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SEPTEMBER 1995

INCORPORATING ELECTRONICS MONTHLY

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VOL. 24 No. 9 SEPTEMBER 1995

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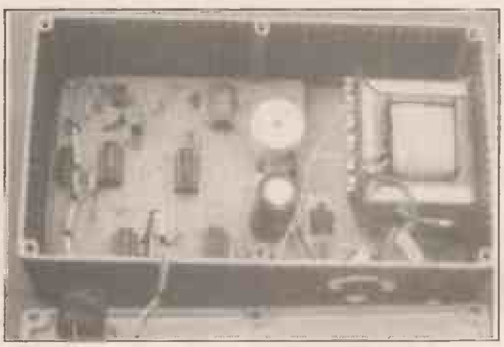

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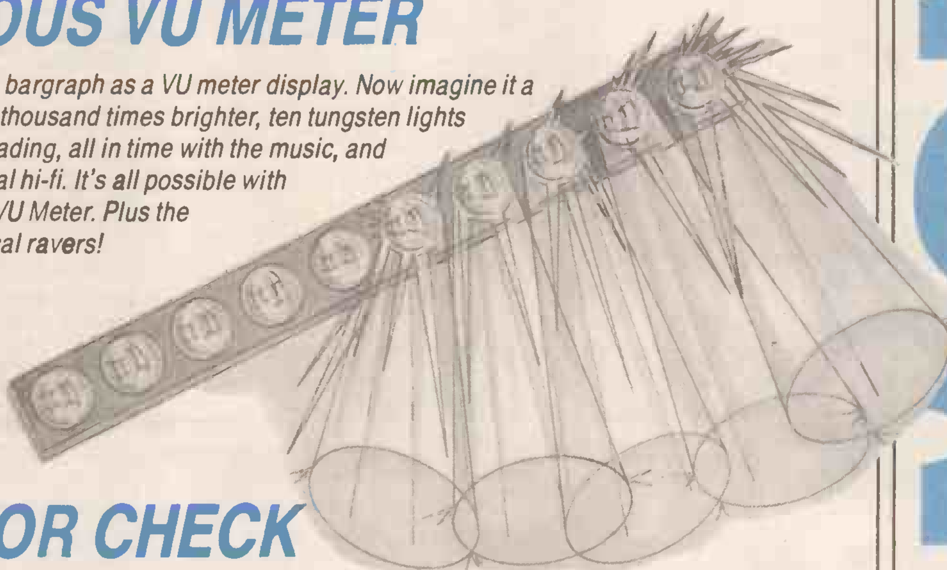

CAPACITOR CHECK

A cheap and cheerful capacitance "meter". There is often a need to measure or confirm the value of an "unknown" capacitor or one on which the lettering has become obscured. Certain components of dubious origin appear to have non-standard markings and this makes them difficult to match up if ever they need to be replaced. The circuit to be described is probably the simplest which can be constructed which will find the value of a capacitor with reasonable accuracy.

It will measure values from less than 10nF to 5000µF with an accuracy good enough to determine the nearest standard value of an "unknown" component.

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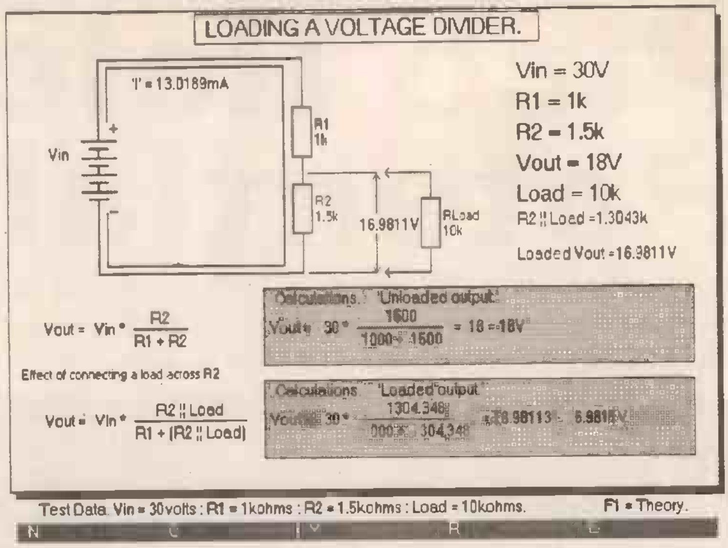

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WEIRD!

Ever since Leon Theremin produced the first successful electronic instrument back in the 1920s the world has periodically reaffirmed its interest in his unusual "musical" instrument which is played without physical contact. One thing is for sure, the sound of the Theremin is very unusual – whether most players can achieve something musical is another matter.

With two of these devices in the office recently they have proved to be compulsive playthings for visitors. This simple design is, as far as we can tell, the only semiconductor design to be published as a full constructional project for many years (with the exception of a full frequency and volume controlled instrument, also by Jake Rothman, in Supplement 40 of our *Modern Electronics Manual*, published recently). Construction of the *Simple Theremin* is reasonably straightforward, playing it is the difficult bit! This basic instrument will give you a taste for the weird world of Theremin music. If you are really hooked we intend to publish a more advanced design, with both pitch and volume control as a future project.

