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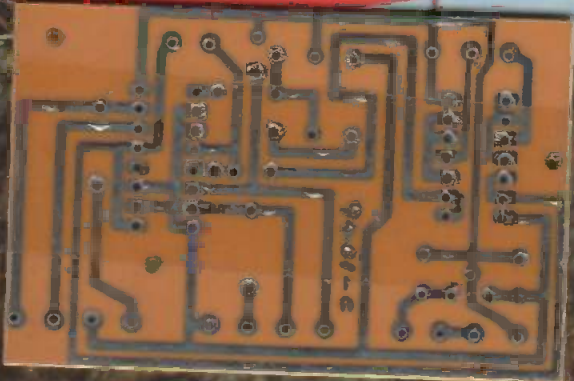
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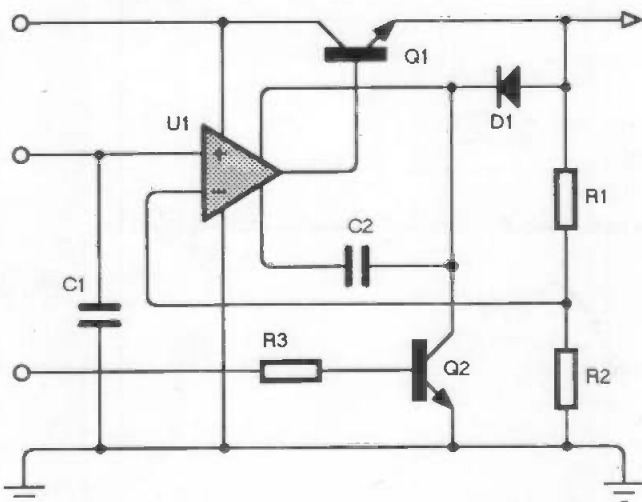
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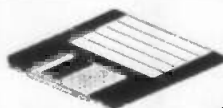
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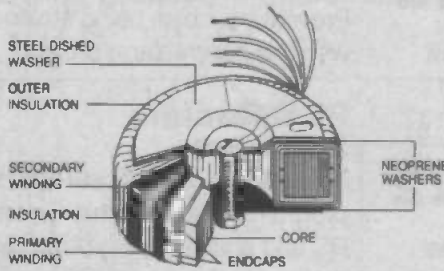
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	13013	15-15	1.00	63028	110	2.04	
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	23012	12-12	2.08		73017	30-30	5.00
	23013	15-15	1.66		73018	35-35	4.28
	23014	18-18	1.38		73026	40-40	3.75
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43012	12-12	5.00	93033		50-50	6.25	
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43014	18-18	3.33	93028		110	5.68	
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	43029	220	0.54				
43030	240	0.50					
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53013	15-15	5.33					
53014	18-18	4.44					
53015	22-22	3.63					
53016	25-25	3.20					
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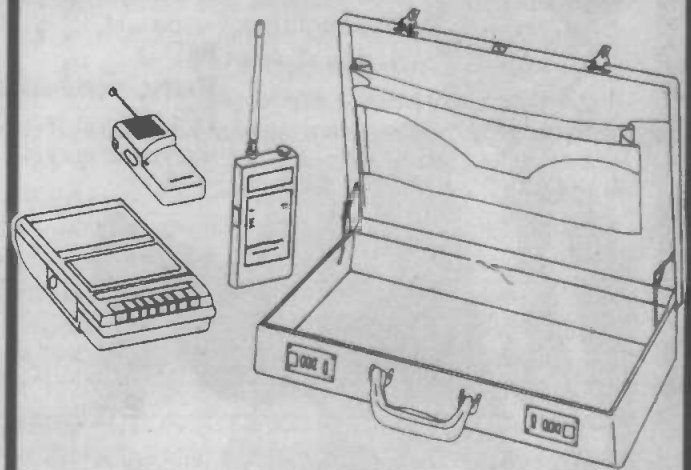
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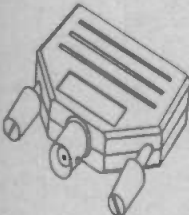


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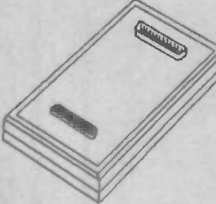
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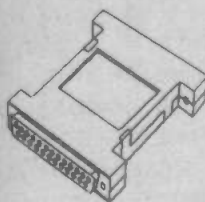
Single Channel 8 bit ADC **£49**

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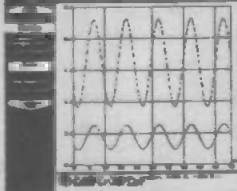
8 Channel 16 bit + sign ADC **£99**

ADC-11 15K samples per second
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D25 input connector
30V overload protection
Parallel port connection
Includes both PicoScope and PicoLog software



11 Channel 10 bit ADC **£75**

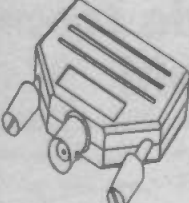
PicoScope 'Virtual instrument' software package for the ADC-10, ADC-11 and ADC-12.



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

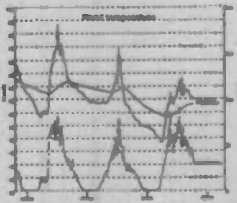
Scope, voltmeter, spectrum analyser

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



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PicoLog Collect samples from 1 perm 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.



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

Typical application	ADC-10	ADC-11	ADC-12	ADC-16
Oscilloscope	●	●	●	
Voltmeter	●	●	●	●
Spectrum analyser	●	●	●	
Audio sampling	●		●	
Chart recorder emulation		●		●
Temperature measurement	●	●	●	●
Pressure measurement	●	●	●	●
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Low cost catalogue from Electromail

Until 31st December, Electromail, the mail order arm of RS Components, is offering its full colour catalogue at a reduced price of just £2.95. The three part, 2000 page, catalogue is usually priced at £6.50 and gives customers immediate access to an extensive range



of over 41,000 RS electronic, electrical and mechanical parts and tools.

Electromail can be contacted on 0536 204555.

Oxford switches to electric transport

The city of Oxford now has an electric bus service, part of the city's move towards creating a better environment. Four buses powered by lead acid batteries are now running a regular service on a

4km circuit in the city. Each bus carries up to 18 people and has a top speed of 64km per hour.

The £125,000 buses are being provided by Southern Electricity and subsidised by

the council. They have been designed by International Automotive Design of Worthing in Sussex and should help to reduce the level of nitrogen dioxide pollution in the city centre.



Mixed technology memory cards from Mitsubishi

Two new series of mixed technology 68 pin PCMCIA version 2/JEIDA version 4 standard memory cards have been launched by Mitsubishi. The two series are firstly a mix of SRAM and Flash and, secondly, a mix of OTPROM and EEPROM.

The SRAM and Flash mixed cards are available in mixes up to 2Mb of total memory. As such they provide ideal solutions to the data and program storage requirements of very small computer systems. The 200ns fast access cards are buffer interfaced and incorporate attribute memory. Programming and data erasing is by software control under the Flash memory and a life of up to 10,000 Flash memory programming cycles can be achieved.

The OTPROM and EEPROM versions are available with 1 or 2Mb of OTPROM and 64 or 256Kb of EEPROM, plus decoder ICs. Applications for these cards include multi-function terminals, instrumentation and measurement. The cards feature an 8 bit data length and an access time of 250ns.

For more information contact Mitsubishi on 0707 276100.



Safe earth testing

We all rely on the fact that electrical systems are properly earthed to guarantee their safety, but is the earth wire properly earthed? A new device from Manchester based Alpha Electronics allows you to test individual earth resistance in multiple earthed systems. This can be carried out safely without any need for disconnection. The system is ideal for testing power pylons, grounding grids and lighting protection systems.

The Unilap GEO-X also offers low resistance and two pole measurement with an AC resolution of 0.001 ohms. Automatic frequency control has been incorporated to ensure measurement validity. Microprocessor controlled measurements are presented on a large, high contrast, LCD and may also be downloaded to a PC or printer.

For more information contact Alpha Electronics on 0942 873434

New car alarm from Maplin

Maplin Electronics has just launched a new low-cost car alarm system, which it claims has more features than many more expensive models. The system is easy to fit with a two wire installation and will alarm and protect the vehicle. It is programmed with a remote control code and has a third wire which can be connected to the ignition switch so that the alarm can not be armed while the engine is running.

If the car is broken in to, the alarm will be triggered. A forced entry will turn on an interior light and then any

sudden shock will start the alarm. The alarm has a 'warn-away' feature which is set by pressing the remote control button twice. When the shock sensor is triggered, a warning tone will tell the intruder to back off. If the shock sensor is triggered more than twice within 15 seconds the full alarm will be triggered.

The car alarm kit costs £29.95 and comes with all components, instructions, remote transmitter and warning stickers. It is available from any Maplin shop or by mail order. Maplin can be contacted on 0702 554161.

Mercury containing copper oxide becomes superconductive

By subjecting a mercury-containing copper oxide to very high pressures, scientists at the University of Houston have caused it to become superconducting at unusually high temperatures - above 150K (-123C). Currently, the highest ambient-pressure superconducting transition temperature on record is 135K. It was measured in the recently discovered compound HgBa₂Ca₂Cu₃O₈₊₈ by Houston physi-

cist Ching-Wu Chu and co-workers.

When Chu's group subsequently subjected this material to 150 kilobars of pressure (almost 150,000 atmospheres), its transition temperature went up to 153K. The researchers measured a transition temperature of 160K at 280 kbar. These results show subsequently that superconductivity in such layered cuprates is possible at temperatures researchers could once only dream of.

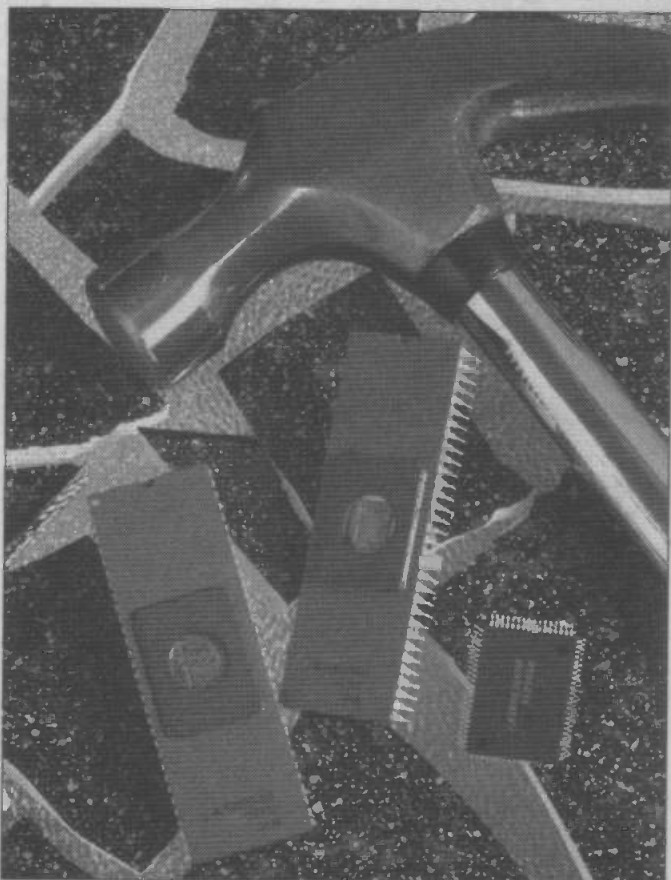
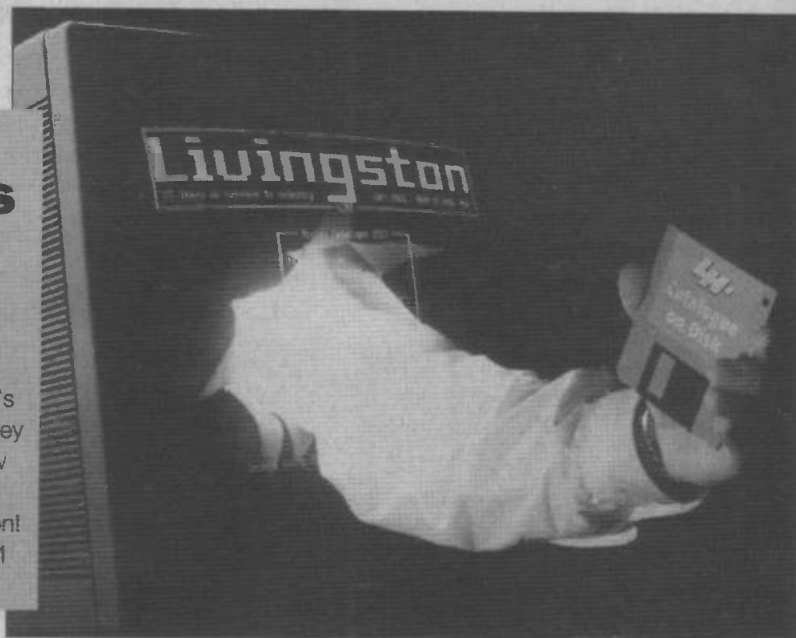
Because pressurising these superconductors is not technically feasible, Chu's team is seeking to duplicate this transition temperature enhancement effect at ambient temperatures using chemical means. One possible route, for example, is to replace the mercury with other elements that have linear oxygen co-ordination and/or a valence of 3 or less.



Disk based catalogue simplifies equipment rental

The well known electronic equipment rental company, Livingston Hire, has taken the unusual step of producing its rental catalogue on disk for PC users. This idea should enable users of the company's services to quickly and easily select the equipment they need. The disk also includes up to date details of new products available for rental and new services.

Catalogues on disk is an idea which could catch on! For more information, contact Livingstone Hire on 081 943 5151.



New microcontrollers from Mitsubishi

Mitsubishi has expanded its 38000 Series range of 8 bit microcontrollers to give a range of devices that should suit the needs of every designer. The 'mix and match' RAM and RAM concept range now incorporates devices carrying between 8 and 48Kb of ROM, with up to 1Kb of RAM.

The Series can be divided into three main groups - general purpose, VFD and LCD controller types. Features include a simple instruction set with 71 basic instructions, together with ROM, RAM and I/O addresses residing in the same memory map for easy programming. The single chip CMOS microcontrollers boast fast instruction times and the

devices operate from power supplies between 2.5 and 5.5V, according to type

On chip functions include 16 vectored interrupts with up to 7 external interrupts and four 8 bit timers, three 8 bit prescalers, plus one USART and between 58 and 74 programmable I/O lines. On some chips, internal A/D converters are also provided offering 8 bit successive approximation conversion, with conversion in 50 clock cycles. The 8 bit DAC is an R-2R ladder network with external reference voltage. Clock rates are up to 6.8MHz.

For more information on the 38000 Series microcontrollers contact Mitsubishi in Hatfield, Herts, on 0707 276100.

Quantum, Connor roll out new disk drives

Two leading US manufacturers of disk drives, Connor Peripherals Inc., and Quantum Corp., have launched a new range of 2.5 and 3.5in models.

Connor has unveiled 2.1 and 1Gb 3.5in drives for use in servers, RAID subsystems and workstations. The two models, both in the Filepro

range, have average access times of 9 and 9.5ms and consume 6.6 and 9.6W whilst idling.

In the 2.5in notebook-systems market, Connor has unveiled 340, 250 and 170Mb drives that weigh only 7oz apiece. They consume 1W while idling and have average seek times of

12ms. Shock resistance is higher than in most other drives - 300Gs in a non operating mode.

Quantum, for its part, is sticking to the desktop with an inch-high drive that stores 1.08Gb. The firm, which unveiled a 2Gb product a few months ago, says that the new member of

its drive family has a 5,400 rpm rotational rate and a 9.5ms average seek time. Power consumption is 7.5W at a 30 per cent seek level, one of the lowest in the industry, Quantum said. While idling, the power rating is 6W.

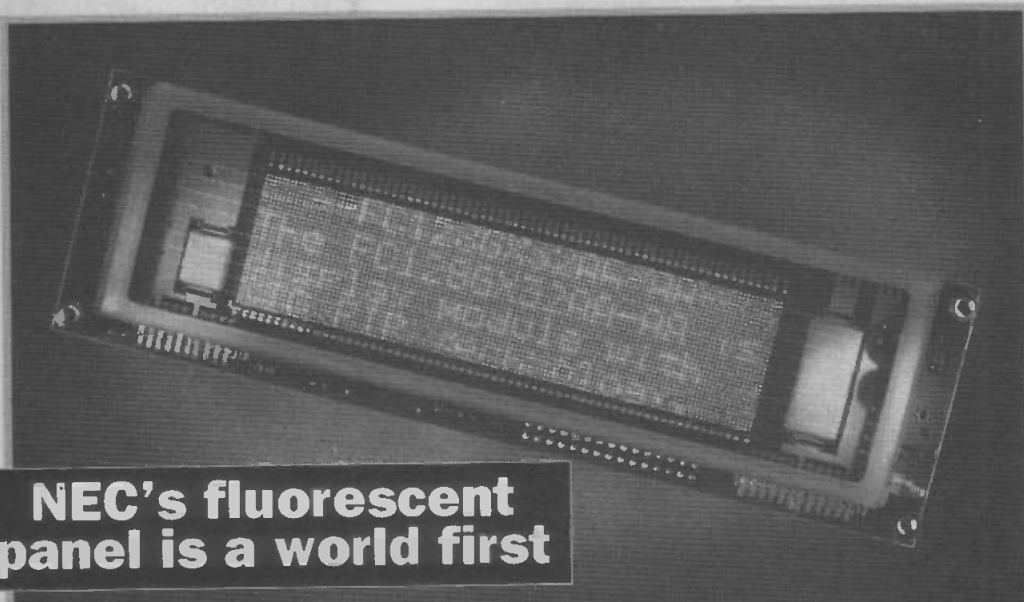
Multichip module

A device claimed to be the world's first electro-fluidic multichip module should have a big impact in areas such as instrumentation and process control. The tiny modules, which link several silicon micro-machined components, control fluid flow from 0.1 to 1,500 cc/min (20psid) with an accuracy of 1% full scale.

Redwood Microsystems Inc., of Menlo Park, California, the firm behind these new devices, says the modules are smaller, more accurate and less expensive than regulators normally used to control non-corrosive gases in analytical and medical instruments.

Each module contains a silicon micro-machined sensor, drive electronics, flow

connectors and one of Redwood's patented Fluistors, a new type of microvalve etched in silicon. When combined with Redwood's analogue control boards, the modules facilitate the design of closed-loop proportional controllers that precisely regulate pressures from 0-30 and 0-100psig.



NEC's fluorescent panel is a world first

NEC Electronics' new chip-in-glass fluorescent indicator panel is the first such display to include the driver ICs on the display substrate, dramatically reducing the module size and the number of lead terminals. Thus the new 128 x 32 dot graphics fluorescent indicator panel is 60% smaller and has just 22 lead terminals, as opposed to 198 for the conventional types.

These new displays will be used in applications such as industrial and medical equipment, office automation, alarm panels, test instrumentation and data terminals. Applications where smaller size and increased reliability are important.

The display module includes an 8 bit microcomputer, a character generator, power supplies and reset circuitry. The microcomputer

reads, stores and edits the display data, and generates all timing signals. The character generator transforms the microcomputer output into 5 x 7 dot patterns. The power supplies change the 5V module supply into power for the anode, grid and AC for the display filaments.

For more information contact NEC Electronics in Milton Keynes, on 0908 691133.

Motion computers

Motion computers, designed for specific motors, are changing the face of automation. Faster chips not only provide more accurate moves, but they also generate profiles that are nearly impossible using mechanical means alone. Two such chips, one for servos and another for stepper motors, are now being marketed.

One chip, actually a chipset, is from Performance

Motion Devices Inc., of Chelmsford, Massachusetts. The DSP-based MC1401, one of the most advanced servo-control chipsets for its price, offers 32 bits of compute power for calculating position, velocity, acceleration, and jerk. Its four built-in profile modes, trapezoidal, velocity-contouring, S-curve and electronic gear - let it generate practically any complex move in real time.

Input features include support for an increment encoder with index pulse, two directional limit switches and a home signal. The chipset

also features a choice of two digital filters - PID and PIVf (velocity feed forward) - and a period register that stabilises the response at low speeds. All filter and profile parameters can be changed on the fly to facilitate multi-axis synchronised motion, based on pulse-width modulation or 160 bit D/A converter compatible motor output signals.

For stepper motors, the new model is the SMC-50, a single-chip microcontroller from Advanced Micro Systems Inc., of Nashua, New Hampshire. The SMC-

Ground breaking digital video recorder from Samsung

Using green light laser technology, developed by the Russian military, the Korean electronics giant Samsung has designed a revolutionary magneto-optic erasable CD, which has sufficient capacity to store a full length film on a single disk. As a domestic TV recording technology it looks likely to set a new standard which will make obsolete conventional VHS tape systems.

Each side of a standard 13cm CD will be able to record 55 minutes of video, about 25Gb of data per side. This is an enormous increase on conventional CDs, which store 600Mb on just one side. The increased capacity is due to the much smaller track dimensions, made possible because green laser light has a much shorter wavelength than that of the infrared lasers used on standard CDs.

50 calculates up to 50,000 steps per second. It supports full, half and microstep drivers, providing absolute or relative position commands with Independent ramping in either direction (accelerating or decelerating).

Three-in-one cycle computer from Maplin

Maplin has launched a new product which should be of considerable interest to cycle owners. It is a compact multifunction computer which displays time, speed and distance on a 33 x 23mm LCD display. Speed and distance are calculated from the output of a wheel mounted sensor, making allowance for wheel size.

The time function can also be selected to provide a 24 hour clock, a journey timer, or a trip timer. The speed function can be selected to give actual speed, average speed, or maximum speed and the distance function can be selected to give trip distance or total distance.

The system is easily fitted, being provided with a



handlebar mounting base and the main unit can be easily removed for security. The cycle computer can be

obtained from any Maplin shop or by mail order price £19.95. Maplin can be contacted on 0702 554161.

Prototype superconductor to be built

The US Department of Energy has awarded a major contract for a two year project to an industry team that will build and demonstrate a novel superconducting current limiter prototype device for use by electric utilities.

The DOE, under its Superconductivity Partnership Initiative, will give \$2.3 million to a collaborative team from General Dynamics Space Systems Division, American Superconductor Corp. and Southern California Edison Co. The

remaining \$1.1 million will be provided by the partners. In addition, Los Alamos National Laboratory will receive funding under a separate agreement to provide technical support.

A current limiter protects expensive electrical equipment by momentarily reducing the flow of excessive current caused by short circuits, lightning strikes, or common power fluctuations. Incorporating newly developed high temperature superconducting wire tech-

nology in the prototype current limiter will allow utilities to use smaller, less expensive circuit breakers and fuses, thus lowering their replacement cost.

Southern California Edison Co. estimates it could save \$7.5 million a year by using the superconducting current limiter in its power grid alone. U.S. utilities potentially could save \$100 million per year.

Fast PC based analogue simulation

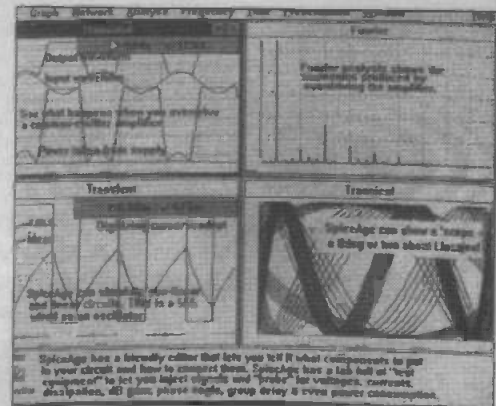
The new version of the analogue circuit simulation software, SpiceAge, from Those Engineers Ltd is over 55% faster and is believed to be the fastest Windows based simulator available today.

The new version, V2.080, offers users some important new features including a DDE interface (supported by a self running demonstration/batch running utility), extra SPICE compatible .MOdels, and even better links to the GESCA schematic entry system. There are also a great many other improvements and additions.

SpiceAge for Windows has been written by British author Graham Baxter and produced by Those Engineers Ltd, a company that has specialised in circuit simulation software

since 1982. It gives users access to a 'lab full of test equipment', which can be used to test analogue circuit designs. Users can inject signals, and 'probe' for voltages, currents, dissipation, dB gain, phase angle, group delay, and power consumption.

For more information on SpiceAge, contact Those Engineers Ltd on 081 906 0155.



March of the micromachines

Around the world, increasing amounts of money are being spent on the techniques for developing machines with dimensions measured in millionths of a meter.

These micromachines are built using the same techniques employed to construct

integrated circuits. They are made from silicon using lithographic and etching techniques and can contain dozens of minute mechanical components, even microscopic electric motors, as well as electronic circuitry.

So convinced are researchers in the United

States of the future importance of these micromachines, that the government, through the Advanced Research Project Agency, has provided significant support for one of the world's leading micromachine research centres, the Microelectronics Center of

North Carolina or MCNC.

The MCNC was set up over 13 years ago to develop advanced semiconductor technology. Already it has produced devices for fifteen separate clients, ranging from defence contractors to a high school, and with expenditures starting as low as \$500.

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Board Maker

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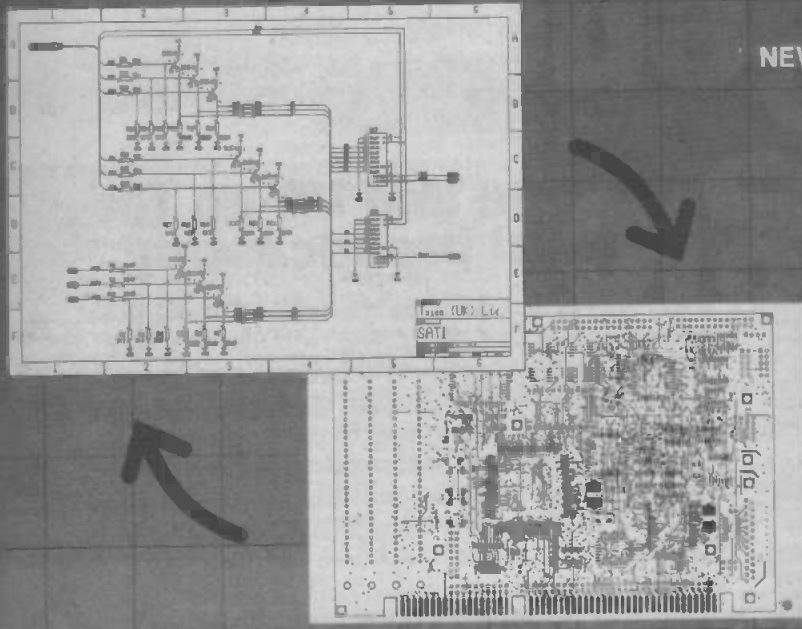
- PCB and schematic drafting
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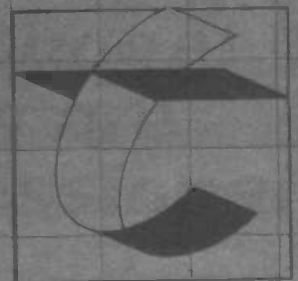
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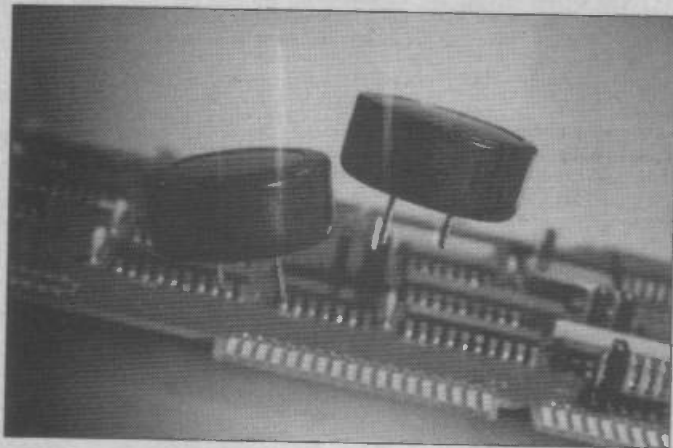
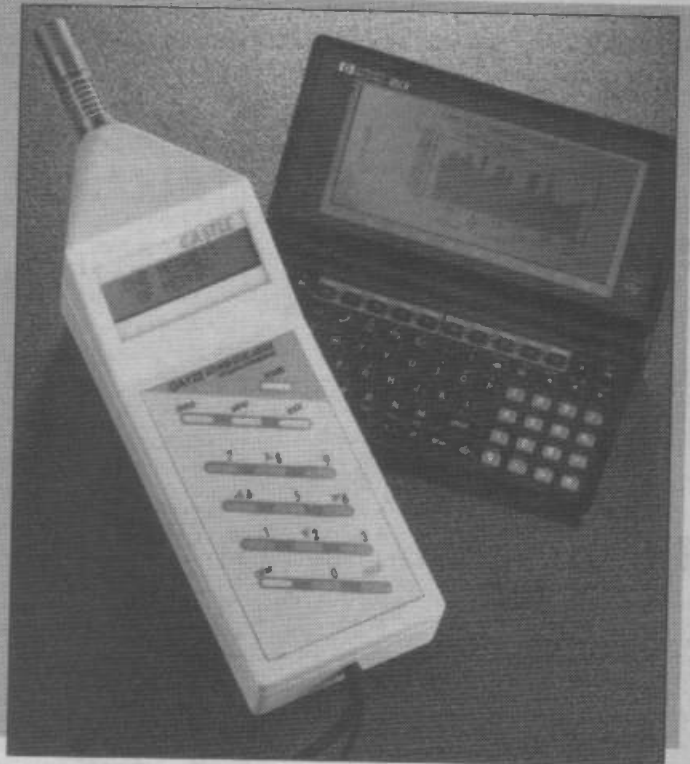
Environmental noise analyser from Castle

Environmental noise is now widely accepted as being one of the most pervasive and aggravating forms of pollution. To help monitor noise pollutions and provide an analysis of it, Castle Associates of Scarborough has launched a new portable Noise Analyser, the GA122.

This hand held device can perform a wide range of different noise measurements using its built in microphone. It is fully waterproof and features a large 32 character display, which is backlit to allow operation in the dark.

The GA122 has one megabit of internal memory for data logging and this is backed up by a lithium battery, which should provide up to five years memory retention. This data can be downloaded to a PC via an RS232 link, and then formatted on the PC to a suitable style and format, using dldata 4W for Windows, a computer package specifically designed by Castle for the GA122.

The GA122 Logging/Integrating Sound Level Meter costs £2,680 complete with software. For further details contact Castle Associates on 0723 584250.



Capacitors as a source of backup power

Electronics giant NEC has just launched a range of capacitors which have been specifically designed to provide backup power for devices such as random access memory chips.

The new Supercaps family have capacitances as high as 3.1F and are currently available in 5.5V and 11V versions. Since a CMOS system only requires tens of microamps to operate in standby mode, it is thus possible to replace a stand-by battery with a large value capacitor to provide enough power to cover even prolonged power supply failure. Thus, a 256Kbit RAM can, according to NEC, be supported for 50 hours by a 2.2F Supercap.

Reserve power supplies based on capacitors are easier to implement than battery based supplies. The capacitor simply being connected across the supply with a current-limiting resistor and diode to isolate it from the primary power supply. It is also a lot more reliable, as a capacitor will stand an infinite number of charge/discharge cycles, while a NiCd battery will survive only a few hundred.

For more information on Supercaps contact NEC on 0908 691133.

New lab power supply from O & S

From Cheshunt based O&S Laboratory Products, comes a new stabilised electronic power supply which provides a voltage range of 0-30V DC continuously variable, together with an amperage range of 0-3A. The ranges are

indicated in either analogue or digital display.

The unit is mains powered and comes with a carrying handle to make it easily portable. For further details contact O&S Laboratory Products on 0992 637373.

Europe and US go for digital broadcasting.

Over the last eight years, the EEC and Europe's big TV manufacturers, the likes of Philips and Thomson, have invested around £500million in the development of high definition television (HDTV). The European development was aimed at creating a standard system based on traditional analogue broadcasting technology, an approach followed by the Japanese with even greater investment.

The US government and US consumer electronics companies started development of HDTV at a later date than the other two main players, and they also took a different approach. What US developers have done is look at an entirely new way of broadcasting TV images - the use of digital technology. This approach allows TV broadcasting to be merged with computing and telecommunications technologies.

It has been so successful that the European companies and their backers in the EEC have now abandoned their previous proposals in favour of a digital system, similar to that developed in the US. Even the Japanese are now acknowledging that they have made a fundamental mistake and are embarking on a crash development of a digital HDTV system.

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- * Data cable included in price.
- Shugart 800/801 SS refurbished & tested £175.00(E)
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- Telebox RGB for analogue RGB monitors (15khz) £69.95

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RGB Telebox also suitable for IBM multisync monitors with RGB analog and composite sync. Overseas versions VHF & UHF call. SECAM / NTSC not available.

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286 AT - PC286



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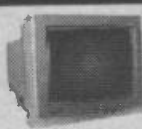


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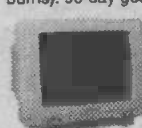
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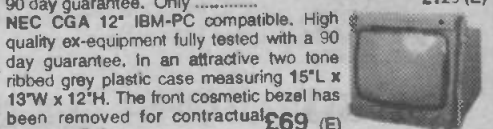
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AMSTRAD DMP4000 Entire printer assemblies including printhead, platen, cables, stepper motor etc. Everything but the electronics and case. Good stripper! Clearance price just £5 REF: MAG5 or 2 for £8 REF: MAG8

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1994 CATALOGUE OUT NOW

The Spark of Ingenuity

People all over the world are becoming increasingly aware of the impact that modern society is having on the environment, an impact which ranges from the effect of vehicle exhaust pollution, to the destruction of the protective ozone layer and global warming, from excessive reliance on fossil fuels, to the problem of excessive noise.



It has to be said that most of the problems we now face with environmental destruction and pollution of one sort or another are directly attributable to a combination of technological development and over population. But it must also be said that they are problems which can be overcome with the aid of human ingenuity and the application of technology.

Alternative energy to the rescue?

Probably the biggest impact on the environment comes from the enormous use of energy in a modern technology based society. Energy for transport, for heating, for powering all the gadgets which we take for granted in our homes and workplace. Energy which we use inefficiently and which comes from mineral resources which are not replaceable.

Inefficiently used fossil energy is a prime polluter, leading to hydrocarbons and CO₂ in the atmosphere, acid rain, etc., but this is something which technology can help to solve. We can create systems which use energy more efficiently, and we can create systems which generate energy using renewable non-polluting resources. So called alternative energy sources.

Some of the most important sources of alternative energy are the wind and the sun and efficiently harnessing these energy sources is a subject which has attracted a lot of research over the last few years. Solar energy systems to have become much more efficient and dropped in price enormously, the same has been true to a lesser degree for wind power. Indeed, the amount of research has been sufficient that both solar and wind power systems are now serious contenders for power generation in many parts of the world, particularly the more remote areas.

In the last decade wind generators have more than doubled in efficiency and their cost has been reduced by a factor of three. Solar energy systems have seen their efficiencies more than quadrupling, and the cost of generating a unit of solar electricity dropping by over 90%.

However, increased efficiency and declining costs have not been sufficient to promote the mass building of solar and wind power plants, and are unlikely to do so for many years to come. The reason is that not all parts of the world are suitable for siting such alternative energy power plants. Also, they require a lot of land on which to place large solar arrays, or windmill farms. This means that they need to be put in remote areas,

far away from the centres of human habitation and thereby incur enormous overheads in both cost and power loss in power transmission between the generating site and the users.

What this means is that the use of alternative energy will be different to the use of more conventional energy. Instead of having large centralised power plants and a national grid of electricity transmission lines, alternative energy power plants will be much smaller and tailored to the needs of the individual or the local community. Every house may have its own wind generator and/or solar panels, power sources which, with good insula-

costing a few hundred pounds can provide enough power for a caravan, or considerably cut down domestic electricity bills. On a smaller scale, these technologies could be used to provide lighting, and limited power, for a garage, garden shed or greenhouse, etc.

There is no reason why we should not all have some form of alternative energy generation system. For a modest outlay we can save money (it takes about ten years to pay back the cost of an alternative energy system, after which all the power it generates is free!), and also do our bit to improve the environment by reducing our reliance upon fossil fuels.



tion and increased efficiency, should be adequate to provide a large percentage of the energy requirements of a household. Indeed, in Denmark, one of the world's leading users of wind power, over 2% of the national power requirement is already met by home based wind generators.

It is the fact that alternative energy systems are probably best applied on a small scale that makes them of particular interest to the electronics hobbyist. A wind generator or solar panel

But don't expect to find such equipment in high street shops, they are not yet considered 'commercial products'. Instead you will have to sit down and design and build your own.

Electricity from wind.

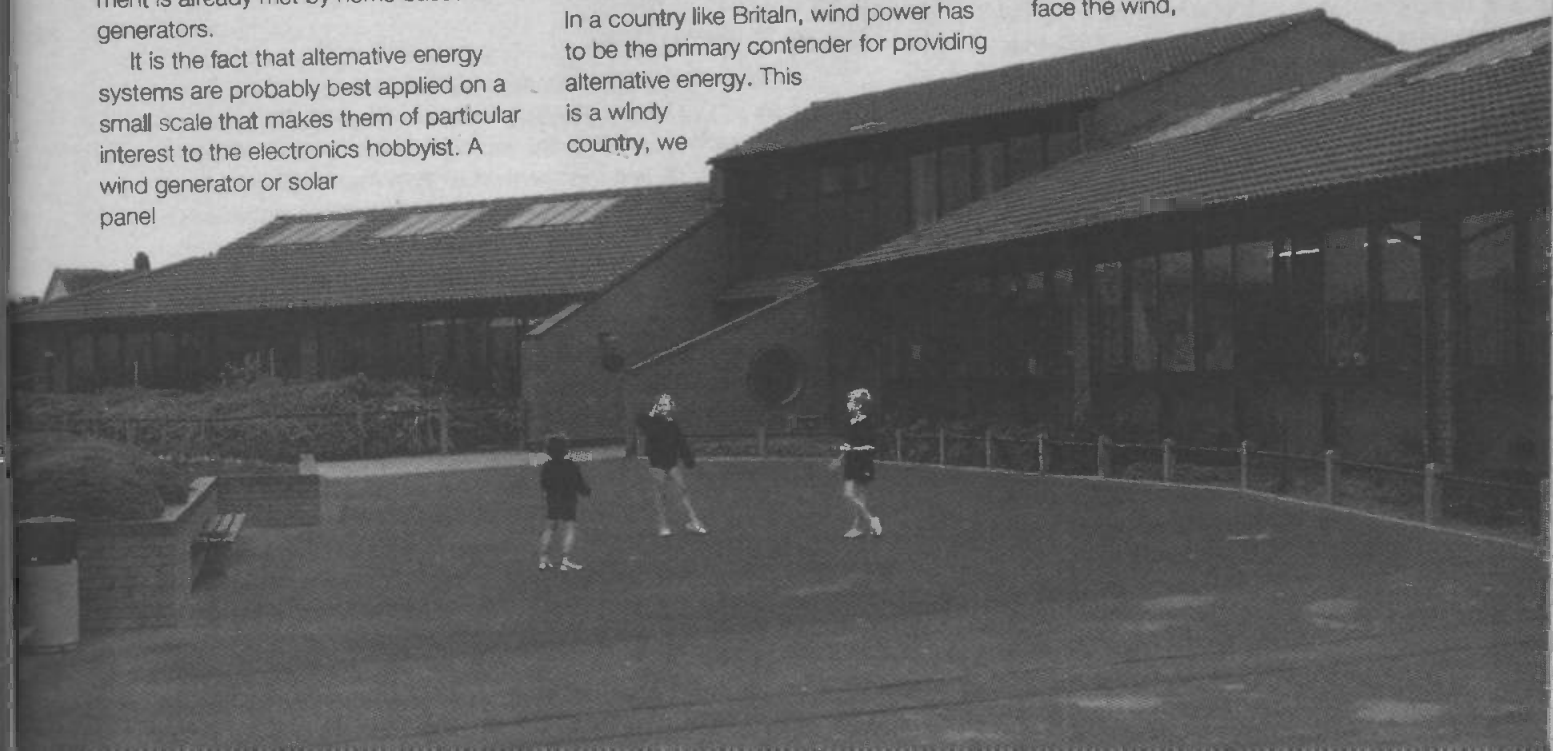
In a country like Britain, wind power has to be the primary contender for providing alternative energy. This is a windy country, we

receive over 40% of Europe's total wind energy potential. Already there are commercial wind farms generating electricity for the National Grid. These can be found in the remoter parts of the UK, in Cornwall, Wales and Scotland, and include one of the largest wind turbines in the world.

So how do we convert wind energy into electrical energy? The answer is, of course, our old friend the windmill. Not the windmills of Don Quixote, Texas ranches, or Dutch paintings, but modern high efficiency designs, based on aerodynamics and computer simulations. Instead of grinding grain or pumping water, these modern windmills are turning high efficiency generators to produce electricity.

The design of a modern windmill, or wind turbine as we should more correctly refer to it, is intended to extract the maximum energy from the wind while at the same time not succumbing to potentially disastrous problems such as vibration. Since the power output from an electrical generator increases in relation to the speed of the shaft's rotation (up to a maximum design level) it is important that the design works at as high a speed as possible in light wind conditions, while at the same time being able to withstand gale force winds.

The wind turbine can have a rotational axis which is either horizontal or vertical. The traditional windmill has a horizontal rotational axis with two or more propeller type blades. Vertical rotational axis wind turbines are much more recent and unfortunately still prone to structural and control problems, and are also less efficient than the traditional horizontal turbine. The only drawback with a horizontal axis system is that it must always face the wind,



although the traditional use of a wind vane is more than adequate to ensure correct positioning.

The favourite configuration for a modern wind turbine is to have two blades since, this produces the highest rotational speed. The blades have an aerofoil section, much like an aircraft wing. Indeed some of the larger wind turbines look rather like a rotating glider. The ideal design will achieve a balance between maximum lift and minimum drag, with the aim of ensuring stability and a rotational speed which is about ten times faster than the wind speed. They are also designed to start producing power with wind speeds of just under 4 metres per second, considerably less than the average annual wind speed for any part of the UK.

The mechanical power output from a given turbine is proportional to the square of the blade diameter. This means that a 6ft diameter turbine will actually produce four times as much power as a 3ft diameter turbine. However, electrical power output is also proportional to the rotational speed of the turbine. This means that in order to



achieve maximum electrical power output, it is usually necessary to use gearing to increase speed, with consequent power losses due to friction, etc.

The problem with wind is that it is a variable energy source. In still air, even the most aerodynamically efficient turbine will hardly be rotating, whilst in a gale it may be rotating at a dangerously high speed. This means that on all but the smallest wind turbines, some form of control is required to protect the system from damage in high winds. On large

commercial turbines this control is provided by a computer, which amongst other things will feather the turbine blades, on small systems some form of manual or automatic clutch mechanism is essential.

Solar electricity

The big problem with solar energy as a source of alternative electrical power in the UK is that we have so few days per annum of bright sunshine. Modern solar cells will actually generate power output

The economics of alternative energy

As we have already seen, the complete system generating, storing, and outputting electricity in a usable form is quite complex, irrespective of whether the power is being generated by the sun or the wind. We can divide this system into four components - the generator, the power regulator, power storage and power output inverter. In order to consider the overall cost of a complete system, we need to look at the cost of each of these components.

If we look at designing a power system capable of delivering a mains voltage with a maximum power rating of 100W for at least seven hours per day, in other words, sufficient to light one medium power light bulb, run a small TV, fridge, computer, etc., then to calculate the cost we need to work backwards, and start with the inverter. A suitable solid state inverter with this sort of rating could be built for about £50, the major cost being the transformer. Savings can be made if one can be salvaged from other equipment.

The inverter draws its power directly from the batteries and these have to have sufficient capacity to cope with continued power use over periods of no sun or wind. In practical systems this means that the batteries should

have a reserve of about five to ten days power consumption. We can calculate the total usable capacity for a 12V battery system as follows:

$$Ah = Wh \times T/12v$$

where Ah is the total usable capacity needed in Amp hours at 12V, Wh is the daily power requirement in Watt hours per day, and T is the storage period in days. In the case of our design requirement of 700Wh per day and five days reserve, the total usable capacity is 291 Amp Hours.

From this we can calculate the total number of batteries needed using the following formula:

$$N = (Ah \times 100/F)/D$$

In the previous equation, F is the full capacity specified for one 12V battery in Amp hours, and D is the maximum depth of the charge cycle in %. With the above design requirements, we need 4.4 12V lead acid batteries, where each battery has a total capacity of 110Ah and can be discharged to a depth of 60%.

The depth of the charge cycle is important. Batteries used for storage will probably spend long periods on partial charge, with consequent reduction in capacity of

Silicon solar cells

The majority of commercial solar cells are made from monocrystalline silicon that has been doped with boron. The thin slices of silicon, each about five inches in diameter, which are cut from the monocrystalline block are then exposed, in a furnace at 1500C, to a gas containing phosphorus. This creates a pn near the surface, between the boron doped substrate and the thin phosphorus doped surface layer. It is this pn junction which gives the slice of silicon its photovoltaic property of converting light into electricity.

After this treatment in the furnace, a network of metal strips is attached to the surface of the slice of silicon. This network forms the contact while a layer of metal on the back of the cell forms the positive contact. An anti-reflective coating is put on the front of the silicon slice which is now a solar cell ready to be mounted into an array.

Another type of silicon used to

make solar cells is polycrystalline silicon. This is slightly less efficient at converting light into electricity, but is much cheaper to manufacture. It is easy enough to tell the difference between the two types by looking at them. Monocrystalline silicon solar cells have a uniform blue colour, whereas polycrystalline cells will show an irregular pattern, like that seen on a galvanised iron bucket.

There is, in addition, a third type of silicon solar cell which is gaining considerably in popularity, the amorphous silicon cell. Amorphous silicon, containing a small amount of hydrogen, is deposited on a conductive glass substrate, then doped in a furnace before having the other conductors added. This type of cell is much cheaper to make than the other two types and, although it has a lower efficiency, it can be made in much larger sizes, cells measuring 6 x 12in are not at all uncommon.

on quite dull days, but the power produced will only be a few percent of that produced on a bright sunny day. However, solar cells do have one major advantage over any other alternative energy source of electricity. This is that they are all solid state, with no mechanical components and thus extremely reliable, robust, and compact. Ideal for use

in remote sites, such as unmanned light-houses and telephone exchanges.

At the moment, there is only one real contender for the generation of solar electricity, the silicon solar cell (see box 2). Other types of solar cell under research are based on semiconductors, such as Gallium Arsenide and Cadmium Sulphide. Technologies based on organic

pigments and an oxygen/hydrogen/water cycle incorporating fuel cells are a possibility for the more distant future.

A typical 4 x 2.5in monocrystalline solar cell will generate nearly 1V at 1/2A in full sunlight. Amorphous silicon solar cells have a lower efficiency, but single cells can be much larger. A typical amorphous cell might measure 12 x 6in and output 12V at 125mA. With both types of cell, higher voltages are generated by connecting numbers of cells in series and in parallel.

A typical solar electricity system thus consists of a number of cells wired together on a watertight, weatherproof panel, placed in an open sunny position. In the UK such a panel must be faced towards the south and inclined at an angle so that it faces the sun and receives the maximum solar energy input (a rule of thumb is that the angle of tilt should be about the same as the angle of latitude for the site).

Alternative energy systems.

The actual power generating component, in both wind and solar electrical power generation, form just one part of a larger system. The overall system must be able to generate electricity, store electricity so that it is available when needed and convert the low voltage DC battery output into a 240V AC mains output, which can be used by domestic and commercial equipment.

In a wind generator system the output

lead-acid batteries due to sulphation. As a result, it is advisable to use only high quality lead-acid lead acid batteries with a depth cycle less than 50% or vented nickel-cadmium batteries.

Using the above calculations we will need about 5 batteries. Depending on the source and whether they are new or second hand, these will cost at least £120 and perhaps as much as £300. This represents a considerable portion of the total investment in an alternative energy system.

Next, we come to the power regulation electronics. This just consists of a rectifier and voltage regulator, so, given the fairly low voltages and power ratings involved, can be constructed for just a few pounds.

Finally we come to the actual power generation part of the system. Here, the average power generated per day should balance the average power used per day with suitable allowance for losses during conversion and storage. So if we are using 700Wh per day, we will need at least 800Wh per day of generating capacity. Since wind power operates 24 hours per day, we are looking at an average power generation capability of about 36W. With solar power the practical generation period could be as little as three hours per day, leading to a requirement for a generating capability of about 200W.

With commercial solar panels costing in the region of £7 per watt of generating power, this means that our solar power system will cost about £1400 for the solar panels. Added to this is up to £250 for batteries, and £60 for other electronics and we reach a minimum system cost of at least £1710, not counting the cost of cables, mounting wood/metal work and labour for installation.

Given a workshop and the ability to make things, a suitable wind generator could be produced for about £100. A vehicle alternator could be used as the generator, the turbine blades can be made from plywood and the gearing can be achieved with the aid of a belt and pulleys. The total cost of a home made wind generator would be between £300 and £400.

Now we come to calculating the actual cost of the electricity generated by such alternative energy systems. Both are producing 0.7kW of power per day, or 0.7 units of electricity. With a single unit of electricity costing about 7.4 pence, this gives a payback period for a solar system of over 62 years, hardly what one would call an economic proposition, more a labour of love or conviction. A wind generating system, on the other hand has a payback period of just over ten years and, as such, is within the bounds of being an economic proposition as well as something one can do to help the environment.

from the generator will be a variable AC current, voltage and frequency, with output changing as wind speed and generator rotational speed changes. Because there will be times when there is no wind, or the amount of electricity being generated is insufficient to meet transitory power requirements, a battery must be used to store surplus power output. Such a battery system is connected across the power lines and in effect trickle charged, but power cannot be taken directly from the electric generator. It first needs to all be converted to DC by passing it through a rectifier and then have the voltage regulated so that there is no danger of applying excessive charging voltage to the batteries.

The batteries will probably store power at either 12 or 24V and some users of alternative energy systems make do with a low voltage DC power system. However, it is far more convenient to be able to use standard mains voltage equipment and this means converting low voltage DC into high voltage AC. Nowadays high efficiency (about 90%) solid state circuitry is used in inverters, as opposed to the old use of a motor/dynamo couple. An inverter basically just switches the DC input off and

on at 50Hz and feeds it through a transformer, which converts 12V into 240V. Simple inverter circuits output a square wave, as opposed to the sinusoidal wave seen in standard AC mains power.

With solar power there is no need to rectify the voltage input from the solar cells, since it is already DC. Otherwise, there is exactly the same requirements for voltage regulation, battery power storage and, finally, the creation of 240V AC power by an inverter.

Is alternative energy practical?

The answer to this question has to be a qualified yes. In remote areas, alternative energy generation systems offer us the best way of bringing electrical power to individuals and communities located in such places. In densely populated cities, alternative energy is less economic and less practical. There is little room for siting large wind turbines or solar cell arrays, and placing them well away from the cities leads to power transmission losses.

But in a country like the UK, with large areas of suburban housing there is probably considerable scope for very small scale alternative energy generation

systems attached to individual houses. If individuals in Denmark can produce over 2%, and rising, of the national power consumption then individuals in the UK can certainly do the same. It is an area which offers considerable scope for commercial development, and for the ingenuity of the individual.

Further information.

To find out more about the practical aspect of alternative energy systems, it is well worthwhile contacting the Centre for Alternative Technology, in Machynlleth, Powys.

For more information on the commercial aspect of renewable energy, contact ETSU for the Department of Trade and Industry at Harwell, Didcot, Oxfordshire.

There is a good practical book on solar energy called *Solar Electricity* by Simon Roberts and published by Prentice Hall. You could also refer to the large number of articles which have appeared over the last decade, in virtually every science and technology related publication.

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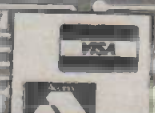
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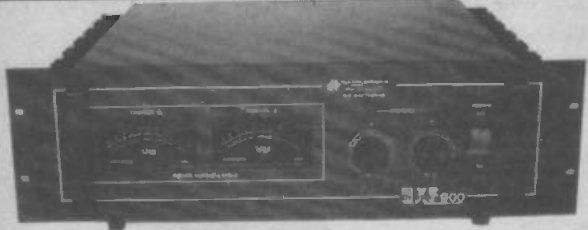
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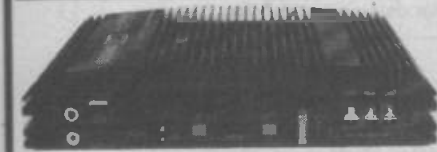


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OMP/MF 200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 50V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 155 x 100mm. PRICE £64.38 + £4.00 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. PRICE £259.00 + £12.00 P&P

NOTE MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS: STANDARD - INPUT SENS 500mV, BAND WIDTH 100KHz. PEC (PROFESSIONAL EQUIPMENT COMPATIBLE) - INPUT SENS 775mV, BAND WIDTH 50KHz. ORDER STANDARD OR PEC.

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- 12" 200 WATT R.M.S. ME12-200 GEN. PURPOSE, GUITAR, DISCO, VOCAL, EXCELLENT MID. PRICE £46.71 + £3.50 P&P
- RES. FREQ. 58Hz, FREQ. RESP. TO 6KHz, SENS 98dB.
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- RES. FREQ. 40Hz, FREQ. RESP. TO 5KHz, SENS. 99dB.
- 10" 100watt EB10-100 BASS, HI-FI, STUDIO. PRICE £30.39 + £3.50 P&P
- RES. FREQ. 35Hz, FREQ. RESP. TO 3KHz, SENS 96dB.
- 12" 100watt EB12-100 BASS, STUDIO, HI-FI, EXCELLENT DISCO. PRICE £42.12 + £3.50 P&P
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- RES. FREQ. 38Hz, FREQ. RESP. TO 20KHz, SENS 94dB.
- 8" 60WATT EB8-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. PRICE £12.99 + £1.50 P&P
- RES. FREQ. 40Hz, FREQ. RESP. TO 18KHz, SENS 99dB.
- 10" 60WATT EB10-60TC (TWIN CONE) HI-FI, MULTI ARRAY DISCO ETC. PRICE £18.49 + £2.00 P&P
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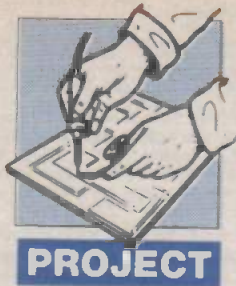
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A low cost Non-volatile RAM programmer for micro-processor developers by Jason



ProgRAM

When developing code for stand alone micro processors, some form of EPROM emulator makes life a lot easier. Battery backed RAMs can be used in place of EPROMs, but programming them can be a problem.

This is because most programmers first check that the memory is blank and refuse to continue if there are not, but ProgRAM provides a very low cost solution to this problem. It is designed to be plugged into the PC parallel printer port, although it should also operate from most parallel printer ports with the appropriate cable.

Centronics Parallel Printer Port

Lets first look at the connection between the ProgRAM circuit and the computer. The standard Centronics printer connector is a special 36 way connector. Most PC compatibles, however, use a 25 way D-type connector. The pin out is shown in Figure 1. This unit connects directly to the 25 way connector.

To restrict the flow of information to slow mechanical printers, handshaking is used. First, assuming Busy is low, the data is placed on the data lines D0 to D7. Strobe is then taken low momentarily by the PC. The printer can latch the data on the falling or rising edge of this signal. The printer then takes Busy high until it is ready for more data. At this point ACKnowledge is pulsed low. This signal is useful for triggering an interrupt.

There are three other important signals. PE is taken high when the printer is out of paper. SEL is pulled high by the printer. ERR is taken low when an error occurs, e.g. out of paper, off line, jammed, etc.

How It works

To extract data from the printer port all the unit needs to do is assert the correct handshake signals. Figure 2 shows the handshake procedure and Figure 3 shows the circuit. The falling edge of strobe sets an SR flip-flop (IC2a), the output of which is connected to the Busy line. On the rising edge of strobe, the data is written into the NVRAM. The rising edge also triggers a monostable (IC1a), which produces a 10µS pulse. The falling edge of this pulse increments the address counters (IC4 and

IC5), and also causes the Busy flip flop to be reset. In turn, the falling edge of the Busy line causes monostable IC1b to generate a 10µS ACK pulse.

The address counter is formed from IC4 and IC5. These dual 4 bit counters are connected to form a 16 bit counter, the high bit of the previous counter being used to clock the next counter.

ERR, SEL and /PE are tied to the appropriate levels, as described above.

The unit is reset by pressing S1. This toggles the Chip enable line of the RAM and resets the address counters to zero. When D2 is alight, the RAM is enabled.

A Switch Is included, so 8Kb or 32Kb RAMs can be programmed. Close switch S2a and open S2b for 32Kb or vice versa for 8Kb RAMs. Some PCs

have printer ports which can be programmed as inputs. If you know how to program them, it is possible to read ROMs with this unit by switching S2d on and S2c off (S2d off, and S2c on, in normal operation).

Construction

Construction is relatively straight forward if the PCB shown in Figure 4. is used. Insert the components in ascending size order and, when assembled, check the board for shorts caused by excess solder. Make sure the DIL switches are in the position required.

The type of ZIF socket used will depend on how the unit is to be cased, but the unit can be used without a box to keep the price low. In this case take care when purchasing the ZIF socket. The socket used in the first prototype was made by Harwin. The IC is locked by pushing the lever to the right

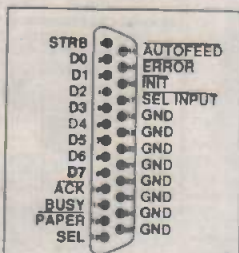


Fig.1 Centronics parallel port

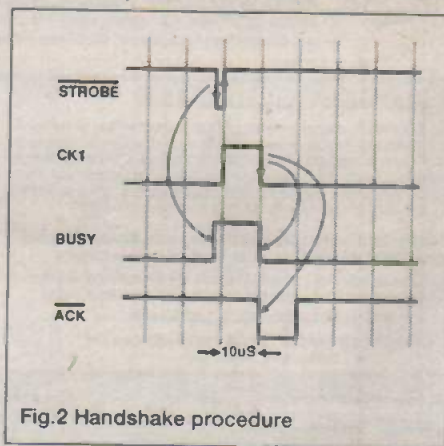
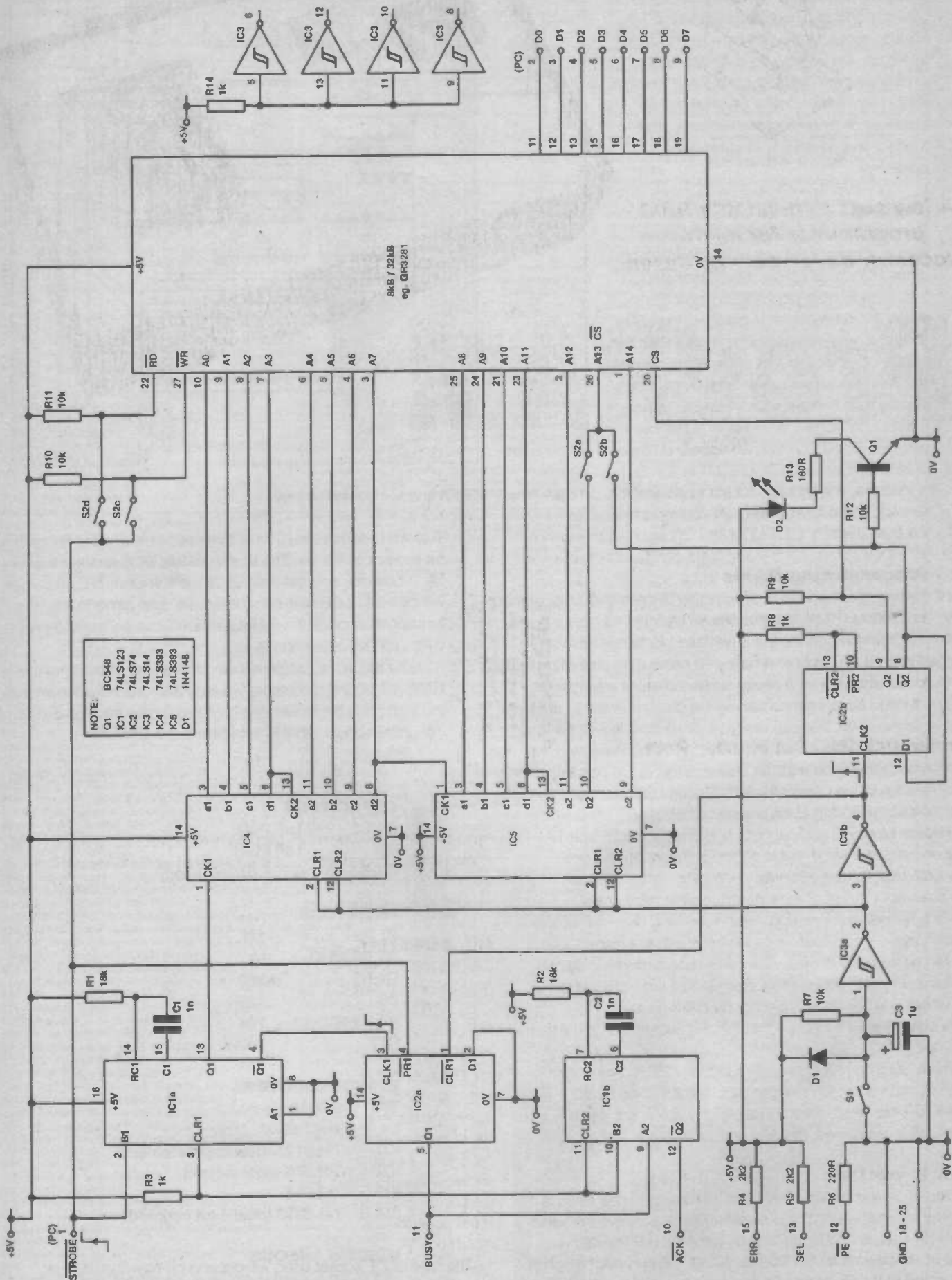


Fig.2 Handshake procedure



NOTE:
 IC1: BC548
 IC2: 74LS123
 IC3: 74LS93
 IC4: 74LS281

Fig.3 Program circuit

although some ZIF sockets, such as the one made by Textool, lock using a lever with upward motion. This type may catch on the 25 way socket. If the unit is to be mounted in a case, the ZIF can be elevated, so it protrudes from the front of the case, using a 28 pin wire wrap socket. The Harwin ZIF pushes into these sockets like an IC, the Textool one doesn't. It would require soldering.

Testing

Connect the unit to a stabilised 5V power supply. Connect the unit to the parallel port of the PC with a 25 way lead terminated with 25 way male connectors at each end. When the push button is pressed, the LED should toggle between on and off. When the LED is on, check that all of the address lines (A0-A14) are around zero volts. Single bytes can be sent to the port from BASIC using LPRINT chr\$(char), where char is the value between 0 and 255 that will appear on the data lines. Each time an LPRINT is performed, the address should increment by one and the data specified will appear on the data lines.

Programming RAMs

Several suppliers stock non-volatile SRAMs and most of these are ordinary SRAMs with a lithium battery and power down circuitry stuck on the top. The lithium batteries have an expected life of approximately 10 years. This should be remembered when you see cheap surplus devices advertised.

If you have a file containing the data you wish to program into the RAM, this can easily be done from MS-DOS. Turn PROGRAM's power off and insert the RAM. Restore power and press the button until the LED comes on. On power on, the unit is often in the correct state, but if the LED was on at power up, press the button twice anyway to make sure. At the DOS prompt type:

```
C:\> COPY file#LPT1:\b
```

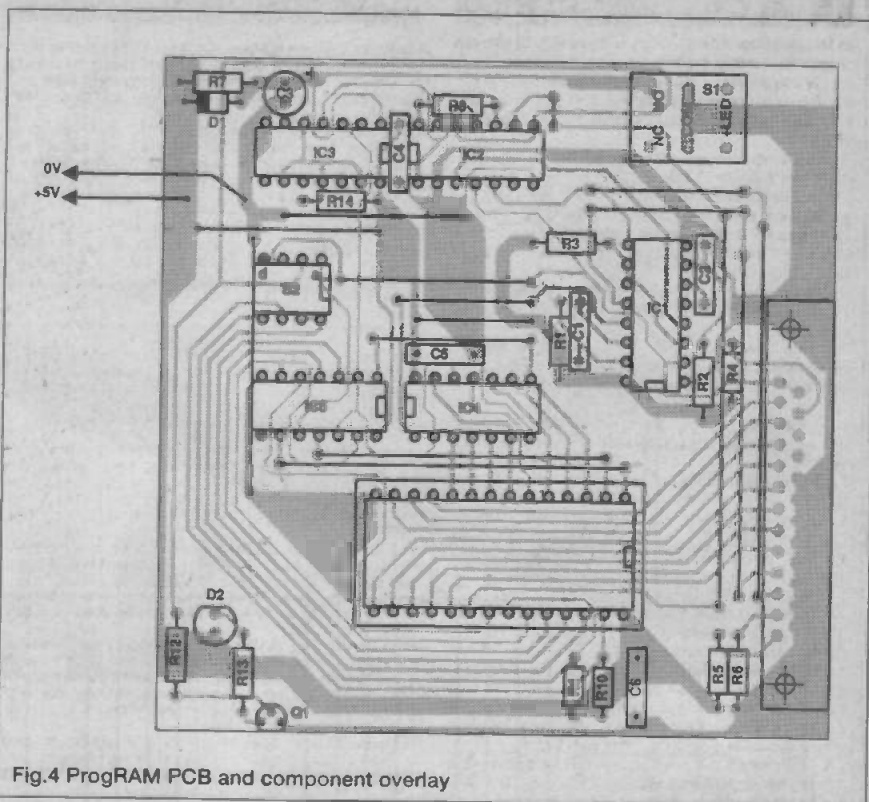
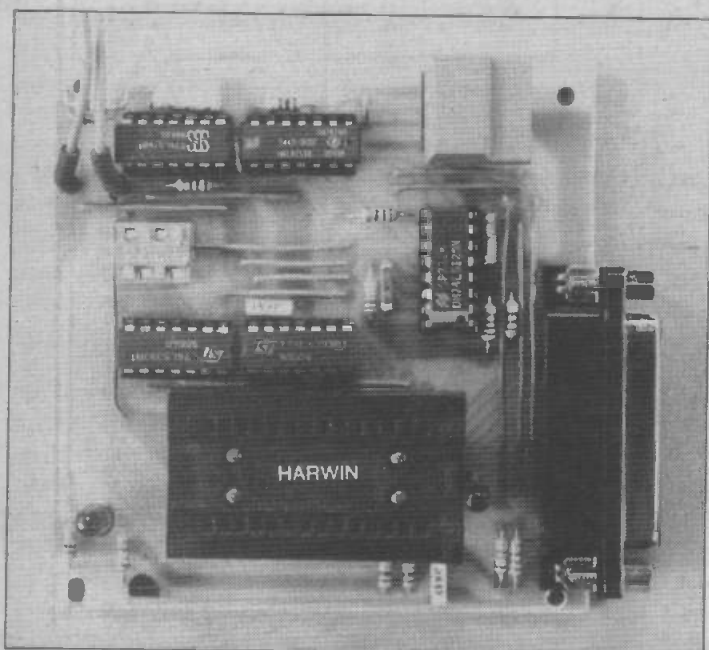


Fig.4 PROGRAM PCB and component overlay

This will program the RAM in three seconds or less, depending on the size of the file. The \b switch tells DOS to send a binary file. If omitted, only the data up to the first Control Z character will be sent. If CPM is being used, PIP can perform a similar function to copy. From BASIC, LPRINT can be used to program bytes, as described above.

Note that if the program is larger than the capacity of the RAM, the address counters will loop and overwrite the data at the start. This could be prevented with some additional logic by using the highest bit of IC5 to disable the RAM.

