Keith Lawrence
on 0425 274274
Distributed by:
JJ Components
Tel: 081 952 4641

PORTABLE POWER

SAJE Electronics of Cambridge has announced the launch of a portable power supply suitable for many applications including boating, yachting, caravanning and camping, as well as for use by motorists and in DIY.

Compact in size for its power, it is designed for multi use. An inbuilt fluorescent light provides up to 5 hours of continuous lighting on a full charge, while a separate flash light is used as a red flashing warning light. It has separate DC outputs at 6 and 12V to supply external electric tools, portable appliances, televisions and toys and also includes jump start cables to assist in starting engines.

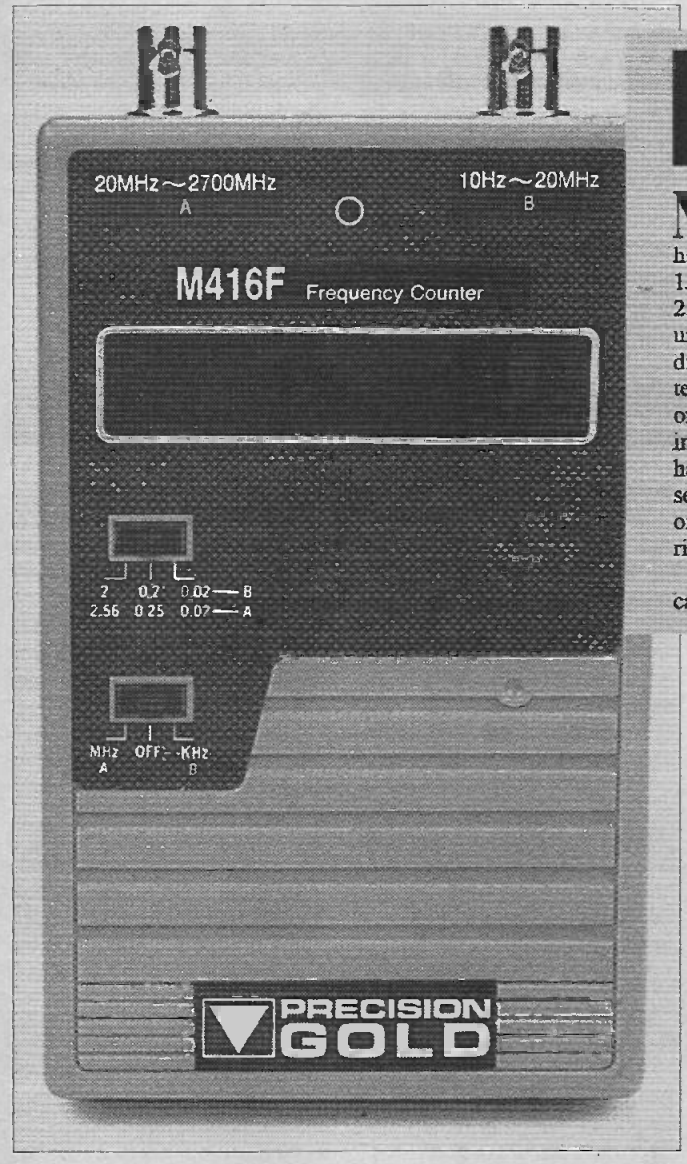
Called the Power Tank, the unit can be charged from either a 12V car cigarette lighter socket which takes approximately 4 hours to fully charge whilst driving, or from a 240V mains supply. There is an internal circuit breaker to protect the instrument from overload conditions and a battery level meter is fitted to monitor battery condition.

The Power Tank is supplied complete with cables, a protective carry case and mains adapter, for the price of £76.50 plus VAT.

For further information please contact:-

SAJE Electronics, Tel; (0223) 425440

DIGITAL FREQUENCY COUNTER

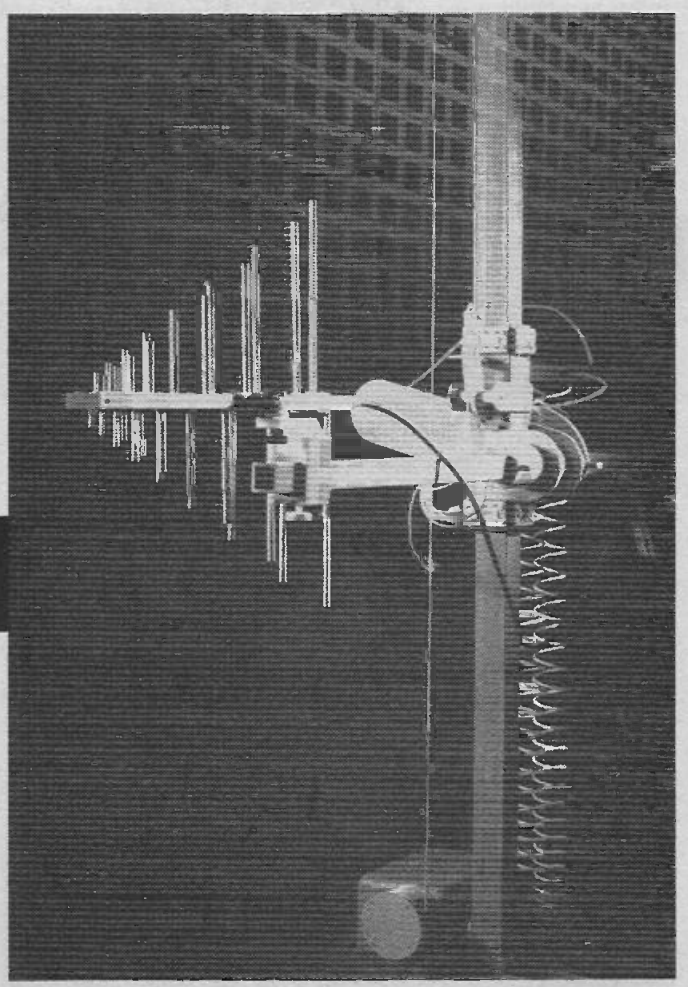


New from Maplin Electronics is a pair of compact, hand-held frequency counters, the 1.2GHz Counter M415F and the 2.7GHz Counter M416F. Each unit features an eight digit LED display and is powered from internal batteries. The counters have only two switches and two BNC input sockets. The lower switch has a centre off position and can select either input, while the second switch selects the gate period.

These high sensitivity meters can be powered from an external 12V DC supply (not supplied) which will also recharge the internal batteries. Normal recharge time is 5 hours and the meters can operate for 4 hours with a full charge. Overcharge protection is included.

The meters are intended for use by any hobbyist, radio amateur, engineer or student who needs an accurate and versatile means of frequency measurement. The 1.2GHz Counter sells for £129.95 (to incl. VAT) and the 2.7GHz version £169.95.

BNR OPENS EMC TEST CENTRE



BNR Europe has opened Europe's first Electromagnetic Compatibility (EMC) Test Centre to use ferrite grid absorber tiles. The Centre, built at a cost of over $1 million (£647,000) at the company's Harlow laboratory, incorporates a semi-anechoic chamber lined with more than 23,000 of the novel ceramic tiles.

The centre will enable the company to test and evaluate telecommunications products to ensure full compliance with the EMC Directive 89/336/EEC.

The Directive stipulates strict product regulations for the emission of, and susceptibility to, electromagnetic energy with the aim of curtailing the growing risk of interference between electronic and electrical equipment.

The new Centre is to be promoted as the cornerstone of a comprehensive EMC test and consultancy service to other UK manufacturers and distributors of Information Technology and telecommunications equipment.

The ferrite tile technology has been proven in extensive commissioning trials and provides high quality, consistent results with the bonus of a virtually maintenance free life compared to conventional organic linings. The small 19mm depth of each tile has also enabled the company to build an anechoic chamber one quarter the volume of that needed if traditional materials had been used.

The tiles absorb incident electromagnetic energy over the frequency range 30MHz to 1GHz and provide a return loss of approximately 18dB at 30MHz, increasing to 40dB at 200MHz and decreasing thereafter to 17dB at 1GHz.

To achieve a negligible reflection, the characteristic impedance of the tiles matches that of free space, as close as practically possible across the frequency range of interest. The metal plate upon which the tiles are mounted helps to ensure this match by modifying the input impedance, a function of the tile's permeability, permitivity, shape and dimensions, to provide a good match at the ferrite/air interface.

The tiles can best be looked upon as a ferrite dielectric transmission line with a short circuit load provided by the plate.

PIN HIGH PHOTODIODE

Telecom Devices has introduced a new Planar PIN Photodiode with a photosensitive area 10mm in diamcter.

Designed to work at Telecommunications and Datacommunications wavelengths of 1300-1550nm, the actual Spectral range is 850-1650nm. The device is now available in the TO3 stylc package, although other package styles can be supplied.

Characteristics of the 35PD10M include, responsivity of 0.85 A/W at 1300nm, low Dark Current of 20µA, Rise Time of 1µs into 50R, and a Dynamic Impedance of 200k.

Although initially available with a circular photosensitive region, other geometric designs will be available later, consistent with alternative packaging options.

Applications for this large area PIN Photodiode will include high sensitivity Test and Measuring Equipment in the 1000-1550nm field, as well as Receiver and Sensor work with Telecommunications and Datacommunications.

For further details contact:
Access Pacific Ltd
Tel: 0234 376695

REDUCTION IN PIRACY PROBLEM

Statistics revealed recently have shown that the level of software piracy has declined in most European markets, although the problem continues to inflict heavy losses, estimated at US$4.6 billion in 1992, upon the European software publishing and distribution industries. After a continual rise, the piracy fell in Europe from approximatly 77% in 1991 to a level of 66% in 1992.

"We have finally seen the tide turn against software piracy in Europe, but we have a long way to go before we can declare victory," said Brad Smith, BSA European Legal Counsel. "The Business Software Alliance's goal is to decrease the supply and demand of pirated software and expand the size of the legitimate software market, and we are steadily advancing toward this goal. However, we will not stop until pirated software is reduced to a zero market share in Europe, and around the world."

According to the BSA's estimates, the reduction in software piracy in 1992 added approximate US$700 million in revenue to the European software publishing and distribution industries.

"The reduction in software piracy created more than 8,000 new jobs in the European software industry last year, including new positions in publishing, distribution, and training companies," said Smith.

The reduction in software piracy is attributed to several factors, including the completion of the European Community Software Directive, which has strengthened copyright laws throughout the member states; creative marketing campaigns conducted by local software associations in individual countries that have increased awareness for the benefits of original software; and an increased pace of legal actions to enforce copyright laws against infringers.

"Last year, the BSA filed more than 100 legal actions in 10 countries in Europe, and coupled with strong informational campaigns about recommended software management practices, we believe the market is finally getting the message that it does not pay to engage in illegal copying," said Smith.

In 1992, software publishers and resellers incurred the highest losses in France, US$1.257 billion, and faced the greatest degree of pirated software in Italy and Spain, where illegal software held 86% of the market in both countries.

THE PC VIDEOPHONE PREVIEWED

BT and IBM UK have previewed the PC videophone. It is thought the low cost face-to-face communications product could transform the way business operates in the future.

The PC Videophone combines telephone and computer to give users the chance to see and share information with the person they are talking to without leaving their desk. In a joint venture, IBM has produced the software with BT technology providing the latest dimension in communications.

Nick Temple, Chief Executive IBM UK, said that the new product would revolutionise business life. "It's the most exciting development in this area of communications for some time and there is massive potential for it to become an office standard."

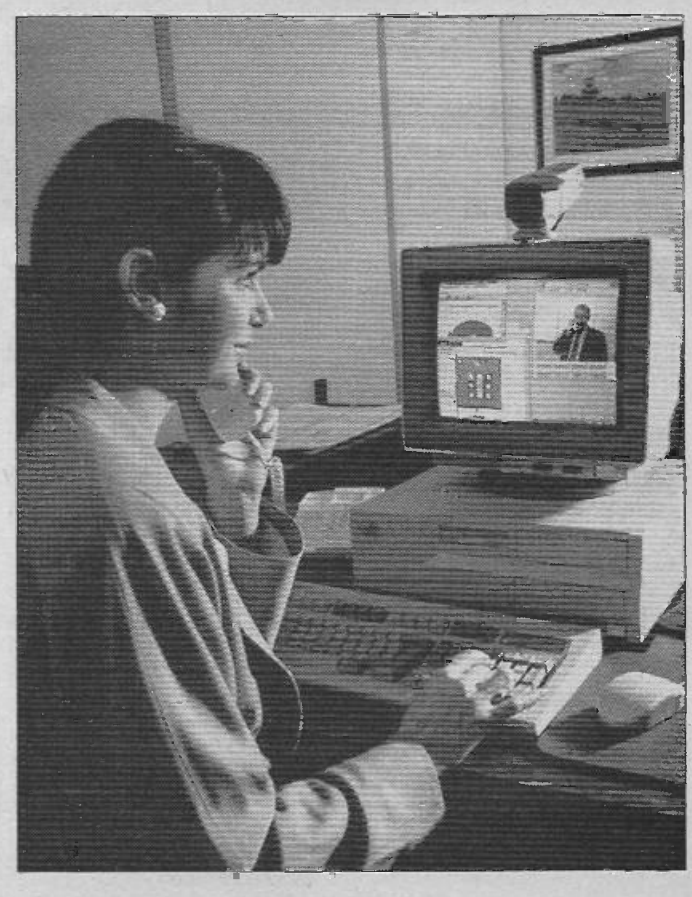
The PC Videophone conforms to the CCITT international standard H.320, which not only allows the product to interwork with videoconferencing systems and videophones but also protects the business investment when purchasing the PC Videophone.

"The main benefits to users will not only be faster decision making, speedier and more efficient use of scarce human skills, cost and time savings from reduced travel, but also the added applications including: access to remote expertise; project management support and staff training," said Chris Frost, IBM UK's PC Videophone Project Manager.

The software uses a graphical interface to provide a video picture in one window, enabling users to work simultaneously in other windows sharing the data they wish to discuss.

As the voice, video, and data operates using BT's ISDN service, the user can also take advantage of the competitive ISDN call charge both in the UK and overseas. At present 90 per cent of UK businesses have access to the ISDN service via over 4,000 modern telephone exchanges.

The PC Videophone kit, comprising software, multimedia communications card, solid state camera and a telephone handset, will be available by the fourth quarter of this year, at a price of approximately £3,000 - £3,500.



ETI NEWS ...Stateside...

Start All Over Again

Both Motorola Inc.'s Cambridge Research Centre and the Computation Structures Group at Massachusetts Institute of Technology are relying on a special custom version of the 88110 RISC processor for the new Start project. This is the successor to the Monsoon parallel data flow computer project.

In presentations at the recent IEEE CompCon conference in San Francisco, Motorola revealed that the processor used for the system, the 88110MP, adds more hardware and new instructions to the basic instruction set in order to handle the special message-passing needs of the Start architecture.

Originally, developers hoped that Start would be scaleable to 1,000 processors, but by putting the 88110MP on special multi-chip modules and assembling the MCMs in special 3-D bricks, the 512-processor system currently in design can be scaled up to 4,096 processors. The 88110MP was optimised for Start and Motorola does not plan to commercialise the processor.

The Start architecture allows for greater use of parallel processing when the computer is engaged in long-latency memory transactions, through the use of special split-phase transactions. These transactions require such a high level of interprocessor message-passing that the original 88110 had to be augmented with new register sets and a special message and synchronisation unit (MSU).

The addition of the MSU required the expansion of the 88110 instruction set to cover 25 new instructions specifically for the MSU. Some of these are used for message-passing, while others carry out a form of multi-threaded compilation that Motorola calls 'micro-threading.' The creation of micro-threads for handling processes between CPUs allows the Start system to carry out its split-phase transactions.

The 88110MP processors are linked in a topology known as a 'fat tree,' used in such architectures such as Thinking Machines Corp.'s CM-5. In a fat tree, the CPUs are seen as 'leaves' of the tree network and each move up the branch represents a move up in the networking hierarchy. Four of the 88110s are connected locally through one router chip, four clusters of four (or 16 CPUs) are controlled through the next layer, etc..

While the operating system uses many Unix-like commands, the lack of a central clock means that the model of parallelising tasks is special. The manager process assigns several child processes called 'players,' with players distributed one per processor for all processors assigned to a parallel task.

The manager process cannot have direct access to the MSU block in the 88110MP, in order to communicate with players; instead, it uses standard Unix inter process communication methods.

Currently, Motorola is scheduled to deliver 32-processor and 512-processor versions of the Start system to MIT in 1994. The first will be a departmental supercomputer platform with performance in the 3-Gflops region, while the 512-processor system will aim for performance of roughly 50 Gflops.

Terminator, Too

A new type of terminal block has been designed for PCBs. It uses a patented contact and actuation design to make connections to a wide range of wire sizes. A turn of a small actuator bar enables a wire to be removed and a new wire inserted and connected.

In making a termination, an operator places a wire against the stop in the applicator opening and depresses the built-in lever. This forces the wire against the 'zero gap' metal body, displacing the wire insulation for an electrical contact. When used with stranded wire, there is no damage to individual strands and opening the lever moves the wire from the terminal contact.

Produced by Pheonix Contact, Harrisburg, Pennsylvania.

Electric Vehicles On The Move

To support the development of fast-charging hardware that is expected to improve the effective range of electric vehicles, the US Federal Transit Administration has awarded the Advanced Lead-Acid Battery Consortium $1.2 million in matching funds.

The ALABC fast-charging research programme aims to develop battery-charging hardware that can return roughly 50% of a full charge in 5 minutes, 80% in 15 minutes and full charge in 4 hours. Contemporary electric vehicles have a range of roughly 80 miles, depending on conditions, with a fully charged set of lead-acid batteries.

Traditionally, the prospect of recharging EVs has been considered an overnight proposition, dovetailing with the extra capacity of electric utilities during off-peak hours.

"Opportunity charging allows the consumer to benefit from the cost advantage of lead-acid batteries and still enjoy reasonable range from an electric vehicle," said Robert F. Nelson, ILZRO's manager of chemistry and electrochemistry. "Though other battery designs may offer greater range in theory, material costs alone can be as much as 10 times higher than lead-acid," he pointed out.

In another move, the US Council for Automotive Research (USCAR) has announced that its members, Chrysler, Ford and General Motors, have signed an agreement to investigate cooperation in the design, development, testing, and possible manufacturing of electric vehicle components. The group will explore opportunities for common designs and specifications of electric vehicle systems and subsystems that would ultimately be used in each company's own vehicle.

USCAR, an umbrella organisation formed to recommend, monitor and develop cooperative non-competitive research among the Big Three, now has nine consortia under way. The new electric vehicle group is being established to find the most effective way to hasten electric vehicle development, in order to help meet the US national and industry goal of providing clean, efficient, domestically fuelled, personal transportation.

More Stateside News Next Month

READ/WRITE ETI Letters

Mains Inverter Comments

With regard to the mains inverter in the December issue, the use of two 4mm connectors was suggested for high current low voltage. Although not the cheapest, the use of three pin XLR plug and chassis socket made a much neater job.

I built the unit so I could demonstrate small portable TVs at car boot sales. Battery leads are expensive and difficult to obtain. It does this job satisfactorally, but will not do larger colour TVs-typically 150watts. I have noticed that when I tried it with two mains radios one valve and one transistor, an intolorable buzzing occurs. The valves light up OK but the AC only set had to have the earth lead connected to lose it. What is happening here? Are there modifications that can be done to the inverter to overcome this effect?

You said in connection with the mains tester checker that 90V HT batteries for portable valve radios were expensive. Apart from a source called The Vintage Wireless Co.,I didn't know that they were obtainable at all!

I had heard of a unit which generates the rail from a PP3 battery but costs £50. May be your checker project could be adapted for this.

Mark Daniels replies:

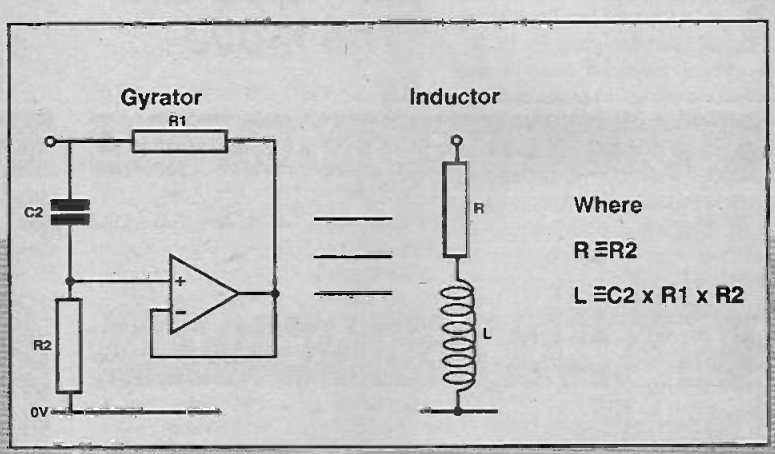
I will take the points in the order in which they are raised in your letter.

The connectors suggested for the 120 Watt version of this inverter were recommended as cheap and readily available. I agree with your suggestion that the use of XLR connectors in this application is probably a better alternative. However, I would suggest the use of the 'reversed' version of this connector (ie. panel mounted plug, lead mounted socket) in Maplin's low cost range, plug KC54J, socket KC57M.

I find it rather surprising that a 120 Watt inverter will not run larger colour televisions, I have run 26" models from this size inverter on several occasions. It may be that the televisions in question are older models with a 'dropper' type supply requiring more power than a modern set using a mains transformer or switched mode supply.

A 225 Watt version of this design is available as a component kit (excluding PCB) from JPG Electronics, Chatsworth Road, Chesterfield, Tel: 0246 211202. The transformer and suitable power transistors (type MJ11016) are also available separately from this source. A 225 Watt toroidal transformer has been produced specifically for use in this design and will perform better than a standard mains transformer used in 'reverse' as suggested in the article.

Low frequency interference (buzzing) has always been a problem with radios of the type mentioned and to a lesser extent with televisions. It is usually possible to cure it by effective earthing as you mention in your letter. A copper grounding rod driven 1.5 to 2 metres into damp ground and connected to the earthed side (neutral) of the transformer secondary may be helpful in more obstinate cases. Where mains electricity is installed the earth connection may conveniently be made to the normal mains earth Ü



5-Band Graphic EQ Maths

Regarding the 5-Band Equalizer featured in June 93 ETI, I am interested in using this circuit as the basis for a 3-Band sweepable EQ, which are quite expensive commercially. Could you print the mathematical formulae for determining centre frequency and the Q of the gyrator circuit, as I cannot find this in any published texts.

Constructors may like to include a small (39p) capacitor across R7 in the circuit, to ensure stability of IC2. For a future project, how about a complete +/-15V regulator using the LM317/337 regulators and 15VA toriodal on one PCB.

F Stewart, London.

Andrew Armstrong replies:

If you wish to sweep the frequency of the stages in the graphic equaliser, you can do so to a limited extent by varying R1. However, the practical range is not very great because R1 must remain considerably greater than R2, and in any case varying it will affect the Q to some extent.

The gyrator circuit used in the 5-band graphic equaliser project replaces an inductor. The inductance can be calculated by writing the equation describing the behaviour of the circuit, and equating this to the standard equation describing an inductor and a series resistor. This permits calculation of the equivalent inductance in terms of the resistors and capacitors in the circuit.

The article did originally include the formulae and a brief outline of their derivation, showing the approximate equivalence between the action of the gyrator and an inductor, but they were judged unlikely to interest constructors.

The answer comparing the gyrator with an inductor and a series resistor, is shown in the diagram.

The centre frequency of the circuit is then calculated using the standard formula:

$$f = \frac{1}{2\pi\sqrt{LC}}$$

where C is the external capacitor

and Q is calculated using:

$$Q = \frac{2\pi fL}{R} = \frac{2\pi L}{R} \times \frac{1}{2\pi\sqrt{LC}} = \frac{\sqrt{L}}{R\sqrt{C}}$$

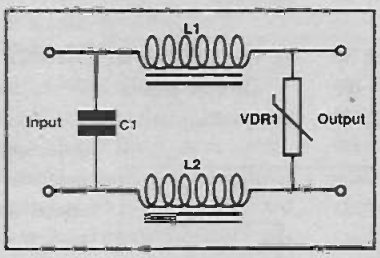
This allows calculation of Q and centre frequency of the active tuned circuit. Such a circuit has the advantages that it can use inductance values which are not obtainable as standard components, and that it does not add the inevitable slight distorion caused by magnetic non-linearity. However, sometimes inductors themselves are better choice for a particular application eg for low power consumption.

via the earth pin of a three pin plug.

A squarewave consists of a fundamental sinewave and all the odd harmonics in the appropriate ratios theoretically up to infinity. A sinewave, by comparison, consists only of the fundamental wave and is normally the only source of a.c. which needs to be filtered out by mains equipment, which will normally have been designed to do just this. The output of the inverter is, of course, a squarewave which will introduce frequencies into the equipment which may not be effectively removed by any filters built into the appliance, so additional filtering of the supply will become necessary.

A low pass filter connected between the output of the inverter and the affected appliance will remove some of the harmonics from the square wave output of the inverter, producing a more ideal waveform for sensitive appliances. Maplin list a ready built unit which may be suitable, catalogue no. KR96E.

For those who wish to build their own I present a simple filter circuit in the figure below which I have used successfully on many occasions. The design may appear 'back to front', but it should be realised that the transformer secondary will provide the necessary inductance for the first stage of this filter. Suitable values for the components are 4 to 10H, 1A rating for L1 and L2, 100n-to 470n 250V AC, for C1 - this component MUST be a class X mains rated device, VDR1 is a 275 volt metal oxide varistor, 275LA15 or similar. A certain amount of experimentation may be necessary to obtain best results.



I must admit that I cannot recall having seen 90V HT batteries on sale in the shops for a number of years now. Wilkinson's definitely used to stock them some time back, but I am not sure whether they still do.

Suggested projects

A modular form of the following FX: Digital Echo and reverb, vibrato, phasing, flanging, chorus and ADT.

Next an instrument that has a few titles. It is known as a harmony generator, a pitch shifter or a pitch transpozer.

Wayne Human
Southdale
South Africa

Wayback in the heyday of analogue electronic music synthesis, vibrato, echo phasing and chorus to name but a few, ETI published circuits galore. Digital circuits have not been so frequent, owing to their complexity and I agree its high time we saw renewed amatuer interest in creating these in the digital age instead of leaving it to the Japanese. Ed

I have not come across the portable h.t. unit which you mention, but I assume it is similar to the unit which replaces the difficult to obtain 15 volt battery in Avo 8 multimeters. This unit is listed by RS Components, catalogue no. 611-048 and has a similar price tag.

I am uncertain how much HT current valve radios require, but the Proving Unit can only output a very small current (a few milliamps at most). This may well be sufficient, but you will need to experiment and see. You may also find that this circuit will cause more interference than the battery to mains inverter, due its much higher switching frequency.

The number of turns on the secondary of the HF transformer in the Proving Unit will need reducing. A simple half-wave rectifier, smoothing capacitor and possibly zener regulator will have to be added to the secondary to produce DC for the valves.

Please send your letters to:
The Editor
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BLUEPRINT

The Blueprint column is intended to suggest answers to readers' electronics design problems. Designs are only carried out for items to be published, and will not be prototyped by the columnist. Circuits published in Blueprint are believed to work, but may need minor alteration by the reader after prototype. Individual correspondence will not be entered into, save as necessary to prepare items for publication.

Kilyobas N. Binga of Hold Trade Air Services Ltd. sent a fax to the ETI offices, to ask about a triac drive circuit. His fax shows the section of circuit illustrated in Figure 1.

He found that, when power was switched on, although switching signals were reaching the MOC3020, the 12W lamp remained on all the time. He then tried disconnecting the gate connection to the triac, which caused the lamp to flash and eventually, after 15 minutes, to remain on.

The project is to build a large clock display, which can be read for 100 metres away. He requested procedures for calculating component values to be used with the MOC3020 and the TIC226M, so that he could make the unit work. Would I be right in guessing that the project is required for use in an airport, perhaps?

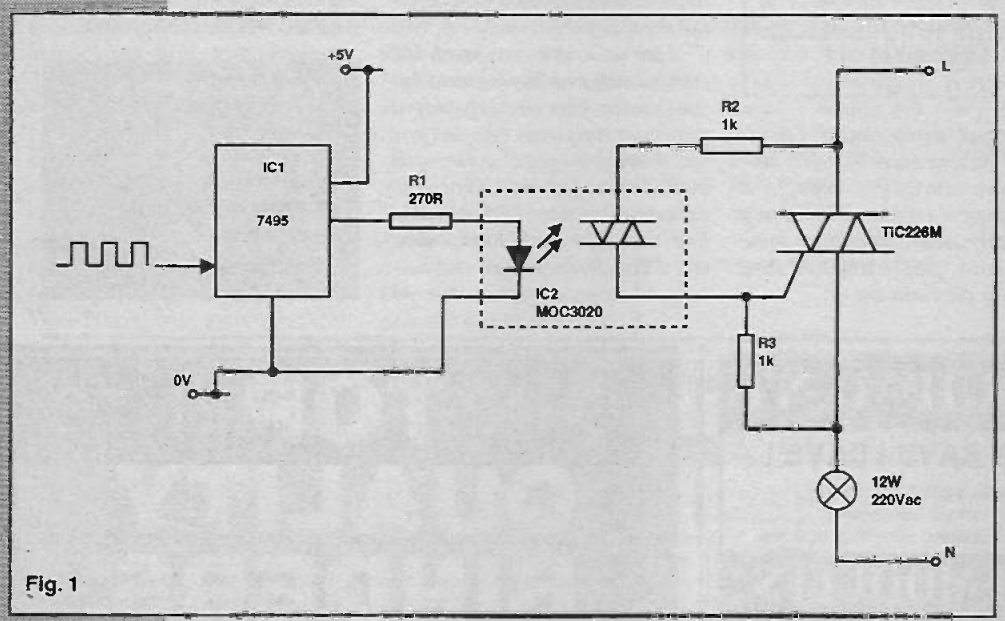

Fig. 1

Cause and Effect

First of all, why does the lamp remain on when the MOC3020 is apparently being switched by its logic drive? There are four obvious possibilities and it should be quick to find out which is the culprit. The MOC3020 may be receiving drive when it appears not to be, the MOC3020 may be defective, the triac may be defective, or the mains supply may contain such a high amplitude of spike interference that the triac is being broken down (which causes false triggering).

To find out which is the cause, first disconnect R2, not the gate connection to the triac. This leaves R3 connected as a bleed resistor for any leakage current or noise which may reach the gate. If the lamp remains off when R2 is disconnected, than reconnect R2 and disconnect R1. If the lamp now remains off, then the drive is at fault, while if it remains, on the MOC3020 is defective.

If the lamp remained on, then either the triac is defective, or it is being falsely triggered by mains spikes. It is, in any case, a good idea to provide the triac with protection against mains spikes, so a snubber network should be connected as shown in Figure 2. If this cures the problem, then it should not recur, but if it doesn't, the only remaining likely cause of the problem is that the triac is defective, so it should be replaced.

A Question of Choice

Several points need to be made about the choice of components and values. First of all, the MOC3020 is rated as requiring 30mA of LED current to guarantee triggering. Most units I have tested will trigger quite satisfactorily with less than 10 mA, but in a large installation the official ratings of devices should be borne in mind. The section of circuit diagram shows the opto- isolator driven from a logic gate, which cannot be expected to provide 30mA drive current, particularly not to several loads at once. It might be better to use the MOC3022, which is rated at 10mA guaranteed trigger current.

The TIC226M triac is an 8amp device which requires 50mA of gate trigger current in quadrants 1,2 and 3 and is not rated to trigger at all in quadrant 4 (with gate positive during negative mains half-cycles). The use of an opto-triac to trigger the device, means that triggering occurs in quadrants 1 and 3, so reliable triggering can be expected if 50mA of gate drive is supplied. Clearly, the value of R2 is too high to permit reliable triggering near to the mains zero crossing. A 1W, 470n resistor would be more appropriate.

The triac itself is too large to be suitable for the job of

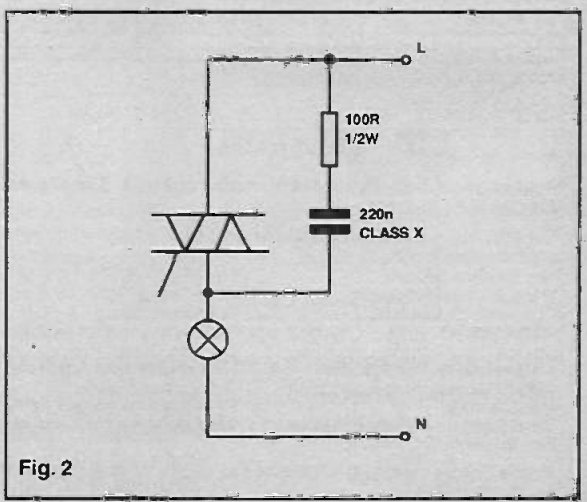

Fig. 2

driving a 12W lamp. When a triac or thyristor is triggered, it continues to conduct until the current falls below a level known as the holding current, a level which maintains sufficient charge-carriers in the junction for conduction to continue. It is unlikely that the current drawn by a 12W lamp will reach the holding current, though this is not specified in my abridged data. The RMS current drawn by a 12W lamp running on 240V AC is only 50mA, while the rated RMS forward current of the MOC3022 is 100mA. It would appear that a single 12W lamp could be driven directly by the MOC3022, the only difficulty being that when a cold lamp is switched on, there is a current surge of several times the RMS operating current and this may cause failure of the MOC3022. Either a NTC thermistor should be connected in series with the lamp, or a lower-current triac such as the TICP206M should be used. This is a 1.5A triac, rated at 8mA trigger current in quadrants 1 and 3. The holding current of thyristors and triacs is usually of a similar order to the trigger current, so the TICP206M should be able to remain triggered over most of the mains cycle.

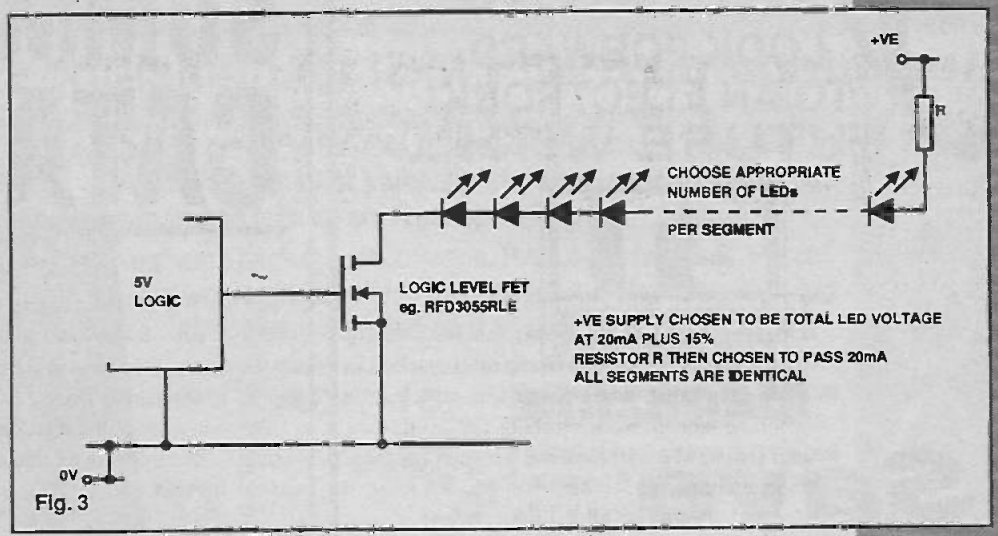

Fig. 3

Dissipation

Mr. Binga goes on to ask how reliable the clock is likely to be when he calculates that the total dissipation of all the lamps he intends to use is 2.5kW and that the unit will be enclosed in a transparent plastic housing which will limit cooling. My estimate is that reliability would be poor and that there could even be a fire-risk. I would, instead, experiment with the visibility of large, high-powered LEDs operated as shown in Figure 3. If a wide viewing-angle is required, then one of the LEDs from the Farnell catalogue is specified at 550 millicandelas over 100° solid angle. If, on the other hand, a narrow viewing angle is acceptable, another LED from the same manufacturer offers 3 candelas over a 20° solid angle. Clearly, one would need more LEDs than incandescent lamps to give adequate readability at a long distance, but the reliability will be much higher.

A. Armstrong

Low cost data acquisition for IBM PCs & compatibles...

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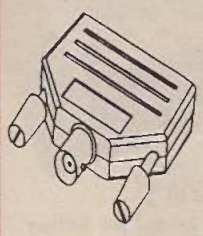
Each device comes with an easy to use software package (PicoScope, PicoLog or both). C, Pascal, and Basic drivers are supplied for those who want to develop their own software, as is a manual giving full details of the hardware and software. All software supplied on 3.5" disk.

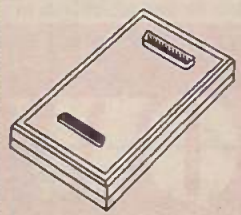
ADC-10



- Up to 24kHz sampling rate from a 386/33MHz machine
- 0-5V Input range
- BNC input connector allows use of standard scope probes
- 30V overload protection
- Parallel port connection
- Includes PicoScope software

Single Channel 8 bit ADC £49

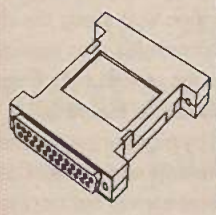
ADC-16



- Software selectable single ended or differential inputs
- Resolution programmable between 8 and 16 bits + sign
- ±2.5V input range
- 5V reference output
- Connects to serial port
- Includes PicoLog software

8 Channel 16 bit + sign ADC £99

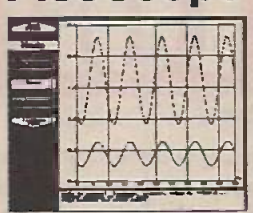
ADC-11



- 15K samples per second
- 0-2.5V Input range
- Digital output
- D25 input connector
- 30V overload protection
- Parallel port connection
- Includes both PicoScope and PicoLog software

11 Channel 10 bit ADC £75

PicoScope

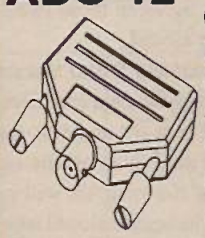


'Virtual instrument' software package for the ADC-10, ADC-11 and ADC-12.

Storage oscilloscope with trigger and timebase. Traces can be printed and saved. Multiple meters on screen. Real time spectrum analysis.

Scope, voltmeter, spectrum analyser

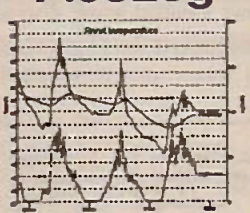
ADC-12



- Up to 18kHz sampling rate
- 0-5V Input range
- BNC input connector allows use of standard scope probes
- 30V overload protection
- Parallel port connection
- Includes both PicoScope and PicoLog software

Single Channel 12 bit ADC £85

PicoLog



Collect samples from 1 per ms to one per day. Scale samples linearly, by equation or by table look-up. Graphical (against time or XY) and text reports can be displayed, printed or exported.

Picolog is also available for the ADC-10: call for details.

Advanced data logging software

Typical application	ADC-10	ADC-11	ADC-12	ADC-16
Oscilloscope	●	●	●	
Voltmeter	●	●	●	●
Spectrum analyser	●	●	●	
Audio sampling	●		●	
Chart recorder emulation		●		●
Temperature measurement	●	●	●	●
Pressure measurement	●	●	●	●
Chromatography				●
Automotive monitoring		●		●
Medical research		●	●	●
Education	●	●	●	●

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A single loop design to detect remote open windows, by Nigel Smith.

Window Monitor

The window monitor has, as its name suggests, been designed to detect which of one's windows are open or closed. This would be a trivial task if one were allowed separate wires from each window to the monitor, but this was ruled out in the original design brief. The requirement was to monitor greenhouse windows, where there were many windows situated some distance away from the monitor. Separate wires were therefore deemed to be impractical and a system was sought in which the windows are connected by a single cable, in loop or chain fashion. The project was designed to solve this problem, but it may find more widespread use as part of a security system. An alarm trigger option has therefore been included.

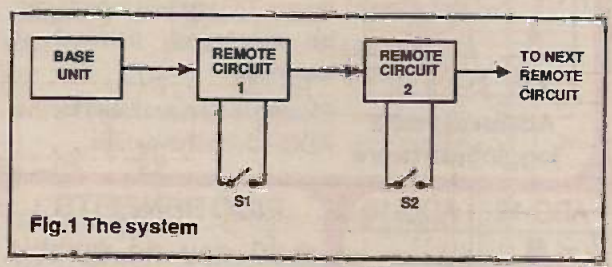


Fig.1 The system

The system consists of a base unit, which contains the power supply and main circuit and a remote circuit, together with a reed switch at each window, as shown in Figure 1. A prime objective has been to keep the remote circuits as simple as possible, so that a large number can be built at a reasonable cost.

Despite its name, the circuit can, of course, also monitor doors or indeed anything else that can operate a switch. Transistors, including phototransistors, may be used instead of reed switches, so the project would make a versatile 'smart loop' if used with an alarm system, since it will detect which switches have been operated.

Operating Principles

The following provides an outline of the system operation - see 'How it works' for further details.

The base unit supplies a pulse train to the chain of remote circuits, each of which routes the first pulse it receives to its switch. All subsequent pulses are then sent along the chain to the next remote circuit. The first pulse is thus applied to the first switch, the second pulse to the second switch and so on. The relevant waveforms are shown in Figure 2.

The state of the switches is read by monitoring the current in the supply line to the chain. The remote circuits use CMOS ICs which draw a negligible quiescent current but can supply up to 2mA when working at 10V. When a pulse is applied to an open switch, the current remains negligible, but nearly 2mA will be drawn if the switch is closed. The current monitor has simply to distinguish between these two states to tell whether a switch is open or closed.

The output of the current monitor is fed to a serial in/parallel out shift register which stores the data and drives the LED display. An HC series shift register and low current LEDs are used, as the former can directly drive the latter.

I have assumed that the state of the switches will mirror that of the windows, i.e. that the switches are closed when the windows are closed and that a warning light should show that a window is open. For each window there is therefore a red LED, which will light if its switch is open.

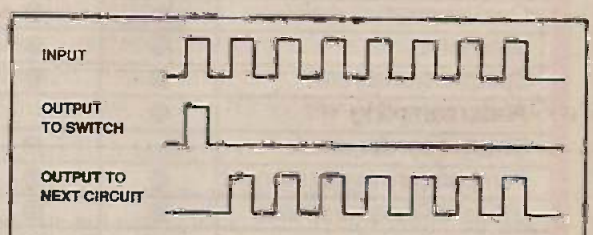


Fig.2 Remote circuit waveforms

The last remote circuit of the chain is terminated by a resistor, which acts as a permanently closed dummy switch. The corresponding LED is a green one which lights to indicate the closed condition. This is used to show that the monitor is operating when all the windows are closed and the red LEDs are therefore off, as well as to provide a continuity check for the chain.

The reading sequence is repeated every 700ms or so, to

PROJECT

give a continually updated reading. The duration of the pulse train will obviously depend upon the number of windows connected, but will typically be about 10 to 20ms. During this time, the LEDs will flicker as the data moves through the shift register, so the display will show a slight flickering at about 1.5Hz in use.

Power Supplies

A choice of mains or battery power supply circuits has been provided. These are shown in Figures. 3 and 4 respectively. Both give nominal 5V, 10V and 15V lines, although the recommended battery voltage is actually 6V. Four 1.5V cells or five 1.2V rechargeable cells should be used. Alternatively, a stabilised 5V or 6V supply may be used with the battery version.

Switching Options

Although the window monitor was designed to operate using reed switches, active sensors and auxiliary circuits may be connected by using transistors as switches. Connect the emitter and collector of an NPN type to points S1 and S2 respectively, vice versa for a PNP type. The connection points are shown in the remote circuit component layout, Figure 12.

A point to watch here is earthing. Connection via transistors is suitable only if the circuits driving them are floating, i.e. if they have no connection to earth nor, worse still, to live, neutral or half live mains. If the window monitor itself is not earthed, then one earthed auxiliary circuit is permissible, but if in any doubt, use an opto-coupler. Most types are suitable and the method of connection for these and for phototransistors

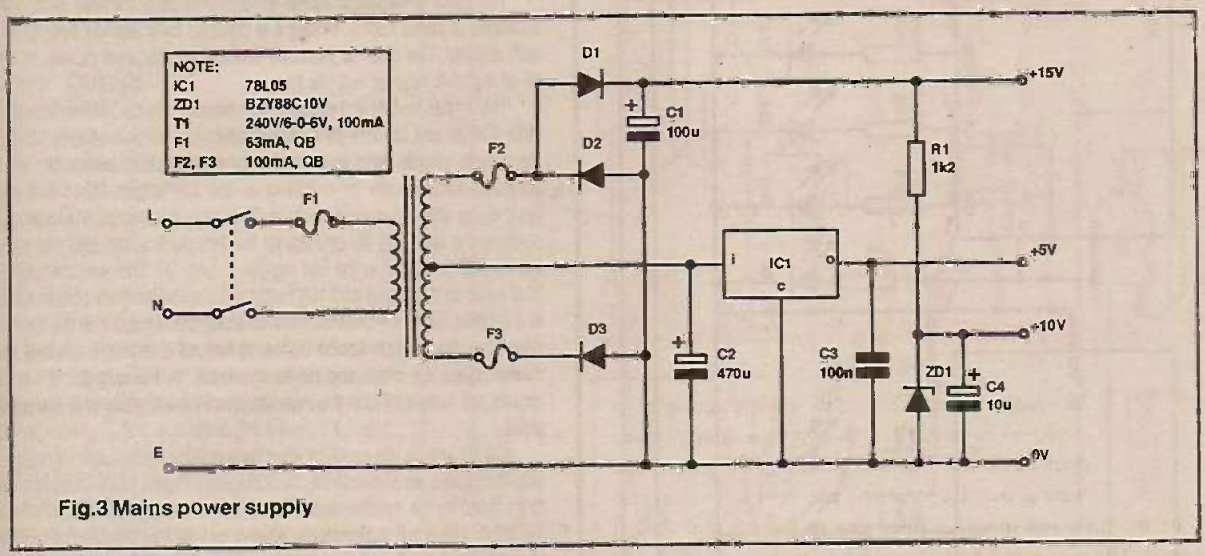


Fig.3 Mains power supply

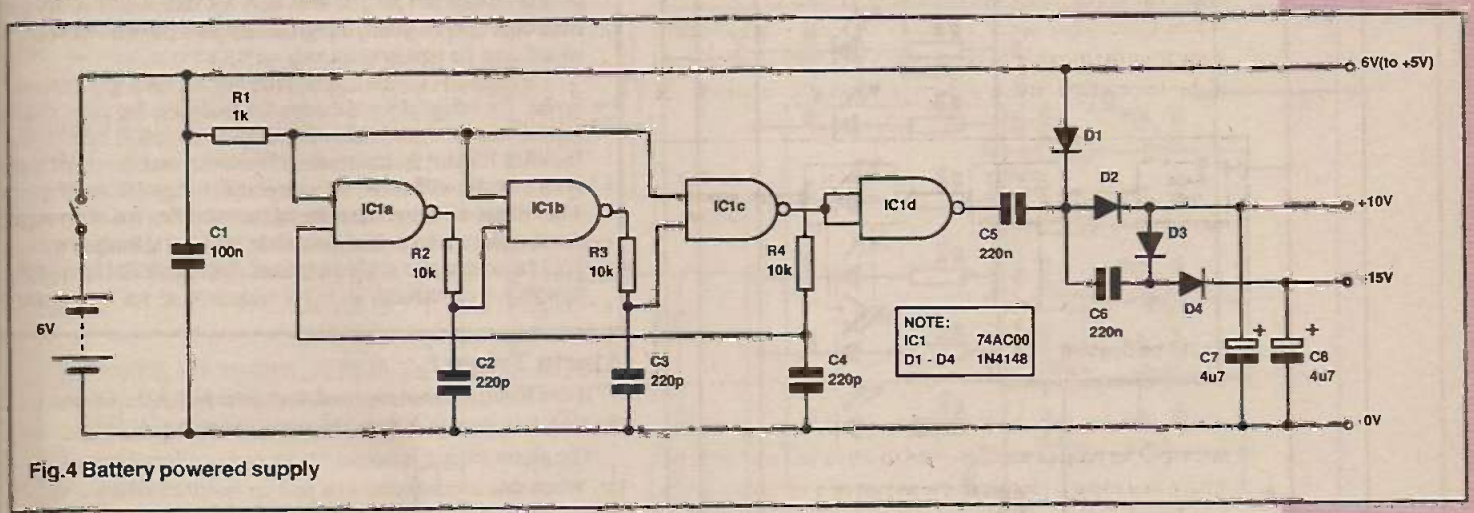


Fig.4 Battery powered supply

A voltage tripler was chosen for the battery power supply, because the higher voltage lines require much less current than does the 5V line. It would have been possible to run the remote circuits at 5V, but some voltage overhead would still have been required for the current monitor. While a voltage doubler could have provided this, the addition of a couple more capacitors and diodes creates a tripler which enables us to run the remote circuits at 10V. This is advantageous, because of the higher output current capability of CMOS chips at the higher voltage. The detector of the current monitor can therefore be less sensitive than otherwise, so that noise immunity is improved.

is as described above for transistors. The requisite ratings for the above devices are modest. The 'on' current is only 2mA, the 'off' voltage is 10V and leakage current up to 100µA is acceptable.

As stated above, it has been assumed that the LEDs are required to be on when the switches are open. If, instead, you want a LED to be on when its switch is closed, then connect it to the 5V line as shown in Figure 6 for LED 6, the green LED, instead of the 0V line as shown for the others. The relationship between a switch and the corresponding shift register output is that an open switch gives high output, a closed switch gives low output. This applies for all types of

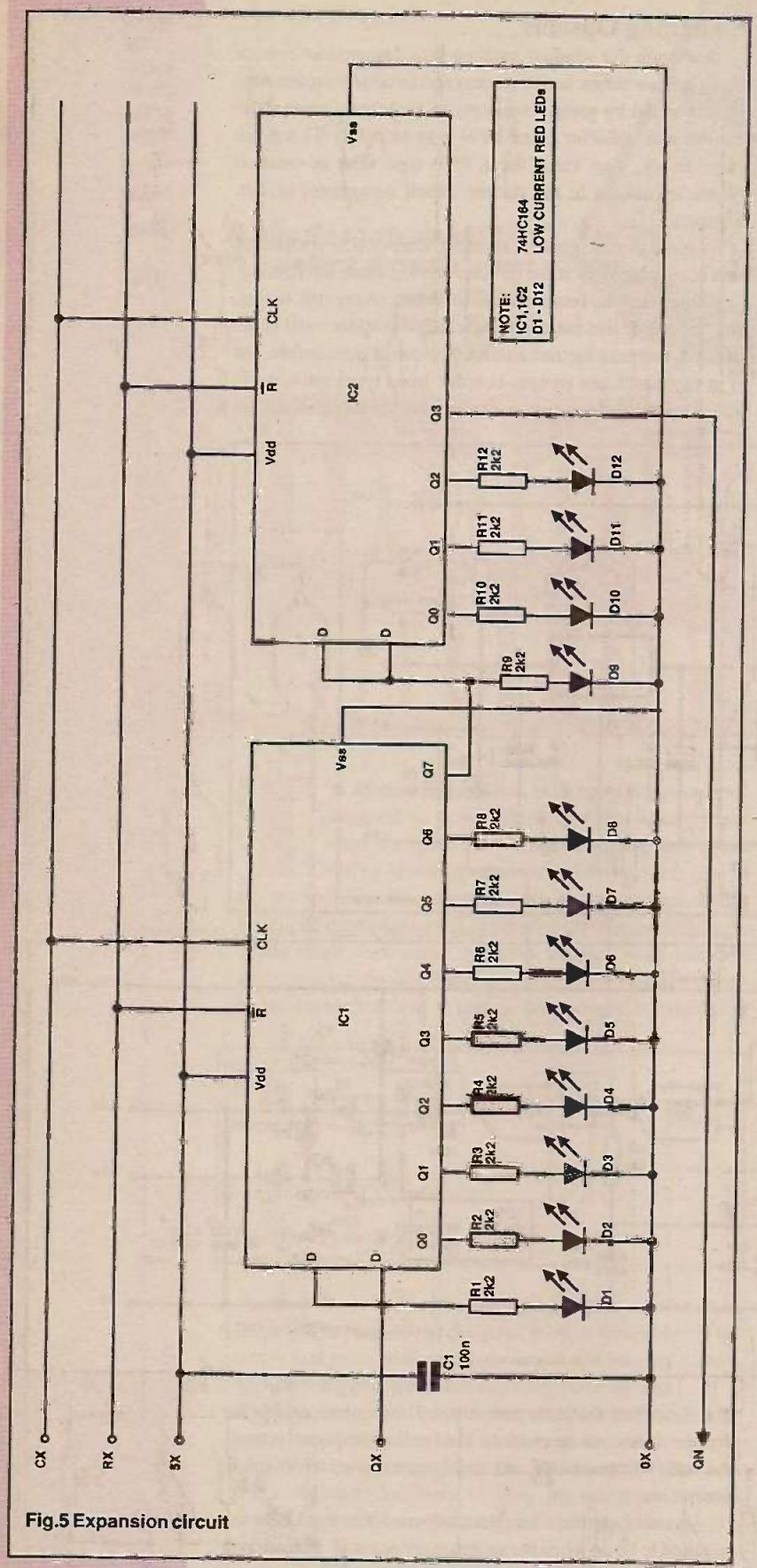


Fig.5 Expansion circuit

switches and both methods of LED connection.

Windows can be 'ORed' by wiring their switches in series with one remote circuit. This arrangement could be useful if you have two or more windows close to each other and it is not necessary to know precisely which one of them is open.

HOW IT WORKS

Power Supplies

The mains PSU, shown in Figure 3, requires little explanation. Full wave rectification and a regulator IC are used for the 5V line, while unregulated half wave rectification is sufficient for the other lines.

The battery PSU, shown in Figure 4, uses ICs 1a, 1b and 1c to generate a 150kHz square wave. This drives the voltage tripler via IC1d to produce the 10V and 15V lines.

Main Circuit

The main circuit is shown in block diagram form in Figure 13 and in the circuit diagrams Figures6 and 8. The diagrams and the text below refer to the case where there are five remote circuits. For the general case where there are n remote circuits, read Q(n+1) for Q6.

The reading sequence is initiated by a pulse from the system reset circuit, which comprises IC1d and associated components. The pulses are negative going, approximately 2ms wide and repeat at 1.5Hz.

The clock generator consists of IC1a and its associated components. It oscillates at about 750Hz, unless it is disabled by a high on output Q6 of the shift register. The clock is therefore enabled by the reset pulses, which take all of the shift register outputs low.

The signal and 10V outputs to the remote circuits are controlled by the latch ICs 2b and 2c. The 10V output cannot be left permanently on because the remote circuits need to be reset for each reading sequence, but this is achieved automatically by switching on the 10V output. When this the data input of the shift register, will be high. This logic 1 becomes a marker bit which controls the latch ICs 2b and 2c. At the first clock pulse after the reset, the marker will be shifted to the first register output, Q0. This sets the latch, which now turns on the signal and 10V outputs. Subsequent clock pulses are output to the chain, while the marker is moved along the register with the switch state data from the current monitor following behind it. When it reaches Q6, the marker stops the clock and resets the latch, so the outputs to the remote circuits are turned off and the data remains in the register until the next reset pulse.

ICs 1b and 3a are used for logic level shifting at the latch inputs and they also form gates, as shown in the block diagram, Figure 13. IC1b allows the latch to be reset by the system reset. This is only necessary for the initialisation of the latch, which will subsequently always be reset by the marker at Q6. IC3a prevents the latch from being set when Q6 is high. This ensures that an open circuit chain condition (putting Q0 high and the green LED off) does not try to set and reset the latch simultaneously.

The operational amplifier IC3b and R19 form the 10V output and current monitor. The voltage of the 10V output line, being also that of the op-amp negative input terminal, will follow the voltage of the positive input terminal. This will be 10V when the latch is set and 0V when it is reset. Any current drawn by the output line will flow from the op-amp output through R19, so the op-amp output voltage will depend upon the said current. When one of the remote circuits applies a pulse to its window switch, the output of the op-amp will be 10V if the switch is open or 12V if it is closed. The network Rs 17 and 18 drop the voltage to approximately 9V or 11V respectively, so that the comparator

Alarm Trigger

If this function is not required, then omit R26, Q1, IC4 and the long link next to it from the main circuit board.

The alarm trigger is output via an open collector transistor. When this is connected to a pull up resistor in the alarm circuit, a positive going pulse will occur if any of the window switches is open. The pulse width is about 1ms and it will repeat every 700ms or so, as long as the switch remains open.

A chassis connection must be made between the window monitor and alarm circuits, so one must be mindful of earthing. If both monitor and alarm circuits are earthed, there is not likely to be a problem, provided that the alarm has its negative or 0V supply line earthed and the two circuits are situated reasonably close together (e.g. in the same room). The best arrangement will depend upon the alarm system in use, but in general the earth connection to the mains powered version of the window monitor should be omitted only if there is a permanent earth connection via an alternative route.

IC1c can compare this to a 10V reference. The comparator output is then fed to the data input of the shift register. The register is clocked at the trailing edge of each output pulse, so the capacitor C2 is used with Rs 17 and 18 to hold the comparator input. The integrating network thus formed will also help to prevent the data being depraved and corrupted by any unpleasantness that may be picked up by the chain.

The alarm trigger circuit takes the shift register output Q0 and passes it to the transistor Q1 via the gate IC4d. All of the switch state data passes though Q0 during the reading sequence, so any open window switch will cause a pulse to trigger the alarm by turning off Q1. The marker bit is excluded from the trigger output by the latch formed from ICs 4b and 4c, which turns the gate off when the system reset pulse occurs. The gate is then turned on by the marker when it appears at Q1, having passed though Q0.

Remote Circuit

The 4555 dual 2 to 4 line decoder is used in a rather unusual application here, so an explanation of its functions is given. The input and output waveforms of the circuit are shown in Figure 2.

Taking IC1b first, inspection of the truth table, Figure 14, will show that it behaves as a NCR gate, since Q0 is the only output used.

Considering next IC1a, we regard the input D0 as a signal and D1 as a control input. The truth table now shows that the signal can be switched by the control, between the outputs Q1 and Q3, with the signal complement appearing at Q0 and Q2 respectively.

When power is first applied to the circuit, C1 being connected to the positive line ensures that Q0b and hence D1a will be low. Q3a will therefore also be low, as will D0a, since it is connected to Q3a of the previous remote circuit. The initial state of IC1a is therefore described by line 1 of the truth table.

At the leading edge of the first input pulse, the state of IC1a becomes that of line 2 of the table, but the delay imposed by the network R1,C1 ensures a brief overlapping of high inputs to IC1b, so its output remains glitch free at logic 0. At the trailing edge of the first input pulse, the delay now ensures an overlap of low inputs to IC1b, so that its output goes high. The circuit is then latched in this condition, with all subsequent pulses appearing at the output Q3a, until the power is turned off and then on again at the beginning of the next reading cycle.

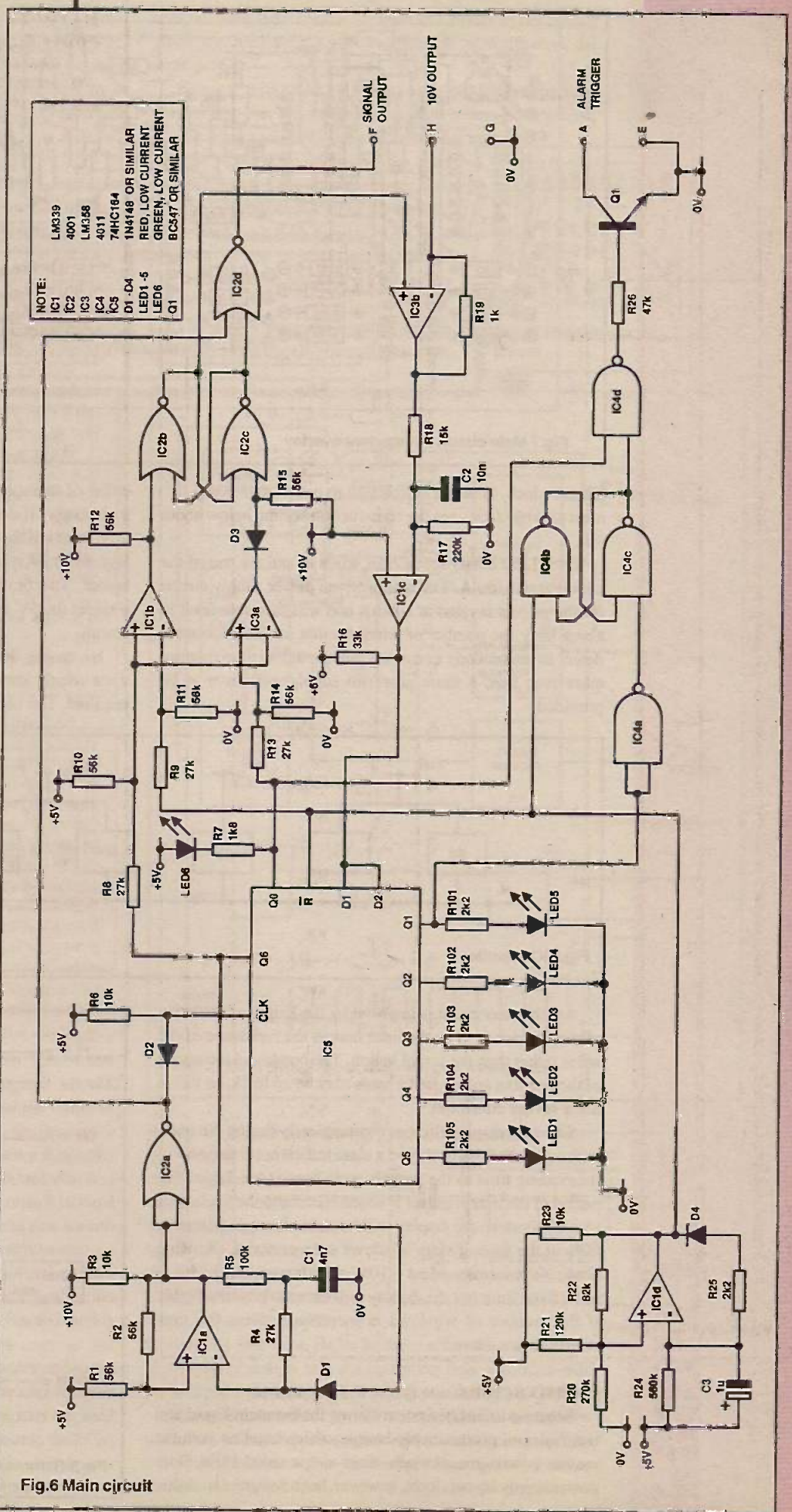


Fig.6 Main circuit

Connecting the monitor earth to the mains earth via a high value resistor might be acceptable in some cases.

Expansion

The main PCB designed for this project can accommodate three eight bit shift registers. Since two bits are required as overhead, up to twenty two windows can be connected.

More shift registers may be added by using an expansion board, as shown in Figure 5. Each additional register will provide for a further eight windows. Points for the connection of an expansion board are provided on the main PCB. These are 0X and 5X for the power, RX the reset, QX the input and

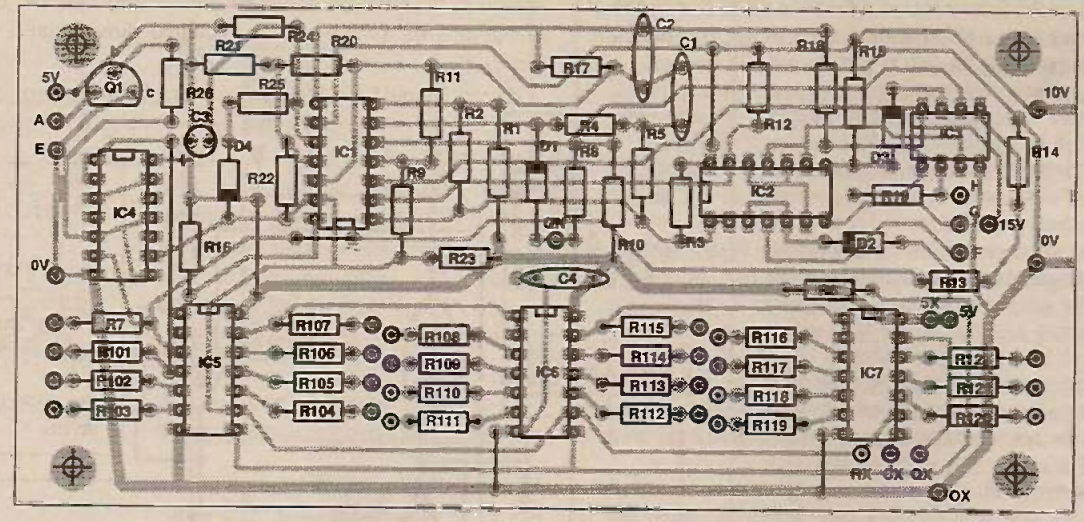


Fig.7 Main circuit component overlay

CX the clock. A return connection to point QN must also be made - see the construction section below about this.