DON'T DO IT!

Finally a word of warning; don't build this project if any member of your family, especially the younger ones, is likely to get hooked. The effect of those learning the Theremin is equally as bad as those learning the violin! It is too early to tell if the ultimate sound will be worth the painful learning process, but somehow I doubt it.

Mike Kenward

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SIMPLE THEREMIN

JAKE ROTHMAN

Take a trip "Back to the Future" and discover the fascinating world of "music and magic" that is the Theremin

FORGET inputting that formant data into your MIDI synthesis workstation via the Qwerty user interface for a limited time window (*enough of this techno-rubbish – Ed!*) and get back to those eerie tones of the good old Theremin.

It was Leon Theremin who first popularised electronic music with his electronic musical instrument the Theremin. His creation certainly followed Arthur C. Clark's assertion that good technology should appear like magic, since it was played with no physical contact. The "Thereminists" moved their hands in a controlled way around the antennas that controlled pitch and volume.

A motionless body was essential for pitch stability, but this merely enhanced the theatrical effect and mystery. Along with its eerie sounds, the instrument's strangeness led the Theremin to be used on the soundtrack of many 1950s science fiction movies, such as *The Day The Earth Stood Still*.

THEREMIN – END OF A LEGEND

The Theremin is surrounded by intrigue and legend and this was played upon a great deal in the *Channel 4* documentary, presented shortly after Leon Theremin's death in 1994. However, the role of a technical magazine like *EPE* is to demystify such things and explain their operation.

It is said that a lot has been discovered in electronics when things go wrong and this is very likely in the case of the Theremin, since the principle of the Theremin frequently arises by accident in electronics as a form of instability.

A classic case occurs in radios where there is a loud whistle accompanying the desired programme. If the tuning control is adjusted the whistle usually changes pitch. Combining this with another common fault, hand capacitance effects, the pitch will change if a hand is moved towards the receiver.

It is very likely that the old regenerative wireless sets popular in the twenties which were prone to these defects, inspired Theremin to analyse and exploit the effect to make a musical instrument. So there is no real mystery, the Theremin is in fact just a glorified audible capacitance meter!

BASIC OPERATION

The basis of all Theremins is two high frequency oscillators, of almost identical frequency, normally operating from 0·2MHz to 2MHz. One oscillator is fixed while the other is connected to a conductor which forms a variable capacitor with the player's hand. As the hand is moved, a minute change in capacitance occurs (in the order of fractions of a picofarad (pF) shifting the oscillator's frequency by a correspondingly small amount.

The oscillator outputs are then combined in a mixer as shown in Fig. 1 to produce a beat frequency as shown in Fig. 2. If the two original frequencies are close enough together, the beat frequency will be in the audio region.

Now here comes the clever bit: since the original frequencies are in the radio frequency (r.f.) region, it only requires a very small percentage shift to make a large difference to the beat frequency, giving a sensitive instrument with a wide pitch range.

The mixer output contains a lot of r.f. and is just like an a.m. radio signal. This then needs to be detected and filtered to obtain a clean audio signal. If the r.f. content is not removed the audio output amplifier may "overheat" and the signal may be radiated by the output wires causing instability.

ORIGINAL THEREMINS

Original Theremins built by RCA in the thirties were very large valve/wooden instruments with a vertical conductor for Pitch and a horizontal loop for Volume. (Basic Theremins, such as the one described here, do not usually have a volume control conductor.) The RCA's Volume control was quite unusual since it had a negative control characteristic, in that no tone was emitted until the hand was removed.

Since voltage controlled amplifiers were not effective at that time, the unique solution of varying the brightness of a directly heated valve filament was used. This filament was fed with r.f. generated by an oscillator that could be damped via the control conductor.

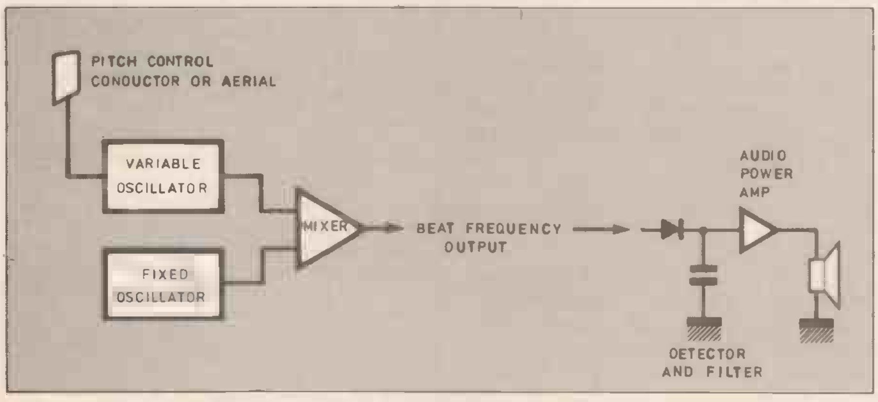


Fig. 1. Black diagram for the basic Theremin,

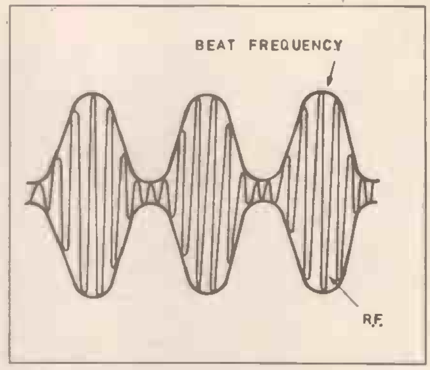


Fig. 2. Beat frequency output from the mixer stage.