PARTS LIST

CAPACITORS

- C1,C2 1nF Poly.
- C3 1uF Elect.
- C4,C4,C6 0.1uF (Decoupling)

RESISTORS

- R1,R2 18k
- R3,R8,R14 1k
- R4,R5 2k2
- R6 220R
- R7,R9,R10-12 10k
- R13 180R

SEMICONDUCTORS

- TR1 BC548
- D1 1N4148
- IC1 74LS123 (dual monostable)
- IC2 74LS74 (dual d-type)
- IC3 74LS14
- IC4,5 74LS393 (dual 4 bit counter)

MISCELLANEOUS

- 28 Pin Zif socket
- 4 way DIL switch (or solder links can be used).
- Push button
- 25-D way socket, PCB mounting

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- 2 x Cord Grip Switch Lamp Holders. Order Ref: 913
- 1 x DC Voltage Reducer. 12v-6v. Order Ref: 916
- 1 x 10 amp 40v Bridge Rectifier. Order Ref: 8696.
- Lightweight Stereo Headphones. Moving coil so superior sound. Order Ref: 896.
- 2 x 25W Crossovers. For 4ohm loudspeakers. Order Ref: 22.
- 2 x nicad Constant Current Chargers. Easily adaptable to charge almost any nicad battery. Order Ref: 30
- 10m Twin Screened Flex. White pvc cover. Order Ref: 122
- 2 x White Plastic Boxes. With lids approx 3" cube. Lid has square hole through the centre so these are ideal for light operated switch. Order Ref: 132.
- 2 x Reed Relay Kits. you get 8 reed switches and 2 coil sets with notes on making relays and other gadgets. Order Ref: 148.
- 1 x Big Pull Solenoid. Mains operated. Has 1/2" pull. Order Ref: 871.
- 1 x Big Push Solenoid. Mains operated. Has 1/2" push. Order Ref: 872.
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- 1 x Mini Stereo 1W Amp. Order Ref: 870
- 1 x In-Flight Stereo Unit is a stereo amp. Has two most useful mini moving coil speakers. Made for BOAC passengers. Order Ref: 29.
- 1 x 10-1mA Panel Meter. Full vision fact 70mm square. Scaled 0-100. Order Ref: 756.
- 2 x Lithium Batteries. 2.5V penlight size. Order Ref: 874
- 2 x 3m Telephone Leads. With BT flat plug. Ideal for phone extensions, fax, etc Order Ref: 552.
- 1 x 12V Solenoid Has good 1/2" pull or could push if modified. Order Ref: 232.
- 4 x In-Flex Switches. With neon on/off lights, saves leaving things switched on. Order Ref: 7.
- 2 x 6V 1A Mains Transformers. Upright mounting with fixing clamps. Order Ref: 9.
- 2 x Humidity Switches. As the air becomes damper, the membrane stretches and operates a micro switch. Order Ref: 32.
- 5 x 13A Rocker Switch. Three tags so on/off, or changeover with centre off. Order Ref: 42.
- 2 x Flat Solenoids. You could make your multi-tester read AC amps with this. Order Ref: 79.
- 1 x Suck or Blow-Operated Pressure Switch. Or it can be operated by any low pressure variation such as water level in tanks. Order ref: 67
- 1 x 6V 750mA Power Supply. Nicely cased with mains input and 6V output lead. Order Ref: 103A.
- 2 x Stripper Boards. Each contains a 400V 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers, etc. Order ref: 120.
- 12 Very Fine Drills. For PCB boards etc. Normal cost about 80p each. Order Ref: 128
- 5 x Motors for Model Aeroplanes. Spin to start so needs no switch. Order Ref: 134.
- 6 x Microphone Inserts. Magnetic 400 ohm, also act as speakers. Order Ref: 139.
- 6 x Neon Indicators. In panel mounting holders with lens. Order Ref: 180.
- 1 x In-Flex Solderstat Keeps your soldering iron etc always at the ready. Order Ref: 196.
- 1 x Mains Solenoid. Very powerful as 1/2" pull or could push if modified. Order Ref: 199.
- 1 x Electric Clock. Mains operated. Put this in a box and you need never be late. Order Ref: 211
- 4 x 12V Alarms. Makes a noise about as loud as a car horn. All brand new. Order Ref: 221.
- 2 x (6" x 4") Speakers. 16 ohm 5 watts, so can be joined in parallel to make a high wattage column. Order Ref: 243.
- 1 x Panostal. Controls output of boiling ring from simmer up to boil. Order Ref: 252.
- 2 x Oblong Push Switches. For bell or chimes these can switch mains up to 5A so could be foot switch if fitted in patress. Order Ref: 263.
- 50 x mixed Silicon Diodes. Order Ref: 293.
- 1 x 6 Digit Mains Operated Counter. Standard size but counts in even numbers. Order Ref: 28.
- 2 x 6V Operated Reed Relays. One normally on, other normally closed. Order Ref: 48.
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- 1 x Magnetic Brake. For stopping a motor or rotating tool. Order Ref: 66.
- 1 x Shaded Pole Mains Motor. 3/4" stack, so quite powerful. Order Ref: 85.
- 2 x 5 Aluminium Fan Blades. Could be fitted to the above motor. Order Ref: 86.
- 1 x Case. 3 1/2 x 2 1/4 x 1 3/4 with 13A socket pins. Order Ref: 845.
- 2 x Cases 2 1/2 x 2 1/4 x 1 3/4 with 13A pins. Order Ref: 565.
- 4 x Luminous Rocker Switches. 10A mains. Order Ref: 793.
- 4 x Different Standard V3 Micro Switches. Order Ref: 340.
- 4 x Different Sub Min Micro Switches. Order Ref: 313.

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Very Powerful Mains Motor. With extra long (2 1/2") shafts out each side. Makes it ideal for a reversing arrangement for, as you know, shaded pole motors are not reversible. £3. Order Ref: 3P157.

Solar Panel Bargain. Gives 3v at 200mA. Order Ref: 2P324.

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12V axial fan for only £1. Ideal for equipment cooling, brand new, made by West German company, Brushless so virtually everlasting. Needs simple transistor drive circuit, we include diagram. Only £1, Order Ref: 919. When we supply this we will include a list of approximately 800 of our other £1 bargains.

PC Operating Systems. Fully user documented and including software. MS-DOS 3.20, with 5" disk. £5 Order Ref: 5P2076; MS-DOS 3.3 with 3 1/2" disk. £5. Order Ref: 5P208; MS-DOS 4.01, with 3 1/2" disk. £10 Order Ref: 10P99.

45A Double Pole Mains Switch. Mounted on a 6x3 1/2" brass plate, beautifully finished in gold, with pilot light. Top quality made by MEM, £2. Order Ref: 2P316.

Amstrad 3" Disk Drive. Brand new and standard replacement for many Amstrad and other machines. £20 Order Ref: 20P28.

High Quality Key Switch. This is a single pole 2 position switch, changeover or on/off. Ideal for mounting through a front panel when it would be secured by a hexagonal nut. It's a Yale type switch and comes complete with 2 keys. Good British make, normally retails at £3, our price £1.50. Order Ref: 1.5P12.

Movement Alarm. Goes off with the slightest touch. Ideal to protect car, cycle, doorway, window, stairway, etc. Complete with Piezo, shrieker, ready to use only £2 (PP3 battery not supplied). Order Ref: 2P282.

Project Box. A first-class, Japanese two-part moulding, size 95mmx86mmx23mm. Held together by 2 screws, this will hold a PP3 battery and a PCB and is ideal for many projects. To name just one, the washer bottle described in September's issue of E.E. This is nicely finished and very substantial. You get 2 for £1 Order Ref: 876.

AM-FM Radio Chassis. With separate LCD module to display date and time. This complete with loudspeaker, £3.50 Order Ref: 3.5P5.

2, 3 and 4 Way Terminal Blocks. The usual grub screw types. Parcel containing a mixture of the 3 types, giving you 100 wares for £1. Order Ref: 875.

12/24 DC Solenoid. The construction of this is such that it will push or pull as the plunger is a combined rod and piston. With 24V this is terrifically powerful but is quite good at 12V and of course, it can be operated by any intermediate voltage. £1. Order Ref: 1.5P10.

2m 3-Core Lead. Terminating with flat pin instrument socket. £1. Order Ref: 879. Ditto but with plug on the other end so that you could use this to extend an instrument lead. £1.50. Order Ref: 1.5P10.

20W 5" 4 Ohm Speaker mounted on baffle with front grille, £3. Order Ref: 3P145. Matching 4 ohm 20W tweeter on separate baffle, £1.50, Order Ref: 1.5P9.

LCD 3 1/2 Digit Panel Meter

This is a multi range voltmeter/ammeter using the A-D converter chip 7106 to provide 5 ranges each of volts and amps. Supplied with full data sheet. Special snip price of £12. Order Ref: 12P19.

Solar Energy Educational Kit. It shows how to make solar circuits and electrical circuits, how to increase voltage or current, to work a radio, calculator, cassette player and to charge nicad batteries. The kit comprises 8 solar cells, one solar motor, fan blades to fit motor and metal frame to hold it complete a free-standing electric fan. A really well written instruction manual. Price: £8.00 Order Ref: 8P42B.

High Power Switch Mode PSU Normal mains input, 3 outputs: +12V at 4A, +5V at 16A and -12V at 1/2A. Completely enclosed in plated steel case. Brand new. Our special offer price of £9.50. Order Ref: 9.5P1.

Ultra Thin Drills, actually 0.3mm. To buy these regular costs a fortune. However, these are packed in half dozens and the price to you is £1 per pack. Order Ref: 797B.

You can Stand On It! Made to house GPO telephone equipment, this box is extremely tough and would be ideal for keeping your small tools in, internal size approx, 10 1/2" x 4 1/2" x 6" high. Complete with carrying strap, price £2, Order Ref: 2P283B.

Ultra Sonic Transducers. Two metal cased units, one transmits, one receives. Built to operate around 40kHz. Price £1.50 the pair. Order Ref: 1.5P14.

1 RPM MOTOR. This is only 2W so will not cost much to run. Speed is ideal for revolving mirrors or lights. £2, Order Ref: 2P328.

12 SOLAR CELL. Could keep a battery charged even when no mains available. £17.50, Order Ref: 17.5P1.

Battery Quick Charger into a flat battery to about 5A the charging rate would be 8-10A, this would fall away as the battery charges up or it can be switched to a lower rate. Complete kit includes mains transformer, rectifier, capacitor, switch and metal case. £7.50, Order Ref: 7.5P20.

15V PSU. Mains operated nicely cased, adequately smooth dc output. £1 Order Ref: 342.

Unusual Solenoid Solenoids normally have to be energised to pull in and hold the core, this is a disadvantage where the appliance is left on for most of the time. We now have magnetic solenoids which hold the core until a voltage is applied to release it. £2 Order Ref: 2P327.

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200VA Mains Transformer. Secondary voltages 8v-0-8v. So you could have 16v at 12A. Could be ideal for car starter charger, soil heating, spot welding, carbon rod welding or driving high powered amplifiers etc. £15. Order Ref: 15P1.

Mains Filler, Resin Impregnated, nicely cased, pcb mounting. £2 Order Ref: 2P315.

Safety Leads. Curly coil so they contract but don't hang down. Could easily save a child from being scalded, 2 core, 13A, extends to 3m, £1 Order Ref: 846, 3 core, 13A, extends to 3m £2 each, Order Ref: 2P290.

Power Supply with Extras. Mains input is fused and filtered and the 12V DC output is voltage regulated. Intended for high class equipment, this is mounted on a PCB and also mounted on the board beautifully removed, are two 12V relays and Piezo sander, £3 Order Ref: 3P80B.

100W Mains Transformers. Normal primaries 20-0-20 at 2.5A, or 30V at 3.5A, £4, Order Ref: 4P24, 40V at 2.5A, £4 Order Ref: 4P59, 50V at 2A £4 Order Ref: 4P60.

Phillips 9" High Resolution Monitor. Black and White in metal frame for easy mounting. Brand new, still in maker's packing, offered at less than price of tube alone, only £15, Order Ref: 15P1.

Insulation Tester with Multimeter. Internally generates voltages which enable you to read insulation directly in megohms. The multimeter has four ranges, AC/DC volts, 3 ranges DC millamps, 3 ranges resistance and 5 amp range. These instruments are ex-British Telecom but in very good condition, tested and guaranteed OK, probably cost at least £50, yours for only £7.50 with leads, carrying case £2 extra, Order Ref: 7.5P4.

Mains 230V Fan. Best make "PAPST", 4 1/2" square, metal blades, £8 Order Ref: 8P8.

2MW Laser. Helium neon by Phillips, full spec, £30, Order Ref: 30P1. Power supply for this is in kit form with case is £15, Order Ref: 15P16, or in larger case to house tube as well £18 Order Ref: 18P2. The larger unit, made up, tested and ready to use, complete with laser tube £89, Order Ref: 89P1.

1/2hp 12V Motor- The Famous Sinclair C5. Brand new, £15 Order Ref: 15P8.

Solar Charger. Holds 4AA nicads and recharges these in 8 hours, in very neat plastic case £6 Order Ref: 6P3.

Ferrite Aerial Rod. 8" long x 3/8" diameter, made by Mullard. Complete with two coils. 2 for £1. Order Ref: 832P.

Air Spaced Trimmer Caps. 2.20pf, ideal for precision tuning UHF circuits. 4 for £1. Order Ref: 818B.

Mains Isolation Transformer. Stops you getting "to earth" shocks. 230V in and 230V out. 150 watt, £7.50, Order Ref: 7.5P5 and a 250W version is £10, Order Ref: 10P97.

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Atari 65XE. At 65K this is quite powerful, so suitable for home or business, unused and in perfect order but less PSU, only £19.50 Order Ref: 19.5P5B.

80W Mains Transformer. Two available good quality both with normal primaries and upright mounting, one is 20V 4A, Order Ref: 3P106, the other 40V 2A, Order Ref: 3P107. Only £3 each.

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Logic Pulse Generator

Build Robert Penfold's latest test project, a handy logic pulser

A logic probe is probably the most useful piece of inexpensive test gear for the logic circuit experimenter, but a logic pulser comes in as a close second.

A logic pulser is the digital equivalent of the audio engineer's sinewave/squarewave generator. In its most simple form, a pulse generator consists of a probe type device which produces a low frequency output signal at TTL logic levels. Some devices of this type also have the ability to produce a single output pulse each time a push-button is operated.

More sophisticated pulsers are in the form of normal bench units which can produce a wide range of output pulse durations and repetition rates. The most refined logic pulse generators have complex digital control circuits and can provide virtually any desired pulse waveform with an extremely high degree of accuracy, obtained by using a crystal reference oscillator to govern the timing of the output signal.

The pulser described in this project is a bench unit of the non-crystal controlled variety. It provides a wide range of output pulse durations and frequencies and although it lacks crystal



virtually any desired mark-space ratio.

Mark Time

Many pulse generators operate on the basis of having the user set an output pulse direction and a repetition frequency (e.g. a $10\mu\text{s}$ pulse at a frequency of 10kHz). This unit uses the alternative method of having the mark and space times individually adjustable. This sometimes requires a little more thought in order to get the required output signal, but with a little practice it becomes second nature.

In the example given above, a $10\mu\text{s}$ pulse rate of 10kHz is clearly a $10\mu\text{s}$ pulse every $100\mu\text{s}$. The mark time is therefore $10\mu\text{s}$, and the space time is $90\mu\text{s}$ ($100\mu\text{s}$ minus $10\mu\text{s}$). The unit is easier to use if you think directly in terms of mark and space times, but it is not usually too difficult to convert pulse durations and frequencies into mark and space times.

An advantage of having adjustable mark and space durations is that there is no risk of accidentally setting a nonsensical output waveform, such as a 100ms pulse at a frequency of 1MHz . Any output waveform that can be set on the controls can actually be generated. The mark and space times are each adjustable from approximately 110ms to $1\mu\text{s}$ in five ranges, as follows.

- Range 1 $1\mu\text{s}$ to $11\mu\text{s}$
- Range 2 $10\mu\text{s}$ to $110\mu\text{s}$
- Range 3 $100\mu\text{s}$ to 1.1ms
- Range 4 1ms to 11ms
- Range 5 10ms to 110ms

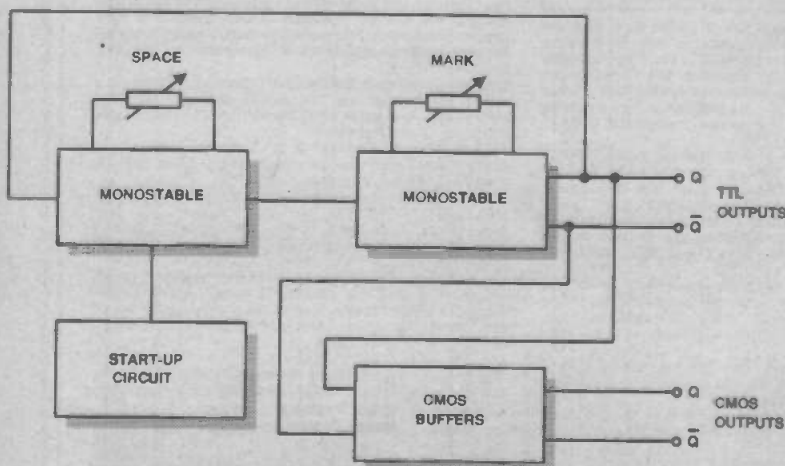


Fig. 1 Pulse Generator block diagram

precision, it is adequate for much logic testing and development work. There are separate TTL and 5V CMOS outputs so that the unit is fully compatibility with a wide range of logic circuits. Anti-phase outputs are available at both TTL and CMOS levels. The unit can therefore provide two-phase clock signals having

This equates to a frequency range of about 4.5Hz with both times set at maximum, to 500kHz with them both set at the minimum value. Clearly a very wide range of mark-space ratios are possible. In fact mark-space ratios as extreme as 100000:1 and 1:100000 can be generated.

System Operation

The circuit is based on two monostables which are used in a form of ring oscillator. The block diagram of Figure 1 helps to explain the way in which the unit functions. Both monostables operate in the negative edge triggered mode. In other words, they are triggered by high to low transitions at the trigger inputs. Once triggered, an output pulse is produced and the length of this pulse is controlled by a C-R timing circuit.

The Q output of the first monostable connects to the trigger input of the second monostable. Similarly, the Q output of the second monostable is coupled to the trigger input of the first one. As the output pulse from the first monostable finishes, it provides a negative edge which triggers the second monostable. When the output pulse from the second monostable ends, it produces a negative edge which triggers the first monostable. The circuit therefore oscillates indefinitely, with the two monostables continuously triggering each other.

There is a small flaw in an oscillator of this type in that it is not guaranteed to start-up at switch-on. In many cases this will happen due to the production of spurious trigger pulses, but initial triggering is dependent on how fast and how cleanly the supply is introduced to the circuit. To ensure correct starting every time, a crude but effective start-up trigger circuit is used to prod the first monostable into action.

Another slight fault with this type of oscillator is that overloads on the output can result in it stalling. In practice this is not likely to be a problem, since removing an overload is almost certain to trigger the oscillator back into action. However, if oscillation should be suppressed, simply switching the unit off and then turning it back on again will spur the circuit back into oscillation again.

A ring oscillator of this type is well suited to pulse generator applications because it gives easy control of the mark and space times. The mark duration (the time during which the Q output is high) is controlled by the timing circuit of the second monostable. The timing circuit of the first monostable controls the space duration. In Figure 1, the mark and space times are shown as being controlled via two variable resistors. In the practical circuit there are also five switched timing capacitors. These provide the unit with its five timing ranges for each output half cycle.

The circuit is based on a TTL dual monostable and this obviously provides outputs that are fully TTL compatible. The Q and not Q are fed to CMOS buffers in order to provide fully CMOS compatible outputs. Note that the unit has a 5V power supply and that the CMOS outputs are therefore at 5V logic levels. Consequently they are not compatible with CMOS circuits which operate at a supply potential of other than 5V.

The Circuit

The full circuit diagram for the pulse generator appears in Figure 2. IC1 is a 74LS221 dual monostable and this contains two identical monostable circuits which have positive and negative inputs. In this case the positive trigger inputs are not needed and are simply wired to the positive supply rail. Each monostable also has a reset input. Taking the appropriate reset input low results in output pulses being brought to an immediate end. Again, these two inputs are not required in the present applica-

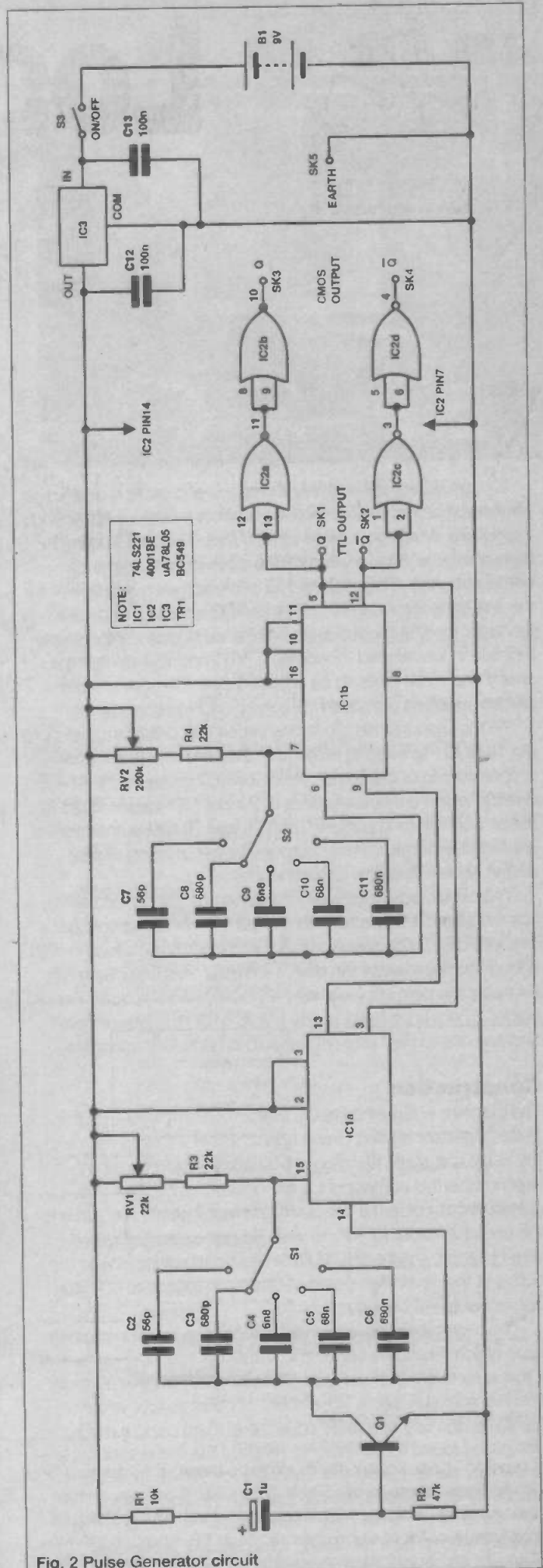
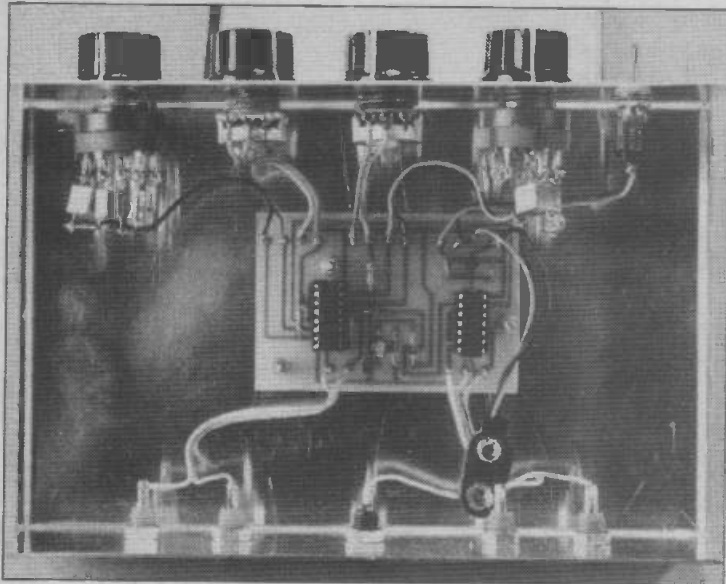


Fig. 2 Pulse Generator circuit



S1 and S2 are respectively the space and mark range switches. Each of these switches controls a bank of five timing capacitors. Although it might appear that C2 and C7 should have a value of 68p, a value of 56p does in fact give much better accuracy. The missing 12p of capacitance is provided by the self-capacitance of IC1. VR1 and R3 are the timing resistance for the first monostable - VR2 and R4 provide the same function in the second monostable. VR1 and VR2 enable the space and mark times to be adjusted over the approximate ranges specified previously.

TR1 is used in a simple timing circuit that briefly short circuits pin 14 of IC1 to earth at switch-on. This ensures that the circuit is spurred into oscillation at switch-on. IC2 provides the CMOS buffers, which are actually pairs of 2 input NOR gates wired to act as non-inverting buffers. The TTL and CMOS output signals are fed to separate pairs of output sockets, making all four output signals available simultaneously.

The circuit requires a well established 5V supply and this is obtained from a 9V battery via a small 5V monolithic voltage regulator (IC3). The supply current is about 15mA, which is high enough to necessitate the use of a medium capacity battery. Probably the best choice is six HP7 size cells in a plastic battery holder. There is no need to use any form of high power cells, and any cheap HP7 size cells should be perfectly adequate.

Construction

The diagram in Figure 3 shows the component layout for the pulse generator printed circuit board. IC2 is a CMOS device and the usual anti-static handling precautions should be taken when dealing with this component. This includes using a DIL integrated circuit holder for the device. In fact, I would recommend the use of a holder for IC1 as well. Do not overlook the two wires just to the right of IC1. Fit single-sided solder pins to the board at the seventeen points where connections to off-board components will be made.

The prototype is housed in an inexpensive metal instrument case which measures about 200 x 130 x 50mm. On the face of it this is far larger than is really necessary, but the five controls and five sockets need a fair amount of panel space, which precludes the use of a really small case. Even using a medium size case I found it necessary to relegate the five output sockets to the rear panel. I used 4mm sockets for SK1 to SK5, but practically any sockets are adequate for this application. The front panel layout is not particularly critical, but use one that avoids the need for a lot of long wires criss-crossing one another.

Mount the printed circuit board at roughly the middle of the base panel using plastic stand-offs, 6BA fixings, or metric M3 fittings. If 6BA or M3 fixings are used, spaces about 6 to 12mm long must be included, so that the connections on the underside of the circuit board are held well clear of the metal case. The hard wiring is then added. Details of this wiring are provided in Figure 4, which should be used in conjunction with Figure 3 (e.g. point A in Figure 3 connects to point A in Figure 4).

As will be apparent from Figure 4, the range capacitors are mounted on S1 and S2 and not on the printed circuit board. This minimises the amount of wiring from the circuit board to the controls, which in turn minimises stray capacitances.

Fitting the capacitors is easier if axial lead capacitors are used, rather than vertical mounting printed circuit types. It is possible to use printed circuit mounting capacitors, but it will probably be necessary to bend the lead out wires outwards at right angles before soldering them in position. The forming of the lead outs must be done very carefully, since the lead out wires are easily detached from many types of printed circuit mounting capacitor. The tags of the switches and the ends of the capacitors' lead out wires should be well tinned with solder, prior to fitting the capacitors onto the switches. There should then be no difficulty in mounting the capacitors on the switches.

S1 and S2 are 12 way single pole rotary switches having an adjustable end-stop. In this case, the end-stops are set for five way operation. The connections to the battery holder are made via an ordinary PP3 style battery clip.

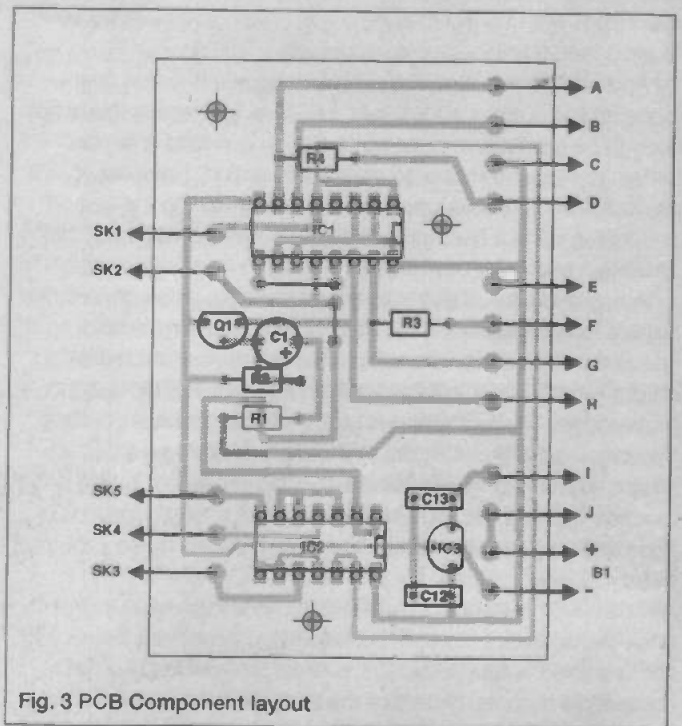


Fig. 3 PCB Component layout

Testing And Use

Ideally an oscilloscope should be used for testing the unit. It is then just a matter of checking that four main controls provide the correct output times and that all four outputs are providing proper signals. Bear in mind that the quoted times for each range are only approximate, and that the tolerances of the timing components will result in small but significant variations from one unit to another.

There will also be small discrepancies from one range to the next. Using 5% tolerance components for C2 to C11 keeps discrepancies within reason, but 1% capacitors must be used if a high degree of consistency is required. Bear in mind that the CMOS and TTL outputs operate at significantly different logic

voltages. The CMOS outputs should provide signals at about 5V peak-to-peak. Expect the signals on the TTL outputs to be at a much lower level (probably no more than about 3V peak-to-peak).

If access to an oscilloscope is not available, monitoring the outputs with a crystal earphone will give a good idea of whether or not the unit is functioning correctly.

A full range of audio tones should be available, plus low frequency clicks and buzzes with the controls set for mark and (or) space times. Short pulsed waveforms give a thin sound, while a mark-space ratio of about 1:1 gives a much fuller sound.

With short mark and space times the output frequency will be beyond the upper limit of the audio range, and completely inaudible. A multimeter set to a low voltage range can be used to check the output at high frequencies. The multimeter will register to the average output voltage.

With a mark-space ratio of 1:1, the output voltage at the CMOS outputs should be half the supply voltage (2.5V). Higher mark-space ratios give higher voltage readings - lower mark-space ratios give lower voltage readings. For example, with a 1:10 mark-space ratio the output is high for only one eleventh of the time, so the average output voltage is only 0.45V (5 divided by 11 = 0.45). The not Q output is the complement of the Q output, and the mark-space ratio here would be 10:1. With this output high for ten elevenths of the time, this works out at an average potential of 4.54V (5V x 10 = 50 volts, 50 volts divided by 11 = 4.54 volts).

Due to a lack of symmetry at the TTL outputs the mathematics are less convenient. However, changes in the mark-space ratio should produce clear changes in the average output voltages. If the CMOS output signals are present and correct it is highly unlikely that there will be any problems with the TTL output signals.

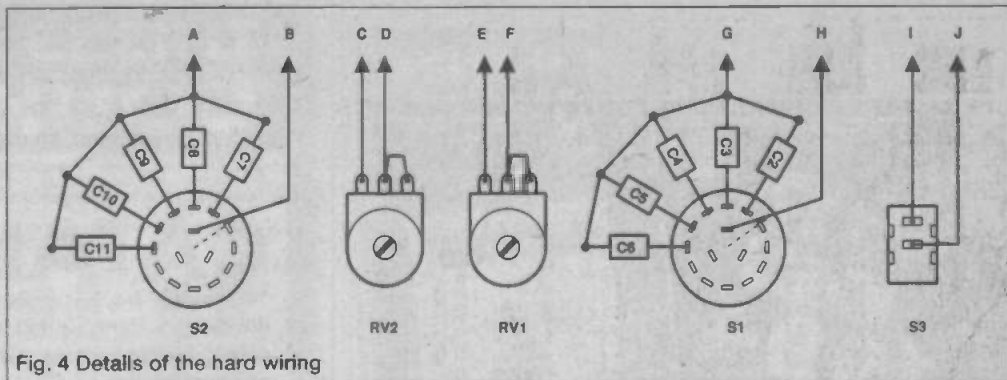


Fig. 4 Details of the hard wiring

Note that the output of this unit should not be connected to a logic output in the test circuit. Where necessary, the integrated circuit providing an existing clock signal should be removed before the pulse generator is connected to the test circuit. Do not overlook the usefulness of the unit's low output frequencies. By operating the test circuit at a low frequency it is often possible to check its operation by using a logic probe or some LED indicators to monitor the logic levels at strategic points in the circuit.

If you are used to working in terms of pulse times and repetition frequencies, it is worth remembering that the reciprocal of the frequency in Hz, kHz, and MHz gives the duration of one cycle in seconds, milliseconds and microseconds respectively. For example, a frequency of 4kHz works out at 0.25ms per cycle (1 divided by 4kHz = 0.25ms).

PARTS LIST

RESISTORS (All 0.25W 5%)

- R1 10k
- R2 47k
- R3 22k
- R4 22k
- RV1 220k lin carbon
- RV2 220k lin carbon

CAPACITORS

- C1 1μ 63V radial elect
- C2 56p polystyrene 5%
- C3 680p polystyrene 5%
- C4 6n8 polystyrene 5%
- C5 68n polyester 5%
- C6 680n polyester 5%
- C7 56p polystyrene 5%
- C8 680p polystyrene 5%
- C9 6n8 polyester 5%
- C10 68n polyester 5%
- C11 680n polyester 5%
- C12 100n disc ceramic
- C13 100n disc ceramic

SEMICONDUCTORS

- TR1 BC549
- IC1 74LS221
- IC2 4001BE
- IC3 uA78L05 (5V 100mA positive regulator)

MISCELLANEOUS

- S1 12 way 1 pole rotary (set for 5 way operation)
- S2 12 way 1 pole rotary (set for 5 way operation)
- S3 SPST miniature toggle
- SK1 - SK5 4mm sockets (5 off)
- B1 9V (6 x HP7 size cells in plastic holder)
- PCB, instrument case about 200 x 130 x 50mm, battery connector (PP3 type), control knob (4 off), 14 pin DIL holder, 16 pin DIL holder, solder pins, wire, solder, etc.



If the unit is to be used alongside an oscilloscope, it is not really necessary to bother about calibrated scales around the control knobs of VR1 and VR2. Much better accuracy will be obtained by using the oscilloscope to monitor the output waveform and then setting the controls for the required mark and space durations. If calibrated scales are required, ideally an oscilloscope should be used to aid the location of precise calibration points. The only alternative is to use a guesstimated scale, but it is unlikely that this will give reasonable accuracy.

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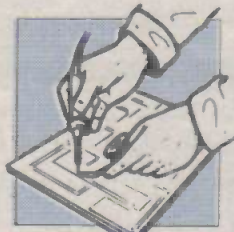
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PROJECT



A handy aid for the car enthusiast, from Terry Balbirnie

Motor Mate

The Motor Mate should prove to be a useful device for anyone who works on automotive type electrical systems. In this category we can include not only car owners, but also motorcycle, caravan and boating enthusiasts. The Motor Mate combines three functions - a voltmeter covering the range 9 to 14V, a low resistance, or continuity tester, which operates a buzzer when resistance is less than 10 ohms, and lastly a no continuity tester which sounds the buzzer when resistance is below 20K ohms.

The Motor Mate voltmeter gives the user a handy way of checking if battery voltage exists at fuses, switches, lampholders, etc. It can also be used to test for excessive voltage drops due to a wire being too thin, or as a result of loose connections, or corrosion. The low-resistance buzz-test may be used to test lamp filaments, fuses, motor windings, etc. and also to check lengths of wire where there is a suspected break. The high-resistance test is used chiefly for checking ignition leads and certain lamp filaments.

Motor Mate is built in a small plastic box, which houses the

circuit panel and a 9V battery to power the buzz-test section. A pair of short wires on top connects a component for the buzz-test and a rotary switch is used to switch the unit off and on, as well as selecting the high or low resistance test. A pair of sockets on the side connects the voltmeter.

At the bar

The Motor Mate 'voltmeter' is not really a meter in the traditional sense. It takes the form of a bar graph display, which shows through a hole in the lid of the case. Thus, a row of ten horizontal LED bars light up one by one as the voltage applied to the input sockets increases. In the present circuit, these operate in approximately half-volt steps. Although the resolution and range are not good enough for general electronics use, this arrangement is adequate for most automotive purposes.

This type of meter is much more robust than a pointer-on-scale instrument and less expensive than a digital one. Also, the LED bars are easily seen in poor lighting conditions. The voltmeter draws approximately 30mA at 12V, so it cannot be

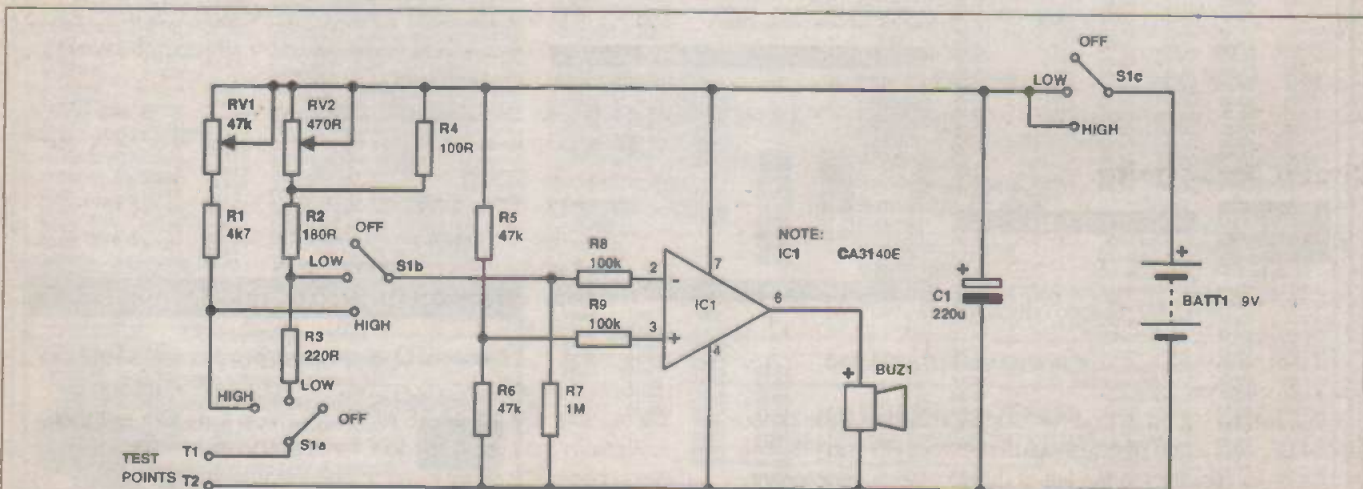


Fig. 1 Motor Mate buzz test section

described as a high resistance instrument by any means. However, for the present purpose, this does not matter and is usually an advantage because it imposes a load on the circuit. Sometimes fuses and corroded wires assume a very high resistance rather than a complete open circuit when they fail. A digital meter having an input resistance of some 10Mohms could therefore give a reading through such a high resistance which would be confusing.

My resistance is high

Car ignition leads carry current at a very high voltage from the ignition coil output to the electrodes in the distributor cap. A rotor arm then distributes the current to the appropriate lead, which is connected to the top terminal of the spark plug. Current completes the circuit back to the coil via the vehicle frame or chassis. The ignition leads are made with a high resistance to suppress TV and radio interference. This will have little effect on the current producing the spark, since the voltage supplied by the coil is very high (tens of thousands of volts).

Ignition leads are a common cause of engines misfiring and being difficult to start if their resistance becomes much higher than the nominal value, because this reduces the current. This may happen if they have been handled carelessly - possibly by pulling on them to remove the caps from the spark plugs - or it could be due to corrosion or simply through old age. The high resistance check can be used to identify faulty leads which may then be replaced singly, a much cheaper exercise than replacing them all at the same time.

As well as being suitable for automotive use, the buzz-test can be used around the house for checking fuses, switches, etc. Since the current requirement is only 20mA on the low resistance test under short-circuit conditions (the worst case), and only 1.6mA while switched on but not actually in use, the battery will have a long life.

The two sections of the circuit - voltmeter and buzz-tests - are described separately. To avoid confusion, components are numbered sequentially, beginning in the buzz-test section and continuing in the voltmeter. It is not necessary to understand how Motor Mate works in order to construct it and readers who wish to go on to Construction may simply omit the next section.

Circuit description

The buzz-test section of Motor Mate is shown in Figure 1. The chief component is IC1, an operational amplifier which is used as a voltage comparator. Thus, if the voltage applied to its inverting input (pin 2) exceeds that at the non-inverting one (pin 3), the output (pin 6) will be low. If the inverting input voltage is less than the non-inverting one, pin 6 will be high and buzzer, BUZ1, will sound.

Pin 3 is maintained at one-half supply voltage by the potential divider, consisting of equal-value resistors R5 and R6. The various other resistors to the left of this form further potential dividers - one set for the low resistance test and another for the high one, as selected by switch S1. The conditions for the op-

amp to switch on and hence the buzzer to sound is met when the resistance of the lower arm is less than that of the upper one.

Switch S1 is a 4-pole 3-position switch. In this circuit, only three of the poles are used, these being referred to in the text and diagrams as S1a, b and c. Poles a and b are responsible for the switching between high and low buzz-tests and pole c simply provides an on-off function.

Suppose S1 is set to high. S1 pole b connects IC1 inverting input via R8 to the potential divider, consisting of preset potentiometer RV1 with fixed resistor R1 in series as the upper arm. The component under test is connected via S1 pole a to test points T1 and T2, this forming the lower arm of the potential divider. Suppose RV1 wiper contact is set to approximately mid-track position. The total resistance of the upper arm will be around 25kW. The buzzer will therefore sound if the test

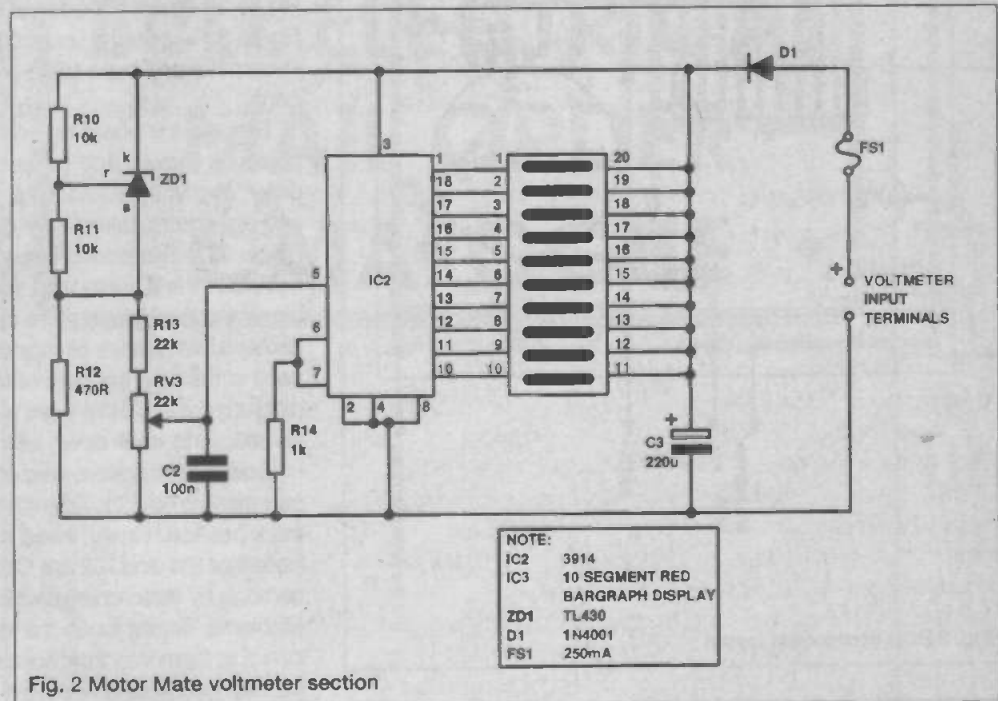


Fig. 2 Motor Mate voltmeter section

component has a resistance less than this figure. By suitable adjustment of RV1, the threshold resistance may be set anywhere between 5kW and 50kW approximately.

A similar situation occurs with S1 set to low, but now S1b connects RV2 in parallel with R4 and R2 in series in the upper arm. The lower arm consists of fixed resistor R3 in series with the component under test. The purpose of fixed resistors R2 and R3 is to limit the current flowing in the potential divider and so prevent excessive drain on the battery. The purpose of R4 is to effectively reduce the value of RV2, since very low preset values are not available from all suppliers. Adjustment to RV2 will allow operation of the low-resistance buzz-test at any point below approximately 50W.

The voltmeter section of Motor Mate is shown in Figure 2. Current is supplied via fuse F1 from the car battery powering the circuit under test and connected to the input terminals.

The circuit centres on bar graph driver IC2 and the bar graph display itself, IC3. IC2 is a complex device containing a set of ten voltage comparators. When the voltage applied to the input, pin 5, is increased, the comparators operate one by one and the outputs, pin 1 then 18 to 10, go low in turn. Current then flows from the supply through the appropriate light-emitting diode bar in IC3 to sink into the corresponding IC2 output.

As it stands, the first bar would light when the voltage at pin 5 reached 0.125V and successive ones with each further

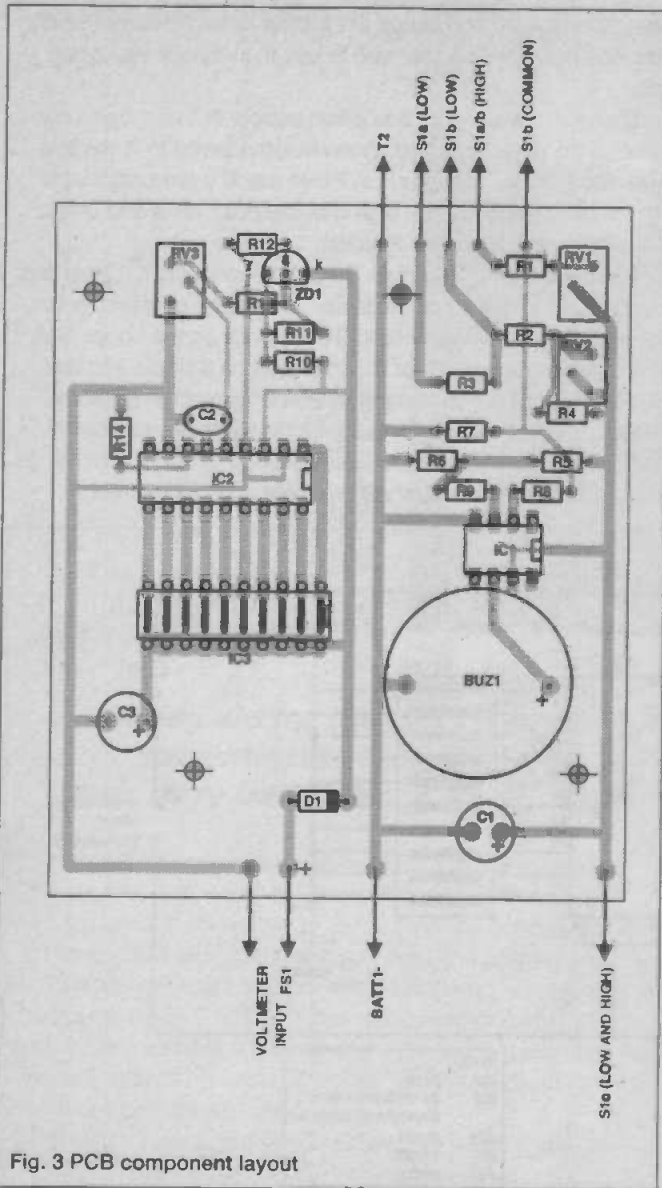


Fig. 3 PCB component layout

0.125V. Thus, the second bar would light at 0.25V, the next at 0.375V and so on. The tenth one would therefore operate at 1.25V. Since the required range of voltage is from about 9V to 14V, this would make IC1 as it stands unsuitable for the purpose.

The behaviour is modified by using ZD1 and associated components. ZD1 is an adjustable Zener diode. Not only is its performance superior to an ordinary Zener diode but its breakdown voltage can be accurately set by connecting two external resistors, R10 and R11, to the reference (r) pin as shown. With the values used here, the breakdown voltage is 7.7V approximately. For readers wishing to alter the voltage, perhaps to use the voltmeter for some other purpose or to set the low operating point more accurately, the formula giving the output voltage is:-

$$V = 2.75(1 + R10/R11)$$

This voltage will then exist between ZD1 anode (a) and cathode (k) as long as the supply exceeds this. ZD1 operates in conjunction with series resistor, R12. Since there is a constant voltage across the Zener diode, the

balance of the supply voltage will exist across R12 and it is this which is monitored by the rest of the circuit. Taking into account the 0.7V, approximately, which exists across input diode D1, zero volts will exist across R12 with an applied voltage of about 8.4V and the first segment of the display will light about 0.5V higher than this - i.e. at about 9V, which is convenient for the purpose.

It is necessary for the bars to light up in approximately 0.5V increments. This means that the existing 0.125V steps must be scaled by a factor of four. This is the purpose of preset potentiometer RV3 and fixed resistor R13. By adjustment to RV3, a certain fraction of the voltage appearing across R12 is applied to IC1 pin 5. R13 limits the range of adjustment.

Construction

Construction of Motor Mate is based on a single-sided PCB. Figure 3a shows topside details (parts placement diagram) while Figure 3b shows the underside (copper foil) view. Both sections - voltmeter and buzz-test - are separately formed on the one panel.

Prepare the board by drilling the four mounting holes in the positions shown. Add the soldered components in the following order. Firstly, the IC sockets, then the presets and all resistors and capacitors, taking care over the polarity of C1 and C3. Solder ZD1 into position (see pin diagram) and diode D1, but do not insert the ICs into their sockets yet. Add the buzzer observing the polarity - this is marked on the plastic underside. Solder 15cm pieces of stranded connecting wire to the labelled pads in the diagram but not to the one marked BATT1. Using different colours of wire will help in avoiding errors which may be difficult to track down later.

Solder the negative wire of the PP3 battery connector to the pad marked BATT1. Adjust all presets to approximately mid-track position. Finally, insert the ICs, observing the orientation. Note that IC1 and IC2 are CMOS devices and possibly liable to damage by static charge which may exist on the body. To avoid problems, do not touch the pins when unpacking them or inserting them into their holders. Alternatively, touch something earthed - such as a water tap - just before doing so. IC3 may be handled freely. Unfortunately, its orientation is not obvious and it will not work if connected the wrong way round. In the prototype unit the identifying lettering was on the right-hand side of the body.

The circuit panel is attached to the lid as shown in the photograph. Carefully measure the position of the bar graph display

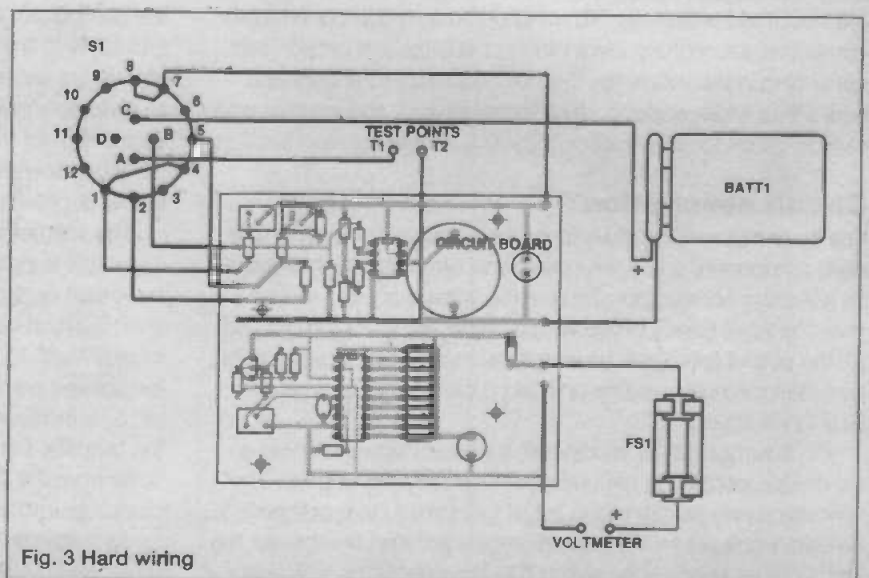


Fig. 3 Hard wiring

BULL ELECTRICAL
250 PORTLAND ROAD
HOVE SUSSEX BN3 5QT
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Telephone between 9.15 and 5.15 Monday to Saturday with an ACCESS, VISA or SWITCH card. On 0273-203500.

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Send a cheque, P.O, cash or Credit Card details to our usual address...
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East Sussex
BN3 5QT

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We are more than happy for you to visit our shop at 250 Portland Road. Portland Road is situated in the centre of Hove and is approximately 1 mile long. It is 2 roads up, parallel to the seafront. We are situated half way along on the south side of the road, opposite the Gala bingo hall. The nearest Train stations are Aldrington or Portslade about 10/15 mins walk.

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MINIMUM ORDER VALUE The minimum order value that we can process is £5.00 goods value (excluding VAT and postage)

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PRICE, DESCRIPTION AND ILLUSTRATIONS These may change from those shown without prior notice.

TRADE ENQUIRIES No trade account facilities are available. However, substantial discounts are available for volume orders, ring us for a quote.

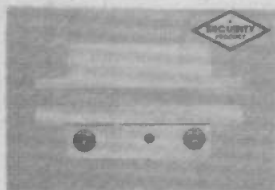
PAYMENT All goods must be paid for prior to despatch. Accepted methods of payment are SWITCH, ACCESS, VISA, CHEQUE, POSTAL ORDER or CASH.

ORDERING INFORMATION You can order your goods by telephone with a credit card Mon-Sat, or with a cheque, credit card, postal order or cash through the post. Or by FAX with credit card details.

PERSONAL CALLERS Our shop is open 6 days a week and stocks most catalogue items plus many additional stock lines so is well worth a visit. If you are travelling any distance it is well worth a telephone call to check availability of the item(s) that you require.

ALARMS

ALARM ACCESSORIES



ALARM SWITCHES
REF : F436H PRICE : £1.90
 For window mounting etc. Contacts normally closed when window is closed. Supplied with magnet and adhesive strips
 Dims: 64x30x13mm
 Fully assembled

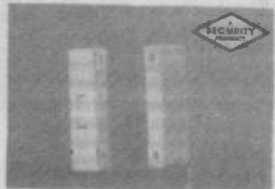
REF : F436J PRICE : £2.10
 Magnetic switch as F436H but with change over contacts.



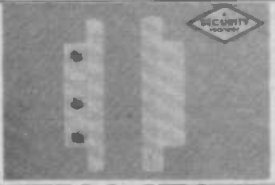
REF : F436R PRICE : £2.40
 Door and window surface mounting magnetic reed switch. Normally open contacts (closed in proximity of magnet) 4 piece kit: magnet, reed, spacer and terminal cover.
 Operating gap 35mm max
 Magnet dims: 63x11.6x12.5mm
 Reed dims: 63x11.6x12.5mm



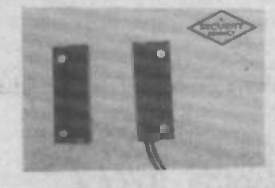
REF : F436S PRICE : £2.60
 Miniature door and window surface mounting magnetic reed switch. Normally open contacts (closed in proximity of magnet).
 Operating gap 23mm max
 Magnet dims 33.6x8x14.7mm
 Reed dims 33.6x8.14.7mm



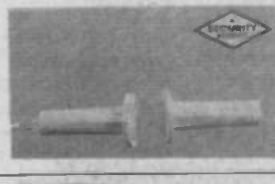
REF : F436W PRICE : £2.60
 Dustproof door and window surface mounting magnetic reed switch. Normally open contacts (closed in proximity of magnet).
 Operating gap 40mm max
 Magnet dims: 50x14x10mm
 Reed dims: 50x14x12mm



REF : F436U PRICE : £2.60
 Door and window surface mounting magnetic reed switch. Change over contacts.
 Operating gap 30mm max
 Magnet dims: 64x13.5x13mm
 Reed dims: 64x13.5x13mm



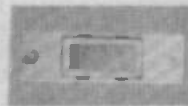
REF : F436V PRICE : £2.60
 Miniature door and window surface mounting magnetic reed switch. Normally open contacts (closed in proximity to magnet).
 Operating gap 23mm max
 Magnet dims: 34x13.5x7mm
 Reed dims: 34x13.5x7mm



REF : F436P PRICE : £2.60
 Recessed mounting magnetic reed switch. Supplied with mounting screws.
 Mounting hole 9.5mm dia
 Operating gap 20mm max



REF : F436T PRICE : £2.90
 Plunger roller ball type reed switch. Normally open contacts (closed when roller ball depressed).
 Mounting hole 19.5mm



REF : F436X PRICE : £1.20
 Surface mounting emergency panic push button switch. Normally open contacts.
 Dims: 76x23x15mm



AUTOMATIC DAYLIGHT SWITCH
REF : F455A PRICE : £7.80
 Automatic daylight switch. Photo electric switches light on at dusk and off at dawn. Weatherproof. Turn on 20 Lux turn off 100 Lux.
 Power: 220/240Vac load Load
 current: 3A
 Dims: 56x45(dia)

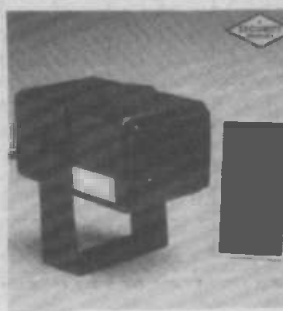


PHOTO ELECTRIC RELAY
REF : TO30 PRICE : £89.95
 Invisible pulsed beam infrared photo relay system. For burglar alarm, automatic counting etc. Exciter receiver/reflector complete.
 Effective dist: 0.8-15m
 Reaction time: less than 50ms
 Release time: Approx 5secs intermittent position
 Output power: 12Vdc
 Power: 220/220Vac 50Hz
 Dims: Main Unit 150x95x75mm
 Dims: Reflector 120x60x5mm



PIR ALARM KIT
REF : F653 PRICE : £38.99
 A compact PIR alarm kit, ideal for small home installations, garages, caravans, trailers, trucks etc. The kit contains a combined PIR and alarm box, 3 magnetic reed switches, compact siren and power supply. Instruction manual and fixing screws included.
 PIR coverage: 100m2
 Exit delay: 2.5minutes
 Entry delay: 15 seconds
 Alarm reset time: 60 seconds
 Power: 12Vdc or AC adaptor
 Dims: 140x90x56mm (alarm panel/PIR)



PIR ALARM KIT
REF : F652A PRICE : £99.95
 A complete alarm kit comprising central alarm box, F604 PIR detector, 3 magnetic reed switches, panic button, 50m of 6 core cable and alarm siren. The alarm box has two instant and one delayed alarm circuit, facility for the connection of a remote key switch and status indicators. Entry delay is adjustable, exit delay is preset at 60 seconds. Siren duration is adjustable up to 10 minutes. Alarm panel circuitry, PIRs and components offer a high level of immunity from false alarms. Complete with wiring instructions and suggested wiring diagram.
 Exit delay: 60secs typical
 Entry delay: 1-90secs adjustable
 Siren duration: 30sec-10min (adj)
 Power: 220/240Vac 50Hz
 Dims: 258x172x172mm

PIR ALARM KIT - DELUXE KIT

REF : F652B PRICE : £149.95

A complete alarm kit comprising central alarm box, two F604 PIR detectors, 3 magnetic reed switches, panic button, 50m of 6 core cable, alarm siren and remote keypad. The alarm box has two instant and one delayed alarm circuit, facility for the connection of a remote key switch and status indicators. Entry delay is adjustable, exit delay is preset at 60 seconds. Siren duration is adjustable up to 10 minutes. Alarm panel circuitry, PIRs and components offer a high level of immunity from false alarms. Complete with wiring instructions and suggested wiring diagram.

Exit delay: 60secs typical
 Entry delay: 1-90secs (adjustable)
 Siren duration: 30sec-10min (adjustable)
 Power: 220/240Vac 50Hz
 Dims: 258x172x172mm (alarm panel)



ALARM CONTROL PANEL

REF : F657 PRICE : £49.95

A compact control panel designed for residential and commercial premises. Three protection zones accepting NO or NC inputs, sealed with end of line resistors. Built in charger for connection of back-up battery.

Protection circs: One 24hr instant circuit
 One instant circuit
 One delay circuit
 Entry delay: 1-90secs
 Exit delay: 60seconds
 Siren duration: 30secs-10mins
 Power: 220/240Vac 50Hz
 Dims: 258x172x72mm

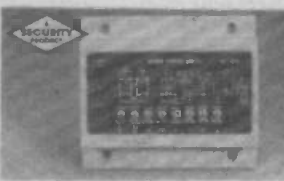


ALARM CONTROL MODULE

REF : F654 PRICE : £16.95

Basic control panel for small residential or commercial premises or for boats, caravans, trucks etc. The panel has two protection zones which accept NO or NC inputs, sealed with end of line resistors.

Protection circs: One instant circuit
 One delay circuit
 Exit delay: 60seconds
 Entry delay: 30seconds
 Siren duration: 3minutes
 Power: 12-16Vdc
 Dims: 133x114x38mm



ANNUNCIATORS

ANNUNCIATOR

REF : T072A PRICE : £24.99

A stand alone PIR message annunciator on which your own message up to 20 secs long can be recorded on a micro chip and played back every time someone is detected by the PIR. The message can be overwritten at any time. Message cancelled when switched off.

Power: 4xAA batteries or 6Vdc supply
 Dims: 92x136x46mm



DOOR ANNUNCIATOR

REF : T072B

PRICE : £9.95

Self contained wall mount/free standing unit. Requires no external contacts, switches reflectors etc. Two tone chime sounds three times when beam is broken.

Sensing dist: 5-7m
 Power: 4xAA batteries



SIRENS

ELECTRONIC SIREN

REF : T007 PRICE : £22.95

All cream plastic. WATERPROOF heavy duty super siren. Adjustable mount bracking. Continuous or 160 cycle per minute siren.

Output: 120dB(A)@6m
 Power: 6-12Vdc 1.5A
 Dims: 20x115(horn)
 234mm (depth)



ELECTRONIC SIREN

REF : T002 PRICE : £9.95

Gold coloured metal horn with circular fixing plate. Emits high power 160 cycle per min walling rate.

Output: 115dB(A) @3m
 Power: 12Vdc 1.5A
 Dims: 130(dia)x160mm



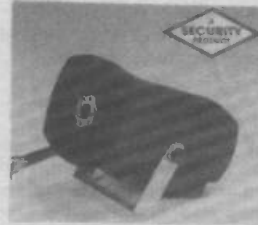
PIEZO SIREN

REF : T003AB PRICE : £9.95

High powered piezo electric siren which emits ear piercing warbling tone.

Frequency: 2.5Hz approx
 Output: 115dB @ 1m typical

Power: 12Vdc
 Current @ 12V: 80mA
 Dims: 85x60x55mm



PIEZO SIREN

REF : T003C PRICE : £9.95

High powered piezo siren which emits a high pitched two tone sound.

Output: 105dB @ 1m
 Power: 12Vdc 150mA
 Dims: 54(dia)x44mm



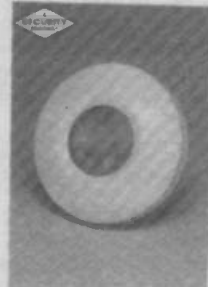
SECURITY

CEILING MOUNTED PIR

REF : F604A PRICE : £24.95

A small PIR intrusion detector giving a conical protection pattern. Offering substantial immunity to false alarms ideal for modern residential and commercial systems.

Coverage: 36° 36' (11m) conical pattern
 Mounting height: 12' (3.6m) max
 Current drain: 15mA typical
 Alarm output: norm closed relay
 Alarm period: 2-3 sec
 LED indicator: Walk test mode
 Operating Voltage: 8-16Vdc
 Weight: 0.08kg
 Dims: 86(dia)x24mm



PIR ALARM

REF : F601A PRICE : £24.95

Self contained portable/wall mount PIR sensor and alarm. The built in powerful piezo siren sounds on detection. Intelligent walk test and mode verification functions.

Programmable security code.
 Coverage: 89deg, 10m
 12 beams in 2 layers
 Power: 3xAA batteries
 Dims: 115x70x36mm



PORTABLE PIR ALARM

REF : F601B PRICE : £11.95

Pocket size portable PIR detector with dual function sounder, two tone chimes as an annunciator or loud 90dB warble as an alarm.

Detection Range: 8m (25ft)
 Detection angle: 90deg hor x 20deg vert
 Power: 3xAA batteries
 Exit delay time: 30 seconds
 Auto reset time: 1 minute
 Dims: 105x68x44mm



MAINS FAIL SAFE ALARM/FRIDGE FREEZER POWER FAILURE DETECTOR

To instal this easily fitted alarm, just place it around the mains cable. Once mains failure is detected a loud shrill audible alarm is sounded and it will not switch off until a magnetic key is inserted or the mains is returned. This alarm can be fitted to any mains powered device, is resettable, operates on a PP3 9V battery and is a compact 120x95x35mm.

REF : Y6P1

PRICE : £6.00



NIGHT SECURITY SENSOR REF : F603A PRICE : £22.95

Swivel mounted PIR sensor for the detection of body heat. A built-in adjustable photo detector prevents daylight operation.

Detection Range: 200 (fan shaped) 15m

Auto Reset Range: 9 secs-12 mins

Adjustable

Lighting Load: 2kW Incandescent, 1kW fluorescent

Power: 220/240Vac 50Hz



PORTABLE PIR ALARM

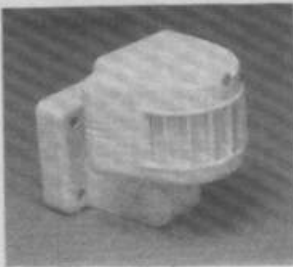
REF : F601C PRICE : £12.95

Wall mounting or free standing PIR detector with a loud (90dB at high volume) sounder.

Coverage: 90 .10m. 24 beams 3 layers

Power: 4xAAA bats or extern adaptor

Dims: 145x95x68mm



NIGHT SECURITY SENSOR

REF : F609 PRICE : £18.95

Swivel mounted PIR sensor for the detection of body heat. Adjustable time on period.

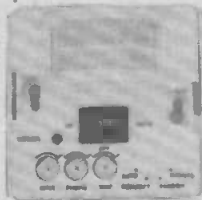
Provided with a walk test LED.

Detection Range : 110 (fan shaped) 15m

Auto Reset Time : 9 sec - 10 min (adjustable)

Lighting Load : 2kW Incandescent, 1kW fluorescent

Power : 220/240ac 50Hz



PIR AUTOMATIC LIGHT SWITCH

REF : F602 PRICE : £23.99

The F602 is an automatic, hands-free light switch. It turns the light on automatically when you enter the room by detecting your body heat and comparing it against the background temperature. When you leave the room the light will gradually dim over 12 seconds and finally switch off. F602 offers: manual override, in which it will perform like any ordinary light switch; security function in which it will act as an alarm, flashing the light on and off and auto function which will act as a buglar deterrent, switch the light on and off at random times for random periods, simulating occupancy of the house



AUTOMATIC DAYLIGHT SWITCH

REF : F455A PRICE : £7.80

Automatic daylight switch. Photo electric. Switches light on at dusk and off at dawn. Weatherproof for outdoor use. Plastic construction.

Power 220/240V ac

Load Current: 3 amp

Dims: 56 x 45mm (dia)

AUTO-DIALLER PCB

A component loaded board made for a *Sentinel System* that when triggered would dial a pre-programmed number alerting the receiver that the alarm had been set-off. There are fifteen socketed chips which include M81C55-5, M80C85A, MC34018P, TCM3105N, 27C32 eprom, two voltage regulators with heatsinks, 5 x clare relays V10301 and V10001. The board measures 205x220mm and also includes two BT phone sockets, two DC power sockets and two 5 pin din sockets. There is provision for a microphone input on the PCB along with over 150 resistors, capacitors and diodes. There are no connection details supplied with this board which for the chips alone makes wonderful spares value. ONLY...