Each LED draws about 2mA when lit and the rest of the circuit about 10mA. The mains driven power supply circuit for the project is rated at 100mA and will therefore limit to about forty the number of windows that can be accommodated. In the unlikely event that you should wish to monitor more than this, a more powerful supply will have to be provided.

either of them may be fabricated on the same board as the main circuit if desired. To do this, simply align the 0V and 10V tracks of the main circuit and the chosen power supply layouts, overlapping by one or two mm to form a single layout. The finished board must then have links fitted to connect the 5V and 15V supplies from the PSU to the main circuit.

No casing details are given here, as these will depend upon which power supply is used and the number of LEDs required. The user will also probably want the arrangement

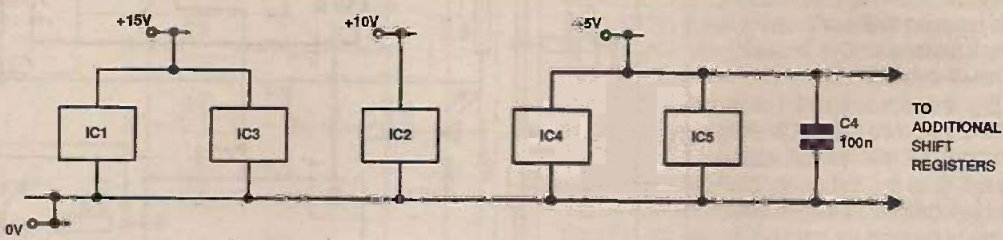


Fig.8 IC Supplies

Another constraint is imposed by the length of the chain of remote circuits, but the limit here is the resistance of the wires rather than the actual length. The combined resistance of the positive and negative leads may be up to 1k, so this is not a severe constraint.

Since the display flickers meaninglessly during the reading sequence, it will not give a clear indication if the ratio of the reading time to the overall cycle time is too large. The period of the output pulses is about 1.1ms and the cycle time about 700ms, so the display will be stable for approximately 90% of the time, if sixty windows are monitored. (Reading time = 60 x 1.1ms = 66ms = 10% of 700ms approx.). This is not a fixed limit but the display will become less intelligible if the number of windows is increased, unless the time constants are altered.

Construction

Separate PCB layouts are shown for the main board and the choice of power supply boards, which together with the remote boards are all made from single sided PCB. Both power supply layouts have, however, been designed such that

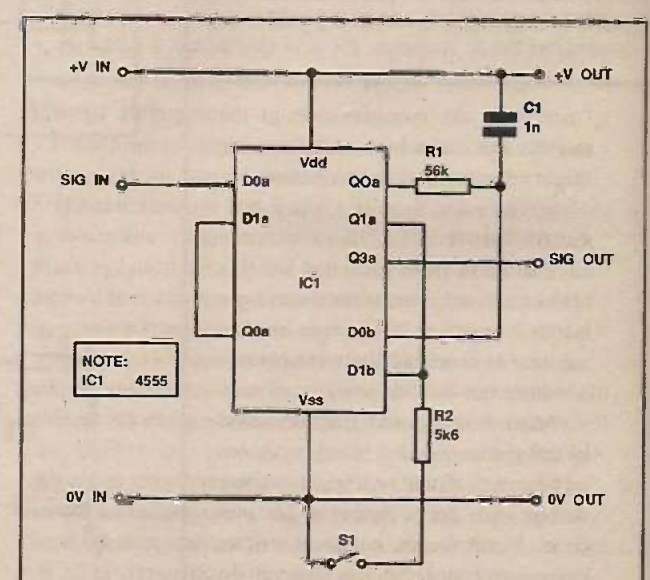


Fig.9 Remote circuit

PROJECT

of LEDs on the front panel to reflect the physical placement of the windows being monitored. No LED PCB is therefore shown and the constructor is left to his or her own devices here. Stripboard would make a suitable alternative to a custom built PCB for the LEDs, or they could be mounted onto the front panel using LED clips and have wires soldered directly to their legs.

The LEDs should be wired to the shift register outputs in reverse order, as I shall now explain. The outputs of the first shift register IC are numbered Q0 to Q7 and, for convenience, let us call the outputs of the other registers Q8 to Q15 and Q16 to Q23 for ICs 6 and 7 respectively. Q0 drives the green LED via R7, while the other outputs drive red LEDs via resistors, whose numbers are derived by adding 100 to the output number, e.g. Q9 is connected to R109. The LED

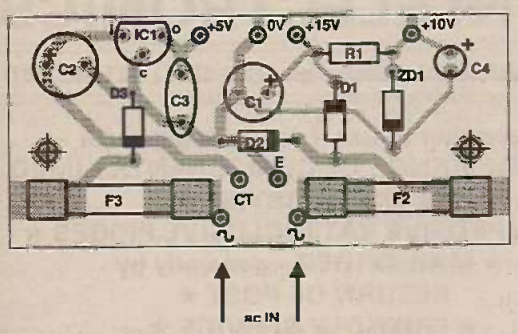


Fig.10 Mains PSU component overlay

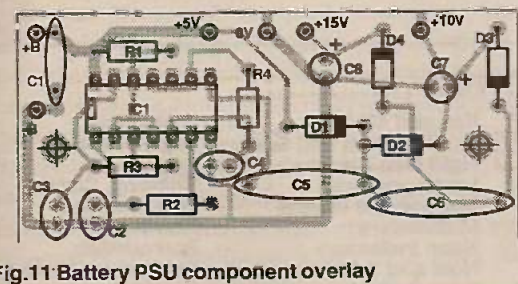


Fig.11 Battery PSU component overlay

connection points are, for clarity, not labelled on the layout of the main board in Figure 6, but their numbers are implied by the numbers of the resistors closest to them. Let us now suppose that we have, for example, five remote circuits which are numbered in the natural order along the chain, as in Figure 1. This is the case which is used for the circuit diagram in Figure 7, so ICs 6 & 7 and resistors R106 and above are not used. The LEDs are connected in reverse order to their series resistors, such that LED1 is fed from R105 and LED5 from R101. This is necessary because the first bit into the shift register moves through to the last output used.

A wire must be fitted between point (near C4 at the centre of the main board) and the shift register output following the last one used for an LED. For the example given above, this will be Q6.

The remote circuits are connected to each other and to the base unit by a three core cable. The prototype uses a stereo jack plug and socket, but these connections may be hard wired via a terminal block or soldered directly onto the PCB. The type of cable used is not critical.

The window switches may be reed switch/magnet combinations of the type commonly used in security systems, or a miniature reed switch can be mounted directly onto the remote PCB.

Points S1 and S3 on the remote circuit board are provided for this purpose. The assembly can then be housed in a small plastic box and used with a suitable magnet. Take care to orient the reed switch correctly if you choose this option.

The last remote circuit of the chain is terminated by a 5.6k resistor. This is in addition to the switch, and should be fitted between the output and a 0V terminal.

The mains powered version of the monitor has the transformer, mains switch

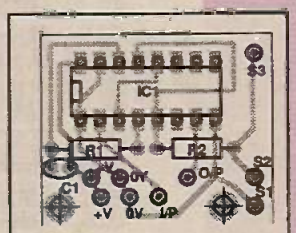


Fig.12 Remote circuit layout

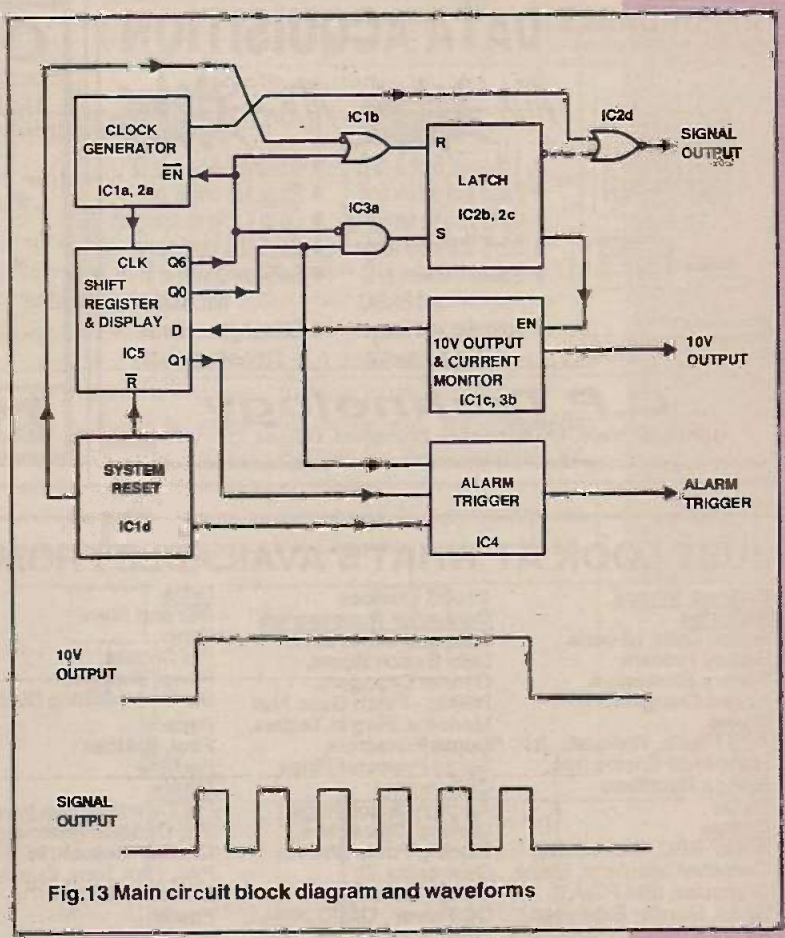


Fig.13 Main circuit block diagram and waveforms

and mains fuse F1 mounted off board, so that there is no mains voltage on the PCB. A double pole switch and a shrouded panel mounted fuse holder are recommended for the above. If a metal case is used, then it should be earthed. The LT fuses F2 and F3, are mounted by fuse clips. Holes for these are not shown because clips vary in design and the mounting hole positions will depend upon the type of clips which you use.

D1	D0	Q0	Q1	Q2	Q3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

Fig.14 Truth table, 2 to 4 Line decoder (1/2 of 4555)

A single pole on-off switch will suffice for the battery powered version. A push-to-make type would be appropriate where intermittent rather than continuous operation is required.

PARTS LIST

MAIN CIRCUIT

RESISTORS

R1,2,10,11,12,14,15	56k
R3,6,23	10k
R4,8,9,13	27k
R5	100k
R7	1k8
R16	33k
R17	220k
R18	15k
R19	1k
R20	270k
R21	120k
R22	82k
R24	560k
R25	2k2
R26	47k

CAPACITORS

C1	4n7
C2	10n
C3	1µ/10V
C4	100n

SEMICONDUCTORS

IC1	LM339
IC2	4001
IC3	LM358
IC4	4011
IC5	74HC164
Q1	BC547
D1-4	1N4148
LED1-5	Red LED
LED6	Green

MAINS PSU

RESISTORS

R1	1k2

CAPACITORS

C1	100µ/25V
C2	470µ/10V
C3	100n
C4	10µ/16V

SEMICONDUCTORS

D1-3	1N4001
ZD1	BZY88C10V

MISCELLANEOUS

T1	240V/6-0-6V 100mA transformer
F1	63mA, QB fuse
F2,3	100mA, 20mm, QB fuses

BATTERY PSU

RESISTORS

R1	1k
R2-4	10k
C1	100n
C2-4	220p
C5,6	220n
C7,8	4µ7/25V

SEMICONDUCTORS

IC1	74AC00
D1-4	1N4148

BUYLINES

All of the components used in this project are readily available, with the possible exception of the 74AC00 IC used in the battery PSU. This is stocked by Maplin. Other logic families cannot be substituted because CMOS types have insufficient output current drive and TTL types have insufficient output voltage swing. Other AC series inverting gates may be used, but would require the PCB to be redesigned.

Power Supplies Without Transformers

An alternative approach to low voltage availability by Andrew Armstrong.

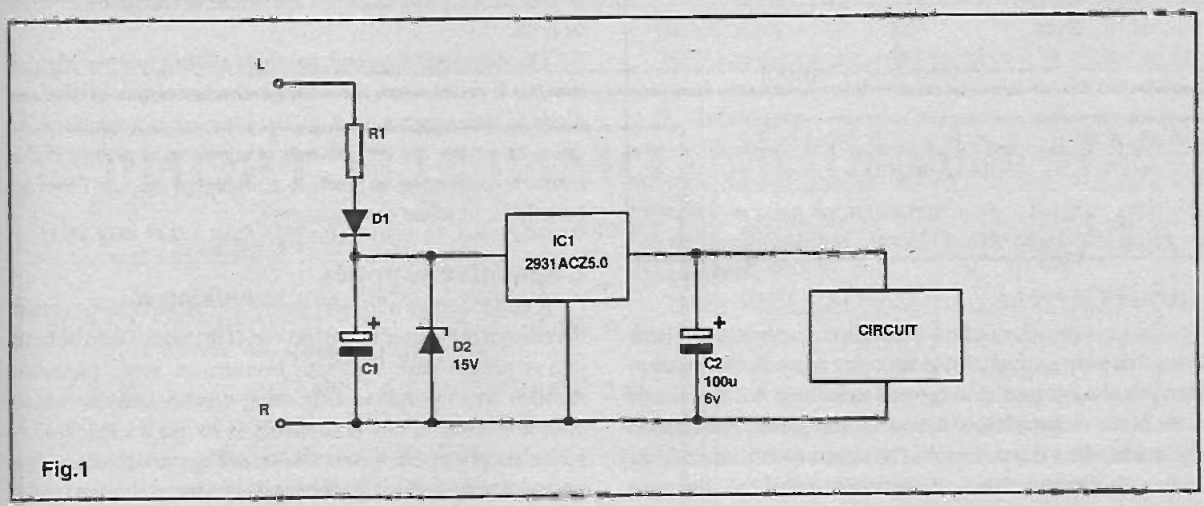


Fig.1

The normal way to power an electronic project is either to use batteries or a mains transformer, rectifier, smoothing capacitor, and voltage regulator. This is fine for many projects, where the circuitry has to be isolated from the mains, or where it draws a substantial current. However, there are instances where the current requirement is very small and the circuitry will never be touched, meaning that the project can be connected to the mains. Maybe the circuitry is already connected to the mains, because it controls a triac. In these applications, a mains transformer is unnecessarily costly and bulky and a direct mains power supply is preferable.

Resistive Supplies

The most obvious type of direct power supply is the resistive type, as illustrated in Figures 1 and 2. In broad terms, the circuit of Figure 1 works by half wave rectifying the mains via a current limiting resistor. The resulting dc voltage is stored on the reservoir capacitor C1.

The voltage on C1 is limited by the zener D2 and is regulated down to 5V by IC1. IC1 is a voltage regulator with very low quiescent current, so as not to waste the scarce available current from this supply. If the supply is intended to run circuitry which does not require a very smooth or accurate power source, IC1 and C2 can be omitted.

The question is: how much current is available? Clearly, the lower the value of the resistor, the higher will be the available current and the hotter the resistor will become. The limit to the heat dissipation of the resistor may be determined by the resistor ratings, or it may be limited by the ventilation of the enclosure in which the circuit is housed.

Let's take a practical example. Assume we can use a 10W resistor, but want to limit the dissipation to 8W under worst case conditions, to give an adequate safety margin. If there were no diode in series with the resistor, the dissipation would simply be $Vrms^2/R$. Because the diode conducts for half the cycle, the dissipation is halved.

For a mains voltage of 264V (a 240V supply, 10% too high), the resistance giving 8W dissipation would be 4356R.

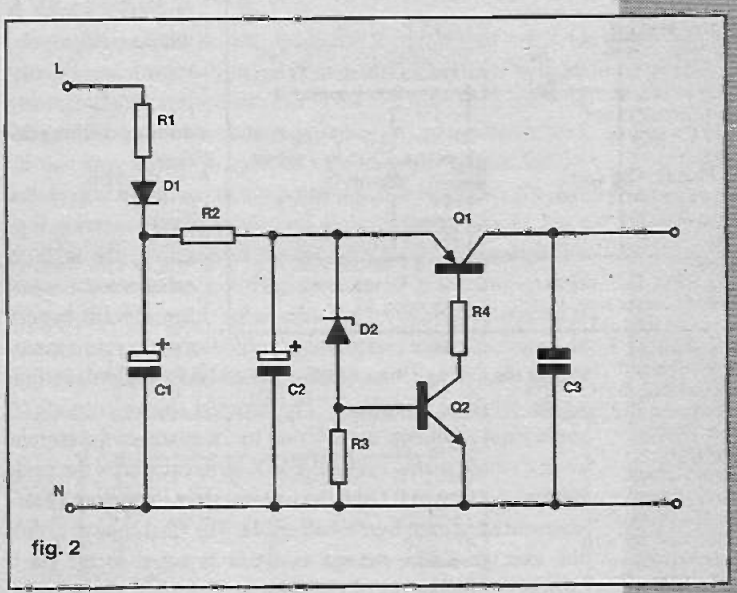
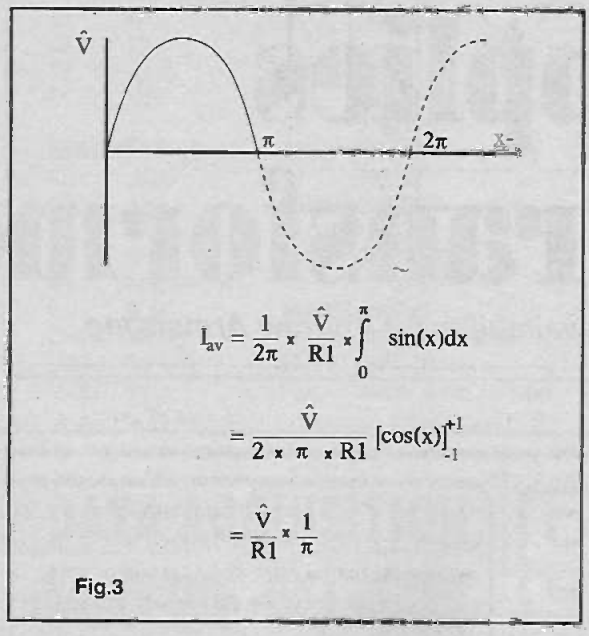


fig. 2

Oddly enough, this precise value is unavailable in normal resistor types, but 4k7 is available. A 10% 4k7 resistor would have a resistance min of 4230R, giving a maximum possible dissipation of 8.2W. This is quite good enough, particularly considering that these approximate calculations have neglected the load voltage, which reduces the peak voltage across the resistor and therefore reduces the dissipation by (probably) enough to keep within the specified dissipation under a worst case situation.



$$I_{av} = \frac{1}{2\pi} \times \frac{\hat{V}}{R1} \times \int_0^{\pi} \sin(x)dx$$

$$= \frac{\hat{V}}{2 \times \pi \times R1} [\cos(x)]_{-1}^{+1}$$

$$= \frac{\hat{V}}{R1} \times \frac{1}{\pi}$$

Fig.3

Direct Current

The next question is, how much direct current is available from this power supply? It is tempting to make the assumption that the DC available is equal to half the AC that would flow in the resistor R1, if R1 were simply connected across the mains. This is not the case, however, as is illustrated by Figure 3. Current flows in the resistor for half the time (neglecting the small offset due to the DC output voltage) and, in order to calculate the average direct current available it is necessary to average the current in R1 over a whole mains cycle, even though the current is only flowing during positive half-cycles.

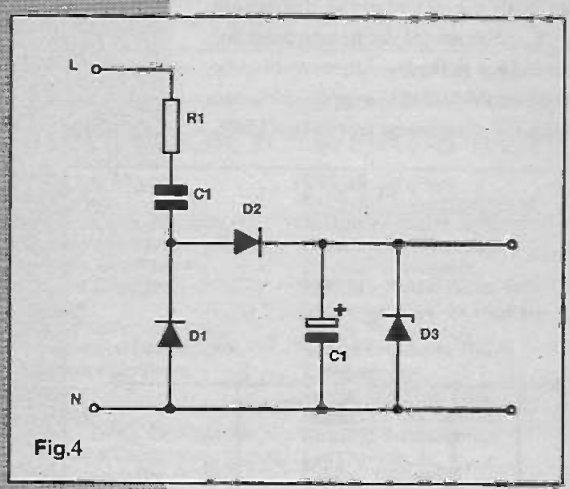


Fig.4

Looking at the maths shown in Figure 3, the way to calculate the average current over a mains cycle is to calculate the average over a half-cycle and then to divide by one cycle, working in radians. The formula shown consists of three main elements: the division by 2π averages the current over a whole mains cycle, the V/R term calculates the peak current flowing in R1 and the integral term integrates a half-sinusoid of current over a half-cycle. The final answer is that the average direct current available is equal to the peak current in the resistor divided by π. Therefore, for a 240V mains supply with a 4k7 resistor, as in the example above, a current of 23mA is available.

In order to avoid the circuit failing to operate under all conditions, it would be prudent to design around the minimum current which could be available, taking into account a below- standard mains supply and subtracting from this the dc voltage at the bottom of D1. A 15% low mains supply would be 204V, so, subtracting the zener diode voltage we are left with 189V. The peak voltage is now 267V, giving an available current of 18mA. If we allow 4mA to be wasted in the zener and the voltage regulator, then the load circuit can be allowed to draw 14mA without any danger of it failing to work.

The circuits of Figure 1 and Figure 2 are very similar in effect, but the circuit of Figure 1 will always provide an output voltage even if there is not enough current available for the supply to reach its proper voltage. In some cases, this can be harmful. If, for example, the circuit is controlling triacs switching an inductive load, then inadequate power supply could result in the triacs only triggering on (say) positive mains half-cycles. This would destroy load or triac or both.

The circuit of Figure 2 provides slightly poorer regulation, as it relies upon the voltage characteristics of a zener diode in series with a base-emitter junction of a transistor. It does, however, cut off the output supply completely if the mains is inadequate to provide a regulated output. This can be helpful in some circumstances.

Capacitive supplies

A disadvantage of power supply circuits like these is that the resistor dissipates a lot of power. If the circuit is to be built into a plastic case, this can become an acute problem. Another way to limit an alternating current, and one which does not result in any dissipation, is to use a capacitor. A power supply of this type is shown in Figure 4. Note that the surge- current in the capacitor at switch-on is limited by R1 and that two diodes are provided in order to permit an alternating current to flow. If D1 were omitted, then C1 would charge to the peak mains voltage, after which no further current would flow in D2.

The disadvantage of this type of circuit is that a capacitor with full mains voltage across it can be prone to failure, unless a high-quality component is used. What tends to happen is that because the electric field across the dielectric is constantly reversing, any weak spot in the plastic film which forms the dielectric for most mains-rated capacitors is worn out over a period of time. As a slight digression, some authorities hold that paper capacitors of nominally the same rating are more reliable.

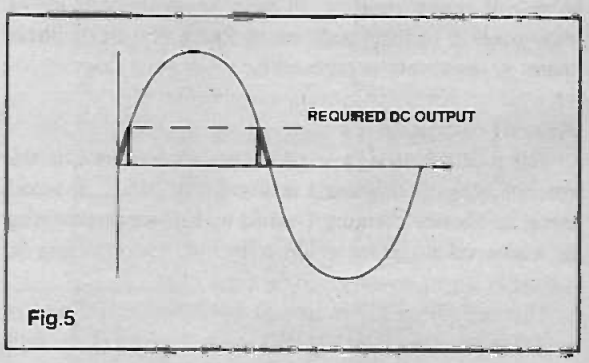


Fig.5

In any case, a class X capacitor (rated for direct connection across the mains) should be used in this type of supply.

Once again, the question arises of how much direct current is available from this type of supply. The same reasoning as was applied to the resistive supply will suit the capacitive supply as well. To calculate the direct current available, we divide the peak current by π. (Remember that only one-half of the mains cycle contributes to the DC output.)

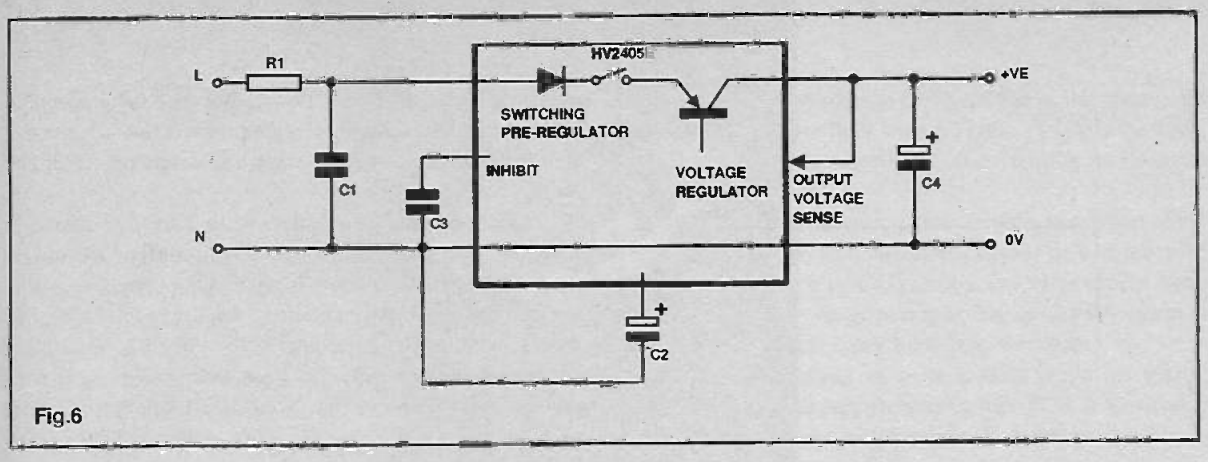


Fig.6

Here is an example, showing the current available if a 220 nanofarad capacitor is used.

$$I_{ac} = V_{rms}\ 2 \times \pi \times f \times c$$

So for 240*V* , *with a* 220*nF capacitor,*

$$I_{ac} = 240 \times 2 \times \lambda \times 50 \times 220 \times 10^{-9}$$

$$= 16.58mA$$

$$\textit{Peak current} = 16.58 \times \sqrt{2} = 23.46$$

$$\textit{DC available} = \frac{23.46}{\pi} = 7.47mA$$

The available current, 7.47mA, is disappointingly low, but a useful amount of current can be obtained if two or three of these capacitors are put in parallel. It is also the case that there are some application circuits that would not need more than seven milliamps to operate.

Switching supplies

A completely different approach to a low-dissipation transformerless power supply is illustrated in Figure 5. This diagram shows the mains voltage waveform with a current drawn only near to the zero crossings on the positive half-cycle. With this scheme, a storage capacitor is charged to whatever power supply voltage is required through the expedient of switching off the charging current while the mains voltage is above the required capacitor voltage. I have seen this scheme used in several applications, not all starting at mains voltage.

While it is possible to do this job with discrete circuitry, the easiest way is to use a standard chip which has been developed for the purpose, the HV2405E. Figure 6 shows the general operating scheme which the chip uses.

R1 limits the surge current and should be chosen so that the peak current at peak mains voltage could not exceed 2.5A. C1 is a spike-suppression capacitor, which should have a minimum value of 47n on normal mains applications. C2 is the main storage capacitor which is charged to a sufficient voltage to operate the output regulator. C3 is there simply to prevent the internal circuitry of the chip falsely triggering on mains interference.

The switching pre-regulator charges C2 to a maximum of 10V above the output voltage. There is then always enough voltage to power the output voltage regulator, which is rated at a maximum of 50 mA. The primary purpose of the output capacitor is to suppress spike interference which could occur on the charging point of C2. A minimum value of 1 µF is required, but higher values will provide better suppression.

Figure 7 shows a practical circuit designed for use on 240V mains. The output voltage is set by the value of R2, at 5V plus 1V/kohm. Thus, for example, if R2 is short circuited, the output will be 5V and if R2 is 1k, the output will be 6V. The maximum allowable output voltage is 24V.

Conclusion

As this article shows, there are a number of ways to provide modest low-voltage power-supply currents without the use of a mains transformer. This can save both cost and weight. The only absolute requirement to power equipment in this way is that it must be safe and appropriate for the equipment to be at mains potential. For example, the circuitry of a remote-controlled light dimmer would be a suitable item to power in this way, but an audio preamplifier would not. When building circuits of this nature, it is important to remember that even the low-voltage parts are at mains potential and appropriate care must be taken in building, testing and using such items.

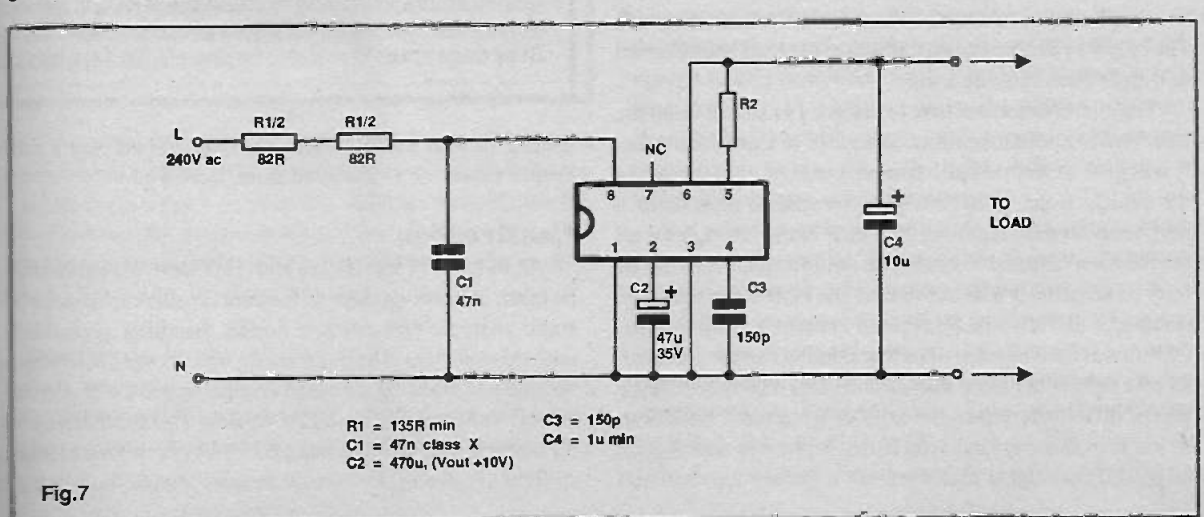
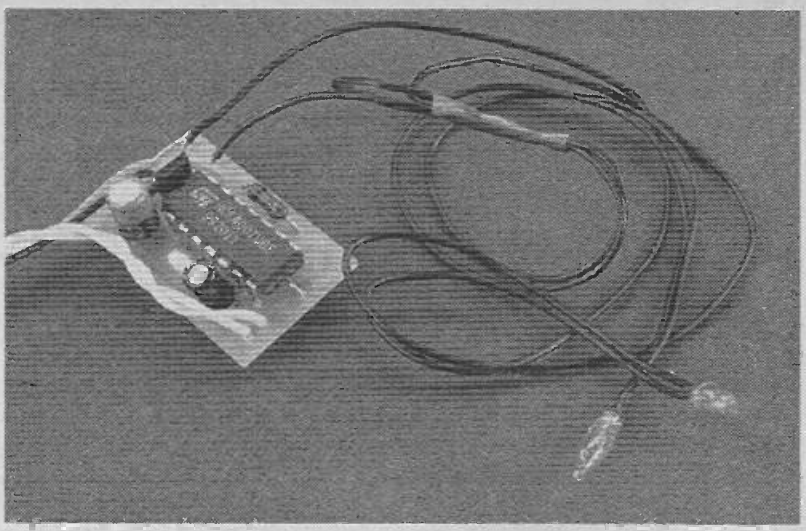


Fig.7



Brake Lights For Radio Controlled Models

By A Craig Talbot

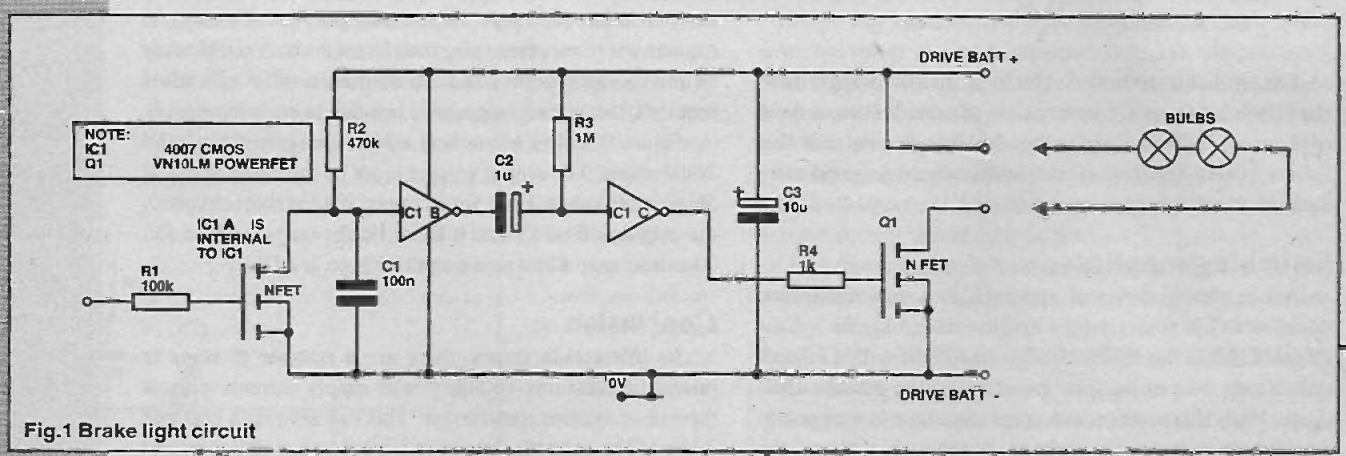


Fig.1 Brake light circuit

Some time ago, while contemplating the building of my 1/16 Scale Model Truck, I decided on a range of what might be described as 'extras'. In addition to the normal electronic Speed Control, I wanted direction indicators, reversing warning sound, headlights, spotlights, engine sound, a flashing beacon (wide load warning) and working brake-lights. As the model has no brakes, I could not operate any mechanical system to switch them on or off. The only way to accomplish this was to use the Speed Control to trigger them in some way.

The circuit described here is designed as an add-on to the Low Power Speed Controller, described in a previous issue. It will give a brief (about 1 second) pulse of light whenever the vehicle stops, goes through a forward to reverse, or a reverse to forward function. The PCB is tiny enough for all but the most diminutive model and while it can, of course, be built on something like Veroboard, the PCB is only postage stamp size and it would be difficult to build it much smaller. CMOS was used because of its low standby current - after all, a brake light is not often switched on. It is also very suitable for the drive battery range, 6 to 12V. For a scale model car, or truck, in fact any land vehicle that represents a road legal original, brake-lights that work are a feature that will add interest to your model. They cost little and employ a very simple circuit, so if you need them, have a go.

HOW IT WORKS

The circuit in Figure 1 uses a 4007 IC, which consists of an inverter and two complimentary pairs of FETs in a package which allows most of the nodes of the FETs to be accessed. Because of this feature, one complementary pair of FETs can be wired as a second inverter and one N channel FET can be selected to act as a switch. This will discharge C1 whenever the input to it is positive, or whenever it is receiving positive pulses. The pulses, in this case, are generated by the Speed Controller (at the point marked 'X'). By this action, it will stop C1 charging up via R2, until the positive pulses or positive level on the input are removed. This will happen only when the Speed Controller is in a stop condition. As you can see. C1 will charge through R2 as soon as the internal FET (in IC1) is switched off. This

Construction

As IC1(4007) and Q1 are both FET devices, care should be taken in handling them as they are sensitive to damage by static charges. Observe the normal handling precautions with these devices. The bulbs need a little thought as to which voltage you are using, since the original Speed Controller can be built as either a 6V or a 12V version. This means that two 3V bulbs in series will be required for 6V, or two 6V in series for 12V. If you elected to use an unusual voltage you will have

PROJECT

to work it out for yourself.

The current rating of the bulbs must be kept below 300mA and, if you decide on parallel connections to the bulbs, then the bulb current will obviously have to be kept below 150mA. This board has several fine tracks that run between the IC pads and care must be taken with your soldering to ensure that no solder bridges are formed. Use a fine pointed bit.

Take a good look at Figure 2, the component overlay. Notice the resistor R2 tucked under the PowerFET Q1 and the two resistors under the IC. This more or less dictates that the resistors must be fitted first on this project. Ensure that R1 and R4 are 1/8W types and are fitted hard down on the PCB surface. This will allow the IC to seat as low as is possible, leaving some leg to solder. I would suggest that IC1 and Q1 come next. Remember not to handle them more than is required (if you don't have the luxury of a conductive mat, try raiding the kitchen for a length of aluminium foil, but do remove it before connecting any battery volts). Care will have to be taken in fitting the IC because of the resistors beneath it. The IC will not sit as close as normal to the PCB, leaving a reduced length of the leg to solder, so make sure that the IC is level, thus ensuring that the same length of leg protrudes through the PCB at each pin. When IC1 and Q1 are in place, the capacitors can be fitted, noting the polarity of C2 and C3, clearly marked on Figure 2.

There are a couple of wires to the brake-light bulbs from the points marked 'Bulbs'. The neat bit of wiring is to the Low Power Speed Controller so you should temporarily disconnect the drive battery, then fit a red wire from +ve on the PCB to the dead side of the Power switch in the Drive Battery positive lead (so that the circuit can be switched off), and a black one from -ve on the PCB to Drive Battery negative. There's one more wire from the point marked 'In' on the PCB (this will eventually go to the Speed Controller from the point marked In, to the Speed Controller at the point marked X (see inter-PCB wiring, Figure 3). If you are keen, you will probably have switched on and tried by the time you read the following!

With that last connection, this circuit is now a part of the Speed Controller. The final test will have to be with the radio control gear. When up and running, the bulbs should light, briefly, whenever you go to stop or through the stop position on the control stick. Not a lot to test, was there?

Heat-shrink tubing or even a short length of plastic insulation tape will encapsulate this little PCB. It would also make a good subject for potting in a suitable potting box.

will cause the input of the first inverter in the circuit to go positive, making its output swing negative. This negative change will be passed across C2 causing the input of the next inverter to go negative, making its output positive, which will turn on the PowerFET (Q1) and hence turn on the light.

The light will stay on until C2 is discharged back too positive by the action of R3, making the gate change state and driving its output back to negative. This will switch off the PowerFET (Q1). R1 is to limit the input current into the gate of the internal FET. R4 serves the same purpose for Q1. C4 is a small decoupler for the power rail, which is a pulse omission detector, followed by a one shot, or monostable. By using this IC, a very simple circuit using very few (and low cost) components is produced. The overall result is a short pulse of light from the brake-lights when we want one and very little current being drawn when the light is off. This is the kind of circuit I like best - no surplus Hi-Tech, just the bare minimum and no waste. That covers the basic circuit description so now it's time to warm up the soldering iron and start to build.

at the point marked 'X' after a brief test). That's the construction of the PCB completed, so now check for the solder bridges that I mentioned at the beginning. If, like me, you use reading glasses, a magnifying glass may be useful. When you are sure that all is as it should be, we can go on to test.

Testing

At this point, the Drive Battery should be re-connected. Switch the power on to the PCB. The bulbs should briefly light up (about 1 second) then go off. That is a sort of power up reset. The next job is to switch off and connect the wire

In Conclusion

The addition of any feature on a model adds to its pleasure and value, personally I feel that the less they cost, the more the pleasure. If you wish, a small model can use 3mm or 5mm Red Light Emitting Diodes (LEDs) instead of bulbs. For this, wire two Super Bright Red LEDs and a resistor, all in series (don't forget the polarity of the LEDs). The resistor should he 100R for 6V and 390R for 12V. I find that translucent, rather than opaque types, look best. It should be possible to use this circuit with other relay reversing, pulse speed controllers, by using pulses from the drive transistor/s that drive the motor, provided that they are positive going and of suitable amplitude, but this is something that I have not personally tried.

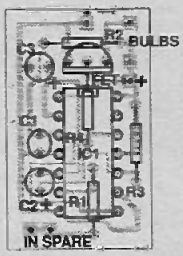


Fig.2 Component Overlay

Any situation in which you require positive pulse detection can use this type of circuit. The pulse repetition frequency that you wish to detect can be accommodated by changing the values of R2 and C1. Likewise, changing the value of R3 and/or C2 will lengthen or shorten the light On time.

A Little Extra

Now, as a bonus, how would you like to fit reversing lights? If so, read on.

The Speed Controller is capable of driving a couple of small bulbs in addition to the Relay, when switched to reverse (i.e. when the relay is called). All that is required is to add a wire to the point marked Y which should be connected via two bulbs to the dead side of the switch in the Drive Battery Positive lead. The bulbs should be selected in exactly the same way as the ones used for the brake-lights except that the current rating must not exceed 100 mA. This applies to all Controllers running at Drive Battery voltages from 6V to 12V. This will allow the 300mA relay drive PowerFET Q1 to drive both loads together without being over-driven. Should the bulbs light while in forward, the wires to the motor should be reversed.

Another feature that can be added at the point marked Y on the speed controller, which applies to trucks in particular, is reversing sound. The reversing sound that you will have heard when juggernauts reverse can be produced by a small piezo ceramic sounder, connected instead of the reversing bulbs. The type with its own built in oscillator, that produces a pulsed tone, is required for this. Again, the 100mA current limitation should be observed.

A point to note is that some of these devices produce very

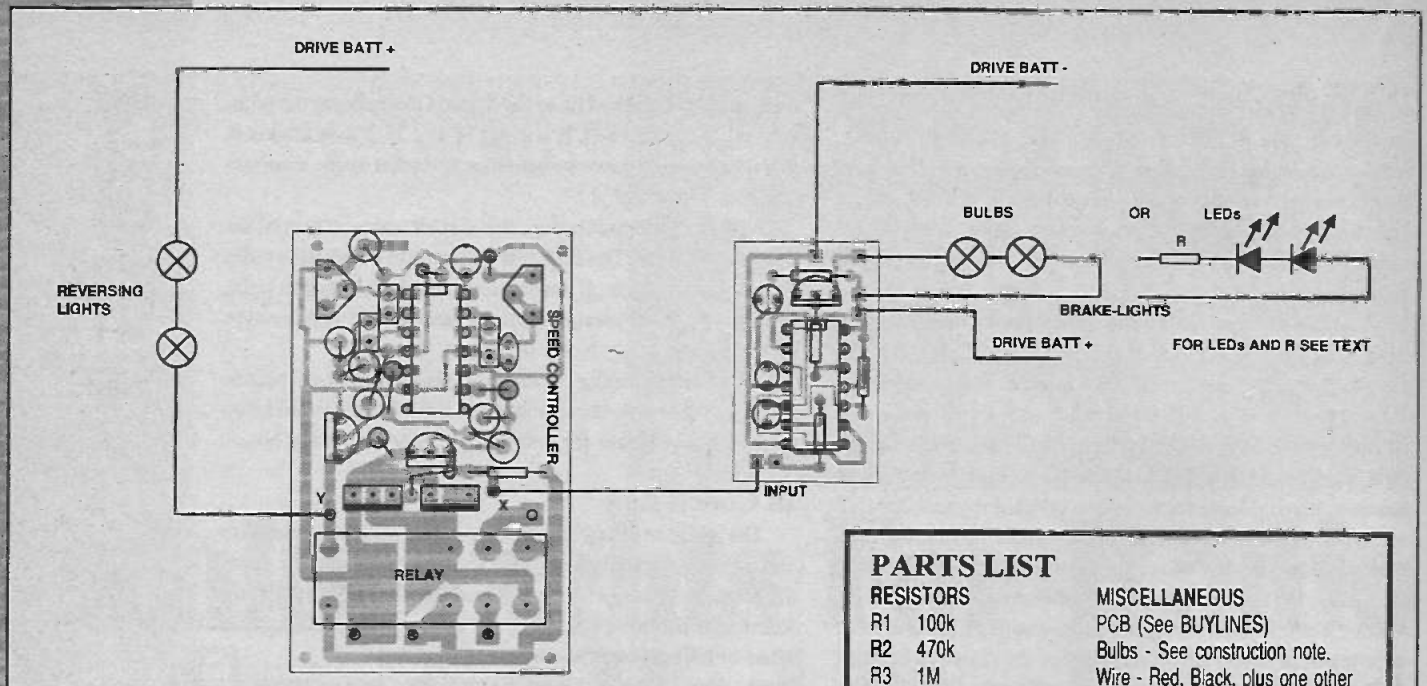


Fig.3 Board interconnections

high output levels on 12V, too loud for some applications. To overcome this, all that is needed is to cover, or partly cover, the sound hole with a strip of tape. This will dramatically reduce the level. The high frequency of these sounders is of the same order of frequencies used on some full size trucks.

Well, that's the project done, along with a few extras. I hope you enjoy building it and that it will add something special to your model.

PARTS LIST

RESISTORS

R1	100k
R2	470k
R3	1M
R4	1k

CAPACITORS

C1	100n
C2	1u/16V
C3	10u/1.6V

SEMICONDUCTORS

IC1	4007 CMOS
Q1	VN10LM PowerFET

MISCELLANEOUS

PCB (See BUYLINES)
Bulbs - See construction note.
Wire - Red, Black, plus one other colour to suit

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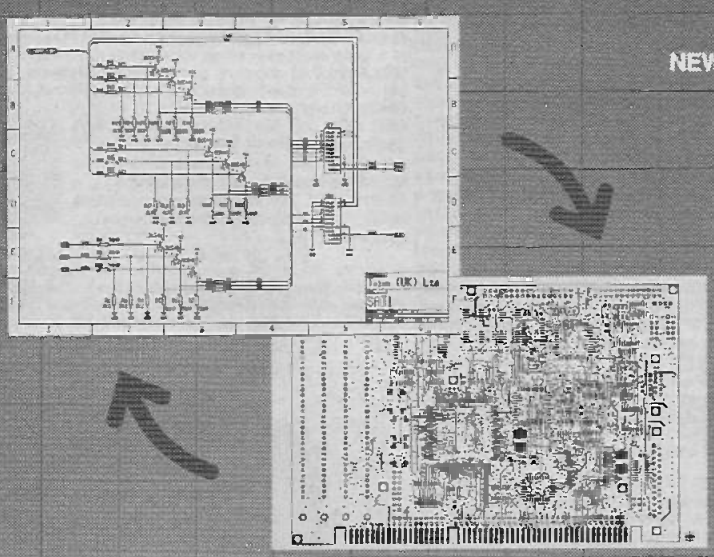

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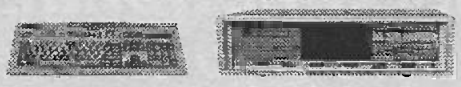

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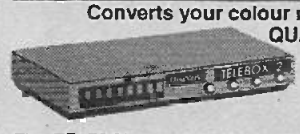

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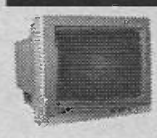

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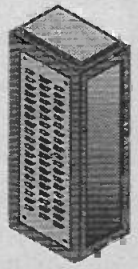

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Measuring Light Spectra

by Douglas Clarkson

New technology is increasingly making use of 'optical' processes and, as a result, there is an increased need to be able to make measurements of a wide range of 'optical' parameters, such as power output of sources as a function of wavelength and the transmission and reflection properties of materials as a function of wavelength.

While, in a strict sense, 'optical' can be considered to relate to visible wavelengths of light between 400nm and 700nm, in practice the term is applied to wavelengths below 400nm (into the ultra violet) and above 700nm (infra red). The bulk of optical communications technology, for example, uses wavelengths around 1500nm. In this field, there is an obvious need to be able to accurately measure the optical properties of fibres as they are manufactured and installed.

Increasingly, optical components such as filters, lenses, reflection coatings, photodiodes, photomultiplier tubes, etc. are being used in new products and services and there is an expanding need to be able to accurately determine the optical properties of such items.

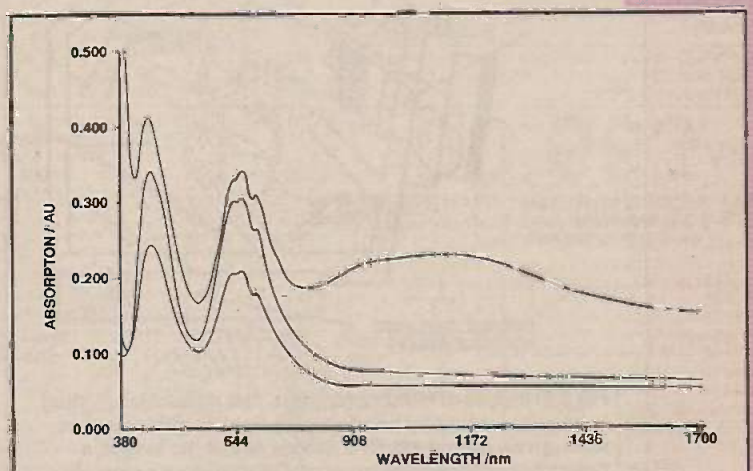

Fig.1 Values of absorption properties of samples of doped glass (Courtesy Rees Instruments Ltd)

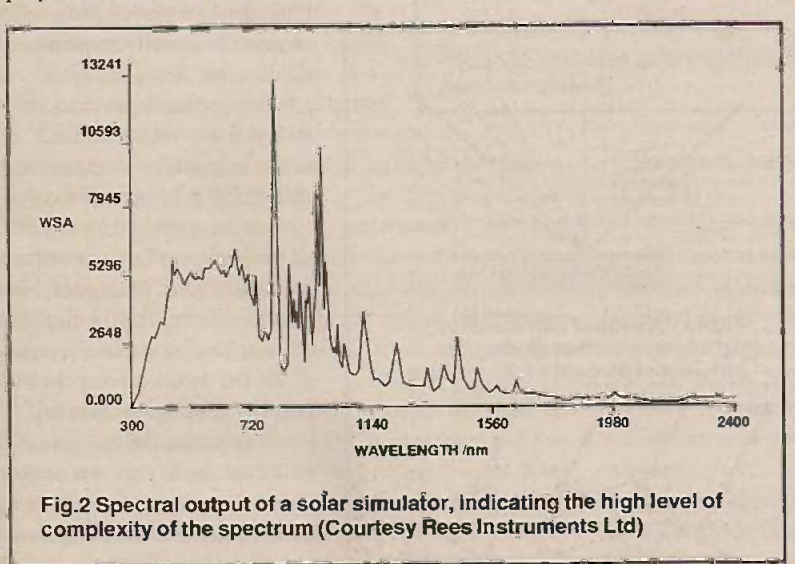

Fig.2 Spectral output of a solar simulator, indicating the high level of complexity of the spectrum (Courtesy Rees Instruments Ltd)

Figure 1 shows the absorption properties of three samples of doped glass as a function of wavelength. There are absorption peaks at around 450nm and 700nm and it is often important to be able to measure such parameters in this way. Figure 2 shows the measured output of a solar simulator. Clearly, only by measuring the spectral output in relatively narrow wavelength bands is it possible to determine the output from the lamp. In addition, there is often the need to capture spectrum data rapidly. The excitation process can be initiated and completed in timescales of hundreds of micro seconds.

Optical Measurement - A Multi-Dimensional Problem

In voltage measurements, the problem is typically one of resolving voltage values with time - i.e. one parameter is being monitored at successive time intervals. In spectral analysis, there are many more independent values to measure. The spectrum of a typical light source from 400nm to 1200nm is in fact a continuum of wavelengths, which may be scanned over wavelength extents averaged over 2nm, 1nm or 0.5nm - so there may be 400, 800 or 1600 independent measurements to be made to determine the spectrum present.

Conventional Approaches - Splitting the Spectra

Optical radiation presents typically as a range of wavelengths. Thus, a standard tungsten lamp will have a spectrum between 390nm and 1300nm. Specific lasers, such as Argon lasers, present a selection of lines of specific radiation - in the case of Argon mainly around 580nm.

Light can be split into its various wavelength components using either a prism or a diffraction grating. The 'traditional' piece of equipment for spectrum analysis is the monochromator, the basic design of which is shown in Figure 3. Although the device shown is a Spectrograph, which can split the spectrum and present it at a long exit slit, in the monochromator the diffraction grating is rotated (with indication of wavelength selected) and a portion of the output spectra passed through a narrow output slit. The

Monochromator itself does not include any equipment to measure the output of the spectra which are emitted. The mirrors in the system have typical efficiencies of 90%. Gold mirrors, with reflectivities of around 97%, can be used for infra red wavelengths.

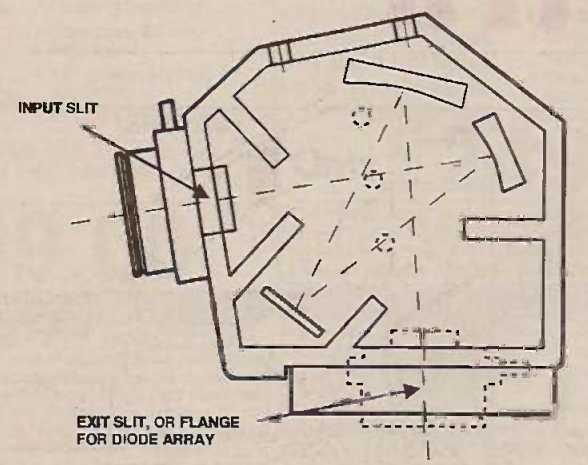

Fig.3 Principle of Monochromator. The diffraction grating is usually rotated by hand and the light output emerges through an output slit. The device shown is, in fact, a Spectrograph manufactured by Oriel where a complete spectrum can be passed to a long narrow exit slit (Spectrograph mode) or a single range of wavelengths can be selected (Monochromator mode).

Light incident on a diffraction grating is split into a series of orders about the main angle of reflection, as shown in figure 4a. Typically, most light is passed into the +1 or -1 order. To improve the amount of light passed into one of the first orders, the surface of the grating is cut in the 'blazed' pattern indicated in Figure 4b. This blazing process, while optimising the efficiency of the grating at a specific wavelength, makes the grating more 'angular sensitive' and limits the spread of wavelengths which can be used. Typically, a grating optimised for use at 500nm can be used between 2/3 and 3/2 of its optimised wavelength - in the case of the 500nm example, between 330nm and 750nm.

Conventional gratings are produced by cutting a master using diamond cutting tips. This invariably introduces an element of random error into the grating performance which results in 'stray light' - light which is reflected in error into the order of the grating being scanned.

Holographic gratings produced by the interference of two coherent light sources, can be used to produced gratings which, while having much less stray light (as little as 1% of that of a ruled grating), have a reduced efficiency because they are not 'blazed', i.e. cut to optimise a specific order. This can be of value where measurements are being made of optical materials with high values of optical densities.

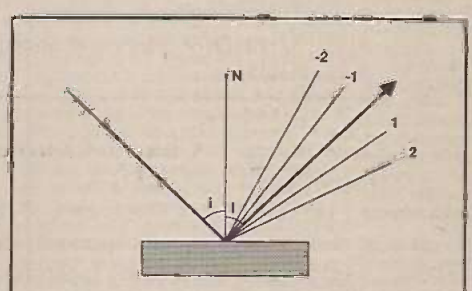

Fig.4a Process of diffraction of light by a reflection grating into different orders +2, +1, 0, -1 and -2

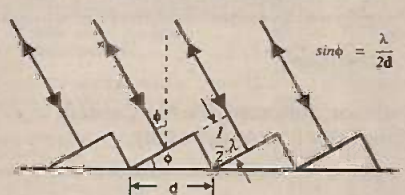

Fig.4b Geometry of 'blazed' grating, to optimise output into the +1 order

Light enters the unit via a pair of slits and is split typically by the diffraction grating. An emergent portion of the spectrum can be selected by rotating the diffraction grating a known extent. This rotation of the grating can be undertaken by hand or through a stepper motor and can be driven between extreme limits. The emergent light will contain a narrow band of wavelengths dependent on the size of output slit, the line numbers per cm of the diffraction grating and the general optics of the system. The smaller the slit and the greater the number of lines per cm on the diffraction grating, then the more selective the monochromator will be.

The width of the wavelengths present will vary typically from 0.5nm to 2nm, depending on the design and construction of the monochromator.

Introducing Rapid Measurements: Spinning Monochromators

The mechanical motion of such a basic design of monochromator is, however, not convenient for many applications where a complete spectrum is required rapidly. The previous 'standard' monochromator, for example, could typically be rotated across its spectra in about a minute. In many applications, such as production line checking of optical components, test results are required much more rapidly.

One option is to rapidly rotate the diffraction grating so that the spectrum is rapidly swept past the output slit. This is the technique used in the Rees Instruments Spectrum analyser whose spinning grating monochromator is shown in Figure 5. A single photodetector device is present at the output slit and the spectrum is constantly rotated past the output slit, which provides a system with a relatively low cost photodetector device that can be selected to match the particular application.

This approach provides flexibility in it's 'mix and match' of needs to available detectors and diffraction gratings and the system can be optimised for any part of the spectrum between 200nm and 15,000nm. The speed with which a spectrum can be obtained is limited by the speed of rotation of the DC motor driving the diffraction grating. At present, a single spectrum can be measured in 80ms with this particular model. Usually a He-Ne laser is used to provide a wavelength reference.

Figure 6 shows the spectral response of a 6118/7 detector - a nine stage photomultiplier tube used with the Rees system. In the photomultiplier tube, electrons are emitted from a light sensitive surface and then cascaded down an avalanche of voltage steps, where each stage increases the number of electrons released. Such a detector has a much higher sensitivity, about 70 A/W (peak), compared with a conventional photodiode detector's 0.5 A/W (peak). The photomultiplier detector can be used with nar-

row output slits in order to provide better resolution of measured spectra.

An uncooled silicon photodiode typically covers the wavelength range between 190nm and 1100nm. An uncooled germanium photodiode covers the range between 600nm and 1900nm while the uncooled lead selenide photoconductive cell covers the range between 1500nm and 4500nm. Thus, needs for specific applications can be met, although there is no universal photodetector which will span all the wavelengths which are required.

Introducing Rapid Measurements: Static Spectra

Developments in semiconductor chip technology have made possible the rapid scanning of complete spectra in short time scales with the absence of spinning diffraction gratings. The technique, however, cannot at present be used for wavelengths in excess of 1100nm.

Figure 7 shows how a linear diode array can be used as a 'static' system for the scanning of an optical spectrum. The light enters the system through the pair of entrance slits and is diffracted by the diffraction grating. The spectrum is incident on the diode array in discrete segments, typically 2.5mm high by 25 microns wide and 25 microns apart. Such a diode array may have 128, 256, 512 or 1024 elements and minimum exposure times of from 5ms to 16.5ms. Thus, the smaller the diode array element, the longer the minimum exposure time. The electron sensitivity of a diode element could be 3500 electrons per count with the wavelength range able to scan ranges from 180nm to 1100nm.

In this mode of spectral analysis, the light is processed into its spectral components by a Spectrograph - the entire spectrum is made available at the exit slit to be read by the solid state linear array of CCD. The solid state detector unit is simply bolted onto the spectrograph output slit structure (Figure 4) and interfaced to a PC via a specialised interface card.

The great advantage of this type of system is that there are no moving parts and the spectrum can be sampled rapidly by reading out the voltage sensed by the various discrete diode elements. Systems can, in addition, be configured to scan a smaller sub set of diode elements more frequently. A scan repetition rate of 25 micro seconds can be achieved by use of special random-access type diode arrays to access specific elements of the diode array.

Linear arrays function on a charge integration basis, where the charge released by electrons being released by the photoelectric effect (light photons release electrons) is accumulated over a specific time period and then reset when a specific pixel's data is read. The so called dark current is the current which flows in 'dark' conditions and it can set a limit on the exposure time during which measurements are made. In low cost linear array systems the dark current at room temperature is around 1pA and the total saturation charge of a diode element is around 7pA - giving a maximum exposure time of around 10 seconds. Diode arrays of a higher specification and which can be cooled either by liquid nitrogen or thermoelectrically by a Thermoelectric Cooler, allow longer integration times. Such improved diodes have a higher saturation charge and a smaller dark current of around 0.01pA - providing integration times of 25 minutes at temperatures of around -10°C.

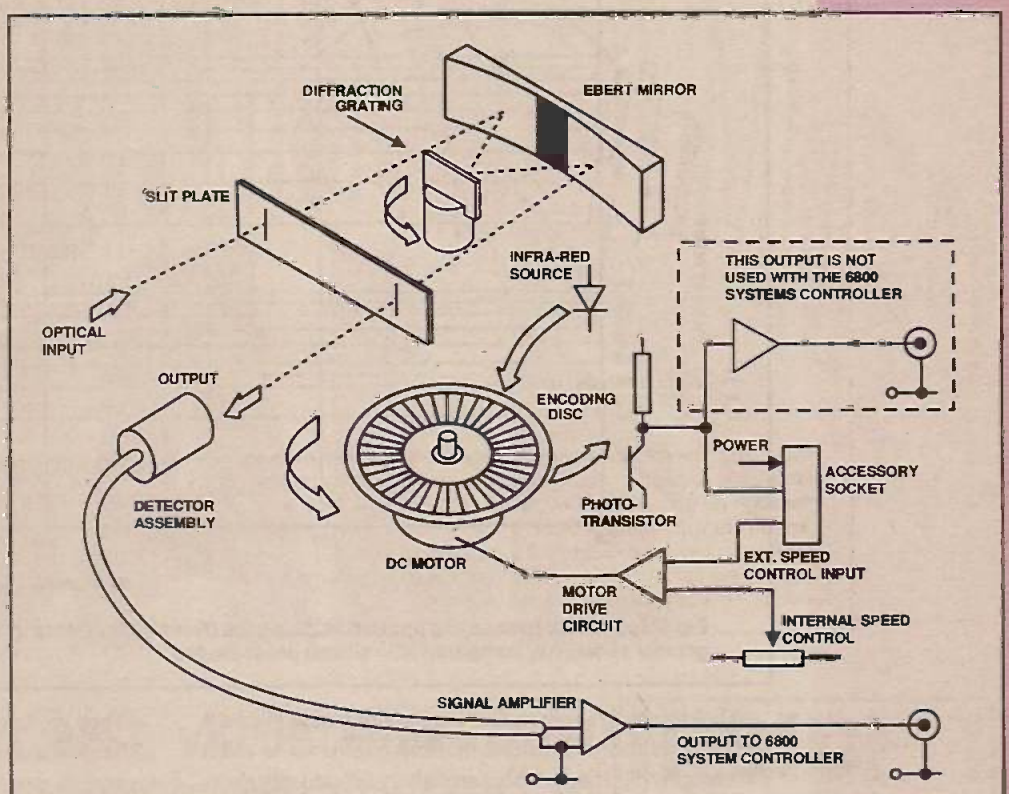

Fig.5 Technique of spinning Monochromator for rapid scanning of spectra (Courtesy Rees Instruments Ltd)

Charge Coupled Device Technology (CCD)

This linear diode array gives a one dimensional view of a specific spectrum, which can be considered as an N x 1 array. There are applications, however, where several spectra are required to be analysed in parallel. The charge coupled device can be considered to be a N x M array, where several spectra which have been processed independently by a diffraction element, can be identified separately on the CCD. CCDs are now produced with in excess of 1024 x 1024 elements.

Figure 8 shows a series of four separate fibre optic inputs which are independently split by means of a spectrograph to produce four separate spectra on the CCD. On a typical CCD unit, of a 1024 by 256 array, each spectrum will typically be contained with a separate array area of 1024 pixels wide by about 64 high. The resulting value for a particular element of the array will be obtained by summing the 64 elements (y axis) at a specific one of the 1024 elements (x axis). Each pixel is typically 22 x 22 microns and systems are now available which can process up to 35 independent spectra on a single CCD element.

The greatly increased sensitivity of CCD devices allows data from experiments to be obtained much more rapidly compared with conventional photomultiplier systems.