Original RCA Theremins were very highly developed pieces of electronics, having excellent stability and range. They have often been used in conjunction with an orchestra and can be considered true concert instruments. Of course this is reflected, along with their scarcity, in the price, which is in the order of £12,000.

SIMPLE THEREMIN

Being £11,980 cheaper than the RCA model, the design presented here is harder to play in tune because of a more compressed range, but when plugged into a loudspeaker with decent bass response and some sound processing gear, the results can be quite acceptable.

To obtain a range comparable with the original necessitates the use of expensive specially made coils, whereas this design uses standard 100μH coils available from most of the main distributors.

CIRCUIT DESCRIPTION

The complete circuit diagram of the Simple Theremin is shown in Fig. 3. The two oscillators are of the Colpitts configuration which avoids the need for a tapped coil by using two capacitors to form a "tapped" capacitance. This allows ordinary off-the-shelf inductors to be used.

The frequency of the fixed oscillator, built around transistor TR1, is around 1·33MHz. The variable frequency oscillator, built around TR2, is connected to the Pitch aerial (note that this is at positive potential since current can flow through coil L2). Trimming for ambient conditions is provided by trimmer capacitor VC1.

Mixing of the two oscillator outputs is accomplished by transistor TR3. To prevent the oscillators locking together at low frequencies the mix resistors R9 and R10 are of high value. Note R10 is about half the value of R9 to ensure the amplitude of the resulting waveform does not fall to zero at the dips of the beat frequency. This ensures there is always some carrier frequency which reduces the distortion produced by the detector.

Two versions of the Simple Theremin, only the Pitch conductor shape has been changed.

The mixer stage is simply a collector biased common emitter stage. If a different transistor is used, resistor R11 may need altering to get lowest distortion. To prevent low frequency oscillation the mixer stage is decoupled by resistor R13 and capacitor C13. Note that the two oscillators have their own decoupling, provided by ceramic capacitors C1 and C6.

Demodulation of the mixer output is provided by diode D2. Capacitor C14 is used to block the half-rail d.c. bias present on TR3 collector. To prevent a d.c. offset building up, diode D1 provides an equivalent d.c. path.

First stage r.f. filtering to recover the audio is provided by capacitor C15. A second stage of r.f. filtering is provided by R15 and capacitor C16 before the signal is fed into load resistor R17.

To prevent the Volume control VR1 from scratching due to d.c., the signal is a.c. coupled via capacitor C20. Unusually for a Volume control, it is acceptable for VR1 to be a "linear" type, although a log. type gives a smoother change at low levels.

A final stage of filtering, built around resistor R16 and capacitor C17, is applied just before the input to IC1, an LM386 power amplifier i.c. The LM386 was chosen since it is less prone to r.f. oscillation than a lot of monolithic power amps and provides an adequate output of 250mW.

A Zobel network consisting of resistor R18 and capacitor C21 is used to prevent any h.f. oscillation due to the voice-coil inductance of the loudspeaker. Capacitor C22 is used to block the half-rail d.c. bias voltage from entering the loudspeaker. Finally, decoupling for the power-amp is achieved by capacitor C18, with high frequency bypassing provided by C19.

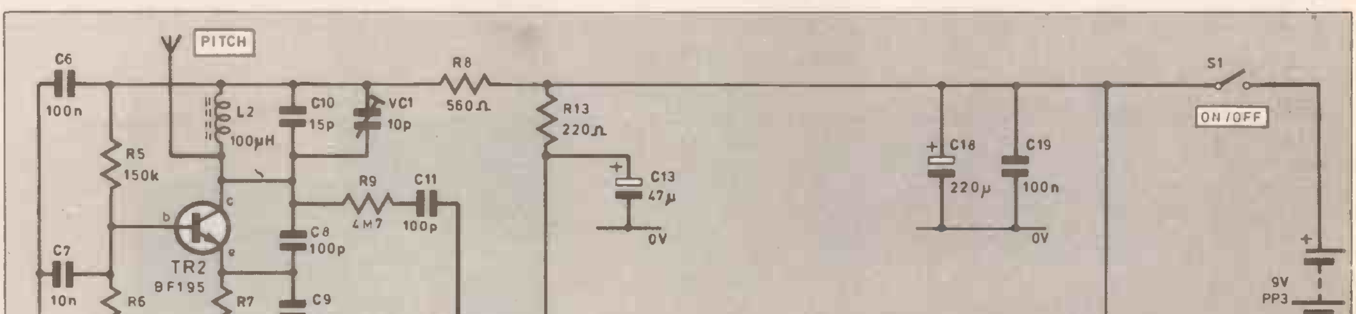


Fig. 3. Complete circuit diagram for the handheld Simple Theremin.