£5.00 EACH REF :Y5P8

MORE ALARMS

PIEZO SOUNDER 3-30V OP 90db OUTPUT ... 1	£1.00	BD647
MINATURE ELEC. BUZZER. 6V 25mA 82db .. 1	£1.00	CD22
MINATURE ELEC. BUZZER. 9V 25mA 82db .. 1	£1.00	CD23
MINATURE ELEC. BUZZER. 12V 25mA 82db 1	£1.00	CD24
BUZZERS standard 6-12V with fly leads 5	£1.00	X2P12
DOOR BURGLAR ALARM		
battery op. safety chain type	£1.00	H1P44
PIR LIGHT ALAR	£12.99	L122L
AMSTRAD CT1 (ALARM CLOCK)	£6.00	T6P1
FIRE ALARM CONTROL PANEL		
350x165x80mm	£15.00	W15P1
MAINS FAIL SAFE UNIT		
PP3 9V battery op	£6.00	W6P1

MORE AERIALS

TELESCOPIC AERIALS FOR RADIOS	PKT	1.00	BD255
INDOOR AERIAL FOR 2M BAND	PKT	1.00	BD5D
SLAB FERRITE AERIALS	PKT	2.00	BD61
TELESCOPIC AERIAL			
knuckled 5 section extends			
from 165-700mm	PKT	3.00	T3P11
FERRITE ROD AERIAL			
102x6mm	PKT4	1.00	BD445
FERRITE RODS 5"			
with LW & MW Coil	PKT2	2.00	BD185

BREAK GLASS DETECTOR

Nifty little device that will detect abnormally strong vibrations by means of a 'trembler' type device encased in a plastic capsule similar in design to a fluorescent starter! Two wires protrude which would lead to your alarm circuitry.

Qty : EACH Price: £2.00 Ref : Y2P1

Qty : PKT 6 Price: £10.00 Ref : Y10P4

RADAR DETECTOR

REF : J59P1 PRICE : £59.00

X and K band Radar Detector with Dual conversion Superheterodyne for detecting radar up to 3 miles away!

Features:

- Audible warning buzzer
- LED signal strength meter
- Highway/City/Power Off
- Variable audio volume control
- Cigarette lighter power cord
- Visor Mount clip
- Adjustable mounting bracket
- Quick mount velcro strips



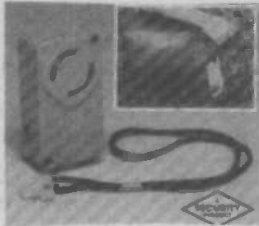
REMOTE CONTROL PIR ALARM

REF : F601D PRICE : £16.95
 An infrared remote control PIR alarm with loud 90dB sounder. Free standing or wall mounted.
 Coverage: 80deg 8m
 Remote Unit: 1x3V battery
 Alarm output: 90dB
 Power: 3xAA batteries or external adaptor
 Dims: 115x69x44mm



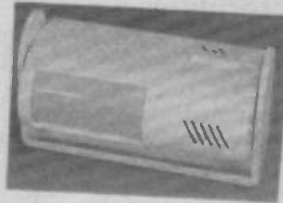
FLASHING LED
 REF : F158Q PRICE : £1.99
 A flashing LED in a mounting bezel designed to indicate that an alarm is armed.
 Power: 12Vdc

PERSONAL SECURITY



PERSONAL SECURITY EQUIPMENT

REF : T026 PRICE : £4.99
 A compact personal alarm that emits a very loud earpiercing sound when activated by pulling the nylon hand cord or sliding the switch on the side of the unit.
 Power: 12Vdc battery
 Dims: 77x42x26mm
 Weight: 45g

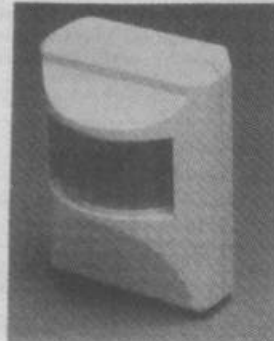


PORTABLE PIR
 REF: F801 PRICE : £17.95
 Pocket sized portable PIR detector alarm. Dual function: alarm sounds a high pitch warble on detection, chime sounds a two-tone annunciator on detection.
 Coverage : 10m (30ft)
 Angle : 60°
 Power : 9V dc (PP3 bats)
 Exit Delay Time : 10 sec
 Auto Reset Time : 30 sec
 Dims : 108x68x35.5mm



PERSONAL AND DOMESTIC ALARM

REF : F601Z PRICE : £5.99
 Features: Burglar Alarm: hang alarm on door handle. Sounds automatically and instantly when INTRUDER touches the door knob.
 EMERGENCY ALARM: just pull out the metal chain and the alarm sounds instantly to call for help. No wiring involved. Must have METAL door knob to operate.
 Power: 9Vdc battery
 Alarm output: 90dB
 Dims: 110x58x26
 Weight: 80g

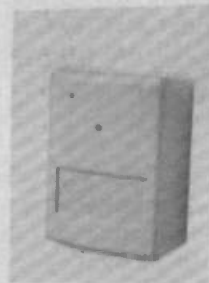


PIR SENSOR
 REF : F804 PRICE : £19.95
 Miniature PIR intrusion detector offering substantial immunity to false alarms and great freedom of mounting height. Contains an anti-tamper switch.
 Coverage: 90.12m.42beams 3 layers
 Adjustment : vertical 0-12°
 Mounting Height: 1.5m above floor level normally closed relay
 Alarm Output: 2-3 seconds
 Alarm Period: single shot/pulse count (selectable)
 Detection Mode: walk test indication
 LED indicator: 8 to 16V dc
 Operating Voltage: 73 x 54 x 35mm

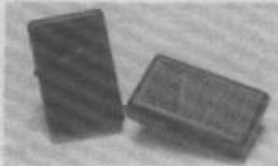
12V PIR SENSORS £9.99

An excellent low cost internal PIR Detector Unit with Long Range, Wide Angle detection.
 Dims: 150x90x110mm

- Features Include:**
 Day/Night Mode
 Latch Freeze
 Silent Relay
 Multi connection
 90 Cover Arc
 20M Range



REF: 10P99



EZ-LINK WIRELESS PERSONAL ALARM
 REF : T026A PRICE : £9.95
 Miniature transmitter/receiver which activates when separated more than a few feet. Ideal for use as a baby monitor, as a reminder or security device. No external wiring.
 Power: 2 x AAA
 Weight: Transmitter 35g inc battery
 Receiver 45g inc battery



XENON STROBE
 REF : L118A PRICE : £7.99
 Low profile fully sealed weatherproof flasher with high intensity long life xenon tube. Reverse polarity protected. Useful on alarm boxes.
 Power output: 1W
 Voltage: 12Vdc
 Currency: 150mA
 Flash rate: 120/min
 Dims: 70(dia)x66mm



PLUG IN TIMER
 REF : F607 PRICE : £18.99
 Plug in timer capable of up to 56 programmable switching operations per week. The programming structure consists of 4 timed events occurring on each day, Monday to Friday and 4 timed events on Saturday and Sunday.
 Power: 220/240Vac 50Hz
 Max Load: 3000W
 Dims: 145x65x42mm

FIRE ALARM CONTROL PANEL
 REF: X15P1 PRICE: £15.00
 Extremely high quality metal cased alarm control panel. Sturdy hinged door with lock and key. Alarm fault indicator and reset button on front panel. Comes complete with electronics but no technical information. Could be adapted for use with PIR System.
 Dims: 350x165x80mm

XENON STROBE (ALARM BEACON)
 REF: X5P5 PRICE: £5.00
 12V Strobe with clear lens. Ideal for alarm box indicator or in multiples as a display array. Great for special effects and other leisure applications. Could be used as a vehicle tamper indicator.

TELEPHONE AND FAX ORDERS WELCOME

TEL: 0273 203500 FAX: 0273 323077
 ACCESS (VISA) MASTERCARD (SWITCH)
 MONDAY-FRIDAY 9.00 - 5.30



CAR ALARMS



ALL-IN-ONE PROFESSIONAL CAR ALARM SYSTEM
REF : A706 PRICE : £
 * Powerful 110dB siren
 * Ultrasonic sensor
 * Twin remote controls
 * Battery back-up
 * 2 x pin switch sensors
 * Quick easy installation



CENTRAL LOCKING INTERFACE
REF : A200 PRICE : £
 * Enables A706 to be installed in cars with central door locking



FLASHING LED
REF : F158Q PRICE : £1.99
 A flashing LED in a mounting bezel designed to mount in the dashboard to indicate that an alarm is armed (even if no alarm is installed) Fitted with a 1.5m lead.
 Power: 12Vdc.



FLASHING LED
REF : B200Z PRICE : £2.49
 A flashing LED built into a car cigar lighter plug to give visual warning that an alarm is activated (whether or not an alarm is fitted). Simply plugs into the cars cigar lighter socket.

HAVE YOU EVER CONSIDERED THAT YOU MAY HOLD THE KEY TO A BUSINESS WAY OF IMPROVING OUR ENVIRONMENT BY REGENERATING YOUR SURPLUS STOCK

WHY NOT CONVERT YOUR "WASTE" INTO CASH AND TEAM UP WITH BULL ELECTRICAL TO OPERATE OUR OWN BRAND OF RECYCLING - YOU BEING THE MOST IMPORTANT PART OF THE CHAIN - THE CONSERVATIONIST

BULL ELECTRICAL GOES GREEN

We are constantly seeking and buying surplus stock, mainly electrical but we will consider ANYTHING. Our only requirement is **QUANTITY**. Before **WE BUY** any item we need to know that you have at least **50 minimum** of each item.

In essence we are aiming to provide schools, colleges small enterprising companies and some home enthusiasts with components and products which can be incorporated into their own innovative projects at more than realistic prices thereby recycling goods which could otherwise have contributed to the unnecessary waste that amasses every day in our environment.

SO..... disguised ~~££££££~~'s could be just sitting there in a corner waiting to be "recycled" back to you..... Give us a call with what you have that you wish to dispose of, or better still, send us a fax 0273 323077 with a comprehensive list of the items, quantity and description you have and we will respond and arrange a visit to assess the goods you have available.

BULL ELECTRICAL
 Tel: 0273 203500
 Fax: 0273 323077

GIVE US A CALL NOW
 Ask for Ext 004



*****WARNING*****
 These products are for export only and are NOT APPROVED for use in the UK. Users are liable to prosecution under the Wireless Telegraphy Act 1949 (and any amendments thereto). This condition may apply to other countries

MOTION DETECTOR ALARM

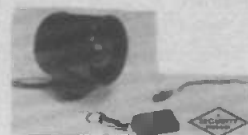
REF : B601 PRICE : £39.95
 When the motorcycle ignition is switched off, the alarm chirps and allows 30 seconds before arming itself to detect any movement of the bike. The alarm disarms itself when the ignition is switched on. If motion is detected a signal is sent to the 115dB siren which sounds for 35 seconds before resetting.



*****WARNING*****
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MOTION DETECTOR ALARM WITH PAGER

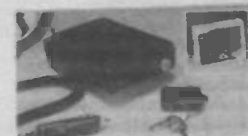
REF : B602 PRICE : £119.95
 When the motorcycle ignition is switched off, the alarm chirps and allows 30 seconds before arming itself to detect any movement of the bike. The alarm disarms itself when the ignition is switched on. If motion is detected a signal is sent to the 115dB Siren AND pager, which sounds for 35 seconds before resetting.



*****WARNING*****
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CAR ALARM

REF : B204 PRICE : £55.95
 Remote Control self contained car alarm with simple two wire connection to the car's wiring harness. Current and shock sensing with additional panic feature operated from remote control. Alarm will sound for 2 minutes before resetting. NOTE: This alarm is not triggered by automatic electric radiator fans - it knows the difference!
 Operation: Current/shock sensing
 Current drain: 20mA Armed 1.1A siren sounding 2 minutes
 Reset time:
 Transmitter battery life: 1 year
 Power: 12-14V dc



*****WARNING*****
 These products are for export only and are NOT APPROVED for use in the UK. Users are liable to prosecution under the Wireless Telegraphy Act 1949 (and any amendments thereto). This condition may apply to other countries

CAR ALARM

REF : B205 PRICE : £44.95
 Remote Control portable car alarm powered from car's cigarette lighter socket. Triggered by the low frequency sounds produced by attempted break in. Internal rechargeable batteries sound alarm if a break in is detected or power is removed. Can be free standing on dash board or fixed in place with bracket.
 Operation: Low frequency sound
 Reset time: 2 minutes
 Power: 12-14Vdc

MOBILE TELEPHONE HANDSET



£5.99
REF: 6P89

TOP QUALITY - PHILIPS - WEIGHTY BLACK TOUGH RESIN HANDSET WITH LCD DISPLAY & 9 LEDS (4 COLOURS). 18 KEY FUNCTION PAD 10 NUMERIC 8 SYMBOLS. WOULD MAKE AN EXCELLENT ACCESSORIE IF YOU ARE BUILDING A JEEP OR 12V CAR FOR A CHILD!!! ALSO EFFECTIVE AS AN INTRUDER DETERRANT FOR WOMEN TRAVELLING ALONE! WHO WOULD KNOW A REAL 999 CALL WAS NOT BEING MADE. COMES COMPLETE WITH CLIP ON BASE INCORPORATING QUALITY SPEAKER AND 6MTR MULTI CORE (10) CABLE. CAN BE WIRED UP TO ILLUMINATE. DETAILS SUPPLIED.

AUDIO

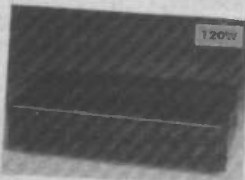
AMPLIFIERS

MIXER AMPLIFIER 120WATTS RMS

REF : P648W PRICE : £299.00

Quality, low cost and high power output, make this amplifier an ideal choice for large PA systems. Five inputs are provided, one balanced microphone input with voice operated priority over all other inputs. Two unbalanced microphone inputs and two auxiliary inputs for background music. Separate bass, treble and individual volume controls for all inputs are located on the front panel. 100 volt line or low impedance loudspeakers may be used. A booster output is provided to enable the system to be expanded. This amplifier can be used in marine and commercial vehicle applications using the 24 volt DC power input. 19 inch rack mount ears are available as an optional extra. Model P648R (PAKIT4)

Power input: 120 watts RMS
 Frequency response: 60-17000Hz + 3dB
 Power requirements: 220/240 volts 50/60Hz
 DC power: 24 volts
 Loudspeaker output: 8 ohms, 70V, 100V
 Booster output: 500mV, 600ohms
 Signal to noise ratio:
 Mic: 60dB
 Misc: 1, 2: 75dB
 Distortion (THD): <2% at rated output
 Mic input 1: 1.5mV/600 ohms
 Mic input 2 & 3: 1.5mV/2K ohms
 Aux inputs 1 & 2: 100mV/2K ohms
 Tone control:
 Treble: bass + 10dB @ 100KHz
 + 10dB @ 10KHz
 Vox priority (Mic 1): 40dB reduction on Aux/Mic 2, 3
 Vox sensitivity: Adj (off 0.7mV Mic. sens.)
 Dims (HxWxD): 88x430x234mm
 Weight: 9.0KG



SPEAKER SPIKES

REF : A181E PRICE : £18.99
 SET OF 4 SOLID TURNED BRASS SPEAKER SPIKES WHICH REDUCE THE POINT OF CONTACT ADJUSTABLE HEIGHT. 4 SPIKES, 4 PLATES AND 8 DOUBLE SIDED ADHESIVE FOAM PADS



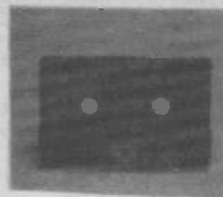
HEAD CLEANING KIT

REF : A167D PRICE : £1.49
 USEFUL KIT PROVIDING: CLEANER PAD INSPECTION MIRROR CLEANER BRUSH CLEANING FLUID REPLACEMENT PADS TAPE REPAIR KIT
 REF : A165 PRICE :
 AUDIO/VIDEO TAPE REPAIR KIT. ROCKER CLAMPS TAPE FIRMLY IN PLACE DURING SPLICING. SAFE BLADE STORAGE. COMPLETE WITH BLADE AND FOUR ROLLS OF SPLICING TAPE



CASSETTE DEMAGNETIZER

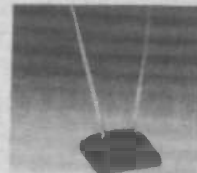
REF : A167C PRICE : £7.99
 ELECTRONIC CASSETTE RECORD/PLAYBACK HEAD DEMAGNETIZER. PLAY FOR ONE SECOND AND THE HEAD IS DEMAGNETIZED. POWERED BY INTERNAL WATCH BATTERY.



AERIALS

TELESCOPIC AERIAL

REF : T147 PRICE :
 75ohm INDOOR AERIAL WITH TELESCOPIC RODS SPECIALLY DESIGNED FOR FM AND VHF RECEPTION. WEIGHTED BLACK BASE HAS WITH ANTI-SLIP FEET.



FM ANTENNA WITH AMP

REF : T146 PRICE :
 A STYLISH FM ANTENNA WITH BUILT IN HIGH GAIN AMPLIFIER WITH GAIN CONTROL. SATIN BLACK FINISH
 Height: 15"
 Frequency: 88-108MHz
 Gain: 18dB
 Gain Control: 0-18dB
 Max Output: 100dBuV
 Impedance: 75ohm
 Power: 220/240Vac 50Hz
 Dims: 425 x 120 x 60mm



AUDIO ACCESSORIES

AUDIO DISTRIBUTION UNITS

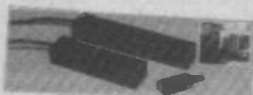
BS4491/CEE22 CONFIGURATION MOUNTED IN A COMPACT DISTRIBUTION UNIT TO GIVE MULTIPLE OUTLETS FROM A SINGLE 13AMP SOCKET.

4 Way Unit
 REF : A091C PRICE : £8.99

8 Way Unit
 REF : A091D PRICE : £11.99

Shrouded Plug
 REF : F324B PRICE : £1.40

CAUTION: Maximum power rating 1500W.



CD WALLET

REF : A162L PRICE : £5.99
 COMPARTMENTED CD WALLET FOR UP TO 20 CDS



CD CARRIER

REF : A162J PRICE : £8.95
 CARRYING BAG TO CARRY PORTABLE CD PLAYER AND SEVERAL CDS AND HEADPHONES. PROVIDED WITH BELT LOOPS AND SHOULDER STRAP.



OTHER AMPLIFIERS

HANDSET AMPLIFIER EACH 5.00 V5P3
 STEREO 2Wx2W AMP
 +V/C+DATA EACH 2.00 2P51
 2W RECORD PLAYER AMP EACH 1.00 BD351
 UNILEX 4W MULLARD EP9000 . EACH 2.00 2P11
 UNILEX STEREO PREAMP
 MULLARD EP9001 EACH 1.00 BD216



CANT SEE WHAT YOU'RE LOOKING FOR

Don't give up hope, give us a call 0273 203500
 We may just have THAT ITEM sitting in our warehouse waiting for your call. Or something even better!



HEADPHONES

IN EARPHONE

REF : A069DH PRICE : £3.99
 REAR VENTED EARPIECES HIGH FIDELITY MYLAR TRANSDUCERS METAL GRILLED TRANSDUCERS ANGLE ENTRY LEADS FOR COMFORT SUPPLIED WITH SPARE EARPADS
 Impedance 18-32ohm
 Response 20-20000Hz
 Power 60mW Max
 Sensitivity 100dB @ 1kHz
 Lead 1.2m Straight screened
 Plug 3.5mm stereo



IN EARPHONE

REF : A069DJ PRICE : £4.99
 REAR VENTED EARPIECES HIGH FIDELITY MYLAR TRANSDUCERS METAL GRILLED TRANSDUCERS ANGLE ENTRY LEADS FOR COMFORT SUPPLIED WITH SPARE EARPADS REEL IN STORAGE CASE GOLD PLATED RIGHT ANGLE MOULDED PLUG
 Impedance 18-32ohm
 Response 20-20000Hz
 Power 60mW Max
 Sensitivity 100dB @ 1kHz
 Lead 1.2m Straight screened
 Plug 3.5mm stereo



WEATHERPROOF IN-EARPHONE

REF : A069DG PRICE : £4.99
 TUNED DUCT VENTED FOR BETTER BASS RESPONSE WEATHER RESISTANT HIGH FIDELITY MYLAR TRANSDUCERS REEL IN STORAGE CASE SUPPLIED WITH SPARE EARPADS RIGHT ANGLE MOULDED PLUG
 Impedance 18-32ohm
 Response 20-20000Hz
 Power 60mW Max
 Sensitivity 100dB @ 1kHz
 Lead 1.2m Straight screened
 Plug 3.5mm stereo



DIGITAL AUDIO EARPHONES

REF : A064D PRICE : £7.99
 SUPERB QUALITY DIGITAL TURBO STEREO EARPHONES WITH GOLD FINISH. SAMARIUM COBALT SPEAKERS PRODUCES EXCELLENT SOUND QUALITY. COMES COMPLETE WITH STORAGE CASE.
 Impedance 18-32ohm
 Response 20-20000Hz
 Sensitivity 100dB @ 1kHz
 Lead 1.2m Straight screened
 Plug 3.5mm stereo
 Extras 3.5-6.3mm gold plated adaptor
 Weight 5gms without card



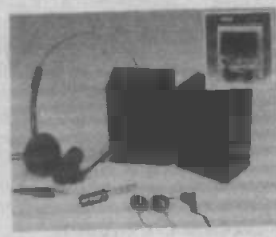
STEREO HEADPHONES

REF : A063F PRICE : £4.99
 FOR USE WITH TV AND ALL AUDIO EQUIP IN LEAD LEFT/RIGHT VOLUME CONTROLS FULLY ADJUSTABLE HEADBAND FREELY ROTATING EAR PIECES FITTED WITH 3.5mm STEREO PLUG. COMPLETE WITH 6.35 ADAPTOR
 Impedance 32ohm
 Response 20-18000Hz
 Power 100mW Max
 Sensitivity 104dB @ 1kHz
 Lead 2.8m Straight screened
 Plug 3.5mm stereo
 Extras Adaptor
 Weight 125g



COMBINATION SET

REF : A070Z PRICE : £5.99
 A PERSONAL STEREO COMBINATION SET COMPRISING: SUPER LIGHTWEIGHT HEADPHONES WITH 27mm MYLAR TRANSDUCERS ULTRA LIGHTWEIGHT REAR VENTED EARPHONES MINIATURE STEREO SPEAKERS 6.35mm STEREO ADAPTOR
HEADPHONE:
 Impedance 32ohm
 Response 100-20000Hz
 Power 100mW MAX
EARPHONE:
 Impedance 32ohm
 Response 100-20000Hz
 Power 100mW MAX
SPEAKERS:
 Size 2.25"
 Impedance 8ohm
 Response 100-12000Hz
 Power 300mW MAX



STEREO HEADPHONES

REF : A084G PRICE : £16.95
 DIGITAL AUDIO COMPATIBLE SUPERDYNAMIC HEADPHONES WITH INDIVIDUAL LEFT/RIGHT LINEAR VOLUME CONTROLS IN EAR CUPS. PADDED RATCHET ADJUSTABLE HEADBAND WITH SOFT PADDED EAR CUPS FOR COMFORT. FITTED WITH GOLD PLATED 3.5mm STEREO PLUG AND 6.35mm ADAPTOR.
 Impedance 32ohm
 Response 20-20000Hz
 Power 120mW
 Lead 3m straight screened
 Plug 3.5mm stereo
 Extras Adaptor
 Weight 155g



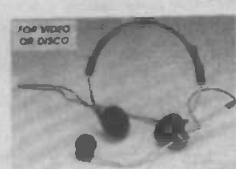
STEREO HEADPHONES

REF : A064A PRICE : £15.95
 SUPERDYNAMIC LIGHTWEIGHT HEADPHONES MYLAR TRANSDUCERS FOR BROAD CLEAR RESPONSE GOLD PLATED 3.5mm STEREO PLUG ADJUSTABLE DOUBLE HEADBAND
 Impedance 32ohm
 Response 15-25000Hz
 Power 70mW
 Lead 2.6 straight screened
 Plug 3.5mm stereo
 Extras Adaptor
 Weight 110g



STEREO HEADPHONES WITH BOOM MIC

REF : A067F PRICE : £9.95
 LIGHTWEIGHT STEREO HEADPHONES WITH ADJUSTABLE DYNAMIC BOOM MIC. PLASTIC HEADBAND WITH STAINLESS STEEL ADJUSTERS. FOAM PADDED EARPIECES WITH HIGH QUALITY SAMARIUM COBALT TRANSDUCERS FOR CLEAR SOUND REPRODUCTIONS. HIGH SENSITIVITY MIATURE DYNAMIC MIC CARTRIDGE WITH FOAM WINDSHIELD.
HEADPHONES:
 Type Mylar Transducer
 Impedance 32Ohm
 Response 20-20000Hz
 Power 150mW
MICROPHONE:
 Type Omnidirectl dynamic
 Impedance 25ohm
 Sensitivity -78dB @ 1kHz
GENERAL:
 Lead 2.5mm straight screened
 Plugs 6.35mm stereo and 3.5mm mono
 Weight 80g



REMOTE HEADPHONE SYSTEM

REF : A085 PRICE : £99.95

A REMOTE STEREO HEADPHONE SYSTEM COMPRISING A TRANSMITTER, A BELT CLIP RECEIVER AND A PAIR OF HIGH QUALITY HEADPHONES. WILL ACCEPT INPUTS (CD DAT TAPE ETC) FROM 3 SEPARATE SOURCES. A BUTTON INTERCOM SYSTEM ALLOWS CONVERSATION WITH THE HEADPHONE USER AND A CSC CIRCUIT IS INCORPORATED TO GIVE A "SUPER BASS" SOUND.



TRANSMITTER:
Power Sup 12Vdc 150mA
AC adaptor supplied

Input Sensitivity:
Source 1 & 2 10kW 100mV
Source 3 33ohm 100mV
Dims 150 x 102 x 56mm

HEADPHONES/RECEIVER:
Power 30mW/channel
16ohm load

Freq resp 100-8000Hz
Power Sup 3Vdc 80mA
2 X AA Batts not supplied

Input Sensitivity:
Source 1 & 2 10kW 100mV
Source 3 33ohm 100mV
Battery life 8 hours nominal
Dims 104 x 62 x 24mm

HEADPHONE EXTENSION KIT

REF : A120A PRICE : £4.99

6m COILED LEAD FITTED WITH A 3.5mm STEREO PLUG AND 3.5mm STEREO SOCKET AND SUPPLIED WITH FOUR ADAPATORS:

6.35mm STEREO PLUG-3.5mm STEREO SOCKET
3.5mm MONO PLUG-3.5mm STEREO SOCKET
2.5mm MONO PLUG-3.5mm STEREO SOCKET
3.5mm STEREO PLUG-2x3.5mm STEREO SOCKETS



INPUT EXTENSION

REF : A097 PRICE : £8.99

A 3 CHANNEL AUDIO INPUT EXPANDER DESIGNED TO EXTEND THE NUMBER OF INPUTS AVAILABLE AT THE REAR OF A HI FI AMP TO ACCOMMODATE CD, DAT AND VIDEO SOUND INPUTS. MONO/STEREO SWITCH FOR VIDEO INPUT, IN/OUTPUTS VIA PHONO SOCKETS.

Dims: 120 x 35 x 72mm

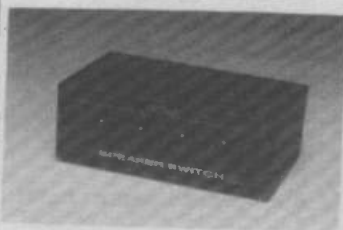


4 WAY SPEAKER SWITCH

REF : A098 PRICE : £15.99

A BEAUTIFULLY FINISHED CONTROL BOX PROVIDES FACILITY FOR USING 4 PAIRS OF SPEAKERS WHERE STEREO AMPL ALLOWS ONLY ONE PAIR. 1.2.3 OR 4 PAIRS MAY BE USED IN ANY COMBINATION.

Dims: 148 x 85 x 50mm

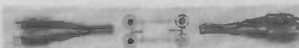


AUDIO LEAD

REF : A114D PRICE : £5.99

2 GOLD PLATED PHONO PLUGS TO 2 GOLD PLATED PHONO PLUGS. HIGH QUALITY LOW CAPACITANCE DOUBLE SCREENED CABLE.

Length: 1.8m



REMOTE HEADPHONE SYSTEM

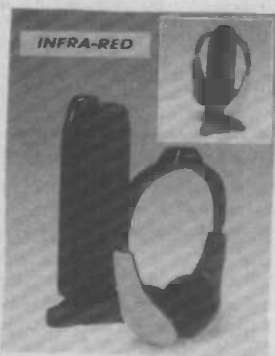
REF : A085B PRICE : £39.95

INFRA RED MONO HEADPHONE SYSTEM FOR USE WITH TV SOUND RADIO OR OTHER AUDIO SOURCES. ENABLES YOU TO LISTEN IN PRIVATE AT YOUR DESIRED VOLUME LEVEL WITHOUT DISTURBING OTHERS. A MAINS AC/DC ADAPTOR ATTACHED TO THE ATTRACTIVELY STYLED TRANSMITTER WHICH SITS ON TOP OF YOUR AUDIO SOURCE AND TRANSMITS SIGNALS BY INFRA RED LIGHT. THE HI FI QUALITY CORDESS HEADPHONES ALLOW YOU TO ENJOY THE MUSIC IN COMFORT WITHOUT BEING TIED TO THE AUDIO SOURCE WITH A CORD.

System Infra Red
Power: Transmitter 12Vdc
(AC/DC mains adaptor)

Receiver 2 x 1.2V AAA Ni Cad Batts

Battery life 6 hours
Freq Response 50-12000Hz (FM Mod)



MICRO CASSETTES 30MIN

REF : A189 PRICE : £4.99

60MIN

REF : A189A PRICE : £5.99

REPLACEMENT MICROCASSETTES FOR MOST MICROCASSETTE RECORDERS AND ANSWERPHONES.



UNDERCHIN HEADPHONES

REF : X1P4 PRICE : 1.00 PKT4

Stet type. 1/4 stereo plug

OVEREAR HEADPHONES

REF : X2P13 PRICE : 2.00 PKT10

No headband 2.5mm plug



MORE ACCESSORIES

AUTOMATIC COMPACT DISC CLEANER

REF : A181C PRICE : £14.99

WET TYPE COMPACT DISC AUTO CLEANER. INSERT A DISC INTO THE COMPARTMENT. PRESS THE START BUTTON AND THE TWIN CLEANING PADS WILL ROTATE AROUND THEIR OWN AXIS, GIVING A RADIAL CLEANING ACTION. INCLUDES 4 CLEANING PADS AND CD CLEANING FLUID.

Power: 3Vdc MAINS/BATTERY

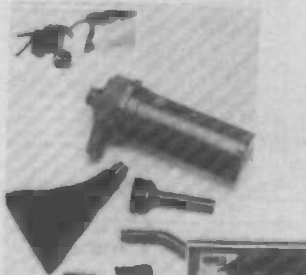


MINI VACUUM CLEANER

REF : A150B PRICE : £7.99

BATTERY POWERED MINI CLEANER WHICH IS IDEAL FOR REMOVING THE DUST FROM TURNTABLES, CAMERAS VIDEO RECORDERS, ETC. 5 PIECE KIT POWERED BY 4 X AA ALKALINE BATTERIES (not supplied)

Power: 4 x AA alkaline batts



FAX CLEANING KIT

REF : A150Z PRICE : £10.95

COMPLETE FAX CLEANING KIT COMPRISING CLEANING PAPERS, SOFT CLOTH, CLEANING SWABS, BAR BRUSH, BLOWER AND CLEANING SOLUTION.



??DO YOU RECEIVE OUR REGULAR NEWSLETTERS AND BULLETINS??

ARE YOU ON OUR DATABASE?

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CAR AUDIO

EQUALIZERS & AMPS

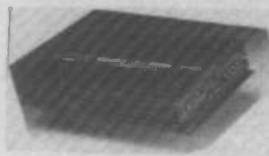
GRAPHIC EQUALIZER

REF : B003C PRICE : £38.95

11 Band graphic equalizer with sub woofer output and CD input. Sub woofer output has adjustable cut off frequency and level control. Standard DIN width for in dash or under dash mounting. Low level in/outputs by via phono sockets only.

Freq Response: 20-25000Hz
 Harmonic Distort: less than 0.05%
 S/N ratio: 85dB
 Separation: 65dB
 Control range: 12dB boost or cut
 Power: 12-14Vdc
 Dims: 178x140x25mm
 Control frequencies:
 60, 120, 250, 340, 500, 750, 1k, 2k, 4k, 6k, 10kHz

WITH PRE-AMP



2 x 150W MOSFET AMPLIFIER

REF : B005P PRICE : £169.00

High power stereo MOSFET power amplifier capable of delivering 2 x 150W rms into a 4ohm load at less than 0.02% THD or 300W rms in mono bridge mode. Inputs via phono sockets with gain controls. Outputs-screw clamp terminals.

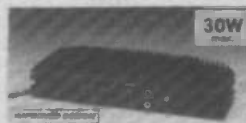
Output Power: 2 x 150W rms stereo or 300W bridged
 2 x 300W stereo or 600W bridged max
 Output Power: 95dB
 Signal/noise: 20-30kHz
 Freq Response: 150mV-3V adj
 Input sensitivity: 4 ohms
 Output impedance: 180
 Damping factor: 14.4Vdc 50A
 Power: 190x350x50mm
 Dims:

EQUALIZER/BOOSTER

REF : B004 PRICE : £25.95

Slimline 7 band equalizer/booster with 60W total output power into 4 speakers. Built in 3.5mm headphone socket. Front/rear fader control.

Output Power: 30W per channel max
 Freq Response: 20-20000Hz
 Input Impedance: 23 ohms
 Control Range: 12dB cut or boost
 Output Impedance: 4-8ohms
 Power: 12-14Vdc neg earth
 Dims: 149x133x28mm
 Control Frequencies:
 60, 150, 400, 1k, 2.4k, 6k, 15kHz



2 x 30W CLASS "A" AMPLIFIER

REF : B005LC PRICE : £36.95

Class "A" stereo in car amplifier capable of delivering 2 x 30W into 4ohms. Overall output level control.

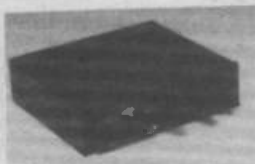
Output power: 2 x 30W stereo
 Signal/noise: 85dB
 Freq Response: 30-20000Hz
 Input sensitivity: 100mV-3V adj
 Input impedance:
 High level 100ohms
 Low level 20kohms
 Power: 14.4Vdc 5.5A
 Dims: 240x70x50mm

12W VEHICLE AMPLIFIER

REF : P101 PRICE : £38.95

The P101 provided low-cost amplification with a microphone input with level control. 'Auxiliary' input with level control and Fog/Stren output. The power output of 12 Watts can be fed into a combined speaker load of between 4 and 16ohm and the unit is supplied with mounting hardware.

Power Output: 12Watts RMS into 4ohm @ 1kHz, 13.8Vdc
 Output Impedance: 4 to 16ohm
 Mic Input: 3.5mV @ 20-50ohm
 Aux Input: 85mV @ 10kohm
 Power req: nominal 12Vdc
 Dimensions: 40x150x140mm



2 x 60W CLASS "A" AMPLIFIER

REF : B005LA PRICE : £54.95

Class "A" stereo in car amplifier capable of delivering 2 x 60W or 120W mono in bridge mode. Inputs direct from the speaker outputs of the car radio/cassette or low level phono inputs, with left and right level controls.

Output power: 2 x 60W stereo 0.1% THD
 120W mono 0.1% THD
 Signal/noise: >80dB
 Freq Response: 20-20000Hz
 Input sensitivity: 100mV-3V adj
 Input impedance: Low level 20kohms
 Output Impedance: 4ohms
 Power: 14.4Vdc 15A nom
 Dims: 240x140x50mm

2 x 200W MOSFET AMPLIFIER

REF : B005Q PRICE : £210.95

High power stereo MOSFET amplifier capable of delivering 2 x 200W rms into a 4ohm load at less than 0.02% THD (not mono bridgeable). Inputs via phono sockets with gain controls. Outputs via screw clamp terminals.

Output Power: 2 x 200W rms stereo
 Output Power: 2 x 400W stereo
 Signal/noise: 95dB
 Freq Response: 20-30kHz
 Input sensitivity: 150mV-3V adj
 Output Impedance: 4 ohms
 Damping factor: 180
 Power: 14.4Vdc 60A
 Dims: 190x434x50mm



CAR RADIO CASSETTE

REF : W22P1 PRICE : £21.95

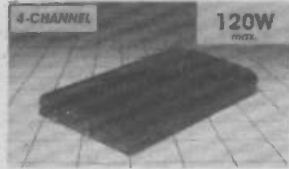
An excellent good quality low cost Car system incorporating Cassette Player with FM ST/FM/AM change switch, Volume, Tone and Balance tuning controls, Fast Forward and Eject Buttons and adjustable shafts.

Tape System: Capstan drive
 Wow and Flutter: <0.35%
 Distortion: <3%
 Signal to Noise: Better 45dB
 Radio Freq: AM:530-1620kHz
 FM:88-108mHz
 Signal to Noise: Better 45dB
 Loudspkr Imped: 4ohms or 8ohms
 Power Reqs: 11-16Volts
 Dims: 178x120.5x43mm



4 x 120W CLASS "A" AMPLIFIER

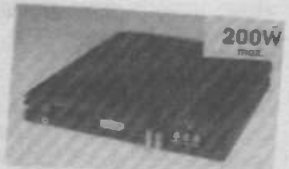
REF : B005N PRICE : £149.95
High power 4-channel Class "A" stereo in car amplifier capable of delivering 4 x 120W or 2 x 240W in bridge mode. Inputs direct from the speaker outputs of the car radio/cassette or low level phono inputs, with front and rear level controls. Additional bass boost (low gain) switch gives an additional 10dB of boost to the rear speakers when used with the built in 75Hz/150Hz low pass filter.



Output power: 4x120W or 2 x 240W (bridged)
Signal/noise: >90dB
Freq Response: 10-50000Hz
Input sensitivity: 100mV-3V adj
Input Impedance:
High Level input 100ohms
Low level 20kohms
Power: 14.4Vdc 60A nom
Dims: 400x240x50mm

2 x 200W CLASS "A" AMPLIFIER

REF : B005M PRICE : £109.95
High power Class "A" stereo amplifier capable of delivering 2 x 200W or 400W in bridge mode. Inputs direct from the speaker outputs of the car radio/cassette or low level phono inputs, with left and right level controls.



Output power: 2x200W stereo 0.05% THD
400W mono 0.2% THD
Signal/noise: >90dB
Freq Response: 10-50000Hz
Input sensitivity: 100mV-3V adj
Input Impedance:
High Level input 100ohms
Low level 20kohms
Output Impedance: 4ohms
Damping Factor: >180 into 4ohms
Power: 14.4Vdc 43A nom
Dims: 240x240x50mm

2 X 30W POWER BOOSTER

REF : B005JA PRICE : £19.95
Compact 2 x 30W power booster taking the usual 7W two speaker output from the car radio cassette and boosting it to a 30W per channel four speaker system.



Output Power: 30W per channel max
Freq Response: 20-21000Hz
Signal/noise ratio: Better than 40dB
Power: 11-16Vac 6A
Dims: 100x110x25mm

CAR STEREO RADIO CASSETTE PLUS TWO SPEAKERS

REF : W24P1 PRICE : £24.95
Yes, this must be one of the best deals we have ever offered! You get a brand new car stereo radio cassette and two excellent speakers for just £24.95!

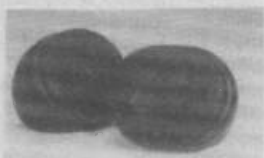


That's less than most companies charge for fitting!

CAR SPEAKERS

CAR TWEETERS

REF : B009T PRICE : £15.99
A pair of high quality in car tweeters which can be flush or pod mounted. Built in high bass filtering allows direct connection across existing car speakers.



Max power 40W
Freq Response: 3k-20kHz
Sensitivity 1W 1M: 93dB
Impedance: 4ohms
Dims: 75x60x50mm

8" ROUND WOOFER

REF : L032L PRICE : £37.99
An 8" high power woofer. foam rubber edged cambric cone with large hi flux magnet. Complete with detachable grill.
Size: 8"
Impedance: 4ohm
Power nom: 125W
Music Power: 250W
Freq Response: 35Hz-3.5kHz
Resonant Freq: 350Hz
Output SPL: 90dB
Magnet Weight: 40oz
Overall Weight: 3.9kg
Dims: 218(dia)x115mm



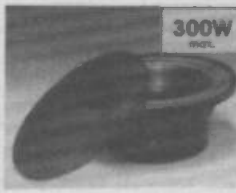
10" HIGH PERFORMANCE SUB WOOFER

REF : L034G PRICE : £47.99
High power high quality woofer for in car use. Rigid cambric cone with foam surround. Totally enclosed rigid frame. Complete with detachable grill.
Size: 10"
Impedance: 4ohm
Power nom: 140W
Music Power: 280W
Freq Response: 33Hz-3kHz
Resonant Freq: 35Hz
Output SPL: 92dB
Magnet Weight: 40oz
Overall Weight: 3.9kg
Dims: 261(dia)x138mm



12" HIGH PERFORMANCE SUB WOOFER

REF : L037D PRICE : £57.99
High power high quality woofer for in car use. Rigid basket totally enclosed the hi flux magnet assembly. Fitted with a strong foam surround cambric cone with a large 50mm voice coil.
Size: 12"
Impedance: 4ohm
Power nom: 150W
Music Power: 300W
Freq Response: 25Hz-3kHz
Resonant Freq: 25Hz
Output SPL: 95dB
Magnet Weight: 50oz
Overall Weight: 5.1kg
Dims: 318(dia)x172mm



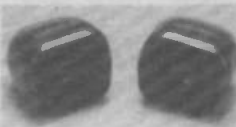
75W SHELF SPEAKERS

REF : B009E PRICE : £25.99
Hi Fi quality 3 way bass reflex rear shelf speakers. Unique design, gunmetal plastic with gold trim. 75W maximum power handling per cabinet.
Max Power: 75W
Freq resp: 80-18000Hz
Spkr sizes 3" woofer 2" mid 1" tweeter
Impedance: 4ohm
Dims: 249x97x120mm



40W SHELF SPEAKERS

REF : B009F PRICE : £11.95
Compact high quality double cone rear shelf speakers. Unique design, gunmetal plastic with gold trim. 40W maximum power handling per unit.
Max Power: 40W
Freq response: 100-18000Hz
Speaker sizes 3" double cone
Impedance: 4ohm
Dims: 114x148x110mm
Mounting Depth: 39mm



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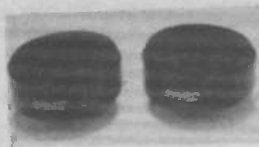
If not, send in a written request and we will gladly add your name and address to our mailing list immediately. Be one of the first to know what's new in stock - before it gets advertised nationally.

200W SHELF SPEAKERS

REF : B009L PRICE : £49.95

Co-axial 3 way shelf mounting speakers consisting of an 8" woofer with mid range and tweeter mounted on axis. These speakers feature a very broad frequency response. Ideal for digital systems. 200W max power handling per speaker.

Max Power: 200W
Freq Response: 18-30000Hz
Speaker size: 8" woofer 2.5" mid
1.5" tweeter
Impedance: 4 ohms
Mounting Depth: 82mm



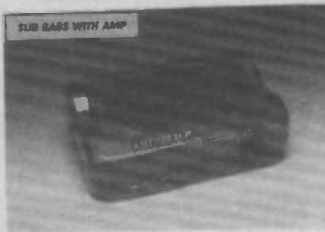
100W SUB BASS WITH AMP

REF : B005Z PRICE : £59.95

Compact self contained sub bass system designed to fit into the car's existing stereo speaker system without any modification.

Speaker Type: 6.5" bass reflex
Output power: 100W max
Freq response: 40-200Hz
Input level: Low - 550mV
High - 2.5V

Power: 14Vdc
Dims: 300x210x90mm

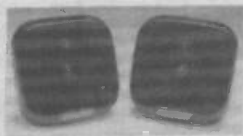


100W DOOR/SHELF SPEAKERS

REF : B009 PRICE : £26.95

Hi Fi quality 3 way co-axial flush mounting speaker system. Gunmetal with black grill. 100W max power handling per speaker.

Max Power: 100W
Freq Response: 60-20000Hz
Speaker Size: 6.5" woofer 2" mid
1" tweeter
Impedance: 4ohms
Mounting depth: 39mm



POWERTUBE

REF : B025 PRICE : £99.95

Powerful bass reflex sub bass tube utilizing an 8 inch speaker designed for fitting in the car boot using the strap provided.

Nominal Power: 100W
Max Power: 200W
Freq Response: 30- 150+ 3dB
Sensitivity 1W 1m: 91dB
Impedance: 4ohms
Dims: 226diax495mm



85W DOOR/SHELF SPEAKERS

REF : B009G PRICE : £16.95

Hi Fi quality 3 way co-axial flush mounting speaker system. Gunmetal with black grill. 85W max power handling per speaker.

Max Power: 85W
Freq Response: 80-22000Hz
Speaker Size: 4" woofer 1" mid
1" tweeter
Impedance: 4ohms
Mounting depth: 43mm



60W DOOR SPEAKERS

REF : B020C PRICE : £12.95

Dual cone door mounting speakers. Integral black mesh grill.

Max Power: 60W per speaker
Freq Response: 80-18000Hz
Speaker Size: 6.5" dual cone
Impedance: 4 ohms
Mounting depth: 30mm



150W DOOR/SHELF SPEAKERS

REF : B009M PRICE : £39.95

2 way co-axial flush mounting speaker system. Gunmetal with black grill. 150W max power handling per speaker.

Max Power: 150W
Freq Response: 60-20000Hz
Speaker Size: 6.5" woofer 1.75" tweeter
Impedance: 4ohms
Mounting depth: 46mm



30W DOOR SPEAKERS

REF : B020D PRICE : £10.95

130mm DIN dual cone speakers with black mesh grill.

Max Power: 30W per speaker
Freq Response: 120-18000Hz
Speaker Size: 5"
Impedance: 4 ohms
Mounting depth: 29mm



20W DOOR SPEAKERS

REF : B020E PRICE : £9.95

100mm DIN dual cone speakers with black mesh grill.

Max Power: 20W per speaker
Freq Response: 120-18000Hz
Speaker Size: 4"
Impedance: 4 ohms
Mounting depth: 29mm

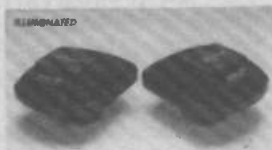


120W SHELF SPEAKERS

REF : B009K PRICE : £36.95

Co-axial 3 way shelf mounting speakers with a unique deflector plate above the mid range and tweeters to project the sound forward. The rear panel contains a 12V bulb for night illumination.

Max Power: 120W per speaker
Freq Response: 45-20000Hz
Speaker Size: 6.5" woofer 2" mid
1" tweeter
Impedance: 4 ohms
Mounting depth: 61mm



COMPONENT SPEAKER SYSTEM

REF : B020 PRICE : £28.95

2 x 3 way component speaker system comprising 2 x 6.5" woofers, 2 x 4" mid range, 2 x 2.25" tweeters and all leads, filters and fixing screws.

Max Power: 60W/ side
Freq Response: 60-20000Hz
Speaker Sizes: 6.5" woofers 4" mid
2.25" tweeters
Impedance: 4 ohms

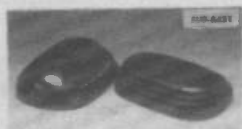


120W SHELF SPEAKERS

REF : B009N PRICE : £44.95

Unique design 3 air link system, shelf mounting speakers. The mid range and tweeters fire upwards and forwards whilst the bass speaker fires forwards into the car and downwards in to the boot to enhance the lower frequencies.

Max Power: 120W per speaker
Freq Response: 40-20000Hz
Speaker Size: 6.5" woofer 2.25" mid 1.5" tweeter
Impedance: 4 ohms
Dims: 267x195x77mm

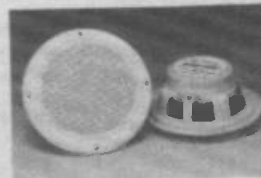


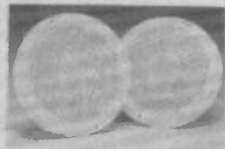
5" MARINE SPEAKERS

REF : B301 PRICE : £22.95

High quality co axial speaker system for use in marine environments. Molded in UV protected plastic with molded in magnet assembly. Supplied with fixing kit.

Max Power: 50W
Nom Power: 25W
Freq Response: 80-20000Hz
Speaker Size: 5" woofers 2" tweeter
Impedance: 4 ohms
Mounting Depth: 50mm
Overall dia: 154mm





6.5" MARINE SPEAKERS

REF : B302 PRICE : £26.95

High quality co axial speaker system for use in marine environments. Molded in UV protected plastic with molded in magnet assembly. Supplied with fixing kit.

Max Power: 80W
Nom Power: 40W
Freq Response: 60-20000Hz
Speaker Size: 6.5" woofers 2" tweeter
Impedance: 4 ohms
Mounting Depth: 56mm
Overall dia: 185mm

STEREO CROSSOVER NETWORK

REF : B007 PRICE : £27.95

200W per channel stereo in car crossover network for more sophisticated systems. Each channel is separated two ways into bass and treble in addition a sub bass output is provided for frequencies below 150Hz. Easy to mount black plastic case.

Type: 2 x 2 way
Max Power: 200W stereo
Crossover Freq: 3kHz 6dB/oct
Sub Woofer: 150Hz
Impedance: 4ohm
Dims: 240x155x55mm



STEREO CROSSOVER NETWORK

REF : B007A PRICE : £21.95

200W per channel stereo in car crossover network for more sophisticated systems. Each channel is separated three ways into bass, mid and treble. Easy to mount black plastic case.

Type: 2 x 3 way
Max Power: 200W stereo
Crossover Freq: 800&5kHz 6dB/oct
Impedance: 4ohm
Dims: 200x135x55mm



CAR CIRCUIT BREAKER

REF : B006G PRICE : £21.95

A circuit breaker that provides current protection for loads up to 70 amps.

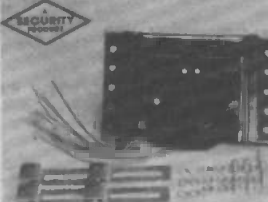


CAR RADIO/CASSETTE SLIDE BRACKETS

REF : B035 PRICE : £6.95

Slide out mount. All Metal. Mounting hardware included. Enables removal of unit from car simply by sliding out.

No wires to disconnect.



CD ADAPTERS

REF : B035D PRICE : £8.99

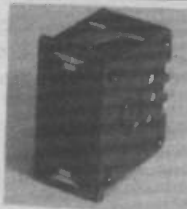
Compact disc adaptor built into a standard cassette. Designed to take the headphone output from the CD and feed it through the car cassette player into the car hi-fi system. No Power Required.



CD ADAPTERS

REF : B035E PRICE : £11.99

As B035D but supplied with a plug in 12Vac to 9Vdc PSU for the CD player.



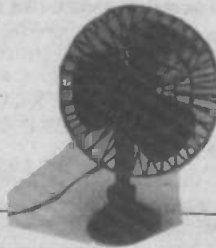
FADER CONTROL

REF : B046B PRICE : £5.99

A compact panel mounting fader control for balancing car stereo speakers. Thumbwheel control. Black.

Panel Cut Out: 31 x 18mm
Dims: 18x36x35mm

12V CAR EQUIPMENT



12Vdc CAR FAN

REF : B047 PRICE : £4.99

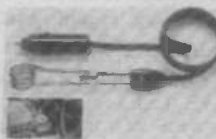
A 12Vdc oscillating car fan with a large suction cup for attaching the fan to the dashboard. Fully adjustable for tilt and angle. Supplied with a 1.7m lead fitted with a cigar lighter plug.



BATTERY ANALYSER/ MAP LIGHT

REF : B034A PRICE : £4.99

Plug in car battery charge analyser with built in two colour map light. 3 LEDs indicate the battery level. Green or white illumination. Flexible stem. Plugs directly into a cigar lighter socket.

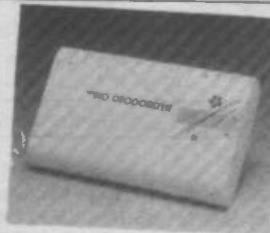


IMMERSION HEATER

REF : B049 PRICE : £2.95

A handy mobile immersion heater for boiling water soup etc. Plugs into cigar lighter socket. Lead 1m length.

Power: 12Vdc 120W



BIO DEODORIZER

REF : B047F PRICE : £15.99

A unique electronic bio deodorizer utilizing a solid block bacteria killing fragrance, gently wafted by an internal fan. Battery powered. Fragrance Blocks available.

Dims: 180x110x46mm
Power: 3 x C cells



BIO DEODORIZER FRAGRANCE

REF : B047FA PRICE : £2.99

Lemon Fragrance Bio Deodorizer Refill



AIR PURIFIER AND IONIZER

REF : B047D PRICE : £11.75

Compact stylish ionizer with coverage volume of 14m3. Ideal for in car use.

DC lead provided AC adaptor provided.

Power: 9-15Vdc or 220240Vac via adaptor
Dims: 160x95x43mm



AIR PURIFIER AND IONIZER

REF : B047E PRICE : £9.95

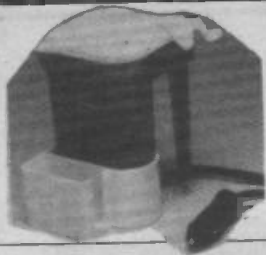
Compact stylish ionizer with coverage volume of 14m3. Designed for car, bus, lorry use. Removes unpleasant smells. Supplied with double sided adhesive pad.

Power: 12Vdc 1.8W
Dims: 110x110x65mm

££££ **SELL US YOUR OLD/UNWANTED/SURPLUS/EXCESS STOCK** ££££

All types of goods considered from Amp Meters to Strobes, Computers to Computer Software, Components, Electrical Accessories.... The list is endless. Only requirement is a minimum quantity of 50 units of each item. Give us a call

TURN YOU MISTAKES INTO CASH - IMMEDIATELY ASK FOR: PURCHASING MANAGER 0273 203500



12Vdc TRAVEL KETTLE
REF : B049A PRICE : £12.99
 12Vdc kettle complete with mounting stand, cup, cup holder. Plugs directly into car cigar lighter socket for power.
 Capacity: 0.5 pints (0.3litres)
 Power: 12Vdc 9A 14Vac 11A
 Dims: 143x125x112mm



DC-DC CONVERTER
REF : B034BA PRICE : £3.99
 A plug in DC-DC Converter with 3,4,5,6,7,5,9,12V outputs at 800mA. Plugs directly into car cigar lighter socket. Output via polarity reversible 2 pin plug to a spider plug.
 Output Voltage: 3,4,5,6,7,5,9,12V
 Output Current: 800mA max
 Input Voltage: 12Vdc nominal
 Weight: 100g



GROUND LOOP ISOLATOR
REF : B070 PRICE : £8.99
 Low level filter designed to isolate the ground between the car radio and the amplifier to prevent noise.
 Distortion: >0.001%
 Freq response: 40Hz - 32kHz
 Input/output impedance: 10kohms
 Dims: 60x33mm(dia)



BOOSTER ADAPTOR
REF : B070A PRICE : £8.99
 Converts high level output from car radio/cassette to low level input for in car amps. Provides ground loop isolation.
 Freq response: 40Hz-32kHz
 Input impedance: 4ohms
 Output impedance: 10kohms
 Dims: 60x33(dia)

OTHER 12 VOLT

12V DC PAPST FAN	EACH	10.00	10P33
12V UNIVERSAL SUPPLY KIT	EACH	25.00	25P13
6 DIGIT COUNTER 12V DC OP	EACH	2.00	2P342
IN CAR PSU 12V, CIG PLUG	EACH	5.00	5P167
PSU 750MA 3/4 5/6 2V DC	EACH	5.00	5P197
PIEZO SIREN 12V DC 150mA	EACH	7.00	7P26



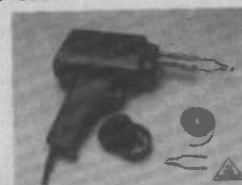
AUTO REVERSE RADIO/ CASSETTE PLAYER
REF : B002E PRICE : £74.99
 DIN size auto reverse car radio/cassette player with electronic PLL tuning and digital clock with back-up memory facility. LCD display with 6 channel soft touch preset stations on each of MW/LW/FM bands (18 total). Volume, bass, treble and balance controls. Mono/stereo, frequency/time, radio band and seek switches. Illumination of controls and detachable control keypad for security. CD input socket.
 Output Power: 25W per channel max.
 Frequency Range:
 LW: 144-280kHz
 MW: 550-1600kHz
 FM: 87.5-108MHz
 Frequency Response: 100-10,000Hz
 Power: 13.8Vdc

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If not, send in a written request and we will gladly add your name and address to our mailing list immediately. Be one of the first to know what's new in stock - before it gets advertised nationally.

100W GUN

Well balanced 100W soldering gun. Complete kit containing soldering gun, spare tip, solder paste and flux cored solder.
Ref : YO61N Price : \$9.95

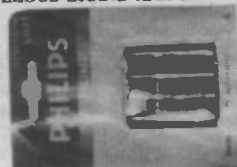


Programmable Thermostat

Microprocessor controlled complete with manual allows six changes per day Monday to Friday and four per day Saturday and Sunday. Summer and Winter schedules. temperature and timings are user programmable, with manual override. Changeover contacts rated at 8 amps - 240 volts.
Ref : F455N Price : \$49.95



FAMOUS BRAND AAA BATTERIES



PHILIPS AAA 1.5V ALKALINE BATTERY PACK
PACKET OF 4

IDEAL FOR: REMOTES
 WALKMANS
 CAMERAS
 ETC, ETC, ETC

REF: B0304 PRICE \$1.00

COMMODORE 64 COMPUTER

Commodore 64 Home Computer System. Excellent low cost computer for all your business, household and leisure computerised activities. **YOU CAN EVEN LEARN TO PROGRAM IN BASIC ON THIS NEAT LITTLE NUMBER!!**
 Features:

- *** 64K Memory
 - *** Lots of Colours (16)
 - *** Sound
 - *** Music and special effects possible
 - *** Complete with Power Supply Unit
- REF: 43P99

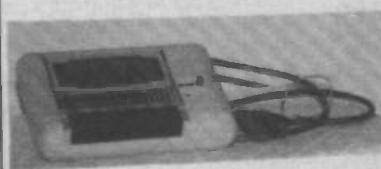
£42.99



C64 DATA RECORDER

The Commodore 1530 Datasette unit is a device for storing and recalling computer programs on ordinary cassette tapes. It can be used for saving programs you have written and wat to recall for later use. It can also be used to read pre-recorded programs that you have purchased.

£19.99



REF: 20P2

BATTERIES, BOXES & BULBS

BATTERIES

RECHARGEABLE LEAD ACID BATTERIES

A range of rechargeable lead acid batteries suitable for high cyclic and standby applications. Constructed in sealed, rectangular high impact plastic cases with 5mm spade connections.



12V 1.2Ah 94x41x50mm 0.54kg	REF: P013A	PRICE: £10.95
12V 6Ah 150x85x93mm 2.69kg	REF: P013B	PRICE: £17.99
12V 1.9Ah 177x34x60mm 0.95kg	REF: P013C	PRICE: £11.95

BATTERY CHARGER

REF: P011D PRICE: £8.99

Universal NiCad Battery charger
Capable of charging up to 4 x 1.5V cells and 2 x PP3 at one time.

Input Voltage: 220/240Vac 50Hz
Charge Current: 130mA max (1.5V)
20mA max (9V)
Charge time: See instructions
Charges: AAA, AA, C, D, PP3
Dims: 181x89x51mm

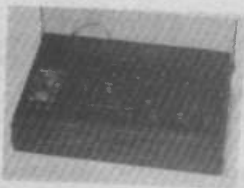


BATTERY CHARGER

REF: P011M PRICE: £16.99

A deluxe universal charger which accepts AAA, AA, C, D, N & PP3 cells. Batteries can be charged singly or in groups.

Input Voltage: 220/240Vac 60Hz
Dims: 280x188x68mm
Weight: 1.5kg



FAST CHARGER with DISCHARGER

REF: P011K PRICE: £24.99

A compact robust unit
Built in timer prevents overcharge
Discharge facility

Power: 220/240Vac 50Hz
Charge Time: 4 hours
Charges: AAA, AA, C, D, PP3



BATTERY CHARGER

REF: P011B PRICE: £6.99

Compact NiCad Battery charger.
High or low charging current with LED indicators. Charge time 6-14 hours.

Input Voltage: 220/240Vac 50Hz
Charge Current: 32-72mA
Charge time: 6-14 hours
Charges: 4xAA or 4xAAA
Dims: 125x75x37mm



BATTERIES

AAA NICAD BATTERY PACK (EX EQUIP)	PKT10	4.00	4P92
AA SIZE BATTERY PACK 1.2V 500mAh	PKT10	10.00	10P125
AA NICAD BATTERY 1.2V 500mAh	PKT4	4.00	4P44
C SIZE NICAD BATTERY 1.2V 1.2AH	PKT2	4.00	4P73
D SIZE NICAD BATTERY 1.2V 1.2AH	PKT4	9.00	9P12
PP3 9V NICAD BATTERY 8.4V 110mAh	EACH	6.00	6P26V
SEALED LEAD ACID BATTERY 12V 38Ah	EACH	46.00	46P3
<i>Heavy duty waterproof batteries extremely heavy 15kg each. 195x165x160mm.</i>			
SEALED LEAD ACID BATTERY 12V 2Ah	EACH	4.00	4P77
<i>200x25x60mm</i>			
CALCULATE & BUTTON CELLS MIXED	PKT10	1.00	CD210
BATTERY HOLDER FOR 6 D CELLS	EACH	1.00	BD286
BATTERY HOLDER FOR 2 D CELLS	PKT2	1.00	BD287
BATTERY CONNECTORS PP3 & LEADS	PKT5	1.00	BD759
TRANSFORMER TYPE NICAD CHARGER	PKT2	1.00	BD385

BOXES

ABS PROJECT BOXES IN BLACK PLASTIC

ABS PROJECT BOX 90x50x25mm	EACH	1.00	CD25
ABS PROJECT BOX 110x56x20mm	EACH	1.00	CD26B
ABS PROJECT BOX 100x75x40mm	EACH	1.00	CD27A
ABS PROJECT BOX 150x100x55mm	EACH	2.00	2P341
ABS PROJECT BOX 165x119x75mm	EACH	3.00	3P49

ABS PROJECT BOXES WITH ANODISED ALUMINIUM TOP PANELS

ABS PROJECT BOX 90x45x30mm	EACH	2.00	2P410
ABS PROJECT BOX 125x70x40mm	EACH	3.00	3P410
ABS PROJECT BOX 220x135x75mm	EACH	5.00	5P510

BOXES PLASTIC WITH SCREW ON LID

PROJECT BOX 218x130x85mm	EACH	4.00	4P7
PROJECT BOX 220x157x65mm	EACH	4.00	4P8

ALUMINIUM 2 PIECE CASES COVERED IN PROTECTIVE FILM

55x40x25mm	EACH	1.00	CD410
105x125x35mm	EACH	3.00	3P411
155x105x45mm	EACH	4.00	4P152
175x125x45mm	EACH	5.00	5P211

BULBS AND INDICATORS

1.5V 300MA MES BULBS	PKT8	1.00	CD10
2.5V 200MA MES BULBS	PKT8	1.00	CD11A
3.5V 300MA MES BULBS	PKT8	1.00	CD12
6.0V 60MA MES BULBS	PKT8	1.00	CD13
12V 80MA MES BULBS	PKT8	1.00	CD14
24V 80MA MES BULBS	PKT8	1.00	BD694
BATTEN HOLDER FOR MES BULBS	PKT4	1.00	BD895
AMBER INDICATORS/NEONS	PKT3	1.00	BD179
AMBER INDICATORS/NEONS ROUND	PKT6	1.00	BD180
PIR O/D MOTION SENSOR BULB	PKT2	12.00	12P43
5mm RED LED	PKT15	1.00	BD893
5mm RED LED	1000	44.00	44P1
5mm GREEN LED	PKT12	1.00	BD894
5mm GREEN LED	1000	54.00	54P1
5mm YELLOW LED	PKT10	1.00	CD5
5mm YELLOW LED	1000	64.00	64P1
3mm RED LED	PKT15	1.00	CD4
3mm RED LED	1000	44.00	44P2
3mm GREEN LED	PKT10	1.00	CD6
3mm GREEN LED	1000	54.00	54P2
3mm YELLOW LED	PKT10	1.00	CD7
3mm YELLOW LED	1000	64.00	64P2
5mm RED FLASH LED 9-12V DC	PKT4	2.00	2P335
5mm GREEN FLASH LED 9-12V DC	PKT4	2.00	2P336
8mm RED FLASH LED 9-12V DC	PKT2	2.00	2P337
8mm GREEN FLASH LED 9-12V DC	PKT2	2.00	2P338
3 COLOUR LED	PKT2	1.00	BD611
LED BUMPER PACK 100	PKT100	5.00	X5P4
NEON INDICATORS 240V.			
sq. front, 10mm dia. panel mount	PKT10	1.00	X1P45
TWIN NEON INDICATORS			
25mm sq. red/green 240V	PKT5	1.00	X1P51

5 CELL NICAD CHARGER STANDBY PCB

Board including 5 x AA Nicads, fast and trickle charge facility, c/o relay. Now supplied with circuit diagram & connection details courtesy Mr Briggs of Wilmslow. One useful feature of this charger is that after a power failure should the battery voltage be below a set value an LED glows to indicate high charge rate dropping when set value is reached. Dims: 150x80mm

Price: £2.99 Ref: Y3P2 Qty: Each

Price: \$9.99 Ref: Y10P3 Qty: Pkt 4

BOOKS



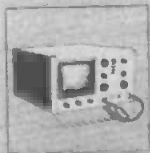
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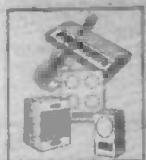
How to Use
Oscilloscopes
and Other Test
Equipment



From Atoms
to Amperes



Loudspeakers
for
Musicians



Magic Electronic
Projects



A Beginners Guide
to MIDI



Circuit Source
Book 2



Practical Electronic
Design Data



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75mm x 2.4mm NYLON WHITE CABLE TIES	100	£1.00	BD868	CLOCK RADIO standard unit with LED display - mains. AM/FM	EACH	£10.00	10P3J
75mm x 2.4mm NYLON WHITE CABLE TIES	1000	£5.00	5P181	2 HOUR TIME SWITCH CLOCK	EACH	£2.00	2P89
142mm x 3.2mm NYLON WHITE CABLE TIES	100	£3.00	3P104	LED ALARM CLOCK standard unit with LED display- mains	EACH	£5.00	B5P3
142mm x 3.2mm NYLON WHITE CABLE TIES	1000	£14.00	14P6	ELECTRIC COOKER CLOCK MAINS OP	EACH	£1.00	BD211
385mm x 5mm NYLON WHITE CABLE TIES	100	£10.00	10P97	AMSTRAD CT1 clock/radio AM/FM/LW	EACH	£6.00	T6P1
CABLE TIE BASES 21 x 21mm SELF ADHES	100	£5.00	5P182	COILS			
CABLE TIE BASES 28 x 28mm SELF ADHES	100	£7.00	7P25	CAR IGNITION COIL	1	£6.00	Q6P2
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SPIRAL CABLE WRAP FOR 12-70mm BUNDLES	10M	£4.00	4P74	AMSTRAD CT1 clock/radio AM/FM/LW	EACH	£6.00	T6P1
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FEET				CONNECTIONS			
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20mm SQUARE SELF ADHESIVE FEET	8	£1.00	BD891	12 WAY 5A CONNECTOR STR	4	£1.00	BD158
12.5mm SQUARE SELF ADHESIVE FEET	12	£1.00	BD892	12 way 25A	2	£1.00	BD159
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MIXED PACK ELECTROLYTIC CAPS	40	£2.00	2P287	4mm BANANA PLUG RED	4	£1.00	BD953
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CAPACITORS EHT				4mm BANANA SOCKET BLACK			
1000PF 12KV CERAMIC	2	£1.00	BD439	4mm BANANA SOCKET BLACK	4	£1.00	BD956
470PF 8KV CERAMIC	4	£1.00	BD440	CROCODILE CLIPS			
150PF 8KV CERAMIC	10	£1.00	BD441	(10 BLACK 10 RED)	1	£2.00	2P309
100PF 8KV CERAMIC	5	£1.00	BD442	BNC 50 OHM PLUG	3	£2.00	2P311a
68PF 8KV CERAMIC	10	£1.00	BD443	SCART PLUG	1	£1.00	BD957
CAPACITORS AC				CO-AX PLUG (TV TYPE)			
8UF 440V 97 x 45 mm	1	£1.00	BD632	CO-AX SOCKEY (TV TYPE)	2	£1.00	BD959
1UF 440V 48 x 38 mm	2	£1.00	BD633A	2.5mm JACK PLUG	5	£1.00	BD960
CAPACITORS ELECTROLYTIC				3.5mm JACK PLUG			
4.700UF 25V AXIAL	4	£1.00	BD613	3.5mm MONO JACK SOCKETS.	8	£1.00	BD697
1.000UF 25V RADIAL	5	£1.00	CD32A	CHASSIS MOUNT BNC SOCKET.			
470UF 25V RADIAL	6	£1.00	CD31A	(4 HOLE)	2	£1.00	BD851
220UF 25V RADIAL	10	£1.00	CD30A	9 WAY D TYPE MALE SOLDER			
100UF 25V RADIAL	12	£1.00	CD29A	GOLD PLATED	3	£1.00	BD941
47UF 25V RADIAL	15	£1.00	CD28A	9 WAY D TYPE FEMALE			
22UF 25V RADIAL	20	£1.00	CD27A	SOLDER GOLD PLATED	3	£1.00	BD942
10UF 25V RADIAL	20	£1.00	CD26A	PLASTIC HOOD FOR			
73.000uf 15V ELECTROLYTIC 105x75mm	2	£2.00	X2P7	9 WAY ADAPTOR	3	£1.00	BD943
CAPACITORS VARIABLE				15 WAY D TYPE MALE			
AIR SPACED 2 GANG 1/4" SPINDLE 365pf	2	£1.00	BD36	SOLDER GOLD PLATED	2	£2.00	BD944
Solid di-electric AM/FM Sections.2 Gang	2	£1.00	BD37	15 WAY D TYPE FEMALE			
COUNTERS				SOLDER GOLD PLATED			
7 DIGIT 24V COUNTER	1	£2.00	2P267	PLASTIC HOOD	2	£2.00	BD945
6 DIGIT COUNTER 12V DC OPERATION	1	£2.00	2P342	FOR 15 WAY CONNECTOR	2	£1.00	BD947
FREQUENCY COUNTER	1	£75.00	Y134	25 WAY D TYPE			
CRYSTALS				MALE SOLDER GOLD PLATED			
1000 KHZ CRYSTAL	1	£1.00	BD866	25 WAY D TYPE	3	£2.00	2P306
QUARTZ XTAL 3.579MHz	5	£1.00	X1P43	FEMALE SOLDER. GOLD PLTD	3	£2.00	2P307
XTAL OSCILLATOR MODULE				PLASTIC HOOD			
25.175MHz 20x12x5mm	2	£1.00	X1P44	FOR 25 WAY ADAPTOR	3	£2.00	2P308
COUNTERS				XLR 3 PIN INLINE			
7 DIGIT 24V COUNTER	1	£2.00	2P267	METAL PLUG. LATCHING	1	£2.00	2P354
6 DIGIT COUNTER 12V DC OPERATION	1	£2.00	2P342	XLR 3 PIN INLINE METAL			
FREQUENCY COUNTER	1	£75.00	Y134	SOCKET. LATCHING	1	£2.00	2P355
CRYSTALS				BNC CHASSIS PLUG			
1000 KHZ CRYSTAL	1	£1.00	BD866	SPIRE CLIPS	4	£1.00	X1P23
QUARTZ XTAL 3.579MHz	5	£1.00	X1P43	takes upto 5mm self tapper	40	£1.00	X1P38
XTAL OSCILLATOR MODULE							
25.175MHz 20x12x5mm	2	£1.00	X1P44				

TALKING CLOCK

A travelling LCD alarm clock which incorporates a talking facility to let you know what time it is even in the dark! Has both 24 or 12 hour format, hour report facility, alarm function with a choice of 2 different alarm sounds, either **Beep** or **Cockcrow**.
REF : 14P200 **PRICE : £14.00**

*****DC SOCKETS*****

REF : V1P5 PRICE : 1.00
PKT 10

Chassis mount standard DC power socket
 (switched so as to disconnect battery etc)

COMPUTERS & ACCESSORIES

COMPUTERS

COMMODORE 64 COMPUTER - Working units, ideal for household, business or leisure, complete with PSU and Manual.	EACH	49.99	W50P1
386SX-33 SYSTEM Complete build yourself 386 Machine. Total System	EACH	565.54	BPC/386
486DX-33 SYSTEM Complete build yourself 486 Machine. Total System	EACH	927.74	BPC/486

See column opposite for more details.