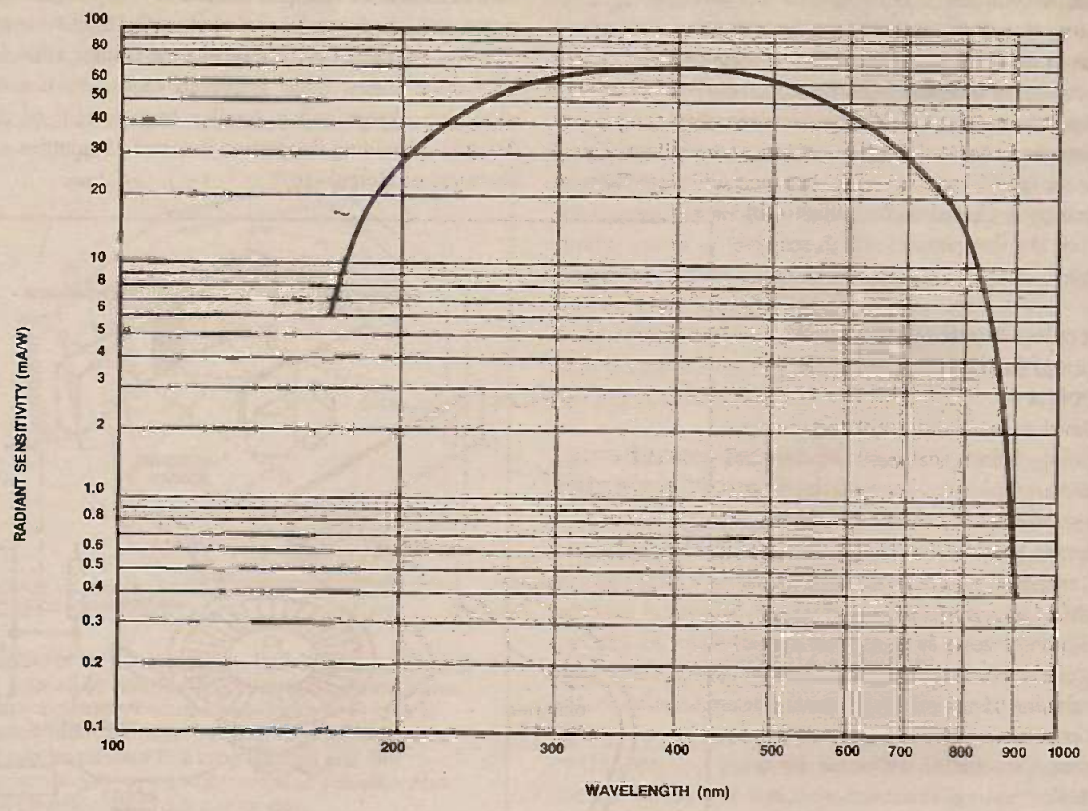

Fig.6 Spectral response of a photomultiplier tube (Rees Instruments 6118/7) which provides significantly greater sensitivity compared with silicon photodiodes

The wavelength response of CCDs is shown in Figure 9. UV enhancement can extend the response down to lower wavelengths (300 microns) but sensitivity falls sharply above 1000nm. Thus, CCD technology cannot at present be used effectively for spectral analysis above this limit. With spinning monochromators, however, the wavelength range can be extended up to 15nm using detectors such as Mercury Cadmium Telluride (MCT).

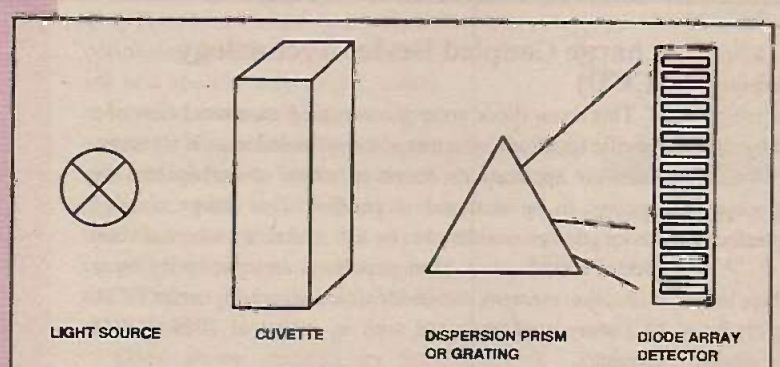

Fig.7 Use of 'static' spectral analysis system, where incident light is diffracted using a static diffraction grating and the output is detected by a stationary linear diode array

The scanning rate of such a complete CCD unit is 40Hz, with the display being updated at 20Hz, although individual pixels can be accessed in fractions of micro seconds.

The technology of the Charge Coupled Device, however, is radically different from that of linear diode arrays and consequently CCDs tend to be expensive. Useful CCDs tend to cost in excess of £15,000 - just for the chip.

They do, however, have an unsurpassed sensitivity. One of the most sensitive units has a sensitivity of 10 light photons to produce one count, several hundred times more sensitive than a conventional linear diode array. CCDs are being developed generally for high quality image data capture. Applications in Astronomy, where extremely weak light sources are being imaged, are particularly relevant.

Dynamic Range

The dynamic range of a spectral analysis system is based on the resolution of its A/D converter subsystem. The common value for resolution is 16 bits - 1 in 65536, while the lowest values tend to be 14 bits - 1 in 16384. The greatest dynamic range, however, is provided with systems incorporating CCD units, where an 18 bit resolution - 1 in 262144 - tends to be standard and 22 bit resolution - 1 in 4194304 - is 'top of the range'.

It is obviously important to have as high a dynamic range as possible. If, for example, the absorption properties of a material were being investigated, a system with a higher dynamic range is going to be able to directly measure higher levels of optical density.

Conclusion

Developments in several areas of technology have made optical spectral analysis more affordable and subsequent developments are likely to increase the range of features which can be implemented at an acceptable cost. A low specification system interfaced to a PC may cost around £10,000. While the ability to measure light spectra is of vital

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3 Free gifts and reduced price offers from previous lists are not available with sale goods
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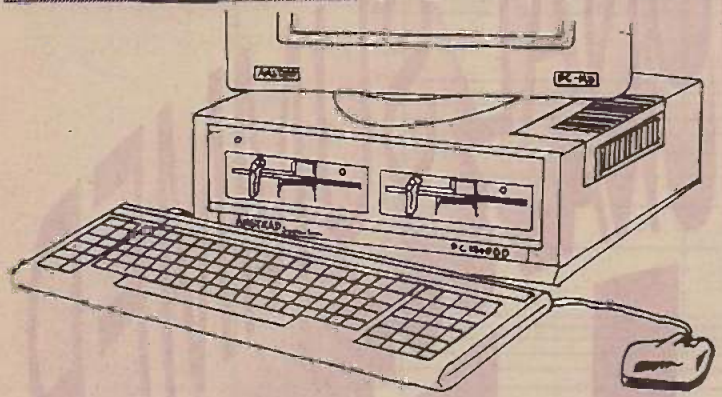
GREENWELD ELECTRONICS LIMITED 27 PARK ROAD SOUTHAMPTON SO1 3TB
TEL: (0703) 236363; FAX 236307; BBS 236315

SUPER SENSATIONAL SUMMER SALE

GREENWELD 27 Park Rd. Southampton SO1 3TB
Tel: 0703 236363 Fax: 236307

All one off and pack prices **INCLUDE** V.A.T. Qty. prices do not.

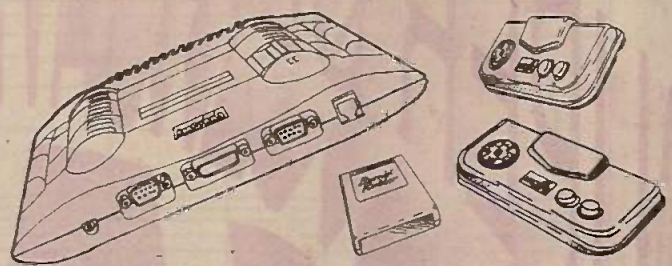
AMSTRAD PC1640 COMPUTER



Brand new full spec base unit, keyboard, mouse and manual (no monitor) Standard PC1640 with 640k RAM and 2 x 5.25" disk drives, only being sold so cheaply because we have no monitors to go with them. Actually worth more as spares (work it out - keyboard £25, 2 disk drives £50, case £20, motherboard £25, mouse £5) but as they're taking up lots of room and we haven't the time or space to take them all apart, you gain an absolute bargain! **£99.95**

AMSTRAD GX4000 HOME ENTERTAINMENT SYSTEM

*Games Console
*2 Control Paddles
*TV lead
*Burnin' Rubber Cartridge
*Power Supply
*Instruction Books



Super games console that never really hit the big time - but it's a beautifully made piece of kit with loads of features, originally selling for around £100 - and the cartridges were £25!

The console itself measures 250x160x40mm and has a myriad of inputs and outputs to cater for most devices. Inputs: 2 paddles with 9 pin D sockets (supplied), also 15 way D skt for analogue joysticks and 6 way aux modular socket for light pen/gun etc. Outputs are 8 pin RGB monitor skt; SCART skt, UHF output to phono skt; and a stereo sound 3.5mm jack socket. It can be powered by the AC adaptor supplied (11V @ 500mA) or 5V from MM12/CM14 monitors.

Inside the plastic case, the PCB 205x147mm contains a wealth of goodies: Z80A CPU in socket, AY-3-8912 sound chip, 168 pin dedicated chip, UM1234 UHF modulator, games cartridge socket, 7805 on a heatsink + a dozen transistors.

EXCEPTIONAL VALUE AT £29.95

SALE PRICE £14.95

SALE OFFER

FREE SOFTWARE

Any 4 pieces of software on page 3 with every PC1640!

See Page 33 for details of VICTOR PC just received

Dataspectrum

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

SALE PRICE £3.50

QUICKSHOT MOUSE

High quality optomechanical mouse by Bondwell
* Microsoft compatible
* IBM PC XT or AT compatible
* Hardware selectable mouse standard
* Programmable resolution 29-1450 DPI
* High tracking speed 500 mm/s
* Silcone rubber coated tracking ball

Includes
* Universal mouse driver
* Performance Test Programme
* D9-D25 connector adaptor

ORDER CODE QS158
PRICE REDUCED TO £19.95

SALE PRICE £14.95

Atari 2600 Games Console

These popular consoles are complete, refurbished units with joystick, power supply, TV lead and games cartridge (Centipede). £29.95

SALE PRICE £14.95

Z8953 Complete unit with power supply and comprehensive instructions. Designed to add the facilities of error correction, speed buffering, encryption (optional) and a battery backed data store with a printer port to existing modems capable of speeds up to 2400 baud. Easy to use. (Send £5 returnable deposit for user manual for further information). **£20.00**

SALE PRICE £10.00

Z9012 Memorex MRX IV ½" computer tape. 600 ft on 175mm dia spool. 6250BPI. In case, in sealed poly bag. List £7.49.
Our price ..... **£3.50** 50+ 2.00

SALE PRICE £1.00

Z9010 Tape streamer. Tandberg TDC3319. Internal fitting (same size as 5¼" disk drive). Takes DC600 tapes. Unsure of capacity - possibly 60Mb. Does anyone know?
Price **£250.00**

SALE PRICE £100

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

SALE PRICE £1.00

Z5123 Modem. Fully functional brand new and boxed. Standard 160 x 100mm Eurocard with DIN41612 connector. Only 300 baud, but at the price we're asking represents superb value for money!! Supplied complete with wiring details - needs ±12V.
Price ..... **REDUCED TO £8.00**

SALE PRICE £3.95

Magnetic card reader head - used for detecting when credit card or similar is swiped. Made by DRH. Type no 01.635. No other info (but our technical expert is working on it).

Order Code	Z2121	
Prices	£2.00	100+ £1.00

SALE PRICE 2/£1.00

CROSSTALK XVI

Another super software deal! - We've purchased a number of the best selling 'CROSSTALK XVI' data communication packages. New and sealed containing a 5¼" disk and 182 page manual. PC DOS V3.61, last selling for around £60 - our Special Price

£17.95

Order Code: **Z5495**

SALE PRICE £8.95

PC-MIX

Z5444 Multitasking Interface Executive for the IBM PC and compatibles. Enables up to 3 programs to be run simultaneously. 96 page handbook and 5.25" disk **£4.95**

SALE PRICE £3.50

See Page 33 for details of WINDOWS SOFTWARE just received

WORDS & FIGURES by LIFETREE

Comes with 546 page manual and spread out menu + disks, all in a library case

Z5442 5.25" version
Z5443 3.5" version

ONLY £14.95

SALE PRICE £9.95

Features Include:

Spreadsheet
- 1-2-3 1A compatible .WKS files
- 9999 rows by 256 columns
- Supports 1-2-3 1A functions, macros
- Protected and hidden cells
- Horizontal or vertical split screen
- Move, copy, transpose ranges
- Sparse matrix data storage
- Supports LIM Expanded Memory
- Uses 8087, 80287 math coprocessor

Word Processor
- Include "live" spreadsheet data in document
- Two-line headers and footers
- Bold, underline shown on-screen
- Global find and replace
- Right & left justify, centering
- Automatic reformat, word wrap
- Import text from ASCII files
- Supports over 200 printers

Auditor
- Toggle from worksheet to audit display with a single command
- Pinpoint circular references
- Identify source of other errors

Data Management
- Three-key data sort
- 7 database statistical functions
- Query using up to 32 search criteria, wild card parameters

Graphics
- Line and XY graphs; scatter plots, pie, bar and stacked bar charts
- Superset of 1-2-3 1A type fonts
- High-resolution display (EGA, Hercules)
- High-resolution output to printers and plotters

Requirements: DOS 2.0 or higher, 256K RAM, two disk drives, monochrome or color display

Printers: Text—over 200 including Epsons, IBM, Tandy, HP LaserJet™ and many others; Graphics—Epson; HP LaserJet, PostScript™ printers, and others.

3½" disk version available; requires 1 disk drive.

'INDIVIDUAL' Tutors

Nicely boxed sets for IBM PC's with handbook and disk

Z5446 Learn to type 3.5" **£3.95**
SALE PRICE £2.50

Z5447 Learn to type 5.25" disk only **£1.95**
SALE PRICE £1.00

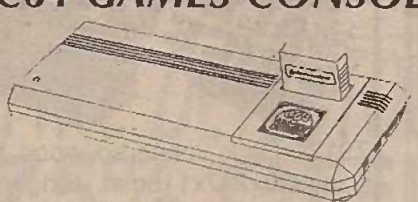
Z5448 Learn to use DOS 5.25" **£3.95**
SALE PRICE £2.50

Z5449 Learn to use DOS 3.5" **£3.95**
SALE PRICE £2.50

Z5450 Learn to use your PC 5.25" **£3.95**
SALE PRICE £2.50

Z5451 Learn to use your PC 5.25" disk only **£1.95**
SALE PRICE £1.00

C64 GAMES CONSOLE



TY1 Clearing final stocks of this popular console. They are customer returns, and are sold "as seen" - no test, no guarantee, except they are complete. Final **reduction to £20**

SALE PRICE £15

Z1101 Sinclair P15/G Pack. 7 cassettes (no library cases) in a boxed set with over **100 games**, all with documentation.

ONLY **£2.95**

SALE PRICE £1.50

Z1102 Sinclair Soft888 pack. 6 cassettes, all in library cases in a boxed set. Oh Mummy, Treasure Island, Punchy, Disco Dan, Crazy Golf, Alien Destroyer.

ONLY **£2.95**

SALE PRICE £1.50

SPECTRUM +2 LIGHT GUN

Action Pack - complete with lead, software and instruction book

£6.95

SALE PRICE £2

STEREO CAR RADIO/CASSETTE

B002 JCS2228

RADIO/CASSETTE PLAYER

DIN standard mounting car radio/cassette player unit with metal tuner. Analog tuning with AM/FM. Local/Distant and Mono/Stereo push button selectors. Overall tune, volume and balance controls. Auto stop cassette mechanism with fast forward control. Orange back-lighting.

Output power.....8.5W per channel RMS
.....20W per channel peak
FM range.....88-108MHz
AM range.....540-1600kHz
Power.....13.8Vdc negative earth
Dims.....140 x 178 x 50mm (body)

Featured in our 1993 Catalogue at £44.95 - now offered at nearly half price! Buy now while stocks last!

£24.95

12+ 14.00

SALE PRICE £19.95

CABLEVISION CALAMITY !!!

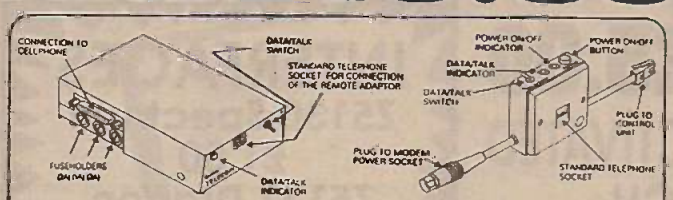
Seems like Visionhire became a bit over-stocked on their cablevision consoles - we've just purchased a quantity of these superb brand new units which contain some great electronics and as ever can offer them at an absolute BargainPrice!!

Two tone brown case (dimensions as shown) contains PCB 192x195mm with easily removed UHF modulator made by Labgear (Sound and Vision); video pre-amp; stabilized power supply and all the decoding circuitry (9 transistors and TBA673 chip).

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

Z8939 £6.95 100+ 3.50 1k+ 2.50. **Add VAT to quantity prices**

SALE PRICE £2.50



DATA INTERFACE

Z8976D DS1000 data interface for using cellular phones for fax transmission. Comes in 2 parts: a) Control Unit in a steel case 170x102x45mm with connections to cellphone and remote adaptor and b) Remote Adaptor, which is a BT socket that has plugs to the control unit and modem, a standard telephone skt, data/talk switch and indicator, and on/off button and indicator. Must have cost a fortune. Brand new and boxed, we're selling these for the useful parts -relays, pot cores chips, plugs, sockets etc. The whole lot, with data for just **£5.95** 100+ 3.50

SALE PRICE £3.00

VISTEL CLEARANCE

Visual telephone + "Ansaphone" for deaf people. Keyboard + 40 character LCD display in case 340x450x137mm. All sorts of facilities - full details in earlier supplements. Although complete with handbook, there is no guarantee they work.

SALE PRICE £20.00

FIRE DETECTOR 75% OFF!!

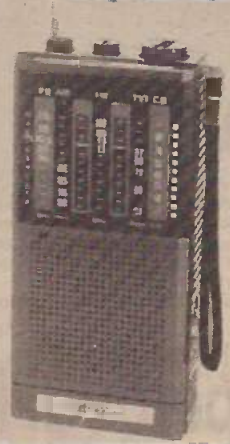
Z5371 Simplex rate-of-heat rise and 135°F detector, model 4255. A rise of more than 15°F per minute, or if temp reaches 135°F will close contacts. Supplied boxed with installation instructions. These normally sell for around 18.00. **Our price £10.00** 100+ 5.50

Z5391 Apollo series 30 heatrise fire detector. Set temp 60°C. Supply 17-28V. OP around 18.00 **Our Price £9.50**

SALE PRICE - EITHER TYPE

£2.50

MULTIBAND RADIO



This compact piece of equipment 200 x 95 x 50mm comes in an attractive metallic grey case with controls on top - tuning, on/off and volume, squelch. The telescopic aerial extends to 500mm and can be rotated in any direction. The 3 wavebands are:

1) CB, channels 1-80
2) TV1 54-87 MHz & FM 88-108 MHz
3) AIR 108-145 MHz & PB 145-176 MHz.

The large 3" full range speaker delivers 280mW of undistorted power. There is an earphone jack and DC adaptor jack. The unit is powered by 4 x AA cells. All this technology for just.....£17.95 10+ 11.90

Order Code MB100

SALE PRICE £14.95

Become a Bargain List Subscriber! A new list every month for just £6 a year. See page 47 for details

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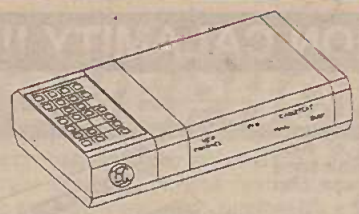
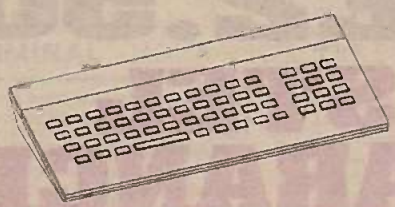


Z8970 Remote control cable TV unit made by GEC. Attractive black plastic case 205x120x40mm with membrane pushbutton keypad (22 keys). Front panel has 4x5mm red LED's to indicate status and a dual 7 seg display to show channel. On the 195x102mm PCB is a small regulated power supply (12V & 5V) derived from Z5226 plug in PSU (not supplied). The main chip is a KS49429 and there are also TBA120T, ULN2003B, 4049 + 4.000MHz crystal & 3 small signal transistors as well as the IR detector diode. 2 screened cases contain (a) a PCB with some filter circuitry utilizing surface mount technology, few small chokes, couple of trimmer caps and input and output sockets; and (b) the infra red decoding circuitry using a TDA3047 chip. Regrettaby, we don't have any remote controllers, but these units offer great value for money – **just £5.95 each**

SALE PRICE £3.95



Z5216 Tandata "Homedeck". These are later versions of Z8963 and are (a) smaller and (b) remote controlled. The two tone grey case is 270x110x28mm and has a full qwerty keyboard and seperate numeric keypad. Inside, on the PCB are a few components to transmit the data via 2 IR LED's to the receiver. The unit is powered by a PP3 battery. Super value at just **£3.00**

SALE PRICE £2.00

Z5200 Spirit Burner. Very useful in science labs or for the home experimenter. Chromed steel container 93mm diax48mm high has absorbent material covered in wire mesh. Adjusting lever allows variations in temperature. Complete with 70mm dia dish for heating substances in. Only **£2.50**

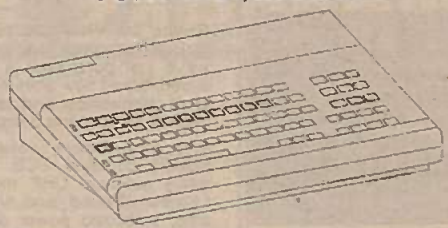
SALE PRICE £1.00

Z5499 UM1233 Astec UHF modulator, brand new, full spec. Currently being sold for around £6.00

OUR PRICE £2.00

SALE PRICE £1.00

Viewdata Terminal/Modem



Tandata TD1100 alphanumeric Viewdata/Prestel Adaptor. These units were used with a home banking system. The console was hooked up to your TV and telephone line, and by using the standard qwerty keyboard with seperate numeric keypad, you could access your account. The well styled black and grey case 300x180x75/40 has a 75 key keyboard connected inside by a DIL plug to the main PCB. This has mounted on it the modem sub-panel + 3 relays, UM1286 Astec colour modulator with sound, + SAA5020, 5050, 5070, SY6504, 68B10, MCM51101P45, 2x2114 & 2732 EPROM all in sockets, as well as over 20 other LS and linear chips, transistors etc. There's a back up nicad battery and a regulated power supply. On the rear panel is an on/off rocker switch, UHF output socket, printer skt(15 way D), and cassette DIN socket for recording data.

There are 3 leads attached; 4m long mains lead with 13A plug, 4m long BT lead with old-style plug, and a 3m long TV co-ax lead.

All in all, a versatile, useful compact unit either to use as it is or for the parts within. The component value alone is over £60, so you can see what a bargain this is – it even comes with a photocopied handbook!!

Order Code **Z8963**. The whole unit as described for just **£12.95**

SALE PRICE £5.00

SOUND ACTIVATED SWITCH

F605 **AML768**

SOUND ACTIVATED SWITCH

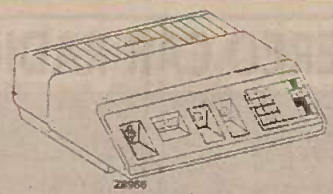
Plug-in sound activated switch, ideal for switching on lights automatically. On detection of a sound above a preset level power will be switched on to the built-in socket for a preset length of time. A photo transistor with control prevents the switch from activating during daylight.

Controls: Sound level, time, light level

Power 220/240Vac 50Hz
Max. load 500W

Superdeal Price £12.95

SALE PRICE £9.95



Z8966 Prestel set less monitor. This cased unit 420x430x100mm made by Philips, model HU01 contains all the logic and control circuitry for Prestel – the monitor (not supplied) sits on top. On the back panel there is an 8 pin DIN socket for text output to monitor, mains outlet to monitor and an 8 pin DIN printer socket. There's also a mains lead and old type lead to telephone socket. On the front panel there is a detachable (on curly lead) keypad (20 keys) on/off keyswitch, tape and keyboard sockets and indicator lamps. Inside there's a large transformer and power supply and 4 PCB's – one is a modem panel; one has 8048 and SBB2626 in sockets + 15 other chips, transistors etc; the third has SAA5030/5042/5020/5050, a bit of memory (2x2114) + a few other chips. The fourth panel has SAA5010 in socket, 9xBSX20, 4xBC548/558. All boards are interconnected with plugs and sockets. These units are complete but not new and may well be in working order – but we're selling them for the parts value only – just **£16.00**

SALE PRICE £4.95

Xtra Special

INTERFACES

Z5130 Spectrum £1.00

Z5131 Dragon £1.00

Z5132 CBM £1.00

Star Buy !!

TELEPHONE LEADS AND HANDSETS

Z5361 Curly lead, new, BT handset plug one end, 4 spade terminals the other. Pale grey. DP 4.11 **Our Price £2.00**

Z5362 4 core telecom lead 3m long with BT line plug one end, 4 way socket the other. DP 4.40. **Our Price £2.00**

Z4309 BT 'breakout' lead. One end has moulded housing with 6 pin BT plug and socket. Other end has 6 pin FCC68 plug (as used on some computers). Overall length 3m
Price £2.20

Z5500 Telephone handset in pale grey with black 4 core lead. No plug **£2.00**

Z5512 Ivory telephone handset, 4 way curly cord with spade terminals which can be unplugged (unusually) from handset. **£2.50**

Z5360 New brown telephone handsets by BT, complete with curly cord and 4 way socket. **£4.50**

ALL HALF PRICE

Z9118 Philips Sopho K8 Telephone System. Brand new wall hung unit, still in original packing until we undid it to find out exactly what it was. Just plug in to the mains, add your lines, buy a few handsets and you've saved a packet!! Wired for 3 lines and 8 extensions. Max capacity 5 lines and 12 extensions. (Extensions can be bought second hand for £25-40 each) Our price (1 only) **£175.00**

SALE PRICE £75.00

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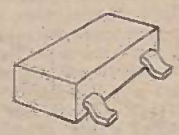
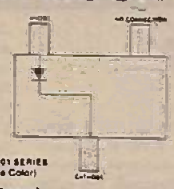
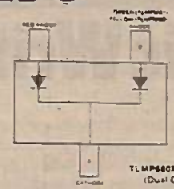
All one off and pack prices INCLUDE V.A.T. Qty. prices do not.

EVERYTHING ON THIS PAGE 2 FOR THE PRICE OF 1

SURFACE MOUNT LED's







These LED's are in a SOT23 package (2.9x1.1x1.4mm)

CODE	PART NO	COLOUR	SPEC	£2 PACK	100+	1k+
Z2671	TFS056	Red	1.6mcd @ 10mA	12	.08	.06
Z2672	TFS059	Green	1.6mcd @ 10mA	12	.08	.06
Z2673	TLMP6301	Orange	0.5mcd @ 10mA	15	.06	.045
Z2674	TLMP6311	Red	1.6mcd @ 10mA	12	.08	.06
Z2675	TLMP6401	Yellow	0.5mcd @ 10mA	15	.06	.045
Z2676	TLMP6411	Yellow	1.6mcd @ 10mA	12	.08	.06
Z2677	TLMP6501	Green	0.5mcd @ 10mA	15	.06	.045
Z2678	TFS021	Red/Green	0.5mcd @ 10mA	8	.12	.09
Z2679	TLMP6802	Red/Yellow	1.6mcd @ 10mA	6	.16	.12
Z2680	TLMP6803	Red/Orange	1.6mcd @ 10mA	6	.16	.12
Z2681	TLMP6811	Red/Green	1.6mcd @ 10mA	6	.16	.12

KS106 A mixed pack of 100, containing most of the above types for just £8.95

MINIATURE LED's

These LED's have axial leads

CODE	PART NO	COLOUR	SPEC	£2 PACK	100+	1k+
Z2691	TFS065	Red 1.8mm	2.8mcd @ 10mA	10	.10	.07
Z2692	TFS066	Red 1.8mm	2.8mcd @ 10mA	10	.10	.07
Z2893	TFS068	Green 1.8mm	4.5mcd @ 10mA	10	.10	.07

STANDARD LED's

These LED's have radial leads

CODE	PART NO	COLOUR	SPEC	£2 PACK	100+	1k+
Z2682	MV6052	Red 5mm	0.7mcd @ 20mA tint/undiffused	25	.045	.03
Z2683	SL35091G	Orange 3mm	16mcd @ 10mA	15	.06	.04
Z2684	HLMP3850	Yellow 5mm	150mcd @ 20mA untint/undiffused	12	.075	.05
Z2685	HLMP3950	Green 5mm	150mcd @ 20mA untint/undiffused	12	.075	.05
Z2686	TLMP7413	Yellow 5mm	150mcd @ 20mA untint/undiffused	12	.075	.05
Z2687	TLMP7513	Green 5mm	150mcd @ 20mA untint/undiffused	12	.075	.05
Z2688	TLMP7313	HE Red 5mm	150mcd @ 20mA untint/undiffused	12	.075	.05
Z2689	LST712L	Orange/Green 5mm	4mcd @ 20mA milky/diffused	10	.09	.06
Z2690	XC5549R	Red 5mm	4mcd @ 10mA tinted/undiffused	30	.04	.025
Z2694	TLMP5401*	Yellow 5x2mm	4mcd @ 20mA tinted/undiffused	15	.055	.035

*These have an interlocking moulding incorporated to enable accurate alignment when stacked.

CODE	TYPE	COLOUR	SIZE	SPECIFICATION	TU/DU	QTY	£2 PACK
Z2907	HLMP0401	YELLOW	2.5X7MM	0.9MCD @ 10MA	TD	1900	12
Z2908	HLMP0504	GREEN	2.5X7MM	0.9MCD @ 10MA	TD	296	12
Z2909	HLMP1321	HE RED	3MM	6.0MCD @10MA	TU	1700	16
Z2910	HLMP1421	YELLOW	3MM	6.0MCD @10MA	TU	100	12
Z2911	HLMP1521	GREEN	3MM	4.2MCD @ 10MA	TU	400	12
Z2912	HLMP3050	RED	5MM	2.0MCD @ 20MA	TU	6880	30
Z2913	HLMP3316	HE RED	5MM	20.0MCD@10MA	TU	1192	15
Z2914	HLMP3416	YELLOW	5MM	20.0MCD@10MA	TU	5444	12
Z2915	HLMP3517	GREEN	5MM	6.7MCD @ 10MA	TU	1514	14
Z2916	HLMP3519	GREEN	5MM	10.6MCD@10MA	TU	2172	12
Z2917	HLMP3862	YELLOW	5MM	8.0MCD @ 10MA	TD	200	14
Z2918	HLMP4610	HE RED	5MM	2.0MCD@ 10MA	TD	8422	25
Z2919	MV54123	GREEN	2X5MM	1.0MCD@20MA	TD	592	15
Z2920	MV6051	RED	5MM	0.4MCD@20MA	UD	4400	15
Z2921	MV64520	GREEN	5MM	12.0MCD@20MA	TU	514	12
Z2922	MV6752	HE RED	5MM	17.0mcd@20MA	TU	19112	20
Z2923	TF5012	HE RED				2416	20
Z2924	TF5031	HE RED	5MM	6.3MCD@10MA	TD	56170	25
Z2925	TF5032	RED	5MM	10.0MCD@10MA	TD	1564	20
Z2926	TLMP5001	RED	2X5MM	INTERLOCKING	TD	2775	20
Z2927	TLMP5301	HE RED	2X5MM	INTERLOCKING	TD	12823	15
Z2928	TLMP5501	GREEN	2X5MM	INTERLOCKING	TD	3600	15
Z2929	TLMP5801	RED/GRN	2X5MM	INTERLOCKING	TD	567	10
Z2930	TLMP7003	UB RED	5MM	200.0MCD @20MA	UU	1278	10
Z2931	TLMP7005	UB RED	5MM	300.0MCD@20MA	UU	924	8
Z2932	TLMP9710	HE RED	TO46	3.0MCD@20MA	H	95	12

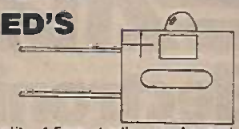
H = Hermetic; TU/DU = Tinted/Untinted/Diffused/Undiffused

Traffic Light LED modules. Plastic moulding 15x10x7.5mm that have 2 x 3mm LED's mounted in them. Ideal for railway modellers etc.
Z2855 Red and Orange
Z2856 Red and Green
Z2857 Green and Yellow
All the same price - any mix, 10 for £2.00

Panel mntg LED's in chrome bezel, with long leads. Require 6mm hole
Z2744 Yellow Pack of 6 £1.00
Z2745 Green Pack of 6 £1.00

Z2860 3mm red diffused IR LED. No other info, so 10 for £1

SUBMIN LED'S



These excellent quality 1.5mm Led's are housed in a 6.2x5x2.4mm package with built in resistor for 5V operation (add 470R resistor for 12V). Available in Green (DP £1.73) or red (DP £1.16).
Z2135 Red ..... 3/£1 100+ 0.15
Z2136 Green ..... 2/£1 100+ .25

Z2461 PC mntg packaged red LED - mounts at right angles to PCB. 10.5x8x3.9mm. LED is 3mm. Ore type 9301A. Pack of 10 £1.00 100+ 0.05; 1k+ 0.04

Z1934 Stackable red LED - white casing round 6x3.5mm. Pack of 10 for £1.00

A couple of small matching rectangular LED's, 3.8 x 1.75 mm:
Z2500 Green Pack of 12 £1 100+ .05 1k+ .04
Z2501 Red Pack of 12 £1 100+ .05 1k+ .04

Z1845 Rectangular LED 7 x 2.5 Red. Unusual size by Hewlett Packard type LMP301.
Price ..... Pack of 12/ £1.00

Z1464 3 way white★ (lights up red) 7.5mm .. 20p 10/ 1.40

Z1932 Red square LED with rounded corners, 5mm. Pack of 15 for £1.00

Z1933 Thin rect. red LED - 5x1.5mm. Pack of 20 £1.00

Subminiature
(Last digit of Type No. denotes array length)

Z2571 Hewlett Packard sub-min red LED array type HLMP6204. Strip of 4 x 1.8mm LED's, easily seperated if required. DP 1.27. Our Price: Pack of 6 £2.00

Z2091 Red 5mm square, Liton type LTL9223A. Pack of 12 £1.00; 100+ 0.038; 1k+ 0.03
Z2098 Red 7x2.55mm rectangular by Senior type SE6511D. Pack of 12 £1.00; 100+ 0.038; 1k+ 0.03
Z2095 Red 5mm square with rounded corners by Phillips type HR44DL. Pack of 12 £1.00; 100+ 0.038; 1k+ 0.03
Z2096 Clear infra red 4.5x1.5mm rectangular, Honeywell type 8406. Pack of 8 £1.00; 100+ 0.06; 1k+ 0.04
Z2097 Red 5x2mm rectangular by GI, type MV57123. Pack of 12 £1.00; 100+ 0.038; 1k+ 0.03 .

Z2182 Standard 5mm red LED with 18mm leads, bent at right angles. 18/ £1.00 100+ 0.03 1k+ 0.02 10k+ 0.015.

Hermetically sealed, TO46 case

CODE	PART	COL	RATING	£2 PK	100+
Z2764	TLMP9210	GRN	3.0 mcd@20ma	15	.07
Z2765	TLMP9310	YELL	3.0 mcd@20ma	15	.07

Z5501 Panel 71x27mm with dual 7 seg LED+red and green rect LED's. Pack of 10 £2.00

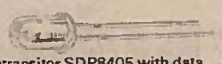
Z5502 Another, this time with a dual and single 7 seg LED+red and green rect LED's. Pack of 8 £2.00

EVERYTHING ON THIS PAGE 2 FOR THE PRICE OF 1

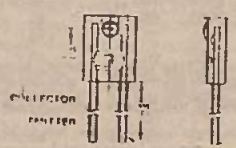
(B) (i) PHOTOTRANSISTORS, INFRA RED

All are in TO18 hermetically sealed cases.

CODE	PART NO	ImA	mW/²cm	£2 PK QTY	100+
Z2766	TDET800W	0.3	5	10	.10
Z2767	TDET801W	0.5	5	10	.10
Z2768	TDET802W	2.5	5	10	.10
Z2769	TDET803	4	5	10	.10
Z2770	TDET804	7	5	10	.10



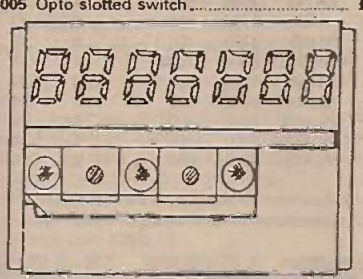
Z1847 4 Phototransitor SDP8405 with data.
Price **£1.00**



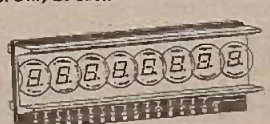
Z1846 2 pairs of infra red emitter/ receiver SDP8406/ 8506 by Honeywell with comprehensive data.
Price **£1.00**

Z2122 Vactel Type VTL 10DI - IR emitter and detector can be removed from the plastic housing if required. An extremely cheap version of TIL100/TIL38!
Pack of 5 ..... **£1.00** 100+ 0.10 1k+ 0.07
Z1743 TIL143 Opto slotted switch. These have cropped leads and some are ex-equip. but are all working.
Price ..... **Pack of 3/ £1.00**

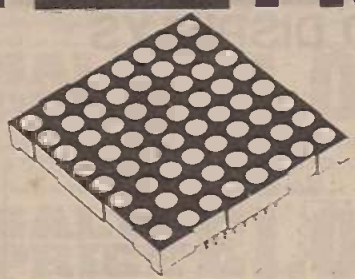
Z1499 Opto slotted switch on small (25×26mm) panel Type P850 ..... **75p**
Z1500 Opto reflective switch type OPB6076 with 3pin connector **75p**
PS4005 Opto slotted switch **£1.00**



Z2658 LED module. An interesting little PCB 50x35mm that has mounted on it a 7 digit 7 segment red display, and a plastic moulding under which are 3 surface mount LED's, one each red, yellow and green. On the back of the PCB is a SED5031M chip. Offered without info at present, although we are working on it. Believed to have been the display on a mobile phone. **Only £1 each**



Z2903D Red **LED** PCB mounted display - 12 bubble digits 0.11" high. **Full data supplied. Only £1.50 100+0.80**
Z415 Display. 8 digit LED multiplexed. With data. 31 × 16mm.
Price **80p**
Z5501 Panel 71x27mm with dual 7 seg LED + red and green rect LED's. **Pack of 10 £2.00**
Z5502 Another, this time with a dual and single 7 seg LED + red and green rect LED's. **Pack of 8 £2.00**



(C) LED BLOCKS

CODE	PART NO	SIZE (MM)	MATRIX	COLOUR	PRICE
Z2759	TFB3358C	35	5X8	YELLOW	1.60
Z5469	TFB3458C	35	5X8	GREEN	1.60
Z2760	TFB3758A	35	5X8	HE RED	1.60
Z5470	TFB3758C	35	5X8	HE RED	1.60
Z2761	TFB5357A	51	5X7	YELLOW	1.80
Z5471	TFB5357C	51	5X7	YELLOW	1.80
Z5474	TFB5457A	51	5X7	GREEN	1.80
Z5475	TFB5457C	51	5X7	GREEN	1.80
Z5478	TFB5757A	51	5X7	HE RED	1.80
Z5479	TFB5757C	51	5X7	HE RED	1.80
Z5472	TFB5388A	58	8X8	YELLOW	3.50
Z5473	TFB5388C	58	8X8	YELLOW	3.50
Z5476	TFB5488A	58	8X8	GREEN	3.50
Z5477	TFB5488C	58	8X8	GREEN	3.50
Z5480	TFB5788C	58	8X8	HE RED	3.50

The suffix A or C to the part number indicates common anode and common cathode respectivelev.

Z1855 7 seg **LED** 81720R – giant 1" digit, red. common cathode **£1.00**

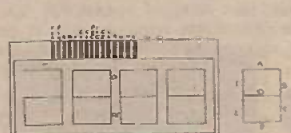
Z2722 7 seg LED, MAN74A 0.3" CC red. **A tube of 25 for £3.50** 500+ 0.10

Z2435 Single 7 seg LED 10mm high digit. Type LN514RK. Common cathode. **4 for £1.00;** 100+ 0.15; 1k+ 0.10

Z2434 Dual 7 seg LED , **type** TDDR5250 by TFK. Red common anode 13mm digit height. DP 1.14. Our special low price (we have 10000 to clear) **2 for £1.00; 100+ 0.25; 1k+0.18**

Z2905D Red 2 digit 0.5" display as above. Common cathode **2 for £1.00** 100+ 0.50

Z2906D As above but common anode **2 for £1.00** 100+ 0.50 1k+0.35



Z2362 MS463M 0.6" common cathode 4 digit multiplexed display on PCB 70x30 with 15 way connector. Intended for digital clock use. Supplied with pin out. **ONLY £1.50**

Z2904D Red 3.5 digit 0.5" PCB mounted LED display. Common anode multiplexed output and stackable with full data. £1.00 100+0.50

Z1361 Right angle DIL socket for mounting 7 seg displays (takes our MAN6740 dual digit). Extremely high quality.
Prices: 40p 10+ 0.26 100+ 0.17.

NEON INDICATORS

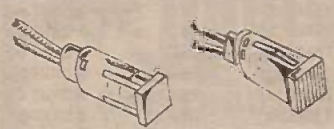
Top quality range by IMO – they are cheap because they're 110/120V – but we supply a suitable resistor for mains operation

Type A - Panel mounting 33 × 15mm with 0.25" tags. Clip fix, requires 25 × 12.5mm cut-out.
Z1899 Green
5 for £1 100+ 0.10 1k+ 0.06

Type B - Panel mounting 36.5 × 26.5mm with 0.25" tags. Clip fix, requires 30 × 22.5mm cut-out.
Z1901 Red
Z1903 Amber
(Any mix) 5 for £1
100+ 0.10 1k+ 0.06

Type C - Small round face 10mm dia. Clip fix, requires 9mm dia hole.
Z1905 Red
Z1906 Green
Z1908 White
(Any mix) 5 for £1
100+ 0.10 1k+ 0.06

Type D - Large round face 13.5mm dia. Clip fix, requires 12.5mm dia hole.
Z1910 Green
Z1912 White
(Any mix) 5 for £1
100+ 0.10 1k+ 0.06



Type E - Small square face 10.5mm. Clip fix, requires 9.5mm dia hole.
Z1914 Green
Z1915 Amber
Z1916 White
(Any mix) 5 for £1
100+ 0.10 1k+ 0.06

Type F - Large square face 13.5mm. Clip fix, requires 12.5mm dia hole.
Z1917 Red
Z1918 Green
Z1919 Amber
Z1920 White
(Any mix) 5 for £1
100+ 0.10 1k+ 0.06

Type G - Small round face 7.5mm dia. threaded body. requires 6.5mm dia hole.
Z1921 Red
Price: **5 for £1; 100+ 0.10; 1k+ 0.06**

Type H - Body dia 17.5mm - chrome bezel. Wire ends.
Z2066 Clear
Price ..... **5 for £1.00**
100+ 0.10 1k+ 0.06

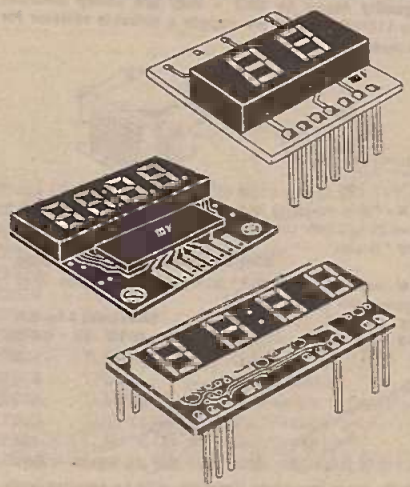
K700 Pack of indicators, types A-G. May include any of those listed above. Great value for money! **20 for £2.50**

Z2459 Neon bulbs 5.5mm dia x 15mm long – wire ended 90V neons at a great saving over normal prices! Made by VCH International. **In packs of 100 at £4.00** 10+ 3.00

Z511 Mains neon, clear 0.25" tabs require 15mm hole.
Prices 20p 10/ 1.30 100/ 10.45
Z514 As above, but 110V red. Same prices.
Z517 Mains neon, orange. Square face. Req 12mm hole.
Prices 20p 10/ 1.30 100/ 10.45
Z518 Mains neon, white. 0.187" tabs. Req 15mm hole.
Prices 20p 10/ 1.30 100/ 10.45
Z529 Mains neons - 90V neon + resistor with clear sleeve over and leads 70mm long. Some have dry joints.
Price **100/ £6.00**

EVERYTHING ON THIS PAGE 2 FOR THE PRICE OF 1

LED INTEGRATED DISPLAYS



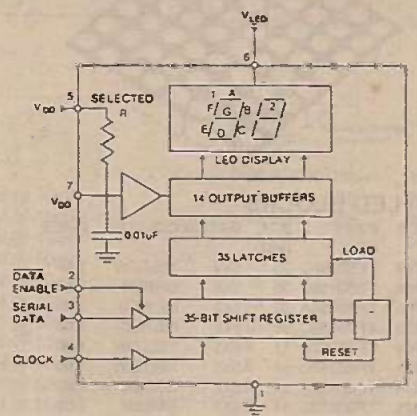


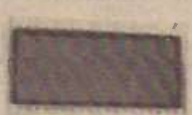
FIGURE 1—Block Diagram

A selection of 2 & 4 digit red and green displays with on board serial data in/parallel data out chips. Designed to operate with minimal interface. TTL compatible. Wide power supply operation. Direct current drive. Comprehensive data available - see below for details.

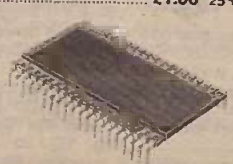
CODE	TYPE	COLOUR	DESCRIPTION	QTY	PRICE
Z2888	TSM4307	RED	2-DIGIT 0.3"p	429	£1.00
Z2889	TSM4507	RED	2-DIGIT 0.5"p	873	£2.40
Z2890	TSM5032	RED	2-DIGIT 0.3"	543	£1.00
Z2891	TSM5032P	RED	2-DIGIT 0.3"p	354	£1.00
Z2892	TSM5052	RED	2-DIGIT 0.5"	131	£1.40
Z2893	TSM5052P	RED	2-DIGIT 0.5p	955	£1.40
Z2894	TSM5232P	GREEN	2-DIGIT 0.3"p	654	£1.10
Z2895	TSM5252	GREEN	2-DIGIT 0.5"	14	£1.50
Z2896	TSM5252P	GREEN	2-DIGIT 0.5"p	14	£1.50
Z2897	TSM5732	HE RED	2-DIGIT 0.3"	663	£1.10
Z2898	TSM5735P	HE RED	4-DIGIT 0.3"p	74	£2.00
Z2899	TSM5752	HE RED	2-DIGIT 0.5"	98	£1.50
Z2900	TSM6232P	GREEN	2-DIGIT 0.3"p	248	£1.10
Z2901	TSM6732P	HE RED	2-DIGIT 0.3"p	358	£1.10

The p suffix indicates pcb with 0.1" pitch pins
Individual data sheets are supplied with each device, and a booklet, Z2999 is available with applications data + program listing on all the devices. price £2.00
K848 A pack of 10 assorted of the above types £5.00

Z2163 4 Digit multiplexed LCD. 50×30mm probably for an electronic balance-symbols include balance pens, 5 stage bar graph, lb's and kg's etc. Digit height 12mm. Self adhesive pad on back. 13 pin PCB connector. **£2.00**.



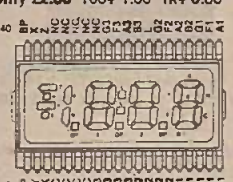
Z1637 LCD Display - Direct drive 3½ digit with 'LO-BATT', 12.7mm high digits. Op voltage 4-12 RMS @ 32Hz type. Consumes only 25µA with all segments on. Trade price £7.97 each. Supplied with data, but no edge connector.
Prices ..... **£1.00** 25+ 0.65 100+ 0.50



Z2119 4 digit LCD 12.5mm high with low battery and clock symbol. Complete with edge connector.
Price ..... **£1.50** 25+ 0.95 100+ 0.65

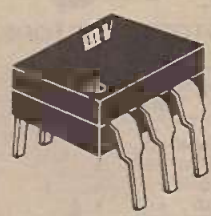
Z4115 8 digit 12.7mm high LCD and holder. These are 14 segment devices allowing alphanumeric display. Normally costing over £15.00 we are offering these for just **£4.50**

Z2432 LCD 8 digit 10mm high. Single sided 36 way edge connector. **Only £2.00** 100+ 1.00 1k+ 0.80



Z2655D Clock or 3 1/2 digit LCD with 40 way connector. 12.7mm character height like H1331CC. DP 4.70. Our price £2.00

Z5287 Here's an oldie - we had a batch of these some time ago - the "Tyrometer" - used to indicate tyre pressures on HGV's, this is the pod that fitted into the drivers cab. On the front panel are two small push and a toggle switch. Inside is a PCB with 11 miniature wire ended bulbs, a choke, 2 caps and a buzzer. There's a short length of 14 way ribbon cable, too. £3.95



(A) OPTOCOUPLERS

(i) Transistor

CODE	PART NO	VOLTS (RMS)	CTR% MIN	NOTE	£2 PK QTY	100+
Z2773	4N35	2500	100		10	.12
Z2775	CNY1711	3000	63		10	.12
Z2777	CNY33	1770	20		10	.12
Z2779	CNY47	2000	20		10	.12
Z2780	CNY47A	2000	40		10	.12
Z2782	CNY51	4000	100		10	.12
Z2783	H11A2	1060	20		10	.12
Z2788	H11A3	1770	20		10	.12
Z2790	H11A520	4000	20		10	.12
Z2791	H11A550	4000	50		10	.12
Z2792	H11AA2	1770	10	D	6	.20
Z2793	H11AGI	4000	300	A	6	.20
Z2794	H11AVI	4000	100		10	.12
Z2795	H11AVIA	4000	100	B	10	.12
Z2796	H11AV3	4000	20		10	.12
Z2797	H11AV3A	4000	20	B	10	.12
Z2800	H11D4	1770	10		10	.12
Z2822	H11F2	1770		C	10	.12
Z2826	H11J3	NO INFO			20	.06
Z2835	MCT2	1060	20		10	.12

Notes: A: CMOS CTR @ 1mA
B: GULLWING
C: FET - NO OTHER DATA
D: AC INPUT

K845 Mixed pack containing many of the above, plus others in quantities too small to list. 25 for £2.95

(ii) Darlington

CODE	PART NO	VOLTS (RMS)	CTR% MIN	£2 PK QTY	100+
Z2771	4N30	1060	100	8	.13
Z2772	4N31	1060	50	10	.10
Z2778	CNY35	1060	10	10	.10
Z2781	CNY48	1500	600	6	.16
Z2798	H11B2	1770	200	8	.13
Z2799	H11B3	1700	100	8	.13
Z2823	H11G1	2500	1000	4	.25
Z2824	H11G3	1500	200	8	.13
Z2825	H11G46	4000	500	6	.16
Z2831	MCA230	2500	100	8	.13
Z2832	MCA231	2500	100	8	.13
Z2835	MCA255	2500	200	6	.16

K846 Mixed pack containing many of the above, plus others in quantities too small to list. 25 for £3.95

(iii) Triac/SCR

CODE	PART NO	VOLTS (RMS)	Itr mA MAX	Vb	NOTE	£2PACK QTY	100+
Z2774	4N39	1060	14	200	S	6	.16
Z2776	CNY30	1770	11	200	S	6	.16
Z2783	GE3009	7500	30		T	6	.16
Z2784	GE3010	7500	15		T	6	.16
Z2785	GE3012	7500	5		T	6	.16
Z2786	GE3021	7500	15		T	6	.16
Z2836	MOC3009	7500	30		T	6	.16
Z2837	MOC3011	7500	10		T	6	.16
Z2838	MOC3012	7500	5		T	6	.16
Z2840	MOC3021LP	7500	15		TP	6	.16

Note: S = SCR T = Triac P = Surface mount pins
K847 Mixed pack containing many of the above, plus others in quantities too small to list. 20 for £3.95

(iv) Schmitt

CODE	PART NO	VOLTS (RMS)	Itr mA (MAX)	£2PACK QTY	100+
Z2827	H11L2	2500	10	3	.35
Z2828	H11L3	2500	5	3	.35
Z2830	H11N1	3750	3	3	.35

GRAPHIC & DOT MATRIX DISPLAYS

LM225 Hitachi 640x200 dot matrix LCD for PC's, WP's, and industrial equipment. Module size 270x150x13mm. Display area 239x104mm. Dot size 0.32x0.46; pitch 0.49. Has on board 16 x HD61100 & 4 x HD61103 chips. Reduced from £39.50. **Now only £25.00**

SALE PRICE £14.95

Z5424D Graphic module LCD by Hitachi type LM212. Viewing area 240 26mm. Overall size 270 63mm. Similar to LM211 but narrower, for which we have data (supplies). **£20**

SALE PRICE £12.95

Z5489 20x2 dot matrix display by Toshiba, type TLC501 with 2xHD44100 & HD44780A00 chips on board. Fitted with 14 pin IDC type plug. PCB 115x37mm. £7.00

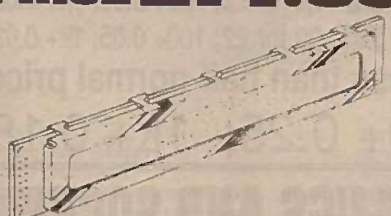
SALE PRICE £4.95

Z5460 Epson dot matrix display type EG2401A. Display area 139x39mm. Overall size 178x69mm. No data at present **£15.00**

SALE PRICE £9.95

Z5458 Epson 20 character x 8 line LCD, model EA-Y-20080AT, with backfight. This is the same spec (apart from the size) of our Z4372. Overall size 140x95mm. Dispaly area 83x63mm. Supplied with comprehensive data. £25.00

SALE PRICE £14.95



(D) LCD DOT MATRIX MODULES

All with HD44780 controller (and HD44100 on larger displays)

CODE	PART No.	SIZE	CHAR	HT	PRICE
Z5482D	TLCM1620	16X2	5X7	4.27	5.00
Z5484D	TLCM2011	20X1	5X7	5.20	4.60
Z5486D	TLCM4021	40X2	5X7	5.20	9.50

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

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Z5096 16 character x 1 line. Very similar to our Z1814 but slightly larger character -6.3x3.15 (8x5 dots). Type LCDM16166 by Refac. Supplied with data. Uses Hitachi HD44780A00 chip.
Price **£8.00**

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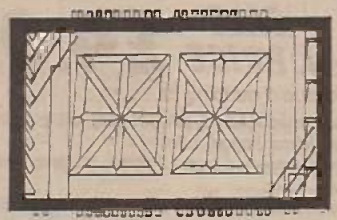
Z1731 NEC Vacuum Fluorescent Display FIP8BII. 8 digit multiplexed output 10mm high. Heater voltage 2V, grid/anode voltage 24V. (Use Z4248 transformer to power).
Price **£3.00**

SALE PRICE £1.00

Z5459 Fulaba 16 character x 2 line vacuum fluorescent display, type 162-BY-01Z. Supplied with pin out. Next month's 'Guardian' will have some driver circuits shown. Only £2.50

SALE PRICE £1.00



Z5118 Giant 30mm fluorescent 2 character green star burst display. 88 x 49 x 8mm. Futaba type 2-JY-02Z. Needs 3V and 10-18V. Data supplied. **Only £2.00**

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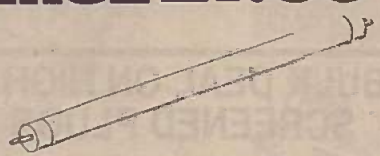

Z2586 6" 4W fluorescent tubes, T5 miniature. DP 1.95 **Our Price** £1.00 100+ 0.70

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Lampholders – rectangular snap in type that take LES bulb. Needs 16.1x11.6mm cut-out. DP (1978) 92p
Z5193 Red 3/£1.00 100+0.15

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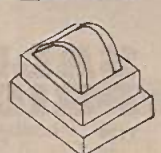
PIR SENSOR



Z2700 PIR sensor. Extremely neat basic sensor (no electronics) in plastic moulding 33x28x30mm. Supplied with circuits and lots of information. Has 10m range. 164° angle of view. <1mW power consumption. **£9.95**

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Z1921 Large square face 13.5mm. Clip fix, requires12.5mm dia hole. Red. **Price:** 5 for £1.00; 100+0.10; 1k+0.06.

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Z2172 40 character x 1 line LCD by Optrex (Japan). High quality double height display with 192 character ROM; other characters can be displayed by generation in RAM. Other features include cursor with control, blink character, scroll display, read and write display data, single +5V supply, data and power inputs by one 16 pin 0.05" SIL socket. pin outs standard and compatible with other Optrex displays, contrast control, easily interfaced with either 4 or 8 bit uP's. Supplied complete with data. Dimensions: Characters are 5 x 12 dot arrays measuring 3.2 x 10mm Display size 170 x 17.5mm Module size 220 x 40mm DP over £50.00 **Our Price £15.00**

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Z5035	687	Phono plug + 5 pin 180° plug both ends.	£1.24	0.62
Z5037	680	PL259 + phono plug to BNC plug + 3.5mm plug.	£2.46	1.23
Z5038	685	PL259 + phono plug both ends.	£2.12	1.06
Z5039	683	PL259 + 2 x phono plug to BNC plug + 5 pin DIN 180° plug.	£2.62	1.31
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Z5053	669	PL259 + phono plug to 2 phono plugs.	£1.72	0.86
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Z5055	675	PL259 + 5 pin DIN 180° plug to PL259 + 2 phono plugs.	£2.36	1.18

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Z4186 3m multicore lead terminated both ends with 50 way centronics (IEEE-488) socket. Ideal for stripping down for flex – total 150m of multicoloured 7/0.2. Connectors alone worth £12.80
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PL616 DC adaptor lead for Walkman, 1.8m long.
Price ..... **30p** 100+ 0.15

PL528 2 pin DIN line socket to phono plug 0.2m long.
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PL708 Video lead. PL259 plug to F type plug. 3m low loss coax.
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PL508 5 pin DIN - 3 pin DIN audio lead 1.2m long.
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Z4353 6 way DIN lead: 1.5m lead terminated one end with a 6 pin DIN plug. Bare wires the other end.
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Z5332 PC keyboard cable – standard heavy duty high quality curly lead with 5 pin DIN plug one end, push in connectors the other. Ex-new equipment. **£2.00**

SALE PRICE £1.00

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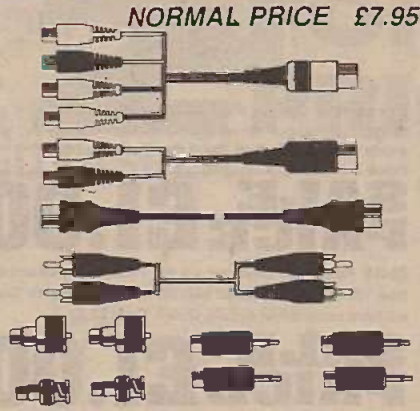

T120A **SALE PRICE £4.00**

Video/audio dubbing kit.

- ★ 1 screened lead - 5-pin DIN plug to 5-pin DIN plug. Mirror image. 1.5m.
- ★ 1 twin, screened lead - 2 phono plugs to 2 phono plugs. 1.5m.
- ★ 1 twin, screened lead - 2 phono sockets to 5-pin DIN. 180mm.
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- ★ 2 adaptors - phono socket to PL259 (UHF plug)
- ★ 2 adaptors - phono socket to BNC plug
- ★ 4 adaptors - phono socket to 3.5mm jack plug

Z4350 A set of 3 different pairs of test leads, offering great value! – a) 67mm long, 2mm probes both ends; b) 110mm long, 2mm probes one end, 4mm plugs the other; and c) 90mm long silicon rubber, 2mm probes one end, shrouded 3mm sockets the other. All are red and black pairs. All three for just £2.00

SALE PRICE £1.00

Z5401 Spider leads – like our P0650 at 99p, but they are grey, 2m long and have a 1.3mm power plug (for Walkmans) as well as the normal 2.1 and 2.5 power plugs, and 2.5/3.5 jack plugs.
2 For £1.00 100+ 0.24; 1k+ 0.16

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Z5387 Car power lead – cigar plug one end, 2.1mm power plug the other. 2m long £1.75 100+ 1.00

SALE PRICE £1.00

Z5417 Scoop purchase on 5PIN DIN – 5PIN DIN leads – 1.2m long, moulded on plug, black lead. **Pack of 10 £2.95**

SALE PRICE £1.50

Z5087 Lead - 6 PIN DIN to 3 coloured phono plugs (video or L and R audio) using flat splittable screened lead. Nice and long-2M. Cheap enough to cut the DIN plug off and reterminate with phonos!
Price ..... **2/£1.00** 10+ 0.35 100+ 0.25

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5 for £2 100+ 0.25; 1k+ 0.18

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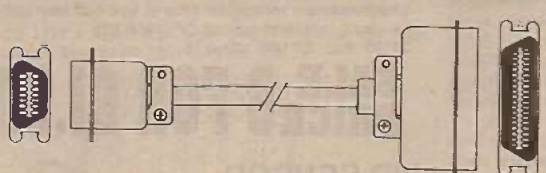
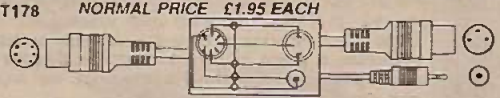


T190B **£2.00**

14-way Centronics plug to 36-way Centronics plug. MSX printer lead.
Length 2m

SALE PRICE 2 FOR £1.00

T178 *NORMAL PRICE £1.95 EACH*



7-pin DIN plug to 3-pin DIN plug and 2.5mm jack plug. Colour grey.
Length 1m

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T108 **BUC12**
BNC plug to PL259 (UHF) plug.
Length 1.2m

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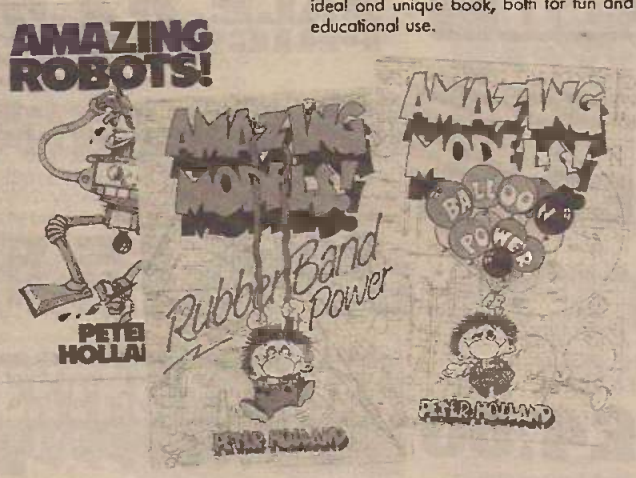

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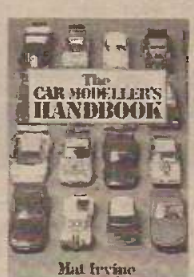

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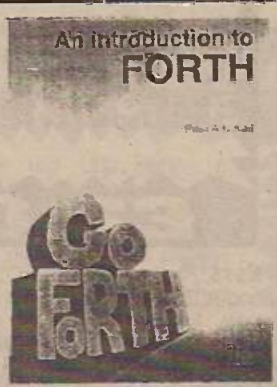

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SALE PRICE £2.00

EXTRA SPECIAL PACK PRICE

K531 Precision Resistor Pack . High quality close tolerance R's with an extremely varied selection mostly 1/4W and 1/2W tolerances from 0.1% to 2% - ideal for meters, test gear etc.
PRICE: 250/ £3.00

£1.50

K523 Resistor Pack . 1000 - yes 1000 mainly 1/2W 5%, 10% & 20% carbon/carbon film resistors with prefomed leads for PCB mounting. Fair range of preferred values.
PRICE: only £2.95

SALE PRICE £1.50

EXTRA SPECIAL PACK PRICE

K572 Resistor Networks. both SIL and DIL in here, from 6 to 16 pin. Plenty of popular values like 1K, 4K7 and10K and a good sprinkling of many other values.
PRICE: Pack of 100 £4.50

£2.00

K503 100 Wirewound Resistors. From 1W to 12W, with a good range of values.
PRICE: £3.50

SALE PRICE £2.00

K525 Preset Pack. Big, big variety of types and sizes-sub-min, min and std, MP, slider, multiturn and cermets are all incuded. Wide range of values from 20R to 5M 100 assorted
PRICE: £6.75

SALE PRICE £3.50

K505 20 Assorted Potentiometers. All types including single, ganged, rotary and slider.
PRICE: £2.30

SALE PRICE £1.20

K827 Cermet trimmers. An excellent range of multiturn minature cermets from 10R to 2M.
PRICE: Pack of 50 £7.95

SALE PRICE £4.50

K828 "Lo-ohm" wirewound pack. Values less than 10R are always popular and this pack contains only resistors between 0R1 and 10R.
PRICE: Pack of 50 £4.30

SALE PRICE £2.50

OPTOELECTRONICS

K701 110V Indicators. This pack of neon indicators comprises round and square panel mounting types in red , green , amber and clear
PRICE: Pack of 20 £2.50

SALE PRICE £1.75

K539 LED Pack . Not only round but many shaped LED's in this pack in red, yellow, green, orange and clear. Fantastic mix.
PRICE: 100/ £6.50

SALE PRICE £3.95

K524 Opto Pack . A variety of single point and 7 segment LED's (incl. dual types) of various colours and sizes, opto isolators, numicators, multi digit gas discharge displays, photo transitors, infra red emitters and receivers.
PRICE: 25 asstd. £4.50

SALE PRICE £3.00

K806 LED Pack contains only red LED's round, square, rectangular etc, from 3mm to 7x 2.5mm.
PRICE: 100/ £5.00

SALE PRICE £3.00

EXTRA SPECIAL PACK PRICE

K801 Seven seg. LED pack . Big variety of sizes in this pack . May include Red and green also overflow/ polarity displays, single/ double digit also 7/8/9 digit. magnified displays . Sizes from 0.11" to 0.8".
PRICE: 20 peices for just £ 3.95

£1.95

K804 Lamp Pack. A superb quality pack containing a wide variety of small lamps. Many different types - wire ended bi-pin , slide, MBC , MES , LES , TI , wedge, miniflange etc in voltages from 2.5V to 220V. Most are marked with voltage/ current
PRICE: Pack of 50 £ 4.00

SALE PRICE £2.50

SUPER SENSATIONAL SUMMER SALE

GREENWELD 27 Park Rd. Southampton SO1 3TB
Tel: 0703 236363 Fax: 236307

All one off and pack prices INCLUDE V.A.T. Qty. prices do not.