COMPONENTS

All the *frequency* determining capacitors should be zero temperature coefficient NP0 ceramic, or better still, negative temperature coefficient, such as N150 ceramic types. The use of N150 capacitors helps compensate for the positive temperature coefficient of the ferrite cored inductors used.

Most N150 ceramic capacitors can be identified by a band of orange paint across the top. However, aiming for high stability in a Theremin can be a pointless exercise since they will tend to drift according to air temperature, humidity and the proximity of any objects.

All the other capacitors are used for coupling and decoupling and cheap poor-tolerance ceramics and electrolytics can be used. None of the resistors are critical and standard five per cent carbon-film types can be used.

The transistors are cheap r.f. types as used in a.m. radios; it is possible to use l.f. types such as BC182s although it may be necessary to alter the value of the emitter components to get a clean sine wave. Although Schottky diodes are specified for the detector, old germanium types, such as the OA91, work almost as well.

CONSTRUCTION

The Theremin printed circuit board (p.c.b.) topside component layout and full size underside copper foil master pattern are shown in Fig. 4. Construction should not present any problems provided the circuit is built on the recommended p.c.b. The board is available from the *EPE PCB Service*, code 952.

To minimise the magnetic coupling between the two oscillators the inductors L1 and L2 are mounted on almost opposite corners of the p.c.b. They are also at right angles to each other, with L1 being horizontally mounted whereas L2 is in a vertical orientation.

CORNFIELD

Back in the early eighties as a young electronics undergraduate one of my lecturers said, "no more cornfields laddie" referring to a recently constructed mixer channel I had designed with all the resistors mounted vertically. However, no apologies are made for this being a "cornfield" design since it is the only way, apart from surface-mount techniques, the Theremin could be made pocket-sized without having to use one of those awful mini-jacks. Only full-size jack sockets are reliable enough, as users of Walkman type cassette players will testify.

Assembling the board should follow the normal rule of "lowest components first" although this will contradict the other general rule of "resistors first" which cannot apply to vertical mount boards. It is a good idea to mount IC1 in a socket and care should be taken bending the leads of the diodes and coils. The transistors are "lock fit" and so despite being of low profile, they can be fitted last, in accordance with good practice.

Trimmer capacitor VC1 *MUST* be mounted on the copper side of the board. This is quite a tricky soldering job necessitating a fine pointed iron, since the

---

COMPONENTS

Approx cost guidance only **£ 20**

Resistors

R1, R5	150k (2 off)
R2, R6	33k (2 off)
R3, R7, R12	4k7 (3 off)
R4, R8	560Ω (2 off)
R9	4M7
R10	2M7
R11	220k
R13	220Ω
R14, R17	12k (2 off)
R15, R16	2k2 (2 off)
R18	4Ω7

All 0·25W 5% carbon film

See SHOP TALK Page

Capacitors

C1, C6, C18, C21	100n ceramic, +80 −20% (4 off)
C2, C5, C7, C9, C15, C16, C17	10n ceramic 20% (7 off)
C3	27p ceramic 2% NP0 or N150
C4, C8, C12, C10	100p ceramic, NP0 or N150 (4 off)
C10	15p ceramic, NP0 or N150
C13, C20	47µ radial elect. 10V
C19, C22	220µ radial elect. 10V
VC1	10p Philips trimmer

Semiconductors

D1, D2	BAT85 small signal Schottky diode (2 off)
TR1, TR2, TR3	BF195 *npn* silicon r.f. transistor (3 off)
IC1	LM386 low voltage power-amp.

Miscellaneous

L1, L2	100µH axial inductor (2 off)
B1	9V alkaline battery (PP3), with clip
SK1	6·3mm (¼in.) mono switched jack socket
S1	s.p.s.t. min. toggle switch
LS1	8ohm 1·5in. diameter loudspeaker, with alnico magnet

Plastic case, with battery compartment, size 105mm x 60mm x 28mm; printed circuit board available from *EPE PCB Service*, code 952; 8-pin d.i.l. socket; 10mm dia., 3mm shaft, collet knob plus end cap; single-ended solder pins (8 off); 16s.w.g. tinned copper wire, approx. 150mm length, for Pitch aerial; multistrand connecting wire; solder etc.

Note
This design is offered as a project for home construction only and no licence for commercial manufacture is implied.

Note that the p.c.b. design and circuit is copyright of Longwave Instruments and many not be manufactured by commercial companies.