DISC DRIVES

3" AMSTRAD DISC DRIVES SS EME157	EACH	30.00	30P20
3.5" CUSTOMER RETURNED DRIVES	EACH	7.00	7P1R
3.5" DISC DRIVE & CONVERSION KIT BBC	EACH	9.00	V9P1
3.5" 1.44MB DISC DRIVE	EACH	33.00	BPC/DD5
5.25" 1.2 MB DISC DRIVE	EACH	39.00	BPC/DD6
5.25" CUSTOMER RETURNED DRIVES	EACH	7.00	7P2BR
5.25" 360K DISC DRIVE	EACH	8.99	X9P1
DISC MOUNTING KIT 5.25 OR 3.5	EACH	5.00	BPC/DD07

HARD DRIVES

10MB TANDON HARD DRIVE MFM/TM252	EACH	25.00	V25P1
42MB IDE HARD DRIVE - 17MS	EACH	99.00	BPC/DD01
89MB IDE HARD DRIVE - 15MS	EACH	166.00	BPC/DD02
130MB IDE HARD DRIVE - 15MS	EACH	215.00	BPC/DD03

MONITORS

VGA 14" MONITOR	EACH	49.00	49P1
CTM644 COLOUR MONITOR ROB INPUT REFURBISHED	EACH	79.00	V79P4
SVGA 14" MONO .28dp	EACH	90.00	BPC/MO1
SVGA 14" COLOUR .39dp	EACH	178.00	BPC/MO2
SVGA 14" COLOUR .28dp	EACH	206.00	BPC/MO3
PHILIPS 9" MONO MONITOR - Uncased	EACH	20.00	20P26
COMPOSITE VIDEO KIT Convert Composite	EACH	8.00	8P30

Video info separate H sync, V sync

PC CASES

DESKTOP CASE - includes PSU	EACH	51.60	BPC/C1
DELUXE SLIMLINE CASE - includes PSU	EACH	60.00	BPC/C2
MINI TOWER - includes PSU	EACH	51.60	BPC/C3
DELUXE MIDI TOWER - with PSU, Twin Fan	EACH	90.00	BPC/C4

MOUSE

2 BUTTON SERIAL MOUSE 3.5" SOFTWARE	EACH	8.40	BPC/M6
3 BUTTON SERIAL MOUSE 3.5" SOFTWARE	EACH	9.60	BPC/M7

VIDEO/ADD ON CARDS

256K 8 bit SVGA Card	EACH	22.20	BPC/VC1
512K TRIDEN 9000 16 BIT SVGA	EACH	31.20	BPC/VC2
1MB TRIDENT 8900 16 BIT SVGA	EACH	45.00	BPC/VC3
1MB CIRRUS AVGA3 (16.7M COL)	EACH	48.00	BPC/VC4
1MB TSENG MULTIMEDIA	EACH	82.80	BPC/VC5
MULTI I/O CARD 2S/1P/2FDD/2HDD	EACH	11.00	BPC/AOC01
ADLIB SOUND CARD WITH SPEAKERS	EACH	37.00	BPC/AOC02
MEDIA CONCEPT +2 (SOUNDBLASTER 2 COMPACT)	EACH	77.00	BPC/AOC03

MOTHERBOARDS

386SX-33 ACER CHIPSET	EACH	82.80	BPC/MB2
386SX-40 UMC CHIPSET W/64K	EACH	110.00	BPC/MB3
486SX-25 UMC CHIPSET W/64K	EACH	191.00	BPC/MB4
486DX-33 UMC CHIPSET W/256K	EACH	378.00	BPC/MB5
486DX-66 UMC CHIPSET W/256K	EACH	515.00	BPC/MB6

MODEMS

WESTINGHOUSE PC MODEM - 1200/75	EACH	6.00	6P478
AMSTRAD PPC INTERNAL MODEM CARDS	EACH	10.00	Y10P9

EPROMS EPROMS EPROMS EPROMS EPROMS

All devices are clean pulls.

27C64 10 for	£5.00	REF: G5P1
27C128 10 for	£8.00	REF: G8P1
27C256 10 for	£9.00	REF: G9P1
27C512 10 for	£10.00	REF: G10P2

AMAZING PRICES AMAZING PRICES AMAZING PRICES AMAZING PRICES AMAZING

386SX-33 SYSTEM

386SX-33 Motherboard	82.80
Case	51.60
2MB Ram	65.00
42MB Hard Drive	99.00
512K SVGA Card	31.20
3.5" FDD	32.34
Multi I/O Card	11.00
SVGA Colour Monitor	174.00
102 Key Keyboard	18.60
TOTAL SYSTEM PRICE:	£565.54
Built Fee (if required)	42.00
BUILT SYSTEM PRICE:	£607.54

486DX-33 SYSTEM

486DX-33 Motherboard	378.00
Case	51.60
2MB Ram	65.00
89MB Hard Drive	166.00
512K SVGA Card	31.20
3.5" FDD	32.34
Multi I/O Card	11.00
SVGA Colour Monitor	174.00
102 Key Keyboard	18.60
TOTAL SYSTEM PRICE:	£927.74
Built Fee (if required)	42.00
BUILT SYSTEM PRICE:	£969.74

Prices include 15min telephone technical support. Additional support available at £7.50 per 15min unit.

NOTE: Up to date prices for all PC stock on application prices subject to change without prior notification

QL MODEMS

Made from the Sinclair QL Computer they consist of two plug together units. The first is a Manual dial V23 modem. 1200/75 baud and 1200/1200 baud 1/2 duplex. Fully cased with a standard BT socket for a telephone and a standard lead to plug into the phone socket. BT approved. The other unit is a RS232 control unit designed for the above unit. It provides full two way buffering and flow control from 75-9,600 baud. The idea being that you plug the two units together and you end up with a reasonable modem. There is an input on the unit for a power supply (this would have originally come from the QL's supply). You will have to sort out your own PSU. Price: £12.00 Ref: Y12P2

PPC MODEM

£10.00 EACH REF: Y10P9

The Amstrad PC 2000, Intelligent modem was originally designed to fit into the laptop computers and has a host of redeming features such as Hayes compatible, Call monitoring, Auto dialling, Auto answering operating to V21, V22, V22 Bis and V23 standard at 75-240 bps. Supplied with a BT lead attached and an on board BT socket. The PCB measures 200 x 120mm. No technical or connection details available with this product.

COMPUTER BARGAINS

FROM TIME TO TIME WE ACQUIRE MASS STOCKS OF ASSORTED COMPUTERS, USUALLY AMSTRAD BUT WE HAVE HAD IN THE PAST EVEREX, ZENITH, COMPAQ AND MANY OTHER HIGH QUALITY FAMOUS BRAND NAMES.

AT THE TIME OF CATALOGUE PRODUCTION, WE HAVE IN ONE OF OUR WAREHOUSES AN ASSORTED NUMBER OF THE FOLLOWING COMPUTER PRODUCTS:-

CUSTOMER RETURNED PC BASES from only £19.00

All the following "CUSTOMER RETURNED" Units are sold without guarantee, and basically have been returned to a retailer after purchase. These units are not checked by the supplier - there may well be nothing wrong at all - but WE DO NOT GUARANTEE this. Its POT LUCK/enthusiasts dream! A very good cheap way to learn about the insides of a computer, and you may well get a working one into the bargain.

AMSTRAD 1512SD BASE UNIT

8086 Processor with one 5.25" disc drive, motherboard with video controller, 512K memory. No keyboard, mouse or power supply. NON RETURNABLE. No guarantee
REF : AM19P1 PRICE : £19.00

AMSTRAD 1512DD BASE UNIT

8086 Processor with two 5.25" disc drives, motherboard with video controller. 512k Memory. No Keyboard, mouse or power supply. NON RETURNABLE
REF : AM25P1 PRICE : £25.00

AMSTRAD 1640SD BASE UNIT

8086 Processor with one 5.25" disc drive, motherboard with video controller and 640k memory. No keyboard, mouse or power supply. NON RETURNABLE
REF : AM25P2 PRICE : £25.00

AMSTRAD 1640DD BASE UNIT

8086 Processor with two 5.25" disc drives, motherboard with video controller and 640k memory. No keyboard, mouse or power supply. NON RETURNABLE
REF : AM30P1 PRICE : £30.00

REFURBISHED/EX-DEMO PC BASES from only £49.00

All the following Units have been fully tested and are in working, as new condition. These units carry out standard 30 day guarantee. All units come complete with Keyboard, mouse, 8086 processor, disc drive(s), motherboard with video controller and memory (as stated within product code). No power supply is supplied although a suitable 150W PSU can be purchased from us. (software and manuals not supplied)

AMSTRAD 1512SD

512k single drive unit Motherboard, keyboard and mouse. Guaranteed 30 days.
REF : AM49P1 PRICE : £49.00

AMSTRAD 1512DD

512k Double drive unit Motherboard, keyboard and mouse. Guaranteed 30 days
REF : AM59P1 PRICE : £59.00

AMSTRAD 1640SD

640k Single drive unit Motherboard, keyboard and mouse. Guaranteed 30 days.
REF : AM69P1 PRICE : £69.00

AMSTRAD 1640DD

640k Double drive unit Motherboard, keyboard and mouse. Guaranteed 30 days
REF : AM79P1 PRICE : £79.00

We can supply a 150W power supply unit which when fitted with a 14pin DIN socket will be suitable for all the above referenced Computer units.
REF : AM10P1 PRICE : £10.00

IBM COMPATIBLE LAPTOP COMPUTERS

From time to time we get a bundle of fabulous Laptop computers. At the time of publishing this catalogue (Dec 93) we have in stock a limited number of such items. Please ring to find out our current stock situation! The specification of these units is as follows:

** Compatibility	IBM compatible
** Operating System	MS-DOS
** Manufacturer	AMSTRAD
** Memory	512 or 640K
** Screen	Green Supertwist LCD
** Keyboard	Full QWERTY (no always UK)
** Drive	3.5" 720k
** I/O Ports	RS232
.....	Video out
** Power	Battery DC supply Mains adaptor

PPC 512SD REF: AM99P1 PRICE: £99.00
Single drive 512k memory

PPC 512DD REF: AM109P1 PRICE: £109.00
Double drive 512k memory

PPC 640SD REF: AM129P1 PRICE: £129.00
Single drive 640k memory & modem

PPC 640DD REF: AM139P1 PRICE: £139.00
Double drive 640k memory & modem

We also have Amstrad PPC MODEMS suitable for these portable units, so you can add one to the 512k version yourself.
REF : AM45P1 PRICE : £45.00

MORE COMPUTER ACCESSORIES



QUICKSHOT PYTHON 3
REF : T165W PRICE : £9.95
 • Ergonomic new design
 • Compatible Sega Megadrive
 • 16 bit video entertainment system
 • 3 Fire buttons
 • Start button
 • 8 direction BioGrip max control
 • High speed turbo fire capability
 • 6 foot cable with 9 pin connector
 • 4 stabilising suction cups



CPU STAND
REF : T200G PRICE : £5.99
 Allows desk top computers to be floor standing. Accepts cases 4"-7.5" (102mm to 190mm)

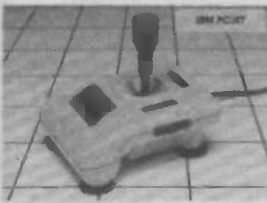


MONITOR STAND
REF : T205B PRICE : £39.95
 Designed to be desk or wall mounted. Lifts both monitor and keyboard off desk. No wall fixings supplied. Fix only with Rawbolts or similar fixings.
 Max desk thickness: 60mm
 Base area for monitor: 350x505mm



MOUSE AMIGA/ATARI ST
REF : T165QF PRICE : £12.95
 • Mouse for Amiga/Atari ST
 • Resolution: 200dpi

KEYBOARD ADAPTOR
REF : T201E PRICE : £2.50
 AT/PS2 6 pin mini DIN plug to 5 pin DIN plug 180°



PC JOYSTICK
REF : T167 PRICE : £10.95
 • IBM PC/XT/AT/386/486 systems
 • Smooth tracking control stick
 • Linear potentiometers
 • X & Y axis trim control switch
 • Auto fire on/off switch
 • Positive response fire buttons
 • 4 suction cups
 • Contoured base
 • X & Y axis mode selector



KEYBOARD REVERSE ADAPTOR
REF : T201F PRICE : £2.50
 AT/PS2 6 pin mini DIN plug to 5 pin DIN socket 180°

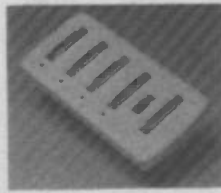


PARALLEL AUTO SWITCH
REF : T200P PRICE : £19.95
 Allows connection of up to two PC's to one parallel device (plotter, printer etc) LED's show which PC has access. Connection is made via 25 pin D sockets. No external power source is required. Time out 8 secs.



PC GAME CARD
REF : T167B PRICE : £11.95
 • Intelligent software controlled game card
 • IBM PC/XT/AT/386/486 systems
 • Complete with easy to use menu driven calibration software on 5.25" floppy disc
 • Software selectable clock speed
 • Manual clock speed adjustment
 • Hot key program for fine tuning
 • 215 pin joystick ports - supports 1-2 joystick operation.

PARALLEL AUTO SWITCH
REF : T200R PRICE : £32.95
 Allows connection of up to four PC's to one parallel device (plotter, printer, etc). LED shows which PC has access. Connection is made via 25 pin D sockets. No external power source is required. Time out 6-8 seconds.



WARRIER 5 JOYSTICK
REF : T165N PRICE : £11.95
 • Ergonomic new design
 • Compatible IBM PC/XT/AT
 • Free floating operating mode
 • Auto centering operating mode
 • Smooth tracking BioGrip
 • 2 positive response fire buttons
 • High speed autofire capability
 • X & Y axis trim control switch
 • 6 ft cable with 15 pin connector
 • 4 stabilising suction cups

BREAKOUT BOX
REF : T2008 PRICE : £19.95
 RS232 breakout box will test RS232 serial interfaces and allow easy re configuring using the 20 jumper leads supplied. 24 DIP switches allow pin-pin connections or separation. 10 bi colour LEDs show the current status of the principal RS232 connections and two spare LEDs can be connected to any other pin using the jumpers.



DATA RECORDER
REF : T150A PRICE : £19.95
 Computer data recorder suitable for Vic-20 and Commodore 64 computers. Record/playback levels preset to be compatible with computers. Tape counter. Auto stop.
 Lead Length: 1.35m
 Dims: 197x158x53mm

PRINTER MECHANISMS INCLUDING PRINT HEAD

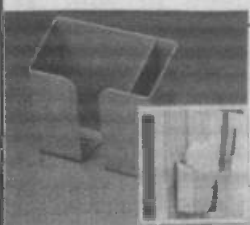
Amstrad LQ9500 Printer Mechanisms, complete with:
 • Print head
 • Paper roller: 10" wide
 • Dims: 14.5"x5.5"x2.5"
 • 2 Stepper motors

Complete Unit
REF: G10P3 PRICE: £10.00
Print Head Only
REF: X5P6 PRICE: £5.00

SCSI TERMINATORS

Standard D50 Male plug-in terminators for SCSI Drive Systems. Normally retail at around £20.00!

AMAZING VALUE
£5.00 EACH
REF : W5P6



MOUSE HOLDER
REF : T200C PRICE : £1.95
 Universal mouse holder designed to accept the majority of mice. Also has small compartment for pens.

MOUSE MAT
REF : T200B PRICE : £1.95
 Helps keep the mouse free of dirt and aids tracking. Rubber backed.

SORRY NO ILLUSTRATION AVAILABLE ON THIS PRODUCT

12V 2A PSU

A very useful power supply, not the plug in type, with a handy 13.9V @ 1.9A. This is a cased PSU measuring 100 x 70 x 60mm. Normal 240V mains input via a mains lead, the output is via a DC power plug also on a lead. Originally made for the Amstrad laptop computers, this **quality PSU would suit other machines, car phones, CB's, infact any item requiring a 12V 2A supply.**

Our Price: £9.99 EACH Ref: Y10P8

PRINTER MECHANISMS INCLUDING PRINT HEAD

Amstrad DMP4000 Printer Mechanisms, complete

with: Print head: 24 pin
Paper roller: 16.5" wide
Carriage Dims: 20"x9"x3"
2 stepper motors CPS SPEC: NLQ 50 Draft 200

Complete Unit: REF:G12P9 PRICE: £12.00
Print Head Only: REF:G7P8 PRICE: £7.00

TAPE STREAMERS

IRWIN TAPE STREAMER - 20MB no software EACH £30.00 30P4

Model 225 Uses DC100 Cartridge MFM

COMMODORE MICRODRIVE

Small cassette driven drive with own operating system capable of speeding up your Commodore 64 up to 5 times faster. Not suitable for copying games etc. but ideal for D.I.Y programmers. EACH £15.00 15P17

COMMODORE MICRODRIVES -

CUSTOMER RETURNS

These are non returnable units.

Sold as seen. EACH £5.00 5P17

MICRODRIVE WAFERS - Tapes for above EACH £4.00 4P5

DATA RECORDERS

ACORN DATA RECORDER ALF503 EACH £15.00 15P43

POWER SUPPLY FOR ACORN ELECTRON EACH £3.00 X3P2

COMMODORE 64 DATA RECORDERS EACH £21.35 T150A

POWER SUPPLIES

150WATT PC POWER SUPPLY EACH £15.00 15P54

200WATT PC POWER SUPPLY EACH £20.00 Q20P1

115V PC POWER SUPPLY EACH £5.00 5P208R

PC POWER SUPPLY - Customer Returns EACH £5.00 5P210

MONITOR PSU - 12" VGA AMSTRAD PC12MD EACH £3.00 V3P5

KEYBOARDS

102 KEY STANDARD PC KEYBOARD EACH £18.60 BPC/M14

102 KEY STANDARD PC KEYBOARD EACH £26.40 BPC/M15

XT KEYBOARD - non UK Keys but set your KEYB=UK in DOS and you will type in English! EACH £5.00 5P612

PC KEYBOARDS - Lucky Dip! Our choice of model specification & country so you may get French/German - still usable by setting KEYB=UK

..... EACH £4.99 T5P2

PS/2 KEYBOARD EACH £18.00 V18P1

PRINTERS AND ACCESSORIES

IBM PRINTR LEAD (D25-CENTRONICS) 3M EACH £6.00 6P50

IBM PRINTR LEAD (D25-CENTRONICS) 2M EACH £5.00 5P186R

IBM PRINTR LEAD (RS232) EACH £5.00 5P187

AMSTRAD PRINTER MECHANISMS including

Print Head - Currently cost trade over

£79.00 each, and includes rollers. EACH £5.00 5P188

AMSTRAD LQ3500 Printer Mechanism EACH £10.00 Q10P3

AMSTRAD DMP4000 Printer Mechanism EACH £12.00 Q20P2

DATA SWITCH 2 WAY CENTRONICS EACH £18.00 18P9

JOYSTICKS & INTERFACES

BBC JOYSTICK EACH £5.00 5P159

QUICKSHOT JOYCARDS EACH £3.00 3P85

QUICKSHOT PC JOYSTICK EACH £11.95 T167

TEXAS INSTRUMENT JOYSTICKS EACH £1.00 BD7D

SPECTRUM +2 JOYSTICKS EACH £5.00 J5P2

BBC/TEXAS JOYSTICK PACK PKT2 £1.00 BD888

BBC COMPOSITE MONITOR

Once again a robustly metal cased green screen monitor made for the BBC. This unit has a composite video input with the usual controls, horizontal vertical brightness and contrast. The controls are located at the front under a pull down flap. Illuminated on/off switch. A very manageable 290x290x290 box. Can be connected directly to a video camera.

Price: £34.99 each
Ref: Y35P1

PC MOTHERBOARDS

We have a pile of old motherboards some with chip missing etc. mixed types, no choice.

REF: T5P3
PRICE: 5.00

12" COLOUR MONITOR RGB/TTL EGA/CGA COMPATIBLE £99.00 Each

VERY LIMITED STOCK

Made for a famous news gathering service these robustly cased high quality colour monitors are much sought after. The dual input is via a 9 pin din for TTL video input and BNC connectors for an RGB input. We have found that these monitors make an ideal companion for the Amstrad 1640. They are fairly compact with an anodised black metal case. Dims: 300x350x275mm

REF: Y99P1

AT KEYBOARD AND LCD SCREEN

BARGAIN BASEMENT PRICES

Top brand AT 96 CLICK KEY ALPHA NUMERIC QWERTY keyboard. Brand new. Boxed. These keyboards were originally destined for the European market and some have slightly different symbols - not alpha characters - markers on the keys - i.e. "@" key may show "o" for Germany users, etc. but totally configurable for UK use. Just set keyb UK in dos and away you go.

C>KEYB UK (RETURN)

or incorporate command in your AUTOEXEC.BAT file!

If you are not overly familiar with your UK keyboard layout, just stick a label on the offending key(s) and put the UK symbol on it...

Not much work to save £££££'s.

Price: £5.99

Ref: Y6P3

COMMUNICATIONS

HANDHELD SCANNERS

PROGRAMMABLE SCANNER

REF: B110 PRICE: £229.00

The COM203 gives you direct access to over 35,000 frequencies in 200 countries.

- Nine radio bands ranging from 68-960MHz
- Superscan enables you to carry out frequency scanning upto 50 steps per second
- Liquid crystal display
- Memory back up
- Built-in charging circuit for rechargeable batteries

Frequency Coverage:

68-88MHz
108-136.975MHz
137-144MHz
144-148MHz
148-174MHz
380-450MHz
450-470MHz
470-512MHz
806-960MHz

Anten Imped: 50ohm
Audio Power: 200mW
Power Reqs: 9Vdc (6xAA batteries)
or suitable mains adaptor

Dims: 145x58x42mm
Weight: 250g (less batteries)



SCANNER

REF: B110C PRICE: £399.00

The COM1300 offers extensively wide frequency coverage in AM, FM and WFM bands in all frequency ranges. Frequencies can be stored in the scanner's 1,000 channels and upto ten sets of upper and lower limit frequencies in the search banks, which can change at any time.

- Continuous frequency coverage 8-1300MHz
- Superscan lets you scan through the channels at 20 channels per second
- Ten channel storage banks lets you group your stored frequencies
- Liquid crystal display shows the selected channels, frequencies, mode, steps and all other functions selected
- Two second scan delay feature helps prevent loss of replies on a channel while scanning or searching
- Lockout function makes the scanner skip over specified channels
- Priority channel (AUX) avoids missing important calls on the selected channels

Freq Coverage: 38-1300MHz continuous

Sensitivity: 1uV
Ant Imped: 50ohm
Aud Power: 250mW
Power Reqs: 6Vdc (4xAA batteries)
or suitable mains adaptor

Dims: 187x65x45mm
Weight: 280g

PROGRAMMABLE SCANNER

REF: B110A PRICE: £299.00

The COM204 gives direct access to more than 48,000 frequencies, it incorporates a custom designed microprocessor.

- AM/FM selectable
- 200-channel direct entry scanning
- Triple conversion superheterodyne receiver
- High speed scanning at 50 steps per second
- Liquid crystal display indicating all active functions
- Manual and auto scan for rapid selection of broadcasts
- Lockout function allowing you to skip specified channels

Frequency Coverage:

68-88MHz (in 5kHz steps)
118-136.975MHz
137-174MHz
220-225MHz
225.0125-400MHz
400.0125-512MHz
806-999.9875MHz

Sensitivity: 1uV (FM) 2uV (AM)
Ant Imped: 50ohm
Audio Power: 250mW
Power reqs: 9Vdc (6xAA batteries) or suitable mains adaptor

Dims: 145x58x42mm
Weight: 250g without external batteries



PROGRAMMABLE SCANNER

REF: B111 PRICE: £399.00

The COM205 is the last word in programmable scanners. A free-standing desk top unit covering nine radio bands in the 25-520MHz and 760-1300MHz. Operates from AC mains or car cigar lighter via suitable adaptor. It incorporates a microprocessor/computer chip, avoiding the need to change crystals, giving special functions as scan delay, memory back-up, priority channels and many more.

Freq Coverage: 25-50MHz

760-1300MHz
Sensitivity: 3uV (nominal)
Ant Imped: 50ohm
Aud Output: 1.3W
Tape Out: 600mV @ 10Kohm
Memory back-up battery: 9V (PP3)

Power Reqs: 220/240Vac 50Hz 15.5VA
Dims: 76x220x205mm
Weight: 2.2Kg



PROGRAMMABLE SCANNER

REF: B110B PRICE: £109.95

A compact handheld scanner covering wide VHF/UHF ranges of more than 22,000 frequencies, enabling you to scan through upto ten channels. The liquid crystal display indicates channel, frequency and all other key modes.

- Front panel keypad
- Liquid crystal display with back up light
- 2-second scan delay
- Memory back-up
- Lockout function
- Built-in charging circuit for rechargeable batteries

Frequency Coverage:

30-50MHz 50-54MHz
138-144MHz 144-148MHz
148-174MHz 380-450MHz
470-512MHz

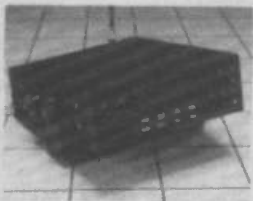
Sensitivity: 1uV
Antenna Impedance: 50ohm
Audio Power: 250mW
Power Requirements: 9Vdc (6xAA batteries) or suitable mains adaptor
Dims (HxWxD): 160x70x40mm
Weight: 300g without antenna and batteries



AM/FM SCANNER

REF : B600 PRICE : £210.00
50-channel 5-band scanner for the reception of HF, VHF low/high, AIR and UHF signals. The 50 channels are divided into banks of 10 channels each which are individually switchable (ON/OFF). Each channel can be switched off by the LOCK-OUT function. A microprocessor controls the frequency input and switches automatically into AM mode for AIR frequencies. The scanner has also a 2-second delay feature. If a reception is detected, the scanners waiting for some seconds for an answer before it continues the scanning. If the priority feature is activated, the scanner stops every 2 seconds on channel 1 and remains on this channel if it has detected an activity, even if other channels are also active. If the power supply is cut off, the data is stored for two weeks. Supplied complete with antenna and mounting hardware.

Freq Range:
HF 26.0-30.0MHz(FM)
VHF LOW 68.0-88.0MHz(FM)
AIR 118.0-138.0MHz(FM)
VHF HIGH 138.0-178.0MHz(FM)
UHF 380.0-512.0MHz(FM)
Power Supp: 13.8Vdc/500mA
Channels: 50
Memories: 5
Delay: 2 seconds
Display: LCD



MULTIBAND RADIO

REF : B118BA PRICE : £17.95
A handheld broadband receiver with range selector switch covers AIR, PB, WB, TV1, FM and CB bands. Built-in telescopic aerial, volume, squelch and tuning controls. Push button on/off switch. Frequency range with LED indicators:

AIR	108-145MHz
PB	145-176MHz
WB	162.5MHz
TV1	54-87MHz
FM	88-108MHz
CB	1-80Ch.

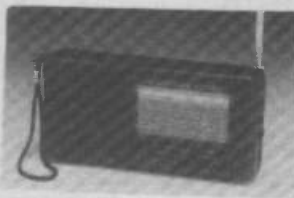
Power: 6Vdc 4xAA batts. not inc
Dims: 95x215x45mm



10-BAND RECEIVER

REF : B118CA PRICE : £16.95
A compact 10 band radio receiver covering FM, LW, MW and seven short wave bands. A built-in ferrite bar antenna receives the MW and LW transmissions and the telescopic rod antenna receives FM and SW.

Frequency Coverage:
FM 88-108MHz
MW 530-1600kHz
LW 150-270kHz
SW1 4.75-5.10MHz(60m)
SW2 5.85-6.20MHz(49m)
SW3 7.10-7.50MHz(41)
SW4 9.45-9.90MHz(31m)
SW5 11.50-11.95MHz(23m)
SW6 15.10-15.55MHz(19m)
SW7 17.45-18.00MHz(16m)
Power: 3Vdc 150mA (2xAA batts. not supplied)
Dims: 160x78x35mm



CB SPEAKERS

CB SPEAKER

REF : B185 PRICE : £6.99
Weatherproof CB extension speaker in compact, robust black plastic cabinet. Adjustable mounting bracket is screw or self adhesive fixing. 1.7m lead fitted with a 3.5mm jack plug.

Impedance:	4ohm
Power Handling:	5W
Speaker:	2 1/4" dia (mylar cone)
Dims:	65x65x55mm



COMMUNICATION SPEAKER

REF : B183A PRICE : £6.99
High power CB/Radio extension speaker with mylar coned 2.5" speaker contained within a compact plastic cabinet. The swivel bracket allows magnetic mounting, screw fixing or free standing with two self adhesive rubber feet.

Max Power:	8W
Impedance:	8ohm
Lead:	2m with 3.5mm plug
Dims:	73x70x30mm



MULTI-BAND RECEIVER

REF : B118E PRICE : £39.95
A compact 4-band radio receiver with PLL synthesised tuning, auto frequency scan, LCD frequency display, clock, alarm and 25 programmable frequency memories. AM/FM/LW and SW receiving. The tuning LED lights when a strong signal is present.

Freq Coverage: AM: 531-1602kHz
FM: 88-108MHz
LW: 146-281kHz
SW: 5.95-15.60MHz
Power: 4xAA (not supplied)
Dims: 195x120x40mm



BROADBAND RADIO RECEIVER

REF : B118B PRICE : £19.95
A hand held broadband radio receiver with a range covering CB, FM radio, TV, AIR and PB bands. Built-in telescopic aerial. Squelch, volume and tuning controls and band selector switch.

Freq Range: AIR: 108-145MHz
PB: 145-176MHz
WB: 162.5MHz
TV: 54-87MHz
FM: 88-108MHz
CB: 1-80 channels
Power: 6Vdc (4xAA batteries)
Dims: 93x198x50mm



RECEIVERS

2-WAY TRANSCEIVERS

REF : B123 PRICE : £29.95
Two-way hand held crystal controlled transceivers with built-in telescopic aerial, call button, transmit/receive key and on-air indicator. Each unit requires a PP3 battery for operation (not supplied)

Operating Freq:	49MHz
Trans Power:	100mW
Freq Tolerance:	+0.005%
Range:	1-2km open field
Oscillation:	crystal controlled
Power:	9Vdc (PP3) battery

WARNING: This item is for EXPORT use only and is NOT APPROVED for use in the UK. Users are liable to prosecution under the Wireless Telegraphy Act 1949 (and any amendments thereto). This condition may apply to other countries



MULTI 10 BAND RECEIVER

REF : 19P47 PRICE : £18.95
An attractive black cased low cost multiband receiver with own telescopic aerial offering a wide range of waveband options.

Features include:
• 9 SW bands
• MW/LW/FM bands
• LED tuning indicator
• Power : AC/DC
• Dims : 265x137x57mm

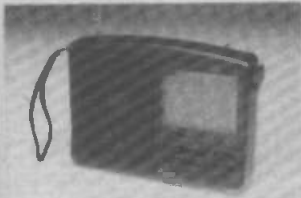


15-BAND RECEIVER

REF : B118F PRICE : £75.95

A compact 15-band receiver covering FM, LW, MW and 12 short wave radio bands. A built-in ferrite rod receives the LW band and MW transmissions and telescopic rod aerial receives the FM and SW transmission. Band selection, volume and tune is by slider control. The tuning LED lights when a strong signal is present.

Frequency Coverage:
FM: 88-108MHz
MW: 150-270kHz
LW: 530-1620kHz
SW1: 3.1-3.3MHz(90m)
SW2: 3.7-3.9MHz(75m)
SW3: 4.5-5.1MHz(60m)
SW4: 5.85-6.23MHz(49m)
SW5: 6.96-7.42MHz(41m)
SW6: 9.45-9.95MHz(31m)
SW7: 11.55-12.23MHz(25m)
SW8: 13.4-14.15MHz(21m)
SW9: 14.85-15.7MHz(19m)
SW10: 17.35-18.35MHz(16m)
SW11: 20.80-22.15MHz(13m)
SW12: 24.95-26.50MHz(11m)
Power: 4xAA batteries (not supplied)
Dims: 200x140x50mm

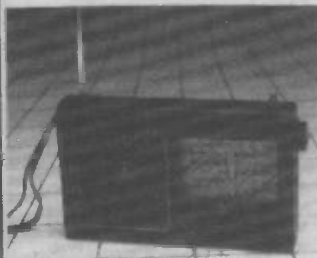


12-BAND RECEIVER

REF : B118D PRICE : £25.95

A compact 12-band radio receiver covering FM, MW, LW and 9 short wave bands. A built-in ferrite bar antenna receives the MW and LW transmissions and the telescopic rod antenna receives FM and SW transmissions. An additional 20ft wire antenna is provided to improve SW reception. The tuning LED lights when a strong signal is present. Wave band selection, tone and volume is by slider controls.

Frequency Coverage:
FM: 88-108MHz
MW: 530-1620kHz
LW: 150-270kHz
SW1: 5.85-6.23MHz
SW2: 6.95-7.42MHz
SW3: 9.45-9.95MHz
SW4: 11.45-12.23MHz
SW5: 13.40-14.15MHz
SW6: 14.85-15.70MHz
SW7: 17.35-18.35MHz
SW8: 20.80-22.15MHz
SW9: 24.95-26.50MHz
Power: 6Vdc (4xAA batteries, not supplied)
Dims: 196x123x35mm



SAB11

REF : SAB11 PRICE : £14.95

An introductory budget priced Airband radio. Receives Airband frequencies 108-135Mhz plus normal FM and MW radio programmes. Rotary controls for on/off, volume and station tuning. Comes with 'rubber duck' aerial for good signal areas and 5 section telescopic aerial for more distant stations. Ear piece for listening in public places which cuts out loud speaker. LED indicator shows when set is switched on to avoid battery drain. Takes 3 size 6 batteries (not supplied). Black cabinet with airband graphic 80mmx140mmx30



MBR7

REF : MBR7 PRICE : £62.95

A deluxe multi feature multiband radio. Receives MW, FM, & FM Marine band and SW. AFC for improved FM reception. Meter shows battery status and signal strength. AM direction finder. Can be used for public address. Sockets for earpiece, microphone and aerial.

Freqs: MW: 535-1620kHz
FM: 87.5-108MHz
AIR: 108-136mHz
MARINE: 136-176mHz
SW1: 7.23MHz
SW2: 3-7.2mHz
Power: 4xD size battery 240Vac
12V external
Dims: 355x270x130mm



MBR8

REF : MBR8 PRICE : £71.95

Top of the range multi band radio. Squelch controls for exclusion of unwanted stations. AFC for enhanced FM stability. Signal/battery strength meter. Flat coil type AM direction finder. Push button dial light. External aerial, microphone and earpiece sockets. World time zone map on back. Protection bars fitted to front of cabinet.

Freqs: MW: 535-1630kHz
LW: 150-300kHz
FM: 87.5-108MHz
AIR: 108-136mHz
MARINE: 136-176mHz
SW1: 7.23mHz
SW2: 2.3-7.2mHz
Power: 4x20 size batteries
240V ac or
12V external supply
Dims: 280x215x140mm



SAB 9 mkII

REF : SAB9 PRICE : £22.49

First class Air and Marine band radio will also receive FM, MW and LW stations. Rotary control for normal tuning plus a fine tuning control on airband frequency. A 6 section telescopic aerial ensures good FM air and marine band reception. An earpiece is supplied for listening in private places which cuts out the loudspeaker.

Freqs: Air/Marine 108-176mHz
Power: 4x6 size batteries
Dims: 102x210x45mm



SAB 9EP

REF : SAB9EP PRICE : £29.95

Gift pack containing SAB9 mkII Radio plus set of headphones and airband radio guide which gives useful airband frequencies and airport information.



SCANNER AND RECEIVER ACCESSORIES

POWER SUPPLY REGULATED

REF : POO6Y PRICE : £8.95

A plug in regulated power supply designed for use with the Comtel COM203 and COM204 scanners. Input Voltage: 220/240Vac 50Hz Output Voltage: 9Vdc Output Current: 350mA max Stability: 2% Ripple: 10mV Dims: 80x56x55mm



POWER LEAD

REF : BO37 PRICE : £2.75

Cigar lighter plug with lead terminating in alternative plugs:- 2.5mm jack, 3.5mm jack, 2.1mm DC and 2.5mm DC. Max current 2A. Fuse (2A) built into plug. Length 1.8m





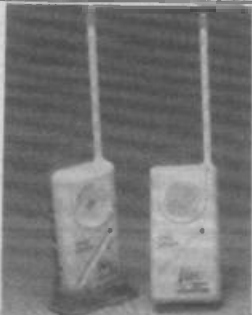
OMNIDIRECTIONAL BASE ANTENNA

REF : B115A PRICE : £64.95
A superior wide band omnidirectional antenna covering a frequency range of 25-1300MHz. The SC1300 not only receives but can also transmit with a maximum power rating of 200 watts.
Frequency: 25-1300MHz
Impedance: 50ohm
Connector: N type
Overall Length: 1.7m
Weight: 1kg
Type: Wide band omnidirectional disc antenna



REGULATED PSU
REF : P006Z PRICE : £8.99
A plug in regulated power supply designed for use with the Comtel COM102 scanner.
Input Voltage: 220/240Vac 50Hz
Output Voltage: 9Vdc
Output Current: 350Ma max
Stability: 2%
Ripple: 10mV
Dims: 80x56x55mm

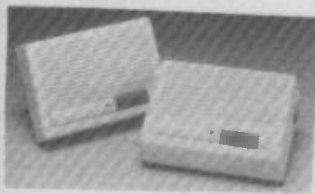
INTERCOM SYSTEMS



BABY MONITOR
REF : P161C PRICE : £29.95
A stylish voice activated baby monitor. With the transmitter placed near the baby, you can monitor baby sound via the receiver even when you move around the home. Two selectable channels. Supplied with desk top stand and belt clips.
Power Supply: 9Vdc (PP3 type) or via AC adaptor
Dims: 130x70x40mm
Antenna: 145mm length

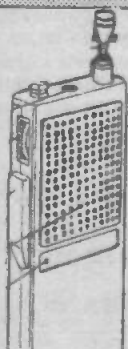


2 CHANNEL FM INTERCOM
REF : P158A PRICE : £34.95
Two channel FM intercom with call, talk and talk lock controls, channel 1, 2 switch and volume control. Supplied as one pair of intercoms. Up to 4 intercoms can be used simultaneously. Ideal for communication between office departments.
Dims: 175x130x38mm
Power: 220-240Vac 50Hz



2 STATION INTERCOM
REF : P152D PRICE : £11.95
Easy to operate and install wired master/slave system. Compact, modern styled units. Connecting cable supplied.
Power Supply: 9Vdc (PP3 batt) or power supply (ref. P006G)
Cable Length: 20m approx
Dims: 130x93x47mm

TRANSCEIVERS



MINIATURE WALKIE TALKIES
REF : 30P12 PRICE : £30.00
Stylish handheld miniature Walkie Talkies, compact and housed in own carrycase for added protection which has a strap for ease of use.
Features:
• Push to talk
• Call Button
• Carry case with handstrap
• Earphone with 3.5mm plug
Operating Freq: 49MHz
Modulation: AM
Antenna: Telescopic
Range: 1-2km open field
Power: PP3 battery
Power out (trans): 120mW nominal
Dims: 52x155x22mm

WARNING: This item is for EXPORT only and is NOT APPROVED for use in the UK. Users are liable to prosecution under the Wireless and Telegraphic act 1949. (and any amendments thereto). This condition may apply to other countries.



KIDS WALKIE TALKIES
REF: W8P5 PRICE: £8.00
Pair of 49MHz transceivers suitable for children. Operate on 9V PP3 batteries, on/off switch, aerial, push to talk, morse code signal button, morse code chart and belt clip.

BARGAIN CLEARANCE 5.25" 360k Disc Drive

Industry standard 5.25" floppy disc drive made by Matsushita. Ideal replacement or second drive for your computer. Model No JA551-047. Fully IBM Compatible.



£9.00

REF: X9P1



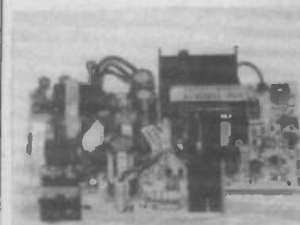
SORRY NO ILLUSTRATION AVAILABLE ON THIS PRODUCT

WOLSEY REMOTE CONTROL UNIT

Original Wolsey Remote Control Units originally designed for Wolsey Satellite Receivers. Excellent kit for experiments. Complete and fully functional. BRAND NEW

£1.00 each REF: X1P7
£10.00 Pkt 10 REF: X10P

ARCHIMEDES POWER SUPPLY UNIT



Made for the Acorn Archimedes. This neat compact power supply unit gives you +5 DC at 4.4A. Other features include an on off switch and selectable mains input. Uncased. Suitable for general Switched Mode use.

£10.00 Each
REF: Y10P2







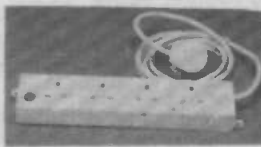





MOBILE TELEPHONE HANDSET



£5.99
REF: 6P89

TOP QUALITY - PHILIPS - WEIGHTY BLACK TOUGH RESIN HANDSET WITH LCD DISPLAY & 9 LEDS (4 COLOURS). 18 KEY FUNCTION PAD 10 NUMERIC & SYMBOLS. WOULD MAKE AN EXCELLENT ACCESSORY IF YOU ARE BUILDING A JEEP OR 12V CAR FOR A CHILD!!! ALSO EFFECTIVE AS AN INTRUDER DETERRANT FOR WOMEN TRAVELLING ALONE! WHO WOULD KNOW A REAL 999 CALL WAS NOT BEING MADE. COMES COMPLETE WITH CLIP ON BASE INCORPORATING QUALITY SPEAKER AND SMTR MULTI CORE (10) CABLE. CAN BE WIRED UP TO ILLUMINATE. DETAILS SUPPLIED.

DISPLAYS AND DOMESTIC POWER

DISPLAYS			
LCD DISPLAY 32 CHARACTER 1 line	EACH 3.00	L3P1	
LCD DISPLAY	EACH 1.00	R1P4	
LED DISPLAY 7 SEG .3" COMMON CATHODE	EACH 3.00	3P117	
LED DISPLAY 7 SEG .3" COMMON ANODE	EACH 3.00	3P118	
LED DISPLAY 7 SEG .5" COMMON CATHODE	EACH 3.00	3P119	
LED DISPLAY 7 SEG .5" COMMON ANODE	EACH 3.00	3P120	
LED DISPLAY 7 SEG .56" COMMON CATHODE	EACH 3.00	3P121	
LED DISPLAY 7 SEG .56" COMMON ANODE	EACH 3.00	3P122	
FLUORESCENT DISPLAY 4 digit NO INFO	PKT4 1.00	X1P11	
INFLEX PUSH SWITCH FOR TABLE LAMPS ETC	PKT3 1.00	BD562	
CEILING MOUNT PULL SWITCH/CORD/TASSLE	EACH 1.00	BD528	
SHAVER ADAPTORS 13A type, 2 pin outlet, unsleeved	PKT3 1.00	X1P52	
13A 3 WAY ADAPTOR unsleeved pins	EACH 1.00	X1P55	
DOMESTIC POWER ACCESSORIES			
	REF : F318A PRICE : £0.68p 3-Pin plug ASTA approved to BS1363. Fitted with 13A fuse.		TWO GANG SOCKET BOX REF : F319Z PRICE : £1.20 30mm depth
	ADAPTOR REF : F318B PRICE : £1.20 2 way multi adaptor. To BS5733		SINGLE GANG EXTENSION SOCKET REF : F319 PRICE : £1.20 Single gang extension sockets to BS1363/A. Socket only
	JUNCTION BOX 15A 4 Terminal REF : F320R PRICE : £1.20 30A 3 terminal REF : F320S PRICE : £1.30		COILED 13A EXTENSION LEAD REF : F319AD PRICE : £9.95 Coiled 13A extension lead with approved plug and single gang socket to BS1363. Extends to 5M length.
	SURFACE MOUNT SOCKET REF : F320B8 PRICE : £2.80 Surface mounting 2 gang 13A switched socket to BS3676.		
	13A SOCKET REF : F320A PRICE : £2.10 13A socket to BS1363 single gang.		FOUR GANG EXTENSION BLOCK REF : F319D PRICE : £6.99 Four gang extension socket fitted with 2M 13A cable and 13A ASTA approved plug.
	13A SOCKET SWITCHED REF : F320B PRICE : £2.80 13A switched socket to BS1363 single gang.		5A SWITCH Single gang 1 way to BS3676 REF : F320E PRICE : £1.40 Single gang 2 way to BS3676 REF : F320F PRICE : £1.90
	SINGLE SOCKET BOX REF : F319Y PRICE : £0.80p Single gang socket box (30mm depth)		SWITCH TWO GANG TWO WAY BS3676 REF : F320G PRICE : £2.50
	13A DOUBLE SOCKET REF : F320C PRICE : £3.60 13A Double socket to BS1363 Two gang.		SWITCH Three gang two way to BS3676 REF : F320H PRICE : £3.00
	13A DOUBLE SWITCHED SOCKET REF : F320D PRICE : £4.20 13A Double switched socket to BS1363. Two gang.		DIMMER SWITCH REF : F455J PRICE : £4.99 All white plastic body. Round plastic on/off switch. BS5518 Rating: 630W
			5A THROUGH SWITCH BS3676 REF : F320V PRICE : £1.50
			CEILING SWITCH 5A BS3676 REF : F320J PRICE : £2.50
			JUNCTION BOX 5A 4 TERMINAL REF : F320SA PRICE : £1.00
			CEILING ROSE LOOP IN TYPE 5A BS67 REF : F320K PRICE : £1.50
			CEILING ROSE & PENDANT HOLDER BS5042 REF : F320KA PRICE : £2.50

FANS, FUSES, FLOURESCENTS, HEATING, HEATSHRINKS, HEATSINKS, IC SOCKETS, INFRARED & INSULATORS



PENDANT LAMPHOLDER.
TYPE T1 BS5042
REF : F320M PRICE : £1.00



PENDANT LAMPHOLDER.
SWITCHED BS5042
REF : F320N PRICE : £1.00



BATTEN LAMPHOLDER 3
TERMINAL BS5042
REF : F320L PRICE : £1.00



BATTEN LAMPHOLDER 3
TERMINAL ANGLED TYPE
T1 TO BS5042
REF : F320Q PRICE : £1.00



FLOURESCENT STARTERS
REF : F525A PRICE : £0.70p
Flourescent lamp glow starters with
built in condenser. White plastic
caps. 4/80W. 200/250Vac.

FANS AND BLOWERS

MUFFIN TYPE FAN 4.5"x4.5" 115V ex equip.....	EACH	3.00	3P36
MUFFIN TYPE FAN 4.5"x4.5" 230V ex equip.....	EACH	5.00	5P40
AXIAL FAN 4.5"x4.5" PAPST 230V.....	EACH	8.00	8P99
14" TANGENTIAL BLOWER - 240V MOTOR ..	EACH	10.00	10P90
18" TANGENTIAL BLOWER - MOTOR 240V ..	EACH	10.00	10P89
CENTRIFUGAL BLOWER 5"x1.5" 240V AC ...	EACH	5.00	5P99
5" ALUMINIUM FAN BLADES FIT .25" SHAFT ..	PKT2	1.00	BD86
MAINS MOTOR TO SUIT ABOVE BLADES	EACH	1.00	BD88

FLOURESCENT LIGHTING

12V CASED FLOURESCENT LIGHT ON/OFF SWITCH 8 WATT	EACH	8.00	8P48
12" 8 WATT FLOURESCENT TUBE	EACH	1.00	BD314
STARTER FOR 40-80 WATT TUBE	PKT2	1.00	BD92
STARTER HOLDER. STANDARD TYPE ...	PKT4	1.00	BD407

FUSES

20mm QUICK BLOW 250ma	PKT10	1.00	BD983
20mm QUICK BLOW 500ma	PKT10	1.00	BD984
20mm QUICK BLOW 1A	PKT10	1.00	BD985
20mm QUICK BLOW 2A	PKT10	1.00	BD986
20mm QUICK BLOW 4A	PKT10	1.00	BD987
720mm QUICK BLOW 5A	PKT10	1.00	BD542
PLUG TOP FUSE 2A	PKT10	1.00	BD993
PLUG TOP FUSE 3A	PKT10	1.00	BD994
PLUG TOP FUSE 5A	PKT10	1.00	BD995
PLUG TOP FUSE 13	PKT10	1.00	BD996
FUSE PACK NO 1 - 50x1" ASSORTED	PKT50	2.00	2P384R
FUSE PACK NO 2 - 50x20mm ASSORTED ..	PKT50	2.00	2P385R
FUSEHOLDER - 20mm PCB MOUNT	PKT10	1.00	BD543
FUSEHOLDER - 20mm PANEL MOUNT ..	PKT4	1.00	BD618
FUSEHOLDER - 1.25" SURFACE MOUNT	PKT10	1.00	BD526
FUSEHOLDER - 1.25" PANEL MOUNT ...	PKT4	1.00	BD752

HEATING

TIME & TEMP MODULE.			
DISPLAYS C or F. 1.5V	EACH	9.00	9P5
TIME & TEMP ADDTL EXTERNAL SENSOR ON LONG LEAD	EACH	3.00	3P60
COIL HEATER. AIR OR LIQUID. 600W 4x3" ..	PKT3	2.00	3P78
JUG KETTLE HEATING ELEMENT. 2KW	EACH	1.00	R1P5
1.2KW TANGENTIAL ELEMENT 70x45mm ..	EACH	6.00	6P54
2.5KW TANGENTIAL ELEMENT 195x45mm ..	EACH	5.00	5P62
3.0KW TANGENTIAL ELEMENT 300x40mm ..	EACH	8.00	8P24
15m heating wire. 90 ohms per yd. Approx 3/16" dia. Waterproof. ideal for pipes. propagators. 15m can be attached to 240V mains. £5			5P109

HEATSHRINK SLEEVING

1.6mm dia Shrinking to .8mm 1.2Mtr	EACH	1.00	BD997
2.4mm dia Shrinking to 1.2mm 1.2Mtr ...	EACH	1.00	BD998
3.2mm dia Shrinking to 1.6mm 1.2Mtr ...	EACH	1.00	BD999
4.8mm dia Shrinking to 2.4mm 1.2Mtr ...	EACH	2.00	2P331
6.4mm dia Shrinking to 3.2mm 1.2Mtr ...	EACH	2.00	2P332
9.5mm dia Shrinking to 4.7mm 1.2Mtr ...	EACH	2.00	2P333
12.7mm dia Shrinking to 6.4mm 1.2Mtr ..	EACH	2.00	2P334

HEATSINKS

T03 BOLT ON HEATSINK 6.9°C/W	PKT2	1.00	CD2
T05 BOLT ON HEATSINK 50° C/W	PKT5	1.00	CD3
T0220 BOLT ON HEATSINK 21° C/	PKT 4	1.00	CD1
50x40x25mm VERTICAL MOUNT 16 FINS ..	PKT2	1.00	T1P1
50x40x25mm VERTICAL MOUNT 16 FINS ..	PKT20	8.00	T14P1
HIGH GRADE ALUMINIUM HEATSINK. 363x190x50mm WITH 15 50mm Fin RUNNING DOWN LENGTH UNDRILLED	EACH	18.00	T15P1

IC SOCKETS

8 WAY IC SOCKET	PK10	1.00	BD778
14 WAY IC SOCKET	PK7	1.00	BD774
16 WAY IC SOCKET	PK7	1.00	BD775
18 WAY IC SOCKET	PK5	1.00	BD776
20 WAY IC SOCKET	PK5	1.00	BD777
24 WAY IC SOCKET	PK4	1.00	BD778
28 WAY IC SOCKET	PK4	1.00	BD779
40 WAY IC SOCKET	PK4	1.00	BD780A

INFRA RED

HI POWER INFRA RED SOURCE	PK3	1.00	CD8
HI POWER INFRA RED SENSOR.....	EACH	1.00	CD9
PORTABLE INFRA RED DETECTOR ...	EACH	17.49	F601

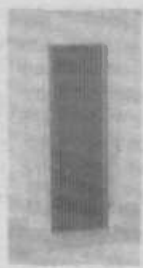
INSULATORS AND CABLE GRIPS

PVC GROMMETS FOR 3/8" CABLE ..	PK100	1.00	BD181
GRIPS FOR UP TO 3/8" CABLE	PK10	1.00	BD431

HIGH GRADE ALUMINIUM HEATSINK

Made of high grade aluminium these
Heatsinks measure 14.5x7.5x2" and
have 15 fins. No one else we know
can offer this grade at this price!

£18.00 each
REF: Y18P2



CANT SEE WHAT YOU'RE LOOKING FOR

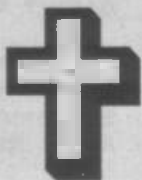
Don't give up hope, give us a call 0273 203500

We may just have THAT ITEM sitting in our warehouse waiting for
your call. Or something even better!



GEIGER COUNTER KIT

Using the SBM 21 geiger Muller Tube this kit is designed with radio engineering in mind, registering hard beta and gamma radiation. Many other uses are possible. Low radiation registers a click about every 30 seconds on the speaker supplied. PCB and components included.



REF : 39P1

PRICE : £39.00

HELIUM NEON LASER TUBE

SPECIFICATION:

Dimensions : 260x37mm dia
Power : 2mW
Beam dia : 0.75mm
Divergence : 1.43m Rad
Starting Voltage : 8kV
Supply Voltage : 1.5kV
Ballast Resistor : 68Kohm 4W
Operating Current : 5mA
Tube Voltage drop : 1.15kV+100V
Wavelength : 632.9nm (Red)
Manufacturer : Phillips



This low powered Helium Neon high spec Laser Tube makes an ideal experimental educational tool for use in schools and colleges. Also ideal as a levelling tool for specialist applications, line of sight, special lighting effects, holograms, etc., etc. The low level red light emission generated creates an extremely safe environment in which to demonstrate the applications and effects of laser power in everyday situations. **WARNING:** Staring directly into the beam may result in eye damage. However this laser is not able to burn, cut or drill. No skin damage will occur.

REF : 40P8

PRICE : £40.00

PORTABLE DIGITAL RADIATION METER

The Jupiter 5 digital radiation meter is a compact instrument designed to measure high energy Beta, Gamma and X radiation in the energy range 30keV to over 1.2Mev. Two Geiger-Muller detector tubes are used to enhance the sensitivity of the Instrument. A piezo-electric speaker provides audible tones for count pulses, Integration period indication and dose rate alarm. The dose rate alarm level is adjustable by a variable control. Two integration periods may be selected (2.5 or 25 secs) to suit the application. The instrument is housed in a compact plastic case with a convenient wrist strap.

FEATURES

• Measurement Range: 5 to 99.99 and 10 to 999.9 uSv/h
Alarm Range: 0.6 to 4.0 uSv/h and off
Integration Period: 2.5 and 25 seconds selectable
Energy Range: 30keV to over 1.2Mev
Tube Life Expectancy: 2E10 counts min. at 25 deg. C
Temperature Range: -20 to +50 deg. C
Display Type: 4 digit LCD
Battery Type: 1 x 9V PP3, 6F22, 6LR61 or MN1604
Typical Battery Life: 600 hours with alkaline battery
Size: 136x71x33mm
Weight: 200g, without battery

JUPITER 5



Only £49.99 Each Ref : Y50P1

KITS

ACCUPNtre	ELECTRONIC ACCUPUNCTURE	7P36
ALARM	UNIVERSAL ALARM SYSTEM	14P18
AMP	ANTENNA AMPLIFIER 2	8P54
AMP	ANTENNA AMPLIFIER 1	5P213
AMP	300 WATT MONO AMP	W8P7
AMP	TELEPHONE AMPLIFIER	8P159
AMP	HI FI AMPLIFIER 1	14P16
AMP	STEREO PRE-AMP EQUALIZER	6P82
AMP	120 + 120 WATT STEREO AMP	W30P3
AMP	300 WATT SINGLE CHAN AMP	W40P3
AMP	30 WATT STEREO AMP	W16P1
ATOMIUM	ATOMIUM	7P38
AUDIO	AUDIO SCOPE	10P151
BELL	VISUAL DOOR BELL	10P152
BRIDGE	INDUCTANCE BRIDGE	12P52
CAR	CAR ANTENNA AMPLIFIER	6P81
CAR	CAR LIGHTS ON WARNING	8P153
CHARGER	UNIVERSAL CHARGER	8P152
CONVERTER	CONVERTER 100MHZ - 100MHZ	15P57
DICE	ELECTRONIC DICE	9P13
DOG	ELECTRONIC DOG BARK	16P10
DOG	ULTRASONIC DOG WHISTLE	6P86
ELECTRIFYING	ELECTRIFYING APPARATUS	7P30
ELECTROTECH	LITTLE ELECTROTECHNICIAN	8P156
FLASHER LAMP	FLASHER	5P214
FOG	FOG HORN	6P56
FREQUENCY	FREQUENCY GENERATOR	4P154
FUSE	ELECTRONIC FUSE	6P83
GAME	GAME OF SKILL	5P215
GAS	GAS SENSOR	20P43
GEIGER	GEIGER COUNTER	3P91
INFRA-RED	INFRA-RED LIGHT BARRIER	10P9
LED	LED MODULATOR/VOLT	10P156
LIE	LIE DETECTOR	6P57
LIGHT	LED LIGHT BAND	10P155
LIGHT	MINI MOVING LIGHT	5P216
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LIGHT	MINI TRAFFIC LIGHT	5P200
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LIGHT	MOVING LIGHT	12P54
LIGHT	10 CHANNEL MOVING LIGHT	30P11
LOCK	COMBINATION DIGITAL LOCK	15P56
MAINS	ELECTRONIC MAINS FILTER	10P153
MELODIES	12 MELODIES GENERATOR	11P12
MESMERIC	MESMERIC INSTRUMENT	8P157
METAL	METAL DETECTOR	5P199
METRONOME	METRONOME	7P40
MICROPHONE	MICROPHONE PREAMP	6P85
MORSE	MORSE CODE PRACTISE	8P158
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POWER	POWER CONTROLLER	12P55
RADIO	IC RADIO MW-SW LW	8P155
RADIO	APPLE POWERED RADIO	7P37
RECEIVER	IC VHF RECEIVER	10P122
RECEIVER	SW CB RECEIVER	15P60
RECEIVER	DIODE RECEIVER MW & SW	8P154
SIREN	WARSHIP SIREN	9P21
SIREN	STAR WARS SIREN	9P23
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SOLAR	NEW SOLAR ENERGY	W12P3
SOUND	DIESEL ENGINE SOUND	11P10
SOUND/LIGHT	12V 3 CHANNEL SOUND-LIGHT	12P57
SOUND/LIGHT	1 CHANNEL SOUND TO LIGHT	6P84
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STETHOSCOPE	SPY STETHOSCOPE	15P59
SWITCH	TWILIGHT SWITCH	9P25
SWITCH	TOUCH SWITCH	7P42
SWITCH	THERMAL SWITCH	9P24
SWITCH	SOUND OPERATED SWITCH	14P17
SWITCH	INTERVAL SWITCH (UNVRS.)	12P53
TV TEST	TV TEST CHANNEL	10P158
VOICE	ROBOT VOICE	8P56
VOLTAGE I	MPULSE VOLTAGE CONTROL	10P154
VU	LED VU METER	15P58
WARNING	ICE WARNING INSTRUMENT	7P39
WATER	ACOUSTIC WATER DETECTOR	

Electronic Dice Kit

After touching a button the digital dice displays a number between 1 and 6. 4.5V. £9.00. REF: 9P13.

Diode Receiver MW & SW Kit

Good educational kit that doesn't require batteries. £8.00. REF: 8P154

Electronic Dog Bark Kit

Generates a dog barking sound. Suitable for a 8R speaker. 9-12V operation. £16.00. REF: 16P10.



Visual Door Bell Kit

A lamp up to 12V .5A connected to this kit will flash for up to 20 seconds. Ideal for deaf people or noisy rooms etc. £10.00. REF: 10P152.

Electrifying Apparatus Kit

Generates a weak adjustable high tension of approx 80-300V from a 9V battery. Ideal for catching worms etc. Max current 50-250mA. £7.00 REF: 7P30

Stereo Pre-Amp Equalizer Kit

For record players with magnetic pickup. 12-24V supply required. £6.00. REF: 6P82.

Electronic Mains Filter Kit

Highly effective anti interference device fits into the mains supply to your computer, TV, video etc. 750 watt max. 110-240V. AC. £10.00. REF: 10P153.

Lamp Flasher Kit

6-24V bulb can be flashed very brightly for adjustable period. Max 1A. £5.00 REF: 5P214.

Fog Horn Kit

Generates a deep noisy sound similar to a ships fog horn. 4.5-12V. 5 watt max output. 8R speaker required. £6.00 REF: 6P56.

Frequency Generator Kit

Adjustable frequency approx 1-50khz 6-12V. Short circuit proof capacitive output. Rectangular waveform output. VHF harmonics. £4.00 REF: 4P154.

Electronic Fuse Kit

An electronic fuse suitable for 5-30V DC only at up to 3A. Cuts off supply when overloaded. Reset by turning supply off and on again. £6.00. REF: 6P83.

Gas Sensor Kit

Detects alcohol propane, benzene, carbon monoxide, ideal for fire and smoke alarm. £20.00. REF: 20P43.



LED VU Meter Kit

30 LED voltage display fully adjustable. Ideal as meter amp output etc. £15.00. REF: 15P58.

Lie Detector Kit

Monitors changes of skin resistance which changes during lies, fear etc. 4.5V. £6.00. REF: 6P57.

Light Barrier Kit

A light barrier which causes an LDR to operate a relay. Light source required (i.e. torch). 5A relay contact output. 12V operation. £9.00 REF: 9P20.

Single Channel Sound to Light Kit.

Illuminates light bulbs to rhythm of music. Ideal for parties etc. Max 240V 1000 watt. £6.00 REF: 6P84.

Six Channel Sound To Light Kit

Each channel is adjustable max 500 watt per channel 240V AC high sensitivity. £17.00. REF: 17P6.

Light Swelling Kit

240V light bulbs (max 200w) are gradually dimmed and illuminated at regular intervals (approx every two seconds) Ideal displays, discos etc. £11.00 REF: 11P11.



Little Electrotechnician Kit

Educational kit for beginners comprising of 7 different circuits. 4.5V batt required. £8.00. REF: 8P156.



12 Melodies Generator Kit

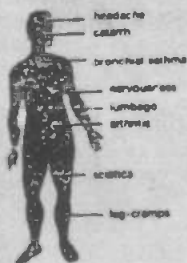
Plays 12 different tunes at the touch of a button. 3V. 8R speaker required. £11.00. REF: 11P12.

A MORE COMPREHENSIVE GUIDE TO THE CONTENTS OF THE ABOVE KITS FOLLOWS FOR YOUR INFORMATION...

Mesmeric Instrument Kit.

Magnetic field instrument is said to have curing effect on certain ailments!

£8.00 REF: 8P157.



Metal Detector Kit

Uses mini ferrite aerial to detect metal in walls etc. 6cm range led output. 9V.

£5.00 REF: 5P199.

Metronome Kit

An adjustable electronic metronome with a signature between 30 and 300 beats per min. Loud speaker output. 4.5-6V supply. £7.00 REF: 7P40.

12V 3 Channel Sound To Light Kit

Kit will drive 3 x 12V halogen bulbs (max 100w each). Heatsinks and bulbs required 12V AC operation.

£12.00. REF: 12P57.

Microphone Preamp Kit

Impedance load variable from 4R to 100kR. Input voltage 2-40mV. Output max 1.8V 20-40khz. 6-20V operation.

£6.00. REF: 6P85.

Mini Moving Light Kit

Moving light with 3 very small bulbs. Adjustable speed 9-12V ideal for models, brooches etc. £5.00. REF: 5P216.

Mini Traffic Light Kit

3 small LED's are illuminated one after the other. 4.5-6V operation.

£5.00 REF: 5P200.

Morse Code Practise Kit

Sound generator with touch switch and loud speaker. 3-9V.

£8.00. REF: 8P158.