SWITCHES & RELAYS

EXTRA SPECIAL PACK PRICE

K532 Relay pack . We've now built up enough surplus relays to offer this popular pack once more. Could contain anything from 2V to 250V coils, SP to 6 pole contacts switching up to 10A.
PRICE: 20 for £6.95

£3.50

W4700 Push button banks. An assortment of latching and independant switches on banks from 2 to 7 way DPCO to 6PCO. A total of at least 100 switches.
PRICE: 100/£6.95

SALE PRICE £3.50

K592 Pack of 25 minature rocker and lever switches from page 125 of the 1991 catalogue.
PRICE: £4.00

SALE PRICE £3.00

K593 Pack of 25 push and slide switches from page 125 of the 1991 catalogue.
PRICE: £3.50

SALE PRICE £2.50

K520 Switch pack. 20 different assorted switches - rocker, slide, push, rotary toggle, micro etc. Amazing value.
PRICE: £2.50

SALE PRICE £2.50

K542 Reed Relays. Mostly DIL single pole & double pole also some changeover, these are manufacturers rejects, but a good proportion work. 5V to 50V coils. 50 assorted.
PRICE: £3.30

SALE PRICE £1.50

K715 DIP Switch pack tremendous selection of DIP switches mostly from page 121 of 1991 catalogue. everything from 1 - 9 way at astonishingly low price.
PRICE: Pack of 20 £3.25

SALE PRICE £2.00

K824 Rocker switches, both minature and standard, single and double pole illuminated red/green/amber and plain Fantastic value.
PRICE: Pack of 20 £4.95

SALE PRICE 100 £6.00

K825 as above but also included some illuminated push switches.
PRICE: Pack of 20 2.95

SALE PRICE £1.95

PLASTIC/SLEEVING

K564 PCB Stand - Offs. A mixture of 8 different styles and sizes from 4.5 to 12.7 mm high.
PRICE: 100/£2.95

SALE PRICE £2.00

K826 Jumbo pack of plastic stand - offs & a few cable clips and bits and peices. 1000 parts.
PRICE: £9.95

SALE PRICE £6.00

K533 Silicon Rubber Sleeves, 15mm long 5.5mm bore, 1mm wall.
PRICE: 100/ 50p

SALE PRICE £0.40

HEATSHRINK SLEEVING
K843 This normally expensive sleeving offered at a fraction of normal trade prices. A pack of 10m, black and clear with at least 5 different sizes from 3.5 to 4.2 mm dia. for just **£3.95.**

SALE PRICE £3.00

CONNECTORS

K557 Terminal Blocks. In all shapes and sizes, solder and screw from single way to 12 way in many different current ratings.
PRICE: 20/ £2.95

SALE PRICE £2.25

K803 PCB pack with/without ears, straight and right angle from 10 to 64 way.
PRICE: Pack of 20 £5.50

SALE PRICE £3.00

K802 Pack of DIN41612 connectors. These popular PCB connectors come as 32/64/96 way Both plugs and sockets, some with pins missing normally costing £1- £3 each.
PRICE: Pack of 25 £8.00

SALE PRICE £5.00

K836 DIL Socket Pack A super selection of DIL IC sockets from 8 to 64 way, low profile and standard mntg, turned pin tinned, gold plated, wire wrap and solder terminals
PRICE: 100 for £14.95

SALE PRICE £9.95

K705 PCB Headers. SIL & DIL PC mounting header plugs straight and right angle mostly 0.1" pitch in a variety of ways from 3 to 30
PRICE: Pack of 100/£6.00

SALE PRICE £4.00

K837 Lead pack. Assortment of signal and power leads terminated with a variety of plugs and sockets
PRICE: 25 for £3.95

SALE PRICE £2.00

K562 Edge connectors. Mostly 0.1 pitch some 0.15, 0.156 and 0.2 as well Single / double sided / tinned / gold plated solder/ wirewrap / PC connections
PRICE: Pack of 20 £3.95

SALE PRICE £2.20

MOTOR+GEAR PACK

K579 This pack contains 10 assorted battery powered motors (mostly 3V) + 90 gears etc. 16 - 60 mm dia. + worms and shafts amazing value.
PRICE: £7.95

SALE PRICE £6.95

HARDWARE

K553 2BA Screw mix . Mostly steel, few brass / nylon etc, cheesehead, hex, countersunk , slot and pozi , mainly in lengths from 7 - 63mm. Excellent selection.
PRICE: 100/ £2.60

SALE PRICE £2.00

K552 4BA screws - Super mix of types mostly steel, with round pan, cheese, c/s heads in lengths from 5mm to 50mm great value.
PRICE: 200 for £2.75

SALE PRICE £2.00

K811 6BA Screws. Nearly all pan head pozi in plated steel. Lengths to 16mm.
PRICE: Pack of 100 £1.50

SALE PRICE £1.20

K807 M3 Screws. Good selection of sizes including a few brass. Most heads. Lengths to 35 mm.
PRICE: Pack of 100 £1.50

SALE PRICE £1.20

K808 M4 Screws. Huge variety! Pan, c/s, cheese, set, slide, pozi. From 4-50mm long. All steel, plated, black / hi-tensile.
PRICE: Pack of 100 £1.60

SALE PRICE £1.30

K809 M5 Screws. As above.
PRICE: Pack of 100 £2.00

SALE PRICE £1.60

K833 M6 pack. Excellent value - contains screws in various lengths and head. Mostly steel, some hi-tensile.
PRICE: pack of 100 £ 4.50
SALE PRICE £3.00

K830 M8 screws and bolts. Good assortment from 16-90mm long, c/s hex, pozi some hi-tensile. All steel.
PRICE: pack of 50 £3.80
SALE PRICE £2.30

K831 M10 Bolts. Mostly hi-tensile hex head lengths from 16 - 90mm
PRICE: Pack of 20/ £3.20
SALE PRICE £2.00

K832 M12 Bolts. Mostly high tensile hex head. Lengths from 40 - 15mm
PRICE: Pack of 10/£2.40
SALE PRICE £1.70

K820 Large bolts and set screws . Could weigh as much as 150g each (up to 16mm dia x 90mm long) Practically all are steel Many different heads.
PRICE: Parcel weighing 5kg £10.00
SALE PRICE £7.00

K527 Hardware Pack This has a large variety of PK (caps) and self tapper screws from 2 x 1.5" up to 8 x 1.25 also washers, some BA metric and whit. Screws plus other miscellaneous brackets, captive nuts and bits and peices 1kg (up to 1000 peices)
PRICE: 1kg £4.00
SALE PRICE £2.50

K581 Copper Clad Board A selection of single and double sided, mostly fibreglass in useful sizes.
PRICE: 200 sq ins £3.00
SALE PRICE £2.00

K535 Spring Pack. Approx 100 assorted compression, extension and torsion springs up to 22mm in diameter and 30mm long.
PRICE: £1.70
SALE PRICE £1.00

K595 Big mix of screws - very few BA mostly metric BSF Whitworth DZU etc. Tremendous variety of heads - cheese, cs, pan, hex, allen round etc. As for size, well we've seen some as small as 3mm and a few as long as 80mm. There's even some 12.5 mm dia in this pack! You'll probably also find a few odd clips washers, nuts etc, too.
PRICE: 500gm pack £2.70
SALE PRICE £2.00

K717 Keyboard caps - a wide variety of sizes and colours from 17 x 16 mm to 25 x 25 mm. Some long ones too. Most have words - some numbers .
PRICE: Pack of 100 assorted £3.50
SALE PRICE £1.50

SURFACE MOUNT

K577 Surface mount FETs including SM versions of 2N430/1, 4392, 4857 5488/9/60/1, also 2N7001/2 etc. Big variety at a low price.
PRICE: Pack of 50/ £4.00
SALE PRICE £3.00

KS102 Transistors - about a dozen different types plus a few diodes, mostly SOT23. Type numbers include BCF29/30, BSR15, BC856, BCV71 BCW29/71/72/81. Supplied with code sheet.
PRICE: Pack of 100 for £3.00
SALE PRICE £2.00

KS103 Resistors. 0.125W 2% in a range of values from 3R3 to 10M. Although there is a fair range (about 50 values) many are E24.
PRICE: Pack of 1000 for £3.00
SALE PRICE £2.00

KS104 Capacitors - over 20 different values from 1pF to 470nF.
PRICE: Pack of 100 £4.00
SALE PRICE £3.00

KS107 3 values only of tants: 1uF, 4uF and 22uF. Pack of 30, 10 each value with DP of 12.70 for just **£3.00**
SALE PRICE £2.00

KS105 Surface mount coil pack, only a few different values 70, 80, 120, 150 and 180uH.
PRICE: Pack of 50 assorted £3.00
SALE PRICE £2.50

EXTRA SPECIAL PACK PRICE

KS106 Surface mount LEDs. This really is an excellent pack, containing a great selection of red, green, yellow and orange LEDs, including some dual types (red/green and red/yellow) mostly SOT23 package.
PRICE: 100 for £8.95
£4.40

FUSES & HOLDERS

K555 Fuses. A marvellous selection of 15, 20, 25 and 32mm fuses both cartriage and wire ended in quick blow and antisurge varieties. May be anything from 32mA to 50A.
PRICE: 100/£3.95
SALE PRICE £2.50

K834 Thermal fuses 104, 109, 121 & 152'C, some with cropped leads.
PRICE: Pack of 20 £2.95
SALE PRICE £2.00

K713 Fuse holders. Panel and chassis mounting from basic clip to high current enclosed types for 15, 20 and 32mm fuses.
PRICE: Pack of 50 £4.00
SALE PRICE £2.50

MISCELLANEOUS

K541 Printed Curcuit boards. A wide variety of high quality printed curcuit boards including audio, RF, digital etc all covered in components - resistors, capacitors, transistors, IC's LED's switches etc, etc. A big pack of 2Kg.
PRICE: only £7.00
SALE PRICE 5KG £10.00

K712 Crystals. Mostly HC60 and HC18U in a wide variety of frequecies from a few hundred kilohertz to many megahertz and the odd crystal oscillator module or two.
PRICE: 20 for £4.95
SALE PRICE £3.00

K829 Transducers. Piezo, electromagnetic, permanent magnet in assorted sizes from 15mm dia upwards. Lovely mix.
PRICE: Pack of 25 £3.50
SALE PRICE £3.00

K506 This one's an absolute gem! Contains a selection of conventions and switch mode power supplies, including AA12531, Z660, Z5307/8 + Lots more! Parcel of 10 originally selling for £40 +.
PRICE: £25.00
SALE PRICE £15.00

K835 New transformer pack. All mains primary, secondary range from 6-35V, 0.5 to 3A.
PRICE: Pack of 12 £10.00
SALE PRICE £7.00

K574 Wire link pack. A wide range of sizes from 3mm to 50mm for use with Breadboards or PCBs. Some are bare, a few are not preformed.
PRICE: per pack of 250 £1.00
SALE PRICE £0.50

K561 Coils and Chokes. Pot cores, IF cans, open wound coils, chokes, etc from a few uF upwards in a wide variety of sizes and values.
PRICE: 50/£2.80
SALE PRICE £2.00

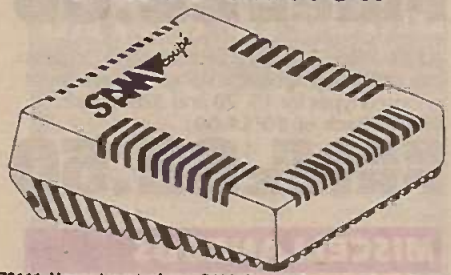
K844 A small parcel of miniature chokes by Greendale. 8 values from 1uF to 68mH, either radial 11x8mm or axial 10x4mm.
PRICE: Pack of 25 £2.60
SALE PRICE £1.80

SUPER SENSATIONAL SUMMER SALE

GREENWELD 27 Park Rd. Southampton SO1 3TB
Tel: 0703 236363 Fax: 236307

All one off and pack prices INCLUDE V.A.T. Qty. prices do not.

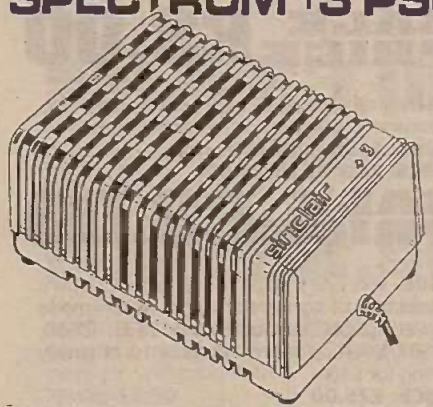
SAM POWER SUPPLY & MODULATOR



Z9111 Never heard of the SAM Coupé Computer? Well, the holding company SAMCO went bust, and now someone is trying to resurrect it - but the liquidators were anxious to turn piles of stock into cash, so we purchased all remaining stocks of the Astec made PSU's and can offer them at an amazing price! Inside the 170x150x70mm grey and black vented case is a linear power supply (240V ac in; 5V 2A & 12V 0.1A dc out) PLUS a UM1286 UHF colour TV + sound modulator! There are 3 leads: 2.2m phono to co-ax; 2m mains & 1.9m output lead fitted with a 6 pin DIN plug. All brand new stock. All this for just **£9.95** 100+ 4.40

SALE PRICE £4.95

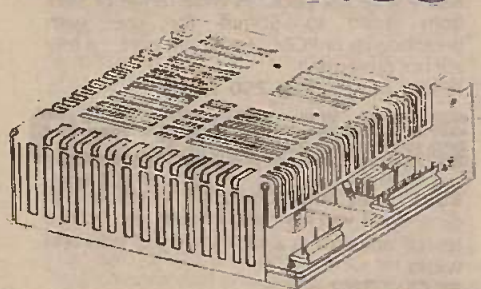
SPECTRUM +3 PSU



Brand new product - our scoop purchase of these linear power units enable you to buy at less than one third the normal price! Attractively cased in a black vented plastic case 155x102x70mm, they have a 1.3m mains lead and an output lead 2m long fitted with a 6 pin DIN plug. Input: 220/240V ac. Output: +5V @ 2A; +12V @ 0.7A; -12V @ 50mA. **Z9110**

£9.95 100+ 4.50

SALE PRICE £4.95

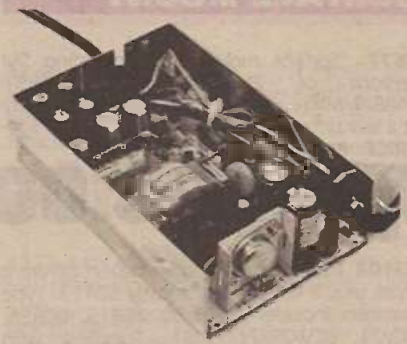


Z9114 This is a super unit 168x110x50mm in its steel case. Again, removed from gaming machines and tested before despatch. Std mains input. Outputs: +5V 3A; +12V 3A; -5V 0.5A; +12V 0.3A. Excellent Value at

£12.50 100+ 5.75

SALE PRICE £5.95

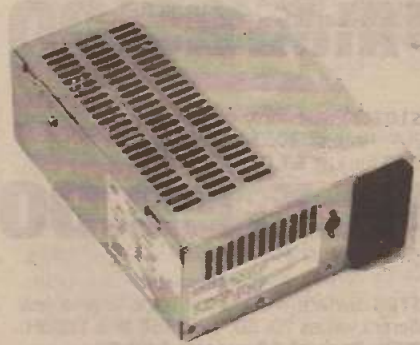
SWITCH MODE PSU's



AA12531 Switch mode PSU by Astec partially cased. 160x104x45mm overall with 160x100mm Eurocard PCB. Inputs and outputs are on colour coded flying leads. Input 115/230V 50/60Hz. Outputs: +5V @ 5A; +12V @ 0.15A. Total wattage 50W.
£6.95; 25+ 5.43; 100+ 4.53

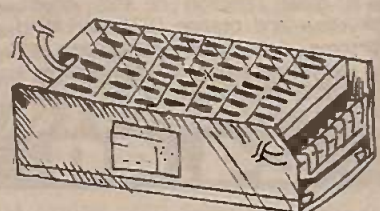
SALE PRICE £2.50

Conversion Kit
K725 This kit converts the AA12531 PSU into a much more versatile supply, giving +5V @ 2.5A; +12V @2A; -12V @ 0.1A and -5V @ 0.55A. Complete set of parts and full instructions **£3.50** Instructions only **(K726) £1.00**



BM41012 Superb switch mode PSU made by Astec. Enclosed case 175x136x65mm with switched and fused IEC mains inlet. 160x80mm PCB with output pins extended to external connector. Input 115/230V 50/60Hz. Outputs: +5V @ 3.75A; +12V @ 1.5A; -12V @ 0.4A. Total wattage 65W
£14.95; 25+ 11.70; 100+ 9.75

SALE PRICE £9.95



Z9109 Although these PSU's are boxed and look in excellent condition, we don't believe they are brand new. However they are all full spec working units made by Source Electronics Ltd, model HSE250-30 and offered at a cost substantially below the market price. The units are fully cased and measure 380x125x65mm. Standard mains input and 3 useful outputs: +5V @ 30A, +12V @ 8A and -12V @ 1A. Maximum total wattage is 250 watts. These would cost around £200 from a distributor - **Our price £24.95.**

SALE PRICE £19.95

Farnell NO55P Power Supplies
We've taken delivery of these popular supplies from several different sources, and now have the following models available. All are switch mode 115/230V input rated 55 watts max. Size of cased units 182x112x55mm, uncased size 160x100x40mm.

Z5304 Model 326, cased. Outputs: +5V 3A; +12V 0.1A; -12V 0.1A. **Price £12.95**

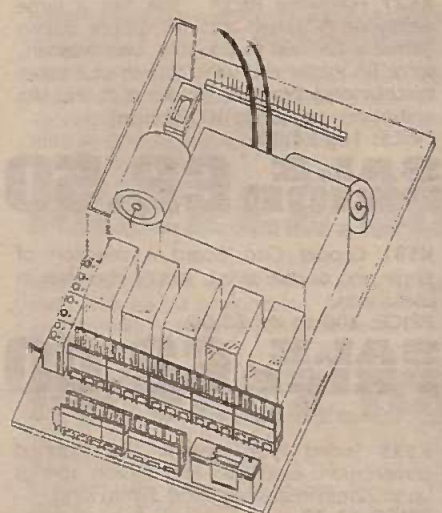
SALE PRICE £6.95

Z5334 Model 314. Outputs: +5V 3.5A; +12V 3A -12V 1A. **Price £14.95**

SALE PRICE £7.95

LIGHT UP YOUR LAYOUT
K692 Super deal for mo ·delers - we supply a mains power supply, 100 miniature lamps for wiring into your railway layout or dolls house, and 100m of flex. Circuits and details of how to wire up the lamps in series/parallel are prived. Everything for just **£19.95**

SALE PRICE £14.95



MODEL RAILWAY CONTROL AND SWITCHING UNIT
This ready built versatile piece of equipment allows:
* Full forward and reverse control of trains using regulated and smoothed supply (1.5A)*
*Requires 3 components (supplied) to be soldered to each panel.
* Relay control of 5 seperate circuits. (10A changeover contacts; ideal for points operation)
* Powering of auxiliary equipment - 2 seperate 5V 1A outputs.

A mains powered panel 185x105mm contains all electronics. All voltages are fully stabilized and both input and output are fused.

Connections, both input and output are by screw terminals which are clipped onto the on-board pins.

The five 12V relays are controlled by transistor circuits which require only 5V 30mA, supplied by the on board power supply.

Supplied uncased with circuit and wiring diagram. (SAE for free copy.)

Suitable black ABS plastic case £3.50
Order Code Z8897 Price reduced to £14.95

SALE PRICE £9.95

SWITCH MODE POWER SUPPLY BONANZA

ALL IN THIS BOX HALF PRICE

Z5504 197x98mm PCB 50 watt unit: +5V 5A;+12V 1A; -5V 0.5A; -12V 1A. £9.95

Z5503 126x76mm PCB. 30 watt unit: +5V 4A; -5V 1A. £4.95

Z5505 205x102x45mm uncased unit rated 120W. +5V 6A; +12V 2A; -12V 1A. Also has a number of leads attached, one with a 15 way D socket, and a small PCB with LM339 and other bits on it. £14.95

Z5508 Cased unit for monitor 205x130x60mm by Source Electronics Ltd, model HSL80-47. Rated 80 watts. +70V 0.9A; +6.3V 0.7A; +15V 1A; -15V 0.4A. £16.95

Z9133 Cased unit 380x128x75mm rated 500 watts by Source Electronics Ltd, model SAX500-02. +28V 16A; +5V 6A, also + and - sense. Super robust unit. £39.95

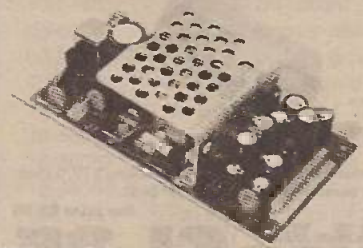
Couple more 125 watt cased SMPSU's by Source in small qty's:

Z9136 +5V 10A; +12V 4A; +12V 1.5A; -12V 0.5A. £17.95

SALE PRICE £9.95

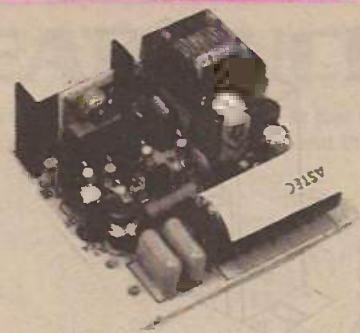
Z9137 +5V 2.5A; -12V 0.25A; +16V 4.5A (Useful for battery charger?) £17.95

SALE PRICE £8.95



Z5256 Switch mode PSU made by Tamura Corporation. Board 195x100mm with outputs on PCB pins. Input 120/240V ac; Outputs: +5V @ 7.5A; +12V @ 1.25A (2A peak); -12V @ 0.1A. All this for just £12.95

SALE PRICE £6.95



Z660 Astec switch mode PSU type AA7271. This small PCB, just 50x50mm will accept 8-24V input and give a stable 5V dc at up to 2A output. The 6 transistor circuit provides current overload protection, thermal cut-out and excellent filtering. Offered at a remarkably low price.
Price £5.00

SALE PRICE £2.50

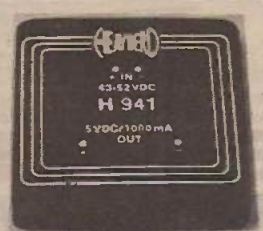
Z5278 Plug in wall type 24V ac 100mA output on 2m lead £1.75 100+ 1.10

SALE PRICE £1.00

DC-DC CONVERTERS

Z5406D High efficiency step down power regulator module by SGS. This is a GSR400 type, as listed by Farnell at £41.11 each. Output is 7V @ 4A from a DC input of 10-46V. Possible uses include battery charger. Our special price - just £5.75

SALE PRICE £3.00



Two 5 watt regulators PCB mounting, DC-DC converters. These are encapsulated in a 51x51x10mm package with output pins on 0.1 pitch. These are ex-equip but guaranteed. DP £59.75.

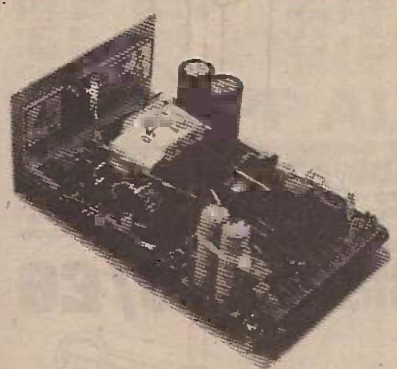
Z1893 Input 48V (43-52V), output 5V 1A.
Price ..... £2.50 100+ 1.00

Z1894 Input 48V (43-52V), output 12V 420mA.
Price ..... £2.50 100+ 1.00

EITHER TYPE SALE PRICE 2 for £1

Z8890 DC-DC CONVERTER BOARD
These panels 220 x 195 require 50V DC input for 5V 19.5A output. Inputs and outputs on DIN41612 connector. These brand new panels made by STZ are now being offered at just:
Prices £7.95 25+ 5.20 100+ 3.89

SALE PRICE £2.95



Z8887 Made by STC, this 160x100mm panel is attached to an aluminium chassis. 165x102x65mm and has a single 5V 6A output. Supplied with connection details, we can offer these at a fraction of their normal cost.
Price £5.95 10+ 4.30 100+ 3.43

SALE PRICE £2.00

Z8888 A larger version of the above, PCB 220x100mm and chassis 225x102x65mm providing a single 5V 10A output. Supplied with connection details.
Price Only £8.95 10+ 6.50 100+ 5.20

SALE PRICE £3.00

Z5280 Neat switch mode PSU on panel 120x100mm and only 32mm high. Mains input via skt supplied. 3 outputs on socket are +5V@2A; +12V@0.3A; -12V@0.2A. These have been removed from equipment, but are clean and in full working order £7.50

SALE PRICE £3.75

Z5418 Switch mode power supply - brand new unit, as fitted in Z8945 micronet terminals (which are now sold out) This is a 60 watt unit on a panel 280 x 240mm (although 120 x 240mm is unused). Each unit is supplied with a final test sheet, listing output voltages and currents which are, typically, +12v 2A; +5v 4A; +5v 0.25A; -12V 0.5A; 13.8V 0.1A (trickle charger output). 115/230v ac input. Excellent value at £14.95

SALE PRICE £7.95

Z5411 Marconi panel 225x195mm. No info on this PSU, but it's got some really nice bits on it - 2x2N3716 TO3 transistors, 13 BCY71, 2XBC107, BFW43, BFX29, LM317K and LM33K TO3 variable voltage regs, some high power zeners, pot cores, R's, C's etc., toggle switch with locking device. Great value at £3.95B

SALE PRICE £2.00

Z9115 Double Ringer by Weir. Right angle panel 190x72x46mm with 2xBUV46 MOSFET's, 3xBF471, some small signal T's, 3xLM358, 75453, R's C's etc. There are 7 wires leading to the inverter transformer which looks about 50VA. This unit was probably designed to take a low level signal and turn it into ringing current - about 75V 25Hz, but we have no further data. Only £4.00

SALE PRICE £1.75

Z5292D 'Power one' power supply. Conventional unit, 120/240V input, output 15V @ 1.5A fully stabilized. Part enclosed size 123x102x54mm. Comprehensive data supplied £10.00

SALE PRICE £4.95

Z5293D 'Power One' power supply. Conventional unit. 120/240V input, outputs +5V @ 2A; + or -12V @ 0.4A; -5V @ 0.4A. Each output uses a 723 regulator and has a preset for adjusting voltage. With data £14.50

SALE PRICE £7.50

The other item is a high quality 12V 2A power supply kit with current limit protection. This comprises a ready built PCB - you just need to add the power transistors supplied. It comes with a full circuit and instructions, but you'll need a 16V transformer and a heat sink. **Order Code Z5298 Price £3.50**

SALE PRICE £1.75

Z5413 KRP PCB mounting power source 90x65x23mm. 220V ac in ±15V 100 mA DC out. Some of these are ex-equip. DP around 30.00 Our price £5.00

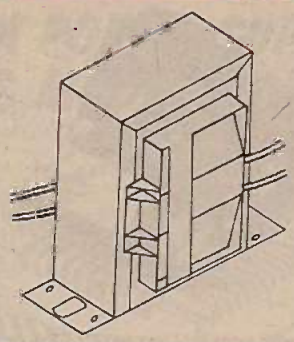
SALE PRICE £2.50

Z5404 Stabilized power supply panel 140x85mm. AC input is rectified and smoothed and is taken via a couple of regulator transistors and a relay to a 12 way terminal block. Probably 24V. Only £2.25

SALE PRICE £1.00

GREENWELD 27 Park Rd. Southampton SO1 3TB Tel: 0703 236363 Fax: 236307

All one off and pack prices **INCLUDE** V.A.T. Qty. prices do not.



Z5206 Super transformer for railway and other modellers. Mains primary, secondary 16V 3A. Size 50x55x60mm high 61mm FC. Great value for money only **£3.00** 100+ 2.00 1k+ 1.50

SALE PRICE £2.00

BOX OF 60 £80

Z4369 Very useful 18VA mains transformer with 0-6, 0-6 secondary, each at 9VA giving 6V@ 3A or 12V@ 1½A. PCB mounting 65 × 52 × 28mm.

Excellent value **£2.50**

SALE PRICE £1.25

Z2305 Neat 6VA PCB mounting low profile mains transformer 53 × 44 × 22mm. Primary 0-120V, 0-120V, Secondary 0-15V, 0-15V, each at 0.2A. DP £8.33

£2.50 100+ 1.80

SALE PRICE £1.00

Toroidal Transformers made by Belclere. These are all physically the same size, rated at 35VA but have different windings as listed below. 75mm dia × 33mm thick. Fixing by means of a tapped bush. All mains primaries.

Z4290 Type TR7353 5V 1.4A and 12-0-12V@ 120mA.

Price **£2.50**

SALE PRICE £1.00

Z4291 Type TR7252 12V @ 130mA; 12V @ 80mA; 5-0-5V @ 600mA.

Price **£2.50**

SALE PRICE £1.00

Z5520 15VA toroidal transformer in screened case with mounting plate by Avel-Lindberg. Bridge rect connected. Pri: 0-120, 0-120; Sec: 0-9, 0-9 @ 7.5VA per winding. **£3.50**

SALE PRICE £2.50

Z2643 Oscillator transformer has push, pull and feedback windings and a secondary of around 385 turns, giving a ratio of about 100:1. As used in high frequency voltage converter circuits. 2 for £1.00

SALE PRICE 5/£1

Z7012 27V 4A Chassis mntg Pri 0-240V Size 98x83x73mm. DP around 18.00 **Our Price £9.00**

SALE PRICE £4.95

Z7013 40V 1.5A chassis mntg. Pri 0-240V Size 79x65x58mm. DP around 7.00 **Our Price £4.00** 100+ 2.50

SALE PRICE £2.00

Z7014 12V 1.5A PC or drop through mntg. Pri 0-240V Size 57x48x52mm DP around 6.00 **Our Price £3.50** 100+ 2.00

SALE PRICE £2.00

Z2450 Tadiran AA size battery 3.6V PC mounting. Date code 6/89. DP on these is 5.17. Our price **£2.00** 25+ 1.50 100+ 1.20

8 FOR £5

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

Our price £2.50

SALE PRICE £1.25

Z2452 Lithium battery – inorganic type by Tadiran, type TL5104. AA size, 3.6V PC tabs. Date code 06/88 **£1.70**

2 FOR £1.50

Z2453 As above, but type SL360, date code 4/87. **£1.50**

2 FOR £1.50

Z2719 Lithium battery, Varta 6201 3V 1500mAh PC mntg 60mm long x 11.2mm dia. DP 6.00+ **Our Price £2.00**

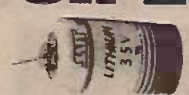
SALE PRICE £1.00

Z2720 Lithium Battery, Vidor G06/53. 3V 1400mAh PC mntg. 50mm long x 15mm dia, individually boxed. DP 6.00+. **Our Price £2.00**

SALE PRICE £1.00

Z2721 Lithium battery 11mm long x 12.5mm dia. 3V 160mA PC mntg. DP 3.73. **Our Price £1.20**

2 FOR £1.20



Z2451 Tadiran 0.5AA size battery, 3.6V PC mntg. Date code 8/86. DP 4.58 Our price **£1.75** 25+ 1.35 100+ 1.05

2 FOR £1.50

Xtra Special

FINAL CLEARANCE

BIB ACCESSORIES

BCC8 Comp term mtce kit - soft & stiff brush, cleaning fluid, air-blast, antistatic liquid, cleaning cloths £2.95

BCC11 Liquid static eliminator in spray can + cloth £1.00

Both for £2

Star Buy !!

Z4248 Mains transformer, 110/ 240V input via PCB pins. Secondary; 6.5V @ 8VA; 22V @ 8VA; 22V @ 1VA; 1.5-0-1.5V @ 1VA. Nicely made by Skot.

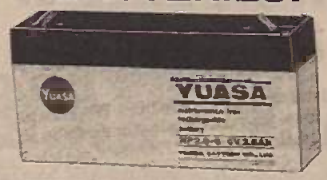
Price **£3.00**

SALE PRICE £1.20

Z4213 25V 1.5A. Clamp type 70 × 57 × 47mm terminated with wires.

SALE PRICE £1.75

ANOTHER SUPPLY OF YUASA LEAD ACID BATTERIES!

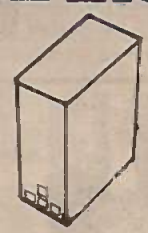


Z8920 Type NP10-6 rated 6V 10A, size 150x95x50mm. Not new, but regularly maintained and full spec. Last time we had these, they flew out the door, and we had many disappointed customers! Don't miss out on this batch - **only** £12.00 each

SALE PRICE £8.00

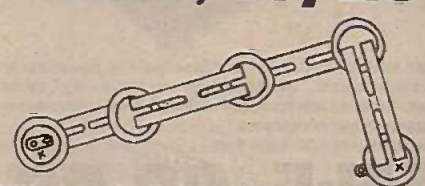
Z9131 12V 24Ah sealed lead acid battery by Dryfit. Not new, but only used for about a year and kept carefully maintained, Size 125x166x175mm. DP 59.33 **Our Price £30.00**

SALE PRICE £15.00



Z4149 Ex-mobile radio Ni-cad batteries, discarded because they either have broken cases and od/or a dud cell - but at the price being asked hay are amazing value! Packof 8 cells, like AA but 73mm long, in a tough plastic case. Either use as a 10V battery pack, or remove from case and use cells individually. Each cell rated 1.25V 900mA. **£3.50**

SALE PRICE £1; 10/£6



Z5329 A set of 5 Ni-Cad button cells 23diax5mm joined together in series in an L shape (easily split into singles) giving out 6V @ 250mA. Removed from new equipment. DP £4. **Our Price £1.50**; 100+ 0.80.

2 FOR £1.50

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

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

BOX OF 25 £3

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

Price **£2.00**

SALE PRICE £1.00

LITHIUM BATTERIES

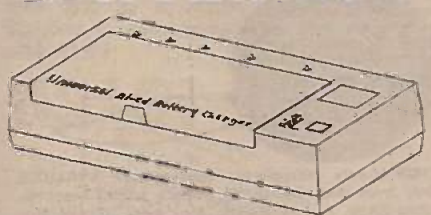
The popular 'coin' type, now available at excellent prices. Individually blister packed *Qty prices exclude VAT*

CR2016	£1.00	10+ 0.66
CR2025	£1.00	10+ 0.66
CR2032	£1.00	10+ 0.66

NI-CAD BATTERIES

Code	Type	Rating	1+	25+	100+
X131	AAA	180mA/H	£1.20	0.85	0.62
X132	AA	500mA/H	£0.99	0.72	0.55
X133	C	1.2A/H	£2.20	1.76	1.20
X134	D	1.2A/H	£2.30	1.82	1.23
X135	PP3	110mA/H	£3.95	3.26	3.10

10% OFF ALL BATTERIES!!



A123 NI-CAD CHARGER
Neat attractive instrument will charge 4 different sizes of battery: AA, C, D and PP3 either singly or in any combination. Charge time 7–8hrs for AA, 14–16 hrs for others. Test facility to check if battery needs charging. Size 210x100x50mm
PRICES 6.95 10+ 4.12

SALE PRICE £4.95

VERO CLEARANCE

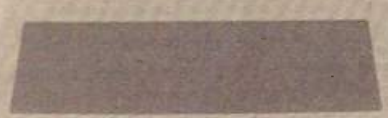
We've stopped selling veroboard and accessories, as imported stripboard is just as good and far cheaper. So grab a Bargain - all remaining stocks at HALF PRICE - and that's half the 1991 cat price - now over 2 years old!

Type	Description	Qty	Was	Now
03-0109	211x213 double sided veroboard	39	11.07	£5.53
02-0134	95x455 plain veroboard	12	4.42	£2.21
10-2445	100x160 DIP board	40	7.07	£3.53
03-0026	100x160 Square pad board	24	7.87	£3.93
03-2989	100x160 do with ground plane	44	10.57	£5.28
10-27563	100x160 microboard	18	8.45	£4.22
18-56070	single sided pins 1.32mm*	119	1.24	62p
18-56071	double sided pins 1.32mm*	54	1.55	52p
18-56067	wirewrap pins single sided*	6	3.97	£1.98
18-56068	do double sided*	55	3.97	£1.98
22-0230	Pin insertion tool for 1.02mm pins	41	3.55	£1.77
22-0229	do for 1.32mm pins	27	3.55	£1.77
10-2445	160x100 DIP breadboard	47	6.92	£3.46
806-21021	156x113 DIP breadboard	17	5.80	£2.90
10-27564	234x160 fibreglass DIP board	7	18.86	£9.43
801-21084	148x74 VQ board	122		£1.95

*All pins are in packs of 100

ALL ABOVE VERO HALF PRICE

Keyboard Enclosure



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

SALE PRICE £5.00

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

SALE PRICE 6 for £1

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

SALE PRICE 8 for £1

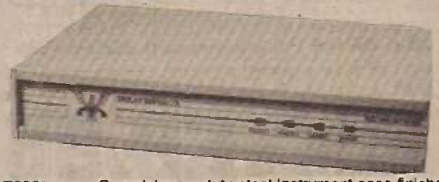
METER CASE

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

SALE PRICE 2 FOR £1

Z5288 Polycarbonate grey sealed box 82c80x55mm with clear lid (DP 9..11). Inside is a steel panel with loud 12V buzzer and a PCB with push button (operates when lid is removed) a green LED and IN4005. There's a 12mm hole in the side of the box and a cable gland to fit. **Exceptional value at £4.00**

SALE PRICE £2.00



Z8969 Superb heavy duty steel instrument case finished in light grey 426x290x78mm with 4 plastic screw on feet. This was an Isolan repeater for use on a data network, and although the contents have been removed (before being used), the front and back panel remain, the former having 4 oblong red LED's and the latter a fused, suppressed IEC mains inlet, on/off DP rocker switch and 2 x 15 way D sockets joined to 16 way IDC skts with a short length of ribbon cable. There's a 60mm circular cut-out for a speaker on one side and mounting pillars in the base. Just look around and see the price this type of high quality case normally costs! - somewhere around the £30–£40 mark - then compare it to our low, low price - **just £9.95**

SALE PRICE £6.95

Xtra Special

HEADPHONE COVERS
Z5547 Large
Z5548 Small
Either size
10prs for £1
Star Buy !!

Z5165 Zonephone Case. These are black simulated leather cases that held the portable phone. Size 190x50x30mm, they have a Velcro fastener along the length; a belt strap and a detachable swing handle with one of those trendy keyring type connectors. I suppose you could keep your pac-a-mac in it - or even use it as a pencil case! **2 for £1.00**

SALE PRICE 5 for £1

SUPER SENSATIONAL SUMMER SALE

GREENWELD 27 Park Rd. Southampton SO1 3TB
Tel: 0703 236363 Fax: 236307

All one off and pack prices **INCLUDE** V.A.T. Qty. prices do not.

Z5306 Adastra 8 ohm 10 watt white 135mm dia boxed horn speaker, model H52. Adjustable bracket. Very similar to our PS109 @ £6.50, but at a much better price £3.95 25+ 2.75

SALE PRICE £3.50

Z578 Super flat speaker 30 × 30 × 3mm by Fuji, rated 16R 0.4W. DP £1.50.

Our Price ..... 60p 25+ 0.35 100+ 0.22 1k+ 0.15

SALE PRICE 4 FOR £1

Z533 Danavox transducer - used as a speaker in pocket pagers. Impedance 50R. 20mm dia leads 90mm long. Extremely high quality unit.

Prices 50p 10/ 3.65 50/ 14.80

SALE PRICE 4 FOR £1

P111D

8 x 5 inch plastic horn speaker with built-in line matching transformer for 70 and 25V line and 8Ω usage. Transformer tapped at 2, 4, 8 and 16W for 70V line and 1, 2, 4 and 7.5W for 25V line, selectable by rotary switch on rear. Mounting bracket fully adjustable for angle and direction. All white plastic.

Size	8" x 5"
Output: 70V line	2, 4, 8 or 16W
25V line	1, 2, 4 or 7.5W
8Ω	16W

SALE PRICE £9.95

Z8988 Super high power siren. Std 5" 5W 8R gold horn mounted on an ABS box (ourV216) which contains the driver PCB. Can supply either single or swept tone and works from 6-28V £8.00

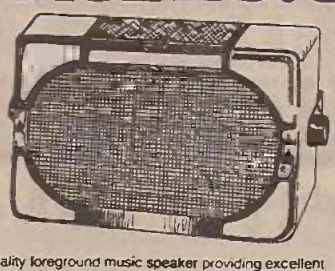
SALE PRICE £5.95

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

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

REDUCED TO £8.00

SALE PRICE £5.00



High quality foreground music speaker providing excellent music quality for pubs, clubs, etc. Ported bass reflex system contains a 5¼" bass driver, 1" soft dome mid and two piezo tweeters. Modern styled all moulded cabinet. Complete with adjustable wall mounting bracket. Supplied in pairs.

Power nom	30W
Power max	80W
Frequency response	80 - 20000Hz
Sensitivity (SPL)	87dB @ 1wm
Speakers	5¼" bass, 1" mid, 2 x 1" piezo tweeters
Overall impedance	4Ω
Dims (each)	275 x 170 x 125mm
Weight (each)	1.8kg

P114B LOUDSPEAKERS

Exceptional quality and value!
Originally sold for over £75 per pair!

OUR PRICE £39.95

SALE PRICE £35.00

40 WATT TWEETER

Z5516 55mm Dia, 3R5 impedance. Ideal replacement for many speaker systems £4.00

SALE PRICE £2.50

ALARM BOXES

Z5396 24V DC buzzer housed in a bright red surface mounting MK switch box 80x78x40mm with louvred front panel £2.00

Z5397 24V LES lamp with red bezel mounted in MK switch box 80x78x40mm with red fascia plate £2.00

Z5398 As Z5396 but with white fascia plate £2.00

Z5399 As Z5397 but with red box £2.00

Z5400 MK surface mntg box in red with 24V buzzer and lamp. Red fascia plate marked 'FIRE ALARM' £3.50

ALL ALARM BOXES HALF PRICE

SOUNDERS & SIRENS

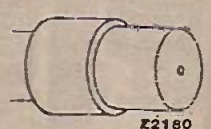
A range of piezo-ceramic sounders made by STC. These are top quality units with extremely high output, up to 115dBm. Now reduced even further to ¼the original 1 off trade price!!

Current consumption	10mA
Frequency	2.7KHz
Pulsing frequency	2 0 4 10Hz selectable
Sound level at 1 metre	85dB(A)
Dimensions	60×33×70mm

Z108 U25ORD1D2, 24V, level 85dBm £1.70
Z109 U25ORD1D2H, 24V, level 90dBm £2.00

EITHER TYPE SALE PRICE £1.00

Z2176



Z2180

A parcel of piezo and magnetic transducers

Code	Manf'r	Type	*P/M	Size	£1 Pack	100+
Z2176	Murata	PKM25-6AO	P	25×8	6	0.08
Z2180	Star	QMB-12A	M	15×22	4	0.12

* P - Piezo; M - Magnetic

EITHER TYPE SALE PRICE 2 PACKS £1

Z1429 Murata piezoelectric speaker type VSB41D25. Only 2mm thick×50mm dia, weight 3.3gm. Freq. res. 500Hz-20kHz. Z=1.2k at 1kHz. Max input 200mW. Normally £2.33

Our prices ..... 75p each 10+ 0.52 100+ 0.40

SALE PRICE 3 FOR £1

Burglar Alarm Bell

Z9138 A loud motor driven bell for home or industrial security systems.

Features include: Internal NiCd battery to drive bell in the event of cable being cut; internal anti-tamper switch; output for external strobe; selectable positive or negative return for control panel type; positive or negative ring control.

Dimensions: Gong diameter 185mm, bracket diameter 220mm, assembled thickness 75mm. Requires additional weather proof case for external mounting. £12.95

SALE PRICE £9.95

Z9139 Similar to above but requires small 12 volt sealed lead acid battery (not included). £9.95

SALE PRICE £7.95

RADIO SCANNERS - Send SAE for full details of our range of high quality scanners at great prices!

HELIX MATHS SET

Colourful 4 piece set - protractor, 15cm rule, 45 and 60 degree set squares in bright primary colours, in a handy pouch

Big Discounts for quantity!
100+ 0.45
1000+ 0.35

99p

Order Code Q86013

(a) Stationery products - mostly as used in plotters.
Pentel Rolling Writers. These fine point cartridges are essentially complete pens without an outer casing, so can be used as they are. Current price is around 60p. Now look at our prices! (State 2nd choice)
Z23199 Black
Z23201 Blue
Z23200 Red
Prices (any mix) ..... **30p each**
24+ 0.20 96+ 0.15

ANY COLOUR 12 FOR £1

Z01266 Staedtler/Mars lumochrom leads. Pack of 12 in dispenser. Blue 2mm. Fits all standard lead holders.
Prices ..... **30p** 10+ 0.20 50+ 0.15
Z01158 Tube of 12×2H leads 2mm dia.
Prices ..... **25p** 10+ 0.17 50+ 0.12
Z01159 Tube of 12 Green leads 2mm dia.
Prices ..... **30p** 10+ 0.20 50+ 0.15

ALL LEADS HALF PRICE

SPECIAL OFFERS FROM HELIX

A range of 'Clearance Lines' offering super value for money on top quality product

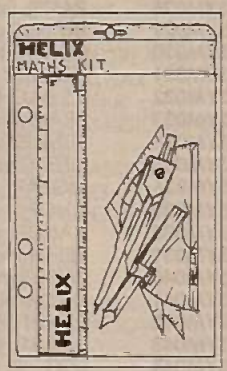
A10000 Economy maths set - 2 set squares, protractor, 15cm rule all in bright colours together with compasses and an eraser in a rigid see-through pack.
Only £1.50

V93021 Helix erasers. Good quality rubbers in blue, yellow and red, each 50x23x10mm. In boxes of **36 for £3.95**

H40 Lettering guide value pack. Contains 4 popular sizes - 5mm & 10mm upper and lower case and 20 & 30mm upper case only. Supplied in compartmentalized clear plastic case. **£1.99**

R08 Magic Pencil Box - amaze your friends - a box within a box makes things disappear!

OUR PRICE £1.99



Q86 Small maths set - colourful rule, 2 set squares, protractor, and a pair of compasses.

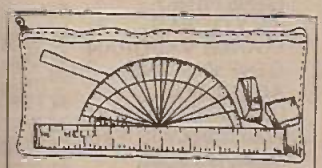
OUR PRICE 99P

R55 Wedge Pencil Case - Great for younger children! 2 shape templates, 2 letter stencils, 5 felt tips, pencil, eraser and sharpener all in a colourful clear zip case!

OUR PRICE £2.20

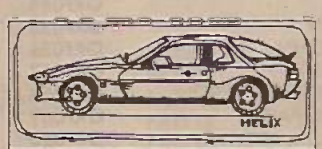
E50 Eraser kit - 5 different + refillable pencil

OUR PRICE 99P



A01 Mini maths set - clear zip pencil case with rule, protractor, pencil, rubber and sharpener.

OUR PRICE 99P



A30 Car Pencil Tin 180x75x20mm

OUR PRICE 99P

Xtra Special CONTACTORS

Z5154 240/415V 32A 3p £4
Z5155 240/415V 50A 2p £3
Z2354 240/415V 10A £1
Z5260 16A 400V 4p £1.50

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Z4370 20A - 1c/o, 1b 4/£1
Z5158 10A 380V 1m 1b 2/£1
Z5191 2A thermal CB 2/£1
Z5192 3A thermal CB 2/£1
Z2084 Skeleton spco 5A 8/£1
Z2166 Low I 1m 12/£1
Z2486 15A spco 4/£1
Z2487 15A 380V 2/£1.50
Z2488 5A roller lever 2/£1
Z2489 5A air operated 2/£1.50
Z2490 As above, double 2/£3.50
Z2491 Sp heavy duty 4/£1
Z2499 Limit sw, 1m 1b 8/£1
Z2947 65mm lever 2/£1

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GRF11	7SWEET SOUL MUSIC 2
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GRF119	ROCK AND ROLL IS HERE TO STAY
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GRF121	BLUE EYES CRYIN IN THE'RAIN
GRF122	LETS TWIST AGAIN
GRF123	SAVE THE LAST DANCE FOR ME
GRF12	4WHEN THE SAINTS GO MARCHING
GRF125	ONE O'CLOCK JUMP
GRF126	WHEN YOUR LOVER HAS GONE
GRF127	I GOT IT BAD AND THAT AINT GOOD
GRF128	IT DONT MEAN A THING
GRF129	STOMPIN' ATTHE SAVOY
GRF130	WILL YOU STILL LOVE ME
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GRF155	POP OPERA
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GRF160	HITS OF THE PET SHOP BOYS
GRF161	ISLEY BROTHERS
GRF162	B.B.KING
GRF163	TECHNO RAVE
GRF164	BROOK BENTON-ENDLESSLY
GRF165	ITALIAN LOVE SONGS
GRF166	HITS OF 1960
GRF167	HITS OF 1961
GRF168	HITS OF 1962
GRF169	HITS OF 1963
GRF170	HITS OF 1964
GRF171	HITS OF 1965
GRF172	HITS OF 1966
GRF173	HITS OF 1967
GRF174	HITS OF 1968
GRF175	HITS OF 1969
GRF176	THE FOUNDATIONS GREATEST HITS
GRF177	HITS OF THE 70'S VOL1
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GRF181	CONNIE FRANCIS
GRF182	GLENN CAMPBELL GREATEST HITS
GRF185	MIKE PENDERS &THE SEARCHERS
GRF186	THE FORTUNES
GRF187	SHOWADDYWADDY
GRF189	TRINI LOPEZ
GRF190	ALLEGRO MILANA PLAY A TRIBUTE
GRF191	GERRY AND THE PACEMAKERS
GRF192	HOLLYWOODS GREATEST HITS
GRF193	INSPARATIONAL SAX
GRF194	MIDNIGHT GUITAR
GRF195	THE MAGICAL MUSIC OF BERT BACHARACH
GRF196	DOO WOP CLASSICS
GRF197	LES MISSERABLES
GRF198	TELEVISION GREATEST HITS
GRF199	JIM REEVES
GRF200	GARY GLITTER
GRF201	STEEL DRUM
GRF202	SOUND OF HAWAII
GRF204	HITS OF THE SHADOWS
GRF207	DONOVAN
GRF209	ALAN PRICE
GRF210	THE ULTIMATE HOUSE
GRF211	DISCO EXPLOSION
GRF213	THE RUBETTES
GRF214	SWITCHED ON COUNTRY
GRF215	THE PLATTERS
GRF218I	KE & TINA TURNER
BAL001	CHA CHA
BAL002	SAMBA
BAL003	WALTZ
BAL004	FOX TROT
BAL005	TANGO
BAL007	LATIN
BAL008	RHUNBA-BOLERO
PAT201	JUNIOR PARTY MEGAMIX
PAT301	PRAISE
PAT911	TOP 20 VOLUME 1
PAT914	CHRISTMAS PARTY
PAT918	TOP 20 VOLUME2
PAT929	TOP 20 VOLUME3
MER001	MADONNA VOL 1
MER002	MADONNA VOL 2
MER003	MARC BOLAN VOL1
MER005	BRYAN ADAMS
MER006	MARC BOLAN VOL 2
MER007	ELKIE BROOKS(PEARLS 3)
MER008	SKY VOLUME 1
MER009	SKY VOLUME 2
MER010	BUCKS FIZZ
MER011	MOTOR HEAD

CD-ROM's

More and more software is becoming available on CD-ROM - and once you've purchased a suitable drive, it's an incredibly cheap way of buying shareware. We can supply a Mitsumi CD ROM drive kit which is Kodak Photo CD compatible (multi-session) with the following spec. We can vouch for it's speed and reliability, as we have one fitted to one of our computers. Look at these features:

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Also the popular **Soundblaster V2 Pro.** This amazingly versatile package will give you stereo music, voice, game port, midi, CD-ROM interface. Supplied with Sereo Card, Audio cables, 3.5" disks, Manual + lots of exciting software - Indy 500, Lemmings, Text to speech, mutimedia encyclopaedia (really amazing - includes still & moving pictures + sound). We'll send you more info on request.
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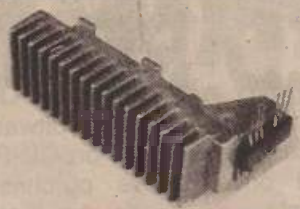


Z611 Finned heatsink 86x27x38/20mm fitted with 2 x 7805 5V 1A voltage regulators - brand new. **Only £1.00**

SALE PRICE 2 for £1

Solder

Z5099 Ersin multicore HMP (high melting point) solder, 22 swg on 500g reels. Composition: 5% tin, 93.52% lead, 1.5% silver. Melting temp 301 C. Rec. bit temp 350 C. DP £18.00.

Our price **£8.00**

SALE PRICE £5.00

STEREO CASSETTE PLAYER

Z5405 High quality heavy duty all metal construction stereo cassette player mechanism, probably intended for continuous background music. This is a lovely bit of kit – starts playing as soon as a cassette is inserted. Has fast forward, rewind and eject keys. It's bi-directional, and the sensing circuit automatically reverses the tape at the end. Has a Canon motor and works off 12V DC. Great value at £4.95.

SALE PRICE £3.95

Z5488 9V stereo cassette deck mech. Record/replay and erase heads, 6 push buttons - fwd, rev, play, rec, pause and stop. **Only £2.95**

SALE PRICE £1.00

Z8885 TAPE DECK PANEL. A type of telephone answering machine believed to have been used as an alarm system - a recorded message was sent down a BT line if premises were being entered illegally. Steel chassis 245x220x35mm contains PCB 228x145mm and an 8 track cassette unit almost identical to Z4307. This is attached to the panel by 3 screws and is easily removable, being connected to the PCB with a 5 way socket. The output from the tape head is fed into an MC3301 quad op-amp. The PCB also has 10 CMOS gates, 3 relays, isolator transformer, several transistors, R's, C's etc. 12 way connector for BT line, 12V supply etc, also plug and socket arrangement for Auto/ Manual and Bell delay. Made by Munford & White PLC. **Price: Reduced to £7.95**

SALE PRICE £3.95

Z5246 Mains synchronous motor with easily accessible gearbox giving a final speed to the 5.5mm dia 12 toothed gearwheel of 0.2RPM (12 revs per hour). **Only £3.95; 100+ 2.50**

SALE PRICE £2.00

Z5488 9V stereo cassette motor 35mm dia x25mm. **Only £1.00; Box of 200 £65**

SALE PRICE 2/£1.00

Xtra Special

K857 MASSIVE CONNECTOR PARCEL

Z5085 1000 Z5084 100
Z2154 100 Z2158 1000
Z5086 1000 Z2157 1000
Z5083 100 Z2160 100
Z5082 100 Z2156 294
Z2155 100
Z5081 100 25W D Plug
Z5082 200 25W D Plug

TOTAL 5194 Parts!

£25

Star Buy!!

Z5427 Tachometer. Here's a nice little unit at a fraction of its true worth - made by Transicon Inc, this will give an accurate voltage for any given speed. Gradient 1.55V/1000RPM. **Only £8.00**

SALE PRICE £4.95

Fans

Z4056 'Patriot' fan. High quality cooling fan for mounting into equipment. 170mm dia x 51mm. Only probelm is they operate on 48V ac (but still work down to 24V).

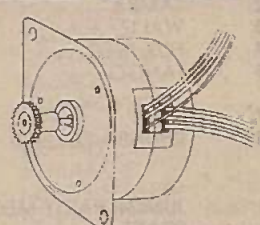
Price **£3.00**

SALE PRICE £1

Z5006 120mm Fan Guard. 110mm FC Chrome plated steel.

Price ..... **£1.20** : 25+ 0.70

SALE PRICE 5 for £1



Z5045 Superb little 12V motor by Airpax 35mm dia x 21mm deep with a 16 tooth 9,5mm dia gear wheel mounted on the 2mm dia spindle. FC 42mm. 7.5° 48 step. Supplied with data. **100+** DP 9.04. **Our Price £3.00; 100+ 2.00**

SALE PRICE £1.50

Z5487 Mabuchi hi-torque 9V cassette motor 35mm dia x 25mm **Only £1.00; Box of 200 £65**

SALE PRICE 2 FOR £1

HIGH QUALITY LOW COST SOLDERING IRON + STAND

Y061DA Mains element with interchangeable bit (std Antex CS types fit). Rated 15 watts. Ideal geneal purpose BS approved iron.

£4.95

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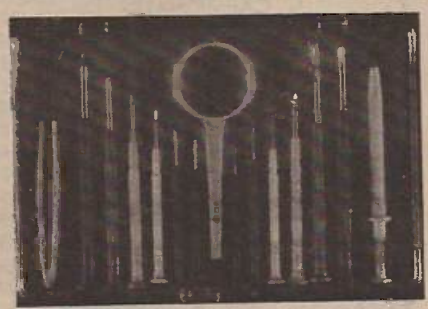


18068 Colourful precision tool set - clear hinged plastic case 210x135mm contains 15 instruments with coloured plastic handles - tweezers, pick up tool, 37mm magnifying glass (not plastic), 6 each pozi and straight screwdrivers. Great value at

£5.95

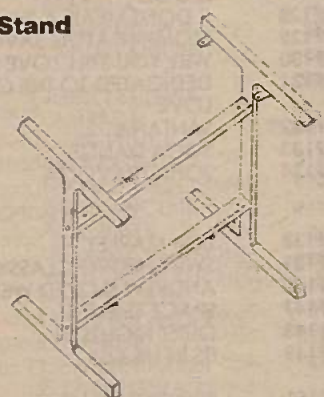
SALE PRICE £4.95

Z314 Precision spring bow compasses 88mm long. Max circle dia 70mm. Replaceable pencil lead and steel tip

Price **£1.00**

SALE PRICE 2 for £1

TV Stand



Z8930 TV/Video/Hi-fi stand. Satin finish steel side pieces with black ends held apart by veneered timber. Overall dimensions 485 wide x 350 deep x 450 high.

A bargain at ..... **£2.50** 100+ 1.25

SALE PRICE £1

Toggle Switches

Z1710 Toggle switch double pole on/ off rated 10A 250V ac. Threaded bush with plastic and metal nut, also can be clipped in panel.
Price **£1.50**

Z1711 Another toggle switch, very similar to above. No rating printed on body, but looks about 10A. This one does not have a clip fix.
Price **£1.20**

Toggle switches by Bonella. High quality, high current, solder tags. All are rated 10A 250V ac

Z352 Type N11LNZ SPCO (4 tags) Metal dolly **56p**
Z354 Type N41LNZ DPCO (6 tags) Metal dolly **84p**
Above 4 types less 25% for 25+ ; less 50% for 100+.

Rotary Switches

Z1522 Switch, Alps SRS 40 way. As used in CB's for channel switching. Body 20×20mm. 6mm dia shaft with M9 fixing nut. Not sure if these are binary or BCD. 7 bits per step. Data sheet supplied. £1.00

Keyboard Switches

Z1523 PCB mounting illuminated keyboard switch. High quality single pole reed with 5V lamp made by FR. Model 18×18mm. No tops unfortunately.
Price **3/ £1.00**

Z1393 PCB mounting keyboard switch with in built yellow LED. SP. Size: 12.5×12.5mm. No tops.
Price **5/ £1.00**

Z2167 Keyboard switch, single pole clip-in type with standard + stem for cap. 13.6×12.9mm. 7.5mm pitch. DP 75p.
Our low price ..... **6 for £1** 100+ 0.10

Rocker Switch

Z1819 Rocker switch in black plastic. SP on/ off rated 16A 250V ac. Needs 30×12mm cutout.
Price ..... **Pack of 4/ £1.00**

Z2596 Keyswitch by Lorlin. 1p3w with 2 keys. For low current up to 1A. £2.00

Z2597 Keyswitch by Lorlin. 2p5w with 2 keys. PC mntg for low current up to 1A £2.50

Z2853 8 position DIL switch - AMP type 435802-9. Gold plated. Pack of 5 £2.00; 100+ 0.25

Z2863 Min high quality push to make switch, overall 19mm long, body 6.4mm dia. 4mm fixing. Plunger 2.6mm dia x 4.5mm long. **Pack of 5 £2.00**

Z2699 Push to make switch, like our W435 only non-locking. Black top. Normally 52p. **Special offer price 8 for £2.00.**

Microswitches

Z4370 Burgess 20A microswitch. Incorporates 2 switches into one housing 20×12.5×17.5mm - 1 changeover and 1 break.
Price ..... **2/ £1.00** 100+ 0.25

Z2084 Skeleton microswitches. SPCO, 5A rating. Two 3.5mm mounting holes on 10mm centres. They are designed to be mounted side by side - in theory the number is only limited by the length of bolts available! (each switch is 5mm thick).
Price ..... **Pack of 4 for £1.00**
100+ 0.15

Z2165 Omron miniature type SS rated 3A 250V. Single break contact operated by bent lever.
Price ..... **5 for £1** 100+ 0.12 1k+ 0.08

Z2166 Omron standard type VL631C. These are for signal switching, contact rating 0.1A 125A AC/30V DC. Single make contact.
Price ..... **6 for £1** 100+ 0.09 1k+ 0.05

Z5158 High current microswitch by Siemens, model 3 SE3 rated 10A 380V AC. Fully shrouded screw terminals (4); 1 pair make and 1 pair break terminals. Overall size 28×30×32.
Price **£1.50**

Joystick Switch

Z004 Skeleton Joystick, switch type. Good quality, made by AB. Brass spindle has 44mm long black plastic handle attached. Body has 4 mounting holes. These really are a fantastic bargain!! **ONLY £1.00**

Z2168 Superb quality British made (TOK). Gold plated DPCO contacts. Key can be removed in either position. PC mounting or clip fix - needs 15x15mm cut-out. Ideal for alarms etc.
Price ..... **£1.95** 25+ 1.20 100+ 0.80

POINTS SWITCHES

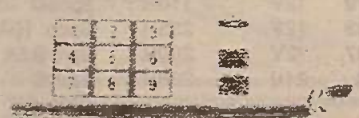
Great switch bargains for railway modellers - these small switches 18mm wide and 12mm high (excluding lever) and just 4mm thick with 14mm FC come in two versions:

Z2383 2 position, 2 pairs make and 2 pairs break. **Pack of 5 £1.00** 100+ 0.10

Z2384 3 position, 6 pairs contacts (2 pole 3 way). **Pack of 5 for £1.00** 100+ 0.10

Z1797 Membrane keyboard 155×113mm with 80×22m aperture for display from case Z4245. 22 keys. Output to 11 way flexible connector. Self adhesive.
Price ..... **Only £1.00**

Z4354 Computagraph Colorwriter panel 352×67×12mm. Ally frame supports a membrane keyboard which has 22keys. On the rear of the panel are 6 yellow submin LED's, a 3mm red LED and 2×19W edge conns.
Price **£1.00**



Z4363 Membrane keyboard 225×84mm with 11 keys - 1-9 & 2 others. Output (common bus) on 12 way ribbon cable. Could be cut down to 95×70mm if only 1-9 needed.
Price ..... **60p** 100+ 0.30

Z4116 24 way (8×3) membrane keypad. Large (200×90mm) area - these were originally used as a teaching aid. Overlay template and pinout supplied.
..... **Now only £2.00**

Neat keypads in various styles by ORCOM, both with encoded and matrix outputs. All PCB's have room for coder chip (74C922) to be fitted. All feature 0-9 keys and other characters as shown. Output via 20 pin plug. Data supplied.
(a) No chip fitted:
Z5107 3×4 (*#) **£2.00**

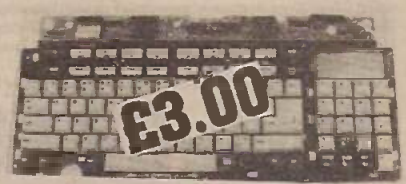
Z3134 Cherry UB70 keyboard, low cost 67 key, std qwerty + F1s 5 etc. New and boxed £3

Z5440 2 keypads. These are packed in pairs - both have 12 keys, but the legends are different: (a) 0-9, * and # and (b) MO LI MU B LO S F WU A and a couple of symbols. They have the graphite coated rubber membrane, but no PCB. Only £1.50

ALL KEYBOARDS £3!!