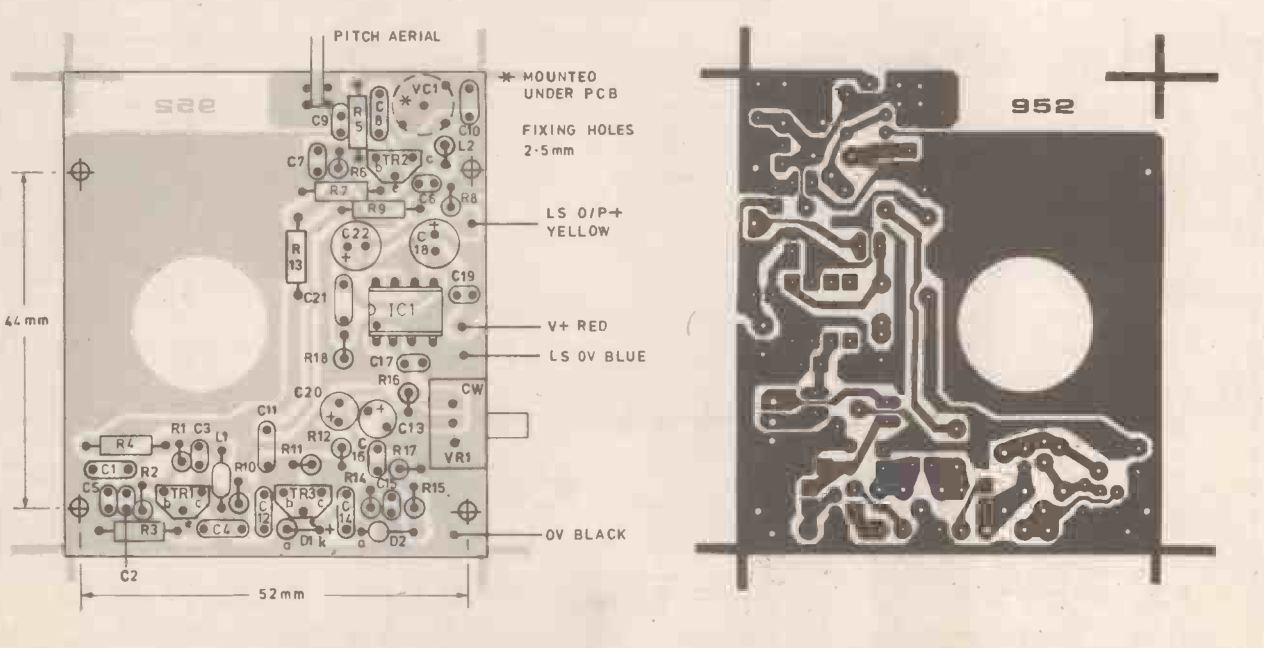


Fig. 4. Printed circuit board component layout and full size underside copper foil master pattern for the Simple Theremin. The size of the speaker cutout may need to be enlarged to suit the size of magnet on the speaker used.

iron has to go under the component to reach the tags. When mounting the potentiometer VR1 it is essential that the tags are firmly bent over before being soldered, since the soldered joins on all p.c.b. mounted pots are subject to considerable mechanical stress.

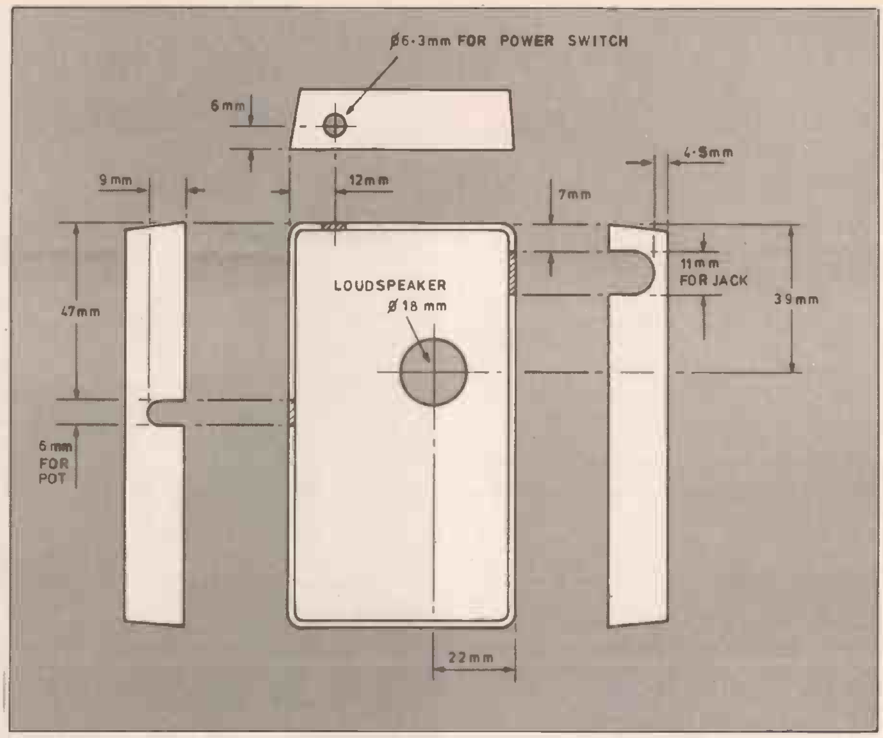


Fig. 5. Case measurements and drilling details.