Moving Rope Light Kit

Complete kit to build a rope light 6.5m long. Gives running light effect. Requires 12V 2.5A. £25.00 REF: 25P28.

Moving Light Kit

Adjustable speed uses 6-24V bulbs max 3A (3 chan). £12.00 REF: 12P54.

10 Channel Moving Light Kit

Drives 10 50watt 240V bulbs. Speed adjustable. £30.00. REF: 30P11.

MW Testing Transmitter Kit

Close range test oscillator. Not to be used for transmitting. £5.00 REF: 5P217.

Power Controller Kit

Regulates bulbs, drills, stoves, soldering irons etc. Max 1300 watt.

£12.00. REF: 12P55.

Spy Stethoscope Kit

Using an earpiece allows you to listen through thin walls, doors, windows etc.

£15.00. REF: 15P59

SW CB Receiver Kit

Short wave receiver for CB etc. (6-30mhz) 4.5-6V.

£15.00. REF: 15P60.

Telephone Amplifier Kit

Suitable for monitoring telephones with pick up coil (supplied) 8R speaker and 9V supply required. £8.00. REF: 8P159.

Thermal Switch Kit

Turns a device on or off at a pre fixed temperature ideal for ice warning, fire, extractor fan, heating etc. -30 to +150 deg C. 5A relay output.

£9.00 REF: 9P24.

Ultrasonic Dog Whistle Kit

Emits high powered ultrasonic sound adjustable from 8000-25000hz. Complete with transducer. 9V battery required.

£6.00. REF: 6P86.

Strobe Light Kit

Stroboscope kit with U shaped tube. Adjustable speed 1-10hz. Ideal for disco or photographic use. 240V AC.

£16.00. REF: 16P15.

Twilight Switch Kit

Turns a light on at twilight and off at day break. Adjustable sensitivity. Max 250watt 240V AC. £9.00 REF: 9P25.



TV Test Channel Kit

Screen pattern generator for connection to aerial socket of TV Choice of different patterns available. 4.5-6V. £10.00. REF: 10P158.

Warship Siren Kit

Decks clear for action siren 3-15 watt output 6-12V operation. 8R speaker required. £9.00. REF: 9P21.



Star Wars Siren Kit

3-15 watt output 12V 1.5A supply 8-32R speaker required. £9.00. REF: 9P23.



Robot Voice Kit

Modulates human voice with an adjustable frequency to produce different voice effects. Voice requires amplification afterwards. ie tape recorder etc. 9-12V supply. £8.00. REF: 8P56.

Touch Switch Kit

If the sensors are touched by a finger of nose etc relay will be operated and can operate equipment as required. 9-12V supply. £7.00. REF: 7P42.

Kojak Siren Kit

Very loud siren 12V 8-32R speaker required. £9.00. REF: 9P22.



Game of Skill Kit

Pass the loop over the wire to prevent the alarm and the light operating. 9-12V £5.00. REF: 5P215.

IC VHF Receiver Kit

High quality receiver uses TDA7000. Good selectivity 8R 1W speaker required. 9V. £10.00 REF: 10P122.

Ice Warning Instrument Kit

Indicates undesirable temperature changes in fridges, freezers or as frost warning for cars. 9-12V supply required. £7.00. REF: 7P39.



Impulse Voltage Control Kit

Almost loss free regulation of speed for DC motors providing almost full torque at all speeds. Ideal for trains, drills, toys etc. Max 2A 12-16V.

£10.00. REF: 10P154.

Inductance Bridge Kit

With this kit coils can be easily measured 2 adjustable scales 1-100mH, 1-10H. 9V operation. £12.00. REF: 12P52.

Infra-Red Light Barrier Kit

Light barrier with invisible infra red light beam. Complete with transmitter and receiver. 6m range 9-12V. 3A relay contact output. £16.00. REF: 16P9.

Interval Switch (universal) Kit

Interval time 1-140sec Length .2-12sec 7.5-12V operation 5A relay contact o/p LED interval indicator. Ideal for wiper controller, lamps, motors, alarms etc. £12.00. REF: 12P53.

LED Light Band Kit

Decorative 1.5m band of 14 LED's which light up alternatively to give a moving display. 18V. £10.00. REF: 10P155.

IC Radio MW-SW-LW Kit

Single circuit radio that receives medium, short or long wavebands. 220mW output. 9V. **£8.00. REF: 8P155.**

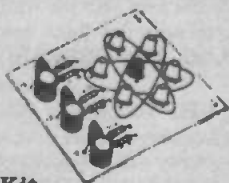
LED Modulator/Voltage Display Kit

A voltage measuring kit. Displays up to 30V. Ideal for batt indicator, amp o/p speaker peak meter etc. 12v operation. **£10.00. REF: 10P156.**



Atomium Kit

A decorative device which uses six red LEDs which optically circle around a green LED. Requires a 9V battery. Ideal for jewellery etc. **£7.00. REF: 7P38.**



Audio Scope Kit

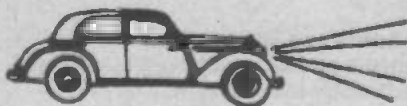
Produces black, vertical bars which move to the rhythm of the music, similar to oscilloscope patterns. Simple connection to the aerial socket of TV. **£10.00. REF: 10P151.**

Universal Ni-Cad Charger Kit

Automatic charger for cells from 1.2 to 15V. The charging current will automatically adjust, to remain constant as the battery charges. Has a selection of seven settings 5-600mA. A transformer 18-20V .6A is required. **£8.00. REF: 8P152.**

Car Lights On Warning Kit

Produces a noisy 'honk' if you turn off the ignition but leave the lights on. Works off car battery. **£8.00. REF: 8P153.**



Combination Digital Lock Kit

After keying in a 4 digit code the relay switches on. The code is independantly programmable and can be easily modified. Relay contact 3A, 1 x c/o. Ideal for keyless locks for door, video, computer etc. **£15.00. REF: 15P56.**

Car Antenna Amplifier Kit

This amplifier is connected between the antenna and the radio, using co-ax cable 60-75R. Gain max 22db. Frequency range 0.5-150mhz. **£6.00. REF: 6P81.**

Converter 100mhz - 200mhz Kit

Extends the range of radios to cover amateur bands, ships, TV stations etc. Simply introduced into aerial cable. **£15.00. REF: 15P57.**

Sound Operated Switch Kit

This accoustic circuit turns on a relay, can be triggered by a clap etc. Another clap turns it off. Adjustable sensor. Ideal for turning on and off lights and equipment. 12V operation. **£14.00 REF: 14P17.**

Diesel Engine Sound Kit

Generates 7-10 watt sound with adjustable exhaust, valves and running speed! For 4-8R speakers. **£11.00 REF: 11P10.**



Accoustic Water Detector Kit

Raises a loud alarm on contact with water. Ideal for broken pipes, overflowing washing machines, bathtubs etc. Sensor can be connected by a longer cable upto 100m away. Power supply 9V battery. **£5.00. REF: 5P212.**

Electronic Accupuncture Kit

This kit operates in accordance with the electronic accupuncture method. Complete with instructions. Migrane, poor circulation, backache etc. 3-12V operation. **£7.00. REF: 7P36.**



Universal Alarm System Kit

Reliable alarm system for 9-12V operation. Max 20 alarm contacts may be connected. Adjustable starting and alarm time delay of a few seconds, alarm time approx 30-60 seconds, includes reset button. **£14.00. REF: 14P15.**

Hi Fi Amplifier Kit

Two types available. No 1 is a stereo amplifier with a 2 x 8 watt output. **£14.00 REF: 14P16.**
No 2 is a 10 watt mono. **£9.00. REF: 9P19**

Antenna Amplifier Kit

Wide band antenna amplifier approx 0.15-350mhz, 9-18V Gain approx 5-20db (VHF approx 10db) Ideal for improving reception of radios and TV sets. (Up to 150mhz). **£5.00. REF: 5P213.**

Antenna Amplifier Kit No 2

Wide band antenna amplifier approx 30-850mhz. 12-18V operation. In and out impedance 60R. Max gain 20db. Ideal for use in the UHF and VHF bands. **£8.00. REF: 8P54.**

Apple Powered Radio Kit

Small medium wave radio. The operating voltage is generated by two special electrodes inserted in an apple. **£7.00. REF: 7P37.**

30 Watt Single Channel Amp Kit

30 watt rms into 8ohm. 20HZ-20KHZ harmonic distortion 0.1%, sensitivity 150MV, mic sensitivity 50MV, 36v x 2 psu required. Complete with base, treble and volume controls and heatsink. **£8.00. REF: W8P7**

120+120 Watt Stereo Amp Kit

240 watts rms into 4 ohm. 10HZ-10KHZ, harmonic distortion less than 0.01%, sensitivity 3MV(phono), 130MV(aux), 2 x 30V psu required **£30.00. REF: W30P3.**

30 Watt Stereo Amp Kit

30 watt rms into 8ohm, harmonic distortion .1%, sensitivity 3MV(phono), 130MV(tuner), signal to noise 80db, 36v x 2 psu required. **£16.00 REF: W16P1**

300 Watt Mono Amp Kit

300 watt rms output, harmonic distortion less than 0.05% 10HZ-10KHZ. 2 x 60V psu required. **£40.00. REF: W40P3**

New Solar Energy Kit

Kit contains 8 solar cells, motor, tools, fan etc plus educational booklet. Ideal gift for the budding enthusiast! **£12.00. REF: W12P3**

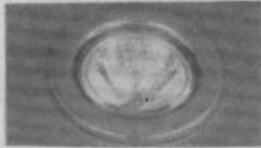
Speed Control Kit

Not the original but could be used with the Sinclair C5 Motor using pulse width modulation for overall control at 12V and upto 30A. Uses rotary pot. for output control. PCB and components included. Requires heatsink. **£17.00. REF: 17P3**

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LIGHTING & LOUDSPEAKERS

LIGHTING



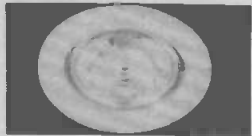
CIRCULAR DOWNLIGHT FITTINGS

A range of four metal circular down light holders for low voltage bulbs and reflectors.

Mounting Plate: 75mm dia
Mounting Depth: 48mm (approx)
(gold)

REF: L153A PRICE: £3.00
(white)

REF: L153B PRICE: £3.00



MIRROR LAMPS

REF: F019HA PRICE: £3.40

A low voltage mirror lamp with open front. 50mm diameter.

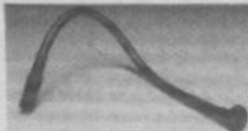


CONSOLE LAMP

REF: L100 PRICE: £4.00

For disco consoles, Hi Fi equipment CB rigs, etc. 12V lamp is enclosed head with switch. Flexible chrome gooseneck.

Length: 300mm
Lamp: 12Vdc 5W tubular filament
Power: 12Vdc



CONSOLE LIGHT

REF: L100C PRICE: £12.99

12V filament lamp fitted in end of flexible black gooseneck.

Length: 420mm



CONSOLE LIGHT

REF: L100B PRICE: £17.99

12V filament lamp fitted in end of flexible black gooseneck. Has standard XLR male socket with pins 1 and 2 wired to lamp.

Length: 450mm
Power: 12Vdc



QUARTZ HALOGEN SPOTLIGHT

REF: L120A PRICE: £5.49

Hand held quartz halogen spotlight with 55W bulb, producing more than 250,000 candle power, directed by a concave electro plated reflector.

Power: 12Vdc
Dims: 125x125x140mm

FLOURESCENT LAMPS

Single 12"

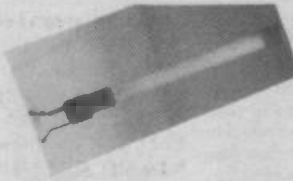
REF: L107 PRICE: £8.50

Double 12"

REF: L108 PRICE: £10.50

Attractive white fitting with ribbed perspex diffuser. On/off switch. Transistorised circuitry. Fitted 3ft cable. Keyhole fixing.

Power: 12Vdc 8W tube
Dims: 360x62x37mm



FLOURESCENT LAMP

REF: L106 PRICE: £8.50

Free standing or hanging 15ft of cable terminating in cigar lighter plug.

Power: 12Vdc 400mA
Dims: 430x30mm dia



WARNING LIGHT

REF: L119A PRICE: £12.50

12Vdc amber dome safety warning light with rotating parabolic mirror gives revolving light beam. Cigar lighter plug. Magnetic base.

Power: 12Vdc 1.4A
Dims: 120diax150
Weight: 0.615kg



XENON STROBE

REF: L118A PRICE: £7.99

Low profile fully sealed weather-proof slasher containing a high intensity long life xenon tube. Reverse polarity protected. Blue lens. Typically for alarm use.

Power: 1W
Voltage: 12Vdc
Current: 150mA
Flash rate: 120/min
Dims: 70diax64mm

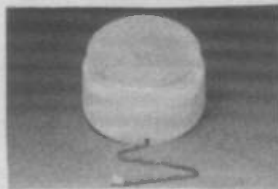


WARNING LIGHT

REF: L118 PRICE: £27.99

High intensity xenon strobe amber warning light. 300,000 candle power flash can be seen for miles. Magnetic base.

Power: 12Vdc 400mA
Dims: 120diax90mm

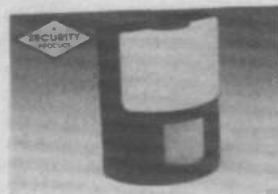


LANTERN

REF: L122K PRICE: £2.99

Battery powered lantern which can be free standing, hung on hook or fixed. Internally powered by batteries. Pull cord and push switch operated comes with spare bulb.

Dims: 114x160x65mm
Power: 4xD cells



PIR LIGHT/ALARM

REF: L122L PRICE: £12.99

Battery powered PIR light/alarm unit in compact free standing or wall mounting case. Slide switch for on/off auto light and alarm.

Detection range: 6m
Power: 4xC cells
Dims: 138x113x65mm



PIR LAMP

REF: L142 PRICE: £12.99

Self contained or wall mounting PIR operated lamp. Slide switch for controls. Light sensor prevents daylight operation.

Detection range: 6m 90° fan
Power: 4xAA batts
Dims: 150x94x68mm

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We may just have THAT ITEM sitting in our warehouse waiting for your call.

**PIR GLOBE**

REF : L134 PRICE : £21.95
 Stylish globe shaped lamp with built in PIR detector which reacts to body heat. A photo detector built into the unit prevents daylight operation. Range is adjustable.

Lamp type: 60W max
 Detection range: 10m x 110° fan
 Power: 220/240Vac 50Hz
 Dims: 300x200x280mm

**TUNGSTEN HALOGEN LAMPS 300W**

REF : F016ZA PRICE : £2.35
 Tungsten halogen replacement lamps: 240Vac.

MAINS MOTOR DRIVER FLASHER 1000W

REF : 2P25 PRICE : £2.00

LOUDSPEAKERS**PIR SPOTLIGHT 300W**

REF : L135 PRICE : £18.99
 Twin spotlight PIR security lamp. The PIR detector and lampholders are fully adjustable for aim.

Detection range: 20m x 110° fan
 Max Load: 300W incandescent
 Auto reset time: 5 sec to 18 min
 Power: 220/240Vac 50Hz

AUTOSENSOR LANTERN

REF : L140 PRICE : £14.99
 Polycarbonate bodied outdoor coach lamp with a built in daylight sensor which allows the lamp to switch on at dusk and off at dawn. Protected against weather to IP23.

Max bulb size: 60W
 Height: 360mm
 Power: 220/240Vac 50Hz

PIR COACH LAMP

REF : L141 PRICE : £21.95
 Polycarbonate bodied outdoor coach lamp with a built in PIR detector. The detector is fully adjustable for angle and has on time adjustment. A photo cell prevents daylight operation. Protected against weather to IP23.

Max bulb size: 60W
 Height: 330mm
 Power: 220/240Vac 50Hz

PIR FLOODLIGHT 500W

REF : L132 PRICE : £29.95
 High powered security floodlight with built in PIR detector which reacts to body heat. Adjustable horizontally and vertically.

Bulb: 500W halogen
 Time on: 9secs-10mins
 Detection: 15m x 110°
 Power: 220/240Vac 50Hz
 Dims: 180x150x140mm
 Light: 90x72x83mm
 Sensor:

PIR FLOODLIGHT 300/500W

REF : L132F PRICE : £21.95
 High powered security floodlight with built in PIR detector which reacts to body heat. Adjustable horizontally and vertically.

Bulb: 300W halogen
 Bulb: 500W halogen
 Time on: 10secs-3mins
 Detection: 8m x 110°
 Power: 220/240Vac 50Hz
 Dims: 185x150x140mm
 Light: 115x50x90mm
 Sensor:

PIR FLOODLIGHT 150W

REF : L132G PRICE : £19.95
 A 150W PIR security floodlight which detects body heat providing positive protection against intruders.

Bulb: 150W halogen
 Time on: 10secs-3mins
 Detection: 8m x 110°
 Power: 220/240Vac 50Hz
 Dims: 145x85x80mm
 Light: 115x50x90mm
 Sensor:

3" ROUND FULL RANGE SPEAKER

REF : L016A PRICE : £4.75
 Full range speaker. Foam edge paper cone with chrome HF dome.

Size: 3" round
 Impedance: 8ohms
 Power nominal: 10W
 Music Power: 20W
 Freq response: 60-16000kHz
 Resonant freq: 120Hz
 Output SPL: 88dB @ 1W
 Magnet weight: 5.3oz
 Overall weight: 400g
 Dims: 78(dia)x40mm

5.25" ROUND FULL RANGE SPEAKER

REF : L022B PRICE : £9.95
 Small size but high power full range unit. All black. Foam rubber edged paper cone. 1" aluminium voice coil.

Size: 5.25" round
 Impedance: 8ohms
 Power nominal: 45W
 Music Power: 60W
 Freq response: 63-20000Hz
 Resonant freq: 63Hz
 Output SPL: 92dB @ 1W
 Magnet weight: 20oz
 Overall weight: 1172g
 Dims: 131(dia)x73mm

6.5" ROUND FULL RANGE UNIT

REF : L026B PRICE : £11.95
 Compact full range driver. Foam rubber edged paper cone. 1" aluminium voice coil.

Size: 6.5" round
 Impedance: 8ohms
 Power nominal: 45W
 Music Power: 60W
 Freq response: 56-20000Hz
 Resonant freq: 38Hz
 Output SPL: 94dB @ 1W
 Magnet weight: 20oz
 Overall weight: 1265g
 Dims: 165(dia)x76.5mm

8" ROUND FULL RANGE UNIT

REF : L032C PRICE : £12.95
 Full range driver. All black. Foam rubber edged paper cone. 1" aluminium voice coil.

Size: 8" round
 Impedance: 8ohms
 Power nominal: 40W
 Music Power: 60W
 Freq response: 38-18000Hz
 Resonant freq: 40Hz
 Output SPL: 89dB @ 1W
 Magnet weight: 18oz
 Overall weight: 1310g
 Dims: 205(dia)x94mm

DO YOU RECEIVE OUR REGULAR NEWSLETTERS AND BULLETINS???**ARE YOU ON OUR DATABASE -**

If not, send in a written request and we will gladly add your name and address to our mailing list immediately. Be one of the first to know what's new in stock before it gets advertised nationally.

BASS REFLEX SPEAKERS

REF : A175G PRICE : £59.00

High performance two way bass reflex speakers. Exceptional smooth and clear response. Threaded inserts on a 58mm pitch for mounting brackets or can be used as shelf speakers.

Speakers:
Bass/Mid 4.5" long excursion
Tweeter 1" super polymer
Impedance: 8ohm
Output: 25W nom 50W max
Freq response 50-22000Hz
Sensitivity (SPL) 88dB
Dims 225x150x130mm



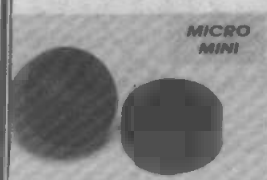
1" HARD DOME TWEETER

REF : B009W

PRICE : £9.45

High powered miniature dome tweeter with easy fix bracket and crossover capacitor for low frequency cut-off and tweeter protection at 6dB/octave.

Size: 1"
Impedance: 4ohm
Music Power: 100W
Frequency Response: 2.300-30,000Hz
Output: 91dB
Crossover: 6dB/octave
Dims: 45mm dia. x 22mm(H)
Weight: 0.025Kg

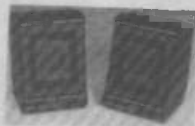


AMPLIFIED SPEAKER SYSTEM

REF : A179R PRICE : £9.25

Stylish two part amplified speaker system designed to give personal radio cassettes a high quality boosted sound output.

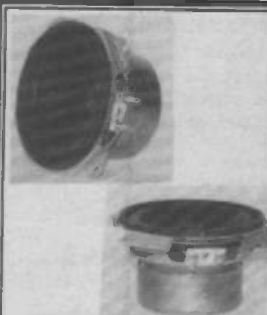
Speaker Type: 2 x 3" full range
Output: 2 x 2.5W max
Freq response: 100-20000Hz
Power: 8xAA batteries or 6Vdc
Dims: 123x89x84mm each



4" Speakers 40hm 10 Watts

A set of two high quality roll surround speaker. Originally made for TV. Shielded Magnet. Overall depth 2.5". 4 Hole fixing and would be ideal for use as car speakers

Absolute unbeatable bargain
£3.00 per pair
REF: 3P419

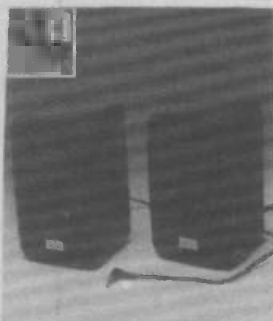


AMPLIFIED SPEAKER SYSTEM

REF : A179S PRICE : £29.95

High output power amplified dual speaker system for use with personal cassette or CD players. Each cabinet contains 3" woofer and 1" tweeter. Unusually mains powered speakers.

Output: 6W nom 12W max
Freq response: 60-20000Hz
Power: 220/240Vac 50Hz
Dims 1165x88x105mm



FAMOUS BRAND AAA BATTERIES

PHILIPS AAA 1.5V
ALKALINE BATTERY PACK
PACKET OF 4

IDEAL FOR: REMOTES
WALKMANS
CAMERAS
ETC, ETC, ETC

REF: BD304 PRICE £1.00



SPEAKER WALL MOUNTING BRACKETS

REF : A173B PRICE : £18.25



TV WALL MOUNTING BRACKET

WHITE

REF : A173CD PRICE : £22.95

BLACK

REF : A173CE PRICE : £22.95



GAFFA TAPE SILVER

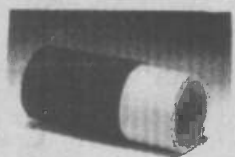
REF : L099R PRICE : £4.55

Standard quality 50m rolls of 2" wide self adhesive Gaffa Tape.

GAFFA TAPE RED

REF : L099SA PRICE : £7.99

Superior quality. 50m rolls of 2" wide self adhesive Gaffa tape. Red



MORE LOUDSPEAKERS

3" Square Loudspeakers	PKT10	1.00	EOY11
6.5" 4ohm 10W Speaker	EACH	1.00	BD137
2.25" 60ohm Speaker	PKT2	1.00	BD453
2.25" 80hm Speaker	PKT2	1.00	BD454
3" 4ohm Tweeter	EACH	1.00	BD433
TV Speakers 3W 8ohm 70x55mm	PKT2	3.00	3P108
TV Speakers 5W 4ohm 55x125mm	PKT2	3.00	3P109
Speaker Grills - Flush Mount 8"	EACH	2.00	2P281
Brackets - Wall mounting loudspeaker	PAIR	5.00	5P152
Quality Speaker 4ohm 10W 4" diameter	PKT4	3.00	X3P13
Mini Speaker 8ohm 1W 10mm dia	PKT10	1.00	X1P24
Mini Tweeter 140ohm 40mm dia	PKT4	2.00	X2P14

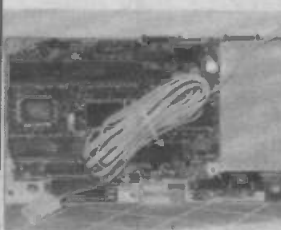
CTM 644 COLOUR MONITOR REDUCED TO £59.00

REF: Z59P1



Working and Tested. completely refurbished Amstrad CTM644 Colour RGB Monitor Housed in a charcoal gray case. Originally made for the 464 Computer but suitable for use with most computers having an RGB Output. 12" Screen with carrying handle and 12V DC output socket on front panel. Brightness control. Dims: 370x340x370

AMSTRAD PPC INTERNAL MODEM



The Amstrad PPC 2000 intelligent modem was originally designed to fit into the laptop computers and has a host of redeeming features such as:

Hayes compatibility.
Call Monitoring
Auto dialing/Answering
operating to V21 V22
V22 Bis and V23
standard at 75-240bps

It is supplied with a BT Lead attached and an on board BT socket.

£5.00 Ref: 5P613

MAMOD WORKING STEAM MODELS

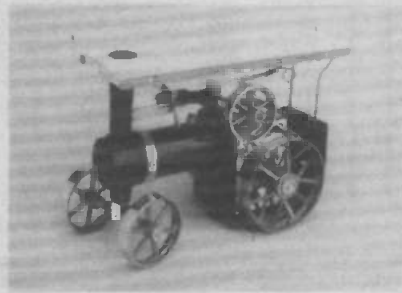
1313 TRACTION ENGINE TE1a

Attractive working model of traditional English traction engine.

Pack: 285 x 150 x 185mm. Gr. Wt. 2900g
11 1/4" x 5 7/8" x 7 1/4"

Price: £59.95 each

Ref : TE1a



1319 STEAM ROADSTER SA1

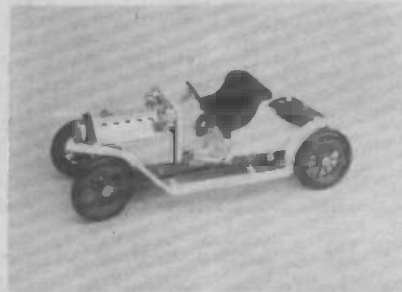
A magnificent working model of a motor car which

captures the elegance of the Edwardian era.

Pack: 450 x 150 x 210mm. Gr. Wt. 2450g
17 3/4" x 5 1/8" x 8 1/4"

Ref: SA1

Price : £79.99



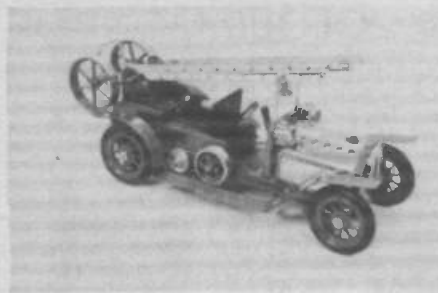
404 FIRE ENGINE FE1

Fine example of an early Edwardian Fire Truck. Finished in typical bright red with brass and chrome trim.

Pack: 490 x 185 x 250mm. Gr. Wt. 2970g
19 1/4" x 7 1/4" x 9 7/8"

Ref : FE1

Price: £99.95



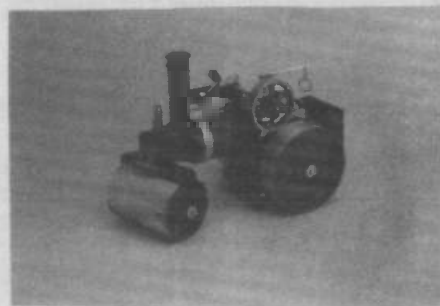
1312 STEAM ROLLER SR1a

A superbly realistic model of an early road roller.

Pack: 285 x 150 x 185mm. Gr. Wt. 1940g
11 1/4" x 5 7/8" x 7 1/4"

Ref: SR1a

Price : £54.95



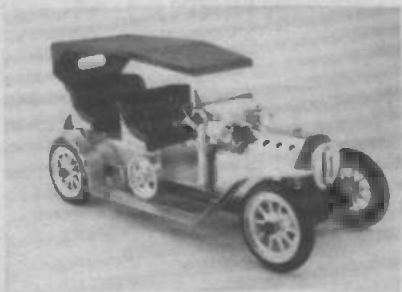
1403 FOURSEATER LIMOUSINE SAIL

This unique and realistic working model captures the realism of years gone by.

Pack: 475 x 195 x 240mm. Gr. Wt. 2750g
18 3/4" x 7 5/8" x 9 1/2"

Ref : SAIL

Price: £92.95



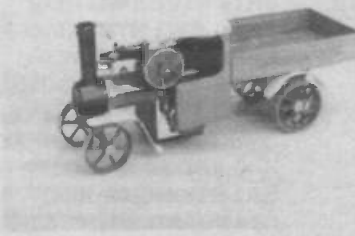
1318 STEAM WAGON SW1

A robust model of a steam wagon.

Pack: 450 x 180 x 210mm Gr. Wt. 3070g
17 3/4" x 7" x 8 1/4"

Ref: SW1

Price : £79.99



MAMOD WORKING STEAM MODELS

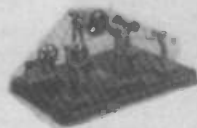
1332 STEAM POWERED ENGINE SP2

Powerful, compact engine capable of driving workshop models. Pack: 210 x 170 x 198mm. Gr. Wt. 1160g 8 1/4" x 6 5/8" x 7 3/4"
Ref: SP2 Price: £37.95



1336 WORKSHOP MODEL WS1

Pack: 260 x 210 x 140mm. Gr. Wt. 1100g 10 1/4" x 8 1/4" x 5 1/2"
Ref: WS1 Price: £34.95



1334 STEAM POWER ENGINE SP4

Versatile unit capable of driving larger models. Pack: 260 x 210 x 195mm. Gr. Wt. 1850g 10 1/4" x 8 1/4" x 7 5/8"
Ref: SP4 Price: £42.49



BELOW IS A LIST OF ACCESSORIES AVAILABLE FOR THE MAMOD RANGE.

REF	DESCRIPTION	PRICE
MAM/12	STANDARD SAFETY VALVE	£3.99
MAM/16	STANDARD WHISTLE ASSEMBLY	£4.99
MAM/19	WATER LEVEL PLUG (non sight glass models)	£2.99
MAM/20	SELECTION OF WASHERS FOR ALL FITTINGS	£1.25
MAM/35	STANDARD PISTON/CYLINDER ASSEMBLY	£5.99
MAM/37	SP4 PISTON/CYLINDER ASSEMBLY	£5.99
MAM/42	STANDARD FLYWHEEL	£3.50
MAM/43	SP4 FLYWHEEL	£3.75
MAM/46	SP2 CRANKSHAFT	£2.99
MAM/17	SP4 CRANKSHAFT	£2.99
MAM/49	SR1a, TE1a, SW1 CRANKSHAFT	£2.99
MAM/55	SA1, SP4, 1/2" PULLEY	£1.25
MAM/60	WS1 DRIVING BANDS (4)	£1.99
MAM/62	UNJOINED 12" DRIVING BANDS (2) for general	£1.45
MAM/62a	SR1a, TE1a DRIVING BANDS (2)	£1.45
MAM/63	SW1 DRIVING BANDS (2)	£1.45
MAM/64	SA1 DRIVING BANDS (2) state which side is d	£1.45
MAM/72	FILLER FUNNEL	£1.05
MAM/74	SA1, FE1, DV2, LB1, BURNER TRAY	£3.50
MAM/74a	SR1a, TE1a, SW1 BURNER TRAY WITH KNOB	£3.50
MAM/74b	SP2, SP4 BURNER TRAY	£3.99
MAM/76	PACKET OF SOLID FUEL	£1.99
MAM/95	SR1a FRONT ROLLERS (PER SET)	£7.99
MAM/96	SR1a REAR ROLLERS (PER SET)	£7.99
MAM/97	TE1a, SW1 FRONT WHEELS (PER SET)	£6.99
MAM/98	TE1a REAR WHEELS (PER SET)	£7.99
MAM/99	SMALL HUB CAPS (2)	£0.89
MAM/100	LARGE HUB CAPS (2)	£0.89
MAM/101	SR1a FRONT FORK ASSEMBLY	£4.25
MAM/102	TE1a, SW1 FRONT FORK ASSEMBLY	£3.45
MAM/103	SR1a STEERING ROD	£3.45
MAM/104	TE1a, SW1 STEERING ROD	£3.45
MAM/105	CANOPY ASSEMBLY	£8.99
MAM/106	SR1a, TE1a, SW1 SCUTTLE	£3.99
MAM/109	SR1a, TE1a, SW1 REVERSE LEVER	£1.99
MAM/110	SW1 REAR WHEELS (PER SET)	£8.25
MAM/113	SA1 WHEEL COMPLETE WITH TYRE	£4.99
MAM/127	SA1 STEERING ROD	£3.75
MAM/128	STANDARD SIGHT GLASS ASSEMBLY	£2.95

MEGAPHONES, MICROPHONES, METERS, MOTORS...

MEGAPHONES



MEGAPHONE

REF : P116B PRICE : £33.95

High output but very compact loudhailer for handheld use. All in one ABS construction with volume control and wrist strap

Output: 5W RMS/10W peak
Range: 0.5k-0.7km depending conditions
Power: 8 x AA type batteries

MICROPHONES

PROFESSIONAL FLOATING DYNAMIC 250 OHM

REF : P655T PRICE : £46.95

High quality dynamic microphone with unidirectional characteristic and selectable floating or unbalanced output. Integral on-off switch, strong wire mesh windsheld, transit/storage case, detachable lead. (XLR to jack)

Sensitivity: 1.0mV at 94dB spl
Impedance: 250 ohm
Response: 60-16000Hz
Front/back: better than 10dB at 1kHz
Lead: 4m low noise with 0.33mm jack plug



DIRECTIONAL RIFLE-TYPE MICROPHONE 600 OHMS

REF : P655M PRICE : £52.95

For hand-held or stand-mounted use. The capacitor microphone is housed in a shock mount and the barrel can be unscrewed for storage. Supplied with full length foam windsheld.

Sensitivity: 3.1mV at 94dB spl
Impedance: 600 ohms, with switch most in use
Response: 30 to 16000Hz
Front/back: approx 18dB
Power: 1 x AA type battery.
Length: 390mm overall



FM CORDLESS MICROPHONE

REF : 15P42A PRICE : £15.00

This unit is an FM broadcasting station in miniature. A 3 silicon transistor FM transmitter with an electric condenser type microphone which is direct coupled to a Field Effect Transistor amplifier resulting in maximum sensitivity and broad frequency response.

Freq Range: 90-105MHz FM
Freq Resp: 50-15000Hz
Range: 500 feet open field
Power: PP3 battery



PANEL METERS

PANEL METERS 80x70mm

0-40V PANEL METER 80x70mm	EACH	6.00	6P24
0-50V PANEL METER 80x70mm	EACH	6.00	6P26
0-80V PANEL METER 80x70mm	EACH	6.00	6P27
0-200V PANEL METER 80x70mm	EACH	6.00	6P28
0-5A PANEL METER 80x70mm	EACH	6.00	6P30
0-10A PANEL METER 80x70mm	EACH	6.00	6P29

PANEL METERS 60x45mm

0-50mA 2K3 INTERNAL RESIST	EACH	6.00	6P39
0-100mA 1K2 INTERNAL RESIST	EACH	6.00	6P40

METAL DETECTORS



METAL DETECTOR

REF : Y090A PRICE : £39.95

Easy to use lightweight, well balanced metal detector. Detectes gold, silver or copper coins and other metal objects through sand or rocky soil. Features:

- On/Off volume control
- Tuning control for sensitivity adj
- VU meter
- Headphone socket
- Telescopic non-corrosive shaft
- 8" waterproof and shock resistant search coil.

Length closed: 600mm
Length extended: 940mm
Power supply: 9Vdc (PP3)
Weight: 1.2KG

METAL DETECTOR

REF : Y090B PRICE : £59.95

A professional model incorporating a discriminator circuit which allows the operator to eliminate unwanted items while still maintaining a high degree of sensitivity to detect most precious metals.

- Features:
- On/Off volume control
 - Discrimination control
 - Headphone jack socket
 - Telescopic non-corrosive shaft
 - Auto-tune button for setting to maximum sensitivity
 - Battery/sensitivity level meter
 - 6" waterproof/shock resistant

Length closed: 605mm
Length extended: 940mm
Power Supply: 9Vdc (PP3)
Weight: 1.18Kg



MORE PANEL METERS

0-500mA 360R INTERNAL RESIST	EACH	6.00	6P41
0- 1mA 100R INTERNAL RESIST	EACH	6.00	6P42
0- 10mA 60R INTERNAL RESIST	EACH	6.00	6P43
0-100mA 0.6R INTERNAL RESIST	EACH	6.00	6P44
0- 1A	EACH	6.00	6P45
0-25V DC 25K INTERNAL RESIST	EACH	6.00	6P46
0-30V DC 30K INTERNAL RESIST	EACH	6.00	6P47

MOTORS

AC MOTORS

MAINS SHADED POLE MOTOR 7/8"	EACH	1.00	BD85
GEARBOX & MOTOR			
500 WATT MAINS MOTOR WITH 3 SPEED CONTROL	EACH	5.00	5P193
60 WATT 5RPM MOTOR, POWERFUL 125x60x45	EACH	5.00	5P54
60 WATT 150RPM MAINS MOTOR, 60X80X90mm	EACH	2.00	2P38A
90W MAINS MOTOR approx. 6"x4"	EACH	3.00	X3P9
60 WATT 60RPM MAINS MOTOR	EACH	5.00	5P173

DC MOTORS

1/10TH HP-12V 1/4" SPINDLE STEPPER MOTOR 7.5°	EACH	4.00	4P22
1/8TH HP 12V MOTOR 75X75mm	EACH	6.00	6P1A
C5 MOTOR NO GEARBOX*****	EACH	22.00	20P22
MODEL MOTOR 1.5-9v	EACH	1.00	BD540
LOW CURRENT MOTOR/SOLAR	EACH	1.00	BD681
MAINS MOTOR SUIT BD86*****	EACH	1.00	BD88

MAGNETS

FLAT MAGNET 1x1/2x1/8"	PKT6	£1.00	BD897
VERY POWERFUL MAGNET 25x13x6mm	PKT2	£1.00	BD642
POWERFUL ELECTRO MAGNET 6V 1x50mm sq AND 1x20mm sq	PKT2	£2.00	2P371

KNOBS

1/4" STANDARD GRUB SCREW	PKT10	£1.00	VIP3
SLIDER POT KNOBS	PKT20	£1.00	VIP10

OPTO

SLOTTED OPTO PHOTO INTERRUPT	EACH	£1.00	BD545
LIGHT DEPENDENT RESISTOR ORP12	EACH	£1.00	BD619
SUB MIN LIGHT DEPENDANT RESTR	PKT2	£1.00	BD19
CAMERA FLASH - XENON TUBE 3V	EACH	£2.00	2P38B

PCB PRODUCTION EQUIPMENT

PHOTO ETCH PCB (UV SENSATIVE)			
203 x 114mm DOUBLE SIDED	EACH	£5.00	5P189
100x160mm SINGLE SIDED	EACH	£3.00	3P133
203x114mm SINGLE SIDED	EACH	£4.00	4P78
100x160mm DOUBLE SIDED	EACH	£4.00	4P79
203x144mm DOUBLE SIDED	EACH	£5.00	5P189
FERRIC CHLORIDE ETCHANT	EACH	£3.00	3P134
DEVELOPER CRYSTALS	EACH	£2.00	2P348
POLYPROPYLENE TRANS 325x225x50	EACH	£2.00	2P349
BRASS WIRE BRUSH	EACH	£1.00	BD837
TRANSFER STARTER PACK ASSORTED	PKT12	£10.00	10P100

POTENTIOMETERS

8ohm 25 WATT 1/4" SHAFT	PKT2	£1.00	BD69
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RELAYS

12V MINATURE RELAY SPDT 16A			
240V AC CONTACTS	EACH	£2.00	2P412
12V MIN RELAY 700ohm Coil 2 c/o cont.	EACH	£1.00	BD51
12V MIN RELAY. 160ohm 4 c/o cont.	EACH	£1.00	BD52
DC OR 24V PLUG IN RELAY 3 c/o cont.	PKT2	£1.00	BD50
24V MIN RELAY 4 c/o 5A cont. 28x20x32mm	PKT2	£1.00	BD580
5V COIL PCB MOUNT RELAY	EACH	£1.00	BD665
PHOTO ELECTRIC RELAY RESTRS	EACH	£85.00	T030
1/4 WATT 2% METAL FILM ASSRTD	500	£5.00	5P170
VARIABLE RESISTORS	PKT3	£20.00	V20P1
24V RELAY DC encapsulated 16A on/off contact	PKT4	£1.00	X1P16
24V RELAY open type 10A on/off contact	PKT5	£1.00	X1P17

MULTIMETERS



10Mohm
REF: Y123AE PRICE: £29.95

- 3.5 digit 24mm LCD display
- 33 ranges including 20A ac/dc
- 5 capacitance ranges
- Transistor test
- Continuity test
- PTC and fuse protection

Battery, instruction manual and fully shrouded test leads included

AC volts: 0-200m-2-20-200 750Vdc ±1.5%

DC volts: 0-200m-2-20-200 000Vdc ±0.8%

AC current: 0-200u-2m-20m-200m-20Aac ±1.2%

DC current: 0-200u-2m-20m-200m-20Adc ±2%

Resistance: 0-200k-20k-200k-2-200Mohm ±2%

Capacitance: 0-200m-200n-2000n-20uF ±3%

Trans hFE: 0-1000 NPN/PNP

Dims: 191x88x36mm

20Kohm/V

REF: Y106 PRICE: £19.95

- 19 ranges (including 10Aac)
- Battery test
- Continuity buzzer
- Fuse and diode protection
- 3-colour mirrored scale
- Two tone beige plastic case
- Leads with 4mm plugs

Batteries and instructions included

AC volts: 10-50-250-1000V ±4%

DC volts: 0.25-2.5-10-50-250-1000Vdc ±3%

DC current: 0-50u-5ma-500ma-10A ±3%

Resistance: 10k-100k-10Mohm ±3%

Battery test: 1.5V 10ohm 9V 900ohm

Decibels: -8to +62dB

Protection: fuse and diodes

Dims: 150x100x40mm



30kohm/V

REF: Y121A PRICE: £26.95

- 24 ranges including 10Aac
- Diode and fuse protection
- Polarity reverse switch
- Transistor test ranges
- Battery test ranges
- Test leads with shrouded 4mm plugs
- Battery and instruction leaflet included

AC volts: 0-10-30-10-300 1000Vdc ±3%

DC volts: 0-30-10-30-10000 1000Vdc ±3%

DC current: 0-100u-3m-30m-30010Aac ±3%

Resistance: 0-1k-10k-1M-10Mohm ±5%

Battery test: 1.5V AA, 1.5V C&D, 9V PP3

Protection: fuse and diodes

Dims: 160x110x50mm



10Mohm

REF: Y122F PRICE: £29.95

- 3.5 digit 12mm LCD display
- 32 ranges including 20A ac/dc
- Transistor test
- Diode test
- Rugged yellow case
- Test leads with shrouded 4mm plugs
- Fuse protection
- Automatic polarity and zero

Battery, instruction manual and carrying case included

AC volts: 0-200m-2-20-200 700Vdc ±0.8%

DC volts: 0-200m-2-20-200 1000Vdc ±0.8%

AC current: 0-20u-200u-2m-20m-200m-2A20Aac ±1%

DC current: 0-20u-200u-2m-20m-200m-2A-20Adc ±0.5%

Resistance: 0-200-2k-20k-200k-2M20Mohm ±0.5%

Trans hFE: 0-1000 PNP/NPN

Dims: 172x88x36mm



10Mohm

REF: Y122HL PRICE: £69.95

- 4.5 digit 15mm LCD display
- 30 ranges including 20A ac/dc
- Transistor and diode test
- Continuity test with buzzer
- Data hold switch
- Built and tested to IEC548
- Fully shrouded test leads

Battery, instruction manual and carrying case included

AC volts: 0-200m-2-20-200 750Vdc ±0.5%

DC volts: 0-200m-2-20-200 1000Vdc ±0.5%

AC current: 0-200u-2m-20m-200m-2-20Aac ±0.8%

DC current: 0-200u-2m-20m-200m-2-20Adc ±0.5%

Resistance: 0-200-2k-20k-200k-2M20Mohm ±0.15%

Trans hFE: 0-1000 NPN/PNP

Dims: 176x90x36mm



2kohm/V

REF: Y102A PRICE: £7.99

- 12 ranges
- Diode protection
- Mirrored scale
- Ohms adjust
- Test leads with 2mm plugs
- Battery and instruction leaflet included.

AC volts: 0-10-50-250-500ac ±4%

DC volts: 0-10-50-250-500dc ±3%

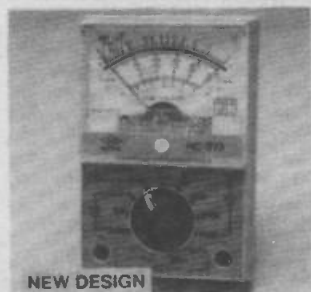
DC current: 0-500u-50m-250mA ±3%

Resistance: 0-1Mohm ±3%

Decibels: -20 to +56dB

Protection: diodes

Dims: 90x60x30mm

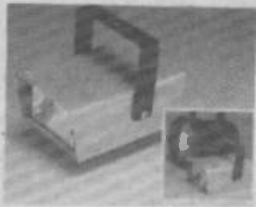


NEW DESIGN

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MINI STROBE

REF : G011A PRICE : £19.95

Mini strobe unit with high light intensity for size. Flash rate adjustable up to 15 flashes per second.

Flash rate: 15 per sec max
Max Tube Power: 15W
Power: 220/240Vac 50Hz
Dims: 125x85x55mm
Weight: 0.52kg



STROBE UNIT

REF : G012 PRICE : £23.95

Strobe light with circular reflector housed in veneered wooden cabinet. Variable speed control.

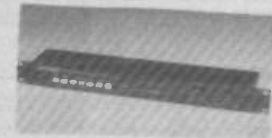
Power: 220/240Vac 50Hz
Dims: 150x150x120mm
Weight: 0.58kg

STROBE CONTROLLER

REF : G011J PRICE : £136.95

19" rack mount 4 channel strobe controller with auto chaser or audio firing of channel outputs. Each channel capable of running up to 6 strobes. Up to 8 different patterns can be selected. LED preview facility enables pre-selection of flash rate and pattern.

Power: 220/240Vac 50Hz
Dims: 484x44x80mm
Weight: 1.82kg



SCANNER

REF : G013A PRICE : £29.95

PAR36 single lamp scanner. 120deg rotation forward and reverse. Smooth running motor. Mechanical reverse. Lamp supplied separately.

Power: 220/240Vac 50Hz
Height: 280mm
Weight: 1.8kg

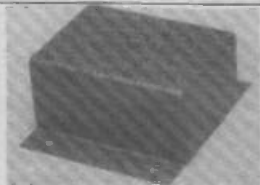


4 LAMP SCANNER

REF : G013 PRICE : £99.95

4 PAR36 scanners on a single beam, each having own motor. 90deg scan with mechanical reverse. Adjustable angle on lampholders.

Power: 220/240Vac 50Hz
Height: 220mm
Length: 900mm
Weight: 7.2kg



MIRROR BALL MOTOR

REF : G007N PRICE : £11.99

Ceiling mounting mirror ball rotator. 3rpm motor.

Power: 220/240Vac 50Hz
Dims: 115x110x45mm

MIRROR BALLS

130MM

REF : G007 PRICE : £10.99

400MM

REF : G007C PRICE : £59.95

Mirror balls for use with high power defined beam spots to create beautiful effects.



SMOKE MAKING MACHINE

REF : G002B PRICE : £189.95

Powerful smoke machine using a heavy duty industrial pump and enclosed heater unit. Smoke generation is remotely controlled by an electronic handset via a 7 meter cable and 5 pin DIN plug.

Heat up time: 5 minutes
Smoke output: 42.5m³/minute
Max fluid cons: 1.75 ltr/hr
Smoke particle size: 0.5-60 microns
Heater: 500W
Power: 220/240Vac 50Hz
Power consume: 3A
Dims: 375x185(dia)mm
Weight: 5.4kg



SMOKE MACHINE FLUID

REF : G002AA PRICE : £19.75

5 ltr bottle of smoke generating fluid for use with smoke machines. Non toxic. Medium persistence.



DIRECT DRIVE TURNTABLE

REF : G053 PRICE : £189.95

Quartz controlled direct drive, fully manual turntable:

Features

Fast start/stop. Remote start/stop/forward/reverse. High quality tone arm. Anti skate. Cue light. Pitch control with central green LED. Turntable strobe. Electronically controlled 33/45rpm.

Sprung feet

Wow and flutter: <0.15 wrms
Turntable platter: 305mm dia aluminium
Speed: 33 1/3 & 45rpm
Tone arm: Statically bal
Power: 220/240Vac 50Hz
Power cons: 5.0w
Dims: 450x152x352mm
Net weight: 10kg



BELT DRIVE TURNTABLE

REF : G055 PRICE : £35.95

Belt drive, fully manual turntable. Brushless DC Motor Electronically cont 33/45rpm Tubular tone arm. Pitch control Turntable strobe Ceramic PU Cartridge

Power (motor): 12Vdc 100mA
Power (strobe): 220/240Vac 50Hz
Dims: 330x285x55mm



CD PLAYER

REF : G060 PRICE : £119.95

3 Beam semi conductor laser 16 track programmable memory Repeat one repeat all facility Built in 3" disc adaptor. Track search and index

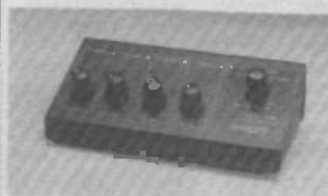


CD CASE

REF : G072 PRICE : £32.95

Black rexine covered heavy duty case with internal partitions capable of holding up to 100 CDs.

Dims: 588x330x190mm
Weight: 6.38kg



MICROPHONE MIXER

REF : G105 PRICE : £21.95

4 Channel mono mic mixer. Input via 6.35mm mono sockets with individual volume controls. Output via 6.35mm mono socket with master volume.

Input sensitivity: 1mV
Input impedance: 600ohm
Output impedance: 1.2kohm
Output level: 90mV (5mV input)
Power: 9Vdc (PP3) battery
Dims: 148x86x46mm

**DIGITAL SAMPLER/MIXER**

REF : G102G PRICE : £199.95

4 Channel stereo mixer with built in 8 second digital sampler. Sample cue, digital delay and single/repeat playback. Capable of mixing a total of 8 line or phono inputs. Output section has 7 band equalization and overall analogue delay.

INPUT SENSITIVITY:

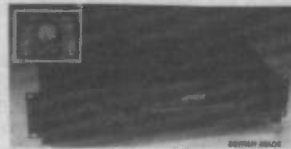
Mic 1mV 600ohms
Phono 3mV 47k ohms
Line 150mV 27k ohm

OUTPUTS:

Amp/tape 1V nom
Headphone 400mV 8 ohm
Freq response 20-20000Hz
Hum and noise less than 3.5mV
Equalizer range +12dB boost or cut
Equalizer freq 2.4k 6k 15kHz

SAMPLER SECTION:

System 4 bit ACPCM system 20 10kHz
Max sampling 8-10 seconds
RAM Memory 1024 megabits
Sampling rate Continually variable
Power: 220/240Vac 50Hz
Dims 482x280x110mm

**125W AMPLIFIER**

REF : G090 PRICE : £239.00

2 unbalanced inputs per channel. 2 outputs per channel. fuse protection.

Output power: 2x125W rms into 4ohms
Freq response: 20-20000Hz
Total harmonic dist less than 0.0005%
Damping factor: better than 100
Input sensitivity: 0dB 0.775V
Input impedance: 10kohms unbal
S/N ratio: 96dB
Protection: 2x20mm QB fuse
Power: 220/240Vac 50Hz
Dims: 484x882x243mm

**DIGITAL SAMPLER**

REF : G025T PRICE : £99.95

Compact add on digital sampling processor with 4 stage memory bank. Variable pitch and effects level control. Assign in from headphone socket of mixer.

Channels: One
Input sensitivity: 150mV 47kohm
Sampler time: 8 seconds
Sampler type: Digital
Output level: 1V/0dB
Power: 12Vac adaptor
Dims: 190x118x25mm

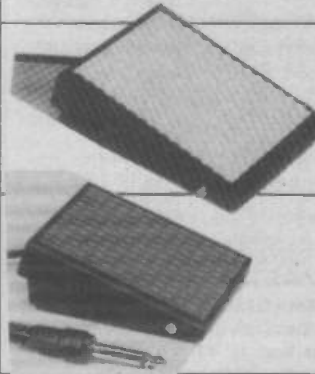
**X-FADE MIXER**

REF : G103N PRICE : £149.00

DJ Mic channel with pitch changer and auto talkover 2 phono inputs. 6 line inputs (4 channels) assignable removable cross fader, six built in sound effects, LED bargraph monitoring of output.

Input sensitivity:

DJ Mic 1.5mV 10kohm
Phono 3.0mV 47kohm
Line 150mV 27kohm
Output: 1V to 7.2V
Autotalkover: cut 12dB of program level
Freq response: 20-20000Hz
DJ Mic 30-20000Hz
Phono 20-20000Hz
Line 20-20000Hz
Power: 12Vac via adaptor
Dims: 385x35x190mm

**FOOTSWITCH**

REF : G028 PRICE : £4.25

60V 1A momentary action. Black metal non-slip base. 1.7m lead with 2.5mm plug.

Dims: 88x86x25mm

FOOTSWITCH

REF : G028A PRICE : £5.75

60V 1A black metal construction. Non slip base. 3m lead fitted with 6.35mm mono jack plug.

Dims: 87x65x28mm

DISCO STEREO MIXER

REF : G103G PRICE : £79.95

A compact 2-channel stereo mixer with inputs for line and phono on each channel. Trigger scratch buttons are provided for each channel. DJ Mic has volume, bass and treble controls with switched talkover facility. Outputs for amp, tape & headphones.

Type: Stereo Mixer
Channels: Two
Input impedance:
Phono 3mV 47kohm
Mic 1mV 600ohm
Line 150mV 27kohm
Output: 1.6V max
Freq response:
Phono/Mic/Line 20-20000Hz
Power: 12Vac
Dims: 255x192x45mm

**GOOSENECKS**

Heavy duty goosenecks. Standard fittings.

CHROME :

8"

REF : G124 PRICE : £4.00

13"

REF : G125 PRICE : £5.00

21"

REF : G126 PRICE : £6.00

BLACK :

8"

REF : G124A PRICE : £4.00

13"

REF : G125A PRICE : £5.00

21"

REF : G126A PRICE : £6.00

STEREO MIXER

REF : G101BC PRICE : £69.95

4 Channel stereo mixer capable of accepting inputs from tape, phono CD or Mic sources. Outputs to amp and tape.

Inputs:
Mic 0.3mV 600ohm/
3mV 50kohms
Line 150mV 50kohm
Phono 3mV 50kHz/
150mV 50ohms

Outputs:
Amp and tape 220mV 50kohm
Freq response: 20-40000Hz
Distortion: 0.3%
S/N ratio: 60dB
Power: 220/240Vac 50Hz

**KARAOKE MIXER****AMPLIFIER**

REF : G081 PRICE : £44.95

2 Mic inputs with bass and treble equalization. Analog echo with time and repeat controls line level input with level control. Output to internal or external amp.

Mic inputs: 3mV/600ohms
Line out impedance: 10kohms

Speaker impedance:

8 ohms

Amp output: 2 x 2.5W

Power: 220/240Vac 50Hz

Dims: 60x400x200mm

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MORE MICROPHONES

**BALANCED DYNAMIC MIC
600ohms**

REF : G147C PRICE : £27.95

Uni directional balanced dynamic mic with shock proofed insert. Black metal mesh head. Self contained anti pop filter. On/Off switch. Complete with carry case and Mic holder.
Impedance: 600ohms
Response: 50-12000Hz
Sensitivity: -74dB @ 1kHz
Head dia: 40mm
Length: 170mm



DYNAMIC MIC 500ohms

REF : G147A PRICE : £21.95

All gold coloured heavy metal construction. Shockproof cartridge insert. On/Off switch. Complete with carry case and Mic holder.
Impedance: 500ohms
Response: 40-17000Hz
Sensitivity: -74dB @ 1kHz
Head dia: 51mm
Length: 167mm



DYNAMIC MIC 50Kohm

REF : G148G PRICE : £18.50

Good quality microphone built of heavy dark grey metal with silver trim. On/off switch. Holder included.
Impedance: 50k ohms
Response: 60-12000Hz
Sensitivity: -74dB @ 1kHz
Head dia: 51mm
Length: 155mm



KARAOKE MICROPHONE

REF : G155LA PRICE : £37.99

Echo condenser microphone for vocal and Hi Fi recording. On/off switch. Echo level controller. Approx 4m cable attached with 3.5mm jack plug. Gunmetal. Takes one AA battery.



DYNAMIC MIC 600ohms

REF : G155M PRICE : £7.50

General purpose low impedance mic with a heavy plastic body and gold metal mesh windshield head. On/off switch in body.
Impedance: 600ohms
Response: 100-10000Hz
Sensitivity: -74dB @ 1kHz
Head dia: 52mm
Length: 228mm



**DUAL IMPEDANCE MIC
600ohms**

REF : G162 PRICE : £19.95

Elegant slimline microphone. Built in FET. High/Off/Low switch. Windshield and holder included.
Impedance: 600ohms/ 50kohms
Response: 50-18000Hz
Sensitivity: -68dB(600ohm)
-50dB(50kohm)
Dia: 22mm
Length: 248mm



SORRY NO ILLUSTRATION
AVAILABLE ON THIS PRODUCT

**EAGLE MICROPHONE
PKT 2**

REF : V1P4 PRICE : £1.00

25mm diameter crystal microphone cartridge complete with fly leads.

TWO CHANNEL DIGITAL RECEIVER

REF : Y5P3 PRICE : £5.00

Model ASAP R2 is a two channel receiver using 9 bit Trinary digital coding. These receivers can perform a wide variety of remote switching tasks. The receiving codes can be varied very easily. see the instructions supplied. We again have a limited stock of these 2 channel. (no transmitter)

RACAL MILGO MULTILINE ADAPTOR MODEL 23

REF : Y10P6 PRICE : £10.00

A very high quality piece of kit. Made to MOD standards, this well made modem add on enables one modem to be shared by up to four lines, we have been informed! This metal cased unit houses a PCB populated with a lot of components consisting of 24 transistors, 9 IC's 8 line transformer, 4 rocker switches and lots of resistors and diodes. A comms enthusiast's dream. All this at a bargain price. The case alone, measuring 430x315x90mm is worth more. Wonderful spares value.

RACAL MILGO PACKAGE

REF : Y20P2 PRICE : £20.00

For just £20 you can have a Milgo package consisting of a Multiline adaptor and a Modem as described below.

RACAL MILGO MODEM 26LSI

REF : Y13P1 PRICE : £13.00

Once again a quality product up to MOD standards. This modem consists of 4 plug in pcb's housed in a sturdy plastic case 195x335x130mm. A mains PSU panel giving +5v/ +12v and -12v each individually regulated, transmitter panel, receiver and interface panels. Designed to work in conjunction with the Multiline Adaptor, the idea was to cut the cost of phone lines enabling four terminals to use one line. Originally costing hundreds of £'s we offer this modem at a bargain price.

8088 XT BOARD plus 18 x 41256's

REF : Y10P7 PRICE : £10.00

Have you ever queued up in a Post Office and been entertained by the moving message displays, most people have at some time or another. The XT Boards we are offering used to be at the heart of these displays. The board 300x215mm contains an Intel 8088 CPU, 18 x 41256 memory chips, a battery board, normal keyboard, 5 pin socket and 12 pin power socket. There is only one expansion slot. Whilst these boards cannot be used for their original purpose, they do make for a bargain in chip value alone.

SINCLAIR C5 SPARE TYRES

13" = REF : R1P2 PRICE : £1.00

16" = REF : R1P3 PRICE : £1.00

As many of you know we have sold out of most of C5 wheels but we have some tyres left so if you would like a spare (either 13" or 16" diameter) or if you are stuck for an unusual birthday present treat yourself for just £1.00.

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POWER SUPPLIES AND PROJECTS

POWER SUPPLIES

3A 13.8Vdc POWER SUPPLY

REF : P001C PRICE : £18.95

Regulated power supply for use with CB rigs, auto equipment. High stability circuitry with high surge current capability. Overload protection Manufactured according to the requirements of the Electrical Safety Regulations for domestic use.

Input Voltage: 220/240Vac 50Hz
Output Voltage: 13.8Vdc
Output current: 3A cont 5A max
Stability: 1%
Ripple: 25mV
Connections: 4mm banana socket
Dims: 170x180x83



POWER SUPPLY REGULATED

REF : P006G PRICE : £5.99

Plug in regulated power supply. output switchable. Reverse polarity switch and LED indicator. Supplied with 6 DC adaptor plugs. IC Regulated output. Automatic thermal cut off. Short Circuit protection. Auto overload cut off.

Input Volt: 220/240Vac 50Hz
Output Volt: 3, 4.5, 6, 7.5, 9, 12V
Stability: 2%
Ripple: 10mV
Dims: 87x62x62mm



5A 13.8Vdc POWER SUPPLY

REF : P001 PRICE : £21.95

Regulated power supply for use with CB rigs, auto equipment. High stability circuitry with high surge current capability. Overload protection Manufactured according to the requirements of the Electrical Safety Regulations for domestic use.

Input Voltage: 220/240Vac 50Hz
Output Voltage: 13.8Vdc
Output current: 5A cont 7A max
Stability: 1%
Ripple: 25mV
Connections: 4mm banana socket
Dims: 195x140x90



POWER SUPPLY REGULATED

REF : P006H PRICE : £7.99

Plug in regulated power supply with 3-12Vdc switchable output. LED indicator. Complete with 6 DC adaptor plugs.

*IC Regulated DC output
*Automatic thermal cut off
*Short circuit protection
*Automatic overload cut off.

Input Volt: 220/240Vac 50Hz
Output Volt: 3, 4.5, 6, 7.5, 9 & 12Vdc
Output current: 650mA max
Stability: 2%
Ripple: 1mV
Dims: 97x68x63mm



7A 13.8Vdc POWER SUPPLY

REF : P001F PRICE : £39.95

Regulated power supply for use with CB rigs, auto equip. etc. High stability circuitry with high surge capability. Overload protection.

Input Voltage: 220/240Vac 50Hz
Output Voltage: 13.8Vdc
Output current: 7A cont 10A max
Stability: 1%
Ripple: 25mV
Connections: 4mm banana socket
Dims: 142x92x195mm



POWER SUPPLY REGULATED

REF : P006J PRICE : £9.99

Plug in regulated power supply 3-12Vdc switchable output. Polarity switch and LED indicator. Complete with 6 DC adaptor plugs.

* IC Regulated DC output
* Automatic thermal cut off
* Short circuit protection

* Automatic overload cut off.
Input Volt: 220/240Vac 50Hz
Output Volt: 3, 6.9 & 12Vdc
Output Current: 1000mA max
Stability: 2%
Ripple: 10mV
Dims: 120x75x63mm

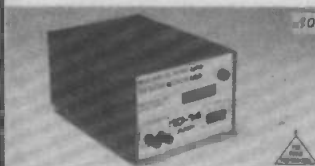


10A 13.8Vdc POWER SUPPLY

REF : P001J PRICE : £45.95

Regulated power supply for use with CB rigs, auto equip. etc. High stability circuitry with high surge capability. Overload protection.

Input Voltage: 220/240Vac 50Hz
Output Voltage: 13.8Vdc
Output current: 10A cont 14A max
Stability: 1%
Ripple: 25mV
Connections: 4mm banana socket
Dims: 156x110x224mm



POWER SUPPLY REGULATED

REF : P006K PRICE : £9.99

Plug in regulated power supply 3-12Vdc switchable output. Polarity switch and LED indicator. Complete with 6 DC adaptor plugs.

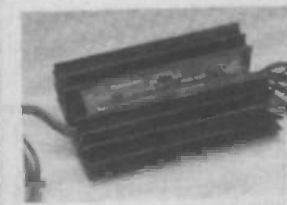
*IC Regulated DC output
*Automatic thermal cut off
*Short circuit protection

*Automatic overload cut off.
Input Volt: 220/240Vac 50Hz
Output Volt: 3, 6.9 & 12Vdc
Output Current: 1200mA max
Stability: 2%
Ripple: 10mV
Dims: 120x75x63mm



PROJECT SWITCH MODE PSU

Made for the Acorn Archimedes. This neat compact power supply unit gives you +5V DC at a whopping 4.4A. Incorporates on/off switch and selectable mains input. Uncased. Dims: 145x100x45mm Less than 1/2 price. Price: £10.00 Ref : Y10P2



12A DC-DC CONVERTER

REF : P006C PRICE : £18.75

Heavy duty DC-DC converter designed for use in commercial vehicles converting from 24Vdc to 12Vdc. Includes on/off switch and LED indicator.

Input: 24Vdc
Output: 12Vdc
Max Rating: 7A cont 12A max
Dims: 200x100x42mm



POWER SUPPLY - NON REGULATED

REF : P006D PRICE : £3.99

Plug in power supply with 6 output voltages. Polarity switch and output is via a 4 way spider plug and 1.3mm dc Walkman plug.

Input Volt: 220/240Vac 50Hz
Output Volt: 3, 4.5, 6, 7.5, 9 & 12Vdc
Output current: 300mA max
Stability: 40%
Ripple: 1V
Dims: 75x52x54mm



POWER SUPPLY - UNREGULATED

REF : P006E PRICE : £5.49

Plug in power supply with 6 output voltages. Polarity switch and LED indicator. Output is via 4 way spider plug and 1.3mm Walkman plug. Thermal Fuse protection.

Input Volt: 220/240Vac 50Hz
Output Volt: 3, 4.5, 6, 7.5, 9 & 12Vdc
Output current: 750mA max
Stability: 40%
Ripple: 1V
Dims: 97x67x62mm



POWER SUPPLY - UNREGULATED

REF : P006F PRICE : £6.50

Plug in power supply with 6 output voltages. Polarity switch and LED indicator. Output is via 4 way spider plug and 1.3mm Walkman plug. Thermal Fuse protection.

Input Volt: 220/240Vac 50Hz
Output Volt: 3, 4.5, 6, 7.5, 9 & 12Vdc
Output current: 1000mA max
Stability: 40%
Ripple: 1V
Dims: 97x67x56mm

SWITCHED MODE PSU

REF : K8P3 PRICE : 8.00

Fully cased unit again made by Wolsey. Complete with mains lead. Well made case finished in black with ventilation holes and power on LED

Dims: 215x145x55mm
Output: +5v +12v and +20v

USEFUL POWER SUPPLIES

REF : K8P1 PRICE : 6.00

Very useful power supplies fully cased in a smart plastic case complete with mains input cable plus DC output cable. The supply is regulated to within 5% and has an 18V output at up to 900mA. An excellent general purpose unit brand new straight from the manufacturers

SPECTRUM +2 PSU

REF: X4P2 PRICE: £3.99

Input: 220/240Vac 50Hz
Output: +5V@2A/
+12V@.2A/-12V@50mA.

USEFUL POWER SUPPLY

EACH 2.99 X3P1

14.5V DC 400mA plug in sleeved pins.
Input: 220/240Vac 50Hz
Output: 14.5Vdc 400mA

ASTECS SWITCHED MODE PSU

REF : T12P12 PRICE : 12.00

These are cased switched mode power supplies complete with on/off switch and IEC inlet.

Input: 120 or 240.
Output: +5v at 5A, +12v at 2A 0 -12v at .25A.
175 x 135 x 65
Dims: 210x135x65mm
model No: BM51049

ASTECS POWER SUPPLY

REF : T10P14 PRICE : 10.00

These are also cased but have a slightly lower output than the model mentioned earlier. Complete with on/off switch and IEC inlet.

Input: 110 or 240.
Output: +5v at 4A, +12v at 1A, -12v at .25A.
Dims: 210x135x65mm.

SAN HUA TIEN PSU

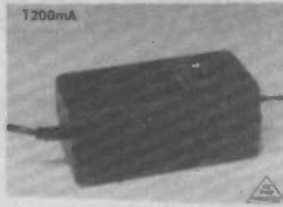
REF : T7P12

PRICE : 7.00
Same spec as the above Astec unit but uncased.