Z8848 Keyboard by Cherry. Room for 104 keys, all normal keys (65) fitted. Chips on board: LS373 × 2, LS374, LM3086 × 2. LS138 × 3, 555, LS08, 6805. Size 442 × 175mm.
PRICE: £10.00

Z8842 Tatung VT4100 keyboard. Cased 85 key units with separate numeric keypad. With circuit. Has 2 or 3 broken key tops. 450 × 65 × 125mm.
Price **£9.95**



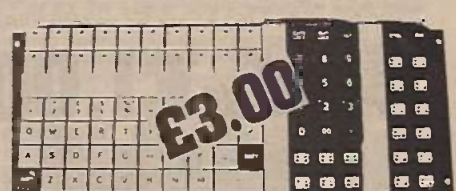
Z8852D Keyboard. Superb brand new high quality keyboard with LCD displaying 1 line of 10 characters and a further line with various symbols. 100 keys. Inc seperate numeric keypad. Chips on board are 2x74HC05, 80C48. LCD + driver chip are easily removed. **Amazing** low price – only **£10.00**

ASCII KEYBOARDS

Z8933 51 key QWERTY keyboard by McMurdo Orcom with 6 bit ASCII encoded parallel output. Measuring 240 × 115mm makes it ideal for rack mounting applications. With control, shift and shift lock keys this keyboard can generate all 128 standard ASCII codes.
The keyboard requires a +12V and +5V power supply connected via a 20 way header type plug. The remaining connections on the plug are DSR, DTR and STR, the strobe and data set ready are switchable to be negative or positive going pulses. The controlling IC is a General Instrument AY-5-3600-PRO chip.
Price **£8.50**

Z8934 As above but supplied in a vacuum formed grey plastic case 280 × 185 × 60mm.
Price **£12.00**

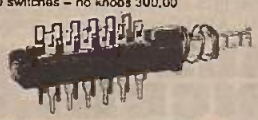
Z8863 Keyboard. High quality unit made by Micro Switch, 69 pale grey and blue keys. 6 red 5mm LED's, 15 various LS chips and socketed D8048 by Intel. Output via 7 way plug and there's a 4 way edge connector too. Keyboard frame is 317 × 128mm. PCB on which it's mounted is 285 × 170mm.
PRICE: £10.00



Z8922 Made by Devlin, this keyboard has 94 keys (18 without caps; 20 with removable tops) and runs off a single 5V supply. Serial ASCII output + switch to emulate AT and XT keyboards.
Price **£12.00**

SUPER SWITCH SENSATION!

K838 A nice parcel of ALPS high quality push switches as used with mounting brackets. Enormous variety from DPCO to 10 pole changeover locking and nonlocking including PC mounting + solder tag, all on standard 4mm mounting. Different colours too. Whats more, there's a big selection of buttons to fit them– round, square, oblong etc in red and black. All at a knock–out price – 100 **assorted switches + 100 assorted knobs £7.95.**
Pack of 1000 **switches + knobs £49.95**
Pack of 10000 switches – no knobs 300.00



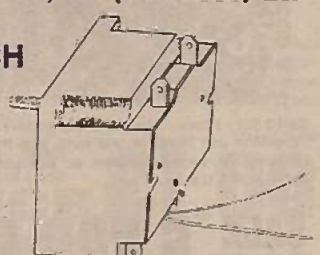
Switches in **K838** available separately as follows:

Code	C'tact	Pins	L/M	£2 Pack	100+	1K+	Qty
Z2601	10PCO	PCB/ST	L	12	.10	.058	600
Z2602	8PCO	PCB/ST	M	16	.08	.056	815
Z2603	6PCO	PCB/PCB	L	20	.07	.044	6k4
Z2604	6PCO	PCB/PCB	M	20	.07	.044	2k4
Z2605	6PCO	PCB/ST	L	20	.07	.044	9k4
Z2606	4PCO	LPCB/ST	M	25	.05	.034	4k4
Z2607	4PCO	LPCB/ST	L	25	.05	.034	480
Z2609	4PCO	PCB/ST	M	25	.05	.034	7k1
Z2611	4PCO	PCB/PCB	M	25	.05	.034	3k8
Z2612	2PCO	EPCB/ST	L	40	.03	.022	12k
Z2613	2PCO	EPCB/ST	M	40	.03	.022	4k2
Z2614	2PCO	LPCB/ST	L	40	.03	.022	5k9
Z2615	2PCO	LPCB/ST	M	40	.03	.022	600
Z2616	2PCO	PCB/ST	L	40	.03	.022	5k8
Z2617	2PCO	PCB/ST	M	40	.03	.022	10k3
Z2618	2PCO	PCB/PCB	L	40	.03	.022	3k5
Z2619	NO CONTACTS		M	100	.01	.007	9k4

Codes used:
Contacts: number of changover switches
Pins: (All on 4mm pitch; contacts on both sides of switch as listed)
PCB PCB mounting
LPCB stand of PCB mounting (8.5mm)
EPCB stand of PCB mounting (24mm)
ST solder tags
L/M: locking or momentary (non locking)
£2 packs: Qty of switches for £2 (other prices per switch)
QTY: total quantity in parcel

SALE PRICES
Pack of 100 £3.95
Pack of 1000 £25
Pack of 10,000 (no knobs) £175

TIMER SWITCH



Z5174 Timer switch by Diehl of Germany. Superb gearec mains motor, (1 rev per 12 hours) operates a cam that switches 2 change over contacts with centre – off positions rated 16A 250V. Size 60x54x43mm. Spindle is 14x6mm dia.
Only £3.00 100+ £1.50.

SALE PRICE £1.00

Pressure Switches

These are operated by very low air pressure – just blowing down the tube will operate the SPCO microswitch within. Useful in a 'spark free' environment.

Z024 80mm dia×45 total depth. SPCO switch rated 16A 250 Vac **80p**

Z025 Similar to above, but 37mm thick **80p**

Z4200 Pressure switch model LDQ by Actu. Can be activated by gas or air at very low pressure. Range 13 – 150mm w.g. Switch is a SPCO micro switch rated 230V 2A. Precision instrument overall dia 110mm × 48mm **£2.00**

SALE PRICE
Pack of 2 of each type **£2.00**

Xtra Special
KEYSWITCHES
Z2107 sp 4w 2A 250V £1
Z2596 1p3w 2 keys 1A £1
Z2597 2p5w 1A 2keys £1
Star Buy!!

Xtra Special
SLIDE SWITCHES
Z301/3/4/5/6
10 OF EACH
PACK OF 50 **£2**
Star Buy!!

TEMPERATURE SWITCHES

Temperature sensitive switches designed to protect components or equipment from damage by overheating. Snap action bi-metallic disc operates the normally open contact. Switch resets when temperature falls.
Z2533 130°C
All the same price – £1.00 each: 25+ (any mix) 0.60:

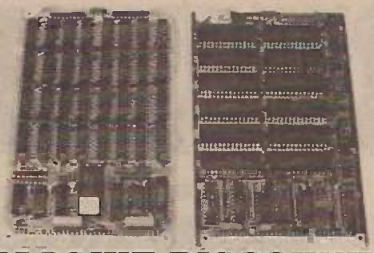
SALE PRICE 3 for £1.00

TV SWITCH

T123A Push button selector switch to give 3 inputs to one TV - co-ax skt inputs, co-ax plug output. Auto substitution of 75R load when channel not in use. Size 90x47x39mm
Normally £3.99
£2.00

GREENWELD 27 Park Rd. Southampton SO1 3TB
Tel: 0703 236363 Fax: 236307

All one off and pack prices **INCLUDE** V.A.T. Qty. prices do not.



MASSIVE DISCOUNTS!

A collection of Eurosize panels (160x100mm) with 64 way DIN plugs fitted.

Z5092 8xHM3-6514-9 RAM + few other chips £1.00
SALE PRICE 40p

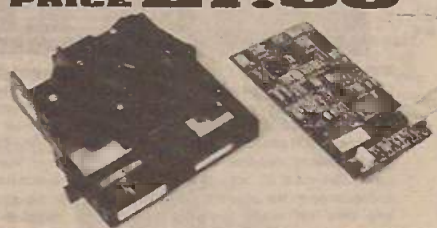
Z5089 32xTC5514AP-3 1kx4 static RAM + few other chips etc £3.00
SALE PRICE £1.20

Z5090 12xM5M5165P-15L 8kx8 static RAM plus few other chips £4.00
SALE PRICE £1.50

Z5100 16xHM6167LP-8 + few other bits £2.00
SALE PRICE 80p

Z5101 2xM5M5165P-10C + few other chips £1.50
SALE PRICE 60p

Z5262 8x2764 in skts + 10 LS chips £4
SALE PRICE £1.50



Z5364 Coin acceptor unit. Moulded plastic case 140x130x50mm (believed used in payphone) which has several coils embedded into it. As a coin passes over the coils, the circuitry on the 135x76mm PCB generates a pulse train. PCB contains MM9504, 82S126 in skt, CMOS 4001x2, 4053, KM2902 quad op-amp, LM2903 dual comparator, 5 small signal transistors, 4 small chokes, R's, C's etc. Only £2.95 100+ 1.75

SALE PRICE £1.00

Z653 Control PCB, 140×115mm with 2×4013, 4020, 4011, 4081, 4071, 8211, LM3909, 2af02.003TIP130, 5×2N3906, switch, C'S R's, LED etc. £1.50

SALE PRICE 2 FOR £1

Z631 PCB 170×135mm with 2×LM324; 2×ILO74; 2×MC14416; 4519; 2×4510; 2×4099; 4001; 4584; 2×741; HCI4 LS05; 74125; 2 relays, Rs, Cs, etc

Price ..... **Reduced to £1.50**

SALE PRICE 2 FOR £1.00

Z629 Occasionally we obtain repeat supplies of panels - this one was featured on B/L 30 and is 170×35 with 2×MC3419 loop interface 4510, LS505, LS514, 4584 all in sockets, also LM324, 4519, 2×4099, 4013 plus 2×4.5V DPCO BT type relays. Also 64 way DIN plug, 2 bridge rects, 6 transistors, Rs, Cs, etc.

Price ..... **Reduced to £1.00** 100+ 0.60

SALE PRICE 3 FOR £1.00

JIMMY

the electronic football game of skill

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

Price ..... **Only £5.00**

SALE PRICE £2.50

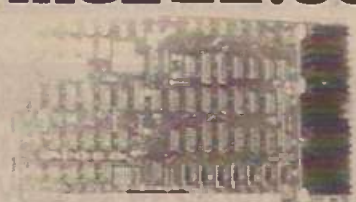
Z5432 Nice little surface mount module. PCB 70x51 has sub panel 56x26mm plugged into 2x18SIL skts. On it are 10 IC's tc. On the main panel are 4 big chips - TMS320, CF34035 & 6, 77C82; 4 xtals - 8MHz, 970, 2048 & 19660.9kHz + some smaller chips - ZN429, TL431C etc. Complete panel for £3.00

SALE PRICE £1.00

Z4294 Neat panel 213×37mm with 5 keyboard switches, 3 red LEDs and a DL1416 4 digit LED display with built in memory. There's half a metre of grey ribbon cable attached to a 34 way IDC socket.

Reduced to **£3.00**

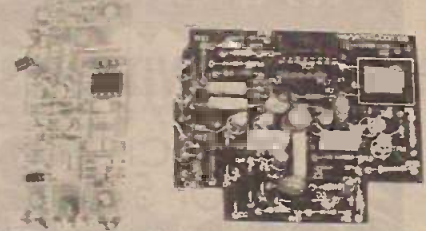
SALE PRICE £2.00



Z4300 Nice panel 330×170mm with 3 chunky heatsinks 47×36×32mm, each with TO220 voltage reg. Also 56×74 series ICs including L+LS. 3×40W IDC plugs, few tants etc. Attached to the board are 2×0.5m long twisted and flat ribbon cables terminated in 50 way IDC sockets.

Price **£4.00**

SALE PRICE £2.00



Z4319 Small panel 85×43mm with 555 timer, BS107 FET, BC109, 3×BFW43, 47µF 35V tant + other Rs, Cs etc.

Price ..... **3/ £1.00** 100+ 0.15

SALE PRICE 10 FOR £1.00

Z4318 Ex - BT tone divider PCB. Panel 84×69mm has on it 2559 tone divider chip, 3.579545 Xtal, 7 small signal transistors, tants, Rs, Cs, etc. Produces required tones for telephone system.

Price ..... **£1.00** 100+ 0.30

SALE PRICE 5 FOR £1.00

Z5203 Relay panel - some panel, this! 50, yes 50 DPCO 24V DC min relays, Omron type G2V (our type W834) on PCB 230x160mm with 2xDIN41612 64 way plugs. At 1 off prices, this would cost around £100, but you can have a complete panel at just 20p per relay - that's only £10.00!

SALE PRICE £5.00

Z5372 Small PCB 102x51mm with 8.4V 170mAh nicad button cell (list 7.31), a DPCO relay and a few other bits £3.00

SALE PRICE £1.50

Z5204 Diecast housing 252x140x25mm (subscriber module) contains PCB with lots of nice high frequency bits, much of which is contained within 2 diecast boxes bolted on to the board. Most of the transistors (there are 17 of them) are BF980, BFR90A/91A BFW92 etc. Single output socket, 2 DIN41612 plugs. Great value at £4.50

SALE PRICE £2.00

Z5301 Panel from Z4113 Contains all components, including transformer. Believed unused - some are very dusty. £3.00.

SALE PRICE £1.00

Z5411 Marconi panel 225x195mm. No info on this PSU, but it's got some really nice bits on it - 2 x 2N3716 TO3 transistors, 13 BCY71, 2 x BC107, BFW43, BFX29, LM317K and LM337K T03 variable voltage regs, some high power zeners, pot cores, R's, C's etc., toggle switch with locking device.

Great value at £3.95B

SALE PRICE £1.50

Z910 391×39mm. This panel has soldered in components - TCA4500A and TBA651R, AM radio with IF amp. Probably complete RF section of radio, as IF's and trimmer are on board + R's, C's, etc.

Price **60p**

SALE PRICE 5 FOR £1.00

Z493 D Module. As above, but PCB has 3×BC184L, BD124, Rs, Cs etc.

Price **£2.00**

SALE PRICE 5 FOR £2.00

½MEG MEMORY BOARD

Z8900 Massive panel 460×400mm smothered in chips. Could be a complete computer judging by the IC's on the board. Made by Whitechapel Computer Works. Contains at least the following (some panels have extra chips):
64×4164-15 RAM's, over 200 74LS, F and other logic chips; 3×4016-3, 2×8253-5,8251, 2×5516, 6 xtals, 3×'D' Plugs and sockets, 3×DIN 64 way socket, + R's, C's etc. Price equivalent to 4164's @ 30p each and rest of chips @ 3p each!

Price **£25.00**

SALE PRICE £10.00

RADIO SCANNERS - Send SAE for full details of our range of high quality scanners at great prices!

Z5140 As listed in BL75, but we've found some of these serial parallel interface cards for the Apple II complete with comprehensive 22 page booklet. It provides full serial RS232C output + a fully decoded 8 bit parallel output port. Excellent value at £5.00

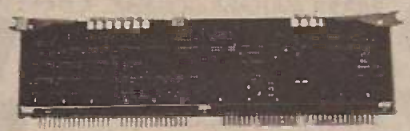
SALE PRICE £3.00

Z5408 Heatsink 152x50mm with 4 x T03 devices mounted on it: 2 x 7805CK 5V 1.5A voltage regs (DP 2.00) and 2 x BUY18S, a 200V 15A NPN transistor. In our cat at 2.30. So the total value is 8.60. .ur special price £2.50

SALE PRICE £1.00

Z5263 Panel 80x60mm with FPT100A phototransistor, LM324 quad op amp. 24V SPCO heavy duty relay. BC546, diodes, R's and C's. Smashing little board –only £1.00

SALE PRICE 2 FOR £1

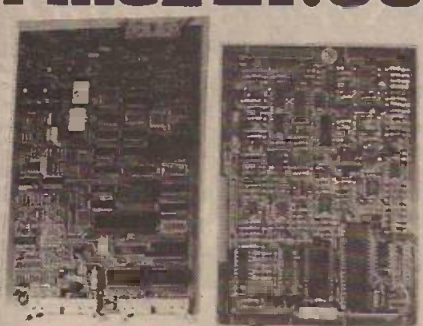


Z4368 Panel 310 × 90mm with 20 CMOS chips. 3 × MC1488, 2 × MC1489, 6 × C251 opto isolators and a 64 pin chip MB60504.
Reduced to **£2.00**

SALE PRICE £1.00

Z4279 Interesting little panel (75mm × 40mm) with 16 position BCD channel switch (24 pins). 2 dual green 7-segment displays: 2 min keyboard switches, and a short A4093. Attached by a short length of ribbon cable is a second panel (same size) with 4518, 4019 and 2 × 5068 chips. Supplied with circuit.
Price ..... **Only £2.20**

SALE PRICE £1.00



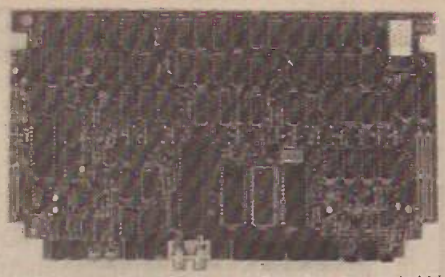
Controller Boards

PCB 175 × 122mm containing a wealth of components - 80C39 CPU, 4 × TL066, TL094, CMOS and 74 series chips, 8 × TO126 transistors, 13 TO92 transistors and lots of R's and C's etc - also a 3V lithium battery. 3 connectors on it go to (a) card reader (b) motor panel & (c) display panel which is identical to our Z027 (P111 of Catalogue).
Order Code **Z5047**
Reduced to ..... **£2.00** 100+ 1.00

SALE PRICE 4 FOR £2

Z5048 Panel 275 × 178mm containing some excellent components: 2 × D8243 I/O expander, 8035 CPU, 8253 timer, 2651 USART all in sockets, 2 × 2111A-4 RAM, 25 mostly CMOS chips, 8 × TO126 transistors, 5 × TO92 transistors, R's, C's etc; 26W IDC plug, 2 × 34W IDC plugs, 2 xtals.
Only **£3.00**

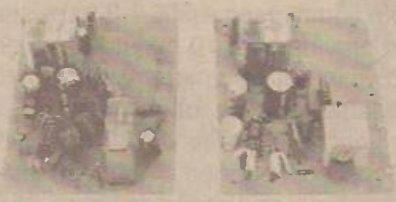
SALE PRICE £1.00



Z672 Newbrain motherboards. Complete but probably faulty **£3.50**

SALE PRICE £2.00

Z674 Newbrain data. Interfaces and connector pin out i/p, o/p, port map, cct diagram + data on CP420C. (This lot replaces cct diag only for 75p) **£2.00**

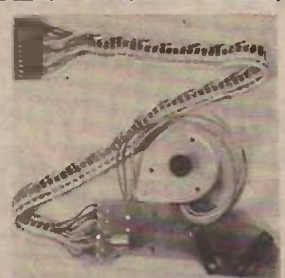


Z925 DPCO 12V 185R relay, 12V DPCO relay with heavy duty contacts, SC146D 400V12A triac, 555 timer, 11 × 1N4001, 2N5061 SCR, 3 × 2N37043, Rs, Cs, etc.
Price **£1.90**

SALE PRICE 3 FOR £2.00

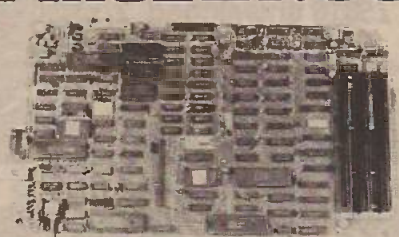
Z926 Similar to above, but instead of heavy duty relay, a T2800D 400V 12A triac and C122D 400V 12A SCR. Both boards 100×75mm **£1.85**

SALE PRICE 3 FOR £2.00



MOTOR PANELS
PCB 92x31mm with mercury tilt switch, 2VTL 10D2 opto slotted switches, length of 11 core cable with socket and stepper motor as described above.
Order Code Z5046
Prices £3.50 100+ 2.20

SALE PRICE £1.50



HIGH QUALITY ICL COMPUTER PANELS – 2 types, the first a mother board and the second a panel which plugs into the first.
Z4209 Panel 360×210mm covered in high quality chips: 8085AHC, 8255, 8257, 8251A×2, 8253 -5, 8275, 8202A, 2732, 2716, all in sockets; 18×4116-2 + other mainly LS chips + min switches, LED's, oscillator, large tants, 3×50 way double sided edge connectors. Amazing value at only **£16.95**
Reduced to **£9.95**

SALE PRICE £5.00

Z5093 Till display. Plastic housing 200x95x45mm contains PCB 195 x70mm with 8 7-seg HP LED'S type 5082-7651, red 0.43 CA;, 16 5mm red leds. 8255 programmable interface and other chips etc.
Price **£2.50**

SALE PRICE £1.00

1W Amplifier - mono

Z914 Audio amp panel 95 × 65mm with TBA820 chip. Gives 1W output with 9V supply. Switch and vol control. Just connect battery and speaker. Full details supplied.
Prices ..... **Only £1.50** 25+ 0.80 100+ 0.60

SALE PRICE 2 FOR £1
BOX OF 128 £35

1W Amplifier - Stereo

Z915 Stereo version of above 115 × 65mm, featuring 2 × TBA820M and dual volume control.
Prices reduced to ..... **£3.00** 25+ 1.80 100+ 1.20

SALE PRICE £1.00
BOX OF 64 £35

Z974 Mixer Amp Panel 115 × 115mm and gives 1W O/P from a TBA820M chip. There are 2 inputs, one via a pre-amp, from phono sockets and separate volume controls. A third pot is used to fade from one input to the other. There are also 2 4p 3w rotary switches. Attached to the PCB by flying leads is a panel on which are mounted the 2 input sockets, 2 × 5 pin DIN sockets and 2 pin DIN speaker socket. A data sheet is supplied.
Price ..... **Only £2.50**

SALE PRICE £1.00

Z1699 Mini inverter - This handy PCB 31 × 23mm uses a 2 transistor circuit to provide a 60V peak ac supply (20V dc @ 1mA) from a 3-7V dc input. Can be used to drive Z1637 LCD or for powering vacuum displays. Originally used in Newbrain computer.
Price **3/ £1.00**

SALE PRICE 10 FOR £1

Z5286D Metal detector panel 185x115mm. This is the complete PCB from an expensive (£80+) "treasure detector" – just add wire coil and meter to make a working unit. Circuit uses 15 transistors and 3 IC's. There are 5 pots and a rotary switch. Detailed info supplied. £12.95

SALE PRICE £9.95

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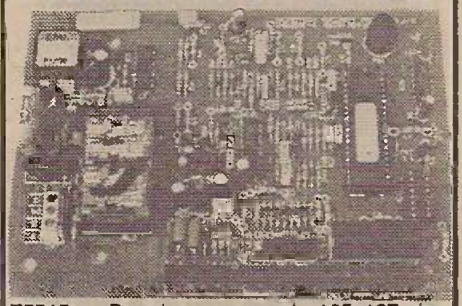
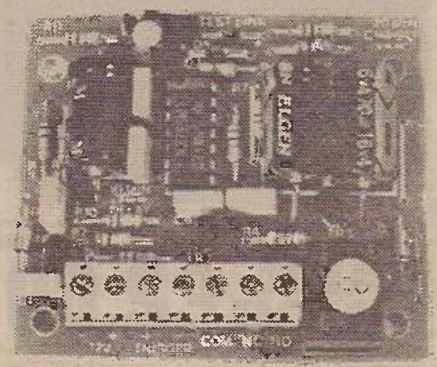
ALARM PANEL



Z5515 Brand new panel 165x127 by Microtech Security. These are for use in an alarm unit (Digicom 8) and contain some excellent parts. However they need a programmed PROM to make the board functional. 12V supply. 8 inputs. Connexion to BT line via opto-isolators. Useful parts include 2 min 12V DP relays; 2 larger Omron DPCO 12V relays and a Clare mercury wetted relay. Chips: LM567; LM324; ULN2003A. Wiring diagram included. Individually boxed. **Great value at £3.00**

TIMER PANEL



Z5514 Universal bell timer. Panel 63x55mm uses a 556 + 3 transistors to provide both 10 minute delay and 20 min cut off timers, with ability to disable one or other. +ve or -ve trigger. SPCO relay. 12V operation. Supplied bagged with adhesive stand-offs and connexion data. **£5.95**

Xtra Special

BBC SOFTWARE

Z4333 Micro Maestro 5.25" disk + tape + C60 stereo cassette + handbook. Concert pitch **£2**
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Z4326 Music Master. Mic to attach to recorder + processor + 5.25" disk + handbook 40t **£3**
Z4327 As above but 80t **£3**
Z4328 Recorder Tutor - 5.25" disk, 38p handbook, C90 cassette with 52 tunes **£2**
Z4329 Ensemble Pack **£1**
Z4330 Duet Pack **£1**

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25% OFF THESE TWO PANELS

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Z2590 TO5 copper 17diax20 16/£1
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K856 Pack of 8 assorted (3 types)

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Z2651 16.384M 20/£2
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Z1653 2.4576M 3/£1
Z1654 8.863256 5/£1
Z2079 14M 3/£1
Z2151 2.45760M 3/£1

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Xtra Special

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Z2651 Crystal Reel of 1000 £50
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Z1661 27C32 12/£1
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Z5266 45mm 15R 6/£1
Z945 5x3" 80R 1W 2/£1
Z578 30mm 16R 0.4W 5/£1
Z5275 57mm 8R 6/£1
Z5267 57mm 75R 6/£1
Z5419 63mm 4R 8/£1
Z533 20mm 50R 3/£1

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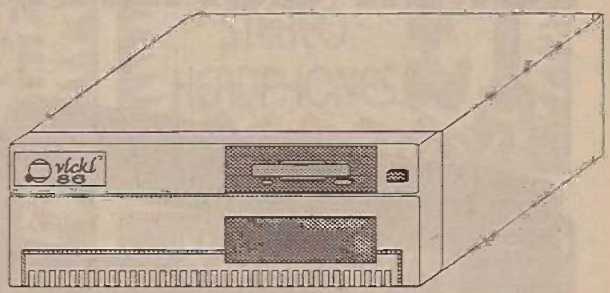
VICTOR *vicki* 86 XT PC

We have a limited quantity of these high quality units - the beautifully styled beige base unit measures 395x330x130mm and is fitted with an 8086 motherboard with 640k base memory, 3.5" 720k disk drive, 75mm dia speaker and a fan cooled switch mode power supply unit. There are 5 8 bit expansion slots and room to fit a further drive. Socketry includes 9 pin D for standard mono monitor, 25 way D parallel and 9 way D serial ports, 7pin DIN keyboard socket and power inlet. The keyboard is a standard PC XT layout, but some keycaps need to be changed for English version (Intended for the German market; stickers supplied). Excellent build quality - steel case cover with plastic fascia.



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SOME MORE GOODS JUST ARRIVED

Z5560 Ni-Cad battery pack. 10 'C' size cells contained in 2 tubes - easily taken apart if required. Rated 12V 1700mAh. Only £6.95.

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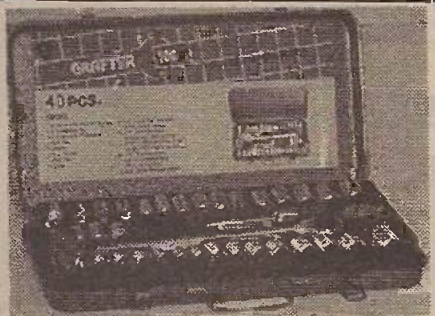

Z9155 40 piece socket set by 'Grafter'. Good selection of sockets at a modest price - 5/32 - 9/16 & 4-14mm + handle, extn. adaptor etc, all in a hinged metal case £6.95

HEADPHONES

H8 Excellent quality Adastra stereo headphones with boom microphone. Freq. response 20-20,000Hz. 32R impedance. Microphone 600R . 2m leads fitted with 3.5mm plug for mic. and 3.5 mm plug +adaptor for headphones. Padded earpieces and leatherette headband.

SALE PRICE £4.95

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Z2105 50R 15W WW 5/£1
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Z1877 0R1 11W WW 18/£1
Z1878 0R27 11W WW 18/£1
Z4402 1R 25W WW 4/£1
Z2701 6R8 5W MC 20/£2
Z2702 8R2 5W MC 20/£2
Star Buy !!

Xtra Special
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Z822 800uF 250V can 3/£1
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Xtra Special
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Z2339 100mH 10A coil 6/£1
Z5060 Italian C60 tape + 32 page book 2 for £1
Z4199 Timer £1.50
Z035/6 Term unit £2
Z5270 Ribbons 4/£1
Z5368 Aerials 5/£1
Z2648 UHF Tuner 3/£1
Star Buy!!

Xtra Special
HARDWARE
Z5144 25D covers 20/£1.50
Z5142 Vacuum case 6/£1
Z2175 4x0.5" pozi pan screws
Z5408 Heatsink with 2x7805 & 2xBUY18S (both TO3) £1.00
Z07007 Sleeved grommet 120/£1
Z2311 Knobs, solid black ally 6/£1
Z4283 Sealing strip 50m/£3
Z5349 32mm conduit clamp 12/£1
Z5149 Self amalgamating tape 125m x 13mm £5
Z5164 As above but 21mm wide £7
Star Buy!!

Xtra Special
SWITCHES
Z2166 microswitch 12/£1
Z2341 DIL switch 10/£1
Z2499 limit switch 8/£1
Z2491 microswitch 4/£1
Z1522 CB switch 2/£1
Z2492 cased uswitch 2/£1.50
Star Buy !!

Xtra Special
Z655 PLASTIC PUMP (from cream dispenser)
10 for £1
Star Buy!!

Xtra Special
Superb Sub-min mic
Z2642 Ideal for bugs, etc
Size 10x7x4mm
3 for £1
Star Buy!!

Xtra Special
LEADS
at ludicrous prices
Z5416 25D p-25D s £1
Z5087 6pin-3phono 4/£1
Z5433 25D s-10w miniDINp 2/£1
Z2346+Z5169 Cable mntg 3w p + skt with 2m 6A lead £1.50pr
Star Buy !!

Xtra Special
SWITCHES
Z1816 Min PCB togg SPCO 6/£1
Z1837 Illum DP push £1
Z2167 sp keyboard 12/£1
Z2108 4p3w rot 6/£1
Z2140 4p3w rot 8/£1
Z2361 HD push c/o 6/£1
Star Buy !!

Code	Type	Description	List	Our Price
Z6124	ICM7170IPG	CMOS µP real time clock - µs to years	8.95	£4.50
Z6125	IRF740	400V TO220 10A 125W MOSFET	2.09	£1.00
Z6126	IRFR014	TO252 HEXFET 60V 33A 25W	1.07	2/£1.00
Z6127	L4885CX	?		£1.00
Z6128	LM2902D	Quad op-amp	0.82	3/£1.00
Z6129	LM2903N	Dual low power comparator	0.76	3/£1.00
Z6130	LM293N	Dual comparator		£1.00
Z6132	LM336B25	Voltage ref diode TO92 2.5V	4.58	£2.50
Z6133	LP365N	Quad low power programmable comparator 4000ns	0.90	2/£1.00
Z6134	MC1489AP	Quad RS232 line driver	0.45	4/£1.00
Z6135	MC3486P	Quad diff RS422/3 line receiver	1.08	2/£1.00
Z6137	OP07EP	Precision op amp	0.92	2/£1.00
Z6138	2N4392	TO18 FET. N, 40V 300mW	1.23	3/£2.00
Z6139	6N139	Darlington single opto coupler 400%	1.30	3/£2.00
Z6140	BD436	4A PNP TO126 32V 36W	0.68	3/£1.00
Z6141	BF869	50mA NPN TO202 250V 5W	0.66	3/£1.00
Z6143	CDP1871ACE	RC IC?	13.86?	£5.00
Z6144	D8753H	?		£10.00
Z6145	DG417DJ	Precision SPST CMOS analogue switch	1.76	2/£1.00
Z6146	MC6809P	8 bit CPU	2.17	£1.00
Z6147	MCT2E	Transistor opto coupler 2.5kV 20%	0.45	4/£1.00
Z6148	MK4501N-12	512x9 Biport FIFO 120ns	4.78	£2.50
Z6149	MM58274CN	µP real time clock	7.93	£4.00
Z6150	N82S129AN	1k bipolar RAM (256kx4)	1.95	£1.00
Z6151	NM1630	Quad translator 5-15V logic isolation	10.10	£5.00
Z6152	NMA0505S	?		£2.00
Z6153	NMC9346N	E²PROM	1.43	3/£2.00
Z6154	OP27GS	Low noise op-amp SM	3.17	£1.50
Z6156	PALCE29MA16H-25	29 input, 16 prog output		£5.00
Z6157	RC5534ANB	wide bandwidth, low noise op amp	1.18	2/£1.00
Z6159	S17660DJ	?		£1.00
Z6160	TIBPAL22V10ACNT	22 input 1 time prog PLD	£10.00	£3.00
Z6161	TL7705ACP	+5V µP power supply supervisor	£1.75	£1.00
Z6162	TL7705AID	do		£1.00
Z6164	TLC272CD	dual do	1.17	3/£2.00
Z6166	TMS9129NL	?		£10.00
Z6167	UC3524AN	Enhanced SMPSU circuit	1.53	3/£2.00

SM = Surface Mount (there may be some SM not so indicated - we're working from a list rather than the devices themselves).

Semiconductors

We've found a number of odd devices whilst clearing out a store, all offered at silly prices.

(a) Diodes

Z2746	ITT907	Pick
Z2747	ITT920	anywhere
Z2748	ITT12601	at 500
Z2749	XK3117	for
Z2750	BAX12A	£5.00
Z2751	OAZ201	Min 100 of
Z2752	TI621425	one type

Z2753 1N5361A plastic 27V 5W zener. 6 for £1.00

Z2754 Stud mounting rectifier, no nuts. 16F40 400V 16A 4 for £1.00

Z2755 Stud mounting zener 1S5056 rated 10W 5.6V. 3 for £1.00

Z6123 BB105B varicap diode 17.5pF @ 1V; 11.5pF @ 3V. Pack of 3 £1.00

Z2756 SD2 pair of recifiers connected thus:

400 for £2.00

Z2757 SD3 as above. Same price

(b) Integrated Circuits

Z6101 LM305H +4.5V to +40V 45mA TO99 voltage regulator. 3 for £1.00

Z6102 LM306H voltage comparator £1.00

Z6103 SN76033N audio amp £3.00

Z6104 SN76023ND audio amp £2.00

Z6105 MC8500P £2.00

Z6106 MC2116J-15L £1.00

Z6107 SH3011 8 pin TO3 device. Voltage reg? £1.50

Z6108 MC68008L8 £2.00

Z6109 7107 DPM £3.00

Z6111 1DAC80-CB1-V-C D/A converter £1.00

Z6112 DAC80-CB1-V D/A converter £1.00

Z6113 2112A 3 for £1.00

Z6114 Z80A DART £1.00

Z6115 2114 2 for £1.00

Z6116 2708Q EPROM 2 for £1.00

Z6117 OP27 op amp DP 2.75 £1.50

Z6118 4N28 optocoupler 4 for £1.00

Z6119 COM816 dual baud rate generator DP 4.37 £2.00

Z6121 SAB3036 £1

Z6122 LM6321 high speed unity gain buffer. DP 6.64 £2.00

Z732 XK1444 CMOS buffer - 7 in one chip. 6 for £1.00

Few IC's that arrived in a recent parcel:

Z2733 14256-80 256k DRAM £1.00

Z2734 LM3524N Switch mode PSU chip £1.00

Z2735 DS14C88 Quad CMOS RS232 line driver 2 for £1.00

Z2736 SN75122 Line driver 2 for £1.00

Z2737 µA9637ATC dual differential line receiver 2 for £1.00

Z2738 27C16Q-45 16k EPROM 2 for £1.50

Z2739 HN58064P-25 64k NMOS EPROM (DP 10.57) £3.00

Z2740 S-82716-3 ??? 64 pin chip £2.00

Yet another parcel of semi's - this one has been in stock for some time, but haven't time to sort and list it!

Code	Type	Case	Description	Qty	Price
Z2874	723	TO99	V. Reg. +2V to 37V 0.1A	260	3/£1.00
Z2875	TAG306/400	TO66	Triac 6A 400V	100	3/£1.00
Z2876	TAG310/400	STUD	Triac 10A 400V	34	3/£2.00
Z2877	TAG3/400	TO66	SCR 5A 400V	74	3/£1.00
Z2878	40430	TO39	Unknown	750	5/£1.00
Z2879	TAG240/500	TO220	Triac 6.5A 500V	250	3/£1.00
Z2880	TAG06/200	TO18	SCR 0.8A 200V	94	5/£1.00
Z2881	2S323	TO18	Transistor	1300	£2.00
Z2882	2S324	TO18	do	500	£2.00
Z2883	BC177A	TO18	do	275	10/£1.00
Z2884	2N4905	TO3	do	90	£2.00
Z2885	2N5108A	TO39	do	156	2/£1.00
Z2886	2N3019	TO39	do	30	2/£1.00
Z2887	2N2223	TO5	dual do	34	£1.00

CODE	TYPE	DESCRIPTION	QTY	LIST	OUR PRICE
Z6168	7905CT	-5V 1A TO220 Regulator	353	42p	8/£2
Z6172	81LS95		396		£1.00
Z6173	VT7C122-15	22 Pin Dil	300		£1.00
Z6174	MCM6064P12	28 Pin Dil	150		£1.00
Z6175	AM9517A-4DC	40 Pin Dil	58		£1.00
Z6176	82S09	28 Pin Dil	94		£1.00
Z6177	MJ2813	28 Pin Dil	175		£1.00
Z6178	P8275		16		£1.00
Z6180	TIBPALI6R4-25CN		9	1.64	£2/1.50
Z6181	TIBPAL16L8-15CN		30	1.64	£2/1.50
Z6182	PAL10H8CN		10		£1.00
Z6183	PALCE26V12H-25PC		12		£2.00
Z6284	AM26LS31	16 Pin Dil	29		£1.00
Z6187	AM26LS32		41		£1.00
Z6188	AM9122-25		10		£1.00
Z6189	PALC18U8Q-25CN		20		£2.00
Z6190	Z80A S10-2		6		£1.00
Z6191	MK3887N-4		35		£1.00
Z6192	Z80A CTC		25		£1.00
Z6193	P21256-12	256K Dynamic RAM	238	3.00	£1.00
Z6194	CDM6264E3	28 Pin Dil 64K static RAM	150	3.00	£1.00
Z6195	MK3885N-4		150		£1.00
Z6196	Z80 SIO-1		13		£1.00
Z6197	P82530-6		5		£1.00
Z6198	VT7C122-12		102		£1.00

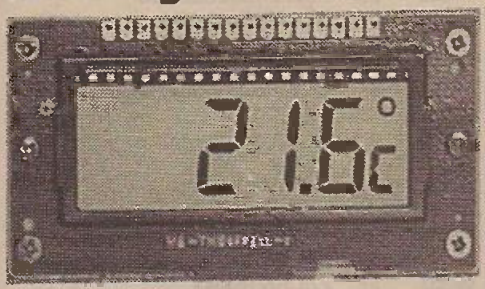
Don't miss the Bargains - Become a Subscriber!

CODE	TYPE	DESCRIPTION	QTY	LIST	OUR PRICE
Z6169	Z80ACTC	Counter timer and controller	100	1.99	£1.00
Z6170	P82510	High Intergration CMOS UART	41	19.27	£5.00
Z6171	SAB80535-N (plcc)	8 bit CPU,256 bits RAM, 12MHz	65	8.46	£2.50
Z6179	M80C3IF (plcc)	8 bit CPU,128 bits RAM, 12MHz	52	2.64	£1.00
Z6199	V20 MICRO	(8609H9V20) NEC	13		£3.00
Z6200	ET12BC	A-D CONVERTER	5		£1.00
Z6202	27C64Q-200	64K EPROM 12.5V Vpp CMOS	80	4.11	£2.00
Z6203	2764D	64K EPROM	65	3.99	£2.00
Z6204	Z80CPU	8 Bit CPU	7	3.00	£1.00
Z6205	51R90035BQ1	24 Pin Device by SEEQ	16		£1.00
Z6206	PAL20R6BCNS	Hex 20 Input and/or Gate Array	55		£1.00
Z6207	MK2716J-8	16 K EPROM	34	5.28	£1.00
Z6208	AM2764A-2	12.5V PGM EPROM 64K	26	3.99	£2.00
Z6209	TMS2732A-35J	32K EPROM	51	4.70	£1.50
Z6210	TMS2764-25JL	64K EPROM	10	3.99	£2.00

LATE ARRIVALS

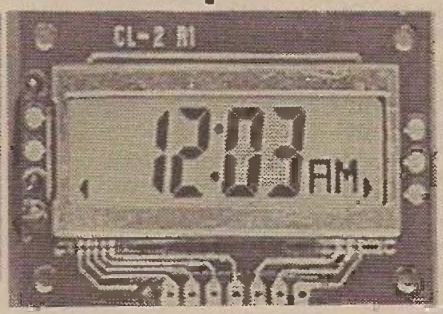
Stocks listed on this page have only recently arrived, and although not included i n our SALE they represent such good value for money, we thought you'd like to see them anyway

Amazing Clock & Min/Max Temp Modules!



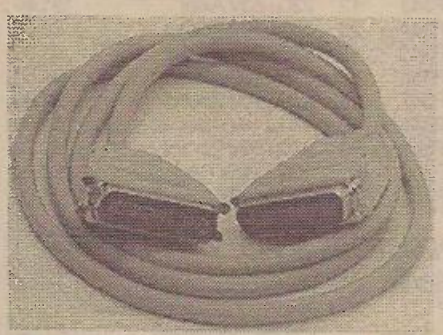
Z5558 LCD Min/max electronic thermometer module. Reads -5 to +50C (23-122F) Resolution 0.1. Accuracy ±1C. Uses single AA 1.5V cell. Size 68x35x24mm. 13mm display. Supplied with comprehensive instructions.

SUPER BARGAIN BUY - ONLY £3 100+ 2.00

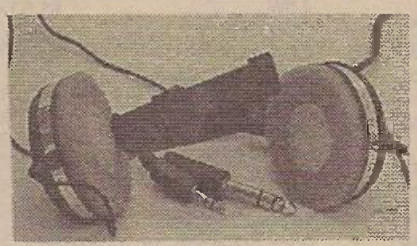


Z5557 Clock module with timer and two alarms. Displays day, hour, min and AM/PM. Overall size 48x32x7mm; display 10mm.

AMAZING PRICE! £3 100+ 2.00



Z5555 Centronics lead – 36 way plug both ends, 1.8m long **£2.50**

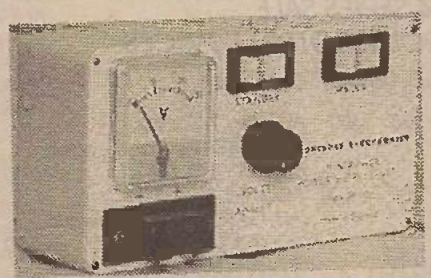


Z5560 These headphones have excellent quality transducers, although the gimmicky fold-up style leaves a bit to be desired. Supplied with mini plug + adaptor to std size. **£3.95**

Some more surplus from Adastra:

Z5553 Intercom lead – 15m of twin flex wound on a handy frame with a 2.5mm plug either end. Great value at **60p**; 100+ 0.25; 1000+ 0.20

XLR connectors – high quality brass chassis mounting:
Z3012 3 pin socket with release catch **£1.00** 100+ 0.60
Z3013 3 pin plug **80p** 100+ 0.50
Z3014 Standard 75R BNC Plug Cat price 99p Superdeal **5 for £2.00** 100+ 0.25 1000+ 0.20



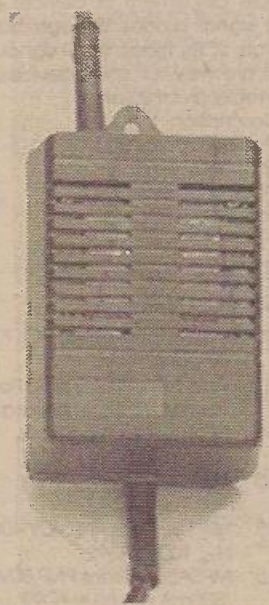
BENCH POWER SUPPLY

Z9154 Well made by Wednesday Electronics, this variable output PSU has std mains input and 0-30V DC 1.5A output. Line regulation 0.01%/V; Load regulation 0.1%; Ripple rejection 65dB; Quiescent current 3.5mA; Output noise 150µV; Size 168x82x55mm. Individually boxed with instruction leaflet.

PRICE £29.95

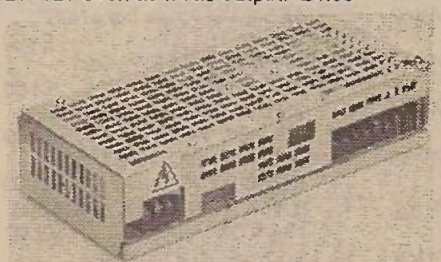
MORE POWER SUPPLIES!

Nice parcel of PSU's,–2 switch mode, 2 linear.



Z5549 Black plastic cased transformer 102x77x70mm with single 'keyhole' hook for hanging on wall. 2m long 3 core mains cable and 2m long output lead terminating in 3 pin socket. 240v ac input, 18v 2.15A ac output. Room inside for bridge, cap and regulator if required. **£4.95**

Z5550 Similar to above, but output lead has 4 way socket. This one is rated 230v ac input, 12v+12v each at 1A ac output. **£4.95**



Z9148 QUEL Powerline switch mode PSU. Ventilated case 267x120x57mm. Input: 42–56V DC. Output: +5V 25A; –5V 4A; +12V 4A; –12V 4A; +24V 4A. Max. output power 200 watts. **£ 9.95**

Z9145 As above, but input 115/230vac (or 325v DC). Outputs: +5v 25A; –5v 4A; +12v .3A; –12v 3A; –48v 2A. Max output power 200 watts. **£19.95**

FIBRE OPTIC CABLE

Just purchased 40,000m of 0.2mm dia top quality fibre optic cable. Ideal for modellers and experimenters. Last tme we had this (Winter 91/92) it whizzed out the door - so don't leave it too long before ordering!
Tech Spec: 1310nm - 0.32-0.39dB/km 1550nm - 0.22-0.24dB/km.
Sold in the follwing packs:
Z3015 10m **£2.00**
Z5559 100m **£12.00**
Z9153 1000m reel **£85**

We're re-offering some red LED displayswhich have appeared in previous lists; now at much reduced prices.

CODE	TYPE	SIZE	CA/CC	DP	QTY	£2PACK	100+	1000+
Z3001	S806RWB	20mm	CA	RH	792	8	.12	.08
Z3002	LTS312R	0.3"	CA	BOTH	1325	15	.08	.05
Z3003	3719	0.3"	CA	RH	1075	20	.05	.03
Z3004	3729	0.3"	CA	RH	9807	20	.05	.03
Z3005	MIP4710	0.43"	CA	RH	1705	20	.05	.03
Z3006	MAN4710A	0.43"	CA	RH	1441	20	.05	.03
Z3007	MIP4720	0.43"	CA	LH	977	20	.05	.03
Z3008	MIP4920	0.43"	CA	NONE	3983	20	.05	.03

SUPER SENSATIONAL SUMMER SALE

GREENWELD
27 Park Rd. Southampton SO1 3TB
Tel: 0703 236363 Fax: 236307

All one off and pack prices **INCLUDE** V.A.T. Qty. prices do not.

1/3rd OFF ALL ITEMS ON THIS PAGE

Bi-Pak Clearance
1/3rd off all remaining Bi-Pak product - please give alternatives where possible, as stocks are low on some items

SEMICONDUCTOR PACK

An incredible assortment of devices ranging from small signal diodes through transistors, ICs, regulators, SCRs, triacs, small signal, power, AF, RF. All are new full spec devices, so this pack offers really great value:

Code	Description	Price
VP917	Pack of approx 200 (count by weight)	£8.00
VP918	Pack of approx 1000 (count by weight)	£30.00

TRANSISTORS

Pack No	Qty	Description	Price
VP46	40	PNP Transistors like BC177/8, all good TO18.	£1.00
VP48	5	Pairs NPN/PNP plastic Power Transistors, 4A, with data.	£1.00
VP50	60	NPN Sil Switching Trans, TO18 and TO92.	£1.00
VP51	60	PNP Sil Switching Trans, TO18 and TO92.	£1.00
VP153	15	TIS91 Sil Trans PNP 40V 400mA H_{Fe} 100+ TO92.	£1.00
VP154	15	MPSA56 Sil Trans PNP 80V 800mA H_{Fe} 50+ TO92.	£1.00
VP155	20	BF595 Sil Trans NPN equiv BF184 H.F. TO92.	£1.00
VP156	20	BF495 Sil Trans NPN equiv BF173 H.F. TO92.	£1.00
VP157	15	ZTX500 Series Sil Trans PNP plastic.	£1.00
VP159	15	ZTX108 Sil Trans NPN equiv BC108 plastic.	£1.00
VP161	25	BC183L Sil Trans NPN 30V 200mA TO92.	£1.00
VP162	5	SJE5451 Sil Power Trans NPN 80V 4A H_{Fe} 20+.	£1.00
VP163	2	NPN/PNP pairs Sil Power Trans like SJE5451.	£1.00
VP164	4	2N6289 Sil Power Trans NPN 40V 40W 7A H_{Fe} 30+.	£1.00
VP165	6	BFT33 NPN Sil Trans 80V 5A H_{Fe} 50-200 TO39.	£1.00
VP167	1	BUY69C NPN Trans TO3 VCB 500 10A 100W H_{Fe} 15+.	£1.00
VP169	10	BXS21 equiv BC394 NPN Sil Trans 80V 50mA TO18.	£1.00
VP170	10	Assorted Power Trans NPN/PNP coded and data.	£1.00
VP171	10	BF355 NPN TO39 Sil Trans equiv BF258 225V 100mA.	£1.00
VP172	10	SM1502 PNP TO39 Sil Trans equiv 100V 100mA H_{Fe} 100+.	£1.00
VP200	30	OC71 type germanium AF Transistors uncoded.	£1.00
VP201	25	OC45 germanium RF Transistors.	£1.00
VP261	4	Programmable Unijunction Transistor MEU22, full data.	£1.00
VP272	10	MOS-FETs Signetics, SD304.	£1.00
VP290	15	MPSA06 Sil Transistors NPN 80V 500mA H_{Fe} 50+TO92.	£1.00
VP429	10	AC176K NPN germanium Transistors 1A 32V.	£1.00
VP430	4	2N3055 Sil Power Transistors full spec.	£2.00
VP431	25	PNP Sil Power Transistors TO39 like 2N2905A.	£1.00
VP451	20	NPN Transistors like BFY50/51 all good TO39.	£1.00
VP452	5	PNP Power Transistors BD244AX equiv TIP2955.	£1.00

ICS

Pack No	Qty	Description	Price
VP59	20	Assorted ICs linear, etc, all coded.	£2.00
VP209	12	74LS00.	£2.00
VP210	12	74LS74.	£2.00
VP211	10	CD4001B.	£2.00
VP212	10	CD4011B.	£2.00
VP214	10	CD4069B.	£2.00
VP215	10	741P 8 pin.	£2.00
VP216	10	555 Timers 8 pin.	£2.00
VP282	1	1Programme Sound Generator Chip AY0-3-8912. G.I. 28 pin IC.	£3.00
VP291	1	Z80A CPU Microprocessor, 40 pin DIL.	£2.00
VP299	3	CA3085 Pos Volt Reg. 1.7V - 46V, 8 pin TO5.	£2.00
VP403	1	TA7204 Audio Amp IC 4.2W, 13V, 2-4ohms.	£1.00
VP404	1	TBA461 Audio Power Amp 4.5W	£1.50
VP435	10	CD4028B.	£2.00
VP436	8	CD4081B.	£2.00
VP461	1	LM380 Audio Amp. 14 pin, DIL 2.5W IC.	£2.00
VP463	2	LM339N Quad Voltage Comparator IC.	£1.50
VP476	10	8 pin IC Sockets.	£1.00
VP477	10	14 pin IC Sockets.	£0.60
VP478	10	16 pin IC Sockets.	£0.75
VP479	1	Pack of 5 each, 18-20-22 pin IC Sockets	£0.85
VP480	1	Pack of 5 each, 24-28 pin IC Sockets	£1.50
VP481	5	40 pin IC Sockets	£1.50

74 SERIES SALE 'ROCK BOTTOM' PRICES

Pack No	Qty	Description	Price
VP223	50	Assorted 74 TTL ICs 'ALL GATES' new and coded our mix 7400-7453.	£6.00
VP224	100	Assorted 74 TTL ICs 'ALL GATES' new and coded our mix 7400-7453.	£10.00
VP74111	4	74111 Dual J-K Master Slave. Flip-flop.	£1.00
VP74121	4	74121 Monostable Multi Vibrator.	£1.00
VP74279	4	74279 Quad S/R Latches.	£1.00

BP801	10	7401	£1.00
BP802	10	7407	£1.00
BP803	10	7410	£1.00
BP804	10	7413	£1.00
BP805	10	7437	£1.00
BP806	10	7440	£1.00
BP807	10	7443	£1.00
BP808	10	7450	£1.00
BP809	8	7460	£1.00
BP810	8	7470	£1.00
BP811	10	7472	£1.00
BP812	10	7480	£1.00
BP813	10	7481	£1.00

CAPACITORS

VP10	60	C280 Capacitors metal foil mixed values.	£1.00
VP11	50	Electrolytics all types.	£1.00
VP12	40	Electrolytics 0.47µF-150µF mixed volts.	£1.00
VP15	25	0.01/250V Miniature layer metal Capacitors.	£1.00
VP180	25	Tantalum Bead Capacitors, assorted values.	£1.00
VP532	20	Electrolytics assorted 2.2-470µF, 40-63V.	£1.50
VP533	8	Electrolytics 2 × 1000/2200/3300/4700µF, 10-16V.	£2.00
VP534	5	Axial electrolytics 1000µF, 16V.	£1.00
VP535	4	Radial electrolytics 2200µF, 16V.	£1.00
VP536	3	Axial electrolytics 4700µF, 10V.	£1.00
VP537	4	Axial electrolytics 10000µF, 6.3V.	£1.50
VP331	28	22µ 10V Radial	£1.00
VP332	24	22µ 16V Axial	£1.00
VP333	20	22µ 40V Radial	£1.00
VP334	16	22µ 43V Axial	£1.00
VP335	25	47µ 16V Radial	£1.00
VP336	15	47µ 50V Radial	£1.00
VP337	24	100µ 16V Radial	£1.00
VP338	20	100µ 25V Axial	£1.00
VP339	12	100µ 63V Radial	£1.00
VP340	10	100µ 100V Axial	£1.00
VP341	16	220µ 25V Radial	£1.00
VP342	14	220µ 40V Axial	£1.00
VP343	12	220µ 63V Axial	£1.00
VP344	20	330µ 10V Radial	£1.00
VP345	12	330µ 25V Radial	£1.00
VP346	8	330µ 100V Axial	£1.00
VP347	16	470µ 10V Radial	£1.00
VP348	12	470µ 16V Axial	£1.00
VP349	10	470µ 50V Radial	£1.00
VP350	8	1000µ 16V Radial	£1.00
VP351	10	2200µ 10V Radial	£1.00

RESISTORS & POTS

Pack No	Qty	Description	Price
VP1	300	Assorted resistors, mixed values and types.	£1.00
VP2	300	Carbon resistors, 0.25-0.5W performed mixed.	£1.00
VP4	200	0.5-1W resistors, mixed values and types.	£1.00
VP16	50	Wirewound resistors, mixed watt values.	£1.00
VP140	50	Precision resistors, 1% tolerance.	£1.00
VP287	100	Close tolerance resistor, 0.05-2% 10-910Ω mixed.	£1.50
VP288	100	Close tolerance resistors, 0.05-2% 1k-820k mixed.	£1.50
VP289	100	Metal oxide high stability resistors 0.25W mixed values.	£1.50

MINIATURE CARBON FILM RESISTORS 0.25 & 0.5W 5%

Resistance values from 1Ω-10megΩ.
Available in lots of 100 pieces per value.
To order state R100 0.25W or R200 0.5W, plus resistance required.
eg R1001k = 0.25W 1k.

BI-PAK PRICE PER 100 PIECES
R100 £1.00 per pack. R200 £1.30 per pack.

RESISTOR DEVELOPMENT PACK

R199 100 of each value individually packed from 1R to 10M ¼W 5% resistors. Total 8,500 would normally cost £85.00.
Special low price £45.00

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A range of miniature pots with spliced 6mm shaft. Body is 17mm dia. and fixing requires a 7mm hole.

Code	Qty	Description	Price
BP633	4	50k lin.	£1.00
BP634	4	100k lin.	£1.00
BP636	4	5k log.	£1.00
BP638	4	50k log.	£1.00
BP639	4	100k log.	£1.00
BP640	4	1M log.	£1.00
BP641	10	Assorted lin values.	£2.00
BP642	10	Assorted log values.	£2.00
VP144	4	100k lin multi turn Pots. ideal variable cap tuning.	£1.00
VP145	10	Assorted Pots, inc dual and switched types.	£1.00
VP148	30	Pre-sets, horizontal and vertical mixed values.	£1.00
VP273	10	10k Lin rotary potentiometers. slim spindle.	£1.00
VP23	10	40mm track slider pots. 100k lin.	£1.00

TOOLS

Vice

VP95 Plastic miniature vice with suction base. £1.75

Rules

VP405 Steel Rules 1 × 4", 1 × 10", measuring ins and mm. 2 for £1.00

VP89 2m/6ft steel tape measure. ABS plastic case. Autopush return. £1.75

Hacksaw

VP406 Junior hacksaw and 3 blades + Hobby knife and 2 blades. £1.00

Hex wrenches

VP410 18 pc Hex Wrench keys. AF sizes in wallet. £1.50

Pliers, Snips & Cutters

VP417A Miniature 4" adjustable wrench. Forged alloy steel. £2.25

VP417 6" adjustable wrench. Forged alloy steel. £2.50

VP415 5" grip locking pliers. £3.00

VP414 End Action Stripping Pliers, adjustable jaws. £1.00

VP221 Miniature Long-nose pliers. £1.55

Snipe &Combination Pliers. 5" red insulated handles. £4.50

VP412 Crimping Pliers, Wire Strippers and Bolt Cutters. £2.00

VP571 4½" pliers. Green insulated handles. £1.95

VP570 4" end nippers. Blue insulated handles. £1.95

VP418 8" tin snips. Hardened steel spring joint. £2.00

Screwdrivers

VP218 Watchmakers Screwdriver Set 6 pieces. £1.75

VP425 7 pc high quality screwdriver set. £8.00

VP426 7 pc high quality screwdriver set 1000V. £12.50

VP427 6 pc cushion grip screwdriver set chrome steel. £4.00

VP103 6pc STANLEY screwdriver set, flat and crosspoint. £3.50

VP422 Screwdriver 400mm long No 2 crosspoint, extra long reach. £3.00

VP421 Screwdriver 400mm long 6mm flat blade, extra long reach. £3.00

VP420 'Chubby' screwdrivers, flat blade 4.5 & 6mm. 2 for £1.50

VP419 'Chubby' screwdrivers, crosspoint No 1 & 2. 2 for £1.50

VP575 Ball Grip Ratchet Screwdriver with 2 flat, and 2 pozidrive bits. £2.50

Files

VP407 10 pc Needle File Set. £3.00

Soldering

VP258 1 Multicore Solder, 5m total, 18 and 22SWG. £1.00

VP247 15W 'Lightweight' high quality low cost soldering iron. 1.7m lead. £3.50

VP491 12V 15W soldering iron. 4.3m lead with car cigar type plug for mobile use. £3.00

Code	Qty	Contents	Price
BP814	10	7482	£1.00
BP816	10	7484	£1.00
BP817	8	7491	£1.00
BP818	8	7492	£1.00
BP819	8	7493	£1.00
BP820	8	7494	£1.00
BP821	8	7495	£1.00
BP822	8	7496	£1.00
BP828	5	74141	£1.00
BP829	8	74151	£1.00
BP830	8	74153	£1.00
BP831	8	74155	£1.00
BP832	8	74156	£1.00
BP833	8	74157	£1.00
BP834	8	74160	£1.00
BP835	8	74161	£1.00
BP836	8	74164	£1.00
BP837	8	74165	£1.00
BP840	8	74174	£1.00
BP841	8	74175	£1.00
BP842	5	74181	£1.00
BP843	8	74182	£1.00
BP844	8	74191	£1.00
BP845	8	74193	£1.00
BP846	8	74195	£1.00
BP847	8	74196	£1.00
BP848	8	74197	£1.00
BP849	8	74199	£1.00
BP850	10	74LS11	£1.00
BP852	10	74LS20	£1.00
BP853	10	74LS26	£1.00
BP854	10	74LS33	£1.00
BP855	6	74LS42	£1.00
BP856	8	74LS55	£1.00
BP857	8	74LS73	£1.00
BP858	8	74LS74	£1.00
BP859	8	74LS76	£1.00
BP860	6	74LS93	£1.00
BP861	8	74LS95	£1.00
BP862	6	74LS122	£1.00
BP863	6	74LS148	£1.00
BP865	8	74LS173	£1.00
BP866	6	74LS221	£1.00
BP868	6	74LS275	£1.00
BP869	8	74LS279	£1.00
BP870	6	74LS393	£1.00

OPTO

Pack No	Qty	Description	Price
VP26	15	Small 0.125" red LEDs.	£1.00
VP28	10	Rectangular 0.2" red LEDs.	£1.00
VP130	6	Red 7 seg CC 14mm × 7.5mm RDP FND353 LED Display.	£2.00
VP131	4	Green 7 seg CA 0.6" LDP XAN6520 LED Display.	£2.00
VP133	6	Red overflow 0.6" 3 × CA 3 × CC 6630 50 LED Display.	£2.00
VP134	5	Green overflow 0.6" CA XAN 6530 LED Display.	£2.00
VP138	20	Assorted LED Displays our mix with data.	£5.00
VP147	1	Pair Opto Coupled Modules with data.	£0.60
VP199	4	DL707R LED display CA.	£1.00
VP203	15	Triangular shape LEDs mixed colours.	£1.00
VP207	10	Small 3mm yellow LEDs.	£1.00
VP243	3	Tricolour LEDs rectangular, 5mm. red. green,yellow.	£1.00
VP266	10	Large 5mm orange LEDs.	£1.00
VP279	10	OCP71 Photo Germanium Transistor PNP.	£1.00

Code	Qty	Contents	Price
VP284	2	Opto-isolator IL74-4N27, single.	£1.00
VP285	1	Dual Opto-isolator ILD74.	£1.00

INDICATORS

Code	Qty	Description	Price
1534	5	T 1½ LES Bulbs 6V 0.36W.	£1.00
1535	5	T 1½ LES Bulbs 6.5V 1W.	£1.00
1536	5	T 1½ LES Bulbs 14V 0.75W.	£1.00
1542	5	MES Round 12V 2.2W.	£1.00
1539	5	MES Round 6.5V 0.15A.	£1.00
1552	5	Panel mounting bezel. High quality black plastic with recessed aperture. 6mm dia. For use with 3mm LED.	£1.00
1553	5	As above, but with convex end.	£1.00
VP578	3	12V indicator. Red, 8mm dia × 30mm long. 220mm long wires.	£1.00
VP579	3	Panel mounting 3mm Green LED in chrome holder. Needs 7mm hole.	£1.00

DIODES & SCRS

Pack No	Qty	Description	Price
VP29	30	Assorted volt Zeners. 50mW-2W.	£1.00
VP30	10	Assorted volt Zeners, 10W coded.	£1.00
VP31	10	5A SCRs TO66, 50-400V, coded.	£1.00
VP32	20	3A SCRs TO66, up to 400V. coded.	£1.00
VP33	100	Silicon Diodes like IN4148.	£1.00
VP34	200	Silicon Diodes like OA200/BAX13-16, 40V.	£1.00
VP35	50	1A IN4000 Diodes all good uncoded.	£1.00
VP49	30	Assorted Silicon Rectifiers 1A-10A mixed volts.	£1.00
VP141	40	IN4002 Silicon Rectifiers 1A 100V preformed pitch.	£1.00
VP184	3	4A 400V Triacs plastic.	£1.00
VP187	10	SCRs 800mA 200V.	