CASE

Being a compact unit, the drilling and mounting details are more critical than for most units. In particular the 2·5mm mounting holes for the p.c.b. are very tight, as is the actual size of the p.c.b.

Some judicious filing of the board will be needed to ensure an accurate fit inside the case. This is best accomplished before the p.c.b. has been soldered up, since the trimmer capacitor is sensitive to dust and abrasion.

The loudspeaker is mounted with Evostik impact adhesive (the brown stuff). It is essential that the speaker used has a colmnar or alnico magnet, the more common ferrite magnets will be too wide and will foul the components on the p.c.b.

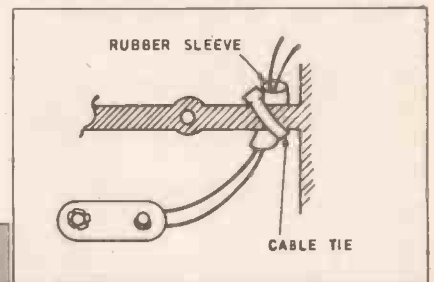
Since the speaker does not have to handle the full range, a single hole sufficient to clear the voice coil will suffice. This provides protection without the need for a covering grille. Fig. 5 shows the drilling details for the box.

The trimmer capacitor mounted on the track side of the p.c.b.

The completed p.c.b. is a tight fit in the case.

INTERWIRING

There is very little wiring in the unit, it only being necessary for the battery clip, switch, output jack socket and loudspeaker. The full interwiring details are shown in Fig. 6. Note that the connecting tags for the jack socket SK1 must be bent over to give a maximum clearance to be able to close the box.



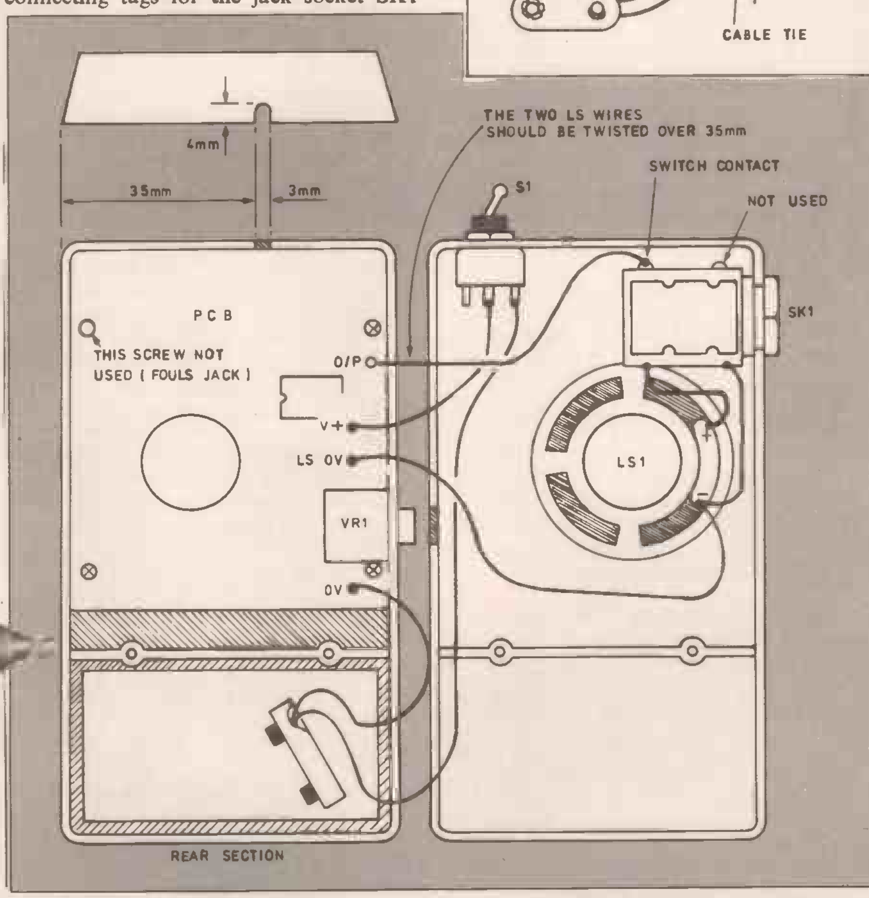


Fig. 6. Interwiring between components mounted in the two sections of the small case. The battery lead is secured to the battery compartment mounting/dividing strut as shown inset.