ASTECS PSU

REF : T7P14 PRICE : 7.00

Uncased PSU
Input 240v
Output: +5v at 3.75A, +12v 1.5A -12v at 0.4A
Dims: 82x165x45mm

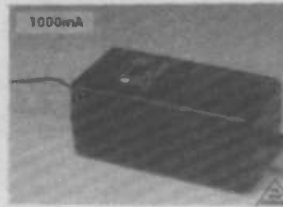


REGULATED POWER SUPPLY

REF : P007V PRICE : £14.95

Superior quality regulated power supply. Several output voltages selected by a rotary switch with a current rating of 1.2A (1200mA). Input via a 3 core mains. Output via a fitted lead with a 4 way spider plug. 9V battery snap and walkman plug.

Output Power: 1.5, 3, 4.5, 6, 7.5, 9, 12 Vdc
Power Input: 220/240Vdc
Output Current: 1.2A(1200mA)
Dims: 150x77x62mm



REGULATED POWER SUPPLY

REF : P006V PRICE : £15.95

Superior quality regulated power supply. Several output voltages selected by a rotary switch with a current rating of 1A. Input via 3 core mains lead. Output via fitted lead with 4 way spider plug. 9V battery snap and walkman plug.

Output Power: 1.5, 3, 4.5, 6, 7.5, 9, 12 Vdc
Power Input: 220/240Vac 50Hz
Output Current: 1A(1000mA)
Dims: 150x77x62mm

ACORN ELECTRON AC PSU

EACH 2.99 X3P2

19V AC 14W very easily adaptable simply add small bridge rectifier. 3 pin plug in.

Input: 220/240Vac 50Hz
Output: 19Vac 14W

60W SWITCH MODE PSU

EACH 6.99 X7P2

This switched mode power supply unit is 110/220V switchable and has an IEC socket. on/off switch.

Input: 110/220V switchable
Output: +5V@5A/-5V@.5A/
+12V@2A/-12V@.5A
Dims: 245x88x55mm

ADVANCED POWER SUPPLY

REF : T55P1

PRICE : £55.00

Brand new switched mode power supplies with fan having some very useful outputs. If you were to buy one of these from the manufacturer you would have to part with more than £500.00.

Input: 220 or 115Vac
Output: 500W
..... +5V @ 60A, +12V @ 7A
..... -12 @ 7A plus
..... 2 x 12V @ 7A rails
Dims: 300x170x100mm

MORE POWER SUPPLIES

24V PSU CHANNELS

FOR STEREO. MAX 20W	EACH	2.00	2P4
6V 700mA PSU IN CASE	EACH	1.00	BD899
6-9V POWER SUPPLY	EACH	1.00	R1P4
750mA 3/4 5/6/7 5/9 12Vdc			
NON REG PLUG IN	EACH	5.00	5P197
IN CAR POWER SUPPLY	EACH	5.00	5P167
PC POWER SUPPLY-150W			
CUSTOMER RETURNS	EACH	5.00	5P210
STC POWER SUPPLY	EACH	6.00	6P59
PC POWER SUPPLY	EACH	4.00	L4P8
200W PC POWER SUPPLY	EACH	20.00	Q20P1
POWER SUPPLY KIT	EACH	22.00	Q22P1
POWER SUPPLY	EACH	4.00	Q4P3
POWER SUPPLY	EACH	8.00	Q8P3
ADVANCED POWER SUPPLY	EACH	55.00	T55P1
ASTECS POWER SUPPLY	EACH	10.00	T10P14
POWER SUPPLY CLEARANCE ..	EACH	1.00	V1P15
AMSTRAD MONITOR PSU	EACH	8.00	V3P5

DO YOU RECEIVE OUR REGULAR NEWSLETTERS AND BULLETINS?

ARE YOU ON OUR DATABASE -

If not, send in a written request and we will gladly add your name and address to our mailing list immediately. Be one of the first to know what's new in stock - before it gets advertised nationally.

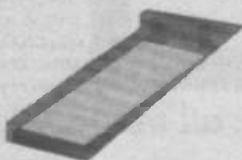
PROJECTS

PROJECT BOARD

REF : YO35D PRICE : £7.99

Solderless breadboard with a total of 840 contacts arranged in two blocks of 64 vertical rows of 5 interconnected sockets and four horizontal rows of 50 interconnected sockets on a standard 0.1" pitch. Supplied mounted in a baseboard with two 4mm sockets.

No of contacts: 840
Contact material: silver plated nickel silver
Dims: 203x75x17mm

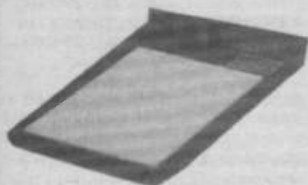


PROJECT BOARD

REF : YO35E PRICE : £15.99

Solderless breadboard with a total of 1680 contacts arranged in four blocks of 64 vertical rows of 5 interconnected sockets and 8 rows of 50 interconnected sockets on a standard 0.1" pitch. Supplied mounted in a baseboard with three 4mm sockets.

No of contacts: 1680
Contact material: silver plated nickel silver
Dims: 224x150x20mm

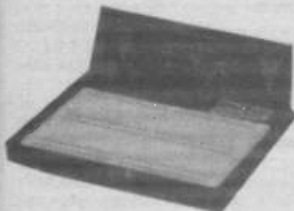


PROJECT BOARD

REF : YO35F PRICE : £17.95

Solderless breadboard with a total of 1580 contacts arranged in four blocks of 64 rows of 5 interconnected sockets and 6 rows of 50 interconnected sockets on a standard 0.1" pitch. Supplied mounted on a base board with three 4mm sockets and an edge plated for mounting switches, pots etc.

No of contacts: 1580
Contact material: silver plated nickel silver
Dims: 190x170x19mm

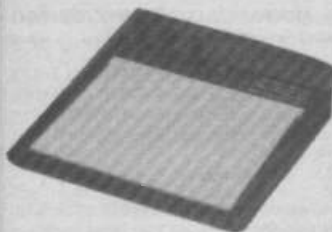


PROJECT BOARD

REF : YO35G PRICE : £19.95

Solderless breadboard with a total of 2420 contacts arranged in six blocks of 64 rows of 5 interconnected sockets and ten rows of 50 interconnected sockets on a standard 0.1" pitch. Supplied mounted on a baseboard with four 4mm sockets.

No of contacts: 2420
Contact material: silver plated nickel silver
Dims: 243x195x20mm



SURFACE MOUNT PRACTICE BOARD

Surface mount technology and soldering has really come to the fore in the last couple of years leading to further miniaturisation. Most constructors would love the challenge and like to have a go at soldering surface mount components. **YOUR CHANCE IS HERE.** We are offering a small PCB containing loads of components up to 50 capacitors, resistors, transistors inductors and also a sm chip. Practice soldering desoldering and learn how to identify surface mount components.

Price: £1.00
Ref: Y1P4
Qty: Each

VARIAC CONTROLLERS

These units are large variable resistors, probably about 500w each they come as a ganged set of three in a chassis measuring approx 10x6x6 inches with a 1/2 inch spindle! Each variable resistor is approx 6 inches diameter with a coil depth of about 2"

REF : V20P1
PRICE : £20.00

CERAMIC SHEET

Pack of 22 sheets of pure ceramic measuring 4.5" x 6.5" x .32" thick!!

Ideal for: capacitor experiments, high voltages, insulation problems

or we believe you can use them for Printed Circuit Board construction??

REF : T10P2 PRICE : 10.00

ELECTRONIC AGITATOR

This super motorised electronic magnetic agitator was originally designed for wine making....BUT what an excellent gadget for etching PCB's. Place suspended board in container of Ferric Chloride mixture and use agitator underneath! Etches PCB in half the time and no need to keep rocking container by hand. Probably hundreds of other uses we haven't even thought of yet. **BRAND NEW AND ATTRACTIVELY BOXED.**

Contains: 1 Motor unit
2 Magnetic Whirlers
1 Whirler Retriever
3 Plastic supports
Instructions

REF : 2P19 PRICE : £2.00

MICROWAVE CONTROL PANEL

A brand new branded (Toshiba) 4 section control panel consisting of:

- ** Display Panel - LCD
- ** Mains transformer & Relay Panel

- ** Two part switch panel

This versatile electronic timer unit can be adapted to almost all projects which require a timing device.

Performs all the functions you would expect from a

Microwave Timer. Control IC is a TMP47C420AF.

Connection details supplied

REF : 6P18

PRICE : £6.00

THE SCHOOL BUDGET BUSTER

A MUST FOR ALL SCHOOL AND COLLEGE LAB TECHNICIANS

WHAT PROJECT NEXT?? Bull Electrical can make that task a little easier by offering you the following:-

1 small low voltage PCB containing over 100 components some of which are:

- ** transistors,
- ** capacitors,
- ** resistors,
- ** diodes and
- *** 7 IC's.

All this contained within an attractive re-usable case measuring 115 x 145 x 45mm. The front and back panels have cut-outs for switches, leads, LED. There are ventilation slots in the top half of this screw together case as well as four rubber feet. This case would quite comfortably house a project. The PCB would be ideal for teaching and practising soldering and desoldering techniques.

PACK OF 10 UNITS

UNBEATABLE VALUE

ONLY £12.00

REF: Y12P1



SOFTWARE

A selection of Shareware with over 100 exciting titles for all the family.
The disks come either in 3.5" or 5.25". IBM compatible.

HELP AND COMPUTER TOOLS

TUTOR.COM computer and DOS tutorial	B55/001	BS3/001
super course in computer terminology and learning DOS		
LOTUS LEARNING SYSTEM req 2 floppys or hard drive	B55/003	BS3/003
disk-based tutorial...over 500 screens cover lotus 1-2-3		
VIRUSCAN/CLEAN UP	B55/009	BS3/009
finds and removes computer viruses and repairs damages		
TUTOR BY ASSOCIATION	B55/012	BS3/012
outstanding, interactive tutorial...perfect for beginners		
DOS SUMMARY	B55/014	BS3/014
having trouble understanding DOS?...then, this is the program for you		
AS EASY AS 1-2-3 lotus like spreadsheet program	B55/103	BS3/103
req 2 floppys or hard drive, super full feature menu driven program		
GALAXY LIFE	B55/110	BS3/110
fast, easy to use word processor with 50,000 word-spell-checker!		
DRAFT CHOICE req hard drive & colour monitor	B55/902	BS3/902
CAD program creates great drawings & graphics		
PC-DRAFT-CAD req hard drive and colour monitor	B55/903	BS3/903
full CAD program for all your drawing & drafting needs		
PRINT PARTNER req colour monitor	B55/9090	BS3/909
print signs, calendars and banners on dot matrix or laser printers		
FOREIGN LANGUAGES		
SPANISH TEACHER 1	B55/2010	BS3/201
get down to basics... beginner Spanish made easy!		
SPANISH TEACHER 2	B55/202	BS3/202
you've graduated beginner Spanish, now the next class		
GERMAN TEACHER 1	B55/203	BS3/203
the wall is down, it's time to learn the language		
GERMAN TEACHER 2	B55/204	BS3/204
the teacher says sit down it's time to learn more		
FRENCH TEACHER	B55/206	BS3/206
French made easy, look out Paris, here I come		
ITALIAN TEACHER	B55/207	BS3/207
with your computer learn Italian for business & pleasure		
JAPANESE	B55/208	BS3/208
great intro to Japanese Katakana vocabulary, grammar and culture		
ULTIMATE SPANISH	B55/210	BS3/210
great easy way to use tutorial for learning Spanish		
ULTIMATE FRENCH	B55/211	BS3/211
great easy way to use tutorial for learning French		
WINDOWS		
WINCHECK req 640k RAM, win 3.0 or higher, HD DD & HD	B55/450	BS3/450
highly rated easy to use windows checking and savings program		
COMMAND POST req win 3.0 or higher & HD	B55/451	BS3/451
excellent quick and easy windows menu system		
IEDIT req VGA mon, win 3.0 or higher, 286 or better & mouse	B55/452	BS3/452
full featured tool for creating and editing icons		
PAINT SHOP PRO req win 3.0 or higher & hard drive	B55/453	BS3/453
powerfully displays, alters and prints graphic images		
LEONARD'S SKETCH req win 3.0 or higher & hard drive	B55/454	BS3/454
easy to use oriented CAD/desktop top publishing program		
WINEDIT req win 3.0 or higher & hard drive	B55/455	BS3/455
great graphical text editor for any size documents		
SCREEN PEACE req windows 3.0 or higher	B55/456	BS3/456
sixteen different screen savers to avoid screen 'burn-ins'		
WINPOST req windows 3.0 or higher	B55/458	BS3/458
easily organize and manage your business day		
THE NEW TESTAMENT VIEWER FOR WINDOWS	B55/459	BS3/459
req win 3.0 or higher, EGA/VGA mon, HD DD, Hard Drive & 286 or better		
full featured, easy to use electronic book of the New Testament!		
GAMES FOR WINDOWS		
WINDOWS VEGAS GAME PACK req win 3.0 or higher & HD, try your luck video poker, slot machine, blackjack and roulette	B55/475	BS3/475
WINDOWS ARCADE GAME PACK req win 3.0 - higher	B55/476	BS3/476
arcade action with alien force, bang! bang! and worm war		
WINDOWS BOARD/CARD GAME PACK req win 3.0 or higher, hours of fun with concentration, yacht-z, tic tac toe and hearts	B55/477	BS3/477

FOOTBALL FOR WINDOWS req EGA/VGA mon, win 3.0 or higher & hard drive, computerised football at its best, Kick off & control the action	B55/478	BS3/478
WARHEADS FOR WINDOWS req win 3.0 - higher & HD	B53/479	
spectacular arcade combat action with you in charge		
GNU CHESS req win 3.0 or higher	B55/480	BS3/480
great 3D full colour chess game with excellent graphics		
WINWHEEL req VGA mon, win 3.0 or higher & hard drive	B55/481	BS3/481
colourful graphics makes the 'wheel of fortune' clone a winner		
MAH JONGG FOR WINDOWS req VGA mon, mouse, win 3.0 or higher & hard drive, High-tech simulation of the ancient Chinese game	B55/482	BS3/482
CARDSHARK HEARTS req win 3.0 or higher, EGA/VGA mon, hard drive & mouse, Addictive & computerised version of the popular Game of Hearts!	B55/483	BS3/483
EDUCATION FOR KIDS		
AMY'S FIRST PRIMER Ages 3-8, req colour mon	B55/500	BS3/500
teaches alphabet, numbers, shapes & problem solving		
SCHOOL MOM ages 4-14, req colour mon	EB55/501	BS3/501
learn at home: music, art, spelling, English and Maths		
BRANDON'S BIGBOX req colour monitor	B55/502	BS3/502
great tutorial for numbers, reading and memory		
GOOGOL MATH GAMES all ages, req colour mon	B55/506	BS3/506
arcade style maths games, designed to make learning maths fun		
WORD GALLERY age 3+, req colour monitor	B55/508	BS3/508
associate words with objects using flash cards and digitised voice response		
ABC-TALK ages 1-7 req colour monitor	B55/509	BS3/509
turn your computer into a talking teacher with 'real voice' response		
123-TALK ages 1-7, req colour mon	B55/510	BS3/510
turn your computer into a talking maths teacher with 'real voice' response		
CRAYON BOX req EGA/VGA mon & mouse	B55/511	BS3/511
enhance your child's creativity with this amazing colouring sketch book & learning tool		
ADVENTURE MATH age 5-10, req VGA mon, 512K RAM, HD DD & HD send your kids into a maths adventure of a lifetime	B55/512	BS3/512
EDUCATION FOR KIDS 11		
ANIMATED SHAPES req EGA/VGA mon & hard drive	B55/525	BS3/525
with animated graphics, teach pre-schoolers shapes and colours		
WORDTRX req EGA/VGA mon & hard drive	B55/526	BS3/526
excellent tetris-like educational game that teaches phonics		
CLASSROOM JEOPARDY req colour mon or hercules	B55/527	BS3/527
excellent teaching tool patterned after the popular TV game show		
WUNDERBOOK ages 3-10, req EGA/VGA mon	B55/528	BS3/528
innovative tutorial of five fun-while-you-learn educational games		
MOM'S MATH ages 6-11, req colour mon	B55/529	BS3/529
imaginative 3-in-1 colourful maths tutorial		
DINOSAUR DATABASE req VGA mon & hard drive	B55/530	BS3/530
interesting and educational games for learning about dinosaurs		
MELISSA'S MUSIC FLASHCARDS req EGA/VGA mon & mouse easy to use tutorial for teaching musical notes	B55/531	BS3/531
KIDS GAMES ages 2-5, req colour monitor	B55/532	BS3/532
wonderful set of educational games to stimulate the learning process		
ANIMATED MATH ages 4-6 req EGA/VGA mon & hard drive, excellent tutorial for addition, subtracting & counting	B55/533	BS3/533
FAMILY AND HOUSEHOLD		
BIBLE-Q	B55/605	BS3/605
heaven help you, this is tough bible trivia quiz		
COMPUTER-CHEF req hard drive	B55/608	BS3/608
menu-driven recipe program and nutrition guide		
DIET DESK	B55/609	BS3/609
great program to help you lose weight & not gain it back		
FITNESS LOG	B55/613	BS3/613
enables the health conscious to regularly monitor exercise activities		
CUMBERLAND TREE req 640K RAM & hard drive	B55/614	BS3/614
full-featured comprehensive easy to use genealogy program		

All shareware only £5.00 per title

HANDWRITING ANALYST B55/700 B53/700	see what your signature says about you... unbelievably accurate!
LOTTO PROPHET req 2 floppys or a hard drive B55/706 B53/706	complete lottery science statistical compiler/evaluator
ORGANISE YOUR COLLECTION req hard drive B55/707 B53/707	full featured, menu-driven program to catalogue all kinds of collections!
PERSONAL GOLF TRACKER B55/713 B53/713	get into the swing and improve your golf game
PERSONAL NUMEROLOGIST B55/718 B53/718	reveal the most intimate traits and desires of yourself and your friends
GAMES FOR KIDS	
PHARAOH'S TOMB req colour mon B55/800 B53/800	arcade/adventure game set in an Egyptian Pyramid
COMMANDER KEEN: EPISODE IV req EGA/VGA B55/801 B53/801	mon & HD DD - hard drive recommended, the adventure continues with 'the secret of the oracle'
SHOOTING GALLERY req MCGA or VGA mon & mouse B55/806 B53/806	best of the best... 7 rounds of colourful shooting action
DUKE NUKEM req EGA/VGA mon & hard drive B55/809 B53/809	five-star super arcade-type action adventure game
QUATRIS II req EGA/VGA monitor B55/810 B53/810	'tetris' clone with superior graphics and action
PAGANIZU: ROMANCING THE ROSE req colour mon B55/811 B53/811	& hard drive, within an ancient aztec pyramid, survive the adventure of a lifetime!
JILL OF THE JUNGLE req colour mon, hard drive, 512K B55/812 B53/812	RAM & 286 or better, spectacular arcade-adventure with great artwork and animation
MATH RESCUE req EGA/VGA mon, HD DD & hard drive B55/813 B53/813	the gruzzles are back to challenge you in this new maths adventure
KILOBLASTER req EGA/VGA mon, HD DD, hard drive B55/814 B53/814	& 286 or better, destroy enemy fleets as you try to save Earth from impending doom!
GAMES FOR KIDS II	
WORD RESCUE req EGA/VGA mon & hard drive B55/825 B53/825	learn while playing this top-rated arcade game
CAPTAIN COMIC req EGA/VGA mon B55/826 B53/826	fully animated Hi-Res graphic action adventure game
MAD PAINTER req EGA/VGA mon B55/827 B53/827	paint the streets of your town with your shiny new paint truck!
BOLOBALL req EGA/VGA mon B55/828 B53/828	mindbending puzzles and problems guaranteed
GALACTIX req VGA mon, hard drive, 286 or better & HD DD B55/829 B53/829	XIDUS have come to conquer the World... only you stand in the way
COSMO'S COSMIC ADVENTURE req EGA/VGA mon, B55/830 B53/830	286 or better & HD DD, help the lovable extra terrestrial find his parents!
SECRET AGENT req EGA/VGA mon B55/831 B53/831	as agent 0061/2, you are to protect the world
CRYSTAL CAVES req EGA/VGA mon & hard drive B55/832 B53/832	enter an underground world of treasure and traps
DARK AGES req EGA/VGA mon & 286 or better B55/833 B53/833	free the great kingdom from the dark age of garth!
GAMES FOR EVERYBODY	
HUGO'S HOUSE OF HORRORS req EGA/VGA mon & B55/850 B53/850	hard drive, animated graphics adventure... the best on the market
2-BIT POKER req EGA/VGA mon B55/857 B53/857	Las Vegas style video poker at its best... fantastic!
HUGO II-WHODUNIT? req EGA/VGA mon & hard drive B55/860 B53/860	the great animated full graphic adventure continues
WOLFENSTEIN 3-D req VGA mon, HD DD, hard drive & B55/864 B53/864	286 or better, high tech 3-D animated combat action with no equal
STELLAR EXPLORER req EGA/VGA mon, hard drive & B55/866 B53/866	640K RAM, explore the alien vessel and uncover its hideous secret
KRIS KROSS req EGA/VGA mon, hard drive & mouse B55/866 B53/866	Impressive combination of crossword puzzles & scramble
WORLD EMPIRE req EGA/VGA mon, 512K RAM & hard B55/867 B53/867	drive your mission?? to unite the world under one leader-you'll
BLACK JACK req EGA/VGA mon or hercules B55/868 B53/868	outstanding game, for the beginners to the pros... learn to win big
RACE THE NAGGS req EGA/VGA mon & 512K RAM B55/869 B53/869	an elegantly simple, animated horse racing game
GAMES FOR EVERYBODY II	
HUGO III-THE JUNGLE OF DOOM req EGA/VGA mon, B55/875 B53/875	HD DD & hard drive, join Hugo in his next and best adventure so far
THE LAS VEGAS EGA CASINO req EGA/VGA mon B55/876 B53/876	blackjack, video poker and slot machine at their best
MILLE BORNES req EGA/VGA mon B55/877 B53/877	fun and challenging graphic card game
PIRADA I-THE FEARLESS req EGA/VGA mon & mouse B55/878 B53/878	uncover cards as you try to maximise scores of 21
EGA TREK req EGA/VGA mon B55/880 B53/880	your starship command is waiting...save the Galaxy!!
MONOPOLY req 512K RAM & EGA/VGA mon B55/881 B53/881	phenomenal animated graphics makes this classic a winner
8IG 2 req 512K RAM & EGA/VGA mon B55/882 B53/882	outstanding and entertaining solitaire card game
EM PYRAMID req EGA/VGA mon B55/883 B53/883	crisp, colourful graphics & sleek interface make this pyramid card game a winner!

NEW RELEASES		
EXPRESSCHECK req 2 floppys or hard drive B55/303 B53/303	comprehensive management of upto 90 checking accounts	
RESUME SHOP B55/304 B53/304	get the job you always wanted with a professional resume	
MEDLIN ACCOUNTING req 2 floppys or hard drive B55/400 B53/400	full-charge accounting services for the small & medium businesses	
TOUCH TYPE TUTOR B55/557 B53/557	super, typing tutorial...4 skill levels & speed tests	
EGA COLOURING BOOK ages 3+ req EGA/VGA mon B55/802 B53/802	bring out the artist in your child	
CRAPS FOR WINDOWS req VGA mon, win 3.0 or higher B55/484 B53/484	& hard drive, experience the thrill while learning craps on your home computer	
OVERKILL req colour mon, 640K RAM & hard drive B55/816 B53/816	high-class space voyage that puts arcade games to the test!	
BRX req 256 colour VGA mon, 640K RAM & hard drive B55/884 B53/884	four brain e'll be taunted, teased and twisted. ...mindboggling arcade game for all	
VIDEO POKER TUTOR req colour mon or hercules B55/885 B53/885	teach yourself how to win big while playing this great casino video poker game!	
PROTCAD 3D req colour mon or hercules & hard drive B55/911 B53/911	complete 3-d CAD/rendering program with a full complement of 3-D drawing & editing tools	

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ORIGINAL LICENCED PRODUCT MICROSOFT CORPORATION

MS-DOS OPERATING SYSTEMS
VERSION 3.3

£5.00

Your chance to acquire a brand new set of MS-DOS Operating System Software, a genuine Licenced Product. The software set comes complete with:

Microsoft MS-DOS 3.3 Manual
This Manual is complete and gives you a very comprehensive guide to using DOS on your computer. Learn how to make the operating system "work" for you and enhance the performance of your computer system to its maximum. An ideal simple to use explicit manual proves ideal for the introduction of those who are new to Computers and their operating systems.

Software supplied on 5.25" only.



REF: 5P612

DOS IN ANOTHER LANGUAGE?

We also have this package available in other languages. We are currently able to offer the above specified product in French, Spanish, German and some other languages. Ideal for students studying foreign languages or educational establishments in the UK or abroad. Quantity discounts available for quantity orders. Give us a call to find out more.

BULL ELECTRICAL 0273 203500

SERVICE AIDS, SOLAR, SOLENOIDS AND SURVEILLANCE PRODUCTS

SWITCHES				SURVEILLANCE PRODUCTS			
MICRO SWITCHES				FM BUG			
V3 SIZE 10A 250V C/O BUTTON OP	PKT4	1.00	BD340	BUILT INSIDE A STANDARD 13A MAINS ADAPTER. THE ADAPTER STILL FUNCTIONS BUT WILL TRANSMIT THE SLIGHTEST SOUND. 88-108kHz FM			
V3 SIZE 15A 250V C/O BUTTON OP	PKT3	1.00	BD341	..... EACH	£30.00	REF :26P2	
V3 SIZE 10A 250V C/O LEVER OP	PKT3	1.00	BD342	FM BUG SUPERIOR			
ROTARY SWITCHES				MINATURE BUILT AND TESTED. 88-108kHz FM. FULLY TUNEABLE			
4 POLE 3 WAY	PKT3	1.00	BD870	..... EACH	£14.00	REF :14P3	
3 POLE 4 WAY	PKT3	1.00	BD871	FM BUG KIT			
2 POLE 6 WAY	PKT3	1.00	BD872	WITH EMBEDDED COIL			
1 POLE 12 WAY	PKT3	1.00	BD873	..... EACH	£5.00	REF :5P158	
PUSH SWITCHES				WARNING These products are for Export use only and are NOT APPROVED for use in the UK. Users are liable to prosecution under the Wireless Telegraphy Act 1949 (and any amendments thereto). This condition may apply to other countries.			
PUSH ON PUSH OFF MAINS LAMP	PKT4	1.00	BD121	SOLAR			
SLIDE SWITCHES				SOLAR PROJECT KIT 1 AN INTRODUCTION FOR BEGINNERS. THIS KIT COMES COMPLETE WITH INSTRUCTION BOOK, SOLAR CELLS, WIRE, MOTOR, EVERYTHING YOU NEED TO EXPERIMENT WITH SOLAR ENERGY.			
SINGLE POLE C/O CHASIS MOUNT	PKT5	1.00	BD756	..... EACH	£8.00	REF :8P51	
MINI SLIDE DPDT 5A	PKT5	1.00	BD869	SOLAR PROJECT KIT 2 ADVANCED KIT WITH INSTRUCTION BOOK, SOLAR CELLS, WIRE, MOTOR AND EVERYTHING YOU NEED TO EXPERIMENT WITH SOLAR ENERGY.			
TOGGLE SWITCHES				..... EACH	£12.00	REF :12P478	
SUBMIN SPST 8x4x7mm	PKT2	1.00	CD415	200mA 12V SOLAR CELL 12x12"			
SUBMIN SPDT 8x4x7mm	PKT4	2.00	2P415	..... EACH	15.00	15P42B	
SUBMIN DPDT 8x4x7mm	PKT3	2.00	2P416	100mA .45V SOLAR CELL			
MINATURE SPST 13x8x9mm	PKT2	1.00	CD416	..... EACH	1.00	BD631	
MINATURE SPDT C/OFF 13x8x9mm	PKT4	2.00	2P417	400mA .45V SOLAR CELL			
MINATURE DPDT 13x13x9mm	PKT3	2.00	2P418	..... EACH	2.00	2P199	
MINATURE DPDP C/OFF 13x13x9mm	EACH	1.00	CD417	700mA .45V SOLAR CELL			
HIGH CURR SPST 10A 30x18x14mm	PKT2	3.00	3P418	..... EACH	3.00	3P42	
HIGH CURR DPDT 10A 30x21x20mm	PKT2	4.00	4P156	1A .45V SOLAR CELL			
STANDARD SIZE TOGGLE SWITCH	PKT2	1.00	BD605	..... EACH	5.00	5P192	
ROCKER SWITCHES				3V SOLAR PANEL			
PANEL MOUNT SINGLE POLE 10A	PKT6	1.00	BD41	..... EACH	3.00	3P99B	
2 POLE C/O 10A	EACH	1.00	BD732	SOLAR BATTERY CHARGER C CELLS			
SPDT C/O 10A 250V CENTRE OFF	PKT5	1.00	BD43	..... EACH	6.00	6P79R	
SPST 13A	PKT8	1.00	BD42	SOLAR BATTERY CHARGER AA CELLS			
DPST 10A 250V	PKT4	1.00	BD44	..... EACH	6.00	6P3	
PRESSURE SWITCHES				SOLAR POWERED WIND UP RADIO			
BRASS - SET FOR 8PSI ADJBL-15PSI	EACH	2.00	2P92	..... EACH	14.00	14P200RA	
MOUTH OP 85x30mm 3 OP PRESSURES	EACH	1.00	BD67	SERVICE AIDS			
TIME SWITCHES				SPECIALISED CLEANING KIT			
10 MINUTE CLOCKWORK - 15A 230V	EACH	1.00	BD579	YO63Z	£33.95		
VENNER SOLAR DIAL - INCLUDING				YO63P	£2.10		
CASE WITH WINDOW	EACH	7.00	7P17	YO63U	£2.95		
ADAPTOR KIT FOR VENNER -				YO63N	£2.75		
GIVING UPTO 12 ON/OFFS	EACH	3.00	3P105	YO63M	£2.25		
90 MINUTE TIME SWITCH-				YO63L	£2.75		
CLOCKWORK 15A	EACH	2.00	2P89	YO63V	£2.25		
2 HOUR TIME SWITCH ENGRAVED				YO62AA	£3.20		
MINS 15A 230V	EACH	2.00	2P90	YO62	£1.99		
100A 1 ON 1 OFF PER 24 HOURS				YO63Y	£3.90		
clockwork reverse	EACH	10.00	10P14	YO63T	£3.20		
BARGAIN PACKS SWITCHES				TAPE HEAD CLEANER			
PACK 10 MIXED SWITCHES	PKT10	1.00	CD212	YO62A	£1.99		
STRIPPER BOARDS				FREEZE-IT 20			
PC STRIPPER PCBs	EACH	2.00	T2P1	YO63S	£2.90		
COMPONENT BOARD FULL OF				YO62B	£2.10		
ICS, TRANSISTORS, ETC	EACH	2.00	2P282	BD707	£1.00		
STRIP BOARD				ETCH RESIST PEN			
5x4" .1 SPACING COPPER CLAD	EACH	1.00	BD736	BD699	£1.00		
PC MOTHERBOARDS (varied specs)	EACH	4.00	4P??	10P86	£10.00		
17x4" .1 SPACING COPPER CLAD	EACH	4.00	4P62	MINI MICRO SWITCH			
SOLENOIDS				This switch is of a changeover type with lever and measures 20x6x10mm. Bargain price. Packet of 10 for only £1.00.			
MAINS SOLENOID .50x35x38mm 20mm TRAVEL	EACH	1.00	BD199	Price : Pkt10 \$1.00 REF : Y1P3			
12V SOLENOID WITH PLUNGER.							
30x12x12mm 20mm TRAVEL	EACH	1.00	BD232				

BARGAIN BONANZA

SOLAR POWER

SOLAR POWERED OUTDOOR PIR AND AREA LIGHTING

FROM ONLY £24.99

FREE GARDEN LIGHTING!!!

IMPRESS YOUR NEIGHBOURS WITH THE LATEST IN SOLAR POWER TECHNOLOGY

These hardy high quality outdoor garden solar light units bring safety, decoration and security in an instant to your home and garden areas. Each unit is made from high impact weather resistant material. These units couldn't be easier to install and we are offering them at bargain basement prices. There are two styles available to choose from, either the Solar Garden Light only or the Solar Garden Light incorporating a PIR motion detector for added security. The units work by capturing sunlight, converting it into energy and storing the energy in a built in rechargeable battery. At night the light sensor detects the coming of night and automatically turns the unit on. Its that easy!



During The Day: The solar panel (A) converts sunlight into electricity and stores it in the built-in rechargeable battery (B).

At Night:

With the switch in the AUTO position, the built-in LIGHT SENSOR automatically turns on



Specifications:

Panel Size: 6"x6"
 Colour: Black
 Switch: Auto/charge only
 Installation: 24" Spike

OUTDOOR PATH LIGHT: £24.99 REF: 25P1

OUTDOOR PATH LIGHT with PIR ALARM: £29.99 REF: 29P1

AND LOTS MORE BARGAIN ENVIRONMENTALLY FRIENDLY SOLAR POWER PRODUCTS

AMORPHOUS PANEL
 6"X6" 6V 150mA

3.99 each REF: 4P1
 1.99 100+ REF: 2P1
 0.99 1000+ REF: 1P1

AMORPHOUS PANEL
 6"X12"12V 300mA

7.25 each REF: 7P1
 4.99 100+ REF: 5P1
 2.99 1000+ REF: 3P1

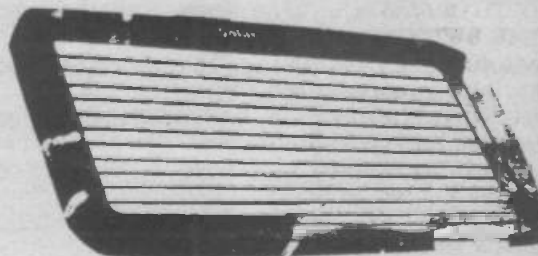
AMORPHOUS PANEL
 3'X1' 14.5V 700mA

£33.95 EACH

(Quantity discounts on application)

FLAT BATTERY? NEVER AGAIN WITH OUR

AUTO SUN CHARGER



A SOLAR PRODUCT OF THE HIGHEST QUALITY AND INNOVATION. THIS 12V AMORPHOUS PANEL IS SECURELY MOUNTED IN A STYLISH BLACK TEXTURED PVC FRAME AND COMES COMPLETE WITH 3M OF HEAVY DUTY FLEX TERMINATING IN A STANDARD CIGAR PLUG. THIS PRODUCT HAS BEEN SPECIFICALLY DESIGNED FOR CHARGING BATTERIES IN CARS, CARAVANS AND ON BOATS. THE UNIT COMES COMPLETE WITH POWERFUL SUCTION FEET ENABLING THE UNIT TO BE POSITIONED AGAINST THE INSIDE OF OF A WINDOW FOR MAXIMUM EFFECT.

POWER: SOLAR 12V
 OUTPUT: 2.5W
 MATERIALS: GLASS AMORPHOUS CELL
 DIMS: 180X340X15mm

REF: 16P20



AMORPHOUS GLASS 12V SOLAR PANEL

- ** 12v 700mA
- ** TOUGH PVC FRAMED
- ** HIGH IMPACT
- ** WEATHER RESISTANT

This Superior quality Solar Panel measures 36"X12" having a 12V 700mA output. The unit consists of an AMORPHOUS PANEL WITH POLYCARBONATE FRAME and the glass panel has been LAMINATED WITH AN EXTRA SHEET OF GLASS FOR STRENGTH. Unbeatable quality and value at only

£45.00 each

Ref: 45P1

(Quantity discounts on application)

(Additional £2.00 Packaging charge applicable on this product)

TV, SATELLITE, VIDEO, TRIPODS, TELECOMMUNICATIONS, TIMERS...

TV SECTION



CO-AXIAL CABLE

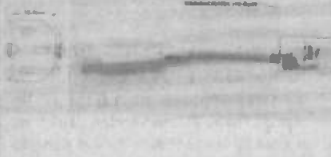
REF : F047 PRICE : £18.00
UHF Low loss. Semi air spaced
75ohm 1/1.0mm (0.78mm) conduc-
tor 6.5mm OD
Brown



CO-AXIAL CABLE

REF : F047A PRICE : £18.00
UHF Low loss. semi aire spaced 75
ohm
1/1.0mm (0.78mm) conductor
6.5mm OD
White

CONNECTORS



10A HOT CONNECTOR

REF : A144FA PRICE : £3.00
3 pin in line moulded on socket for
use with hot appliances such as
kettles, toasters, etc. Approved to
BS4491 and most European stand-
ards. White lead and moulded on
plus. Length 1Mtr
Fitted 13A Plug



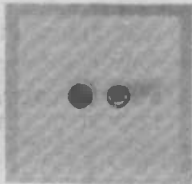
TV OUTLET

REF : F355 PRICE : £0.90p
Single flush mouting outlet. White.
Standard Wall mounting centres.



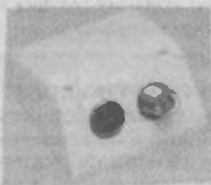
TV OUTLET

REF : F356 PRICE : £1.10
Double flush mount outlet. White
plastic. Standard Wall mount cen-
tres.



TV/SATELLITE OUTLET

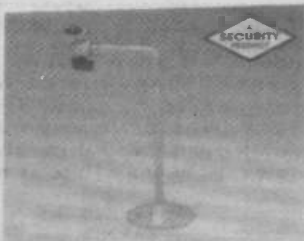
REF : F356A PRICE : £1.25
Double flush mounting plate for TV
and Satellite. Plat contains F type
and co-axial sockets. Standard wall
mounting centres. Supplied with
fixing screws.



TV/SATELLITE OUTLET

REF : F353A PRICE : £0.90p
Dual surface mounting outlet for
TV and satellite. Co-axial 9.5mm
socket and "F" type socket. White
Plastic.

CCTV EQUIPMENT



CAMERA STAND

REF : P720 PRICE : £15.00
Mounting stand. 90° swivel on a
ball joint with locking screw. Sup-
plied with cable ties, clamps and
mounting screws.
Length: 200mm
Base: 80mm



CAMERA TO MONITOR CABLE

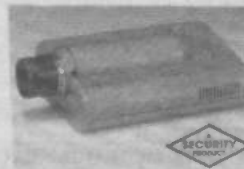
REF : P721 PRICE : £18.00
Cable for connecting a camera to
a monitor. 18m.



CCTV WITH VIDICON CAMERA

REF : P700 PRICE : £299.00
A complete ready to use surveil-
lance system, consisting of Vidicon
Camera with mounting bracket,
10' monitor and 18m of connect-
ing lead. The monitor has 2-way
audio facility and provision for
upto four cameras plus video re-
corder. A camera weatherproof
housing is available for outdoor
use.

Camera	
Tube:	S4097 2/3"
Vidicon	
Bandwidth:	8mhz
Resolution:	600 lines
S/N ratio:	46dB FET input
DC supply:	15V from monitor
Dims:	15x53x175mm
Weight:	0.66kg
Monitor	
Tube:	10" dia 90° deflection angle
Resolution:	More than 800 lines
Video In/out:	TV P-P neg sync.
System:	CCIR standard
Channel Switching:	3-15 seconds adj
Dims:	220x237x247mm
Weight:	6.5kg



VIDICON CAMERA

REF : P710 PRICE : £149.00
Standard camera for use with the
VSS70 system. Built-in
microphone and 16mm lens.
Supplied with camera stand and
18m connecting lead.

Tube:	S4097 2/3"
	Vidicon
Bandwidth:	8MHz
Resolution:	600 lines mtn
Video Output:	IVp-p 75ohm. sync. negative
Lens Mount:	Standard "C" mount
Camera Mount:	1/4-20UNC (bottom)
Dims:	115x58x175mm

TV, VIDEO AND SATELLITE



UHF/VHF/FM AERIAL WITH AMP

REF : T143D PRICE : £19.95
This unit is a large mesh dish
antenna designed for dual pur-
pose use, in the home using 220/
240Vac or mobile using 12Vdc.
The antenna dish can be rotated
left or right to pick up best signal,
which can be boosted using the
built in amp. The amp can also be
used to boost the signal from an
external aerial with integral LEDs
indicating which aerial is in use.
Gain: 20dB VHF
36dB UHF
Gain control: 0-36dB
Max output level: 100dBu
Power: 220/240Vac
12Vdc
Dims: 330x290x110mm

ACTIVE ANTENNA

REF : T142A PRICE : £29.95

Active UHF/VHF antenna for home or mobile use, with built in amp. Kit includes active antenna with mast clamps, indoor power supply, co-axial cable fitted with "F" type plug and weatherproof boot for connection to the antenna and co-axial plug.

Gain: 20dB
Output impedance: 75ohms
Freq response: VHF 40-230MHz
UHF 470-860MHz
Max output level: 100dBu
Power: 12Vdc or 220/240Vac 50Hz



1 WAY AMPLIFIER

REF : T100 PRICE : £9.20

1 in 1 out antenna amp for colour and black/white TV. On/off switch, LED indicator and 1m lead.

Band width: 40-890MHz
Gain: 7dB + 1dB
Impedance: 75ohm
Power: 220/240Vac 50Hz
Dims: 125x79x50mm



2 WAY AMPLIFIER

REF : T102 PRICE : £10.50

1 in 2 out HIGH GAIN antenna amp for colour black/white TV. On/off switch, LED indicator and 1m lead.

Band width: 40-890MHz
Gain: 14dB + 1dB
Impedance: 75ohm
Power: 220/240Vac 50Hz
Dims: 125x79x50mm



HIGH GAIN AERIAL AMPLIFIER

REF : T103B PRICE : £10.95

Six way aerial amp designed for large industrial applications to boost the signal received by the aerial for distribution to TV or radio sets. One in six out.

Band width: 40-890MHz
Gain: 5dB per channel
Gain total: 21dB
Isolation between outputs: 40dB min
Impedance: 75ohm
Power: 220/240Vac 50Hz
Dims: 197x80x50mm



HIGH GAIN AERIAL AMPLIFIERS

REF : T103C PRICE : £23.95

Eight way aerial amp designed for large industrial applications to boost the signal received by aerial for distribution to TV or radio sets. One in eight out.

Band width: 40-890MHz
Gain: 5dB per channel
Gain total: 21dB
Isolation between outputs: 40dB min
Impedance: 75ohm
Power: 220/240Vac 50Hz
Dims: 197x80x50mm



AUDIO/VIDEO

15 PIECE SCART LEAD KIT

REF : T120E PRICE : £9.95

- 2 Universal scart adaptors in/out switch
- 2 Leads - 6 pin DIN socket to 3 phono plugs. 200mm
- 2 Leads - 5 pin DIN socket to 2 phono sockets. 200mm
- 1 Lead - 6 pin DIN socket to 6 pin DIN plug. 2m
- 1 Lead - Phono plug to 2 phono sockets. 150mm
- 1 Lead - 8 pin mini DIN plug to 6 pin DIN socket. 150mm
- 2 Adaptors - Phono socket to BNC plug
- 2 Adaptors - Phono socket to PL259 plug
- 2 Adaptors - Phono socket to 3.5mm mono plug.



14 PIECE CAMCORDER

LEAD KIT

REF : T120F PRICE : £12.95

- 1 Lead - 6 pin DIN plug to 6 pin DIN plug. 1.5m
- 2 Leads - 6 pin DIN socket to 3 x phono plugs. 240mm
- 2 Leads - 5 pin DIN plug to 2 x phono sockets. 240mm
- 1 Lead - 6 pin DIN socket to 2 x phono plugs and 4 pin mini DIN plug. 240mm
- 1 Lead - 6 pin DIN socket to 8 pin mini DIN plug and 4 pin mini DIN plug 240mm
- 1 Lead - 6 pin DIN socket to 8 pin mini DIN plug. 240mm
- 1 Lead - 6 pin DIN socket to 2 x phono plugs. 240mm
- 1 Lead - phono plug to 2 x phono sockets. 240mm
- 1 Adaptor - 6 pin DIN socket to scart plug
- 3 Adaptors - BNC plug to phono socket



ADAPTORS

SCART ADAPTOR

REF : T113W PRICE : £12.99

Scart plug to 5 scart sockets. For coupling together three or more pieces of audio and video equipment with scart sockets.



AUDIO BREAKOUT BOX

REF : T113Y PRICE : £9.95

A scart adaptor to tap off the audio signal from TV and video and feed it into hi fi systems. Scart plug to scart socket adaptor with audio out via 2xRCA phono sockets with audio/video sound c/o switch.



VIDEO

VIDEO TAPES

To quality blank 3 and 4 hour VHS tapes. Manufactured under licence of JVC Each packed in attractive cardboard sleeve and cellophane wrapped.

PKT5??x 3 Hour

REF : T122A PRICE : £10.00

PKT5??x 4 Hour

REF : T122B PRICE : £14.00



VHS-C TO VHS ADAPTOR

REF : T122D PRICE : £13.99

All mechanical adapter cassette allowing the playback of VHS-C tapes on VHS video players. The action of closing the door moves the tape into position.



VHS-C TO VHC ADAPTOR

REF : T122E PRICE : £29.95

Electro mechanical adaptor cassette allowing the playback of VHS-C tapes on VHS video players. Powered by a single AA battery. (not supplied)



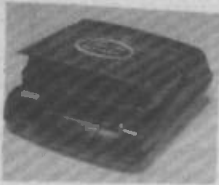
VIDEO 8 REWINDER

REF : T084 PRICE : £24.95

Compact battery powered Video 8 Rewinder/fast forwarder. Designed to limit unnecessary wear and tear on the camcorder mechanism and batteries. Tape counter.

Dims: 130x150x50mm
Power: 4 x AA cells



**VHS REWINDER**

REF : T084B PRICE : £19.95

Compact VHS tape rewinder. Designed to limit wear and tear on the VCR mechanism. Has push button, forward/reverse, auto stop & eject.

Dims: 220x210x70mm
Power: 220/240Vac 50Hz

**TAPE REPAIR KIT**

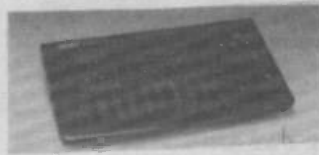
REF : A165 PRICE : £4.25

Audio/video tape repair kit. Rocker clamps tape firmly in place during splicing. Safe blade storage. Complete with blade and 4 rolls of tape.

**VIDEO HEAD CLEANER**

REF : T121 PRICE : £2.75

Video cassette recorder head cleaner for VHS type systems. Contains all that is required for routine cleaning of VCR heads. Uses the WET TYPE system, cleaning fluid, supplied. Full instructions. 40 cleaning applications.

**VIDEO PROCESSOR**

REF : T130H PRICE : £149.95

A compact and stylish video processor for mtrding down video and audio signals with a variety of additional effects. The processor has two AV input channels with phono and S-VHS inputs and two AV outputs with phono and S-VHS outputs. In addition two mic inputs and a stereo music input are provided. The controls over the output mix are:

- Mic, music and AV sound levels with master level
- Video stability, tint and colour controls
- Video enhance and detail controls
- Channels A to B audio and video crossfade
- Video signal insert
- Colour fade in and out with duration control
- AV fade with duration control. Fade to black or white
- Tint in/out control linked to level fader
- Picture wipe facility with in/out control

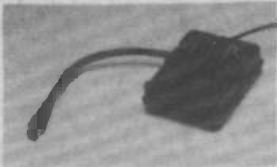
Operating System: PAL
Video/in/outputs IVp-p 75ohm
Fade duration: 1-6 seconds
Power: 12Vdc 600mA
Dims: 355x220x61mm

TV**AUTOMATIC TV SWITCH**

REF : T124C PRICE : £6.25

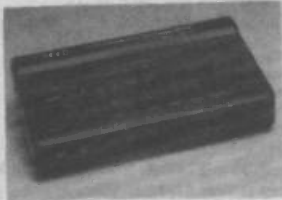
Automatic TV selector switch which automatically overrides the aerial signal when a signal from a computer or game is present. Input from computer / game via 2.4m flying lead with phono plug, aerial input via co-axial socket. TV output via 150mm flying lead with co-axial plug.

Impedance: 75 ohms
Dims: 85x65x26mm

**VIDEO ENHANCER/AUDIO MIXER**

REF : T126D PRICE : £34.95

A 3 channel stereo video sound mixer with a built in video enhancer specifically designed for video dubbing. The audio input from the camera/VCR mic and music sources can be mixed at will, with overall output controlled by a master slider. The video enhancer will clean up the picture on older recordings. Powered by an external 12Vdc power supply (not supplied) Complete with all connecting leads and adaptors.

**VIDEO CONTROLLER**

REF : T128F PRICE : £49.95

A 3 channel video/sound mixer and enhancer. Enables recordings to be made simultaneously on two VCRs. The sound is recorded in stereo mode and can be mixed for mono recordings. The enhancer will clean up foggy or old recordings and reduce picture noise. Powered by internal 9V battery or external 9Vdc mains adaptor. Compatible with NTSC, PAL and SECOM systems.

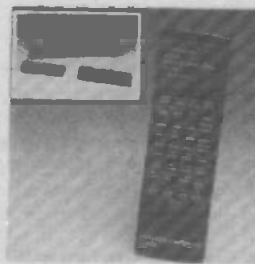
Input Video: 1V @ 75ohms
Input Audio: 0.1-0.3V @ 47kohms
Output Video: 0.5-1.5V @ 75ohms
Output Audio: 0.1-0.3V @ 10Kohms
Freq response: Audio 20Hz-20KHz
Power: 9Vdc
Dims: 150x145x50mm

**UNIVERSAL REMOTE CONTROL**

REF : T149Z PRICE : £22.95

Infra red remote controller which is capable of replacing 4 remote controls. The universal remote control is capable of learning up to 124 commands for controlling TV audio, video, etc. A MACRO key is provided which can link up to 10 commands for frequently used sequences.

Power: 4 x AAA cells

**UNIVERSAL REMOTE CONTROL**

REF : T149Y PRICE : £22.95

Pre programmed URC employing the latest in infra red technology to give convenient one hand control over all your household audio and video equipment. Easy to operate.

Power: 6Vdc 4xAAA
Dims: 194x58x17mm

**SATELLITE****SATELLITE FINDER**

REF : T135 PRICE : £33.95

Satellite finder kit designed to aid the speedy installation and lining up of satellite dishes. The kit consists of a signal strength meter, a compass, a connecting lead and a battery pack with a vinyl case.

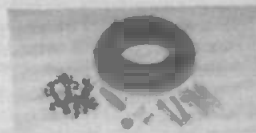
Power: 10 x AA cells

**SATELLITE DISH KIT**

REF : T115A PRICE : £9.95

Complete satellite dish fixing kit consisting of:

- 20m black FO49A cable
- 5 x 10mm fixing bolts
- 2 x "F" connectors
- 30 cable clips
- Weatherproof boot
- Compass



CAMCORDER

VIDEO LIGHT KIT

REF: T081B PRICE: £59.95
A semi professional video light kit comprising 100W halogen lamp, remote 12Vdc 7Ah sealed lead acid battery in carrying case with shoulder strap. 220/240Vac operated battery charger and camcorder power supply adaptor.



VIDEO LIGHT

REF: T081A PRICE: £15.99
30W video camera light with hot shoe fitting and power on/off switch. Accepts 6V 1700mA battery pack (Sony NP55 and NP77 typically)



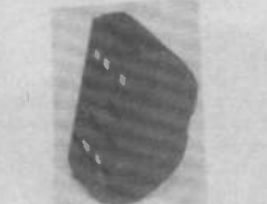
VIDEO LIGHT

REF: T081 PRICE: £44.95
30W halogen video light with 6V 1700mAh battery pack. The video light is provided with a synchronisation lead which when the light is switched to remote, allows the light to switch on when the camcorder is also switched on. (Sony and Panasonic camcorder) The on/off remote switch has a lock button to prevent accidental movement.



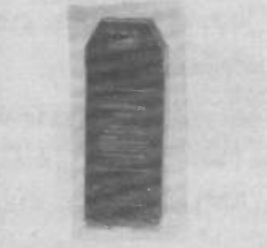
UNIVERSAL BATTERY PACK

REF: T080M PRICE: £19.95
Universal Ni-Cad battery pack designed to fit both Sony and JVC camcorders.
Output Volt: 6V
Rating: 2000mAh
Dims: 90x46x45mm



CAMCORDER BATTERY DISCHARGER

REF: T080D PRICE: £14.95
Universal camcorder battery discharger designed to discharge camcorder batteries to a preset level, sounding an alarm when that level is reached thus preventing memory effect. 3 LED bargraph indicates state of charge. May also be used as a battery tester.



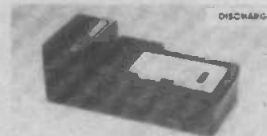
CAMCORDER BATTERY CHARGER KIT

REF: T080B PRICE: £19.95
Universal camcorder battery charger/power supply consisting of:
• Charger
• Cigar lighter socket lead
• Camcorder power lead
• 4 Adaptor plugs and a pouch
• Compatible with majority of 6.7.2 and 9V camcorder batteries.



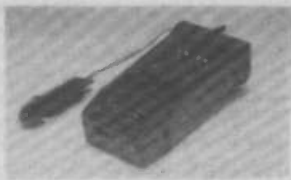
CAMCORDER BATTERY DISCHARGER

REF: T080C PRICE: £18.95
Universal camcorder battery discharger designed to discharge the batteries to 1V per cell prior to recharging, preventing memory effect. A 5-LED bargraph indicated state of charge and a beeper indicates full discharge. Compatible with majority of 6.7.2 and 9V camcorder batteries.



UNIVERSAL CHARGER/DISCHARGER

REF: T080E PRICE: £21.95
This unit is dual purpose fast charger and battery refresher, with both functions carried out automatically. Once the battery has been inserted into the unit it will be discharged to a preset level prior to recharging. This unit may also be used as a power supply adaptor for powering camcorders.



CAMCORDER BATTERY CHARGER

REF: T080F PRICE: £32.95
This unit is suitable for charging a wide range of batteries, 6, 7.2, 9V. It can be used from the mains adaptor supplied or from a car lighter socket using the lead supplied. Two camcorder battery adaptor plates are supplied for use with various makes and types of batteries.



TRIPODS

TRIPOD

REF: T090 PRICE: £13.95
Camera/Video tripod with 3 section legs, collet locks, 2 way panhead with lift elevator and rubber shoes for non slip use.
Height: 45.5" (1.16m)
Packed height: 15" (0.38mm)
Weight: 0.75kg



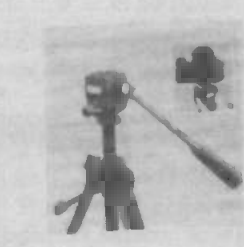
TRIPOD

REF: T090A PRICE: £20.95
Camera/video tripod with sturdy 3 section legs and additional radial braces for greater stability. 2 way panhead with lift elevator and rubber shoes for non slip use. Flip up leg locks.
Height: 54" (1.35m)
Packed height: 19.5" (0.5mm)
Weight: 0.85kg



TRIPOD

REF: T090B PRICE: £27.95
Video tripod with sturdy 3 section legs and additional radial braces for greater stability. 2 way panhead with fluid damped action and quick release platform. Gear driven centre column with folding crank.
Height: 53" (1.34m)
Packed height: 21.25" (0.54m)
Weight: 0.95g



TRIPOD

REF: T090C PRICE: £39.95
Video tripod with sturdy 3 section legs and additional radial braces for greater stability. 3 way panhead with quick release platform. Gear driven centre column with friction controlled action. Adjustable spiked feet.
Height: 61.5" (1.56m)
Packed height: 23.5" (0.6m)
Weight: 1.6kg



TRIPOD

REF: T083B PRICE: £11.99
Table top camcorder/camera tripod. Fully adjustable for angle. Folds down to a small size for storage in camcorder bag.



TRIPOD

REF : T090D PRICE : £44.95
 Video tripod with sturdy 3 section legs and additional radial braces for greater stability. The high precision 2 way panhead is fluid damped and incorporates two lateral safety hooks a quick release platform and spirit level. Gear driven centre column with friction controlled action and folding crank. Adjustable spiked feet.
 Height: 61" (1.55m)
 Packed height: 24.5" (0.5m)
 Weight: 1.8kg



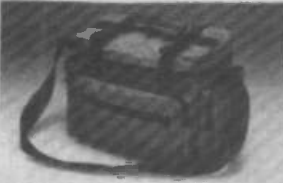
CAMCORDER BAG

REF : T089 PRICE : £9.95
 Soft padded camcorder bag with shoulder strap. Designed to carry the camcorder and accessories. Black weatherproof material.



CAMCORDER BAG

REF : T089A PRICE : £12.99
 Soft padded camcorder bag with shoulder strap. One internal pocket and four zipped external pockets. Silver weatherproof



MORE TV AND SATELLITE

CO AX PLUG (TV TYPE)	PKT5	1.00	BD958
CO AX SOCKET (TV TYPE)	PKT2	1.00	BD959
75 ohm LOW LOSS CO AX CABLE	10M	2.00	2P236
75 ohm LOW LOSS CO AX CABLE	100M	15.00	15P31
SATELLITE CABLE	100M	14.00	V14P1
UHF PATCH LEAD 9" long with coax plug and socket	PKT5	£2.00	X4P5
F-PLUG SPLITTER 1 in 7 out	PKT2	£3.00	X3P18

VIDEO SENDER UNIT

Instantly sends audio/video signals to any TV in your home WITHOUT CABLES. Easy to install. Works with ANY Audio/Video component. Can be used with VCR, Video Camera, Computer/TV games or with TV Monitoring Systems.

Transmission Channel 31
 Power 10-13.8V DC

REF : 15P39
 PRICE: £15.00

WARNING: This item is for export use only and is NOT APPROVED for use in the UK. Users are liable to prosecution under the wireless Telegraphy act 1949 (and any amendments thereto.) This condition may apply to other countries.

SATELLITE FINDER

(limited stock)

A simple to use tone satellite finder enabling accurate pinpointing of those elusive satellites!! Full instructions, compass and headphones supplied together with satellite location map.

PRICE: £10.99 REF: X11P1

FERGUSON SRB1

REMOTE CONTROLS

Satellite receiver remote controls. Brand new ideal as a spare or we believe you can adapt them for Philips etc.

REF : Q4P2 PRICE : £4.00 EACH
 REF : Q15P2 PRICE : £15.00 PKT5

INFRA RED REMOTE

CONTROLS

Brand new units made for controlling satellite equipment. Remember these have an infra red LED plus keyboard plus control electronics. Ideal for experiments!!

REF : R1P1
 PRICE : £1.00

SATELLITE CABLE

This cable is probably used for mainly internal work. Printed on the cable is PK1 CATV-DROP CABLE. It measures approx 4mm in diameter and is finished in white. Standard coax construction.

REF : V14P1 PRICE : £14.00

ACTIVE AERIAL COMBINERS

We believe that these units were made to plug in the back of your VCR or TV and combine two incoming signals?? They are fitted with two UHF sockets and one UHF plug. They are tunable inside.

REF : T1P6 PRICE : £1.00(PKT2)

TELECOMMUNICATIONS

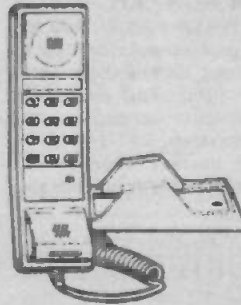
TELEPHONE HANDSET

REF : K6P1 PRICE : £8.00

Compact one piece push button telephone handset. BT approved and easy to install.

Features:

- Last Number redial
- Push Button keypad
- Wall or table mount
- Modular plug system
- LED ring indication



EXTENSION KITS

REF : P205 PRICE : £5.99

Extension kit containing cable connected to double adaptor, one compact socket and cable clips. Length: 15m



A RANGE OF NOVELTY TELEPHONES

We now have as a standard stock line a range of very high quality novelty telephones. Ideal as an unusual christmas/ birthday present or just to brighten up your home/office environment as a talking point! Bright attractive colours, sturdy constructions, the all have the following features:

- Tone/Pulse Switch
 - Integral receiver
 - Integral microphone
 - Push button dialling
 - Last number Redial
 - Reset button
- (Not approved)

APPLE
 REF: NTS



FRENCH FRIES

REF: NT1 PRICE: £17.99



HAMBURGER

REF: NT3A PRICE: £17.99



HOT DOG

REF: NT4 PRICE: £17.99



PIZZA

REF: NT2 PRICE: £17.99



BANANA

REF: NT6 PRICE: £17.99



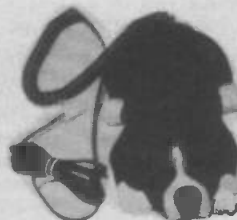
FRENCH BREAD

REF: NT3B PRICE: £17.99



PUPPY PHONE

REF: NT11 PRICE: £17.99



SPUD

REF: NT7 PRICE: £17.99



AMAZING ANSWERPHONE BARGAIN

FAMOUSE BRAND RESPONSE 200 & 400 MODELS

Refurbished tested working, guaranteed. Offered at less than half the original retail price.

EACH UNIT IS SUPPLIED WITH: ** Micro Cassette

** Power Supply

** User details

RESPONSE 200

The Response 200 Unit has the following features:

Answering machine with telephone:

- Micro Cassette
- Call screening/call count
- Memo facility
- Remote facility
- Answer only option
- 2 way conversation record
- 13 memories
- Last number re-dial
- Variable ringer volume
- BT Network services
- PABX Compatible
- Mute facility
- Ren 1.0.



RESPONSE 400

The Response 400 Unit has the following features:

Answering machine with telephone:

- Micro Cassette
- Call screening/call count
- Memo facility
- Remote facility
- Answer only option
- 2 way conversation record
- 20 memories
- Last number re-dial
- Variable ringer volume
- On hook dialling
- Hands free speech
- BT Network services
- PABX Compatible
- Mute facility
- LCD Display with clock timer
- Ren 1.0.



REF : Y36P1

PRICE : £35.99

REF : Y50P2

PRICE : £49.99

TONE DIALLER

A remarkably small sized gadget the Touchtone Dialler can provide most pulse dialling phones with a tone facility and all the advantages that go with it. i.e. speeds up and eases dialling, remote interrogation of answerphones, in fact almost all computer based services.

REF : YSP4

PRICE: £5.00

CUSTOMER RETURNED ANSWERPHONES

We also have available Answerphones suitable for the home projects enthusiast. Specification is exactly as described above for the Response 200 and 400 Units, but these units have been "returned" by retail outlets as having faults. Each telephone has two specific known faults, one we tell you how to fix and supply you with the components to do it, including circuit diagram, the other is labelled on the unit. All units are unique in that each fault is different - basically POT LUCK! No power supply, cassette or user details supplied with this purchase.

RESPONSE 200CR REF: Y18P1 PRICE: £18.00

RESPONSE 400CR REF: Y28P1 PRICE: £28.00

TELEPHONE ACCESSORIES

100M REEL WHITE 6 CORE CABLE	EACH	14.00	14P11
3M LEADS NEW STYLE PLUG BLACK	PKT2	1.00	BD639
3M LEADS NEW STYLE PLUG WHITE	EACH	1.00	BD705
5M NEW STYLE EXTENSION LEAD	EACH	3.00	3P70
PLASTIC CLEAR CENTRE DIAL DISC (746)	PKT10	5.00	5P401
BAKERLITE DIAPHRAM EARPIECES	PKT10	5.00	BD484
TELEPHONE HEARING AMPLIFIER	EACH	5.00	5P402

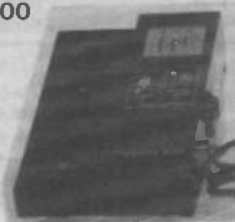
amplifies volume on earpiece

PHONE BOX PANEL

BT approved. Made to retail at £79. You can now be the proud owner of a Talking Coin Box Panel. This panel should enable you to *convert your phone into a pay phone*, taking £1 or 50p coins it also takes the old 10p so a slight modification is needed here. You will need to make a secure base. Even as a stripper unit this panel will provide loads of useful components including a speech chip, speaker, BT lead, 4 x C size battery holder, plus many components. We do not offer these units as tested and working but in almost all cases they do function perfectly. Even at this extremely low price we provide a small user manual which would enable programming and using the unit.

Price : £5.00

Ref : 5P400

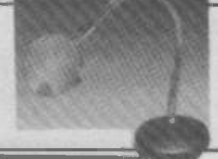


TOOLS AND SERVICE AIDS



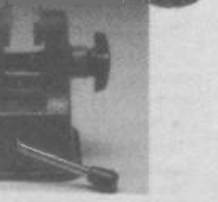
QUICKTEST BLOCK

REF : Y003A PRICE : £15.95
Quick test block with 1m lead and 13a plug



PRISMATIC MAGNIFIER

REF : Y00C1 PRICE : £0.50p
Credit card size prismatic magnifier. All plastic.



GOOSENECK MAGNIFIER

REF : Y006D PRICE : £9.95
2 x magnification 3" diameter on a flexible 13" gooseneck with heavy base. Useful for close, precise work.



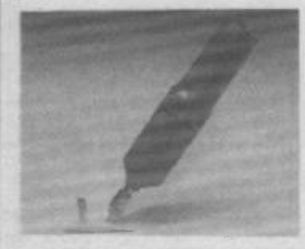
MINI VICE

REF : Y010 PRICE : £1.99
Miniature plastic and metal vice with strong suction base. Single lever action to secure to smooth, non-porous surface. Aluminium covered jaws open to 40mm
Dims: 60x80x68mm approx



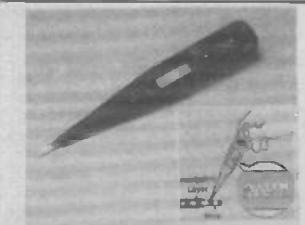
MINI VICE

REF : Y010A PRICE : £8.99
Aluminium-alloy vice with screw clamp for fixing to base of 30mm maximum width. Jaws open to 50mm.
Dims: 135x120x60mm approx
Weight: 0.46kg



MINI DRILL

REF : Y061J PRICE : £8.99
Precision PCB mini-drill. Ideal for small or delicate work on printed circuit boards or similar. Hand-held operation. Power supplied from any suitable dc power supply operating on voltages 5-14Vdc. Power input via 3.5mm jack plug. On/off switch. Accessories:
Collet for 0.8mm to 1.2mm drills.
1mm twist drill and tommy bar.
Input Voltage: 5-14Vdc
Nominal Voltage: 12Vdc
No-load Current: 250mA
Stalled Current: 3.5A
No-load Speed: 6000rpm
Dims: 35dia x 165mm



VOLTAGE TESTER

REF : Y023BA PRICE : £3.99
Dual function screwdriver type circuit tester. Used as an inductance tester it will detect buried live cables, breaks in cables etc. touching a live part with the tip will indicate the voltage level on the LCD screen. AC or DC up to 250V max.



CRIMP TOOL

REF : Y028D PRICE : £17.99
High quality ratchet strip and crimp tool for American style 4-pin and 6-pin telephone plugs. Cushioned plastic grips and ratchet release lever.



43-PIECE TOOL KIT

REF : Y012D PRICE : £14.99
A 43 piece tool kit comprising a ratchet driver handle, 100mm extension bar, 150mm flexible extension, hex to square drive adaptors, (male-male and female-female), 8 screwdriver tips, 8 torque driver tips, 8 hex key tips, 7 metric sockets and 7 imperial sockets in a hinged plastic case.



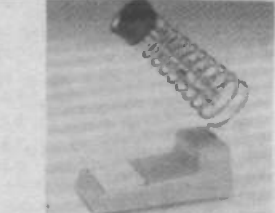
PRECISION TOOL SET

REF : Y030B PRICE : £12.49
5 piece precision, pressed stainless steel tool set with precision ground blades. The set comprises side cutters, bent nose pliers, round nose pliers, long nose pliers and flat nose pliers. Spring insulated handles.
Length: 4" (100mm)



WIRE STRIPPER

REF : Y025 PRICE : £9.95
Wire stripper for stripping cables with diameters of 1.1, 1.4, 1.6, 1.8, 2.4 and 3.5mm. Fully automatic action, place wire in appropriate groove; squeezing grip with simultaneously strip and eject the insulation. Cast aluminium with blue insulated handles.
Length: 178mm



SOLDERING IRON STAND

REF : Y061K PRICE : £4.99
Top quality stand with heavy cast-iron base and rubber feet. Highly stable unit for professional use. Tip cleaning sponge provided. Diecast base.
Weight: 0.5kg (including holder)



SOLDER KIT

REF : Y061Z PRICE : £19.95
This kit offers a 25W soldering iron, holder, desolder pump, solder, helping hands and a range of tools, all contained in a black moulded plastic carrying case.
Power: 220/240Vac 50Hz
Dims: 320x250x70mm
Weight: 1.48kg



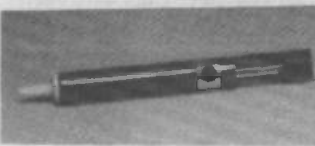
HELPING HANDS

REF : Y057A PRICE : £4.99
Rod mounted horizontally on a heavy base. Crocodile clips attached to rod ends. Six ball and socket joints allow infinite variation of clips through 360°. Plastic magnifier.