		2N5064 plastic TO92.	£1.00
VP194	50	OA91 point contact germanium diodes uncoded.	£1.00
VP195	50	OA47 gold bonded germanium Diodes uncoded.	£1.00
VP196	50	OA70-79 detector germanium Diodes.	£1.00
VP197	50	OA90 type germanium Diode uncoded.	£1.00
VP198	40	BA248 Silicon Diode 350V 2A fast recovery.	£1.00
VP222	20	3A stud Rectifiers, 50-400V assorted.	£1.00
VP264	4	3A 400V Bridge Rectifiers.	£1.00
VP265	25	OA10 germanium Diodes.	£1.00
VP274	12	SCRs (Thyristors) 1A 100-400V TO39.	£1.00
VP275	3	5A 400V SCRs, TO220, TIC106D.	£1.00
VP276	5	SCRs standard type 5-16A to 400V.	£1.00
VP277	4	Triacs 2A 400V TO39.	£1.00
VP278	4	6A 1000V plastic Silicon Rectifiers.	£1.00

MISCELLANEOUS

VP872 4 channel light sequencer, chassis version. PCB 143 × 41mm ready assembled for immediate use. Takes up to 200 watts per channel. 4 mode settings. Variable speed control. Each channel individually fused. Just wire in lamps and mains to connector blocks on PCB. £12.95

VP873 Wireless Babyphone. Small PCB 55 × 20mm contains ready built transmitter operating from 88-108MHz. Operates from PP3 battery. £7.95

VP875 Speaker terminal. Pax panel 60 × 20mm has phono socket and 2 screws. FC52mm Pack of 4 £1.00

ZON X-81 SOUND UNIT

The ZON X-81 sound unit is completely self-contained and especially designed for use with the ZX-81. It just plugs in: no dismantling or soldering.
No power pack, batteries, leads or other extras.
Manual Volume Control on panel - ample volume from built-in loudspeaker.
Standard ZX-81 - 16K Rampack or printer can be plugged into ZON X-81 Sound Unit without affecting normal ZX-81 operation.
Huge range of possible sounds for games or: Music, Helicopters, Sci-Fi, Space Invaders, Explosions, Gunshots, Drums, Planes, Lasers, Organs, Bells, Tunes, Chords, etc. or whatever you devise!
Uses 3-channel sound chip giving programme control of pitch, volume of tones and noise, all with envelope control.
Easily added to existing games or programmes using a few simple 'BASIC' lines.
Full instructions with many examples of how to obtain effects and the programmes, supplied.
Fully guaranteed. £9.95

LOPT TESTER

Dynamic Line Output Transformer Tester. This invaluable piece of test equipment will allow an engineer to test LOPTs under working conditions. It has been designed by a TV engineer with 30 years experience and is both simple to use and effective. Mains operation. £19.95

Tool Sets

VP514 6 pc min. screwdriver set, crosspoint 2.4; 3mm: flat 1.4; 2.4; 3mm. £1.65

VP513 6 pc min. screwdriver set, sizes 1.4; 1.8; 2; 2.4; 3; 3.8mm. £1.65

VP512 5 pc min. tool set, 3 hex key wrenches; 2 crosspoint screwdrivers. £1.75

VP511 5 pc min. wrench set, sizes 4; 4.5; 5; 5.5; 6mm. £1.75

VP510 5 pc min. nut driver set, sizes 3; 3.5; 4; 4.5; 5mm. £1.75

VP490 41 pc T-bar socket driver bits set. High quality steel set consists of:
1 pc T-bar magnetic driver handle.
3 pc Phillips bits, Nos 1, 2 & 3
4 pc Slotted bits, Nos 3-4, 6-8, 8-10, & 10-12.
4 pc Allen bits, Nos 3/32 1/8 5/32 & 3/16.
2 pc Square Recess bits, Nos R1 & R2.
6 pc Torx Bits, Nos T-10; 15; 20; 25; 30 & 40.
9 pc Metric Sockets, 5; 6; 7; 8; 9; 10; 11; 12 & 13mm.
9 pc SAE sockets 3/16" 7/32" 1/4" 9/32" 5/16" 11/32" 3/8" 7/16" 1/2".
1 pc 1/4" Socket adaptor.
1 pc Bit adaptor.
1 pc 90° Offset adaptor.
Housed in matt steel box. 40 tools in 1 box. £9.95

Wirestrippers

VP573 Wirestrippers with adjustable stop for 12-26g. £1.20

WIRE & FLEX

Pack No	Qty	Description	Price
VP17	50	Metres PVC single strand wire, mixed colours.	£1.00
VP18	30	Metres PVC multi strand wire, mixed colours.	£1.00
VP19	40	Metres PVC single/multi strand wire, mixed colours.	£1.00

BATTERIES & CAGES

VP178	5	Assorted battery holders & clips, PP3/9, AA/D. etc. £1.00
VP904	2	Battery cage to take 10 'AA' cells. Uses PP3 connector. £1.00
VP905	6	Battery cage to take 1½ 'AA' cell. Solder tags. £1.00
205	5	Battery cage to take 4 'AA' cells, 2 each side in line. £1.00
VP238	4	AA Ni-cad Batteries 1.25V 500mAh CR MA. £4.00
VP239	2	C-HP11 Ni-cad Batteries rechargeable. £3.50
VP240	2	D-HP2 Ni-cad Batteries, rechargeable. £4.00

VP912 Large battery clips with insulated red and black handles. Rated 30A. Overall length 75mm. Per pair 75p.
VP913 Gun type probes - pull on lever to open jaw. Takes 4mm plugs. Red and black. Per pair £1.95

MICS, SPEAKERS, EARPIECES

1338	2	Crystal mic insert 23mm dia × 12mm £1.00
VP908	2	Magnetic mic holder for CB mic. £1.00
VP909	1	2" dia speaker, 8R 0.3W £1.00
1918	1	2½" dia speaker 80R 0.3W £1.00
VP910	1	4" dia high power speaker for bass applications. Frequency range 50-8000Hz, max power 20W 8R. £9.95
VP911	1	8" 8R speaker, max 12W. 60-15000Hz. £7.95
VP525	1	8Ω earpiece, magnetic, 2.5mm plug. £0.25
VP526	1	8Ω earpiece, magnetic, 3.5mm plug. £0.25
VP260	1	9" × 6" elliptical 8Ω 10W RMS speaker. Freq res 60-10000Hz. Gauss 10000. Centre HF cone. £4.50
VP260A	1	2.25" transducer waterproof speaker. Polyester film diaphragm. Moisture resistant, 8Ω 300mW RMS freq res 20-20000Hz. £1.00

CASSETTES ETC

VP232	1	Cassette head cleaner/ demagnetizer in case. £2.00
VP230	10	C90 Cassette tape. 2 × 45 minute, low noise. £6.00

FUSES/HOLDERS

VP176	30	Fuses 20mm and 1.25" glass, assorted values. £1.00

BUZZERS, SIRENS

VP107	1	Piezo buzzer miniature, 12V. £1.25
VP83	1	Electronic buzzer 6V 25mA. £0.95
VP84	1	Electronic buzzer 9V 25mA. £0.95
VP85	1	Electronic buzzer 12V 25mA. £0.95

CONNECTORS

Pack No	Qty	Description	Price
2.5mm Jack			
			
1696	3	2.5mm Metal screened jack plug	£1.00
			
1706	5	2.5mm Black plastic jack plug	£1.00
			
1676	4	2.5mm In-line jack socket	£1.00
3.5mm Jack			
			
1746A	2	3.5mm Metal stereo plug	£1.00

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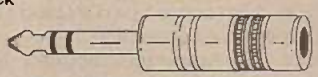
1628 5 3.5mm Chassis mounting socket, enclosed £1.00

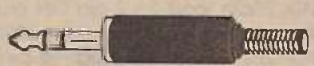
1677 4 3.5mm In-line socket. Black plastic. £1.00

¼" Jack

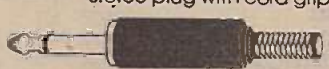


1701 2 ¼" stereo Jack Plug. Metal; screened. £1.50

1707 4 ¼" stereo Jack Plug. Black plastic. £1.50



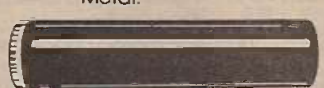
1707A 3 ¼" high quality plastic stereo plug with cord grip. £1.50



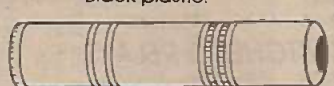
1678A 4 ¼" high quality plastic mono plug with cord grip. £1.50

1678 3 ¼" mono in-line socket. Black plastic. £1.00

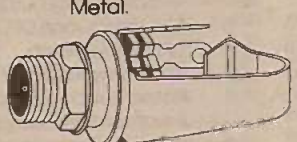
1679 2 ¼" mono in-line socket. Metal. £1.00



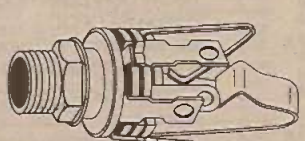
1680 3 ¼" stereo in-line socket. Black plastic. £1.00



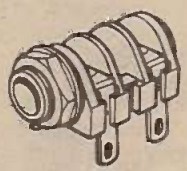
1681 2 ¼" stereo in-line socket. Metal. £1.50



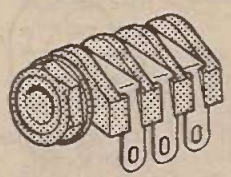
1658 3 ¼" socket. Mono switched. Panel mounting. Metal. £1.00



1659 2 ¼" socket. Stereo unswitched. Panel mounting. Metal. £1.00



1664 3 ¼" socket. Mono switched. Panel mounting. Black Plastic. £1.00



1669 3 ¼" socket. Stereo switched. Panel mounting. Black Plastic. £1.00

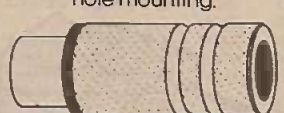
1669A 4 ¼" socket. Stereo switched. Panel mounting. Black Plastic. £1.00

1665 2 ¼" socket. Built in DPDT switch for headphones. Stereo. £1.00

Phono

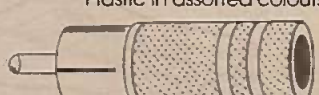
1660 8 Panel mounting phono socket with plastic surround. £1.00

1660A 4 Panel phono socket single hole mounting. £1.00

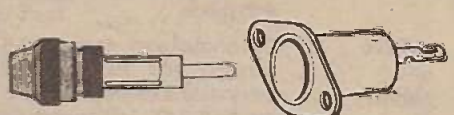


1683 3 In-line phono socket. Metal screened. £1.00

1687 6 In-line phono socket. Plastic in assorted colours. £1.00



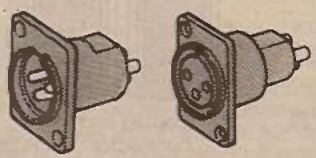
1708 3 In-line phono plug. Metal screened. £1.00



1666 3 Car aerial chassis mounting socket. Metal. £1.00

1703 2 Car aerial plug. £1.00

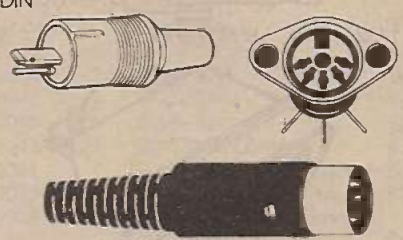
1640 6 4mm socket. Black. £1.00



1736 1 Panel mounting. 3 pin XLR plug. £1.00

1737 1 Panel mounting. 3 pin XLR plug. £1.00

DIN



1689 6 2 pin DIN plug. £1.00

1689A 6 2 pin DIN speaker plug. single piece. £1.00

1691 4 4 pin DIN plug. £1.00

1693 4 5 pin DIN 180° plug. £1.00

1694 4 5 pin 'Domino' plug. £1.00

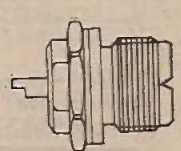
1627 3 7 pin DIN plug. £1.00

1673A 3 4 pin DIN in-line socket. £1.00

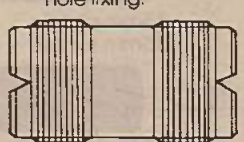
1675 3 5 pin DIN 240° in-line socket. £1.00

1655 4 5 pin DIN 240° socket. Chassis mounting. £1.00

UHF

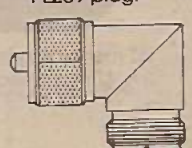


1717 2 SO239SH chassis mounting socket single hole fixing. £1.00



1718 2 PL259 double ended line connector. 2 sockets back to back. £1.50

1720 5 PL259 reducer for PL259 plug. £1.00

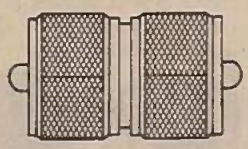


1721 2 Right angle coupler for PL259 and SO239. £1.50

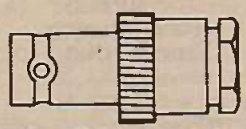
1722 1 T-Adaptor. 2 × PL259 sockets to 1 × PL259 plug. £1.50

1760 2 TNC plug. £1.00

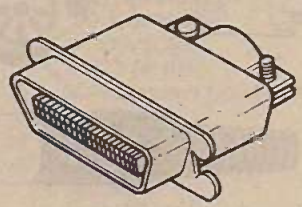
1/3rd OFF ALL ITEMS ON THIS PAGE



1723 2 Double end line connector. 2 × PL259 plugs back to back. £1.50



1732 1 BNC line socket. £1.50



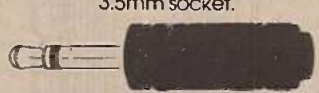
1759 1 IDC amphenol connectors. 36 way plug. £2.00

DC Power

1644 3 2.5mm DC in-line plug. £1.00
1645 3 3.1mm DC in-line plug. £1.00
1646 3 2.1mm DC in-line plug. £1.00

1741 2 3.5mm plug to phono socket. £1.00

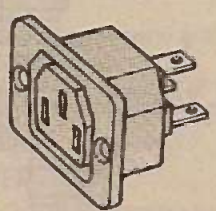
1744 2 2.5mm plug to 3.5mm socket. £1.00



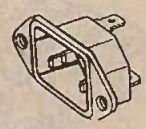
1764 2 3.5mm mono plug to 3.5mm stereo socket. £1.00

1779 1 ¼" mono plug to 2 × ¼" mono socket. £1.50

Power



1630 2 3 pole mains outlet. 6A 250V Panel mounting socket. £1.50
1632 2 2 pole mains outlet. 6A 250V Panel mounting socket. £1.50



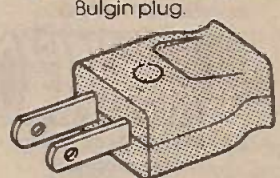
1638 2 Mains inlet. 3 pin EEC Panel mounting plug. 6A 250V. £1.00

1639 1 3 pin right angled in-line Bulgin socket. £1.50

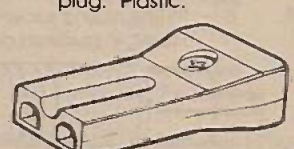
1641 1 6 pole Bulgin in-line socket, mains connector. £1.50

1642 1 6 pole Chassis mounting plug. Bulgin mains inlet fits 1641. £1.50

1643 2 3 pole Chassis mounting Bulgin plug. £1.50



1667 3 2 pin AC mains socket. USA type panel mounting. £1.00
1711 3 2 pin USA type flat pin plug. Plastic. £1.00



1713 3 cassette mains in-line socket in black plastic with guide. £1.00

VP226 20 DIN chassis sockets metal 2-8 pin 180° 240° 360° mixed. £2.50
VP227 18 DIN in-line sockets plastic 2-8 pin 180° 240° 360° mixed. £2.50
VP484 1 Pair line socket and chassis plug Euro style 6A 250Vac. £1.00
VP485 1 Scart plug. 21 way Euro Video plug. £1.00
VP486 1 2 × 23 way edge connector and matching PC board, blanked at pin 3 as for ZX81, etc. £1.00

LEADS & TELEPHONE ACCESSORIES

VP300 10m Speaker lead, 2 pin DIN socket. £1.00
VP301 2m video lead coax socket - coax socket + 2 adaptors. £1.20
VP302 3m 4 core cable individually screened 5 pin DIN plug - 5 pin DIN plug. £1.80
VP303 TV extension lead. Coax plug - coax plug, white. £1.00
VP304 1.5m 4 core cable individually screened 5 pin DIN plug - tinned open end. £1.00
VP305 1.5m cable 5 pin DIN plug - 3.5mm jack plug pin 1 & 4 connection. £1.00
VP306 2m typewriter/calculator lead 3 pin plug, angled European IEC configuration, 6A 250Vac. 2 for £2.00
VP307 60cm patch lead, PL259 plug - PL259 plug. £1.00
VP308 1.2m patch lead, PL259 plug - PL259 plug. £1.50
VP309 1.2m lead, 4 phono plugs - 4 phono plugs. £1.50
VP310 20cm lead 2 × 2 pin DIN plug - stereo in-line jack socket. £1.00
VP311 2m lead, scart plug - 5 pin DIN plug and 2 BNC plugs. £6.00
VP312 1.2m video lead, BNC plug - phono plug. £1.50
VP313 3m headphone lead, 3.5mm jack plug - 3.5mm jack socket. £1.00
VP314 2m coax lead, BNC plug - BNC plug. 75Ω. £3.00
VP315 2m coax lead, BNC plug - UHF plug. 70Ω. £3.00

LEADS & CABLE

Code	Qty	Description	Price
397	1m	2 core oval mains cable. 2.5A.	25p/m
VP301A	1	Phono plug to coax plug lead 2m long	£1.00
366	1	Enamelled copper wire 38swg, 2oz reel.	£1.20
383	1	Tinned copper wire 16swg, 4oz reel.	£1.70
382	1	Tinned copper wire 18swg, 4oz reel.	£1.70

SWITCHES & RELAYS

Code	Qty	Description	Price
1991A	1	Calculator keypad 24 way + data matrix output.	£2.00
1973	5	Min slide switch DPDT.	£1.00
1974	4	DPDT slide switch.	£1.00
1965	2	1p 12 way rotary switch.	£1.00
1965A	1	Rotary switch, 25mm dia, 5 wafers. 1p 12 way each.	£2.00
1962	2	Min latching push button 3A SPST, red top.	£1.50
1963	2	Min latching push button 3A SPDT, red top.	£1.50
1995	1	Heavy duty push - foot action 6A DPDT.	£2.50
VP174	5	DIL switches 1 & 2 way slide, 6 way SPST, assorted.	£1.00
VP114	1	Coax Antenna Switch. 3 way.	£4.75
VP115	1	High pass filter/suppressor CB/TV.	£0.50
VP281	4	Plug-in relays, mixed volts, etc.	£1.00

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All one off and pack prices **INCLUDE** V.A.T. Qty. prices do not.

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HARDWARE

(a) Fasteners (steel)

Code	Qty	Description	Price
839	25	1" 0BA cheesehead screws	95p
840	25	½" 0BA cheesehead screws	75p
842	25	1" 2BA cheesehead screws	70p
843	25	½" 2BA cheesehead screws	55p
844	25	¼" 2BA cheesehead screws	65p
847	25	¼" 4BA cheesehead screws	35p
848	25	1" 6BA cheesehead screws	50p
850	25	¼" 6BA cheesehead screws	30p
863	25	½" 8BA cheesehead screws	40p
864	25	¼" 8BA cheesehead screws	35p
865	25	8BA nuts	30p
859	25	0BA washers	15p
860	25	2BA washers	15p
861	25	4BA washers	15p
866	25	8BA washers	15p
851	25	0BA solder tags	45p
854	25	6BA solder tags	35p

(b) Heatsinks

Code	Qty	Description	Price
873A	3	TO3 black finned sink 46 × 46 × 20mm	£1.00
877	10	TO18 Black push fit. 13 dia × 6mm	£1.00
VP42	10	Black heatsinks fit TO3 and TO220 drilled.	£1.00
VP43	4	Power-fin heatsinks 2 × TO3, 2 × TO66.	£1.00
VP44	15	Assorted heatsinks TO1; TO3; TO5; TO18; TO220.	£1.00

(c) Knobs (all for ¼" spindles)

Code	Qty	Description	Price
1101	4	Black plastic knob with calibrated metal skirt. 30mm dia × 18mm high.	£1.00
1109	3	As above, but 28mm dia × 16mm high.	£1.00
1111	3	Similar to above without black Inlay 24mm dia × 17mm high.	£1.00
1113	4	Matches 1101, but with indicator line.	£1.00
1115	6	Pointer knob with skirt. Black plastic silver insert. 22mm dia × 14mm high.	£1.00
1115A	10	Slider 19 × 13 × 13mm. 4mm slot.	£1.00
VP474	12	Slider Pots knobs. black/chrome, push fit.	£1.00

(d) Cases

Code	Qty	Description	Price
161	1	4" × 2¼" × 1½" aluminium box. 102 × 57 × 38mm.	£1.30
1o5	1	7" × 5" × 2½" aluminium box. 178 × 127 × 63mm.	£2.70
166	1	8" × 6" × 3" aluminium box. 203 × 152 × 76mm.	£3.50

(e) Miscellaneous

Code	Qty	Description	Price
	2	Solder - 3 yds of 22g solder in handy dispenser.	£1.00

DATA BOOK

BPX6 Excellent value TTL data book. Includes H, L, S & LS. A5 format, 116 pages, giving mechanical data, Interchangeability Guide, Function Selection Guide, and pin outs of TTL from 7400-74670. As this was published some years ago, the very latest types do not appear, but at the price, this book offers superb value. Price ..... Only £1.50

TRANSFORMERS

(All have mains primary)

Code	Qty	Description	Price
2036	1	0-17V 250mA	£2.30
2034	1	0-35V 1.7A	£4.90
2042	1	0-25V 2A	£4.40
2035	1	0-55V 2A	£8.95
2043A	1	20-0-20V 500mA	£3.80
2031	1	0-19-25-33-40-50V 500mA	£7.50
2032	1	0-19-25-33-40-50V 1A	£9.30
2038	1	Miniature driver, Primary 20k. Secondary 2k CT	£1.20

BULK PACKS FOR LARGE USERS

(See relevant pack numbers for full details of contents.)

VP1	Resistors	20,000	£35
VP2	Pre-formed resistors	20,000	£35
VP10	Polyester Caps	10,000	£50
VP11	Electrolytics	10,000	£80
VP200	OC71	5,000	£70
VP145	Assorted Pots	1,000	£50
VP42	Heatsinks	1,000	£50
VP224A	74 Series inc LS - gates & complex logic, all new in tubes.	1,000	£60

These transistors are part of Bi-Pak's stock. Offers are invited for those unpriced:

Type	Qty	100+
2N696	550	0.10
2N708	276	0.07
2N718	942	0.10
2N726	6500	0.15
2N743	532	0.15
2N914	200	0.70
2N929	161	0.07
2N1131	500	0.20
2N1132	485	0.21
2N1488	20	0.50
2N1613	40	0.12
2N2193	350	0.19
2N2217	220	0.28
2N2218	758	0.10
2N2218A	656	0.10
2N2219A	133	0.10
2N2220	500	0.08
2N2221	740	0.08
~~2N2221A~~	~~120~~	~~0.08~~
2N2368	374	0.09
2N2411	287	0.40
2N2412	517	0.19
2N2711	3170	0.09
2N2904A	680	0.10
2N2904	1115	0.09
2N2906A	5000	0.10
2N2906	200	0.10
2N2906	4500	0.10
2N3011	899	0.09
2N3114	1800	0.85
2N3416	96	0.09
2N3708	592	0.03
2N3710	3223	0.03
2N3711	3858	0.03
2N3789	26	
~~2N3792~~	~~11~~	
2N4058	2388	0.03
2N4061	480	0.03
~~2N4399~~	~~32~~	
2N4901	10	0.40
2N4911	23	0.60
2N4914	9	0.40
2N4915	44	0.45
2N5295	2030	0.18
~~2N5838~~	~~10~~	
2N6286	15	
2N6289	104	0.22
~~2N6488~~	~~18~~	
2S012	26	
2S013	31	
2S302	310	3.00
2S303P	63	3.00
2S304	67	3.00
2S306	343	3.00
2S324	35	3.00
2S3210	4087	
2SB89A	100	
~~AC119~~	~~390~~	~~0.10~~
AC121	2900	0.10
AC140	70	0.10
AC141K	300	0.12
AC176K	200	0.12
AC180	250	0.14
AC181K	190	0.16
AC186	490	0.16
AC187/01	100	0.09
~~AD126~~	~~14~~	~~0.80~~
AF200	600	0.20
AF116	650	0.30
AF118	550	0.30
AF179	39	0.30
ASY76	750	0.30
~~BC101~~	~~311~~	
~~BC108~~	~~36~~	
~~BC134~~	~~56~~	
~~BC154~~	~~1000~~	~~0.85~~
BC157	13500	0.05
BC159	11600	0.05
~~BC169C~~	~~160~~	~~0.05~~
~~BC172~~	~~2000~~	~~0.03~~
BC173B	2905	0.03
BC175	106	0.09
BC178	188	0.09
BC181	1525	0.05
BC186	1920	0.05
~~BC208~~	~~630~~	~~0.03~~
BCZ212	121	0.20
BC321	3900	0.03
BD176	660	0.18
BD180	400	0.20
BD185	300	0.30
BD196	50	0.50
BD206	25	0.20
BD208	55	0.20
BD235	100	0.15
BD236	200	0.16
BD239	600	0.18
BD240	500	0.17
~~BD244AX~~	~~1000~~	~~0.17~~
BD312	145	0.17
BD508	400	0.37
BD609	127	
BD1540	10	
BD1560	10	
BD2550	10	
BET885	400	
BFX29	476	0.10
BFX48	250	0.10
BFX86	155	0.10
BFX87	87	0.10
BF119	160	0.19
~~BF152~~	~~786~~	~~0.09~~
BF153	1724	0.09
BF159	2565	0.10
BF160	6460	0.10
BF181	840	0.12
BF186	155	0.12
BF254	3000	0.10
BF255	1178	0.11
BF257	541	0.12
~~BF537~~	~~325~~	~~0.12~~
BF355	2260	0.12
~~BF495~~	~~1000~~	~~0.12~~
BF595	3000	0.07
BF679S	1000	
~~BF743~~	~~315~~	
BFR52	500	0.08
BFT83	505	
BFX29	476	0.10
~~BFX48~~	~~250~~	~~0.10~~
BFX86	155	0.10
BFX87	87	0.10
~~BIP12~~	~~41~~	
BIP20	33	
BIP20	46	
BRY56	372	0.17
~~BS195A~~	~~1676~~	
~~BSX19~~	~~380~~	~~0.08~~
CV7001	134	
CV7086	25	
CV7644	50	
CV7735	197	
CV9507	1000	
CV9507	2000	
CV9790	950	
~~FBD330~~	~~47~~	~~0.20~~
FBD223	47	0.20
~~FBD420~~	~~15~~	~~0.20~~
~~FC423~~	~~5~~	
~~IRF132~~	~~300~~	
MC7724	76	
ME1120	12000	
MPSA06	2273	0.07
MPSA56	26750	0.07
MJE340	595	0.15
MJE521	97	0.28
MJ490	140	0.50
MJ3000	2	
OC41	81	0.15
OC42	2245	0.15
OC42	935	0.15
OC45	145	0.15
OC70	500	0.15
OCP71	1700	0.17
OC72	208	0.15
OC73	400	0.15
OC75	200	0.15
OC75N	470	0.15
OC76	11550	0.15
OC79	73	0.15
OC82	530	0.15
OC200	600	1.80
RCA16083	100	1.00
TIP29C	60	0.12
TIP30A	1470	0.12
TIP30B	1354	0.12
TIP30C	590	0.12
TIP32B	96	0.12
TIP30A	102	0.12
TIP62B	96	
TIS90	4000	0.07
TIP111	22	0.20
TIP112	55	0.20
TIP117	42	0.20
TIP126	15	0.20
~~ZTX504~~	~~643~~	~~0.08~~

NOTE: PRICES EXCLUDE VAT

CLEARANCE OF CAPACITORS AND PRESETS

C280 POLYESTER CAPACITORS.
All new and boxed. 250V working. Samples free on request.

Value	100	1000
5.6nF	.02	.015
10nF	.02	.015
12nF	.02	.015
15nF	.02	.015
18nF	.02	.015
27nF	.02	.015
39nF	.02	.015
68nF	.02	.015
82nF	.02	.015
120nF	.03	.02
150nF	.03	.02
180nF	.03	.02
330nF	.04	.03
390nF	.04	.03

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Value	100	1000
10µF 160V	.03	.02
47µF 16V	.03	.02
22µF 16V	.04	.03

PRESETS

100R	V AB	.03	.02
220R	V AB	.03	.02
1K	V AB	.03	.02
4K7	V AB	.03	.02
47K	V AB	.03	.02
47K	V Piher	.04	.03
47K	H AB	.03	.02
47K	H Piher	.04	.03
47K	M AB	.03	.02

We also have large quantities of many values of pots, especially switched and dual types which we are clearing at 10p each.

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LOGIC PROBE

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Working voltage: 4-16V
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Input Z: 1M. Max input freq: 20MHz

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M9 Adastra general purpose mic with stand. Omni directional, 500R. Freq Res. 100-8000Hz. Sensitivity 76dB±4dB. To clear at

£1.00

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Foldable, designed to give portable radios, cassettes or CD players a high quality boosted sound output. Amp can be switched in or out. Powered by 4xAA cells or external supply (neither included)

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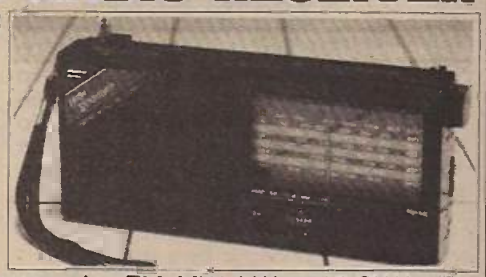
Frequency Coverage:
FM 87.5-108.5MHz
MW 522-1620kHz
LW 150-281kHz
SW1 4.5-5.1MHz
SW2 5.82-6.2MHz
SW3 7.1-7.5MHz
SW4 9.45-9.9MHz
SW5 11.45-11.95MHz
SW6 17.45-18.06MHz
Uses 2xAA batts
Size 170x60x30mm



Compact receiver covering FM, MW, LW and 6 SW bands (19, 25, 31, 41, 49 & 60m). Built in ferrite rod + telescopic aerial. Tuning LED, earphone skt. Great spec. at a low, low price! **£12.95**

SALE PRICE £10.95

AMPLIFIED UHF/VHF/FM AERIAL

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Dish can be rotated to pick up best signal, then boosted using built in amp with gain control - can also be used with external aerial.

Gain..... 20dB VHF; 30dB UHF
Gain Control 0-30dB
Max Ouput level..... 100dBµV
Power..... 12V DC
Size..... 340x220x110mm

£9.95

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Y136C INSULATION TEST UNIT

Intended for use with the M260 and M266 clamp ammeters, but now they are no longer available - however instructions are included to use with almost any digital meter

Original Selling Price £45+ **£12.95**

500Vdc insulation test unit designed for use with the M260 (Y136B) and M266 (Y136A) digital clamp ammeters. Unit plugs directly into the meter sockets. Insulation resistance readings directly on clamp meter display. Complete with leads, instruction manual, battery and carrying case.

Measuring voltage 500Vdc
Measuring ranges ..... 100k-20MΩ ±2%
10MΩ-1999MΩ ±4%
Batteries 4 x AA (supplied) Dims ..... 90 x 70 x 50mm

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Z592 Yellow tape 3mmx66m 5/£1
Z1440 Screws 4x8mm 1000/£1
Z2170 Veropins DS for 0.15 1000/£1
Z2333 Ceramic beads 3.4mm od 400/£1
Z2335 Stand offs 24mm, 3.5mm thread 12/£1
Z2336 Stand offs 11mm, 2.5mm thread 20/£1
Z2337 Screws 6BAx12mm pozi/pan 1000/£3

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Z598 PC IEC skt 3/£1
Z1987 75R conn 3/£1
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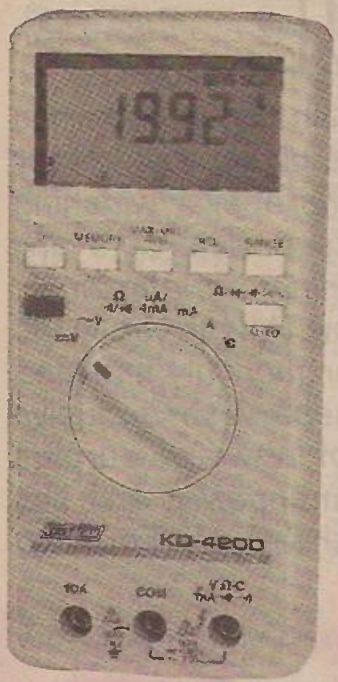

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- ✱ 3,999 count resolution
- ✱ 40 segments bargraph
- ✱ Max., min. and average function
- ✱ Ratio measurement Function
- ✱ Error correction function
- ✱ Relative magnitude function

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Previously £49.95
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Y130 or Y130A (temp probe not included)

AC volts	0-4-40-400-750Vac ±1%
DC volts	0-400m-4-40-400-1000Vdc ±0.5%
AC current	0-40m-400-10Aac ±2%
DC current	0-40-400m-10Adc ±1%
Resistance	0-400-4k-400k-4M-40MΩ ±1%
Frequency (Y130 ONLY)	0-10k-65kHz TTL level (5V)
Temperature (Y130A ONLY)	-50 to 1200°C
Dims	165 x 78 x 35mm

Y123AC

- 3.75 digit 25mm LCD display (2999 count) with 40 point bargraph
- True RMS measurement
- Auto/manual ranging
- 20A ac/dc measurement capability
- Frequency measurement
- Memory mode for relative measurement
- Data hold
- Diode test
- Full overload protection

NORMAL SELLING PRICE £89.95
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AC voltage: Auto	0-20-200-700Vac ±1%
Manual	0-30-300-700Vac ±1%
DC voltage: Auto	0-200m-2-20-200-1000Vdc ±0.7%
Manual	0-300m-3-30-300-1000Vdc ±0.7%
AC current	0-30m-300m-20Aac ±1.8%
DC current	0-30m-300m-20Adc ±1%
Resistance: Auto	0-200-2k-20k-200k-2MΩ ±0.8%
Manual	0-300-3k-30k-300k-3M-30MΩ ±0.8%
Frequency	10Hz to 20kHz ±0.5%
Dims	190 x 85 x 40mm

10MΩ Order Code M818B

- ★ 40 point analogue bargraph display
- ★ 3.75 digit 17mm LCD display
- ★ Autoranging voltage and resistance
- ★ High and low frequency ranges
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Battery, instruction manual and carrying case included.

AC volts	0-40-400-750Vac ± 1.5%
DC volts	0-400m-4-40-400-1000Vdc ± 0.5%
AC current	0-4m-40m-400m-2-10A ac ± 1.5%
DC current	0-4m-40m-400m-2-10A dc ± 1.2%
Resistance	0-4k-40k-400k-4M-20MΩ ± 0.8%
Frequency	0-4k-40k-400kHz ± 2%
Dims	187 x 87 x 34mm

Y123PA

10MΩ PROBE MULTIMETER

- ★ 3.5 digit 8mm LCD display
- ★ Fully autoranging
- ★ Display hold facility
- ★ Probe styling
- ★ Auto polarity and zero

Complete with extended probe, fully shrouded test leads and vinyl carrying wallet

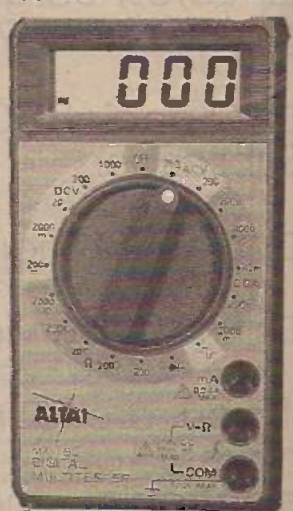
AC volts	0-2-20-200-500Vac ± 1.2%
DC volts	0-200m-2-20-200-500Vdc ± 1.0%
Resistance	0-200-2k-20k-200k-2M-2MΩ ± 1.0%
Dims	160 x 35 x 20mm

Previously £19.95
SALE PRICE £17.95

10MΩ MX190

- ★ 19 ranges
- ★ 3½ digit 12mm LCD display
- ★ Signal injector function
- ★ Diode test
- ★ Fuse protection
- ★ Automatic polarity and zero
- ★ Test leads with 4mm plugs

Battery and instruction manual included.



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DC volts	0-200m-2-20-200-1000Vdc±0.8%
DC current	0-200µ-2m-20m-200m-2Adc±1.0%
Resistance	0-200-2k-20k-200k-2MΩ±0.8%
Signal injector	50Hz square wave. 5V peak to peak
Dims	126 x 70 x 24mm

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commercial importance, it is also important that such measurement techniques are available within the educational sector, in order to focus awareness on a vital area of future economic growth. Such systems do not necessarily need to be so expensive or complex. A specification such as a wavelength 2nm resolution between 250nm and 750nm, with 12 bit dynamic range and a spectrum able to be produced in 10 seconds would be a useful starting point - educational scientific designers and manufacturers should take note.

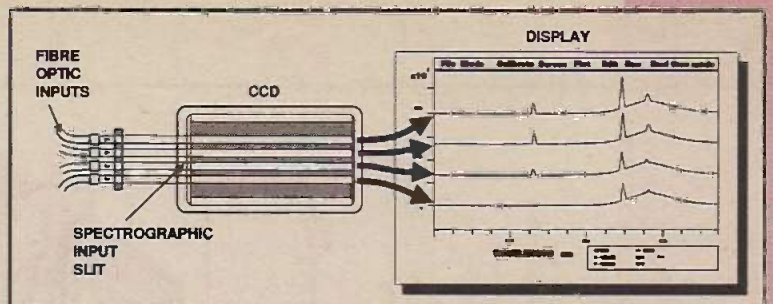


Fig.8 Use of a CCD to record four simultaneous spectra: in this example each spectrum is mapped to a specific region of the CCD surface

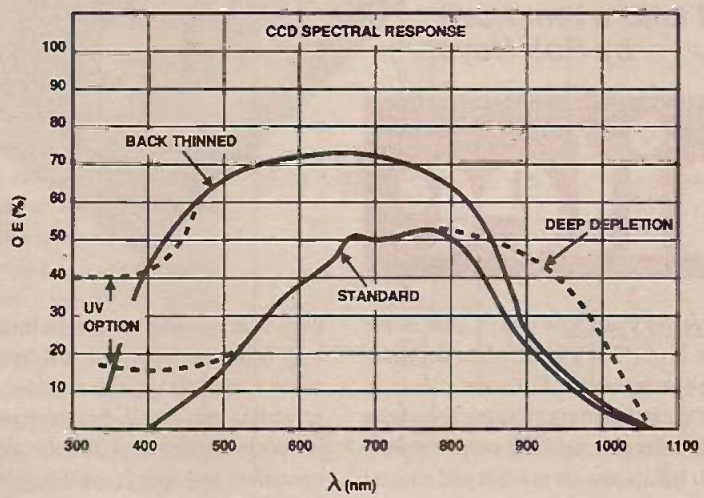
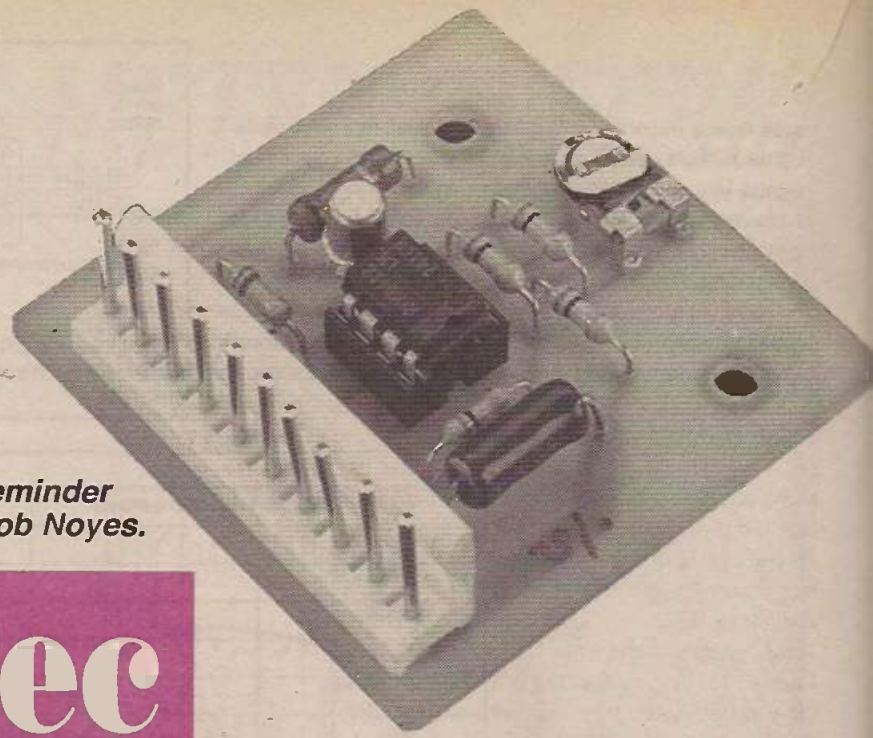


Fig.9 Typical Quantum efficiency of CCD units. Specific options of back thinning, deep depletion or UV enhancement can improve performance as indicated.



A car light failure reminder
by Bob Noyes.

Lumitec

"Oi mate, did you know one of your brake lights is out?" It's good when someone alerts you to the fact, but more often than not you can be driving around for weeks without knowing your lights aren't working properly. And how many times have you followed a car at night and noticed that only one tail light is working, thinking "how dangerous, I wonder if my lights are OK"? In a perfect world, everyone should regularly check their cars out for the basics but it's not perfect and a lot of us don't bother. How nice it would be to have an audible warning when a tail light failed - it would bring peace of mind, for as well as increasing safety it would help you to keep your car 'legal'.

One of the tail lights on my car failed a couple of months ago and I didn't know about it until my son spotted it, so I decided to design a simple circuit - 'Lumitec' - to monitor the power going to the bulbs. A small resistance is inserted into the power positive wire to the bulb in question and, when the bulb is powered, a small volt drop is experienced across the resistor. Because of the relatively high currents, this series resistor is very small. For the brake lamps/indicators, 0.05R is recommended and for the tail lamps, 0.1R. When in operation, less than 200mV is dropped across these resistors so the brightness is not noticeably affected and the power dissipation in these series resistors is minimal.

The output can either illuminate an LED or sound a buzzer, or both. The buzzer is preferable because an LED can illuminate and not be noticed, whereas a buzzer attracts immediate attention.

Fitting And Setting

Because this board is going to work in a car where condensation can be a problem, the tracks should be cleaned of flux and sprayed with a PCB lacquer, to protect the copper

HOW IT WORKS

As indicated before, a small value sense resistor is inserted, into the positive side of the bulb in question. The size of this resistor depends upon the current in the circuit being monitored. The value of the resistor should be chosen so that when the bulb(s) are on, a voltage of no more than 200mV is developed across it. To give some indication of values, here is a table of currents, powers and so forth.

	BULB POWER WATTS	CURRENT AMPS	RESISTOR OHMS	PD VOLTS	POWER WATTS
Brakes	2 x 21	4	0.05	200mV	0.8
Indicators	21	2	0.05	100mV	0.2
Tail Lamps	2 x 5	1	0.1	100mV	0.1

These values are only an indicator, as battery voltages vary depending upon age, charging rates, etc. and bulbs vary in power depending upon age and state of wiring, etc..

The current in the amps column is the steady current if the bulb is left on, but such bulbs as indicators and brake lights are constantly switched on and off. When a bulb is cold, its resistance is much lower, so a high current pulse flows until it warms up. This pulse can be several times the steady state value so, where fixed value resistors are fitted, the power ratings are much higher than normal. 2.5W wire wound has been used and no problems have been experienced.

A 741 op-amp is used as a voltage comparitor, to compare the voltages either side of the sense resistor. As op-amps do not like sensing at their rail voltage, both sides of the sense resistor are potentially divided down to approx. 1/2V so the sensing is done around 6V. The +ve side of the sense resistor is used as the supply for the op-amp, because it cannot be turned on all the time or it will give an indication that the brake lamp bulb has blown when the brake has not been activated Each of the sense circuits is individually powered only when the appropriate bulb is powered. The centre of the potential divider, R4-R5, on the +ve side of the sense resistor R1 is connected to pin 2 (inverting input) while a small variable resistor, 1k RV1, is fitted in the middle of the bulb side potential divider, R2-R3. This will allow for any tolerance incompatibilities in R2, R3, R4 and R5 to be cancelled out. The centre of the preset is taken to Pin 3 of the op amp - the Non-inverting input. The setting of this variable resistor is critical for the correct operation of the circuit.

When the circuit is working correctly, the voltage presented at Pin 3 of the op-amp is slightly below that at Pin 2, because the volts drop across R1 due to the current of the bulb(s).

When one of the bulbs, if there are two, or the bulb if there is only one

tracks from corrosion.

The 4-way Lumitec has been designed to fit at the back of a car behind the lamp assembly. Most cars have a left and right rear light assembly where all the lamps are mounted in one block - a loom comes in from the front of the car to either the left or right assembly and is connected to the other via a short loom (as per diagram).

The wires on the rear of the light assembly can be identified simply by seeing where they go and can be confirmed by monitoring the voltage on each pin when various lights are activated. Because these assemblies usually have special connectors, it is best to leave them well alone and cut the wire several inches up the loom - enough to allow the wire to pass through into the box containing Lumitec and fitting the female insulated spade connector which plugs directly onto the PCB. If desired, Lumitec can be connected to a connector block and the wires connected from the connector block into the loom. All cars are different and it is a matter of taking great care with all the wires by not letting them short and checking that all wiring and connectors are of sufficient current carrying capacity (see table). The buzzer can be mounted in the rear of the car, but in the boot the sound might not be detected, so the best place for it is under the dash. A wire is taken from Pin E up to the dash to the buzzer and, for safety, the +ve side of the buzzer has an inline fuse - 500mA up to the ignition switched side. The single channel Lumitec can be mounted anywhere, such as behind the dash with the LED output mounted on the dash, but the buzzer should also be connected. To find the correct wire to monitor any given light the car's circuit diagram should be consulted. If you're still not sure, ask at your local garage.

A good earth (0V) connection is required, do not use the bulb common. Wire direct to the chassis

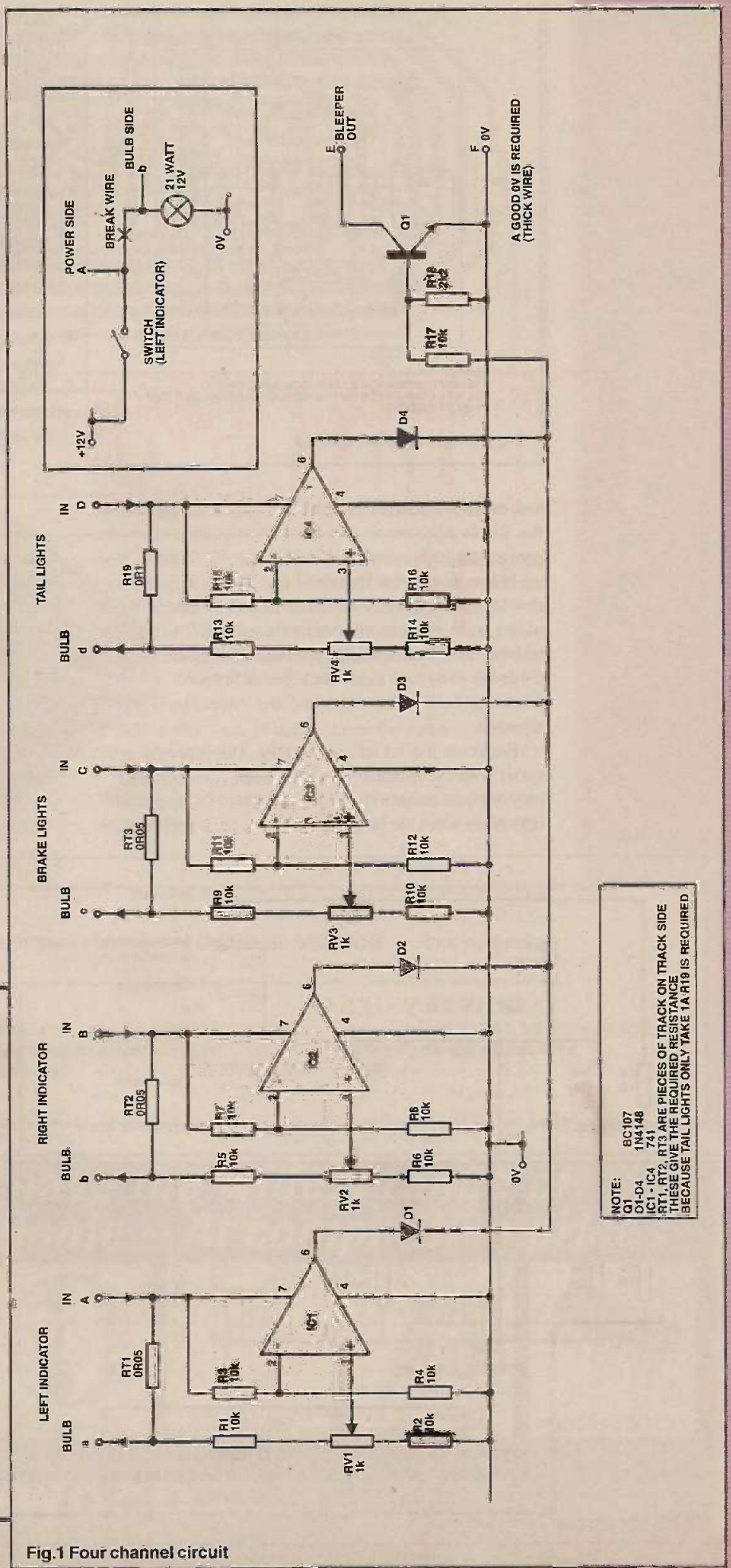


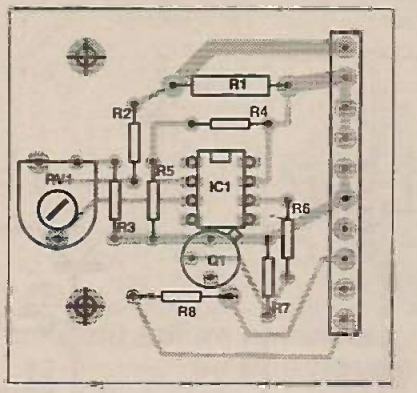
Fig.1 Four channel circuit

blows, the current through R1 will reduce. This in turn means that the voltage at Pin 3 of the op-amp is no longer lower than Pin 2 and the output of the op amp will go from its normal low to a high. This turns on Q1, which in turn activates the buzzer, the +ve of which goes to the ignition switched side, i.e. at 12V when the car is in motion.

To save on buzzers, a 4-channel block has been designed, the operation of which is exactly the same as the smaller single channel, but the outputs are connected via diodes to one drive transistor, Q1. This in turn goes to the buzzer and again the +ve side of the buzzer goes to the ignition switched side.

Because of the size of the 4-way Lumitec, the sense resistors have been formed by the PCB track. This saves fitting power resistors on the brake light and both indicators, but because of the relatively high value 0.1R for the tail light, a resistor, R19, is still required.

Although the first three circuits of the 4-way Lumitec look the same, the length of track that forms the sense resistors differs. That is why the shortest piece of track, channel 3, is used as the brake monitor, as this normally has around 4amps through it, so a smaller track length is required to drop the required sense voltage.



NOTE:
10 WAY CONNECTOR 0.156 BLOCK MALE PINS
10 WAY CONNECTOR MAY BE REPLACED BY SOLDER PINS
FOR R1 SEE TEXT

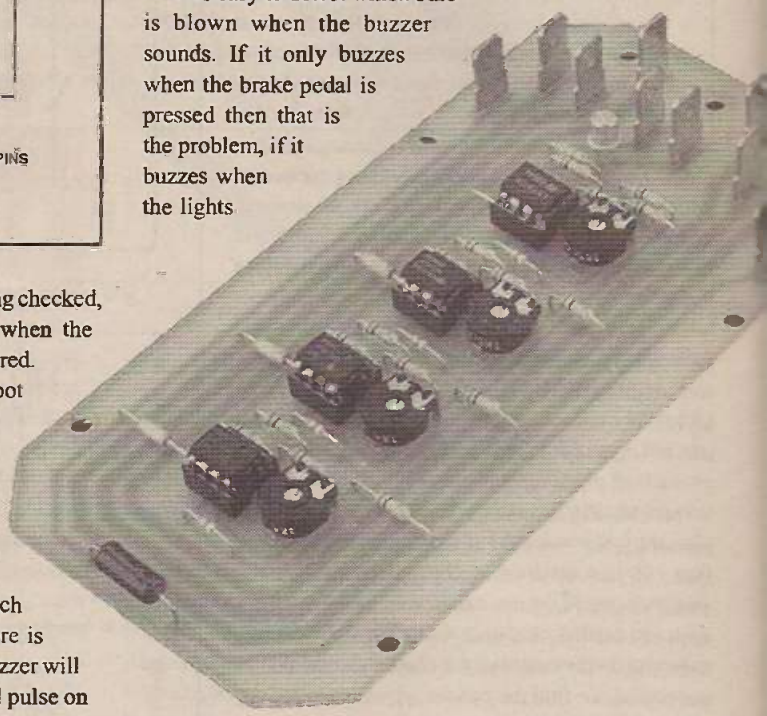
Fig.2 Single channel overlay

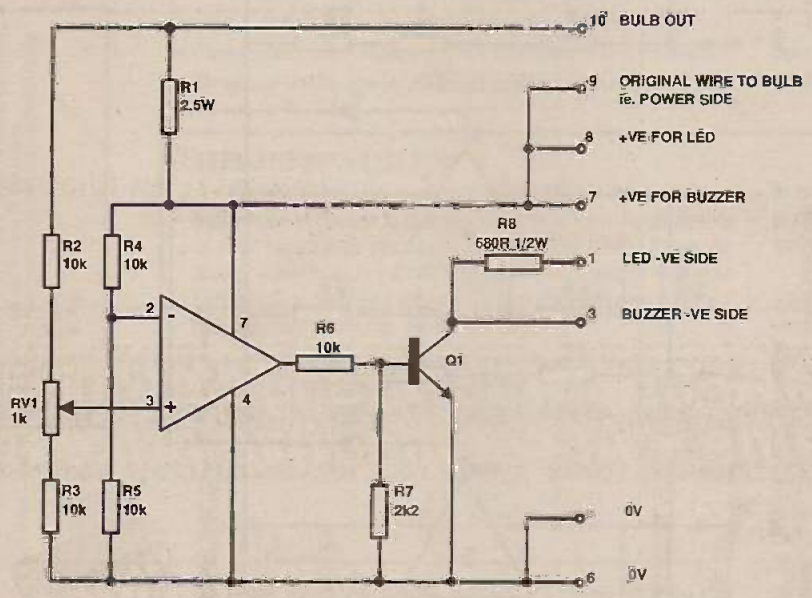
and, once the Lumitec has been fitted and the wiring checked, the RV is adjusted so that the buzzer sounds when the appropriate bulb is removed and the circuit powered.

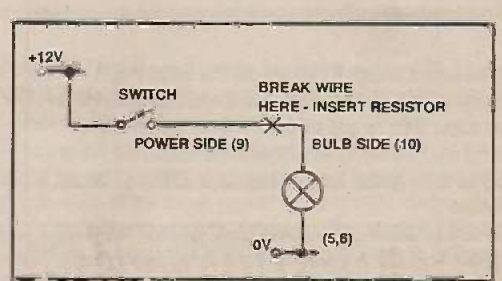
In the case of the brake and tail lights, the pot should be set so that the buzzer sounds when one of the bulbs is removed. Assuming normal 5% resistors have been used, the pot should be set in the centre as a rough guide and adjusted to sound when the bulb is removed and the circuit is powered.

Each circuit is set up one at a time. This is much easier with the indicators because at the rear there is only one bulb on each circuit. The output of the buzzer will only bleep when the lamp should be on, i.e. it will pulse on and off at the indicator speed (normally slower when a bulb is dead or removed). When all of these have been adjusted, drive around the block to check they work in all combinations - sometimes a slight readjustment may be required. When you're happy with the settings, the pots can be sealed with a small dab of paint - this will stop the vibration of the car from adjusting the presets - then fit the lid. The box can either be mounted or laid in the shell of the car. Care should be taken that no strain is put on the wires and that it doesn't vibrate in motion.

It is easy to detect which bulb is blown when the buzzer sounds. If it only buzzes when the brake pedal is pressed then that is the problem, if it buzzes when the lights

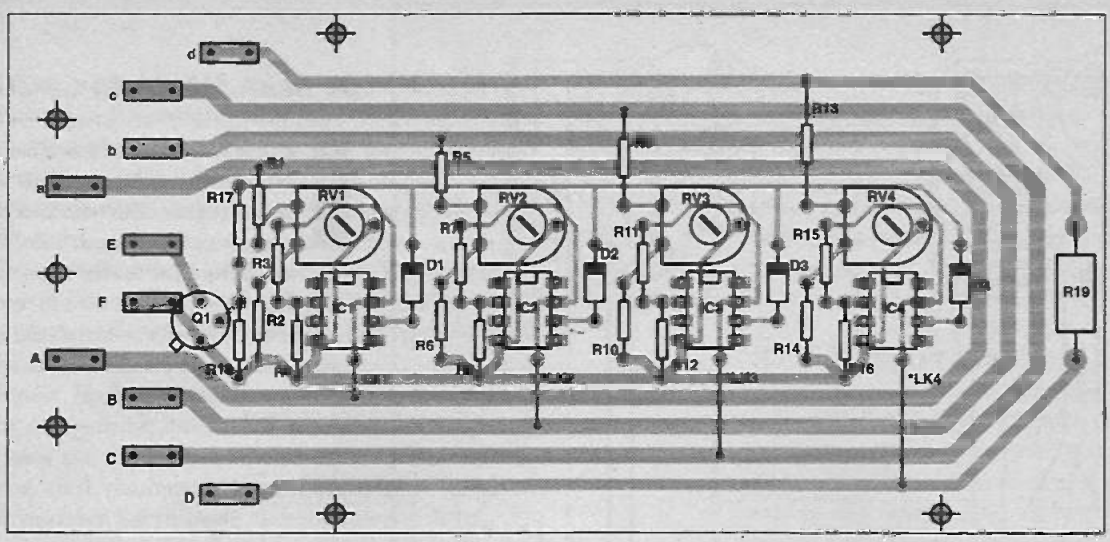






NOTE:	
Q1	BC107
IC1	741
R1	SELECT FOR MAX OF 200mV ACROSS R1 ON LOAD
TAIL LIGHTS, SIDE LIGHTS	0R1 2.5W
INDICATORS, BRAKES	0R05 2.5W

Fig.3 Single channel version of circuit



NOTE:
*LK2, LK3, LK4 MAY BE REPLACED BY ZERO OHM RESISTOR TYPE LINKS
MALE SPADE CONNECTORS
MOUNTING BOLT HOLES
CORNERS MAY HAVE TO BE REMOVED TO FIT BOX

Fig.4 4 channel overlay

are on that gives it away. The sound of the buzzer is annoying, so it should encourage you to replace a dud bulb quickly - not a bad thing from the safety aspect but it should reduce the risk of being stopped by the police.

NB. With the brake or tail lights the buzzer does not sound immediately. This is because although one bulb may have failed, the other one draws a high current pulse which is high enough not to trip the comparitor on switch on. When the bulb settles down to its steady state current, the buzzer sounds. This circuit has been designed for the rear lights, although the single channel unit could be fitted to the front side lights.

The headlights should not be monitored as they draw much more current - 60 watts each - which is around 10amps steady state. The heated rear windows should not be connected to this circuit because some of these draw around 20amps - far beyond the capabilities of this circuit as presented here, although the same monitoring principles apply.

Wire Rating

Before any work is done, check the currents expected. These wire ratings may help:

16/0.2 mm	**0.5mm**	**3A**
24/0.2 mm	**0.75mm**	**6A**
32/0.2mm	**1.0 mm**	**10A**

PARTS LIST

SINGLE CHANNEL VERSION

RESISTORS

R1	see text	
R2-6	10k	
R7	2k2	
R8	680R	1/2W
RV1	1k preset	

SEMICONDUCTORS

Q1	BC107
IC1	741

MISCELLANEOUS

ABS box, e.g. Maplin Cat No. LH20W
M3 nuts and bolts to suit

4 CHANNEL VERSION

R1-17	10k	
R18	2k2	
R19	0R1	2.5W
RV1-4	1k preset	

SEMICONDUCTORS

Q1	BC107
D1-4	1N4148
IC1-4	741

MISCELLANEOUS

ABS box 2005, e.g. Maplin Cat No. LH61R
M3 nuts and bolts to suit

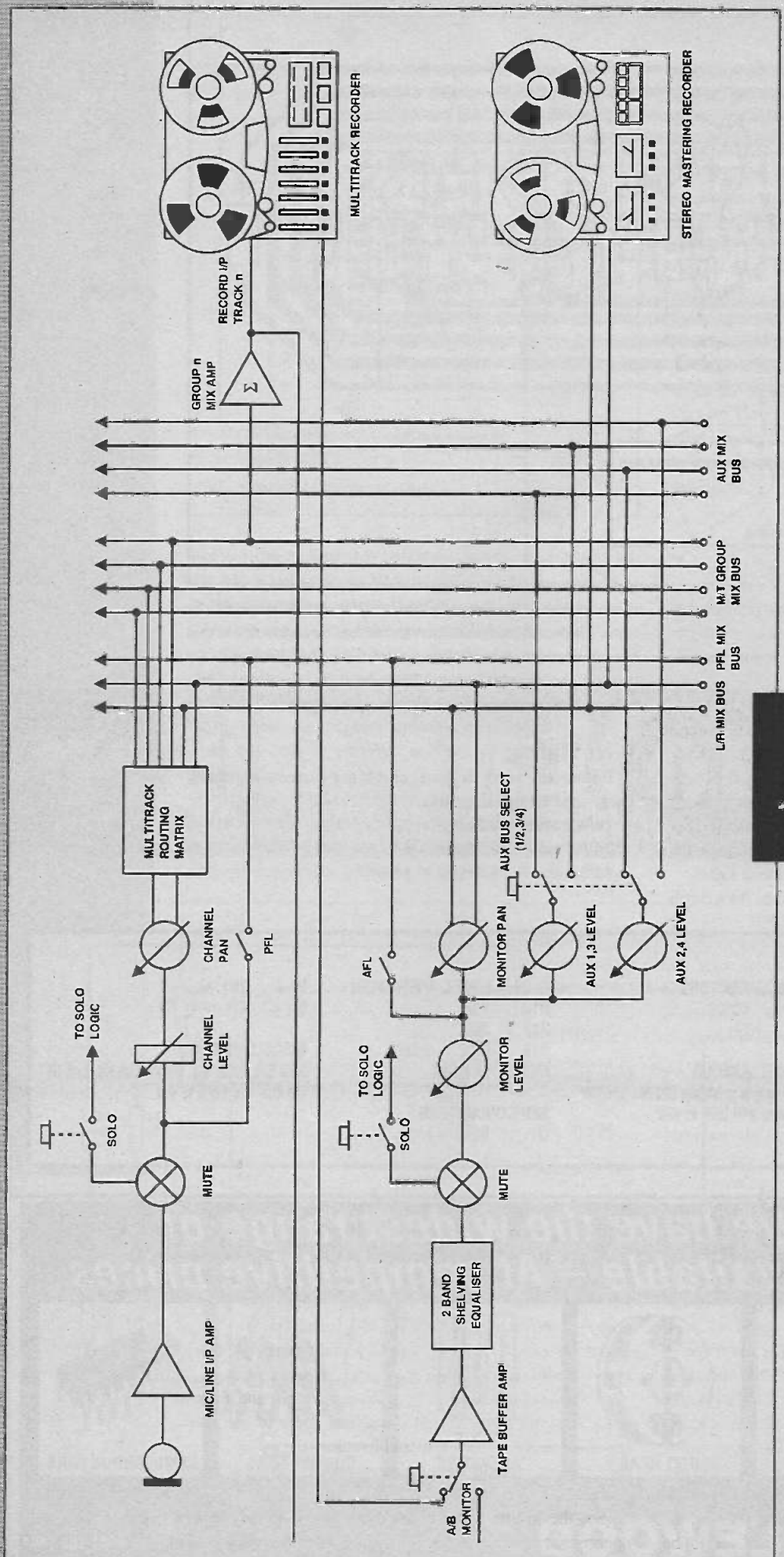


Fig.1 Split desk showing simplified input section and monitor section

by Mike Meechan

In this latest part of the AutoMate series, we're going to look at routing and some of the devious paths along which audio must pass, on its way from microphone to stereo master via the multitrack recorder.

Routing deals with switches (and other controls, as we'll discover later) which determine the audio pathway within the console architecture, whether it is in the channel itself, on or off the mix busses, or out of the mixer completely. It also encompasses such mundane but necessary functions as the switching in and out of equalisers, filters and dynamics processors.

Evolution of the In-Line Console

On any multitrack recording desk, it must always be possible to monitor the input or recording signal on each of the separate tracks, be there four, eight, sixteen or whatever. A mix, both of what is

Annive

going on to tape and what is down already is then presented to the monitor loudspeakers as a reasonable representation of the final stereo mix. This is the so-called monitor mix. For us to be able to achieve this, there has to be made available some method of inputting each track taken off-tape into the console. Conventionally, this is known as off-tape monitoring, B check or tape machine return. Controls to manipulate level, spatial positioning (pan) and perhaps FX send levels must also be provided in any comprehensive system. See Figure 1.