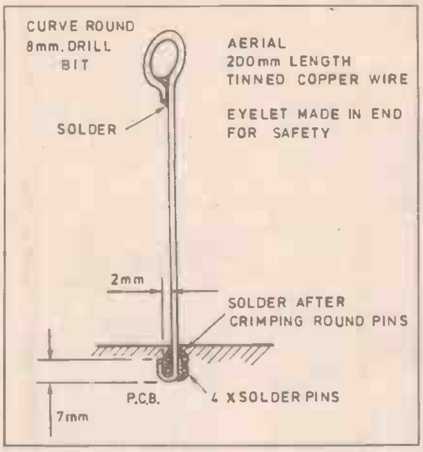
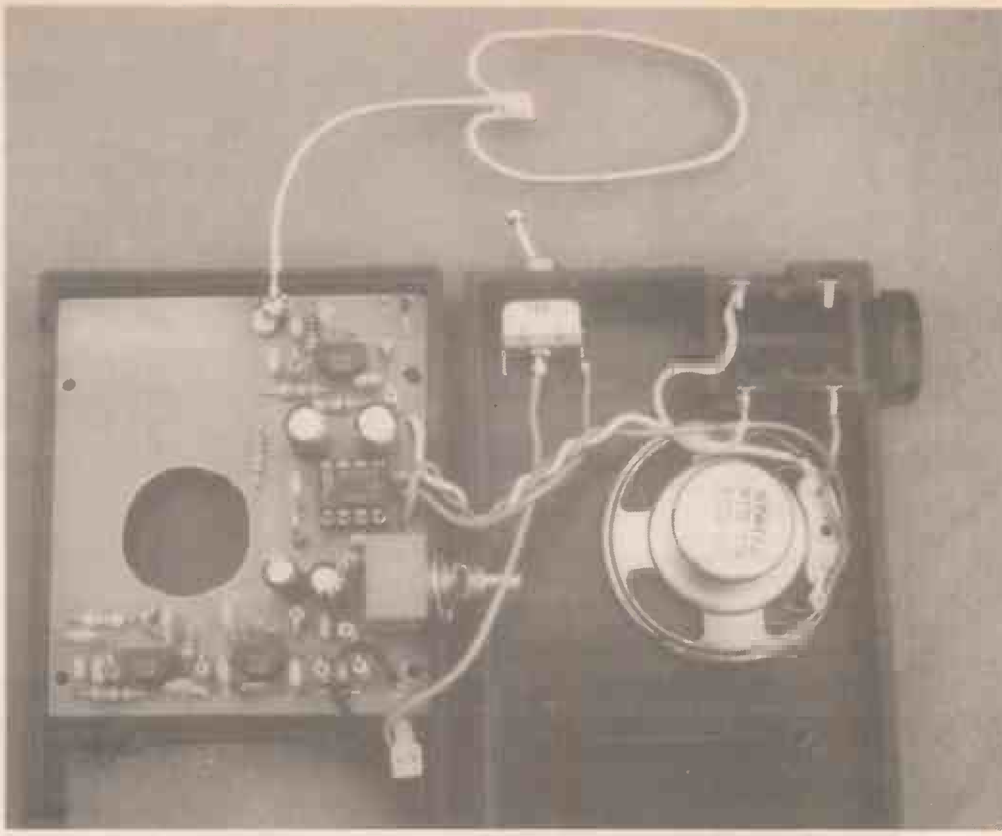


Fig. 7. Construction and mounting of the Pitch aerial.

The aerial is made of 16s.w.g. tinned copper wire and is soldered between four solder pins as illustrated in Fig. 7 and photographs. For maximum strength it is best to insert the pins using a large soldering iron by heating the pin up for a few seconds before firmly pushing it into the board with the bit. Using the standard pin insertion tool does not seem to work with glass fibre boards so the soldering iron technique was found to be the most effective approach.



Positioning and interwiring between components mounted in the two halves of the case. Note the jack socket connecting tags have been bent down.

TESTING

When testing the unit, the most common cause of no output is the oscillators being too far apart in frequency due to component tolerances. It should be possible to adjust VC1 so that the null point or "zero beat" should occur when its plates are half enmeshed.

Above the null point the frequency should increase as the hand is brought nearer the "Pitch aerial". Interestingly, at the other side of the null point the frequency goes down. If the oscillator frequencies cannot be brought close enough with VC1 it will be necessary to pad-up either capacitor C10 or C3.

Another cause of zero output is one of the oscillators not oscillating. This is most commonly due to an "open circuit" inductor, incorrect insertion of the transistor or solder bridges.

If available, the oscillator output should be checked with a 'scope probe set to × 10 to provide a degree of isolation. The output should be a good sine wave in the order of a few volts peak-to-peak, see Fig. 8.

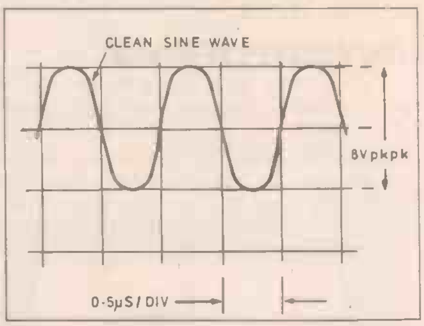


Fig. 8. Oscillator output waveform taken with x10 probe. Voltage may be higher than battery voltage due to resonance.