3-CORE SOLDER

REF : Y048 PRICE : £8.99
3-core resin solder. 60% tin, 40% lead. Melting point 185°C. 1.2mm 3kg reel.



DESOLDERING PUMP

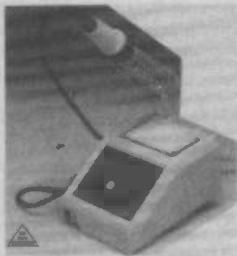
REF : Y051 PRICE : £4.99
High suction pump with automatic ejection. Finest quality all-metal construction. Heavy duty return spring and close tolerance manufacture give extra-high suction. Teflon nozzle. Gold and black.
Dims: 19dia x 192mm



220/240Vac IRON

REF : Y061DA PRICE : £4.99
High quality mains powered, lightweight soldering iron. Designed for ease of use. 1.7m lead with cord grip and cable protector.
Length: 195mm
Power: 220/240Vac 50Hz, 15W

DO YOU RECEIVE OUR REGULAR NEWSLETTERS AND BULLETINS???
ARE YOU ON OUR DATABASE -
If not, send in a written request and we will gladly add your name and address to our mailing list immediately. Be one of the first to know what's new in stock - before it gets advertised nationally.



SOLDERING STATION

REF : YO61 PRICE : £79.95
 A professional quality soldering station with full temperature control. Digital temperature pre-setting and temperature monitoring. High power heating element raises the tip to working temperature in less than a minute. Temperature fully variable between 150 and 480°C. Full electronic switching and grounded tip protects sensitive components from damage. Long life iron plated tip.
 Temperature: 150-480°C, 300-900°F
 Power: 220/240Vac 50Hz
 Dims: 170x120x90mm (controller)
 Length(iron): 200mm



12Vdx IRON
 REF : YO55 PRICE : £4.99
 12Vdc soldering iron for mobile use. 4.3m lead is terminated in a cigar lighter type plug. Black phenolic handle with bright plated barrel.
 Length: 220mm
 Power: 12Vdc 8W

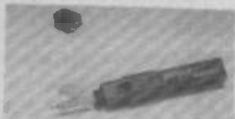
TEST EQUIPMENT



BATTERY TESTER
 REF : Y126A PRICE : £2.99
 Compact universal battery tester on a keychain. 3 LED's indicate battery charge level. Tests all battery types from button cells to PP3



VIDEO HEAD TESTER
 REF : Y139M PRICE : £39.95
 A VHS video head tester for determining whether a video head is in good condition by detecting the wear state and displaying it on a meter. Complete with carrying case and leads.
 Measuring frequency: 1MHz
 Measuring system: Bridge measuring circuit
 Power: 9Vdc (PP3 battery)
 Dims: 142x95x30mm



PORTASOL HOBBY GAS SOLDERING IRON
 REF : YO60GS PRICE : £14.99
 The Portasol Hobby is a versatile, butane powered catalytic soldering iron, fully portable for use around the home, car, workshop or out in the field. A fully charged canister will run the soldering iron for approximately 30 minutes. Refillable from standard butane lighter fuel canisters.
 Operating Time: 30 mins typical
 Tip Temp: 350°C max
 Length: 196mm



LCR METER
 REF : Y134D PRICE : £69.95
 Hand held 3.5 digit LCD digital LCR meter. 7 capacitance ranges, 6 inductance ranges and 7 resistance ranges. Supplied complete with test leads, battery, and instruction manual.
 Capacitance ranges: 0-200p-2n-20n-200n-2u-20u-200uF
 Inductance ranges: 0-20-200-2k-20k-200k-2M-20 200Mohm
 Power: 9V PP3 (battery, not supplied)
 Dims: 170x81x43mm



CHISEL TIP FOR YO60GS
 REF : YO60GT PRICE : £5.95
FINE TIP FOR YO60GS
 REF : YO60GU PRICE : £5.95
KNIFE TIP FOR YO60GV
 REF : YO60GV PRICE : £5.95



PORTASOL PROFESSIONAL GAS SOLDERING IRON KIT
 REF : YO60JA PRICE : £39.95
 A complete gas soldering iron kit consisting of a Portasol professional gas soldering iron, soldering iron stand, tip cleaning sponge, hot knife tip, blow torch tip, hot air blower and 2.4mm soldering iron tip, all contained within a compact carrying case. The soldering iron can be refilled from a standard butane lighter fuel canister.



FREQUENCY COUNTER
 REF : Y134 PRICE : £89.95
 7-digit frequency counter for frequencies between 10Hz and 200MHz/Power on/off. x1/x10 gate time and VHF/HF switches. Inputs via BNC sockets. Supplied complete with instruction manual and test lead. Requires an external 9Vdc nom 200mA power supply.
 Frequency range: HP 10Hz -20MHz
 VHF 10MHz to 200MHz
 Input voltage: 50mV to 200 MHz
 Gate Time: 0.1sec . 1sec
 Input impedance: HF 1Mohm
 VHF 50ohm
 Power: 7-10Vdc 200mA
 Dims: 140x65x122mm



1.0mm TIP FOR YO60JA
 REF : YO60JB PRICE : £7.95
2.4mm TIP FOR YO60JA
 REF : YO60JC PRICE : £7.95
3.2mm TIP FOR YO60JA
 REF : YO60JD PRICE : £7.95
4.8mm TIP FOR YO60JA
 REF : YO60JE PRICE : £7.95
HOT KNIFE TIP - YO60JA
 REF : YO60JF PRICE : £7.95
HOT AIR BLOWER -YO60JA
 REF : YO60JG PRICE : £7.95
BLOW TORCH - YO60JA
 REF : YO60JH PRICE : £7.95

THERMOMETERS



DIGITAL THERMOMETER
 REF : Y137M PRICE : £9.95
 A dual sensor digital thermometer designed for comparative temperature measurement, for example inside/outside temperature. The thermometer can be free standing or mounted with the Velcro strips provided. The remote sensor is fitted with a 3m lead and mounted with double sided tape. A digital clock is built in.
 Temp range: -20 O to +70OC + 1OC
 Resolution: 0.1OC
 Power: POO9H button cell

SORRY NO ILLUSTRATION AVAILABLE ON THIS PRODUCT

CANT SEE WHAT YOU'RE LOOKING FOR
 Don't give up hope, give us a call 0273 203500
 We may just have THAT ITEM sitting in our warehouse waiting for your call. Or something even better.



AQUARIUM THERMOMETER
REF : Y137P PRICE : £7.95

A dual sensor digital thermometer designed for comparative measurements between water and room temperature. The external sensor can be attached to the glass within the tank with the sucker provided. The internal sensor measures room temperature. The thermometer can be attached to the aquarium with the strips provided.

Temp range: -50 to +70°C
Power: P009H button cell
Resolution: 0.1°C
Dims: 59x40x14mm

DIGITAL THERMOMETER / CLOCK

REF : Y137Q PRICE : £7.95

A dual sensor digital thermometer for comparative temperature measurement, for example inside/outside measurement. The thermometer will display temperature in °C or °F, and includes a digital clock. The remote sensor can be mounted up to 3m away from the unit. The backlit LCD display makes it ideal for in-car use. Battery supplied.

Temp range: -50 to +70°C
Power: 1 x AA battery
Dims: 107x25x13mm



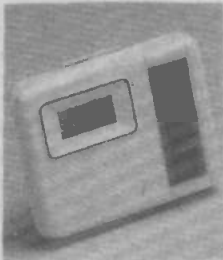
TIMERS

COUNTDOWN TIMER

REF : Y137S PRICE : £4.99

Simple to use electronic countdown timer with 19 hours, 59 mins countdown capability. The internal alarm sounds when the set period has timed out. Hundreds of applications from process control to the kitchen. Free standing, spring clip and magnetic mounting.

Timing Period: 19hours 59 mins
Power: P009H button cells
Dims: 82x50x11mm



COUNTDOWN TIMER

REF : Y137T PRICE : £5.99

Large digit electronic countdown timer with 19 hours, 59 minutes countdown capability. The internal alarm sounds when the set period has timed out. 19mm LCD display. Hundreds of applications from process control to the kitchen. Spring clip of magnetic mounting.

Timing Period: 19hours 59 mins
Power: 1 x AA battery (not supplied)
Dims: 90x60x21mm



2-CHANNEL DIGITAL CLOCK

REF : Y137V PRICE : £9.95

Large LCD digital alarm clock with two independent alarm functions. The LCD displays time, day and date and alarm status. Compact and easy to use. Batteries included.

Power: 2 x AAA batts
Dims: 68x102x27mm



DIGITAL CLOCK

REF : Y137W PRICE : £9.95

Large LCD digital alarm clock with snooze control and LCD illuminating light. The snooze control silences the alarm for 7 minutes before resounding it. Compact and easy to use. Batteries included.

Power: 2 x AAA batteries
Dims: 95x65x68mm



DIGITAL CLOCK/TIMER

REF : Y137U PRICE : £8.99

Free standing digital clock with built-in timer. The timer functions initially as a countdown timer, counting down from up to 23 hours 59 minutes and then sounding the alarm. Immediately the alarm sounds the timer switches to count-up mode, indicating the period since the alarm sounded. A separate count-up timer function is provided for general timing. Battery provided.

Power: 1 x AAA battery
Dims: 87x82x45mm

TORCHES

HAND LANTERN

REF : L122H PRICE : £5.99

High powered hand lantern with focused beam. Body moulded in one piece and fitted with seal to make the lantern weatherproof.

Dims: 190x125x120mm
Power: PJ996
4xD cells or battery



RUBBER TORCHES

Range of all moulded waterproof rubber torches with high intensity krypton bulbs. All black with bright yellow seal and wrist cord toggle.

REF : L122 2 x AA BATS PRICE : £3.00

REF : L122A 2 x D BATS PRICE : £4.00

REF : L122B 3 x D BATS PRICE : £5.00

ALUMINIUM TORCHES

High quality turned aluminium waterproof torches with adjustable focus beam, from spot to flood light. Finished in satin black anodising. Supplied with high intensity krypton bulb, spare bulb and lanyard ring.



REF : L122F 2xD BATS PRICE : £16.00

REF : L122G 3xD BATS PRICE : £20.00

KRYPTON BULBS

High light intensity krypton bulbs. Supplied Pkt 2.

2.4V 700mA REF : F019GL PRICE : £2.00

3.6V 700mA REF : F018GM PRICE : £2.00

4.8V 750mA REF : F018GN PRICE : £2.00



RECHARGEABLE TORCH

REF : L122N PRICE : £12.99

A rechargeable torch powered by internal Ni-cad batteries. The torch offers a flashing light facility which is useful in emergencies.

Bulb: 2.4V 0.7A
Power: 5.3Vdc 140mA
adaptor supplied
Dims: 252x65(dia)mm



ALUMINIUM TORCHES

A range of high quality turned aluminium water proof torches in presentation cases. Beam can be focused from wide angle to narrow beam. Batteries included. 1xAAA Cell with keychain



1xAAA CELL WITH KEYCHAIN REF : L122D PRICE : £6.00

BULB REF : F018GX PRICE : £1.00

1xAAA CELL WITH WHISTLE REF : L122C PRICE : £5.99

BULB REF : F018GY PRICE : £1.00

2XAA CELL REF : L122E PRICE : £7.99

BULB REF : F018GZ PRICE : £1.00

TRANSFORMERS				TRANSISTORS			
MAINS TRANSFORMERS				BC108	PKT6	£1.00	BD911
6V 1A UPRIGHT MOUNTING	PKT2	£1.00	BD9	BC109	PKT6	£1.00	BD912
12-0-12V 4.2V A PCB MOUNTING	EACH	£1.00	BD636	BC182L	PKT12	£1.00	BD921
20-0-20V 2.5A UPRIGHT MOUNT	EACH	£4.00	4P24	BC184L	PKT10	£1.00	BD923
50V 2A PLUS 6.3V UPRIGHT MOUNT	EACH	£3.00	3P10	BC212L	PKT10	£1.00	BD924
250-0-250V 60mA PLUS 6.3V @ 5A	EACH	£4.00	4P41	BC238B	PKT10	£1.00	BD927
TORODIAL TRANSFORMERS				BC337	PKT10	£1.00	BD928
These transformers are of extremely high quality - type tested to 4KV. High power density for size, low magnetic interference. All primary windings rated at 220/240Vac. Supplied with fixing kit.				BFY51	PKT3	£1.00	BD933
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30VA 0-12,0-12 70x30mm	EACH	£5.99	PO42A	MJ2955	PKT2	£2.00	2P299
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50VA 0-12,0-12 80x30mm	EACH	£6.99	PO42C	TIP29A	PKT6	£2.00	2P301
80VA 0-12,0-12 80x40mm	EACH	£8.99	PO42D	TIP30A	PKT6	£2.00	2P302
80VA 0-22,0-22 80x40mm	EACH	£8.99	PO42E	TIP31C	PKT5	£2.00	2P303
120VA 0-12,0-12 95x40mm	EACH	£11.99	PO42F	TIP32C	PKT5	£2.00	2P304
120VA 0-30,0-30 95x40mm	EACH	£11.99	PO42G	2N3055	PKT3	£2.00	2P305
120VA 0-110,0-110 95x40mm	EACH	£11.99	PO42H	ZTX300	PKT5	£1.00	BD34
160VA 0-12,0-12 95x65mm	EACH	£14.99	PO42J	SEMI CONDUCTORS			
160VA 0-35,0-35 95x65mm	EACH	£14.99	PO42K	LM317T VARIABLE VOLT REG 1.5A	PKT2	£1.00	BD905
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225VA 0-110,0-110 105x55mm	EACH	£18.99	PO42N	TIP3055 POWER TRANSISTOR	PKT1	£1.00	BD655
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300VA 0-35,0-35 110x55mm	EACH	£20.99	PO42Q	8A 140V 100W IN Channel & IP Channel			
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500VA 0-45,0-45 120x65mm	EACH	£30.99	PO42S	20 MIXED ICS IN BARGAIN PACK	PKT20	£1.00	BD906
500VA 0-110,0-110 120x65mm	EACH	£30.99	PO42T	TIP 125 darlington transistor			
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These transformers are of the finest quality construction. Type tested to 4kV primary to secondary. All primary windings rated at 220/240Vac.				HEF 4060BP cmos			
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9-0-9 2A 36VA 59x59x50mm	EACH	£6.00	PO34	DIODES			
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6-0-6 8A 96VA 78x65x72mm	EACH	£12.00	PO37D	IN4006 800V 1A	20	£1.00	BD973
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12-0-12 8A 192VA 96x83x82mm	EACH	£22.00	PO37J	TRIACS AND THYRISTORS			
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5V 2A TO220 VOLT REG. 78S05	PKT2	1.00	BD966
-12V 2A TO220 VOLT REG. 78S12	PKT2	1.00	BD967

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SINCLAIR C5 16" TYRE	EACH	1.00	R1P3

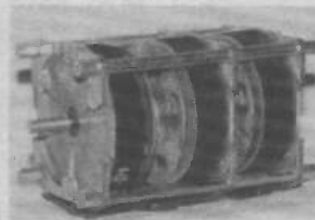
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FIBRE OPTIC CABLE. AVAIL. IN DIFF. LENGTHS	5M	7.00	7P29
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EXTRA FLEXIBLE CABLE BLACK	25M	3.00	3P132
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We suspect that this unit was originally used in some kind of military application as a variable voltage transformer. The unit consists of three completely separate torroids which are tapped at winding ends and also near the ends giving an inductance of about 1/2 Henry per torroid at less than 1/20Ohm. Each wiper has a variable contact resistance of less than 1/20Ohm. One of our more informed customers, Mr John Remington, has suggested the use of this inductor in the following applications:

- ** High Current Smoothing Circuits
- ** Variable Voltage Transformer
- ** Very Low Variable Frequency Resonant Circuit



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Our technicians are available for product information and assistance on the telephone between 10am -3pm Monday to Friday. Whilst we are more than pleased to be able to assist our customers with the general product availability and specifications it is not possible however for any of our staff to give detailed instruction on how to incorporate our components into personal projects, or indeed in most cases the wiring or connecting of our products. However, any products supplied by us will be provided with all technical/specification details that we ourselves have to hand, including connection details where relevant.

With regard to our Computers and Computer Accessories, unfortunately we do not have the technicians available to assist with telephone technical support on these products and they are sold with the understanding that the purchaser has his own technical resources. We do however have one technician in house who has a basic understanding of Computerised Hardware and will be more than happy to assist with telephone technical support but this is a chargeable service and should be specifically requested at the time of the call so that you call can be directed to the correct department. The current 15min Unit Rate is £7.50. We have no software support staff and are therefore unable to assist with Operating Systems or Packaged Software.

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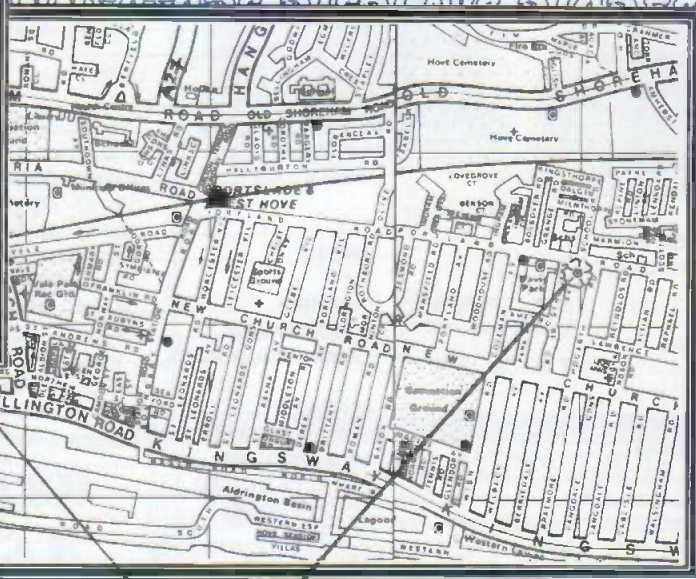
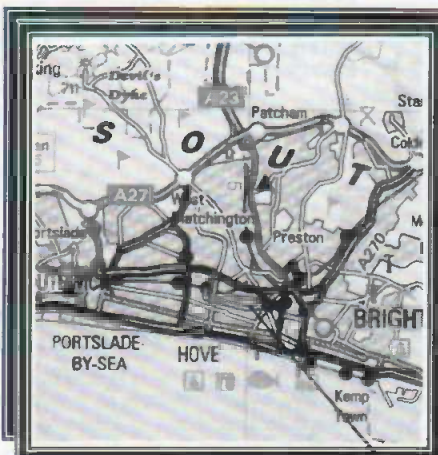
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and the mounting holes, and mark them on the lid. Make the holes for these and, using thin nylon bolts, mount the circuit panel temporarily in position. In the prototype unit it was found that no spacers were needed on the bolt shanks because the presets and capacitors on the board provided the right amount of clearance so that the face of the display ended flush with the case. However, use some plastic spacers if necessary. Remove the circuit panel again - this is necessary so that the other holes may be drilled safely and also to enable adjustments to the presets to be made later.

Drill the hole in the lid for rotary switch S1 and for the small bolts which will be used for the buzz-test wires - more will be said about this later. Drill two holes in the side of the box for the 4mm voltmeter sockets. Drill the holes in the side for fuse holder F1 and in the base for the PP3 battery holder. Drill a few small holes above BUZ1 position for the sound to pass through. Mount all components but not the circuit panel and, referring to Figure 4, and complete all internal connections shortening any wires as necessary. Note that S1 is shown disproportionately large for clarity. The numbers and letters are conventional and found inscribed on most switches of this type. On completion, the use of small cable ties will tidy up the wiring by grouping it into neat bundles.

In the prototype unit, the buzz-test connections were made using two small nuts and bolts, each with a solder tag inside and outside the box. The external solder tags are used to connect short test leads. This method has the advantage that the leads can be bent to make contact with a wide variety of lamps, fuses, etc. Also, they are easily replaced when they eventually break. In the prototype, 22 swg tinned copper wire was used, but cut-off pieces of paper clip or resistor ends would probably serve just as well. A length of one inch (25mm) will be found convenient. A little heat-shrinkable sleeving used on the soldered ends is cosmetic, but makes the device look more professional.

Adjustments

The best way to set up the 'voltmeter' is to use a variable voltage power supply unit and a conventional voltmeter. If this equipment is not available, you will have to make do with a 12V battery - say a 9V battery connected in series with two 1.5V cells. In the absence of a voltmeter, you will have to assume that the batteries have their nominal voltage. Make up a pair of leads for the voltmeter terminals. These will have 4mm plugs on one end and possibly small crocodile clips on the other. It would also be possible to use standard 4 mm test meter probes. To some extent, the design and length will depend on the anticipated use.

If a variable output mains-operated power supply is being used, connect it to the voltmeter sockets, observing the polarity. Begin at zero and gradually increase the voltage. The first bar of the display should light at about 9V. Continue to increase the voltage and note that the segments light one by one. Adjust RV3 so that the last one comes on at 14V. Do not exceed 15V at any time. Note that there is a slight overlap built into IC2 operation so it is possible for two bars to light at the same time.

If you are using a 12V battery, connect it to the voltmeter terminals and adjust RV3 so that the 6th or 7th segment lights up. If the true voltage can be checked with a voltmeter so much the better. Note that when RV3 is adjusted for the required high point, this will alter the low point slightly. However, there should

be no problem in adjusting it to a suitable compromise position. At this stage it would be a good idea to make a rough voltage scale. Do not aim for high accuracy here - the prototype covered 9 - 14V in a slightly non-linear way.

Buzz tests

Connect BATT1 and switch S1 to low. Hold the 10W test resistor onto the test points and adjust RV2 until the buzzer sounds. It could be arranged to operate at any resistance below about 50W by using the appropriate test resistor.

The high resistance buzz-test is similarly adjusted using, say, a 22kW resistor in the test position. Set S1 to high and adjust RV1 until the buzzer sounds. The resistance of most car ignition leads is around 5kW per foot (30cm) of length and adjustment to 20 - 30kW will be found to work well in practice.

It only remains to fit the circuit panel into position and make permanent labels for the voltmeter scale and switch. Fit the lid, checking carefully for trapped wires. Stick plastic feet on the bottom of the case if necessary. Note that very low-power 12V bulb filaments and most mains lamps have a cold resistance higher than 10W. When checking such lamps use the high-resistance buzz-test. Remember, after using the buzz-test, to switch the unit off or the battery will soon be drained.

PARTS LIST

RESISTORS

R1	4k7
R2	180R
R3	220R
R4	100R
R5,6	47k
R7	1M
R8,9	100k
R10	18k
R11	10k
R12	470R
R13	22k
R14	1k
RV1	47k
RV2	470R
RV3	22k

Additional 10W and 22kW resistors required for testing purposes - see text.

CAPACITORS

C1,3	220µF 16VW
C2	100n

SEMICONDUCTORS

D1	1N4001
ZD1	TL430 adjustable Zener diode
IC1	CA3140E
IC2	LM3914 bar graph driver
IC3	10 segment red bar graph display

MISCELLANEOUS

S1	3-position 4-pole rotary switch break-before-make action.
BUZ1	PCB mounting solid-state buzzer 3 - 24V operation. 23mm diameter
F1	250mA 20mm fuse and chassis fuseholder
BATT1	PP3 battery, connector and holder
Plastic box	118 x 98 x 48 mm external
8-pin dil socket, 18-pin dil socket, 20 pin dil socket.	
4mm sockets	
Solder tags - 4 off.	
Small nuts and bolts.	

TL430



Fig. 5 PIN diagram of ZD1 looking at flat of body

Lets go fishing

Andrew Armstrong helps solve an ETI reader's fishy problem

We had an interesting query recently from an ETI reader in Germany. The reader, Andrew Mathison of Echzell-Bisses, is interested in angling as well as in electronics, and would like to build a fish-bite detector. He owns one at present, which he thinks is too costly, so instead of buying a second one, he wants to build one for himself.

His present detector uses an idler-wheel with magnets fitted around it close to the rim, as shown in Figure 1. A reed switch is mounted so that the magnets can activate it as they pass. Because a number of magnets are fitted to the wheel, only a small movement of the fishing line is needed to make the reed switch operate. The magnets need to be light and numerous for the best performance.

He goes on to say that his commercial bite detector uses a 4538 chip and that, when a bite is detected, there is a 0.5 second bleep generated by a Piezo sounder. A light-emitting diode is switched on for between 10 and 15 seconds, as well, in order to show which detector (if several are in use) has detected a bite.

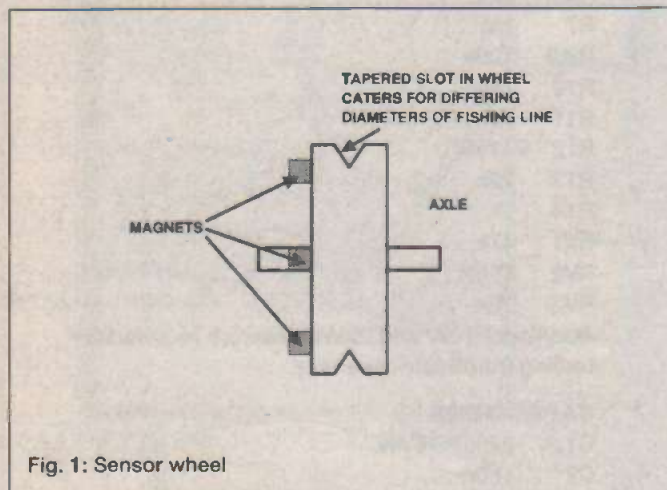


Fig. 1: Sensor wheel

Not one to leave anything to chance, Andrew wishes to add a further refinement: the ability to choose the frequency of the tone, so as to identify which bite detector has operated audibly, as well as visually.

According to my data book, the 4538 is a dual-precision CMOS monostable, which would seem the obvious chip to use for this kind of job. It can be triggered either by a negative-going clock edge on the B input, or a positive-going edge on the A input. There is no upper limit on the output time duration, except that imposed by practical capacitor and resistor values, so a 10 second time period is easily obtainable.

Figure 2 shows a suitable design employing the 4538. No on-off switch is shown in this design, because the quiescent current consumption is so low that the switch is unnecessary. The circuit is shown as being powered from a 5V supply, but this type of CMOS chip will work over a voltage range of 3 to 18V, so in practice a set of four AA-size batteries in series will form a suitable power supply, giving 6V when the batteries are

new.

When the wheel turns and the reed switch closes, both monostables are triggered. The first monostable has a time-constant, given by R2 and C2, of 10.34 seconds. One of the design features of the 4538 is that its output time period is equal to the RC time constant.

The LED is driven directly by the output of the first monostable, with a current-limiting resistor to save components. A low-current LED, which gives a good brightness with a current of around 3 mA, should be used. The Hewlett-Packard HLMPK 150 is particularly suitable for this job. If this is not bright enough, or if a low-current LED is not available, then a small mosfet should be used to drive a higher-current LED. One example of a suitable mosfet would be the VN10.

The second monostable has a time-constant of 470 milliseconds and its output drives one of the gate inputs of a conventional CMOS oscillator. The frequency of this oscillator may conveniently be chosen by selecting a suitable value for R6, the approximate output frequency being given by $1/(2.2 \cdot R \cdot C)$. The output from the oscillator is fed via a capacitor with a bleed resistor to 0V, to avoid applying DC to the Piezo-electric sounder. Most Piezo-electric sounders have a specific resonant frequency and the oscillator frequency should be chosen to match this. Maplin stocks transducers, resonant at 1.8 kHz, 2.8 kHz and 4.2 kHz, as well as stocking one which can operate, though with lower efficiency, over the range 750 Hz to 20 kHz. This particular range of sounders is not encased, and should be mounted on a suitable surface to act as a sounding board.

An alternative sounder output is provided in case a higher volume is required, or for use on lower voltages. This operates symmetrically, so DC blocking is not required. The apparently complicated gating arrangement is used to lock the output to logic 0 rather than logic 1, when the sounder is not activated, to avoid placing a continuous DC voltage across it.

This fish-bite detector will cost a lot less than the £40-£100 which they apparently cost in Germany. It does use high impedances, in order to keep current consumption low and to allow practical-sized timing capacitors, so care must be taken to house it so that water ingress is prevented. Because it is to be used beside a river and could be dropped into the water, it is probably best to encapsulate the circuit board once everything is working. In my experience, some epoxy encapsulants can slowly absorb water, interfering with the operation of high impedance circuitry. I therefore recommend a two-part silicone rubber encapsulant or, if this is not obtainable, a thick layer of spray-on conformal coating.

This is a simple unit which should present few problems and, to my mind, the only difficult part is the mechanical bit. Do remember, however, that in order to obtain good reliability and low current consumption, anti-static handling procedures must be observed with the CMOS chip. As I have discovered, CMOS has a static damage mode in which quiescent current consumption is increased, but the chip works, perhaps for months, before failing.

SUMMER 1993 CATALOGUE

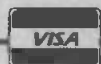


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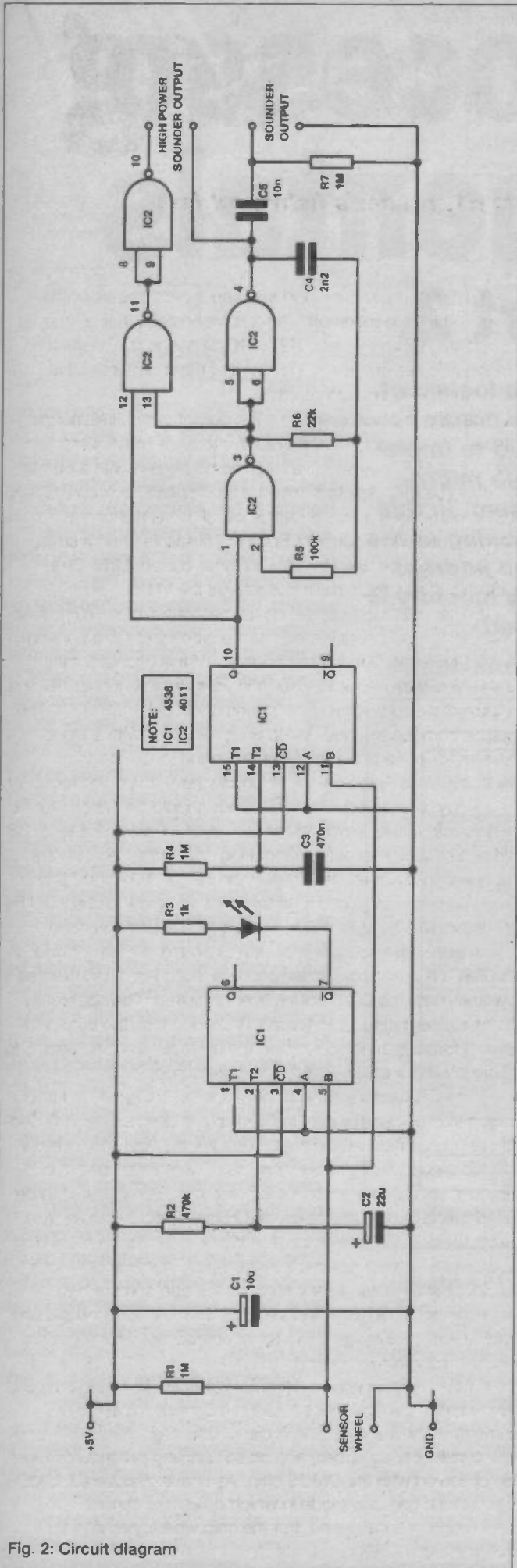


Fig. 2: Circuit diagram

Microprocessor Fundamentals

Part 2

Most simple eight bit microprocessors, such as the 6502 and the Z-80, have sixteen address lines and eight data lines, the so called address and data buses. The processor uses the address lines to select memory locations, and with a binary output on sixteen address lines it can select any one of up to 216 or 65,536 unique memory locations. Once a memory location has been selected, data can be read from it, or written to it, using the eight bit wide data bus.

These memory locations could be read only memory, ROM, or read/write memory, RAM, the type of memory depending on whether it is used for the permanent storage of a program or the temporary storage of data or program code. I have used the word memory location, but such a location does not have to be within a memory chip, it could equally well be a register or an input/output port, a register being a memory location that is used to transfer data between the processor and some other circuit, and an I/O port being a means of allowing the processor to communicate with external devices, such as keyboards, etc. To the processor, registers and I/O ports look and behave exactly like ordinary memory locations.

The memory map

The sixteen address lines of a common 8 bit microprocessor allow us to access 65,536 memory locations. This is referred to as the processor's address space. Some processors, like the 6502 have just a single address space in which all memory and input/output registers are located, while other processors like the Intel 8080 family separate the address space for memory from the address space for I/O, a feature which allows such processors to have special I/O instructions.

If we are using a processor in which ordinary memory and I/O reside within the same address space, then we need

Last month we looked at some of the control circuitry needed to implement a simple micro-processor system. In this issue we are looking at the main data and address buses, and how memory is mapped

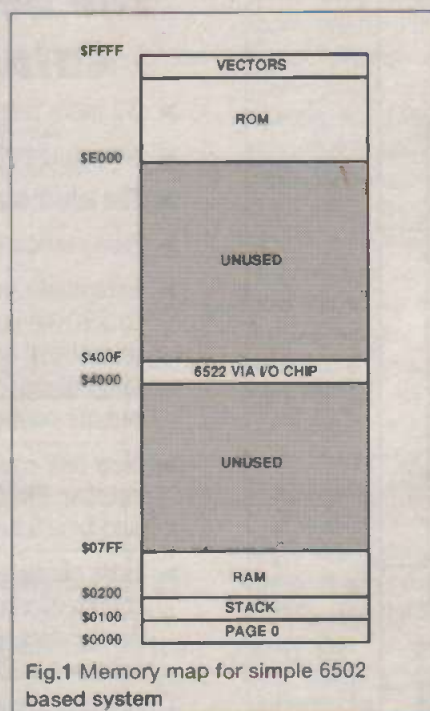


Fig.1 Memory map for simple 6502 based system

to define certain areas of the address space for I/O ports, other areas for ROM memory and other areas for RAM memory. This mapping out of specific areas for specific functions within the overall processor address space is referred to as the memory map and its creation is one of the primary tasks in designing any processor based system. A memory map is equally important in systems where there is a separate memory address space and an I/O address space, it is simply a little more

complex.

Every system will have to have some code resident on ROM, as without such code it, would be virtually impossible to load a program into RAM memory and then run it. This minimal code is often referred to as the kernel and has the function of initialising the processor registers and any I/O registers. The kernel program will then either jump to the main program, which is also stored in ROM, or will attempt to get data from an external device, such as a keyboard or a serial port. Data which it will store in RAM and which may constitute the code for the main program.

Whereas all systems will have some ROM memory, it is possible for a system to function with no RAM memory. Indeed, many control applications can get by with simply using the processor's internal registers for data storage. As far as I/O is concerned, a system could function perfectly well without data input from, or output to, the external world, but such a system would be somewhat pointless since it would not do anything. All practical systems will, therefore, have some memory locations dedicated to use by I/O registers.

When the processor powers up, or is reset, it automatically sets the program counter to a memory address which is stored in a specific location in memory, called the Reset Vector. This is the starting address of the kernel program. It is one of a number of vectors and others specify starting addresses of routines which handle hardware interrupts, etc. All these vector addresses are stored in ROM memory.

The memory address which is stored in the Reset Vector, is the starting address of the kernel program, also stored in ROM memory, and it thus makes sense to reserve memory locations around the vector addresses (usually the top half a dozen memory locations in the memory map) for ROM memory. A common memory map

Address decoding

Armed with the memory map, a system designer can now turn to the decoding circuitry which will ensure that the address bus will access the correct type of memory at the locations designated on the memory map.

For the simple design outlined above, we have three components which need to be attached to the address and data bus, a ROM chip (probably an EPROM), a RAM chip and the 6522VIA I/O chip. For the ROM chip,

we could use a 2764 EPROM which is organised as 8K x 8 bit words, and for the RAM memory a 6116 static RAM which is organised as 2K x 8 bit words. In simple designs, static RAM is preferable to dynamic RAM, since it requires

three chips would occupy memory locations that overlapped in the address space with that occupied by the other two. The result would be a chaotic system full of erroneous data.

We need to separate the three memory chips so that each occupies its own unique portion of the address space and, to do this, we need an address decoding circuit. For a simple system like this, we can use an address decoding circuit which divides the memory address space into eight 8K blocks. Then we can put our ROM into the top 8K block, the RAM into the bottom and the I/O into the third block up from the bottom.

We can do this address decoding by using the top three address lines from the processor, A13-A15, and feeding them into a decoder chip, such as a 74138. The eight outputs from this decoder chip can then be used to generate the appropriate chip select for our three memory and I/O chips. This decoding circuit is shown in Figure 2.

We can see how this circuit allocates blocks of the memory address space, in

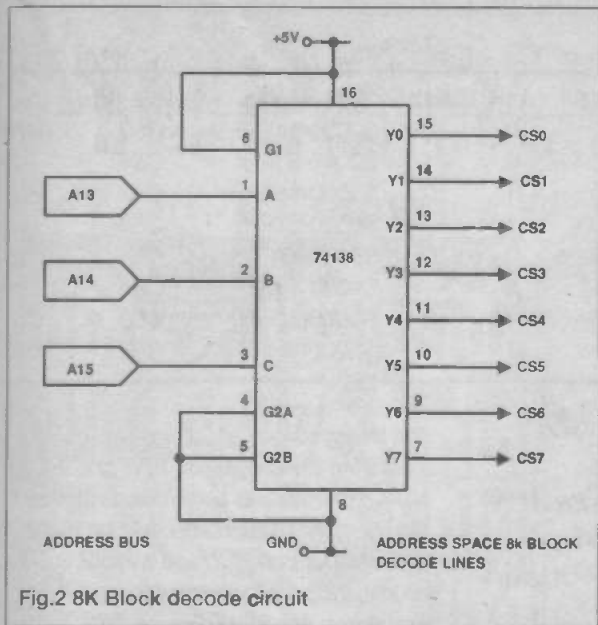


Fig.2 8K Block decode circuit

arrangement is to allocate the top 8 or 16Kb of address space to ROM memory.

As far as RAM memory is concerned, the system may not need any. However, if RAM memory is needed then, it is best located at the bottom of the memory address space. This is because many processors make use of a series of read/write memory locations called a stack and most of them locate this stack in the bottom part of memory. The stack is a special area of memory used to put temporary variables and has its own special processor register, the stack pointer. The stack makes programming a lot easier and allows us to use subroutines.

All we are now left with is the location of the I/O registers. These can be placed anywhere in the unused address space beneath the area allocated to ROM memory and above the area allocated to RAM memory. When choosing the location of I/O registers, it is wise to use memory locations which start at one that is easily decoded, such as location 4000hex. Many I/O devices will use several registers, but it is only the first register which needs to be decoded.

So, if we are designing a simple microprocessor system, we can now lay out a memory map. The proposed system is based on the 6502 and it has 8Kb of ROM memory, 2Kb of RAM memory and a single 6522 VIA chip for I/O. This uses sixteen memory locations starting at location 4000hex, and the memory map for this system is shown in Figure 1. More complex designs will, of course, have more complex memory maps.

no refresh circuitry.

On all three chips, the data lines are connected directly to the data bus and the address lines to the corresponding lines on the address bus. In the case of the ROM chip, A0-A12, for the RAM chip, A0-A9 and for the VIA, A0-A3. If they were left like this, then each of the

the memory map used in Figure 1, to the different components in table A.

The unused chip selects could be used to add extra ROM, RAM or I/O to the system. By and large, decoding the memory space into 8Kb blocks should be adequate for most applications, but where a lot of I/O is used, it may be

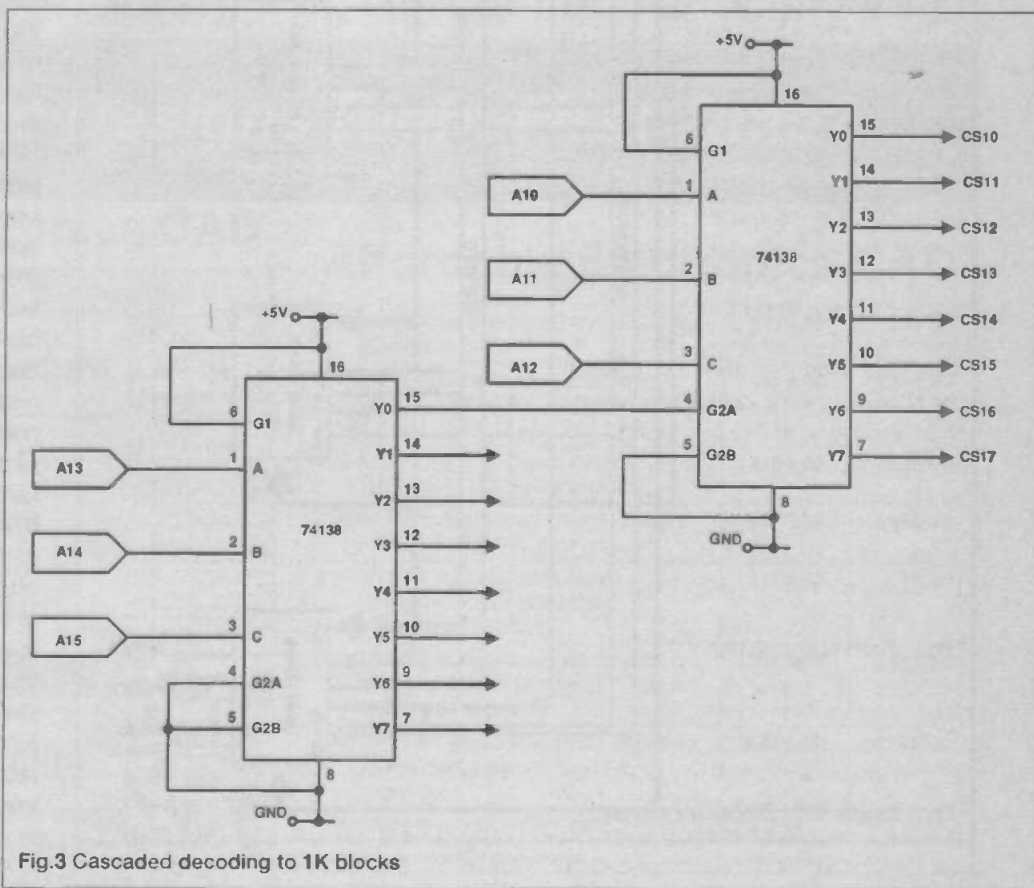


Fig.3 Cascaded decoding to 1K blocks

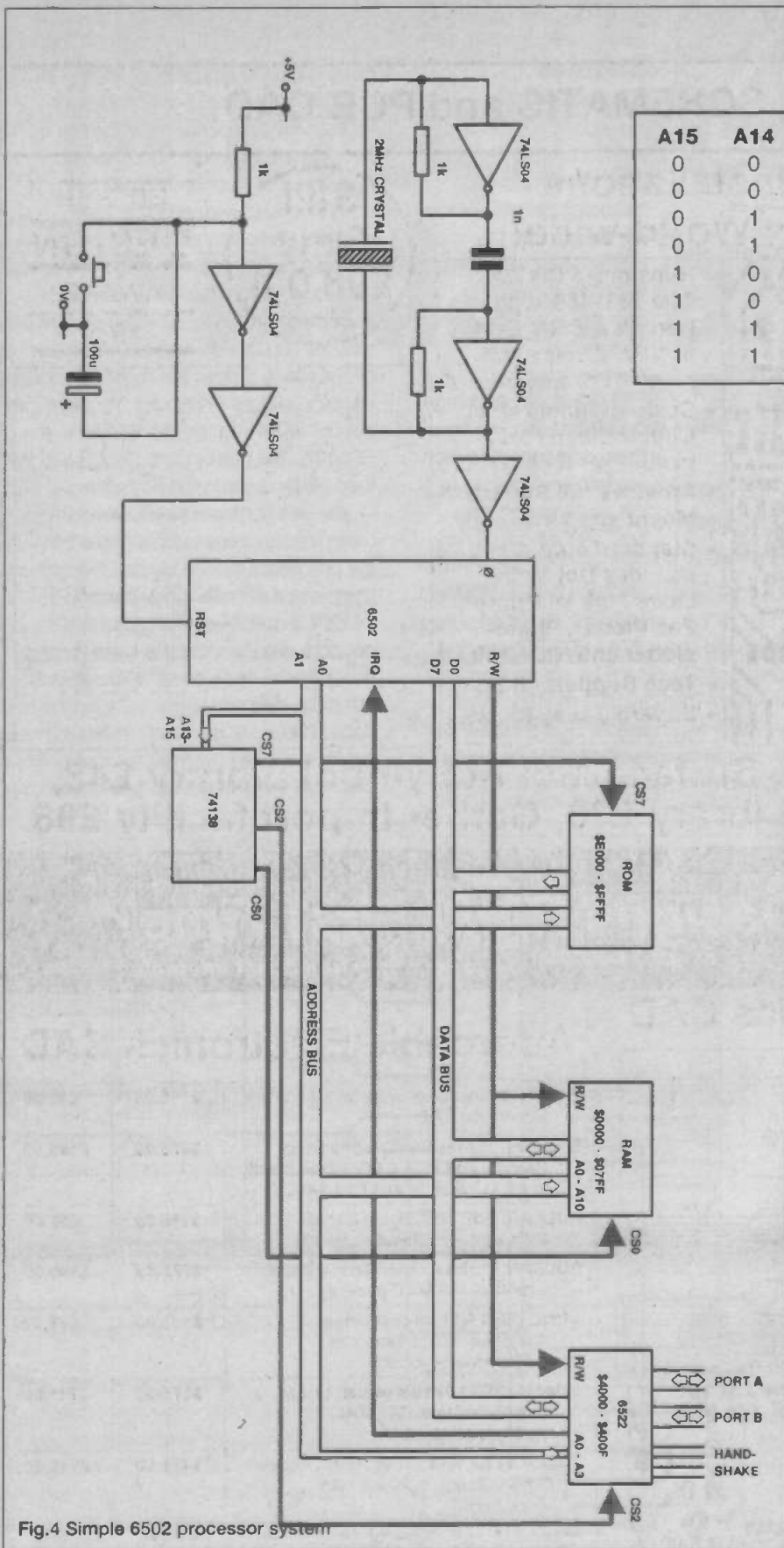


Fig.4 Simple 6502 processor system

Table A

A15	A14	A13	Addresses	Select line	Use
0	0	0	\$0000-\$1FFF	CS0	RAM
0	0	1	\$2000-\$3FFF	CS1	
0	1	0	\$4000-\$5FFF	CS2	I/O
0	1	1	\$6000-\$7FFF	CS3	
1	0	0	\$8000-\$9FFF	CS4	
1	0	1	\$A000-\$BFFF	CS5	
1	1	0	\$C000-\$DFFF	CS6	
1	1	1	\$E000-\$FFFF	CS7	ROM

first things to look at are the two control lines from the processor, R/W and IRQ(or NMI). The R/W line determines whether the memory location specified on the address bus is being read by the processor, or written to by the processor. For ROM memory, this line is not needed since one can only read it, but for both RAM and I/O it is essential and should be connected to the appropriate line.

The IRQ and NMI lines are used by I/O circuitry to generate processor interrupts. The difference between the two is that software can be used to disable the IRQ interrupt, but an NMI interrupt will take priority over all other operations, including an IRQ interrupt. When either of these interrupt signals is generated, the processor will halt its current operation, and jump to a piece of code, which has a beginning address specified in the appropriate vector at the top of the memory address space. One of these two interrupt control lines should be connected to the appropriate interrupt output from the I/O chip.

We now have all the components connected together for a simple micro-processor system, shown in Figure 4. Larger systems will, of course, be a lot more complex. Thus, for example, if a lot of ICs are connected to the data and address buses, it may well be necessary to incorporate bus drivers in the design to increase the drive capability of the bus lines. Other types of I/O will bring with them their own complexity. However, the fundamental design of any micro-processor system is the same and will vary but little from that in Figure 4.

Alex Stewart

necessary to further decode a single block. This is simply done with the aid of another 74138, as shown in Figure 3, which breaks one of the 8K address space blocks into eight 1Kb blocks.

Putting it all together

Using the memory map in Figure 1, we have now developed a very simple

processor design using the 6502. The system has 8K of ROM, 2K of RAM, two 8 bit bi-directional I/O ports, a 16 bit timer and a serial I/O line. A system which is adequate for a wide range of control functions, and as the basis for many projects.

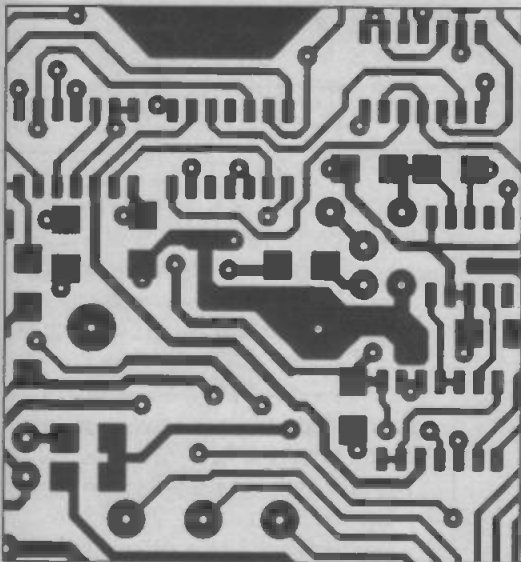
However, we first of all need to bring all the bits of the design together. The

Next month

We will be looking at the basic control software for this simple system and taking a further look at I/O circuitry. Elsewhere in ETI, we will be including a project to build an ultra small Z-80 processor, ideal for incorporating into a wide range of projects.

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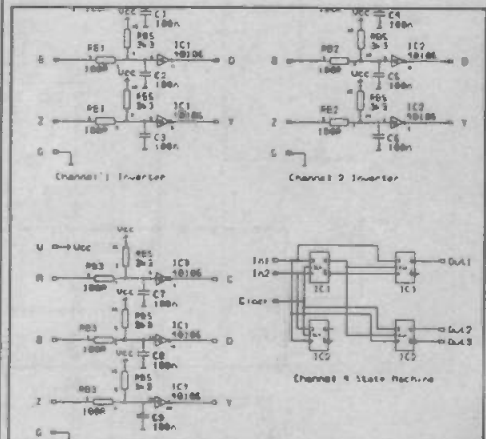
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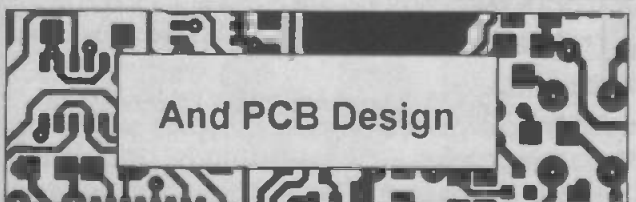
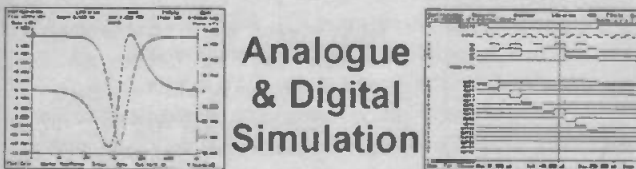
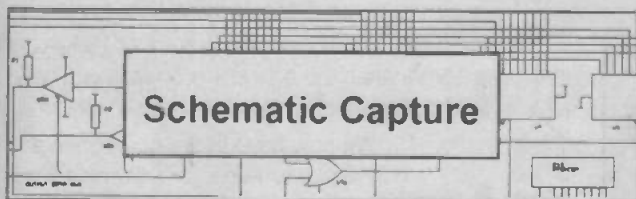


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PROJECT

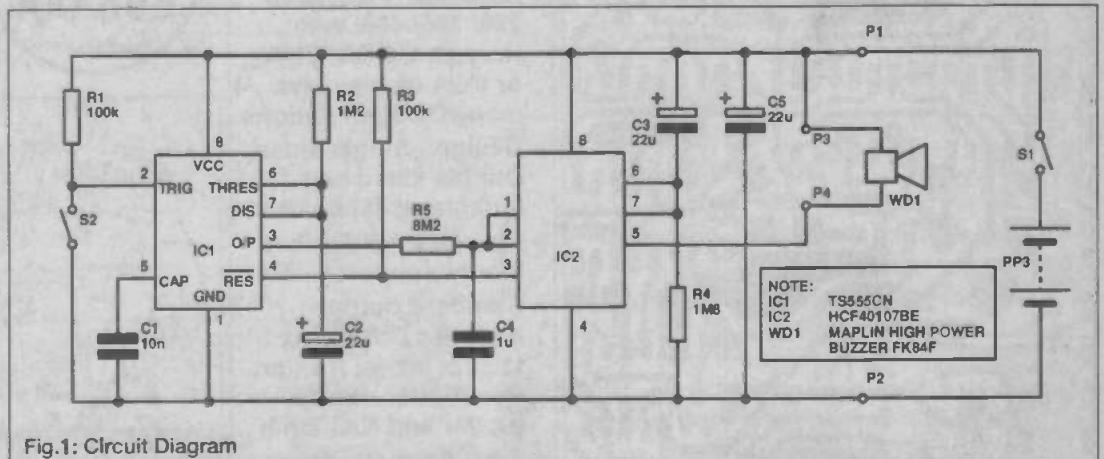


Fig.1: Circuit Diagram

Bicycles are an easy target for any thief, and cyclists find themselves increasingly encumbered with chains and padlocks to try and counter this constant threat. But even chaining your bicycle to a lamppost or some railings may not be enough to deter the skilful thief armed with a few tools. He may not steal the whole bike, but he might steal parts of it!

attempting to break the lock or carry the bike to a van will, after a short delay, cause the sounder to operate for approximately 25 seconds. The alarm will then re-arm, ready to be triggered again. Continuous vibration will operate the alarm continuously.

Immediately after the alarm has been switched on there is a 'turn-on' delay of about 21 seconds, before it will respond to vibration to allow the owner time to remove the key and close the pocket.

A turn-off delay has also been provided. The sounder will not operate for approximately 7 seconds after a detected vibration to allow the owner time to disarm the alarm.

The alarm has a low quiescent current of 135µA and only uses 15mA when the sounder is operating. The alkaline PP3 battery should therefore have a very long life.

How it works

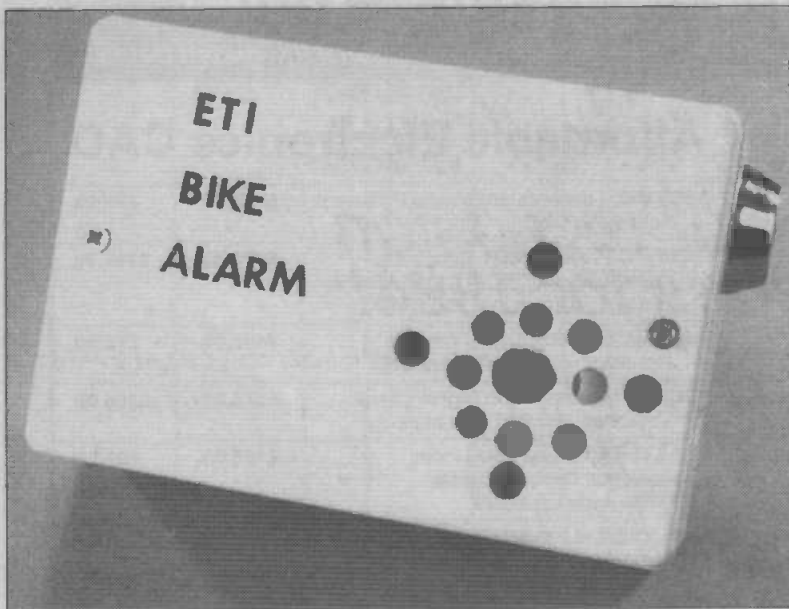
The heart of the circuit is IC1, a TS555CN CMOS low power timer IC configured as a monostable.

When in the armed state, IC1's trigger input is normally held high by resistor R1. When the alarm is knocked, the vibration detector (S2) will close, pulling IC1's trigger input low. The output of IC1 (pin 3) now goes high for a period of $1.1R2C2$ (32 seconds in this case).

The output of IC1 is followed by the R5C4 delay circuit. This provides approximately a 7 second delay, before the sounder operates. IC2 is an HCF40107BE CMOS dual NAND gate with 'open drain' outputs. It is used as a high input impedance buffer following the turn-on and turn-off CR delays.

Reset (Turn-on) CR Delay and Buffer

One half of IC2 is used as an inverting buffer between the C3R4 turn-on delay and IC1's Reset pin. The CMOS buffer will change state at approximately $1/2V_{cc}$, as opposed to the TS555CN's Reset pin which views 0.7V and above as High. The use of the buffer therefore requires a smaller C3R4 product and allows the use of a smaller and cheaper capacitor. R3 is a pull up resistor for the buffer's open drain output stage. This



One obvious solution to the problem is to fit your bicycle with an electronic alarm unit which will be triggered whenever the bicycle is moved. With an alarm fitted, anyone trying to tamper with the bike will almost certainly trigger an audible alarm. Enough to frighten them, and send them looking for an easier target.

The cycle alarm described in this project is small, light and compact. It is operated by a key and is small enough to hide in a pannier or saddle-bag pocket.

The alarm system

The alarm in this design is armed and disarmed by a key operated on-off switch. Any vibration due to a would be thief

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inverting buffer and C3R4 delay holds IC1's Reset pin (and hence its output pin) low for approximately 21 seconds after the alarm is switched on.

Sounder (Turn-off) CR delay and buffer

The other half of IC2 is used as a non inverting buffer. Its MOSFET output transistor can sink 32mA at 5V and 74mA at 10V, so can therefore be used as a follower to drive the sounder.

WD1 is a high output Piezo sounder with built-in drive circuitry. At 9V it uses approximately 15mA. C5 is a power supply decoupling capacitor.

Calculating the buffered CR Delays

Assuming the buffer changes state at approximately $1/2V_{cc}$ then

$$\text{Delay} = 0.7 CR \text{ (approximately)}$$

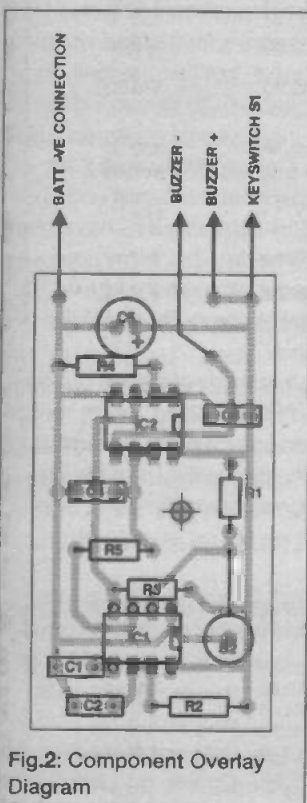


Fig.2: Component Overlay Diagram

Reset (Turn-on) Delay

The length of this delay was not critical, so a +/- 20% tolerance tantalum capacitor was used. Its leakage current will affect the calculated delay length. A 22µF capacitor and 1.8M resistor gave a delay of approximately 21 seconds.

Sounder (Turn-off) Delay

Since this delay is short it needs to be calculated more accurately, so a polyester capacitor was used because of its +/-5% tolerance and low leakage. A combination of 1µF capacitor and 8M2 resistor gave a 7 second delay. The PCB can accept a tantalum capacitor if a much longer delay is required.

As there may be some variation in the threshold voltage between different 40107BE

ICs, several values of R5 may need to be tried. However, I got the same delays from two different 40107BE ICs.

Construction

Fit the components as shown in the component overlay diagram, Figure 2. Both ICs are fitted in sockets. IC2 is static sensitive so the usual handling precautions apply.

Vibration detector S2 is supplied with a single thick pin which is fitted to the PCB pad as shown. Its other connection is made by soldering a link between the PCB pad and S2's case. The case layout is shown in the accompanying photograph. The PCB is mounted on a 1/4in M3 spacer. The sounder is also attached using M3 mounting bolts. A grill is made as shown in the photograph and the key switch is mounted in a 19.9mm diameter hole drilled in the case. The PP3 battery holder is attached using Quickstick pads.

Testing

First fit the battery and test that the unit's quiescent current is

approximately 135µA. An initial slow surge to several mA (due to 40107BE Reset buffer's slowly changing inputs) will occur before slowly falling to a steady 135µA. If all is well the operation of the alarm can now be tested.

Turn the key to switch the alarm circuit on and shake the alarm until the sounder is operated. The time between switch-on and sounding is the Reset (turn-on) delay (21 seconds) followed by the sounder (turn-off) delay (7 seconds). The sounder should now operate for ((1.1R2C2 seconds - (turn-off delay)) = 25 seconds).

The sounder (turn-off) delay can be calculated by switching the alarm on, waiting for the Reset (turn-on) delay to elapse, then triggering the alarm by knocking it and measuring the delay before the sounder operates.

The alarm should use approximately 15mA when the sounder is operated.



PARTS LIST

SEMICONDUCTORS

IC1 TS555CN
IC2 HCF40107BE

RESISTORS

R1 100K
R2 1M2
R3 100K
R4 1M8
R5 8M2 (may need to be increased/decreased)
All 1% metal film.

CAPACITORS

C1 10nF Ceramic (5mm lead pitch)
C2 22µF Tantalum
C3 22µF Tantalum
C4 1µF Polyester layer
C5 22µF 25V Electrolytic

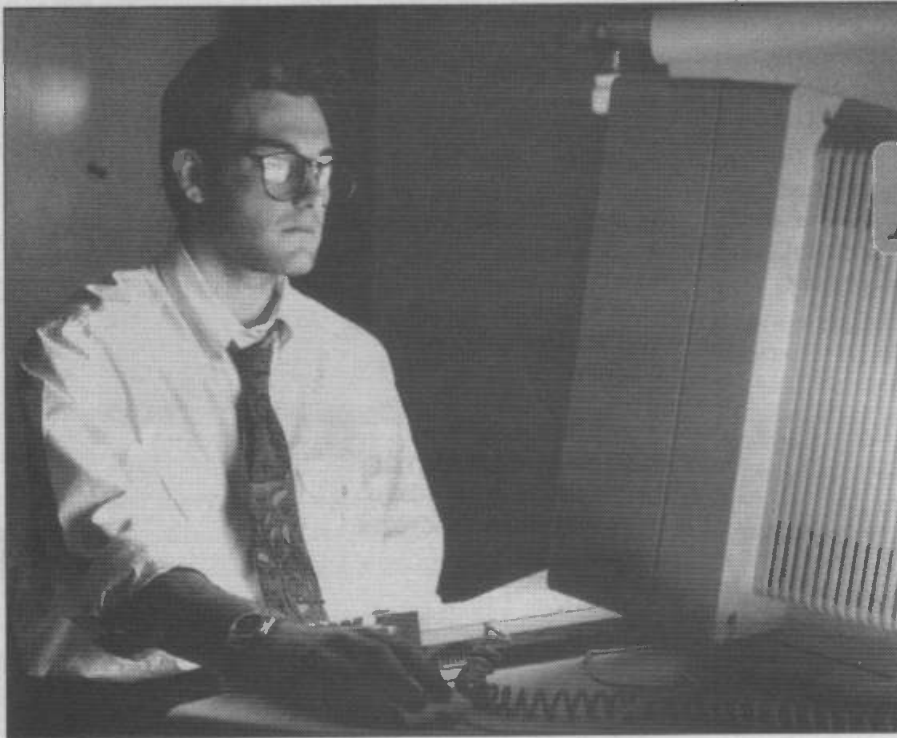
MISCELLANEOUS

WD1 Maplin High Power Buzzer (FK84F)
S1 Keyswitch
S2 Maplin Vibration Detector (UK57M)
Maplin Box PB1 (114 x 72 x 38 mm)
Maplin Recess Plate (HH23A)
Alkaline PP3 battery
PP3 Clip
Maplin PP3 battery holder (CK65V)
Two 8 pin DIL IC sockets
PCB pins
Quickstick pads
Connecting wire
Three 16mm M3 bolts
Three M3 nuts
One 1/4in M3 spacer

BUYLINES

All the components for this project are available from Maplin Electronics Ltd.

PCB Design Programs



Alan Chadwick looks at some PCB design programs for the hobbyist

As a keen electronics enthusiast I enjoy designing and bread-boarding new circuits, but find the task of producing suitable PCB layouts rather tedious. For many years I have made do with nothing more sophisticated than 0.1in graph paper and a pencil and rubber. PCB design programs have been around for some time but in my case have remained a pipe-dream, due to the lack of a suitable computer and the necessary cash.

However, I recently splashed out on a second-hand PC-XT clone, which meant that a PCB design program became a real possibility, particularly as software prices have been gradually falling over the years. Since my experience of

Easy PC

Easy-PC was one of the first so-called affordable PCB design programs to be marketed and this is very evident when it is compared with more modern programs of similar cost. Although it is capable of performing all the basic functions

outlined in the introductory section, it has a number of awkward characteristics and lacks the polish of other programs.

The screen has three small squares across the top which provide access to the pull-down menus and a short status line at the bottom. A number of the menu options lead to very confusing text screens for setting such things as track and pad sizes.

Only three colours are available for assigning to a possible ten layers even in EGA mode. The colour selected for the silk-screen layers is also used for objects which occur on all layers, which can be confusing.

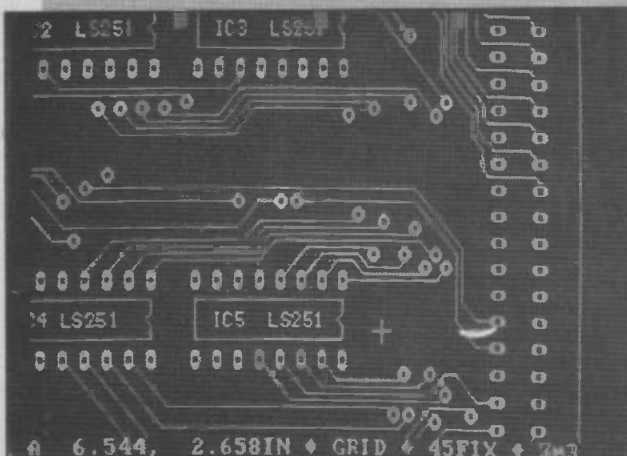
Symbols are

selected from the library by means of a code. You can display the contents of the library but this is simply a list of codes with no descriptions attached and so until the symbol is on the PCB you don't know whether it is what you want.

There is very little status information displayed on the screen despite the space available in EGA mode. Pad and track sizes are selected by a code number which corresponds to a size set on a separate text screen. An indication in the status line of the actual pad and track sizes would be useful.

There is only a subtle change in the appearance of objects when they have been selected. This makes editing rather tricky, particularly in the case of tracks as it is difficult to see which segment is going to be affected when a node is deleted.

On the positive side the redraw speed is very good and a large area

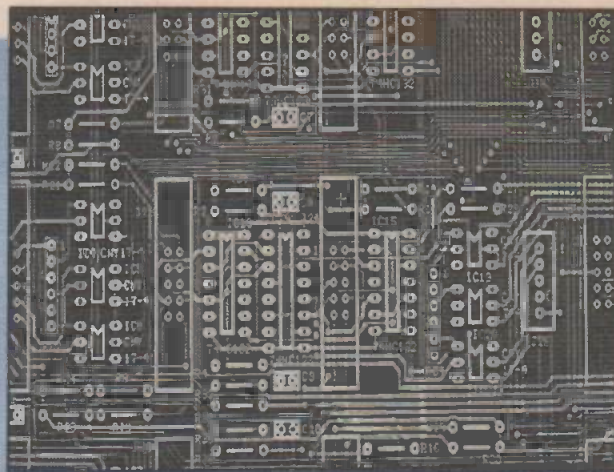


Boardmaker 1

Boardmaker 1 follows very similar lines to Easy-PC but with most of the deficiencies mentioned previously removed. It makes good use of the larger EGA colour palette with a choice of six colours for various layers and types of object. A seven-label menu bar runs across the top of the screen with plenty of status information in a single line at the bottom. The text screens are retained, but options are changed via a series of drop-down menus accessible with the mouse.