Further, we must be able to monitor the track return in isolation (provision of more Solo monitoring points) and perhaps also create foldback mixes from the signals coming off tape, thus allowing a feed of the machine sync. signal or the line input signal to be sent to the artist's headphones. The recorder electronics may be used to effect this switching (most incorporate logic switching/audio routing systems which are smart enough to achieve this easily) or there may be a Monitor A/B switch associated with each track on the monitor channel (in normal studio convention, A is the Record or input side of the

tape signal and B is the Replay or output side). Much depends on the console designers overall pricing strategy and the kind of machines which he envisages being connected to the desk. Limited EQ (normally LF and HF shelving types) is also sometimes provided. Figure 1 shows a typical split configuration desk.

With reference to the above, it is easy to see that many of the monitoring facilities attributable to the machine returns are, in fact, similar or identical to those which constitute the

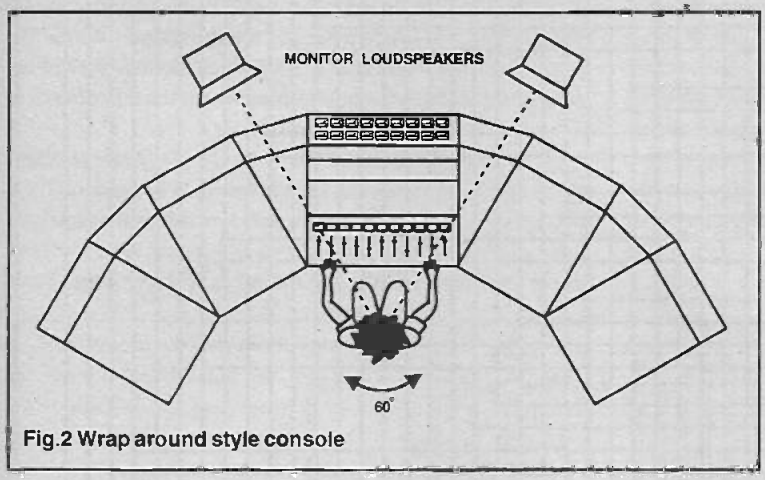


Fig.2 Wrap around style console

The amount of redundancy of console electronics at any one stage in the recording process was growing at a rate commensurate with the number of tracks involved. Desks of this immensity became not only an economic nightmare, but an ergonomic nightmare into the bargain. During a session, engineers were constantly to-ing and fro-ing, on wheeled seats, across the wide expanse of the desk in an effort to reach the farmost controls.

It's a Wrap(around)

A partial compromise (an expensive compromise) was in the adoption of the 'wrap-around' style of console. This type found vogue in the early Seventies until, later in that same decade, the width increased again. Despite rumours to the contrary, it was because of a growth in the number of input channels (which increased the central width) and not in an effort to accommodate the engineer's flared trousers! Nevertheless, and in spite of the punitive cost of such a design, it was a good arrangement. Costs were prohibitive, though, because each desk was in essence a one-off, custom job. See Figure 2.

sary AutoMate Mixer

mixer input channel. To this end, it is not unusual for multitrack desks to have an entire secondary sub-mixer - the monitoring mixer - to achieve the mixes necessary. This is the principle behind so-called 'split' consoles, with one section completely dedicated to recording to multitrack (the input section) and split from the other (the one dedicated to the group output/monitoring input facilities and mixdown to stereo).

These are the lines along which large recording desks first evolved. Channel, group/monitor and master sections were all in different modules. As music recording progressed from four track (in the Sixties) up through eight, sixteen and twenty four tracks, still there remained a requirement for each track return to have all of the controls listed previously and more besides. As the number of tracks increased, so the number of different foldback mixes needed to allow the musicians to keep track of what was going on during the recording session multiplied. What was present for most of the session on the stereo bus, except during mixdown, bore no resemblance at all to the finished mix. The provision of many different foldback mixes was one of the measures necessary to ensure that the artist was fed with what he/she needed at any particular point during the session. The effect on the size of the desk, when one considers a 24 bus example, needs little imagination - two mammoth mixers side by side, a recording one (say 56 inputs) and a monitor one (24 groups/monitors), split only by the master module. All of the separate facilities of each were considered never to be needed simultaneously.

Eureka?

To sidestep such problems, the designers of the era needed to take a tangential look at the mixer and do some rather lateral thinking.

We've already said that just about every aspect of the monitor mixer is identical to that of the input mixer. It was a natural process of evolution to combine them in a multipurpose, input/output channel which could then be configured for whichever job it was being asked to do at a given time. Realising that both input and group/outputs could be combined in a single module - since the full facilities of each section would never be needed simultaneously - was a major step forward in the recording world since all recording/mixdown requirements could be fulfilled in one multitask module.

It proved to be a somewhat radical, but nevertheless successful marrying of input and monitoring electronics. Understandably, however, there was more than a little reticence shown by many engineers to using a system which deviated so wildly from the conventional format and today, both types of desks find their proponents and detractors.

A further benefit, both from an operational and from a manufacturing point of view, was that some of the more superfluous parts of the split architecture - the group faders, for example - could be eliminated entirely from the new design.

So, the in-line console was born. Very quickly, other operational advantages were exploited. Facilities once available, on the input channel alone could now be arranged to

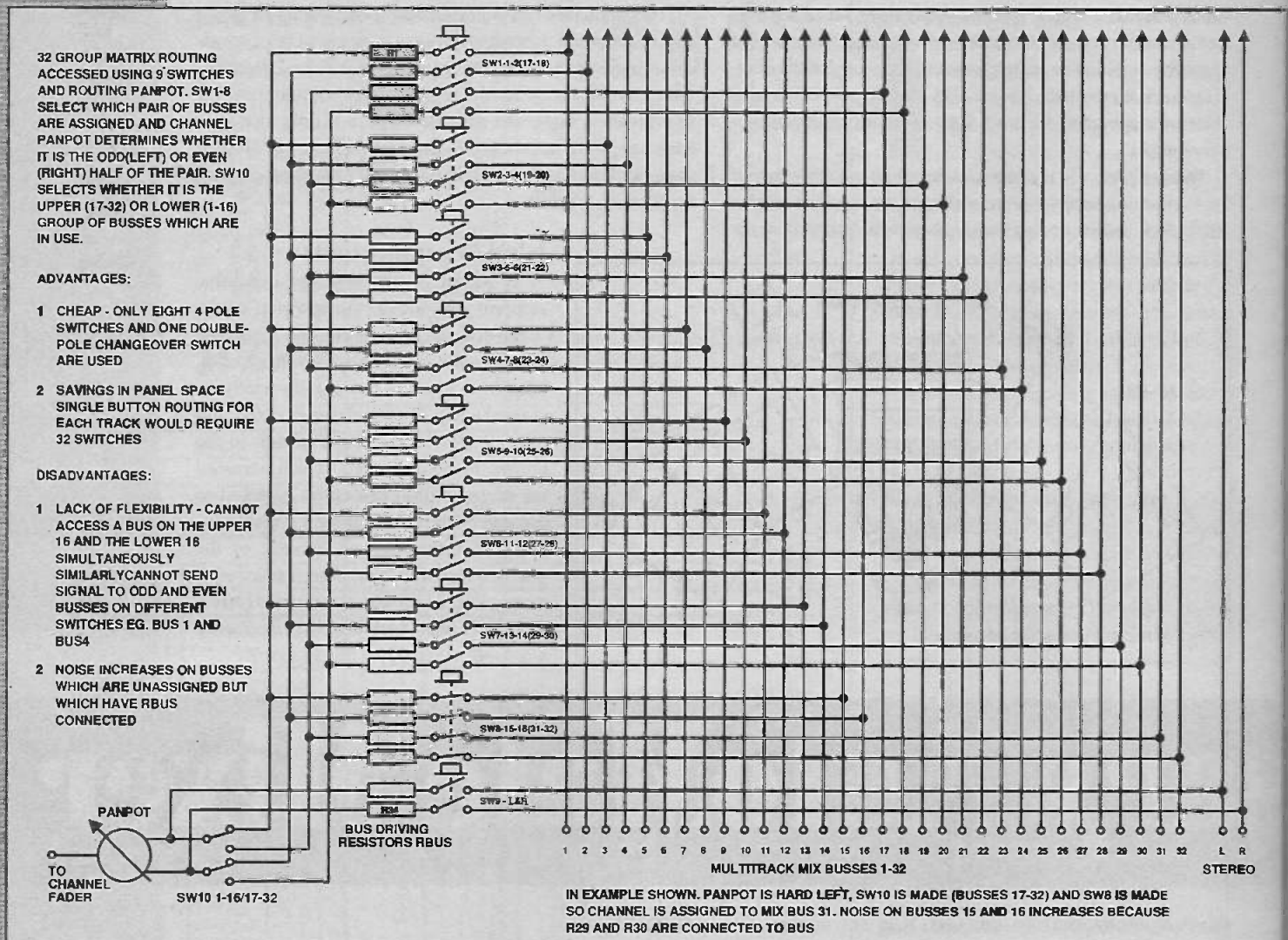


Fig.3a Group routing matrix example (32 bus example - limited access)

appear in either of the two parallel signal paths evident in this architecture. Normally, 'Flip' or 'Master' push buttons local to sections expedite this exchange of facilities between channel and monitor signal paths with, perhaps, a 'Master Channel Flip" control that effects rerouting of all signal paths within the module. There may also be a 'Console Flip' push-button (located on the master module) which can configure signal paths in each channel across the desk (although local Channel Flip controls can reconfigure individual channels as desired). Figure 4 in the June issue of ETI is representative and, rather than 'Channel Flip' type controls, the diagram shows multiway 'Mode' switches at strategic points throughout the channel electronics. These will be commanded by the automation system which resides in the Master module, although some, as in the example mentioned above, can in certain circumstances be overridden locally (on the channel strip). Other switches annotated with an asterisk will also normally be plumbed into the console automation system. Interlocks exist in certain modes and between certain switches to stop non-sensical routing arrangements from causing havoc with the console audio pathways.

The only downpoint, ergonomically and consequently, in the operation of the in-line design, was the required increase in channel module length, as a result of having to accommodate on each channel the increased number of switches and push buttons inherent in an in-line topology. This extreme length has meant adopting the practise of arranging that the most infrequently-used controls are sited at the top. To this end, channel input gain, phase reverse switching and phantom power switching controls, which are infrequently changed, normally reside in these murky recesses of the channel strip. In most normal circumstances, this is a minor irritation and a small price to pay for the overall increased convenience which in-line consoles afford the user.

Nevertheless, at least one major manufacturer, at the pinnacle of the pro-audio profession, considers that there is a lot of redundant circuitry in the In-Line type. Designers of these desks hold the belief that it is rare, except during overdubbing, for the module functions to be operated simultaneously and so cutting the signal path number from two, back to one, means making a single path of high quality more affordable. Their philosophy is to integrate the best features of the in-line architecture - comprehensive logic systems and master switching - into a 'split' format. The desk features a wraparound-style of design and is very expensive, but it may be a new answer to a familiar problem.

The Recording Process

In previous paragraphs, the words mixdown, overdubbing and recording have been bandied about freely. To fully

understand what might reasonably be expected of a decent mixer routing system, we must first look at each of the steps involved in going from the original recording session, via multitrack, to the final stereo master. Only in this way will it become apparent just what a decent routing system must accomplish.

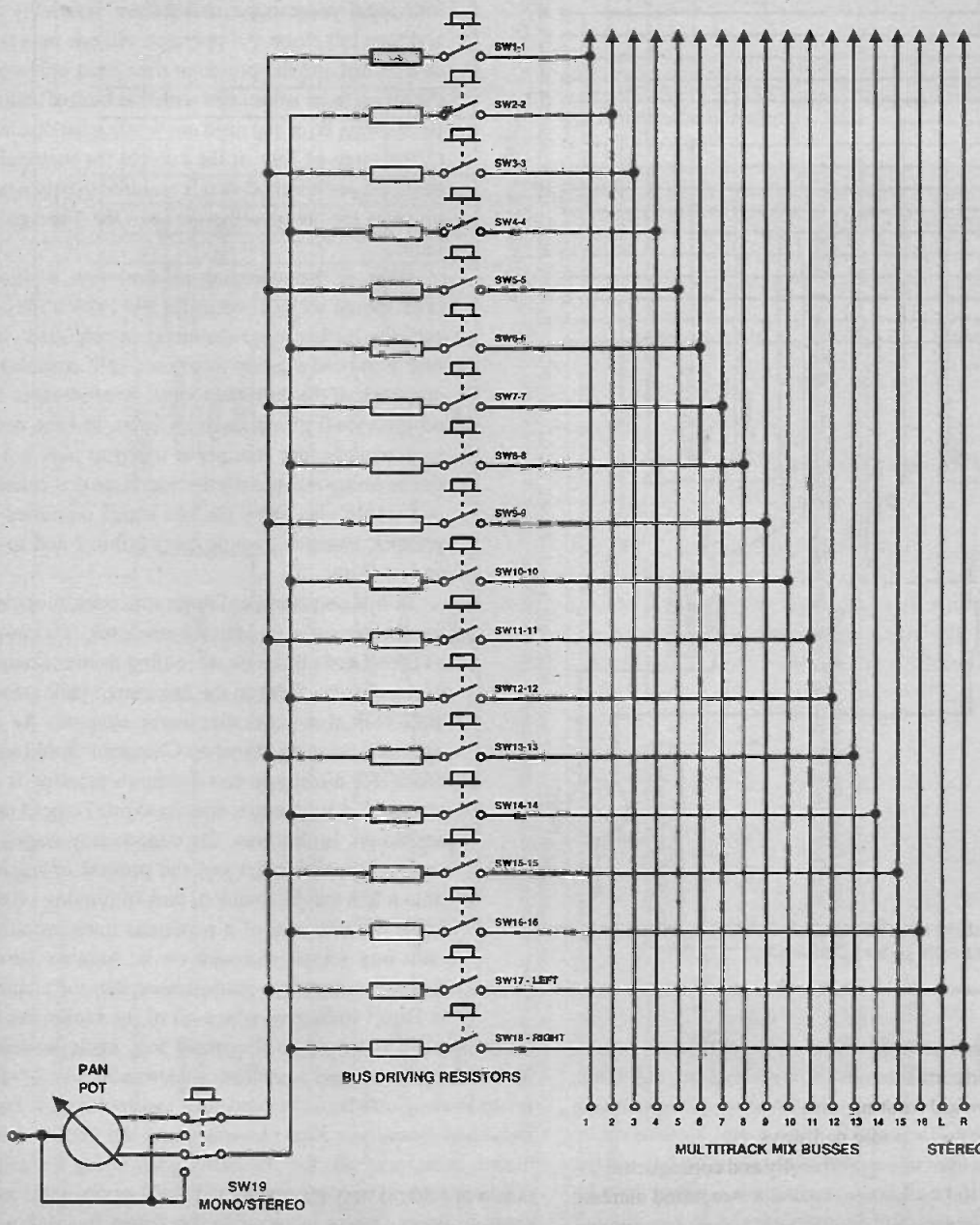
We will now look at the ways in which each of the two types (in-line and split) achieve the audio routing required at each of the different steps involved in the recording process. Where appropriate, in the description of each of the stages, I'll outline the differences which exist in the way that the audio is processed. Each of the main sections of Figures 1 and 4 from the June issue are represented schematically as boxes.

Recording

The name of the game during the recording step is to get the signal from the vocalist or musician, via a microphone and mic input (or the line input, in the case of an instrument) onto a given track of the multitrack. The only modules where mic amps are fitted are the input modules so any mic'd source must be applied to these. Little manipulation of the sound is done at this point, since the idea is to capture the sound just as it is - once it's safely on tape, it's an entirely different matter. The exception to the no-processing rule is in the use of noise gates, compressors or filters, which are used to tighten up the sound for recording, or to improve the overall clarity or fidelity of it.

The channel fader controls the input signal level to the bus, while the channel panpot sets its position in the stereo field. In-line architectures contain both channel and monitor faders (large fader and small fader) and channel and monitor panpots, hence the distinction. After the panpot comes the multitrack group routing matrix (and the post-fade take-offs for the post-fade Aux Mixes). This is a matrix of push buttons, either momentary if controlling solid state switches or latching if the mechanical switch itself is doing the routing of the audio.

With an eight bus system we need to be able to access each



16 GROUP MATRIX ROUTING ACCESSED USING 17 SWITCHES AND/OR ROUTING PANPOT. SW1-16 SELECT THE RELEVENT BUS (ODD=LEFT, EVEN=RIGHT)AND SW19 DETERMINES WHETHER THE SIGNAL IS DERIVED POST-PANPOT (AND FOLLOWS IT), AND SO IS STEREO OR IF IT IS DERIVED PRE-PANPOT AND IS MONO.

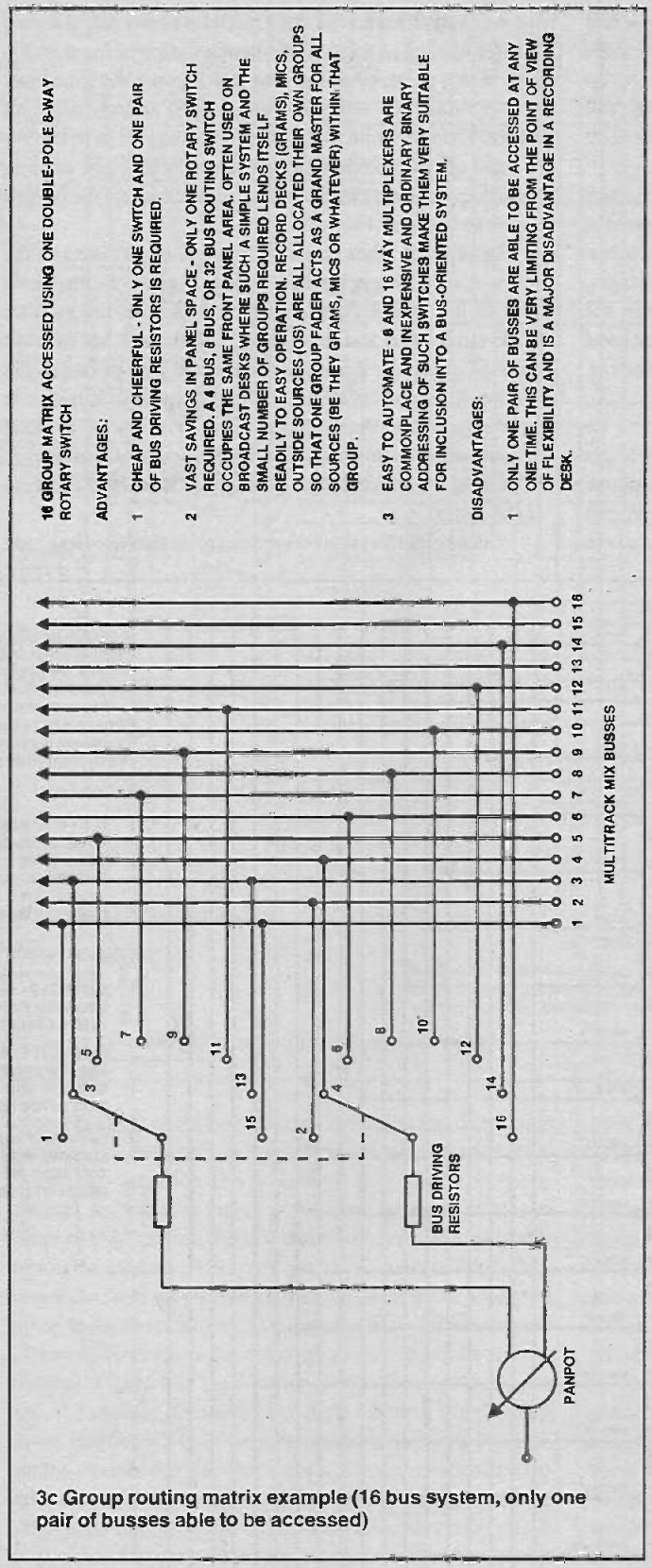
ADVANTAGES:

1. **VERY FLEXIBLE - ALL BUSSES ARE ABLE TO BE ACCESSED INDIVIDUALLY OR COLLECTIVELY, NO MATTER WHETHER THEY'RE ON ADJACENT BUSSES OR NOT (EG. 5 & 6, 11 & 12). MATRIX INPUT SIGNAL CAN BE MONO OR STEREO.**

DISADVANTAGES:

1. **EXPENSIVE - 16 SINGLE POLE SWITCHES REQUIRED EVEN FOR A MEDIUM SIZED 16 BUS EXAMPLE.**
2. **PUSHBUTTON MATRIX OCCUPIES A LARGE AREA OF FRONT PANEL SPACE, SO BUTTONS MUST BE MADE SMALL IN ORDER THAT SPACE USAGE BE MAXIMISED.**
3. **DIFFICULTY IN AUTOMATING AN ARRANGEMENT SUCH AS THIS - REQUIRES TWO EIGHT BIT WORDS TO DETERMINE ON/OFF STATUS OF EACH GROUP.**

3b Group routing matrix example (16 bus system, all busses able to be assigned singly)



3c Group routing matrix example (16 bus system, only one pair of busses able to be accessed)

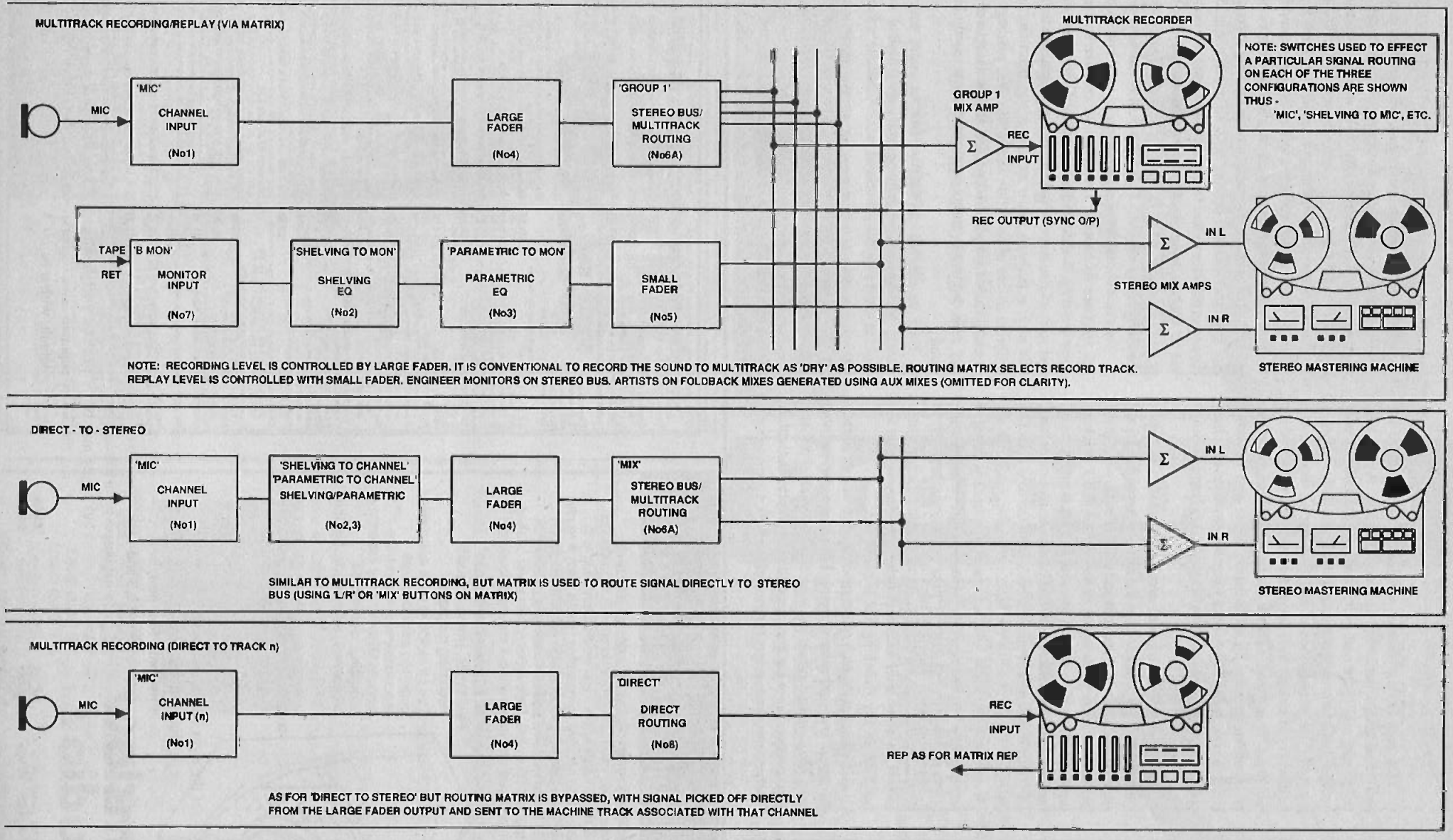
of the eight busses individually.

Depending on the manufacturer, a typical eight bus example might use only four push buttons, each accessing two adjacent busses, i.e. 1 and 2, 3 and 4, etc.. Normal studio convention is for the odd-numbered busses to be left and the even-numbered to be right. Accessing a bus singly may be done by using the pan-pot; to access group 4, say, the 3/4 button is pushed and the pan-pot routed hard right. Other systems use an odd/evens push-button in conjunction with the bus switches to achieve the same effect, while some use eight individual push buttons. Up to about 16 groups, a similar principle is applied. Above this, the number of push buttons necessary to access groups either individually or in pairs becomes cumbersome and another push-button, similar in operation to the odds/evens one, accesses the upper or lower 16 groups, say, of a 32 group matrix. It is normal also to fit a Stereo or Mix push-button to the matrix, this being used to route to the main stereo mix bus. Figures 3a, b and c are representative of just about all of the routing systems currently in operation in small to medium-sized consoles. It is of interest to note that invariably, broadcasters go for a much simplified version of 3c, with perhaps only two or three groups assigned via one rotary or three position switch. Tapes, Grams (turntables) and Mics occupy their own groups, so that the faders associated with individual programme sources are invariably set and then left alone. An operator will cue up a tape or a record and the presenter then need only open the group fader associated with that kind of source. In this way, he or she need not worry what machine of the three or four in the cubicle the material is being played upon, all that is required to play a tape on air is for the presenter to open the Tape group fader.

Back in the recording environment, a signal, once routed on to a particular bus (which may be carrying further input channels), is outputted via a mix amp (and a group fader on a split console) to one track of the multitrack tape. Because there are no individual group modules in an In-Line desk, each input/output channel is wired to pick a particular group mix bus off the matrix, so that channel one would also carry the bus signal outputted as group 1, channel 2 would carry group 2 and so on and so forth.

In-line consoles (and some split ones, too) cater for another audio route to the tape track. It is known as Direct and allows direct routing from the output of the channel fader to the bus output jack associated with that particular input channel. As an example, pressing Direct on Channel 1 would send channel 1 directly to bus 1 output, pressing it on channel 7 would send it directly to bus 7 output jack and so on. In this way, the unnecessary stages of routing, amplification and the process of mixing onto a bus can be avoided, thus improving on the noise performance of a particular track requiring only one source recorded on it. Another Direct function sometimes incorporated into the channel is Direct to Stereo, where all of the inputs can be mixed straight down on to the stereo bus, again avoiding unnecessary use of - and possible degradation because of - the group routing matrix. Some consoles incorporate a feature known as Bounce or Free Grouping into the track routing matrix, which extends the flexibility when using a smaller machine such as an eight track, and we'll explore this as a separate issue. Others incorporate the Direct function as a default, with a button having to be depressed to disable it.

Fig.4 In line and split methods of recording



This track laying process is repeated along each of the individual tracks until each is recorded upon. As the mix progresses and more and more tracks of the tape become occupied, it becomes increasingly important that the person providing the contribution at any time during the mix can hear what has already been recorded on tape. It is normal for the drum sound and balance to be done first since the drummer is recorded in an isolation booth and the other musicians normally like to have something to listen to as they play. Next comes bass and electric guitar, keyboards, vocals, etc..

This is where the monitor sections come in. On a split console, the tape returns (from the machine repro heads) are situated on the monitor sections and normalled through to the individual channel line inputs or separate B-check machine inputs. Each monitor section can source what is going out on the Group bus associated with that particular section or track (A-check or Source) or coming back from the tape track (B-check or Tape). All but the least expensive machines are clever enough to know what any particular track is doing at any one time - recording or replaying - so this switch is often left permanently connected to Tape and the machine left to control source/tape switching. As mentioned earlier, some mixers do away with such a switch completely and let the machine do any switching that is necessary.

Associated with each of the monitor sections, as already discussed, is a level control, simple EQ section, pan-pot, and level and routing controls allowing access to each of the Aux Mix busses. These are then used to generate the individual foldback mixes necessary for each of the different musicians. Obviously, different musicians playing different instruments might have different foldback requirements, so access to a large number of such foldback mixes is advantageous operationally.

An in-line console does things somewhat differently. The off-tape signal is routed back to its associated input/output channel via the Tape Return jack. All of the facilities of this channel - noise gates, filters, EQ, large channel fader, etc. - and any other channel dealing with an off-tape signal, are flipped to monitor so that for the monitor signal, the engineer has at his/her disposal all of the facilities and flexibility normal available only to input (channel) signals during recording.

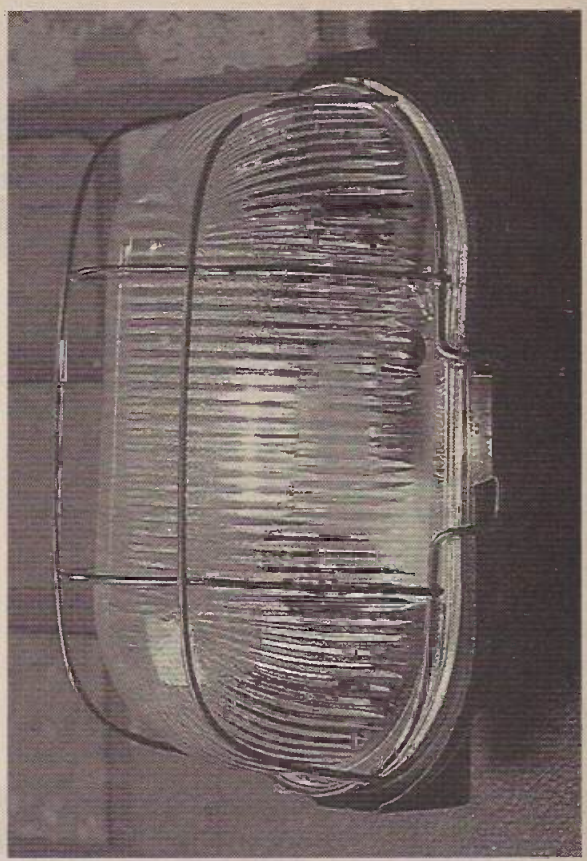
Figures 4 shows the main elements of input and monitoring facilities as blocks. These can be cross-referenced to corresponding dashed and numbered sections of the in-line and split schematics of Figures 1 and 4 in the June issue. In this way, it is much easier to follow signal routing in the different modes of operation and to see what part they play in each. Such a simplified approach allows the operation of any desk, no matter how complicated, to be easily understood.

Next month, we continue to look at audio pathways during Mixdown, Overdubbing and sub-grouping before looking at the switching involved in the Automate's Aux mix busses.

References

Dove, Steve, Consoles and Systems, The Audio Cyclopedia (edited by Glen M. Ballou), SAMS

An auto, low-level path-light
by Mark Daniels



Twi-Light Zone

A light which comes on automatically at dusk and switches itself off at dawn, all without user intervention, has many applications. The Twi-Light was originally designed to provide all night low-level illumination of the author's otherwise unlit garden path.

Conventional outside lamps, the majority of which use mains bulbs of 60W or greater, would prove qnite expensive to use for regular all night illumination. Taking an average usage of 12 hours per night over a period of one year, a 60W lamp will use roughly 250 units of electricity. With current electricity costs of around 7.5 pence per unit, at standard rate, the annual running cost would be nearly twenty pounds.

The cost of running the 2.2W bulb used in the prototype unit is around one pound per year - barely significant. Thus the cost of constructing the unit could be recovered in less than twelve months.

A mains power supply is not essential for the Twi-Light, so it may easily be adapted for use as an automatic outside lamp for a caravan, which on some of the caravan sites frequented by the author would not be regarded as a luxury!

ETI Cover PCB Project

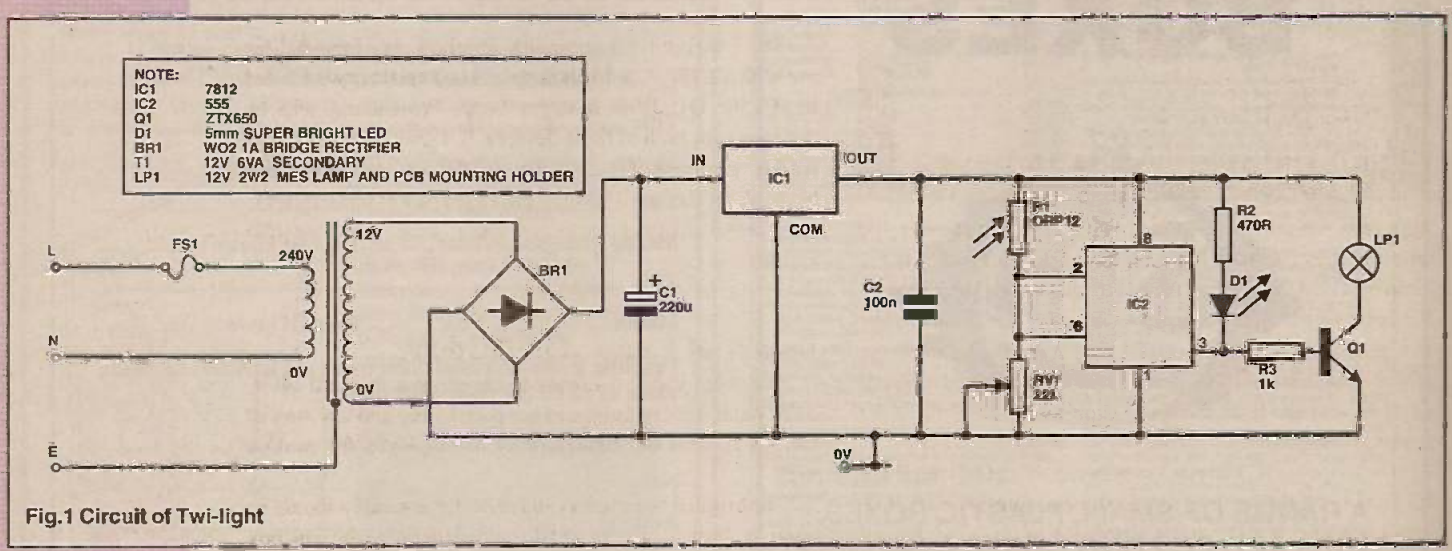


Fig.1 Circuit of Twi-light

Light Sensing

Electronic sensing of light levels is not difficult and there are many suitable transducers on the market, most of which are inexpensive.

The cadmium sulphide (CdS) light dependent resistor (LDR) is one of the best known devices available, particularly as the ever popular ORP-12. It is also amongst the least expensive and is probably the easiest to use, with its linear luminance/resistance characteristic and its wide variation of resistance with light level.

Circuit Description

The complete schematic for the mains powered version of the Twi-Light is provided in Figure 1. A suitable mains

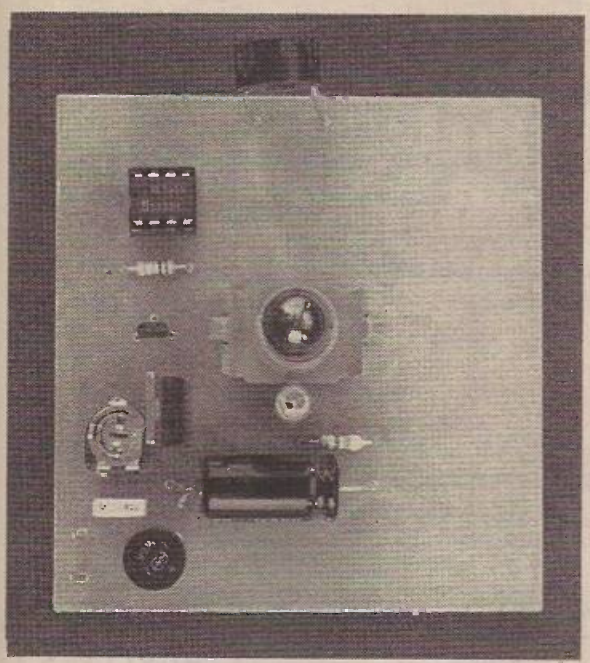
power supply is also included in this circuit diagram, but if operation from a car battery is envisaged, the power supply section may be omitted. Complete details of this modification are provided later.

The mains power supply section, comprising transformer T1, bridge rectifier BR1, smoothing capacitor C1 and monolithic voltage regulator IC1 provide regulated 12V DC for the electronics and the lamp.

The light dependent resistor R1 and a preset potentiometer RV1 are connected across the 12V, supply forming a potential divider network. The output voltage of the potential divider varies with illumination level and is sensed by the flip-flop in a 555 timer, IC2.

This device normally senses the voltage level on a timing capacitor, which is omitted here, the output going high when pin 2 (the Trigger input) is taken to a voltage level of less than 1/3 of the supply voltage. The output returns to the low state when pin 6 (the Threshold input) is taken higher than 2/3 of the supply voltage.

The difference in the voltage levels required for the output to switch from the high to low states and vice-versa is very important in this application as it provides the necessary



hysteresis for correct operation. Without this hysteresis, the output would fluctuate between the on and off states as the lamp was switched on and the photocell being illuminated by the lamp would experience a fall in resistance, thus turning the lamp off again. This would repeat cyclically until the ambient light level fell sufficiently for the combined effect of daylight and the light from the lamp to be insufficient for repeated triggering.

The output of IC2, at pin 3, is only capable of driving small loads and is followed by a single stage of transistor amplification, comprising Q1 and resistor, R3 to limit the current into its base. The device specified for Q1 is capable of handling currents of up to 2A and will comfortably drive a 10W (maximum) bulb at 12V.

An LED, D1, connected between pin 3 of IC2 and the positive supply rail via current limiting resistor R2, switches on during daylight hours to indicate that the circuit is powered and functioning. In darkness, when the lamp illuminates, the LED is extinguished.

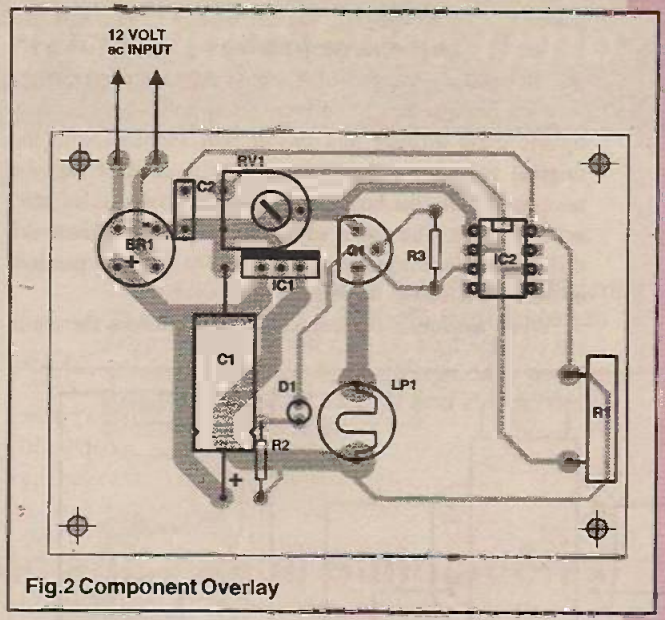


Fig.2 Component Overlay

PCB Construction

A suitable PCB foil pattern and component overlay for the Twi-Light are provided in Figure 2. The heavy tracks on the board have been designed to handle the current required by a 10W lamp, so if an alternative layout is envisaged this should be borne in mind.

The order of assembly of components to the PCB is not particularly critical, though fitting the smaller components first would be sensible. Take care with the semiconductors, as they are easily damaged by the application of excessive heat. The orientation of these devices is also critical and particular care should be taken with the bridge rectifier, BR1. A socket is recommended for IC2 and will alleviate any problems which may occur with this device.

The LDR, which is mounted at one end of the PCB, should be angled to face away from the main bulb and any external light source (other than the sky) to avoid unwanted triggering.

The Twi-Light, as originally designed, was intended for use with a 2.2W, 12V MES lamp and no heatsinks were fitted to IC1 or Q1. With a larger lamp, heatsinking will be necessary for both of these devices. IC1 may be fitted with a readily available TO-220 clip on device. A commercial heatsink for the small 'E-line' packaged power transistor, Q1 may prove difficult to locate and a small piece of thin aluminium super-glued to the device after it has been soldered should prove adequate.

Bulkhead Lamp Modifications

The prototype Twi-Light was housed in a standard 240V, 60W weatherproof bulkhead lamp assembly and any similar unit, of suitable dimensions, may be employed for outdoor use.

The original lampholder and reflector assembly should be removed from the fitting and discarded (or put in the junk box for future use). Knock one of the cable entry holes through in the fitting and assemble the supplied cable gland to it. Use round double insulated mains cable for the 12V feed to the unit, increasing its diameter with PTFE thread tape as necessary, to form a water-tight seal when the gland is tightened onto it.

If the mains version is being built, connect the cable to the DC input pins on the PCB, the polarity being unimportant.

For the 12V version see Modifications.

The printed circuit board as shown is the correct size to fit the most popular type of bulkhead lamp and is held in place by the glass diffuser and rubber seal supplied with the original unit. If another type of unit is used, it may be necessary to fix the board in place with double sided self-adhesive pads. The use of any fixings which necessitate the drilling of holes in the lamp fitting is not to be recommended, as this could lead to the ingress of moisture.

When mounting the completed unit outside, the cable should enter the unit at the bottom and the LDR should, ideally. point towards the sky.

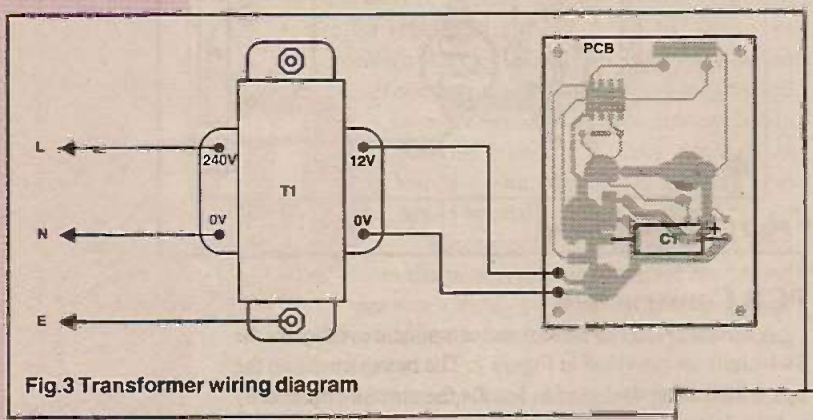


Fig.3 Transformer wiring diagram

Mains Power Supply

If the Twi-Light is to be mains powered then a suitable transformer will be required. The transformer needs to have a 12V secondary with a VA rating of at least twice the power of the lamp, e.g. a 10W lamp will need a 20VA transformer.

The transformer should be fitted in a ventilated enclosure and mounted remotely from the lamp. Figure 3 shows the wiring details. The mains plug should be fitted with a 3A fuse and the transformer must be earthed.

Setting Up

Set the preset, RV1 to its mid-position, apply power and cover the LDR with your hand. The lamp should light immediately. If not, try adjusting RV1 until it does.

Fit the lamp in its final installed position and, at dusk, adjust the preset until the lamp just comes on. Fitting the glass may have an effect on the triggering point, thus requiring adjustment over a period of a few days until the optimum trigger point is obtained.

Fault Finding

The circuit is very simple and fault finding should be quite straight forward. Before suspecting component failure, look for obvious faults such as solder splashes, semiconductors inserted the wrong way round (particularly BR1), etc.. The use of an IC socket for IC2 may well be appreciated at this stage, since it may be readily checked by substitution with a known working device. Check the supply voltage to IC2, as this device will withstand a maximum of 15V and requires a minimum of 3V to work. In this application, 12V is required for the bulb.

Modifications

For operation from a 12V car battery (for use with a caravan, etc.) the PCB layout given in Figure. 4 should be used. All component values are as per the mains version and are given in the components list. The LED has been retained as its current consumption is so small as to be insignificant, but it may be omitted if desired.

It is very important to note the new positions for the 12V supply connections and also that the polarity is now of vital importance for the survival of the semiconductors. An in-line fuse, fitted in the positive supply lead as shown, will give protection against overload or short circuits.

For a child's night-light, the PCB may be trimmed down and installed in a plug in power supply box. A tinted filter securely fitted over a cut-out in the box lid will provide a gentle glow to chase away the shadows. The LDR should be mounted on the outside of the case with its leads fed through suitable holes to their respective connections on the board.

Particular attention should be paid to safety if the Twi-Light is to be used in a child's room, especially with regard to the choice of enclosure. Make sure that the plug-in case has shrouded live and neutral pins.

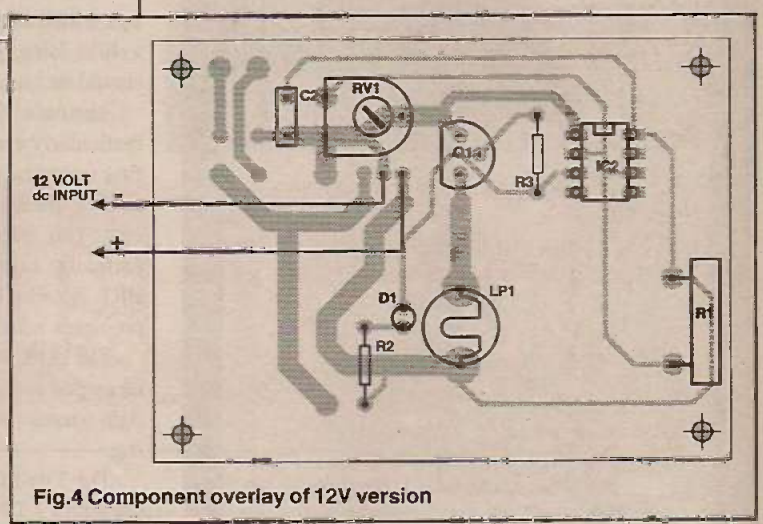


Fig.4 Component overlay of 12V version

PARTS LIST

RESISTORS
R1 ORP12
R2 470R
R3 1k
RV1 22k Sub Min Horiz Preset

CAPACITORS
C1 220µ 25V Axial Electrolytic
C2 100n Polyester 5mm Pitch

SEMICONDUCTORS
BR1 WO2
D1 5mm Super Bright Red LED
Q1 ZTX650
IC1 7812
IC2 555

MISCELLANEOUS
T1 Mains Transformer 12V 6VA Secondary
LP1 12V 2.2W MES Lamp and PCB Mounting Holder
Bulkhead Lamp Fitting; PCB; 5A Round Mains Cable, 2 Core; Case to suit Mains Transformer

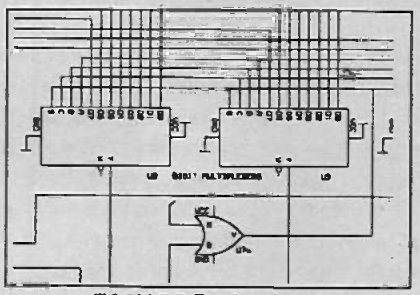
BUYLINES

The bulkhead lamp fitting was purchased from Wilkinsons.

PROJECT

Electronic Designs Right First Time?

From Schematic Capture -



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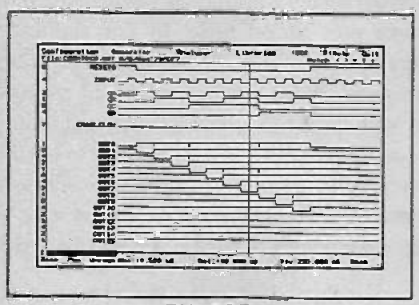
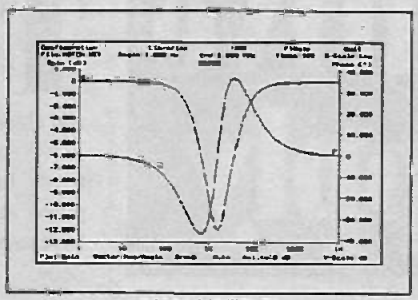
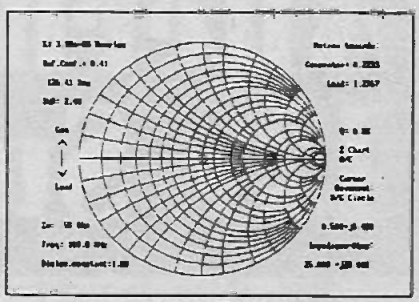
through Analogue and Digital Simulation -



PULSAR



ANALYSER III



Z-MATCH II

If the results of the simulations are not as expected, the configuration and component values of the circuit can be modified until the required performance is achieved.

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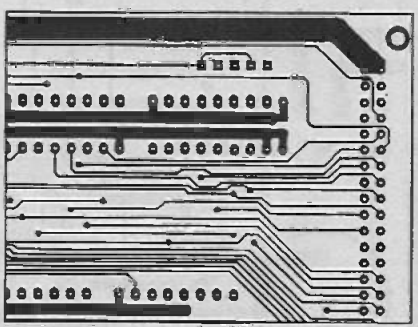

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ANALYSER III: Low cost Linear Analogue Circuit Simulator ~ 130 nodes.	**$195.00**	**£98.00**
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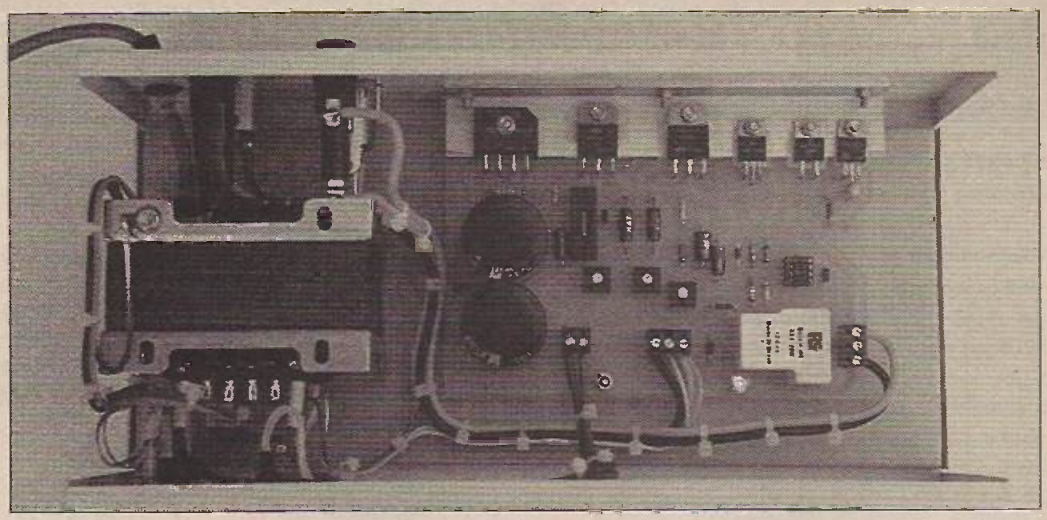

Alternative 12V Supply

by K R Ginn

This power supply was originally designed to power a three port packet node. In this application, where a quiescent current of approximately 400mA per rig was needed, totalling some 1.2A on receive and about 15A with three rigs simultaneously transmitting. A 20A supply could have been designed and built to suit these needs, but I decided to adopt a different approach to the power supply problem. To understand the reason why, you have to consider the structure of current demand for a packet node.

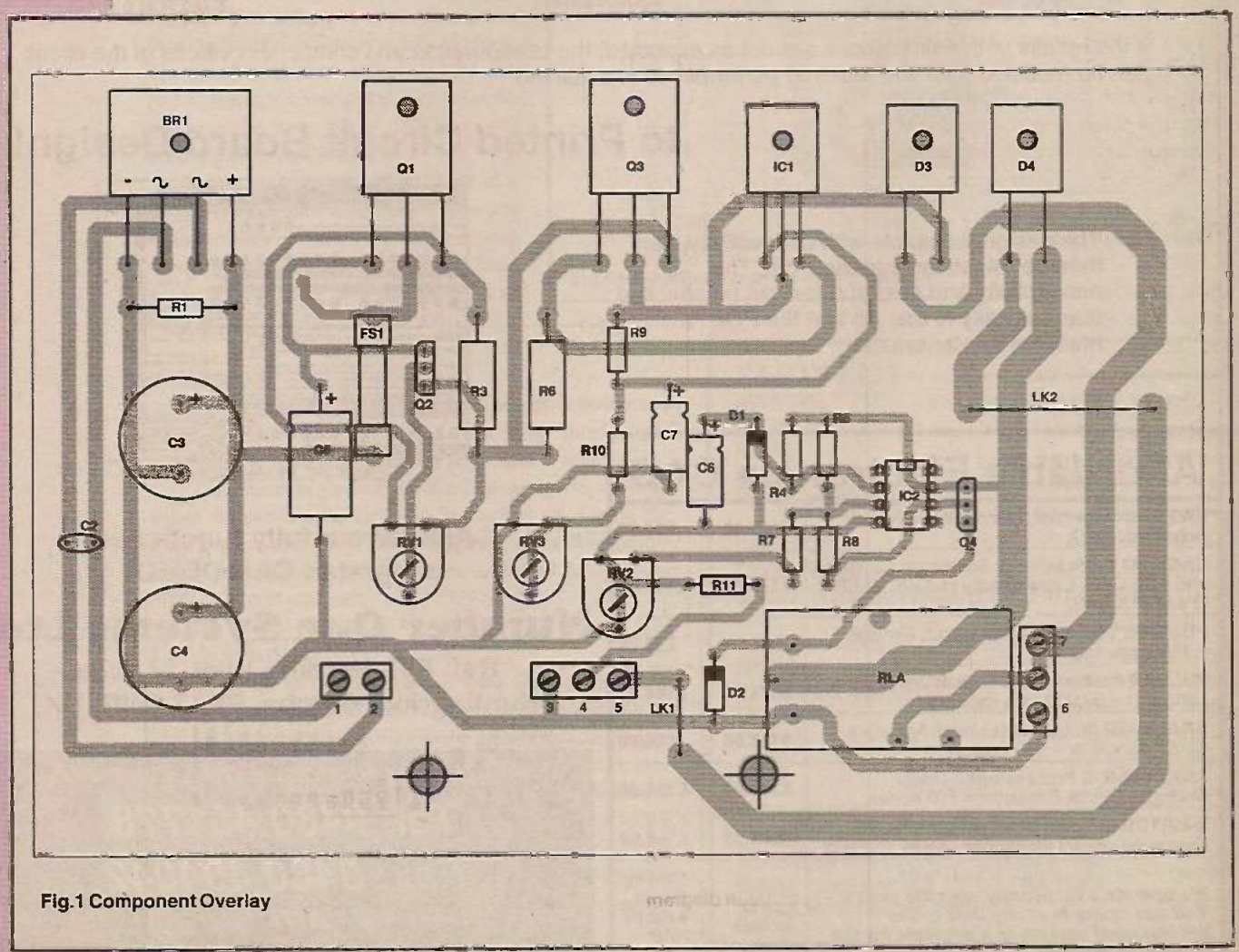

Fig.1 Component Overlay

Current Demand

In a packet system, the node (or Terminal Node Controller, TNC) is waiting and in a receive state for what could be 90% of its operational time, for the majority of nodes. The rest of the time it is, of course transmitting, from which we can see that there is quite a high duty cycle biased towards the receive. What was called for in this design was a power supply which would supply the quiescent current during the receive part of its duty cycle and only supply the additional higher current on demand, without building a full blown 20A supply. There may be times when all three rigs will be transmitting together, i.e. drawing maximum current from the supply, but this incidence is bound to be very low. The situation where two rigs are transmitting is more common and a peak current of 10A is the more likely of the two. Nevertheless, the PSU had to have the capability of supplying the full simultaneous transmit current of the three rigs.

The supply I chose is basically a low current source, which will supply the receive current for the three rigs from the ac mains derived power source. The additional transmit current will come from a gel cell storage battery, which is float charged during receive times and is topped up during the transceiver's receive cycle.

Mains input stage

The AC mains is taken through a mains isolating transformer (T1). converting the voltage down to 15V rms ac, then rectified through the bridge rectifier and onto the smoothing capacitors (C3 and C4). At this point we will expect to see 23V dc. C1 and C2 serve to illuminate noise coming through the mains transformer, either mains born noise to the equipment or RF noise to the mains supply.

Current Limit Circuit

There follows a discrete current limit circuit, Q1, Q2, R2, R3, RV1 and C5, which limits the current drawn from the transformer to 3.0A and this will operate only when one or more rigs goes into transmit, or if the battery needs to take a high charge current, having been discharged. This circuit will limit the dc supply current drawn from the mains transformer secondary's rectified side to 3.0A DC (approximately 5.2A RMS AC) whose

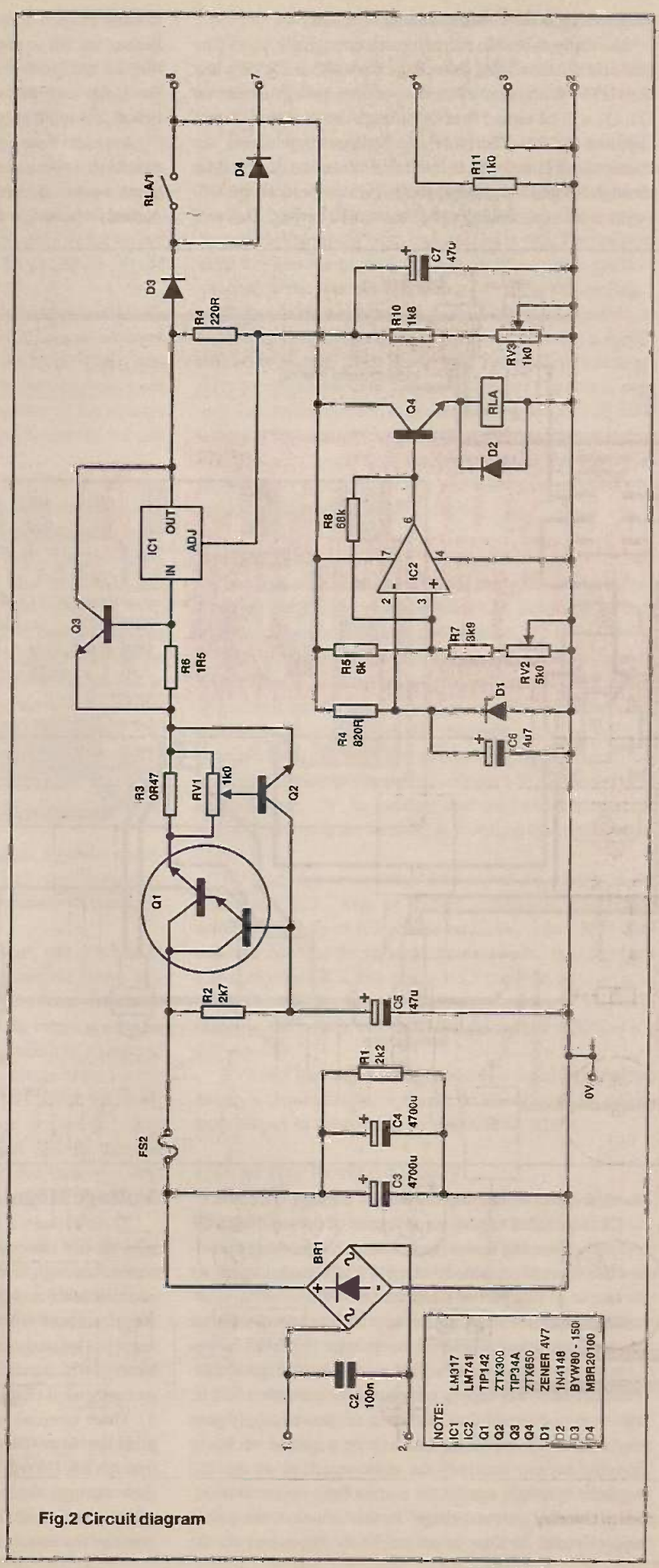

Fig.2 Circuit diagram

actual value is set with adjustment of RV1.

Normally, when the current drawn through this part of the circuit is less than 3.0A, the voltage across R3 and RV1 is less than 0.7V. With insufficient base-emitter voltage to turn on Q2, Q1 will be turned hard on through the base bias current supplied by R2. Therefore, the voltage drop across the current limit circuit will be minimal. When the current rises through R3 and the voltage across it in proportion, Q2 will begin to turn on, robbing Q1 of base drive current. This will have the effect of limiting the current through Q1 and R3.

C5 is included to give some degree of decoupling to Q1 and will reduce any mains ripple from the smoothing capacitors to a more acceptable level, i.e. 250mV peak-to-peak on the output of this part of the circuit.

The reason for adopting this approach to have a separate current limit circuit ahead of the voltage regulator, as opposed to one incorporated within a constant voltage source. If a standard power supply were used, for example a 723 IC regulator, you would find that when the power supply goes into current limit (during transmit or a period of heavy charging current demand) the error amplifier of the 723 regulator will fight against the current limit circuit to maintain a constant output voltage. In this situation, the power supply would oscillate at an amplitude dependent on the amount of current drawn, the greater the current drawn the greater the fall in output voltage and the greater the oscillation of the power supply's output voltage. This would inevitably amplitude modulate the dc supply to the transceiver and ultimately the RF power to the aerial.

A current limit condition in most power supplies is a fail condition of some sort, a failure of the load which has for some reason decided to draw more than the permitted current, whereas in this circuit it is not and is exploited.

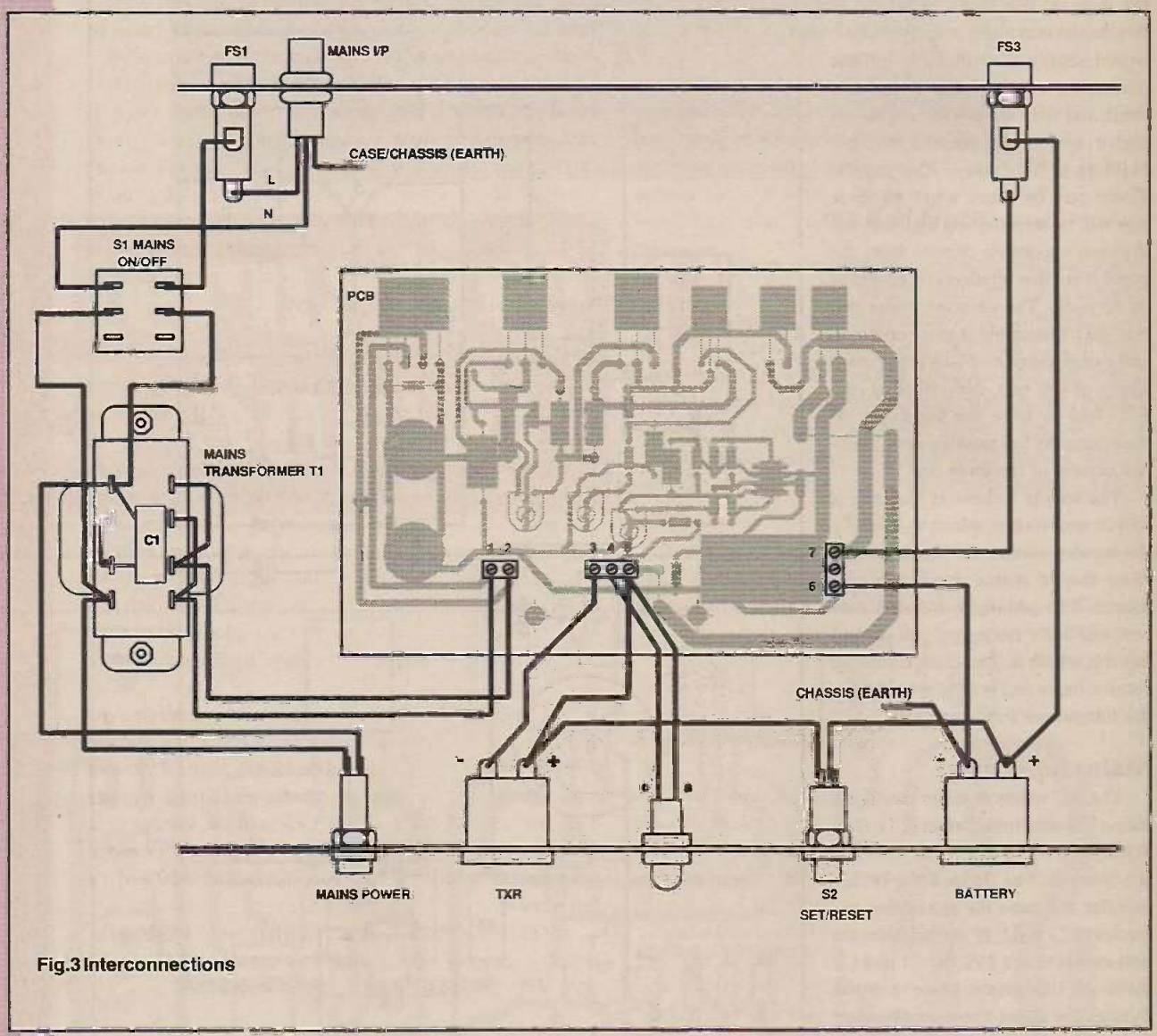

Fig.3 Interconnections

Voltage Regulator Circuit

There follows a three terminal regulator with an extension to the basic configuration, which will increase the current through what is a 1.5A regulator. This, with the addition of R6 and Q3, will raise the current handling of this stage to above 4A, more than is actually needed for the supply. This stage sets the charging voltage for the gel cell battery. which can be set to between 14.4 and 15.0V, the recommended charging voltage for these types of battery.