A list of symbols in the library can easily be called up and selections made directly from it. A graphic preview of the chosen symbol is given before the component is placed on the board, which I found very useful. Editing tracks is far easier with a clearer indication of the segment of track being changed and the proposed modified route. There are also many useful extra facilities. One of these is the ability to automatically increment the number part of a component reference. Another highlights the full length of a selected track, which makes checking connections very simple. Ground planes can be quickly produced with a block fill function.

At £95 Boardmaker 1 is very good value.



Supplier: Tsien (UK) Ltd,
Cambridge Research Laboratories,
181A Huntingdon Road,
Cambridge, CB3 0DJ.
Tel: 0223 277777

Hardware requirements: IBM PC or compatible, 640k RAM, two floppy disk drives or one hard and one floppy, DOS 3.0 or later, Hercules, CGA, EGA, VGA graphics.

Price (excluding VAT and p&p): £95

Upgrade? Yes

computer technology stemmed from the days of the ZX81 it took me a little while to come to terms with DOS, disk drives and databases, but as soon as I felt that I was 'up to speed' I decided to have a look at what was on the market.

Spoilt for Choice

It immediately became obvious there was a wide range of software available but limiting my budget to around £100 soon

of the screen is available for PCB display.

A timer is incorporated that periodically beeps and asks you if you want to back up your work so far. This is useful if you are in the habit of falling asleep at the keyboard!

Although the price of Easy PC has fallen from £275 when originally released to £98, it is still outperformed by some cheaper alternatives.

Supplier: Number One Systems Ltd, Harding Way, St Ives, Huntingdon, Cambridgeshire, PE17 4WR.

Tel: 0480 61778

Hardware requirements: IBM PC or compatible, 512k RAM, Hercules, CGA, EGA, VGA graphics. Mouse recommended.

Price (excluding VAT and p&p):

£98

Upgrade? Yes

narrowed the field down to the so-called entry-level programs.

The main feature I was looking for in a program was the ability to easily edit the PCB layout to achieve a high density and the minimum of links, something that is very time consuming with paper and pencil. Of secondary importance was a schematic drawing facility, although many PCB design programs include this at no extra cost. Similarly, I was not particularly interested in anything more than single-sided boards, although most programs seemed to handle up to eight.

Autorouting of PCB tracks looked like a nice idea at first but it soon became apparent that autorouters were not usually available at the budget end of the market and in any case were often intended for double-sided boards.

I discovered that my choice of program might also be restricted by hardware requirements. Although many low-cost programs will run on a basic PC with possibly only a CGA or monochrome display, the trend in minimum requirements is towards EGA graphics, a mouse and a hard disk. In the end I decided to upgrade my PC from CGA to EGA graphics and install a hard disk drive and I was very satisfied with the benefits.

Evaluation

Taking account of all the above considerations, the choice was now between the handful of programs. Most of these have been reviewed individually elsewhere, but without a basic knowledge of PCB

design programs the articles were not easy to follow and the fact that the reviews were written by different people made comparisons difficult. I decided that the only answer was to obtain the demonstration disks which are available for most of the programs and make my own comparison. I hope this article will save readers the trouble of doing the same.

Not surprisingly, I found a similar range of functions included in all the programs and the description of these should serve as a good introduction for those readers unfamiliar with PCB design programs. In the section on each program I have only commented on the method of implementation of the standard functions and highlighted any differences in the facilities available.

Many of the programs I looked at are entry-level versions of more comprehensive packages, which would be worth investigating if your budget can stand it. Alternatively if you think you will have spare cash in the future, check whether the basic program can be easily upgraded.

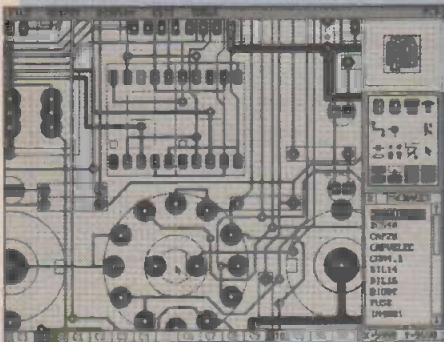
The system requirements for each program are shown in Table 1. All testing was done on an Amstrad 1640 with EGA graphics, Amstrad mouse, 20 Mb hard disk, and an Epson FX-85 9-pin dot-matrix printer.

The Results

With all the programs, I found I spent a lot of time zooming and panning in order to view the right area of the board in

PCB II

PCB II again provides a set of functions very similar to the previous two programs but with a far more modern graphical user interface which in many respects is very similar to a GEM environment. There is still a pull-down menu bar across the top of the screen but most of the common functions are selected by pointing and clicking on icons in a tool-box area to the right of the screen. The contents of the tool-box changes depending on the mode of the program.



At the bottom right of the screen is a small GEM-type selector window which is used for selecting different types of track, pads and components. At the top right is an overview window which permanently displays a miniature view of the layout. By pointing and clicking in this overview area any part of the layout can be displayed on the main screen. Along the bottom of the screen is the layer selector, used to select which board layers are displayed. Only two copper layers are allowed with PCB II.

Placing components on the layout is a two stage process. First of all the components that will be required for the particular circuit are selected from the main library and placed in the selector window at the bottom right of the screen. Each type of component is then selected from this window and placed in position on the board. I found this a very efficient method of working, as on a small layout you may only need half a dozen component types out of a library of several hundred.

Pads and tracks are placed in a similar way, although, as there is a far more limited range of styles, these are immediately available in the selector box without being called up from a library. Text is available in various heights and widths but the thickness is fixed.

The program is very much oriented towards use of a mouse. Once you get the hang of it this is a very speedy method of working but it can be frustrating at first. For instance, once the type of component has been selected each press of the left-hand mouse button lays down another component. This is unnerving when you have been used to selecting the component with the first press, moving it into position and then fixing it with a second press as in the Easy-PC and Boardmaker programs.

Most objects are easily selected by pointing anywhere within their outline and pressing the right mouse button. However a second press of the button immediately deletes the object with no request for confirma-

tion. Sensibly, there is an undelete function.

The track editing function is very powerful allowing sections of track to be modified or deleted at will. The sections do not even have to begin or end on existing nodes. Selecting tracks is no problem if they have been routed with the grid snap option on. If not, any vertical or horizontal track can only be selected by pointing precisely at its centre-line which can be very difficult to find.

Dialogue boxes, another GEM concept, are used for editing such things as text and pad sizes. These consist of an outline containing options that can be selected with the mouse and text fields for keyboard input.

As with Boardmaker 1 there is an auto-increment function for component references, a net highlighter and a block-fill facility. Although PCB II is limited to PCB design, a schematic drawing program called Isis Supersketch, employing a very similar user interface, is now bundled with PCB II, the complete package being known as Cadpak.

At £79 I thought this was an excellent buy.

Supplier: Labcenter Electronics, 14 Marniner's Drive, Bradford, BD9 4JT. Tel: 0274 542868

Hardware requirements: IBM PC or compatible, 640k RAM, DOS 3.3 or later, Hercules, CGA, EGA, VGA graphics, hard disk, mouse.

Price (excluding VAT and p&p): £79
Upgrade? Yes

Quickroute 1.5

Quickroute is a shareware PCB design program of very moderate cost. The initial screen layout looks promising with a menu bar across the top of the screen, a row of icons called a button bar immediately below and status information and co-ordinates along the bottom. In fact the selection of the various functions using the menus and icons is fairly logical, if cumbersome at times, and helpful prompts appear at each stage. There is also an on-line help facility which, although common elsewhere, seems to be rare in PCB design programs. Most of the usual facilities are available, but for me there are a number of minor irritations and major flaws in the program.

The redraw time is very slow especially if the grid is enabled. A sample layout supplied with the program took 10 seconds to redraw although admittedly this was a fairly

large double-sided design. There is a 'turbo' option, which speeds things up a bit by only drawing the outline of objects but the clarity of the display suffers. A quick zoom option has also been introduced in recent versions, presumably in an attempt to solve this problem.

Panning is achieved by pressing the right mouse button and a handy custom zoom level can be set so that the design just fills the display area. However there is no auto-pan which would be very useful if you wanted to route a track beyond the display area boundary.

Placing of components is frustrating as the first click of the mouse fixes them in position with no opportunity for adjustment. Editing of individual objects is limited to pads and tracks. With the pick mode selected, pointing and clicking causes the nearest pad or track to be marked with a cross. Options then allow it to be deleted, moved or copied. Each segment of a track is treated as a separate object. Similarly, components from the library are

Ranger 1

Ranger 1 is a complete CAD package, although at £100 without the autorouter it is still competitive with many PCB design programs. When using the graphic editor to design a schematic or PCB layout there is a row of menu boxes along the bottom and left-hand side of the screen. To select a menu box the cursor is positioned in the box and the mouse button pressed. This selects the function or changes the contents of the menu boxes to another set of options. There are no short-cut keys. The remainder of the functions are selected through a messy and inconsistent assortment of text screens using function keys, cursor keys and the mouse. However, prompts are provided.

The cursor moves in a series of small jerks which do not correspond with the grid points, even when the grid snap facility is on. This makes it difficult to consistently select or place objects except by using a high zoom level.

To use the package for simple PCB design, components must be selected by code and a netlist produced manually by entering a list of connections. This is a very tedious business and it is far better to use the package as intended and produce a schematic diagram from which the program will automatically generate a component list and a net list.

Whichever route is chosen the next step is to use the graphic editor to place the components on the PCB.

Connections can be shown as a 'rats nest' whilst positioning the components, which is very helpful when trying to minimise track complexity.

If you can afford the extra £50 the tracks can now be autorouted. Otherwise, manual routing involves selecting a connection from the rat's nest and converting it into a properly routed track by adding and moving bends to 'rubber-band' the track into the desired position. The manual routing facilities are really intended for tidying up a previously autorouted board and are nowhere near as easy to use as those in a purely manual PCB design program.

As a CAD package, Ranger 1 seems to be very comprehensive. For hobby use, the complexity and poor user interface make it a poor choice.

A version of Ranger 2, Ranger 1's big brother, has recently been released as shareware. This has all the features of the full package but is restricted to 32 parts or 128 component pins.

Supplier: Seetrex CAE, Hinton Daubnay House, Broadway Lane, Lovedean, Hants, PO8 0SG.

Tel: 0705 591037

Hardware requirements: IBM PC or compatible, 640k RAM, DOS 2.0 or later, EGA, VGA graphics, 20M hard disk. Mouse recommended.

Price (excluding VAT and p&p): £100

Upgrade? Yes

► sufficient detail, something that you do automatically when using pencil and paper. It is therefore important that these functions are easy to use and the redraw time is not too long.

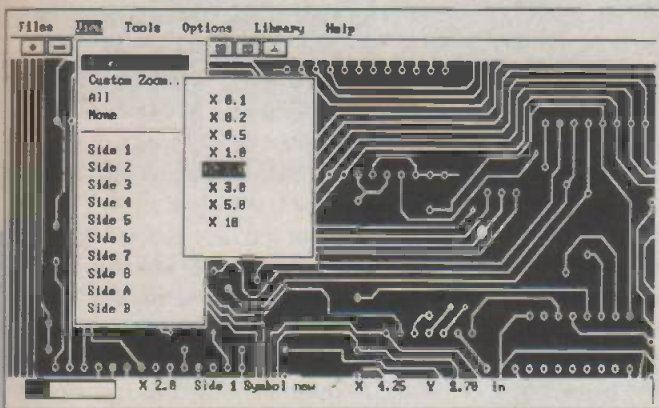
Of course, none of the programs solve the problem of producing the

board itself, even though they ease the design of the layout. Reasonable quality artwork can be obtained using a dot-matrix printer, particularly if printed at twice full size with a new ribbon, but this then needs to be reduced to a full size transparency. Various methods were

discussed in ETI (Read/Write September 1991 to January 1992) including photocopying on to film or spraying a

paper copy of the layout with transparentiser. More recently (Read/Write May 1993) a reader suggested using carbon paper and draughting film in a dot-matrix printer.

If you can afford it, there are plenty of companies willing to produce either film positives or even complete boards directly from information supplied on disk in an acceptable format.



treated as individual parts once they have been laid down and so can only be moved as a whole by using the block functions.

The block functions are selected from the button bar. Once the block has been defined by pointing at diagonally opposite corners the rectangular outline is immediately attached to the cursor. However, instead of the outline remaining in position and the cursor jumping to its centre, it is the outline that is redrawn round the cursor so that the relationship of objects to the block outline is lost. As the block contents are not continuously redrawn while the outline is moved, it is very difficult to place the block in its

new position. Furthermore, any tracks crossing the block boundaries are not 'rubber-banded' to the new position.

On the positive side, there is a simple autorouter included but its performance is disappointing, leaving you to finish off connecting most of the tracks. Output options are limited to 9 and 24-pin dot matrix, laserjet printers and HPGL plotters but this is adequate for hobby use.

Quickroute does provide a working program at a very competitive price but personally I would rather pay twice as much and avoid the frustration of coping with Quickroute's limitations.

Supplier: Powerware, 14 Ley Lane, Marple Bridge, Stockport, SK6 5DD. Tel: 061 4497101

Hardware requirements: IBM PC or compatible, 512k RAM, Hercules, CGA(mono only), EGA, VGA graphics, mouse.

Price (inclusive): £39

Upgrade? No

Layo1

Layo1 is a recent addition to the market originally written as an 'in-house' PCB design program for a Dutch electronics company. Later, a facility for schematic capture from Orcad or similar packages was incorporated. However, the versatility of the program means that suitable component and netlists can be created manually although they are by no means essential to allow the program to be used successfully.

The lowest priced version has all design facilities but is restricted to 4000 datalines. This should cope with typical hobby-sized circuits as long as you don't use too much text which seems to eat up datalines.

The package comes with a project manager to provide a user-programmable menu system, initially set up to allow selection of the graphics editor program for PCB design, a text editor, a font editor, or an output driver program. Design files are grouped under a project title and each user of the program can have his own set of preferences.

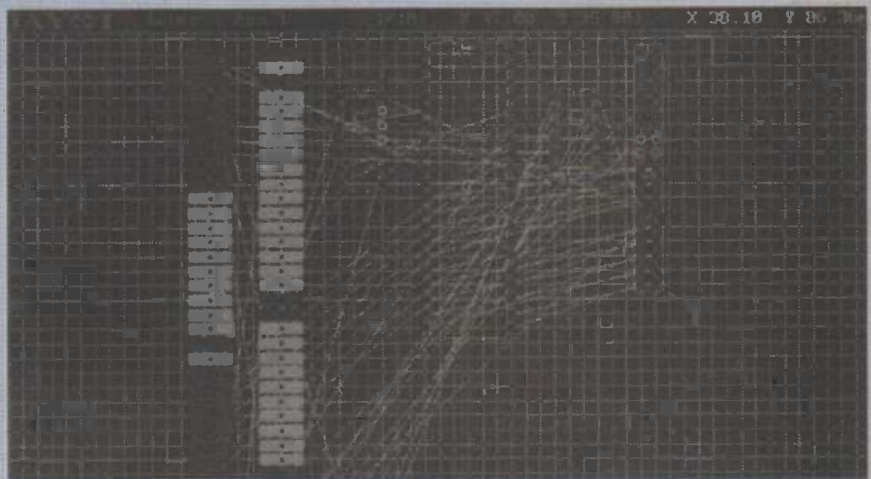
The display area is uncluttered, with a single status line across the top and an optional overview window in the top left-hand corner. However the menu structure leaves a lot to be desired. The main menu bar is called up by pressing return on the keyboard or the right-hand mouse button. This is confusing as the right-hand button is elsewhere equivalent to the Esc key which is used to exit from menus and functions. Functions are selected from the menu bar by pressing return or the left-hand mouse button. However, not all functions are available by this method and must be selected instead by various keyboard characters. There are also short-cut key combinations for the main menu functions. To further complicate things, functions can be activated by pressing combinations of the three mouse buttons, the effect of which vary depending on the current mode. The possible combinations and their effects can be discovered by pressing F1.

On the positive side, the program remembers the last path selected through the menu options. There is also a macro facility so that single keys can be programmed to activate frequently used keyboard sequences.

Selecting a zoom level is slow but a useful option magnifies the board to fill the screen.

Designing a PCB involves three basic stages. Layo1 is very versatile as it allows a number of alternative methods to be used for each stage. The first stage is to select the components, which can be done manually from the library in the usual way but is rather a tedious process as the component libraries are at the ends of the branches of a large directory tree which has to be stepped through each time a new component is required.

Importing a component list from a schematic program, or writing your own by means of Layo1's text editor, avoids this problem as the components will be automatically called up and positioned. A print out of all the library components is included in the manual.



The next stage is to define the routes. This is optional if you intend to lay down the tracks manually but to use the autorouting or rats nest facilities a netlist is required. This can be imported, written using the text editor or produced 'on the fly' by simply pointing at pads that are to be connected together. The resulting connections can be displayed as a 'rats nest' which then allows manual repositioning of components to minimise track complexity.

Moving components is not as elegant as with some programs. If the display is continually updated as the component is moved, the redraw time is fairly slow especially if tracks are connected. To get round this problem the user has the options of redrawing when a mouse button is pressed, or after a set delay once the

cursor has stopped moving.

A nice facility is the ability to rotate a component by pressing both mouse buttons at once.

At the final stage of routing the tracks, Layo1 is even more flexible. The most basic method is to route by hand, defining where each bend is to occur. Any of the other methods requires a netlist and uses the autorouting function in various ways. Before invoking the autorouter, certain parameters have to be set such as whether the board is double or single sided, whether vias are allowed and what type of routing strategy to use. Once this has been done, the auto router can be unleashed either on the whole board or on various restricted parts such as a selected net or a selected trace.

If the autorouter has not been 100% successful, the unrouted nets can be displayed. These can be

manually routed or the program can be asked to reroute certain tracks and nets which will often allow completion of the remainder.

Draft quality output, which is supposed to be satisfactory for prototypes, can be obtained from within the graphics editor. The full range of output is available by using the separate output driver program. **Supplier:** Pentagram Electronic Designs, 6 Pasture Close, Clayton, Bradford, West Yorkshire, BD14 6LY. Tel: 0274 882609

Hardware requirements: IBM PC or compatible, 640k RAM, DOS 3.0 or later, EGA, VGA graphics, hard disk, mouse preferably three button.

Price (excluding VAT and p&p): £99 for 4000 data lines

Upgrade? Yes, but same facilities

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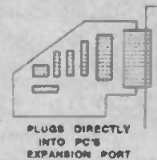
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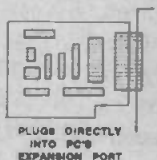
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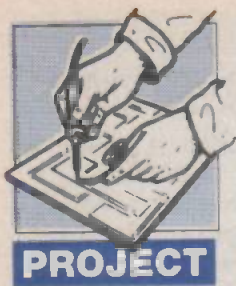
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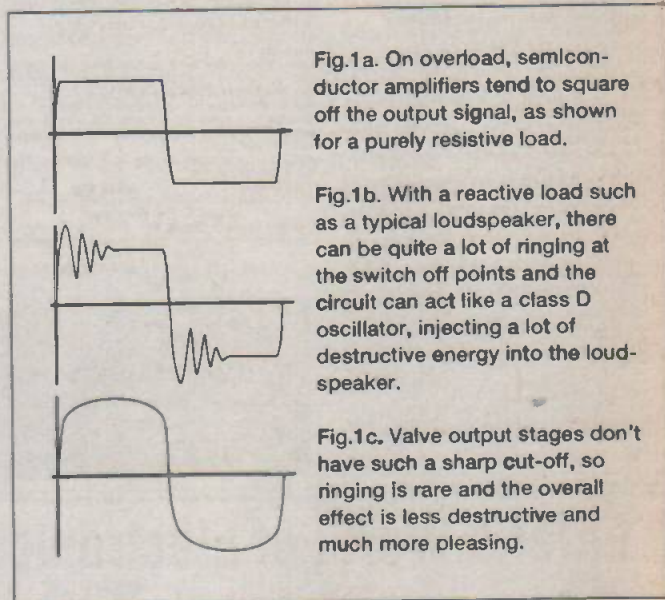
Welcome to the world of valves. In this short series, I am going to describe two guitar amplifiers - the first is a 15W design, intended as a practice amplifier, the second a 50W version, with some extra facilities, that is powerful enough to 'gig' with. Firstly, however, I want to describe some valve basics and I'm including some circuits which you can experiment with using a prototyping board.

Why Valves?

The first question which comes to most non-guitarists is, why valves? Semiconductors may reign supreme in most applications, but all guitarists, even three-chord wonders like the author, know that for guitar amplification they are still the business.

The reason for this is the overload characteristics, as shown in Figure 1.

When valve amps are driven hard,



they go into overdrive gracefully, producing a pleasing mellow tone, rather than the harsh solid-state noise that assaults the ear (or even worse, speaker-destroying high frequency ringing). The Paleface allows you to overload either the preamp or the power amp, which produce different characteristics.

With varying degrees of success, designers have sought to simulate the distortion of overloaded valves using solid state circuitry. But why simulate when you can have the real thing? There are also some who believe that valve hi-fi amplifiers are the bee's knees. I hope ETI readers will give me the chance to investigate this by building a practical design sometime in the not too distant future.

If Noise Annoys

You will not get the noiseless performance from a valve amp that you routinely expect from a semiconductor amplifier, at least not this side of several thousand pounds. Both mains hum and high frequency noise (HF noise, or hiss) are inferior with the

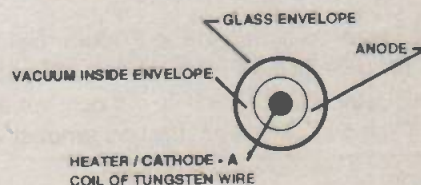
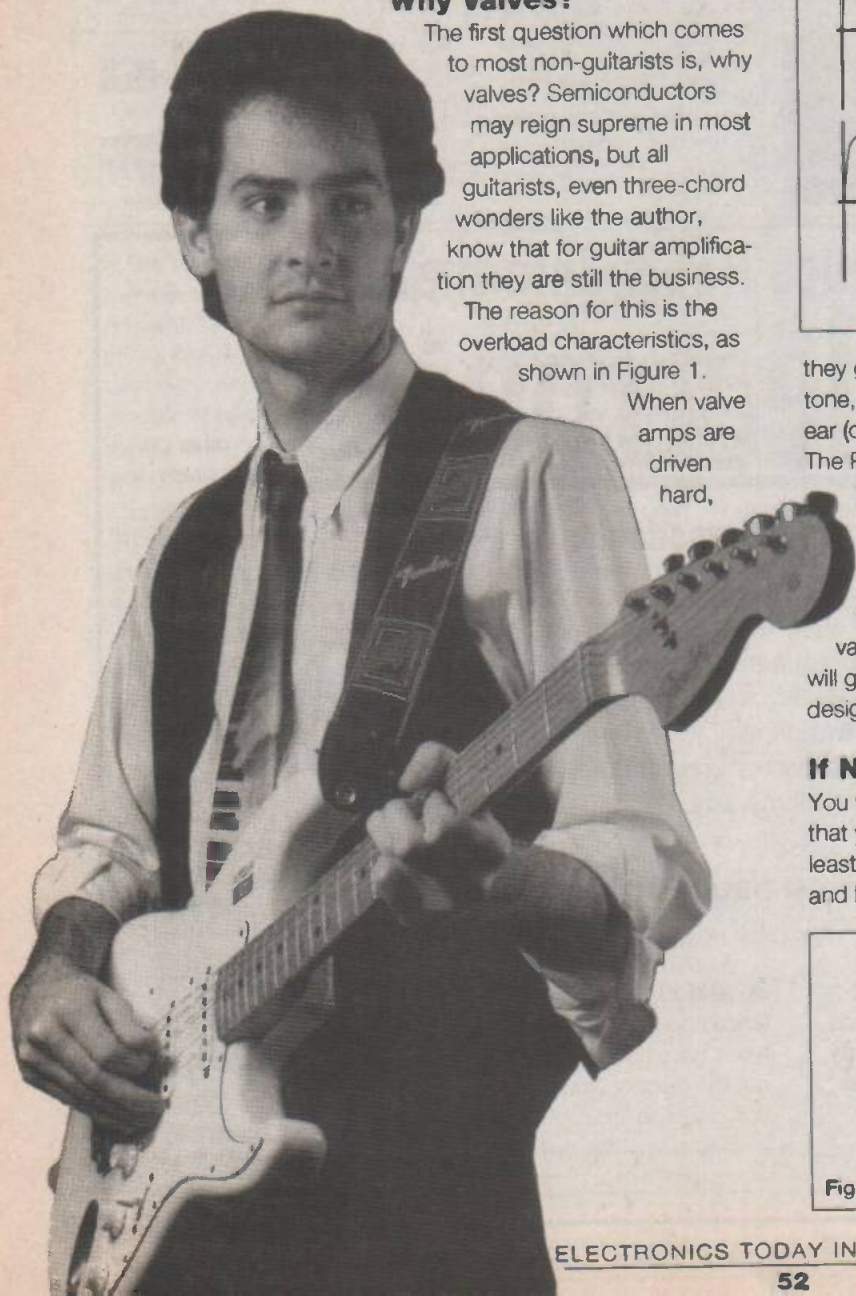
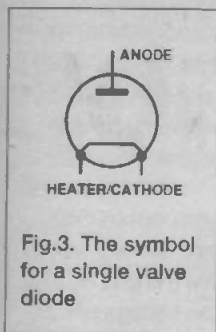


Fig.2. Cross-section of a diode.



valve amp.

Supply line ripple is the main culprit in the hum problem. This is due to the poor availability and high cost of high-voltage electrolytics. The lower charge stored in the capacitors means there is a disproportionately higher ripple voltage on the high voltage supply line.

For example, the largest easily available 400V capacitor is 4705 and this currently costs nearly £10, one-off. At

maximum voltage, this stores 188 millicoulombs of charge. By comparison, a commonplace 10,000 25V capacitor can store 250 millicoulombs for around £1.50 to £3.50, depending on ripple current capability.

The other contributor to hum performance is the high signal impedances in valve circuits. This is a problem at the input stage, where signal voltages are low. However, intermediate signals tend to be several volts, so the noise they pick up is much less significant. There are lots of sources of hum in the amplifier itself, for example in the power supply and the 6.3V AC for the heaters and the high voltage secondaries on the power transformer.

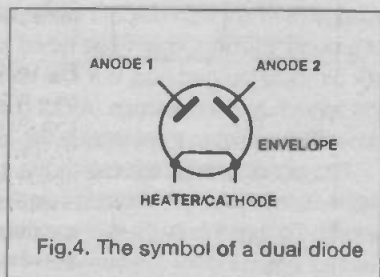


Fig.4. The symbol of a dual diode

A contributing factor is that overall feedback is rarely used in pre-amplifier stages, and in

power amplifiers the level of feedback is relatively low. However, care with layout and some judicious use of screening can diminish the hum.

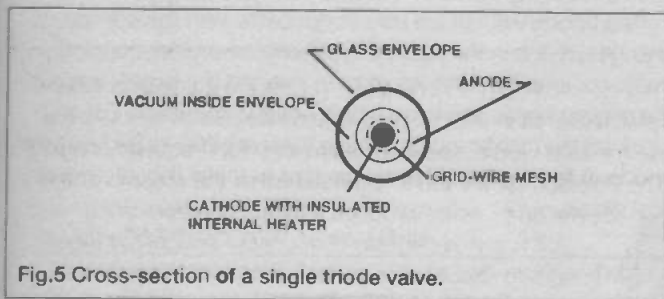


Fig.5 Cross-section of a single triode valve.

As far as high frequency noise (hiss) is concerned, valves are not as good as semiconductors, because they operate at high temperatures, so they heat up all the surrounding components and they use high voltages. Again, the generally higher signal voltages offset this to a large measure.

Valve Basics

I'd like to be able to recommend a good book on valves, but have been unable to find any that are in print - all mine are 30 year old! So here goes...

Valves have three types of electrode, sealed together in a high vacuum using a glass envelope. The cathode is a cylindrical pipe made of special metal at the centre. The anode is a cylinder of metal around the cathode. Between these are grids which are also cylinders, but this time of mesh. Valves typically have one or three grids. However, the very simplest valve has no grid at all, just a cathode and an anode.

Cathode Action

When it is red hot, the cathode emits electrons which form a

small cloud around it. This phenomenon is called thermionic emission. When first switched on, the cathode takes a little while to get hot enough for electrons to be emitted, hence the typical warm-up time of valves.

As readers will know, electrons can move around freely inside metals. How quickly the fastest move depends on

the temperature of the metal. When the metal is heated to a high enough temperature (say, 1000°C), some electrons will be moving fast enough to escape altogether from the surface of the metal. This is rather like water molecules evaporating from the surface of a pool of water. Some materials emit electrons very easily, particularly certain oxides, so it is normal to coat the cathode with one or more different such oxides.

To make the cathode hot enough, it needs a heater, i.e. a thin tungsten wire which is made very hot by a current passing through it. The simplest arrangement is to make the heater and cathode the same thing. This type of valve is said to be directly heated. However, this severely constrains the usefulness of the circuit, because we either have to connect all the cathodes together (imagine designing transistor circuitry if all the emitters had to be connected together), or each valve would need a

separate heater supply.

Most valves are indirectly heated. The heater is a winding of tungsten inside the cathode but insulated from it by a thin layer of aluminium oxide. The heater plays no other part in the circuit unless the insulation breaks

down. Nearly all heaters require 6.3V (usually AC supplied from a special transformer winding). The current they consume depends on valve type.

Diodes

The very simplest valves have no grids and are diodes (Figure 10). When the anode is positive with respect to the cathode, electrons are attracted to it and are absorbed into it, i.e. a current flows through the vacuum. If the anode is negative with respect to the cathode, no current can flow, as the anode is not hot and does not emit electrons. This is the rectifying action that characterises a diode, discovered in 1883 by Edison. Figure 2 shows the lay-out of a valve diode and Figure 3 shows the symbol of a valve diode.

As with semiconductor diodes, there are two main types - signal diodes, with low current capability but also low capacitance and rectifier diodes, with high current capability. Both types have been completely replaced by semiconductors in all but the most esoteric of applications. However, you may well come across valve rectifiers in older valve amplifiers.

Because of the high voltages at the cathode, valve rectifiers are normally directly heated. The voltage between the cathode would be so high that some diode action would occur between

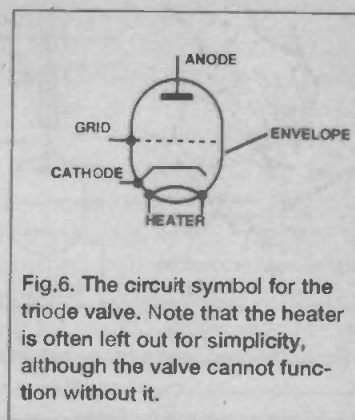


Fig.6. The circuit symbol for the triode valve. Note that the heater is often left out for simplicity, although the valve cannot function without it.

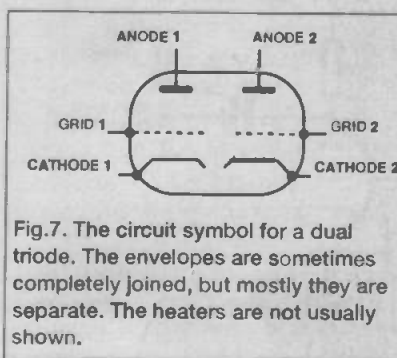


Fig.7. The circuit symbol for a dual triode. The envelopes are sometimes completely joined, but mostly they are separate. The heaters are not usually shown.

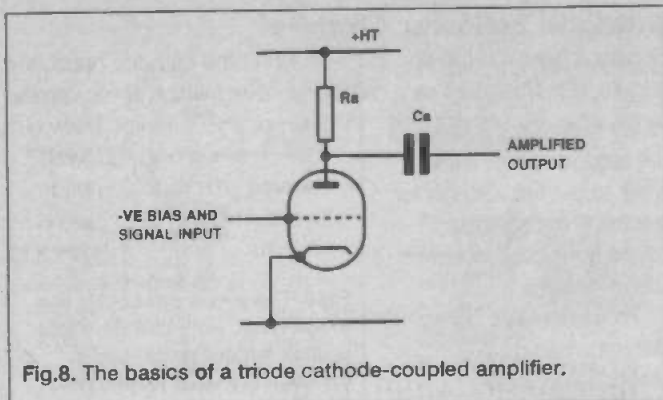


Fig.8. The basics of a triode cathode-coupled amplifier.

the heaters and the cathode. For this reason, they require a separate heater supply insulated from all the other valves.

Most valve rectifiers are dual diodes. Some of these are two anodes with a common heater/cathode, but others have two separate diodes within the same envelope, with the heater/cathode windings joined - the effect is the same. Figure 4 shows the symbol. Dual diodes were the fore-runners of today's bridge rectifiers. For example, with a 250-0-250V transformer, a single rectifier valve produced a full-wave rectified output.

Valve rectifiers have one advantage over semiconductor diodes, in that they start to conduct slowly when first turned on as their heaters warm up. The capacitors are therefore charged up more gently than with semiconductor diodes and there's much less of a surge of current at switch-on.

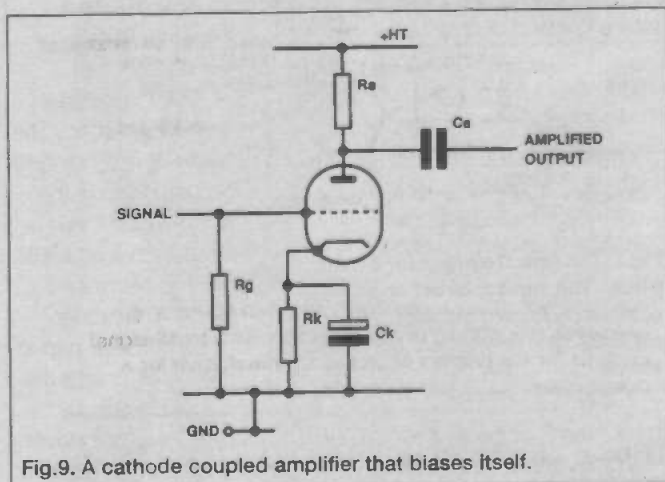


Fig.9. A cathode coupled amplifier that biases itself.

Triodes

Figure 6 shows the simplest type of valve with a grid, a triode valve. A single triode valve is broadly equivalent to a single transistor, although a valve is a voltage-controlled device, so it is closer to a FET rather than a bipolar transistor. Valves have higher gain and linearity than FETs and a single valve stage is often equivalent to an op-amp stage. I must hastily add that valve circuitry is nothing like op-amp circuitry.

Most modern triodes are dual triodes, i.e. two separate triodes in a single envelope. The ECC83 used throughout the project is of this type. One can think of these as the valve equivalent of a dual op-amp. The heaters are nominally separate, but are joined. Usually, we apply the 6.3V heater supply between the join and the two other terminals connected together. Again, like the supply rails in op-amp circuits, the heater connections are normally left off but the valve will not work without them.

The grid between the cathode and anode gives us a way to modulate the flow of current between the cathode and the anode. For the valve to work, the anode has to be positive with

respect to the cathode so that electrons are heading from the cathode towards the anode - anode voltages of 100 to 300V are typical in triode circuits. When the grid is positive, it has little effect and the valve continues to act as a diode with current flowing, the grid just tending to act as a rather poor second anode.

When the grid is a few volts negative with respect to the cathode, the grid chokes off part of the electron flow between the cathode and the anode. The more negative the grid is, the less current flows, up to the cut-off voltage (the voltage which stops all current flowing).

With the grid voltage between zero volts and the cut-off voltage, small changes in the grid's voltage can make very big differences to the current passing through the valve. To take advantage of this, we apply a steady negative voltage, called the grid bias voltage and add the signal voltage to this. This voltage sets the operating point of the valve, in the same way that the current flowing into the base can set the operating point of a transistor. Choosing the best grid bias voltage is a bit of a black art, and it is normally recommended in valve data charts.

With the ECC83 triodes used in the Paleface Minor, grid bias voltage of -1.5V with respect to the cathode will give a current of around 1.2mA. Other valve types will give different figures, but typically the grid bias is a few volts and the current through the valve is a few milliamps. As long as the grid remains negative with respect to the cathode, no current flows from it.

The signal voltage applied to the grid voltage creates sympathetic fluctuations in the current between the cathode and anode. To turn this back into a voltage signal, we place a resistor (Ra in Figure 12) between the anode and the positive supply.

An important point to note here is that valve supply voltages are often labelled HT, or HT+ (for high tension). HT voltages are usually 200 to 400V, and sometimes higher. These voltages should always be treated with respect, for obvious reasons.

The anode voltage will vary in sympathy with the current changes, much in the same way as with an emitter-coupled transistor amplifier, and we gain an inverted but large version of the original signal. We need a high-voltage capacitor, Ca, to block off the high standing voltage (typically 200 to 300V) at the anode. A few more details are needed to make this into a practical circuit.

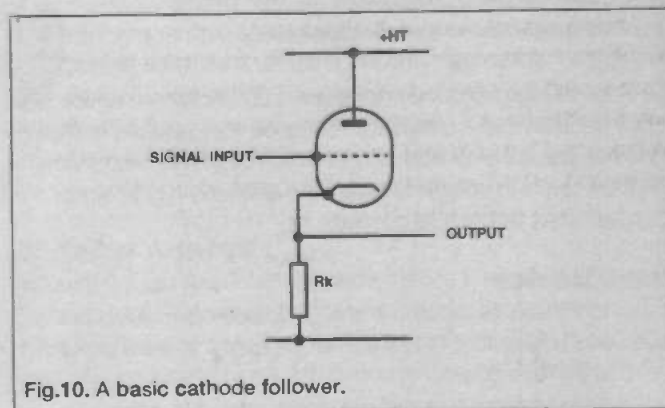


Fig.10. A basic cathode follower.

In most circuits, it is not convenient to have a special negative voltage source to set the operating point. Since this voltage is effectively the signal earth, any noise on it is added to the signal and amplified. There is an easier way to set the operating point and that is to allow the valve to find its own operating point. To do this, we insert a resistor (Rk) between the cathode and ground and add a high-value resistor (Rg) to keep the grid at zero volts, as shown in Figure 9 (ignore the capacitor, Ck, for

the moment). This circuit will settle at a point where the voltage is a volt or two negative, so applying its own negative grid bias (because the grid is at zero volts, i.e. negative with respect to the cathode). The amount of current flowing through the valve will depend almost entirely on the size of the cathode resistor. The anode resistor, R_a , makes very little difference to the current flow, provided it is below a certain value.

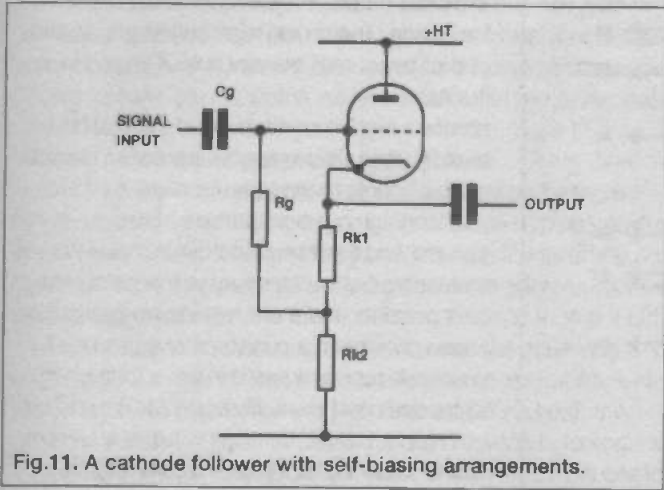


Fig.11. A cathode follower with self-biasing arrangements.

The main disadvantage of using a cathode resistor is that it reduces the gain of the valve by adding local negative feedback. Suppose the signal at the grid temporarily increases the grid voltage. This makes more current pass through the valve, which because of the cathode resistor, increases the cathode voltage in line with the grid voltage. This feedback cancels out most of the current increase caused by the increase of the grid voltage. Similarly, when the grid voltage decreases, the current falls and the cathode voltage falls again cancelling out most of the decrease in the grid voltage. As a result, we get some amplification, but much less than we got with a separate grid bias voltage. This circuit is still useful, because it offers good-quality amplification and a medium gain - typically around 10 to 20 for the values shown.

Adding a cathode capacitor, C_k (shown dotted in Figure 9), stops the cathode voltage responding to AC variations in the current through the valve, and so increases the gain of the stage to the maximum that the valve can give. However, C_k does not affect the DC conditions of the valve.

Another complication is that the valve's gain is quite affected by the current flowing. Calculating the gain in advance requires hours poring over valve characteristic charts, and even then it's only an estimate. It's usually much more fun to try it and see if it works. Then, if you're really serious, you try it with old and new valves and see if it still works.

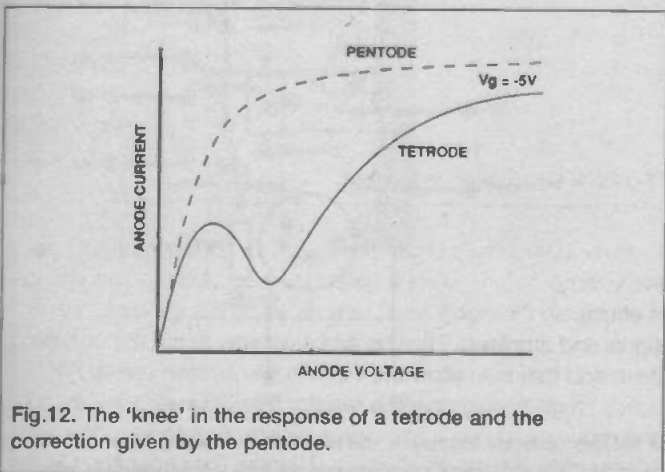


Fig.12. The 'knee' in the response of a tetrode and the correction given by the pentode.

Cathode Follower Circuits

Suppose we ditch the anode resistor and the cathode capacitor (Figure 10). This gives us a cathode follower which is very similar to a bipolar transistor emitter follower, or a FET source follower. Although it has only unity voltage gain, it can provide a lower output impedance. Due to local feedback, the output impedance is considerably lower than the resistance of R_k , which is normally 47 or 100k. For maximum voltage swing, the grid must be biased at around half-way between ground and HT+.

Biassing the grid is a problem. The simplest way is to couple the grid directly to the anode of the previous stage, where there is one. An alternative is to use a voltage divider between earth and HT+, but this requires a capacitor to suppress supply noise, then another resistor to stop the signal being suppressed by the capacitor.

A more elegant way is the self-biasing arrangement in Figure 11. R_{k1} is typically 1 to 2k, while R_{k2} is 47 or 100k. This works exactly the same way as the cathode-coupled stage biasing. However, both the cathode and the grid are at a high positive voltage and capacitor C_g is needed to block the grid voltage from the input. This circuit has a bonus in that the grid resistor 'bootstraps' the input, raising the input impedance well above the value of the grid resistor R_g .

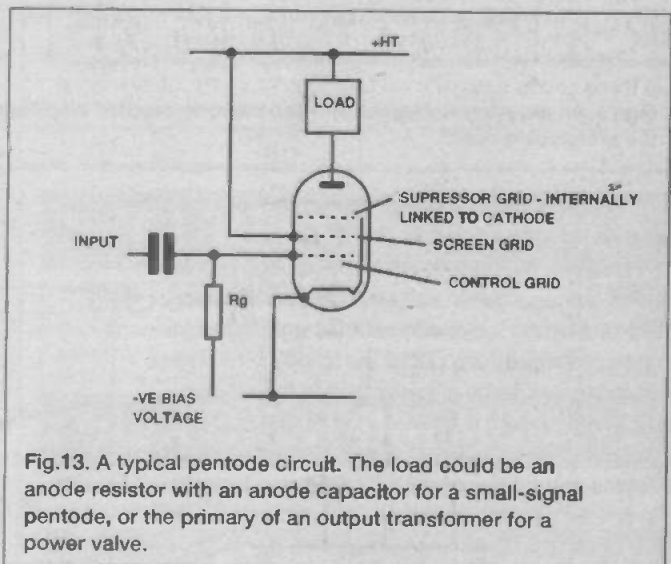


Fig.13. A typical pentode circuit. The load could be an anode resistor with an anode capacitor for a small-signal pentode, or the primary of an output transformer for a power valve.

Triode Limitations

One of the most serious drawbacks of triodes is a result of the small capacitance between the grid and the anode, typically around 10 to 20pF. This 'stray capacitance' gives rise to unwanted negative feedback from the anode to the grid. Small though this feedback is, it can be significant at high gains or at high frequencies. Also, triodes generally do not pass enough current for power amplification.

However, triodes are very useful for low frequencies (typically audio), lower gains (up to around 100) and lower powers (perhaps 100mW). Other, more complex valves extend these limits.

More Complex Valves

In tetrode valves, there is a second grid, called the screen, between the first grid (the control grid) and the anode. Provided it is held at any constant voltage, this minimises the negative feedback from the anode to first grid. Applying a high voltage (usually HT+) to the screen, maximises the current flow through the valve, so increasing the power output. Even though the mesh of the screen grid is kept very thin so that most electrons speed by it and it intercepts very few, a substantial current

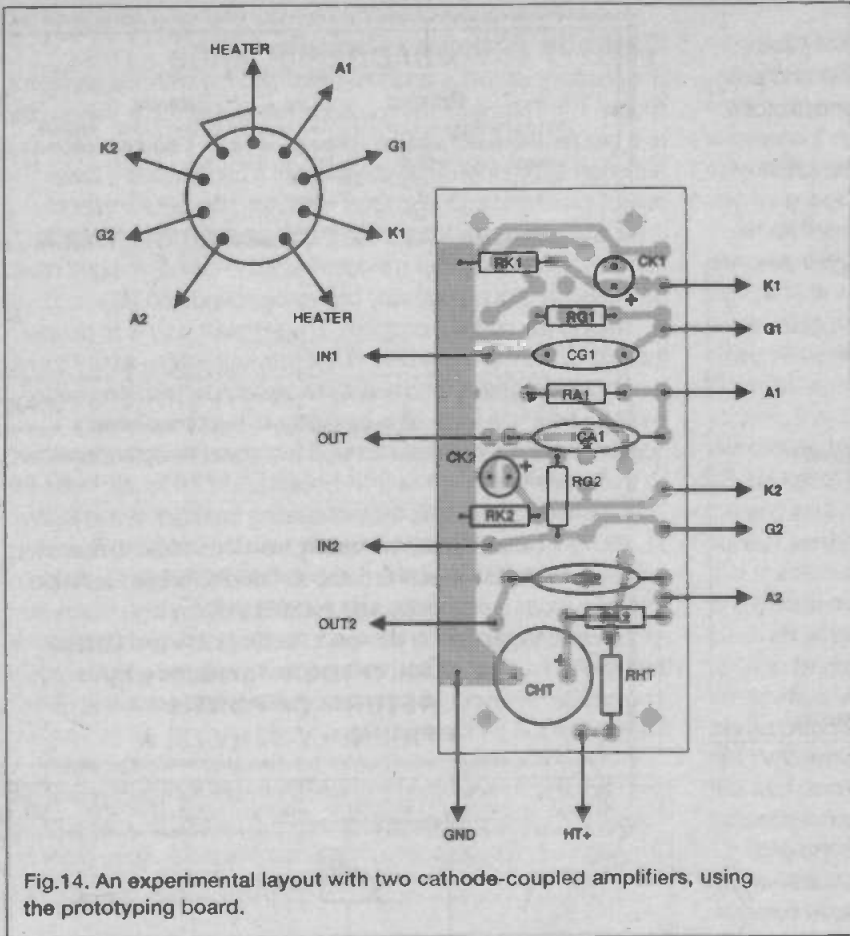


Fig. 14. An experimental layout with two cathode-coupled amplifiers, using the prototyping board.

a scaled-down version of the EL34). In the US, common types include the 6L6 (also sold as the KT66 and 5881), and the KT88.

Manufacturer's specs. are actually simpler with more complex valves. Rather like IC specs., they give precise values for the circuit values.

Audio output stages have to use transformers, to match the high output impedance of the valves with the low output impedance of the loudspeaker. Actually, I did once come across a high-impedance loudspeaker driven directly from a valve anode. I couldn't get the radio it was in to work, so I junked it - 25 years on, I know it would now be worth a fortune! Another reason to use transformers is that without a transformer, push-pull operation isn't possible (there are no tubes using holes). I have not drawn a push-pull output stage - you'll see one next month, with a longer explanation of how it works.

Circuits To Experiment With

So that you can experiment yourselves with valves, I have designed a prototyping board to accommodate cathode-coupled and cathode-follower circuits. It makes a neater prototype than the typical rat's nests that infest most valve prototypes. Originally, I planned to mount the valve on the PCB, but this caused

(10mA or more) can flow into the screen grid, as it looks like a rather poor second anode.

However, the tetrode still has a serious problem due to a phenomenon called secondary emission, electrons hitting the anode with enough speed to knock other electrons out of the anode itself. These secondary electrons are attracted to the screen and, when current is flowing through the valve, the screen is often at a higher voltage than the anode. Besides current being wasted by flowing through the screen and not the anode, secondary emission also leads to a 'knee' in the response curve of the valve, which is not good news for linearity.

This problem can be overcome by placing a suppressor grid between the screen grid and the anode, thus making the valve a pentode. If this grid is kept at a low voltage (often it is internally attached to the cathode) the emitted electrons do not reach the screen so they return to the anode.

There are two types of pentode, low power and high power. Low power pentodes, such as the EF86, are often used for small-signal amplification, typically as IF amplifiers in valve radios. Two of the most common are the EF80 and the EF86, the latter being designed for audio circuits that demand high gain and low noise.

Besides high power pentodes, constructed as described above, there are also beam tetrodes. In my book these are pentodes, but the suppressor grid has become a plate around the anode. Both types are used extensively as audio power output stages, either singly or, more commonly, in push-pull pairs. In Europe, common types are EL34 (capable of 100W from a pair, using an 800V power supply) and the EL84 (also called the 6BQ5,

too many mounting and access problems and made rather poor use of the board space.

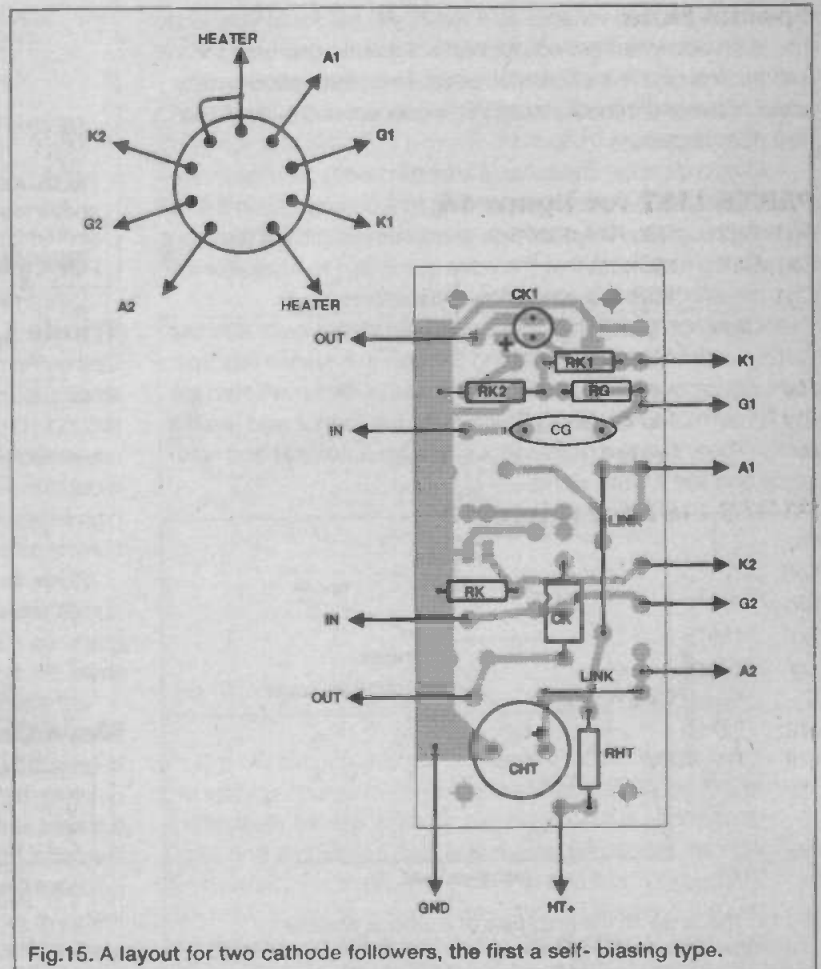


Fig. 15. A layout for two cathode followers, the first a self-biasing type.

To build these circuits, you will also need a high-voltage positive supply of 100-300V, capable of giving 10mA and a heater supply of 6.3V, 0.3A. A power supply will be described next month as part of the main amplifier project.

I do recommend beginners at electronics to build some low voltage circuits first, not least because of the high voltages involved. Personally, the first things I built were with valves, but I gave myself a fair number of shocks. Even the experienced should be careful - just 100V is enough to kill, given a sufficiently good contact. Remember also that the smoothing capacitor, Cht, can stay charged after the supply has been disconnected.

The Cathode-Coupled Amplifier

Figure 10 shows the layout for two cathode-coupled amplifier triode circuits, using the prototyping PCB and an ECC83 dual triode valve. There is no necessity to build both if only one is required. The suggested values are given in the table, but these are only suggestions.

A practical use for this circuit is as a valve distortion unit, especially if a low HT voltage of 50-70V is used to give the valves no 'head room'. Rx and Rg2 attenuate the signal between the two stages, to make the clipping more even. These values need some experimentation and Rg2 could be an off-board potentiometer. This circuit will be used in the 50W amplifier.

Cathode Follower

The first stage can be used as a self-biasing cathode follower, using the layout in Figure 11. It is a self-biasing design, the second stage being a simpler stage that needs a bias voltage applied to it. Again, the component values given are just suggestions.

Special Note

This is an advanced project. Not only does it involve working with the mains, but it involves circuits using high voltages. We advise inexperienced readers against building this project as their first electronics project.

PARTS LIST for figure 14

Rg1, Rg2	1M0 Rk1, Rk2	1k2
Ra1, Ra2	100k	1W
Cg1	100n	low-voltage capacitor, or link
Ck1, Ck2	10µ	25V (or leave out)
Ca1, Ca2	100n	400V
Rht	22k	
Cht	10µ	400V
Rx	see text	

PARTS LIST for figure 15

Rk	47k	
Rk1	1k2	
Rk2	47k	
Rg	1M0	
Cg	100n	
Ck	10µ	100V electrolytic
Rht	22k	
Cht	10µ	400V

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- E9210-FC Wizards Hat E
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- 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
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- 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
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- E9310-2 Electronic Picture H
- E9310-3 Sega Box J
- E9310-4 Transistor Amp (2 Boards).....N
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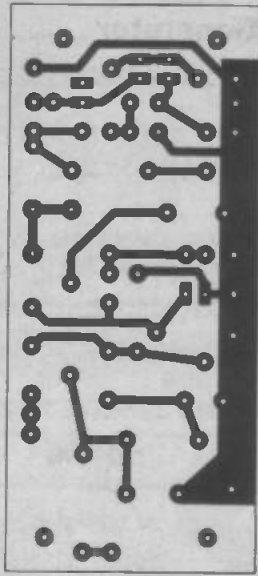
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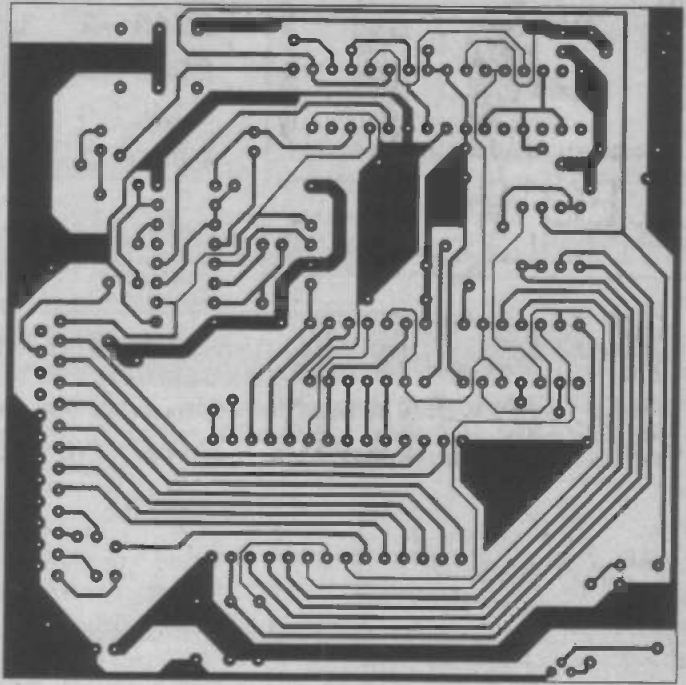
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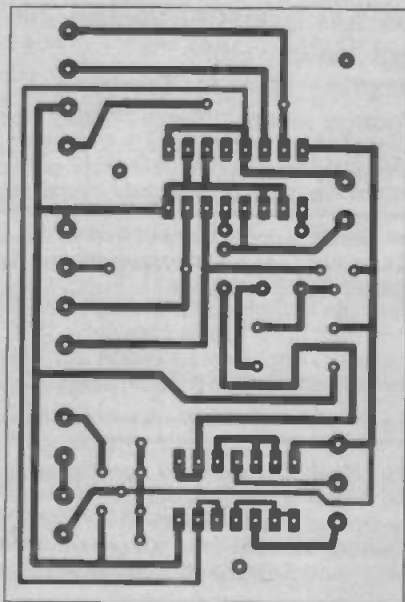
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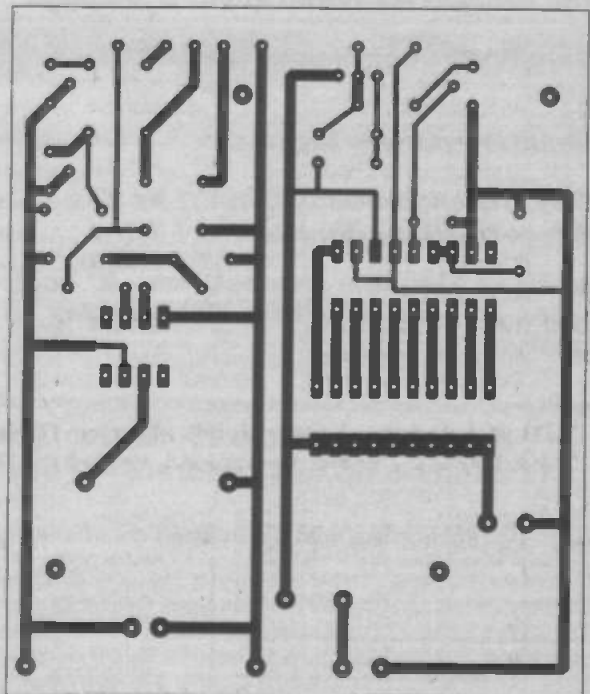
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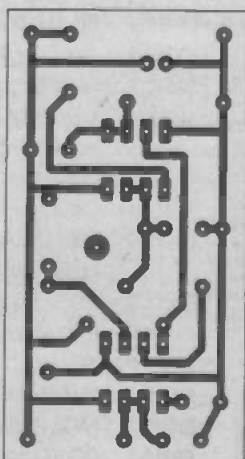
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Open Forum

The electronics industry thrives on innovation. Indeed, without constant development of new products to meet new customer demands, it would probably slowly die. Creating new ideas to meet the demands of new markets is the hallmark of the entrepreneur, and the electronics industry should be the natural home of such people. People who actively look for new markets and new ideas and, in so doing, create new businesses and new jobs. But in the UK, with a few notable exceptions such as Alan Sugar, electronics is not an industry that is brimming over with entrepreneurial activity.

The markets exist for new products, especially in specialist niche areas, and are very often largely unexploited. The talent exists to create the products that would satisfy the demands of these markets, but hardly anyone is putting them together to create new electronics based businesses.

We seem to be mesmerised by imports from the far east. We seem to have acquired some kind of complex, that people in this country cannot design, make and profitably sell electronics products. To do that you have to have large research budgets and cheap labour - only a big company, a Japanese, Korean, or Taiwanese company, can do that.

This attitude is quite frankly rather simple minded. Anything that can be done by producers in the far east can be done here in the UK. You do not need cheap labour, the savings in import costs more than counter balance this. Neither do you need large R&D budgets, profits can be made from very simple devices.

Look at this issue. The Motor Mate would be bought by a great many motorists at £20, but in small quantities

could be made on a kitchen table for just a few pounds. The same goes for the fisherman's bite detector and the bike alarm. Admittedly, none would ever sell in large quantities, but they are potentially profitable products in small niche markets.

So, if the electronics entrepreneur can easily design and make an electronics based product, why are they not getting into the shops?

A Little Learning

Partly, the answer to this is probably a matter of trust. The man in the street is, by and large, completely ignorant about electronics. He cannot tell whether he is making a good buy or throwing his money away. The man in the street relies on a familiar brand name to reassure him that the product is well designed, reliable and value for money. He relies on the fact that it is made in Japan, for that also signals quality and reliability. In other words, the customer is brainwashed by years of advertising, propaganda and his own ignorance.

The other half of the answer is that businessmen find that there is more money to be made, with less trouble, by simply importing products from the far east. All you have to do is sell and take your profit.

So, is there hope? I think there is. We just do not try hard enough, we have lost faith in our own ability to create high quality innovative products at value for money prices. There are probably hundreds of readers of this magazine who have the talent and ability to become electronics entrepreneurs, the founders of a revitalised UK electronics industry.

Come on, lets show the rest of the world what we can do!

Next month ...

In next month's issue of ETI we look at recycling old computers and using them as the basis for some interesting projects. We continue our two series - building a 12W valve guitar amplifier and taking a look at microprocessor interfacing. Projects will include a single board Z-80 computer that can be used as the basis for a wide range of projects. We build a frequency meter adapter, another useful piece of equipment for the test bench. For computer users, there is a printer switch that will allow the user to easily switch between two different printers. We will also be showing how to build a novel text display system that works on the eye's latent image.

Plus...

On the cover of next month's issue we will be giving away a diskette, containing a complete PCB design program to run on your PC!



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Sub Editor **Jim Bluck**

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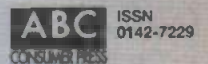
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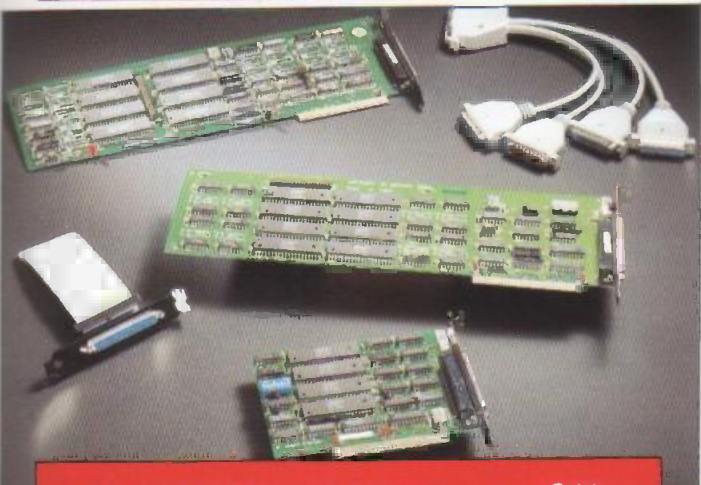
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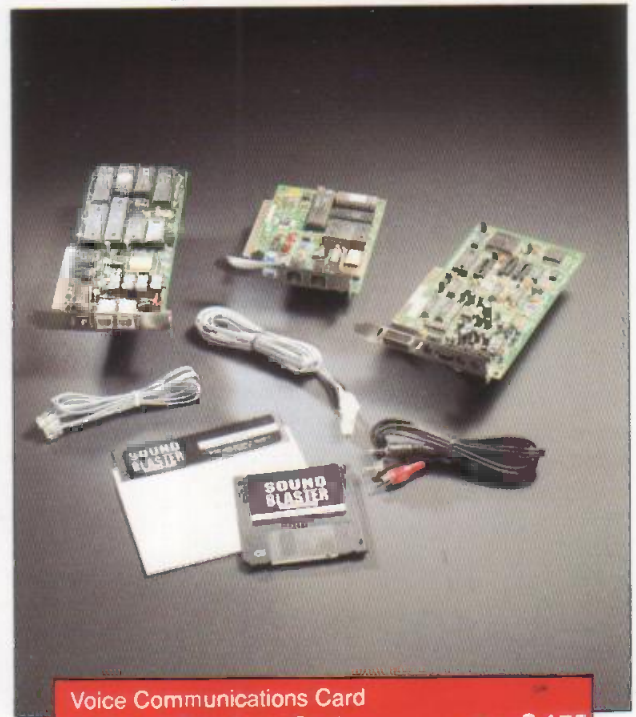
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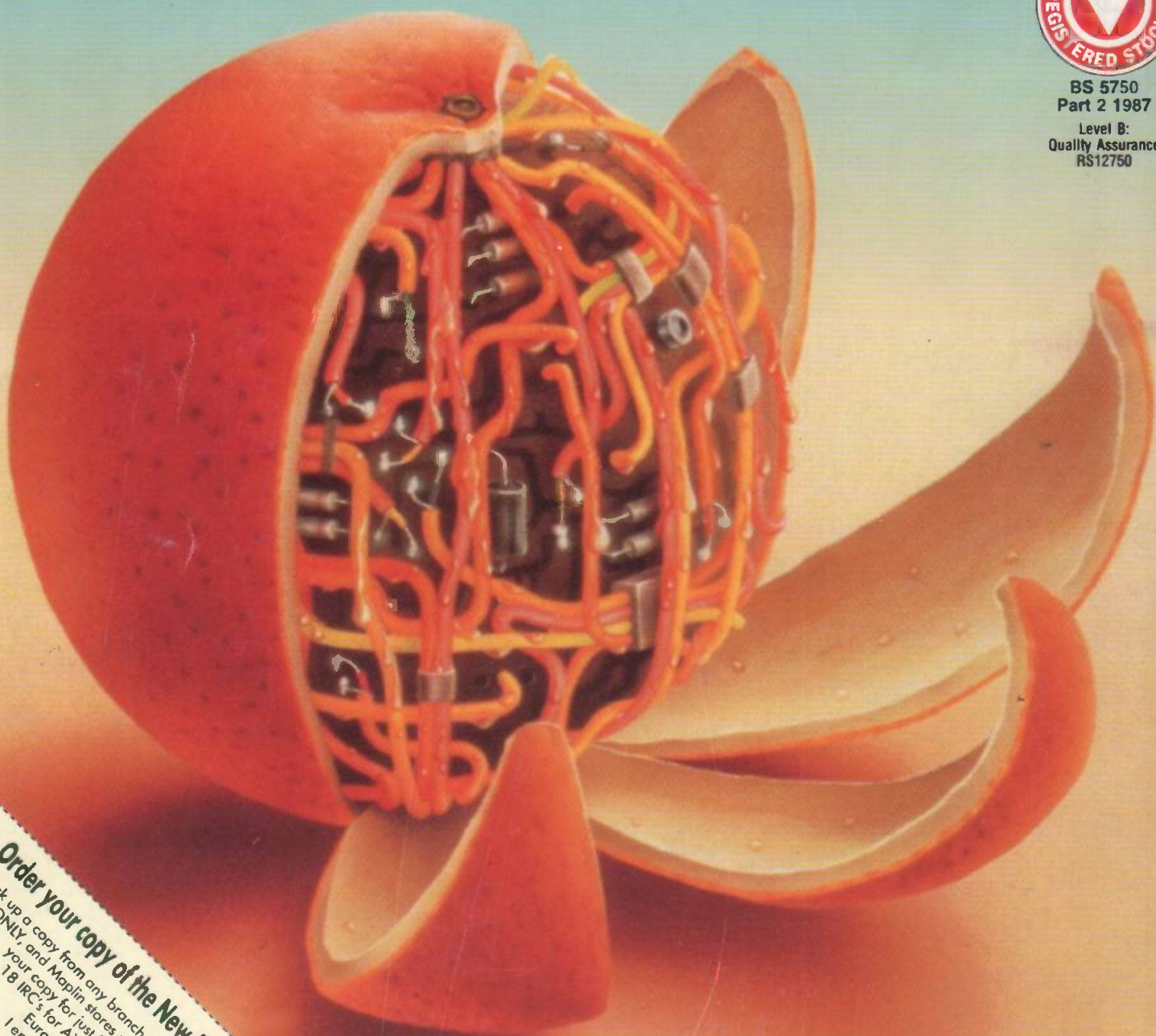
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