Three terminal regulators are quite common - IC1 supplies the first 400mA of current and as the current rises through R6, Q3 will begin to turn on, thus causing current to flow through the emitter-collector of the transistor. Any additional current above 400mA will flow through Q3 and increase the current handling of the regulator circuit.

PROJECT

Safety Cut-out

Incorporated alongside is a safety cut-out circuit, which will isolate the battery from being over discharged in the event of a mains failure. It is a 741 op-amp configured as a comparator, with additional hysteresis of about 1V added. The purpose of the cut-out circuit is to monitor the battery's terminal voltage and, as long as the battery voltage remains above 11.5V (set with RV3) it will remain active within the system and will supply the additional transmit current required by the connected equipment. It ensures that the battery is not destroyed by too deep a discharge, which would otherwise cause irreparable damage.

When a supply of around 12V is applied to the circuit via the momentary push button switch S2, IC2's circuit becomes active. D1 is supplied with a current via R4 of 10mA and supplies a stabilised reference voltage to the comparator pin 2 of 4.7V. Pin 3 of IC2 picks off a portion of the voltage applied to this circuit, with the potential divider R5, R7 and RV2. R8 provides the hysteresis.

When the voltage applied to the circuit is higher than 11.5V, the voltage at pin 3 of IC2, when set correctly, will be a little greater than the 4.7V which is supplied by the zener diode as the reference to pin 2 of the same IC. The voltage on the output of IC2, that is, pin 6, will also be high in this condition (+12V) causing Q4 to conduct and turning RLA on, as the voltage is higher on the non-inverting input of IC2 than the inverting input. The voltage at pin 3 of IC2 will also be influenced by a secondary path to this input, as R8 is effectively in parallel with R5. When the voltage to the circuit drops below the trigger level, i.e. 4.7V at pin 3 of IC2, the output of IC2 will fall to 0V, thus turning off the relay RLA. R8 will now be effectively in parallel with R7 and RV2, causing the voltage at pin 3 IC2 to fall lower, further changing it's operating point.

When power is reinstated to this circuit, a greater potential has to be applied to it to overcome the hysteresis built in. This is simply effected by closing momentarily the contacts of S2.

The hysteresis is added for two reasons, one of which is that at the switching point of the comparator, the output will tend to oscillate and cause the relay RLA the buzz erratically. The second is to enable the battery, in the event of a mains failure, to be recharged successfully before it is connected back to the supply's load. The terminal voltage of the battery in a discharged state will be low, so this has to be raised sufficiently to give the battery time to be charged up before being discharged again. If this approach was not adopted with an additional mechanical reset, the battery would undoubtedly take a considerable time to reach a fully charged state.

As the mains supply (current limit) would be supplying current to the transceivers in both receive and transmit modes as well as the battery, the transmit output current of the supply would not be reached in this way with a discharged battery. Time is given for the battery to be charged again before the equipment is once again connected to the supply.

Construction

The whole unit can be built in one of two ways, either housing all the electronics, including the gel cell battery, within a common enclosure, or housing the battery remotely. The first approach was employed here, as this lends itself to a greater flexibility in the choice of batteries. The whole unit, including the battery, was to be housed within a home made enclosure, which would make the whole unit safe from prying hands and falling objects, which could be rather dangerous if they were to come into contact with the terminals of the battery, in particular.

The components are mainly accommodated on one PCB, as shown. The board is attached to the rear of the enclosure with a piece of aluminium angle which forms part of the heatsink and all the major power devices, which emit a reasonable amount of heat, are attached to this. This helps to keep the whole unit cool. An additional heatsink could be attached to the rear of the enclosure to aid in the cooling.

Wiring within the unit is made as short as possible, to avoid unnecessarily long runs which would induce a significant voltage drop along it's length. Those wires which are carrying any appreciable current will have to be able to cope with the running current, in this case 15A peak. 50/0.25 cable is rated at 30A continuous and will be adequate, but at a pinch 32/0.2 is also suitable, as the current rating for the power supply is not a continuous one and will not permit the wire to heat up to any appreciable degree.

Setting Up

The unit once fully assembled is ready for setting up and there are only three presets on the PCB, making it an easy task. Set all presets to their mid position.

RV1 sets the current limit to, in the prototype's case, 3.0A. This is accomplished by connecting a high power wirewound resistor or combination to make 3R3 ohms to the output of the supply, i.e. the transceiver socket, with an ammeter in series with the resistor. Adjust RV1 until the current reads 3.0A. The output voltage will fall slightly, by approximately 1V, to indicate that the circuit is working properly. Remove the resistor, as it will be dissipating some 36W.

RV2 sets the low voltage drop-out of the supply on the comparator IC2. With no battery connected, the voltage across the supply of IC2 should be 13.8V, adjust RV3 until this is so. Monitor the voltage across the pins 2 (positive) and 3 (negative) of IC2 and adjust RV3 until the voltage is at 1.5V. This will have set the drop out voltage to 11.0V and at this point the battery will have been discharged to 30% of it's full capacity.

RV3 sets the output voltage, which is set to 14.4V at the battery's terminals. There should be less than 13.8V on the main output to the transceiver and at least 12.5V.

Use of the Power Supply

The power supply as previously mentioned was originally designed to run a three port packet node. The circuit can however be used to run in a single TNC and transceiver combination with very few modifications. These would only be to actual component values in the circuit.

The capacity of the storage battery in the power supply is dependent on two factors, the first of which is related to the amount of backup required in the event of a power failure. It is also dependent on the total current drain from the power supply. For example, if the transceiver were disconnected from the supply and the battery remained connected, the maximum charging current would remain at 3.0A. For a gel cell battery, as used here, a maximum charging current of 3.0A relates to a minimum battery capacity of 12A/H. The maximum charging current is a quarter of the Amp Hour

capacity in the type of battery used in the prototypes, but according to one manufacturer, Yuasa, it is quite in order to charge a gel cell at twice the current of it's Amp/Hour capacity, which means that a 1.5A/H gel cell can be used. This will result in a 20% reduction in the life of the battery if this is done often, would have little effect on the overall life of the battery as this charging rate would be a rare occurrence. A 12V 3A Hour battery would be most suitable for this unit. In the case of a single TNC/transceiver combination, the charging current (current limit), when the transceiver is disconnected, can be reduced to 1.5A or even 1.0A, thereby reducing the size and cost of the storage battery needed. There need only be one component change and this involves a new selection for R3.

For a limiting current of 1.0A, R3 can be changed to 1R0. For a higher current of 1.5A, R3 will stay as in the modified case above at 1R0. The adjustment can be accommodated for the additional current with the preset RV1. This will therefore change the size of battery needed and the cost and size of the enclosure required. Limiting the current to 1.0A charging current will need a 12V 4A hour battery, 1.5A will need 6A hours.

One further thought on the construction of the power supply should be considered if the storage battery is built within the same enclosure as the rest of the electronics. A simple battery On/Off switch should be incorporated in series with the positive line to the battery. This will enable the battery to be isolated from the rest of the circuit in the event of the unit being switched off from the mains supply for any appreciable length of time, which may discharge the battery.

Using the Power Supply

Firstly, the power supply is connected to the mains and switched on and the battery is connected to the unit, if it is external. The mains neon will illuminate on the front panel, but the power led LED1 will remain unlit until the push button S2 is momentarily pressed. This should not be done unless either the battery is in a fully charged state, or the supply has been allowed to charge the battery for at least two hours. This should give the battery time to actually get some charge in it before it is used. Press S2 and the relay RLA will energise, causing the contact to be made between the battery and the transceiver. The relay will remain energised if the battery is in a good state, otherwise it will de-energise as the storage battery will need tend to take all current in charging.

Conclusions

The unit has been in operation since March this year and shows no signs of deterioration. The main problem associated with this type of PSU incorporating a storage battery, is that batteries need some form of exercise, rather like you and I. They need to be cycled often to maintain their efficiency and this design keeps the battery float charged and cycled throughout use, as the extra current demanded on transmit is enough to cycle the battery, with the float charge part of the circuit keeping it in top condition.

This power supply has replaced a 12V 30A switch mode power supply, which can now be put to other uses. There seems to be no apparent change in performance of the equipment and the after some time in use, I have seen no problems with the storage capacity of the battery, which was always a worry.

PARTS LIST

RESISTORS
R1 2k2 1/2W
R2 2k7 1/4
R3 0R47 2.5W wirewound
R4 820R
R5 6k8
R6 1R5 2.5W wirewound
R7 3k9
R8 68k
R9 220R
R10 1k8
R11 1k0
RV1 1k0 horizontal preset
RV2 5k0 horizontal preset
RV3 1k0 horizontal preset

CAPACITORS
C1 100n 250V AC RMS working
C2 100n ceramic
C3 4700µ 50V 10mm pitch pc mounting electrolytic
C4 4700µ 50V 10mm pitch pc mounting electrolytic
C5 47µ 25v axial electrolytic
C6 4µ7 25v axial electrolytic
C7 47µ 25v axial electrolytic

SEMICONDUCTORS
IC1 LM317T 1.5A adjustable regulator, plus insulating kit
IC2 LM741N opamp

Q1 TIP142, plus insulating kit
Q2 ZTX300
Q3 TIP34A, plus insulating kit
Q4 ZTX650
BR1 200V piv 4A pc mounting bridge rectifier 0.2" pitch
D1 4V7 500mW zener diode
D2 1N4148 signal diode
D3 BYW80-150 fast recovery diode, plus insulating kit
D4 MBR20100 20A diode
LED1 0.2in 10mA, green LED

MISCELLANEOUS
LP1 240V mains neon indicator, with internal resistor
RLA 12 volt coil, 30A contact SP relay. RS stock no. 351-768
F1 500mA 20mm anti-surge fuse and chassis holder
F2 3.15A 20mm fuse and PC mounting holder
F3 15A 1 1/4" fuse and chassis holder

BAT1 12V 15A/H gell cell battery (used in prototype), 3AHcapacity battery can be used can be used as an alternative. T1 240/15V 100VA mains transformer
SW1 240V 3A mains switch, DPDT
SW2 Push button switch (momentary), push to make
Case, bracket fabricated from aluminium sheet for heatsink, connecting wire, mica washer insulating kits, connectors, 3R3 25W resistor (test purposes only), etc.

EXPRESS COMPONENTS

74LS SERIES

74LS00	0.10
74LS01	0.10
74LS02	0.10
74LS03	0.10
74LS04	0.10
74LS05	0.10
74LS06	0.39
74LS07	0.39
74LS08	0.10
74LS09	0.12
74LS10	0.10
74LS11	0.10
74LS12	0.10
74LS13	0.18
74LS14	0.22
74LS15	0.12
74LS20	0.12
74LS21	0.12
74LS22	0.12
74LS24	0.33
74LS26	0.12
74LS27	0.12
74LS28	0.12
74LS30	0.12
74LS32	0.13
74LS33	0.13
74LS37	0.14
74LS38	0.13
74LS40	0.13
74LS42	0.23
74LS44	1.62
74LS47	0.50
74LS48	0.46
74LS49	0.62
74LS51	0.11
74LS54	0.11
74LS55	0.13
74LS73	0.20
74LS73A	0.26
74LS74	0.16
74LS74A	0.18
74LS75	0.21
74LS76	0.22
74LS76A	0.24
74LS77	0.42
74LS83	0.34
74LS85	0.34
74LS86	0.22
74LS90	0.24
74LS91	0.50
74LS92	0.29
74LS93	0.24
74LS95	0.38
74LS96	0.46
74LS107	0.25
74LS109	0.25
74LS112	0.25
74LS113	0.25
74LS114	0.25
74LS122	0.33
74LS123	0.33
74LS125	0.28
74LS126	0.21
74LS132	0.28
74LS133	0.25
74LS136	0.21
74LS137	0.62
74LS138	0.24
74LS139	0.26
74LS145	0.58
74LS147	0.86
74LS148	0.70
74LS151	0.25
74LS153	0.28
74LS154	0.70
74LS155	0.25
74LS156	0.25
74LS157	0.20
74LS158	0.25
74LS160	0.32
74LS161	0.32
74LS162	0.32
74LS163	0.32
74LS164	0.30
74LS165	0.48
74LS166	0.53
74LS168	0.58
74LS169	0.53
74LS170	0.66
74LS173	0.56
74LS174	0.24
74LS175	0.24
74LS181	1.48
74LS182	1.58
74LS183	1.58
74LS190	0.25
74LS191	0.24
74LS192	0.29
74LS193	0.39
74LS194	0.39
74LS195	0.24
74LS196	0.24
74LS197	0.24
74LS221	0.36
74LS240	0.32
74LS241	0.32
74LS242	0.32
74LS243	0.32
74LS244	0.32
74LS245	0.33
74LS247	0.32
74LS248	0.38
74LS249	0.68
74LS251	0.24
74LS253	0.34
74LS256	0.50
74LS257	0.24
74LS258	0.24
74LS259	0.48
74LS260	0.28
74LS266	0.14
74LS273	0.32
74LS279	0.25
74LS280	0.86
74LS283	0.49
74LS290	0.24
74LS293	0.24
74LS295	0.58
74LS298	0.63
74LS299	1.18
74LS322	1.58
74LS323	1.78
74LS347	0.90
74LS348	1.18
74LS352	0.78
74LS353	0.88
74LS363	1.38
74LS364	1.38
74LS365	0.24
74LS366	0.28
74LS367	0.26
74LS368	0.28
74LS373	0.32
74LS374	0.32
74LS375	0.34
74LS377	0.32
74LS378	0.62
74LS379	0.86
74LS385	2.22
74LS386	0.46
74LS390	0.25
74LS393	0.24
74LS395	0.32
74LS396	1.68
74LS398	1.22
74LS399	0.62
74LS445	1.50
74LS490	0.90

D CONNECTORS

SOLDER BUCKET

9 PIN SOCKET	0.27
9 PIN PLUG	0.26
15 PIN SOCKET	0.34
15 PIN PLUG	0.34
25 PIN SOCKET	0.42
25 PIN PLUG	0.40

4000 SERIES

4000	0.16
4001	0.16
4002	0.16
4006	0.31
4007	0.16
4008	0.30
4010	0.22
4011	0.15
4012	0.15
4013	0.16
4014	0.29
4015	0.30
4016	0.17
4017	0.24
4018	0.26
4019	0.18
4020	0.30
4021	0.30
4022	0.32
4023	0.16
4024	0.21
4025	0.15
4026	0.40
4027	0.18
4028	0.28
4029	0.27
4030	0.17
4031	0.70
4033	0.55
4034	1.23
4035	0.30
4040	0.28
4041	0.30
4042	0.21
4043	0.27
4044	0.30
4046	0.30
4047	0.24
4048	0.30
4049	0.19
4050	0.19
4051	0.24
4052	0.24
4053	0.24
4054	0.55
4055	0.29
4060	0.30
4063	0.28
4066	0.18
4067	1.90
4068	0.15
4069	0.19
4070	0.16
4071	0.20
4072	0.17
4073	0.17
4075	0.17
4076	0.30
4077	0.17
4081	0.14
4082	0.17
4085	0.27
4086	0.26
4089	0.35
4093	0.15
4094	0.30
4095	0.55
4097	1.19
4098	0.31
4099	0.37
4502	0.37
4503	0.31
4508	0.89
4510	0.25
4511	0.28
4512	0.30
4514	0.72
4515	0.77
4516	0.30
4518	0.26
4520	0.25
4521	0.62
4526	0.39
4527	0.38
4528	0.39
4529	0.43
4532	0.31
4534	2.20
4536	0.99
4538	0.36
4541	0.30
4543	0.45
4555	0.34
4556	0.33
4560	1.17
4566	1.95
4572	0.24
4584	0.23
4585	0.32
4724	0.69
40106	0.30
40109	0.49
40163	0.45
40174	0.33
40175	0.35
40193	0.59

VOLTAGE REGS

78L05	0.23
78L12	0.23
78L15	0.23
79L05	0.27
79L12	0.27
79L15	0.27
7805	0.27
7812	0.27
7815	0.27
7905	0.37
7912	0.37
7915	0.37
78S05	0.48
78S12	0.48
LM317T	0.43
LM323K	2.49
LM338K	4.95

IC SOCKETS

8 PIN	0.06
14 PIN	0.10
16 PIN	0.14
18 PIN	0.14
20 PIN	0.15
24 PIN	0.18
28 PIN	0.20
40 PIN	0.24

RESISTORS

ALL 1/4 WATT MF 1% 10 FOR £0.15 (1 VALUE). INDIVIDUAL RESISTORS £0.03 EA. SKELETON PRESETS £0.10 ANY VALUE. STANDARD POTS 1/4" SHAFT, LOG OR LIN £0.35 EACH. SWITCHED POTS £0.45 EACH.

LEDS

3MM RED	0.05
3MM GREEN	0.10
3MM YELLOW	0.12
5MM RED	0.05
5MM GREEN	0.07
5MM YELLOW	0.07
5MM FLASH RED	0.48
5MM FLASH GRN	0.51
8MM FLASH RED	0.99
3MM CLIPS	0.04
5MM CLIPS	0.04
8MM CLIPS	0.18
COMMON CATHODES	
.3" 7 SEG RED	0.70
.5" 7 SEG RED	0.75
.56" 7 SEG RED	0.85
COMMON ANODES	
.3" 7 SEG RED	0.70
.5" 7 SEG RED	0.75
.56" 7 SEG RED	0.85
10 BAR DIL RED	1.39
ORP12 (LDR)	0.65

LINEAR

TL061	0.33
TL062	0.39
TL064	0.43
TL071	0.30
TL072	0.33
TL074	0.45
TL081	0.32
TL082	0.32
TL084	0.45
TBA120S	0.62
L165V	1.85
TLC271	0.55
TLC272	0.96
L272M	1.65
L293E	3.20
L297	4.90
L298	4.90
LM301A	0.30
LM311	0.32
LM318	0.80
LM324	0.22
LM334Z	0.80
LM335Z	0.90
LM339	0.34
LM348	0.32
LF351	0.35
LF353	0.35
LF356	0.79
LM358	0.26
LM380	1.10
LM381	2.60
LM386	0.46
LM393	0.27
ZN414Z	0.99
ZN416E	1.59
ZN423	1.45
ZN424P	1.20
ZN425E	4.90
ZN426E	2.90
ZN427E	9.40
ZN428E	7.90
ZN435E	6.25
ZN448E	9.20
SL486	2.70
SL490	2.35
NE531	1.54
NE544	2.75
NE555	0.19
7555	0.41
NE556	0.34
NE565	1.49
NE566	1.10
NE567	0.35
NE570	2.35
NE571	1.98
LM710	0.80
LM711	0.80
LM725	4.80
741	0.17
LM747	0.38
LM748	0.30
TBA810	0.67
TBA820	0.38
ML924	4.65
ML926	4.25
ML927	4.25
TDA1024	1.80
SAA1027	3.20
ZN1034E	3.20
LM1458	0.30
ULN2003	0.39
ULN2004	0.42
TDA2004	1.75
TDA2030	1.18
ULN2064	1.20
ULN2065	1.20
ULN2068	1.20
XR2206	4.20
UA2240	2.60
ULN2803	0.64
LM2917N8	2.60
CA3046	0.35
CA3080E	0.71
CA3130E	0.97
CA3140E	0.55
CA3240E	1.20
MC3302	0.60
MC3340	1.75
LM3900	0.70
LM3909	1.45
LM3911	2.20
LM3914	2.65
LM3915	2.65
RC4558	0.36
NE5532	0.79
NE5534	0.80
ICL7106	5.80
ICM7555	0.45
ICM7556	1.20
ICL8038	4.90
LM13600	1.10

ELECTROLYTICS AXIAL

47UF 16V	0.09
100UF 16V	0.09
220UF 16V	0.10
470UF 16V	0.19
1,000UF 16V	0.28
2,200UF 16V	0.45
4,700UF 16V	0.75
10UF 25V	0.05
22UF 25V	0.05
47UF 25V	0.06
100UF 25V	0.09
220UF 25V	0.11
470UF 25V	0.22
1,000UF 25V	0.35
2,200UF 25V	0.52
4,700 25V	1.35

ELECTROLYTIC RADIAL

47UF 16V	0.05
100UF 16V	0.06
220UF 16V	0.08
470UF 16V	0.12
1,000UF 16V	0.19
2,200 16V	0.35
10UF 25V	0.05
22UF 25V	0.05
47UF 25V	0.05
100UF 25V	0.08
220UF 25V	0.11
470UF 25V	0.17
1,000UF 25V	0.25
2,200UF 25V	0.49

TANTALUM CAPACITORS

0.1UF 35V	0.10
0.22UF 35V	0.10
0.33UF 35V	0.10
0.47UF 35V	0.10
1UF 35V	0.12
2.2UF 25V	0.14
3.3UF 25V	0.16
4.7UF 25V	0.18
6.8UF 25V	0.20
10UF 25V	0.22
15UF 16V	0.28
22UF 16V	0.28
33UF 16V	0.50
47UF 16V	0.62
68UF 6V	0.72
100UF 10V	1.40
100UF 16V	1.70

CERAMIC CAPACITORS

1.8PF	0.05
2.2PF	0.05
3.3PF	0.05
4.7PF	0.05
6.8PF	0.05
10PF	0.05
15PF	0.05
22PF	0.05
33PF	0.05
47PF	0.05
56PF	0.05
68PF	0.05
82PF	0.05
100PF	0.05
120PF	0.07
150PF	0.07
180PF	0.07
220PF	0.07
270PF	0.07
330PF	0.07
390PF	0.07
470PF	0.07
560PF	0.07
680PF	0.07
820PF	0.07
1NF	0.07
1N5F	0.07
2N2F	0.07
3N3F	0.07
4N7F	0.07
6N8F	0.07
10NF	0.07
100NF	0.07

POLYESTER/MICA CAPACITORS 15V

1NF	0.05
2N2	0.05
4N7	0.05
10N	0.05
22N	0.05
47N	0.05
100N	0.05
220N	0.05
470N	0.05
680N	0.05

POLYSTYRENE CAPACITORS 120V

47PF	0.09
68PF	0.09
82PF	0.09
100PF	0.09
120PF	0.09
150PF	0.09
180PF	0.09
220PF	0.09
270PF	0.09
330PF	0.09
390PF	0.09
470PF	0.09
560PF	0.09
680PF	0.09
820PF	0.09
1NF	0.09
1N5F	0.09
2N2F	0.09
3N3F	0.09
4N7F	0.09
6N8F	0.09
10NF	0.09

TRIMMER CAPACITORS

2-10PF	0.38
2-22PF	0.38
5.5-65PF	0.38

BRIDGE RECTIFIERS

W005 50V 1.5A	0.18
W02 200V 1.5A	0.19
W04 400V 1.5A	0.22
BR32 200V 3A	0.34
BR34 400V 3A	0.38
DB602 200V 6A	0.59
DB608 800V 6A	0.78
DB2502 200V 25A	1.40
DB2506 600V 25A	1.90

TRIACS/DIACS THYRISTORS

Z0105DA	0.40
Z0102MA	0.42
TIC206D	0.62
TIC226D	0.69
TIC246D	0.99
BR100 DIAC	0.19
TIC106D	0.40
TIC116D	0.69
TIC126D	0.79

CONNECTORS

BNC 50R PLUG	0.69
BNC 75R PLUG	0.69
BNC CHTS SOC	0.59
TNC 50R PLUG	0.89
TNC CHTS SOC	0.65
PL259 PLUG	0.55
REDUCER (PL259)	0.16
PL259 SOCKET	0.55
COAX PLUG	0.18
COAX LINE SOC	0.38
SCART PLUG	0.65
IEC CHTS PLUG	0.49
IEC LINE SOCKET	1.70
IEC 2M LEAD	1.80
IEC RA 2M LEAD	2.40
1/4" MONO PLUG	0.18
1/4" STEREO PLUG	0.29
2.5 MONO PLUG	0.12
3.5 MONO PLUG	0.12
3.5 STEREO PLUG	0.20

TOGGLE SWITCHES

SPDT 3A 250V	0.57
SPDTC/O 3A 250V	0.62
DPDT 3A 250V	0.67
DPDTC/O 3A 250V	0.79

MINATURE PUSH TO MAKE SWITCHES

RED	0.19
BLACK	0.19
GREEN	0.19
BLUE	0.19
YELLOW	0.19
WHITE	0.19

ROTARY SWITCHES

1 POLE 12 WAY	0.75
2 POLE 6 WAY	0.75
3 POLE 4 WAY	0.75
4 POLE 3 WAY	0.75

DIL SWITCHES

4 WAY 8 PIN	0.49
6 WAY 12 PIN	0.69
8 WAY 16 PIN	0.79

TRANSISTORS

AC125	0.30
AC126	0.29
AC127	0.29
AC128	0.28
AC176	0.34
AC187	0.35
AC188	0.36
AD142	1.90
AD161	0.78
AD162	0.85
AF124	0.78
AF126	0.46
BC107	0.12
BC107B	0.13
BC108	0.11
BC108B	0.13
BC108C	0.14
BC109	0.13
BC109C	0.14
BC140	0.24
BC141	0.26
BC142	0.30
BC143	0.33
BC147	0.33
BC148	0.33
BC149	0.11
BC157	0.11
BC158	0.11
BC159	0.11
BC160	0.27
BC168C	0.16
BC169C	0.16
BC171	0.11
BC177	0.17
BC178	0.17
BC179	0.17
BC182	0.07
BC182L	0.07
BC183	0.07
BC183L	0.07
BC184	0.07
BC184L	0.07
BC212	0.07
BC212L	0.07
BC213	0.07
BC213L	0.07
BC214	0.07
BC214L	0.07
BC237B	0.08
BC238B	0.08
BC308	0.09
BC327	0.09
BC328	0.09
BC337	0.09
BC338	0.09
BC477	0.33
BC478	0.33
BC479	0.33
BC517	0.19
BC547	0.07
BC548	0.07
BC549	0.07
BC557	0.07
BC558	0.07
BCY70	0.20
BCY71	0.19
BCY72	0.19
BD115	0.48
BD131	0.36
BD132	0.36
BD135	0.19
BD136	0.19
BD137	0.19
BD138	0.19
BD139	0.22
BD140	0.23
BF180	0.30
BF182	0.30
BF185	0.30
BF194	0.18
BF195	0.18
BF196	0.19
BF197	0.19
BF198	0.19
BF199	0.19
BF257	0.32
BF258	0.35
BF259	0.32
BF337	0.35
BFR40	0.38
BFR80	0.38
BFR81	0.38
BFX29	0.28
BFX84	0.30
BFX85	0.30
BFX87	0.43
BFX88	0.43
BFY50	0.28
BFY51	0.25
BFY52	0.27
BFY53	0.46
BFY55	0.46
BSX20	0.26
BSX29	0.55
BSY95A	0.48
BU205	1.39
BU206	1.40
BU208	1.65
MJ2955	0.75
MJE340	0.35
MJE520	0.44
MJE521	0.60
MJE3055	0.85
MPSA05	0.27
MPSA06	0.27
MPSA12	0.27
MPSA56	0.17
MPSU05	0.56
MPSU06	0.56
TIP29A	0.30
TIP29B	0.30
TIP29C	0.31
TIP30	0.31
TIP30A	0.31
TIP30B	0.30
TIP30C	0.30
TIP31A	0.30
TIP31B	0.30
TIP31C	0.31
TIP32A	0.30
TIP32B	0.30
TIP32C	0.31
TIP33A	0.66
TIP33C	0.71
TIP34A	0.69
TIP34C	0.74
TIP35A	1.05
TIP35C	1.15
TIP36A	1.15
TIP36C	1.25
TIP41A	0.35
TIP42A	0.35
TIP120	0.37
TIP121	0.34
TIP122	0.36
TIP141	1.20
TIP142	1.05
TIP147	1.10
TIP295S	0.62
TIP305S	0.62
ZTX107	0.17
ZTX108	0.17
ZTX109	0.17
ZTX300	0.16
ZTX302	0.20
ZTX341	0.24
ZTX500	0.15
ZTX501	0.24
ZTX502	0.24
ZTX504	0.24
2N2219A	0.27
2N2222A	0.15
2N2369	0.24
2N2484	0.24
2N2904	0.24
2N2904A	0.24
2N2905	0.20
2N2905A	0.20
2N2906A	0.20
2N2907	0.19
2N2907A	0.19
2N2926	0.14
2N3053	0.26
2N3054	0.85
2N3055	0.56
2N3442	1.34
2N3702	0.09
2N3703	0.09
2N3704	0.09
2N3705	0.09
2N3706	0.09
2N3773	1.78
2N3866	1.18
2N3903	0.09
2N3904	0.09
2N3905	0.09
2N3906	0.09
2N4062	0.16

FETS

BF244B	0.34
BF256B	0.36
2N3819	0.39
2N3820	0.58
2N5457	0.49
2N5458	0.49
2N5485	0.42

DIODES

1N4001 (10 PACK)	0.24
1N4002 (10 PACK)	0.25
1N4003 (10 PACK)	0.26
1N4004 (10 PACK)	0.27
1N4006 (10 PACK)	0.28
1N4007 (10 PACK)	0.29
1N5401 (5 PACK)	0.30
1N5402 (5 PACK)	0.31
1N5404 (5 PACK)	0.33
1N5406 (5 PACK)	0.34
1N5408 (5 PACK)	0.37
OA47 (5 PACK)	0.95
OA90 (5 PACK)	0.40
OA91 (5 PACK)	0.50
1N914 (5 PACK)	0.20
1N4148 (10 PACK)	0.22

74HC SERIES

74HC00	0.14
74HC02	0.14
74HC03	0.14
74HC04	0.14
74HC08	0.14
74HC10	0.14
74HC11	0.14
74HC14	0.18
74HC20	0.14
74HC27	0.14
74HC30	0.14
74HC32	0.14
74HC42	0.26
74HC73	0.26
74HC74	0.19
74HC75	0.19
74HC76	0.19
74HC85	0.25
74HC86	0.19
74HC107	0.19
74HC123	0.32
74HC125	0.23
74HC126	0.22
74HC132	0.25
74HC133	0.26
74HC138	0.25
74HC139	0.25
74HC151	0.25
74HC153	0.25
74HC154	0.38
74HC157	0.28
74HC158	0.26
74HC160	0.32
74HC161	0.25
74HC162	0.25
74HC163	0.25
74HC164	0.25
74HC165	0.40
74HC173	0.32
74HC174	0.25
74HC175	0.25
74HC192	0.47
74HC193	0.40
74HC194	0.36
74HC195	0.32
74HC240	0.35
74HC241	0.36
74HC242	0.36
74HC243	0.46
74HC244	0.34
74HC245	0.49
74HC251	0.28
74HC253	0.28
74HC257	0.28
74HC259	0.34
74HC266	0.25
74HC273	0.34
74HC280	0.36
74HC299	0.59
74HC354	0.42
74HC356	0.44
74HC365	0.32
74HC366	0.32
74HC367	0.25
74HC368	0.25
74HC373	0.34
74HC374	0.34
74HC390	0.44
74HC393	0.32
74HC423	0.36
74HC533	0.42
74HC534	0.42
74HC563	0.46
74HC564	0.46
74HC573	0.42
74HC574	0.42
74HC640	0.60
74HC643	0.72
74HC646	1.10
74HC648	1.10
74HC688	0.48
74HC4002	0.34
74HC4017	0.32
74HC4020	0.38
74HC4040	0.39
74HC4049	0.26
74HC4050	0.26
74HC4060	0.40
74HC4075	0.16
74HC4078	0.16
74HC4511	0.40
74HC4514	0.80
74HC4538	0.40
74HC4543	0.66
74HC7266	0.26

CRYSTALS

1MHZ	1.10
1.8432MHZ	1.78
2MHZ	1.66
2.097MHZ	0.76
2.4576MHZ	0.98
3.276MHZ	0.76
3.579MHZ	0.76
4MHZ	0.76
4.194MHZ	0.76
4.43MHZ	1.78
4.915MHZ	0.76
5.008MHZ	0.76
5.06MHZ	0.76
6MHZ	0.76
6.144MHZ	0.76
8MHZ	0.76
10MHZ	0.76
11.05MHZ	0.76
12MHZ	0.76
16MHZ	0.76
18MHZ	0.76
39.925MHZ	0.76

MEMORIES

2114	1.25
4164-10	1.16
4164-12	1.08
4164-15	0.98
41256-8	1.60
41256-10	1.46
41464-10	4.24
41464-12	4.20

WIRE AND CABLE

SPEAKER WIRE 7P A METRE ANY LENGTH. STEREO SCREENED CABLE 16P A METRE ANY LENGTH. 4 CORE SCREENED ANY LENGTH 28P A METRE. STANDARD TV COAX CABLE 20P A METRE ANY LENGTH

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AMP KITS

30 WATT SINGLE CHANNEL

30 watt rms into 8ohm, 20HZ-20KHZ harmonic distortion 0.1%, sensitive to 150MV, mic sensitivity 50MV, 36V x 2 psu's required complete with base, treble and volume controls and heat sink.

Our Price : £8.00 each
Our Ref : EE/W8P7

120+120 WATT STEREO AMP

240 watts rms into 4 ohm, 10KZ-20KHZ, harmonic distortion less than 0.01%, sensitivity 3MV (phono), 130MV (aux), 2 x 30V psu's required.

Our Price : £30.00 each
Our Ref : EE/W30P3

30 WATT STEREO AMP

30 watts rms into 8ohm, harmonic distortion .1%, sensitivity 3MV (phono), 130MV (tuner), signal to noise 80db, 36V x 2 psu's required.

Our Price : £16.00 each
Our Ref : EE/W16P1

300 WATT MONO AMP

300 watt rms output, harmonic distortion less than 0.05% 10KHZ. 2 x 60V psu's required.

Our Price : £40.00 each
Our Ref : EE/W40P3

AMSTRAD MP3

A complete fully tunable VHF/UHF TV reciever with RGB and composite video out, audio on internal speaker. Intended for use with CTM644 colour monitor but can be used with monitors that have a 15.825kHz line frequency. Needs 12V DC psu. BRAND NEW AND CASED.

Our Price : £19.00
Our Ref : ET/V19P1

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BATTERIES AND HOLDERS	IONISERS
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CAR AMPS, RADIOS & SPKRS	PIR LIGHTS AND DETECTORS
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MINIMUM GOODS ORDER £5.00. TRADE ORDERS FROM GOVERNMENT, SCHOOLS, UNIVERSITIES & LOCAL AUTHORITIES WELCOME. ALL GOODS SUPPLIED SUBJECT TO OUR CONDITIONS OF SALE AND UNLESS OTHERWISE STATED GUARANTEED FOR 30 DAYS.
RIGHTS RESERVED TO CHANGE PRICES & SPECIFICATIONS WITHOUT PRIOR NOTICE. ORDERS SUBJECT TO STOCK. QUOTATIONS WILLINGLY GIVEN FOR QUANTITIES HIGHER THAN THOSE STATED.

THIS MONTHS SPECIAL OFFERS

COMMODORE 64 & PSU

Once again available due to a bulk purchase. Commodore 64 together with Power Supply, supplied and tested in working order.

Our Price:£50.00 Ref:ET/W50P1

PIR MOVEMENT DECTECTOR

Once again we have acquired stocks of this popular line and are able to offer you a very high quality and professional detector at only ***£15.00***. Range: 20 Mtrs with a 90° arc. Day and Night Mode Dimensions: 15cm x 9cm x 11cm. New and boxed complete with installation guide.

Our Price:£15.00
Our Ref :ET/W15P2

ELECTRIC MOTOR - 3 PHASE

GEC Alpak Induction Motor. This is an extremely well made industrial 3 phase motor. BRAND NEW & UNUSED. Supplied with full installation and maintenance literature.

Our Price: £60.00
Our Ref : ET/W60P1

PORTABLE ALARM SYSTEM

'PAL' Portable Multi Bean Scanning System. Lockable Stand-alone PIR unit with removable keys(3 supplied). This unit uses a PP3 battery and when activated emits a piercing SHRILL! The units scans the room and memorises the layout. Should this change, the alarm is triggered. There is a 60 second exit delay.

Our Price: £17.00
REF : ET/W17P1

CAR PHONE HANDSETS YUPPIES LOOKOUT!!

Brand New High quality handsets originally intended for use with Phillips Mobile Phone System. We have acquired a number of these handsets, supplied in two parts, speaker and combined phone rest unit plus handset with LCD display, LED indicators and push button dialling. 6 additional keys as well as the conventional 12 numeric keypad. No transmitter /receiver. 5 Mtr 12 core black cable attached. Excellent Dummy Mobile Phone!!!

Price: £6.00 each
Ref : ET/W6P3

MINI MULTI TESTER

Mini multi-tester with 9 ranges. AC Volts up to 1000. DC Volts up to 500.
Ohms/mA ranges.
1K ohm/V. Ideal for pocket or toolbox use and at only £5.00 each - replaceable!!

Our Price: £5.00
Our Ref : ET/W5P2

HEAT DETECTOR

This is a Japanese made combination type heat detector which could be linked to a suitable fire alarm panel. 105mm dia. 30V operational.

Our Price:£4.00 OurRef:ETW4P1

SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK

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USEFUL POWER SUPPLY - £5.00

14.5V DC @ 400Ma battery charger
Plug in type with sleeved pins. Lead terminates in 3 pin din plug, easily removeable. Originally intended for mobile phone charging. (Large quantities available)

Our Price : £5.00 each
Our Ref : ET/W5P8

AMSTRAD PRINTER MECHS

We have both Amstrad LQ3500 and Amstrad DMP4000 printer mechanisims No case or electronics but complete with print head. Ideal for replacement. The mechanism comes with two high quality stepper motors which together with the print head are worth much more than we are selling the whole unit for!!!! This unit could also be utilised for a number of other projects including coil winding, laser scanning(*!) etc.
(Quantity Prices available on application)

AMSTRAD LQ3500 units
Our Price : £10.00 each
Our Ref : ET/W10P5
AMSTRAD DMP 4000 units
Our Price : £20.00 each
Our Ref : ET/W20P3

MANY MORE SPECIAL OFFERS IN OUR REGULAR NEWSLETTERS

PC CORNER

PC CASES desk top case +psu £51.60 ref BPC/C1,Deluxe slimline case +psu £60.00 ref BPC/C2, Minitower case +psu £51.60 ref BPC/C3, Deluxe midi case +psu £90.00 ref BPC/C4.
MONITORS Mitac 14" SVGA .39DP £174.00 ref BPC/MO2, Mitac 14" SVGA .28DP £202.00 ref BPC/MO1,
MEMORY 256K Simm 70ns £8.40 ref BPC/MI1, 1MB Simm 70ns £26.40 ref BPC/MI2, 4MB Simm 70ns £96.00 ref BPC/MI3
MICE 2 button serial mouse with 3.5" s/ware. £8.40 ref BPC/MI6, 3 button serial mouse with 3.5" s/ware £9.60 ref BPC/MI7.
KEYBOARDS 102 AT UK standard keyboard £18.60 ref BPC/MI4, Deluxe keyboard 102 AT UK £26.40 ref BPC/MI5.
SOFTWAREMS DOS 5 OEM version £39.60 ref BPC/MI8, MS WINDOWS 3.1 OEM version £42.00 ref BPC/MI9.
6 286-16 Headland chipset £46.80 ref BPC/MB1, 386SX-33 Acer chipset £82.80 ref BPC/MB2, 386SX-40 UMC with 64K cache £110.00 ref BPC/MB3, 486SX-25 UMC with 64K cache £191.00 ref BPC/MB4, 486DX-33 UMC with 256K cache £378.00 ref BPC/MB5, 486DX-66 UMC with 256K cache £515.00 ref BPC/MB6.
FLOPPY DRIVES 1.44mb 3.5" drive £32.34 ref BPC/DD05, 1.2mb 5.25" drive £38.40 ref BPC/DD02, 3.5"-5.25" mounting kit £5.00 ref BPC/DD07,
HARD DRIVES 42MB IDE 17ms £99.00 ref BPC/DD01, 89MB IDE 16ms £166.00 ref BPC/DD02, 130MB IDE 15ms £215.00 ref BPC/DD03, 213MB IDE 14ms £298.00 ref BPC/DD04.
VIDEO CARDS 256K C&T 8 bit SVGA card £22.20 ref BPC/VC01, 512K Trident 9000 16 bit SVGA card £31.20 ref BPC/VC02, 1MB Trident 8900 16 bit SVGA card £45.00 ref BPC/VC03, 1MB Cirrus AVGA3 16.7M colours £48.00 ref BPC/VC04, 1MB Tseng multimedia £82.80 ref BPC/VC05
ADD ON CARDS Multi I/O card 2s,1p,1g,2fdd,2hdd£11.00 ref BPC/AOC01, ADLIB sound card with speakers £37.00 ref BPC/AOC02, Orchid sound card with speakers £63.00 ref BPC/AOC03.

EXAMPLES OF COMPLETE SYSTEMS

386SX-33 SYSTEM
386SX-33 board at £82.80, case £51.60, 2MB ram £52.80, 42MB drive £99.00, SVGA colour monitor £174.00, 102 keyboard, £25 build fee if required. Total £579.34

486DX-33 SYSTEM
486DX-33 board £378.00, case £51.60, 2MB ram £52.80, 89MB drive £166.00, 512 SVGA card £31.20, 3.5" FDD £32.34, multi I/O card £11.00, SVGA monitor £174.00, 102 keyboard £18.60, £25 build fee if required. Total £939.84

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PCB Service August

Price code	Price (inc. VAT)
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D	£2.50
E	£3.25
F	£4.00
G	£4.75
H	£5.50
J	£6.62
K	£7.20
L	£8.80
M	£10.60
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O	£15.80
P	£17.90
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R	£23.90
S	£25.90
T	£29.00
U	£32.20
V	£35.80
W	£37.90
X	£40.70

E9308-1 Window Monitor (4 Boards) ..... K
E9308-2 Alternative 12V Supply ..... M
E9308-3 Single Channel Lumitec ..... E
E9308-4 Four Channel Lumitec ..... H
E9308-FC Twi-light Zone ..... F

PCBs for the remaining projects are available from the companies listed in Buylines.
Use the form or a photocopy for your order. Please fill out all parts of the form. Make sure you use the board reference numbers. This not only identifies the board but also tells you when the project was published. The first two numbers are the year, the next two are the month.
Terms are strictly payment with order. We cannot accept official orders but we can supply a proforma invoice if required.
Such orders will not be processed until payment is received.

E9201-5 Enlarger Timer Selector Board (2 sided) ..... K
E9201-6 Enlarger Timer Switch PCB ..... E
E9203-1 MIDI Switcher- Main Board L
E9203-2 MIDI Switcher- Power Suply ..... E
E9203-3 Sine Wave Generator (surface mount) ..... F
E9204-1 Auto Car Lights ..... F
E9205-1 Bat Detector ..... E
E9205-2 Pond Controller ..... F
E9206-FC Stereo amplifier ..... G
E9206-2 Xenon flash trigger Main Board ..... J
E9206-3 Xenon flash trigger Flash Board ..... F
E9206-4 Scanner for audio generator ..... D
E9207-1 Improved Rear Bike Lamp ..... D
E9207-2 Mini Baby Bug Monitor C
E9207-3 Ultrasonic Audio Sender (2 boards) ..... H
E9207-4 Camera Add-on unit (4 boards) ..... O
E9207-5 AutoMate 5V/48V Mixer power supply ..... J
E9207-6 AutoMate Precision 17V power supply ..... J
E9207-FC Surround Sound Decoder ..... F
E9208-1 Dynamic Noise Limiter ..... F
E9208-2 Touch Controlled Intercom (2 boards) ..... H
E9208-3 MIDI Keyboard ..... K
E9208-FC Battery charger ..... F
E9209-1 Intercom for light aircraft ..... H
E9209-2 Alarm protector C
E9209-3 Temperature controller ..... M
E9209-FC 45W Hybrid power amp ..... F
E9210-1 Universal I/O Interface for PC (2 Sided) ..... N
E2910-2 Rapid Fuse Checker ..... E
E9210-3 Heartbeat/Audio Listener ..... E
E9210-FC Wizards Hat ..... E
E9211-1 Electronic Die ..... E
E9211-FC Car Alarm ..... F
E9212-1 Digital Circuit Tester ..... F
E9212-2 Communications Link by RS232 L
E9212-FC Mains Inverter ..... E
E9301-2 Fading Festoonery ..... G
E9301-FC Infra Red Receiver ..... F
E9302-1 EPROM Programmer (2 Sided) ..... N
E9302-2 Sound to MIDI Board L
E9302-3 Puddle Tec ..... E
E9302-4 DiscoAmiga Light Selector ..... H
E9302-FC Infra Red Transmitter ..... E
E9303-1 Ni-Cd Battery Charger ..... E
E9303-2 IC Tester ..... E
E9303-3 Disco Amiga (motor driver board) ..... H
E9303-4 Direct Conversion Reciever (2 Sided) ..... N
E9303-FC LED Stoboscope ..... F
E9304-1 Solo Mic Pre-Amplifier ..... F
E9304-2 Multimate Tester C
E9304-3 The Keepsafe Alarm ..... F
E9304-4 Proving Unit ..... E
E9304-5 Infra Guide Receiver Module C
E9304-6 Infra Guide Transmitter ..... F
E9304-FC (AutoMate) Peak Program Meter ..... F
E9305-1 Pentacode Main Board ..... F
E9305-2 Pentacode Relay Board ..... F
E9305-4 Vibration Detector ..... D
E9305-FC The Fuzztone ..... E
E9306-1 Graphic Equaliser ..... F
E9306-2 Super Spooker ..... H
E9306-3 Middle & Side Stereo Coding ..... D
E9306-FC The Chaperon ..... F
E9307-1 Car Battery Tester (Double Sided - Surface Mount) ..... E
E9307-2 Mind Trainer ..... F
E9307-FC Microwave Monitor ..... F

ETI PCB Service, Reader's Services, Argus House, Boundary Way, Hemel Hempstead HP2 7ST

Please Supply:

Quantity	Ref No.	Price Code	Price	Total Price
	E		£	£
	E		£	£
	E		£	£
			Post & Packing	£ 0.75
			Total Enclosed	£

Please send my PCBs to:

Name .....

Address .....

.....

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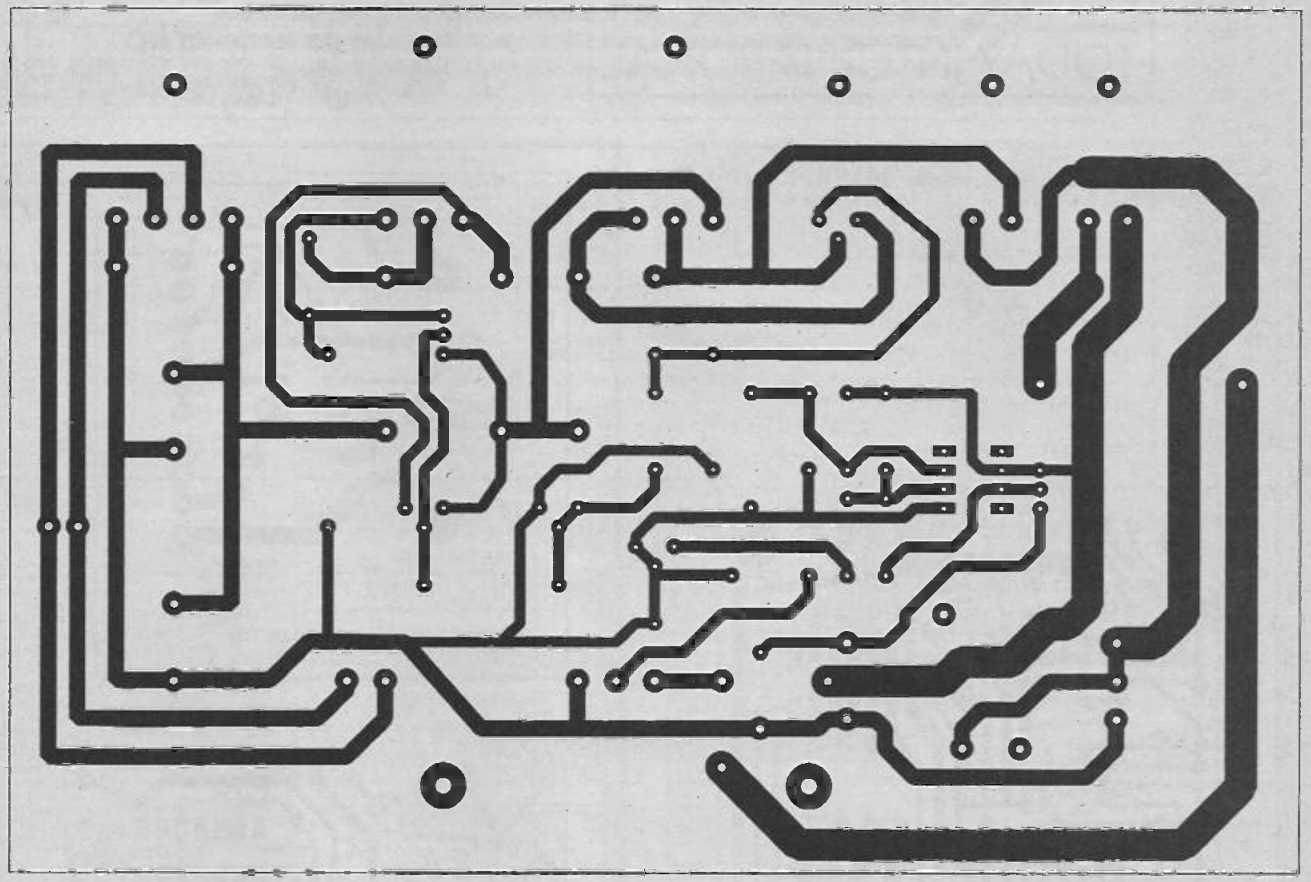
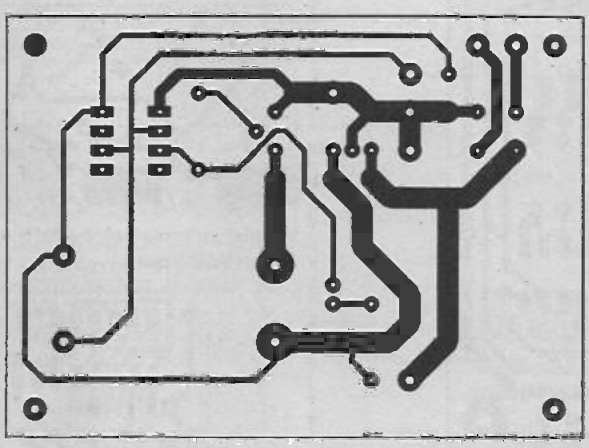
CHEQUES SHOULD BE MADE PAYABLE TO ASP.

PCB Foils

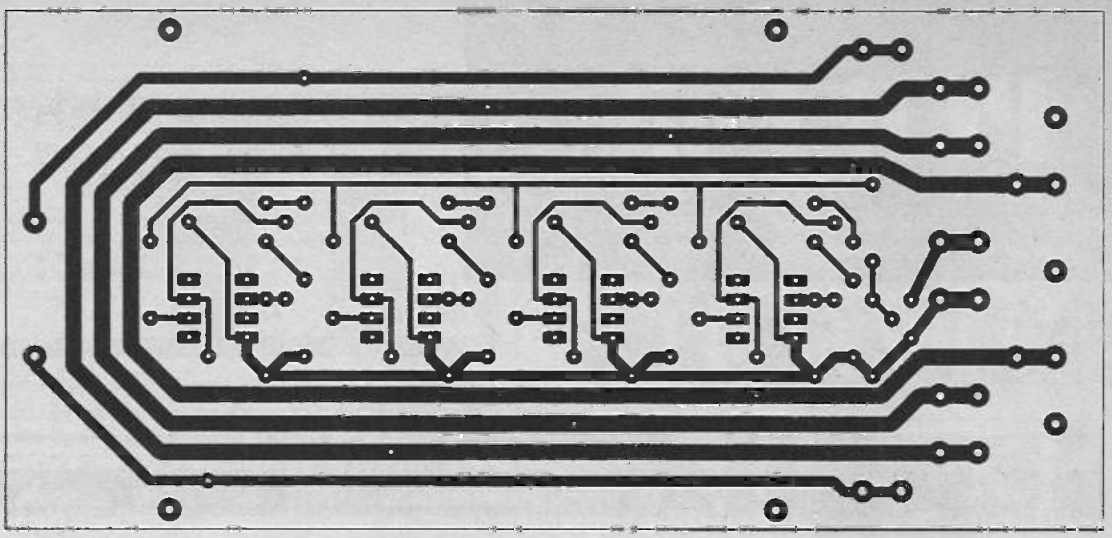
The PCB foil patterns presented here are intended as a guide only. They can be used as a template when using tape and transfer for the creation of a foil.



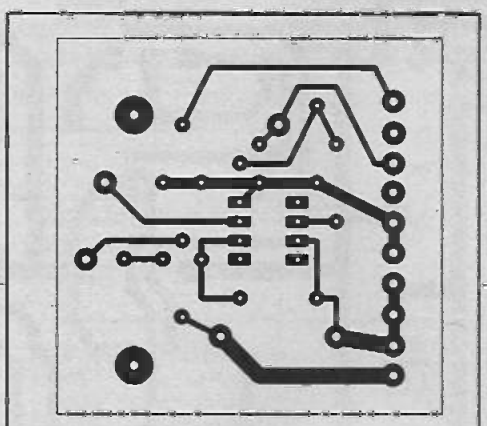
Alternative 12V PSU



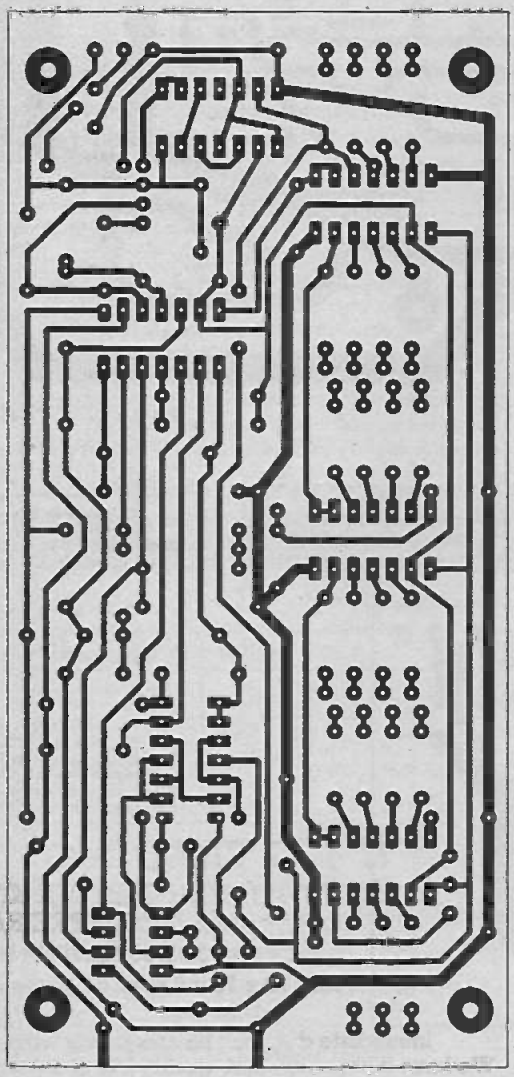
Twi-light Zone



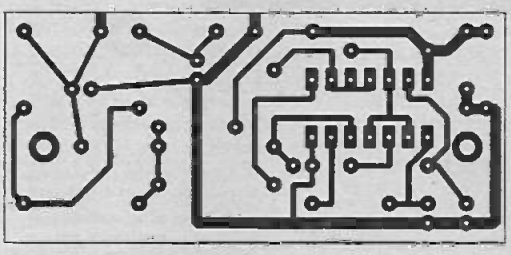
4 Channel Lumitec



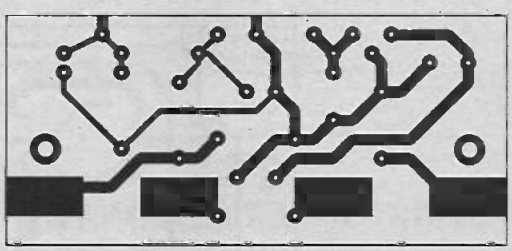
Single Channel Lumitec



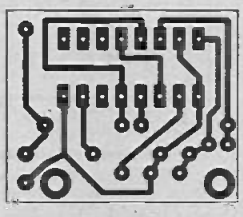
Window Monitor



Battery PSU Board



Mains PSU Board



Remote Circuit Board

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READER OFFER

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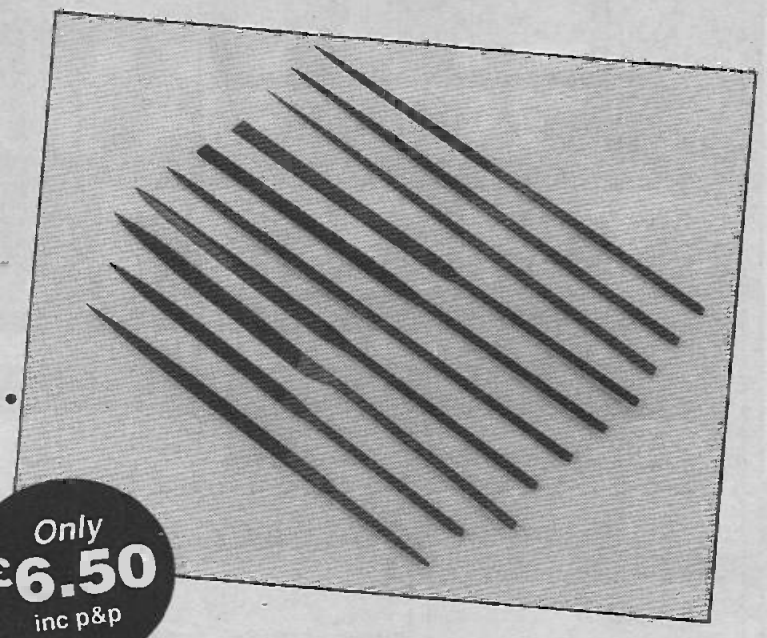

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Next Month

Why not build a simple 4-range capacitance meter using our PCB next month or if you feel you want to be entertained with messages and patterns, how about having a go at The Electronic Picture, an LED matrix indicator panel. If home entertainment is not for you, then it may be time to construct an RF Signal generator for your workshop or even a MIDI Analyser for the music workshop. It sometimes helps to know what signal is going where and at what time.

OK, so if you're not bothered by all those wonderful projects maybe the latest news on Digital compression techniques will interest you. Either way it would be a safe bet to pop into your newsagents for the next eagerly awaited copy of **ETI**. Out on **Friday 6th August.**

The above articles are in preparation but circumstances may prevent publication

LastMonth

Our July issue featured:

Microwave Monitor
Car Battery Tester
Look No Hands (Hands Free-Telephones)
Switch Change for RC Models
Mind Trainer
Low Cost Cases
Anniversary AutoMate Mixer
Charge Pump Devices

Back issues can be obtained from Argus Subscription Services. Address in column to left.

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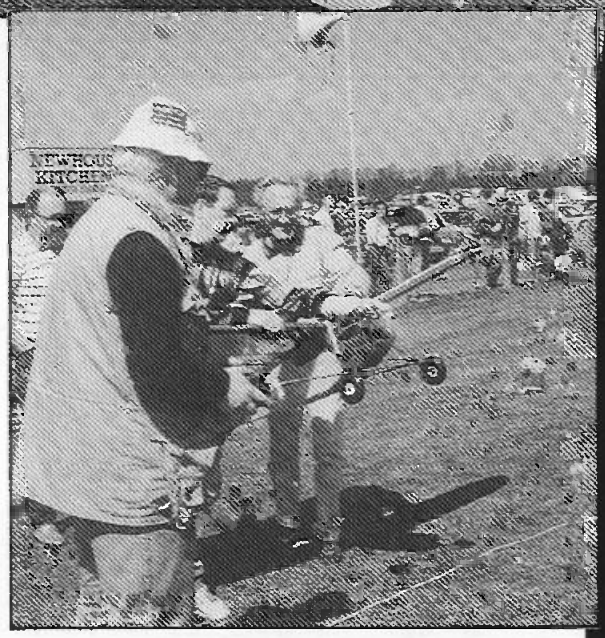

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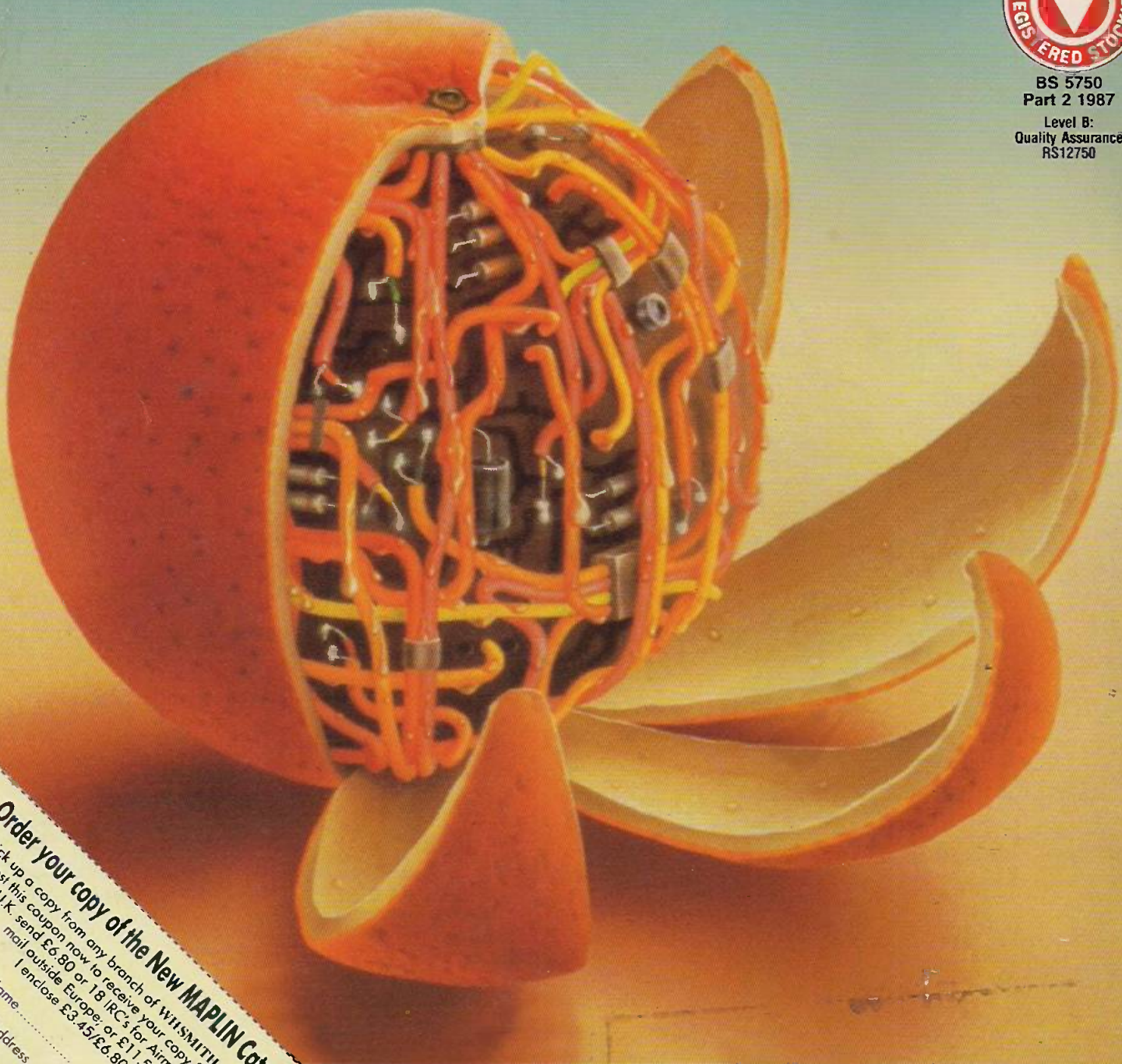

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