A harmonically rich sound can be achieved by clipping the waveform by over driving the mixer stage. Another method is to increase the coupling between the oscillators by reducing the value of the mix resistors, R9 and R10, or by encouraging magnetic coupling. This technique produces a ramp waveform as a result of the oscillators "pulling" each other.

The original Theremins were designed to have a harmonic structure very similar to a violin. It is interesting that Leon achieved this by careful tweaking and listening, not having the advantage of oscilloscopes and spectrum analysers in those days.

AUDIO OUTPUT

The audio output of the simple Theremin should also be a clean sine wave, since this is the standard "Theremin sound". Some circuits have a buzzy sound as a result of harmonics. This can sometimes give good results if sound processing is used.

Playing or "conducting" the Theremin is accomplished by "waving" the hand(s) near the Pitch aerial.

USING THE THEREMIN

Do not expect to be able to play a tune on the Theremin immediately; they are very hard to play, even making the violin seem easy! One of the reasons for this, is the unusual control law which results in the rate of pitch change rapidly increasing as the hand gets nearer the "aerial".

Secondly, the effective range of the pitch control is only a few inches and thirdly there is no tactile feedback. However, the unit is great for special effects and a tuneful rendition can be obtained if the instrument is sampled.

For loudness control a guitar style volume pedal can be used.

The Theremin will cause slight interference to a.m. radios and will transmit its whistle at the low end of the MW band, where it should cause few problems since there are hardly any stations and the range of the interference is only a few feet.

Traditionally, Theremins are played by moving a hand near the Pitch aerial. However, with the Simple Theremin the unit can be handheld and moved against a fixed conducting object, such as a desk lamp.

Interesting effects can be made when two Theremins are played against each other since they beat together and may also lock when the aerials touch. Having suffered the effects of children having a "Theremin war" it is suggested this is tried in a sound-proofed room! Generally, children love Theremins and they may be of some therapeutic value to the handicapped.

MIDI

Pitch to MIDI converters are now available which greatly extend the possibilities for using Theremins. One advantage is that special software can be employed to make the instrument's control characteristic easier to play, such as by increasing the spacing between notes for example. Theremin manufacturers Longwave Instruments are currently developing a pitch to MIDI converter. □

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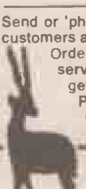

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Innovations

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

ARE DIAMONDS A PATIENT'S BEST FRIEND?

New diamond-coated X-ray needle gun attacks malignancy from within

– by Hazel Cavendish

ADVANCED electronic technology has found a way of attacking cancer cells from the inside of a tumour rather than by passing high-energy beams through a patient's body. It is the first time this has been done successfully.

A remarkable electronic gun invented in America – at present on its British trials in the treatment of brain tumours in a British Hospital – fires electrons along a 10cm-long needle to irradiate and kill a mass of cancerous cells in a single treatment lasting only half an hour.

The Photoelectron Corporation in Maine, USA has spent the last six years developing electron-beam systems, based on highly innovative technology which originated in the R&D centre of another American company, the Thermo Electron Corporation. Their president, Peter Nomikos, set out to merge the disciplines of physics with radiosurgery to create a radical new approach to the therapeutic treatment of malignant tumours. The result was the development of an effective X-ray system which could minimize or eliminate tissue damage during radiation treatment.

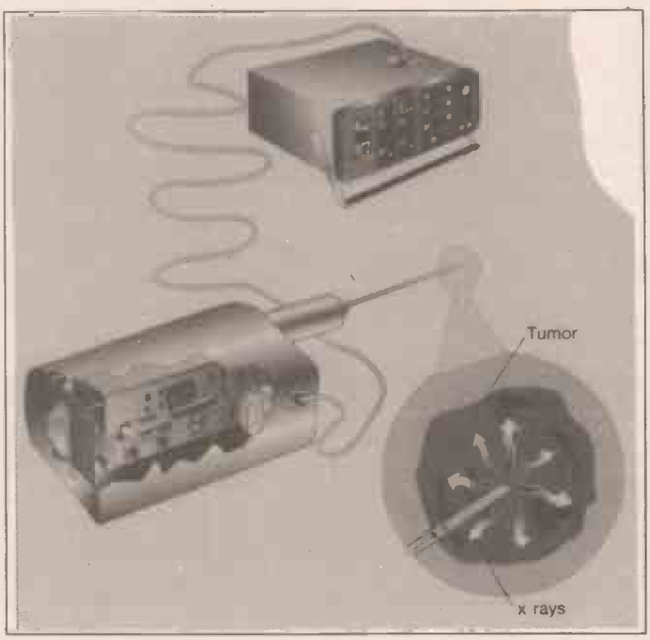
ENCOURAGING TRIALS

The first trials involving patients with brain tumours have proved highly encouraging. In 14 patients treated at the Massachusetts General Hospital in Maine, and four other major US hospitals, tumour growth was halted and cancer cells killed in nearly all the cases. Tumour growth recurred in only three patients, and those cases occurred at the tumour margin where the radiation dose was minimal. In the second phase of trials the peripheral dose was increased with successful results.

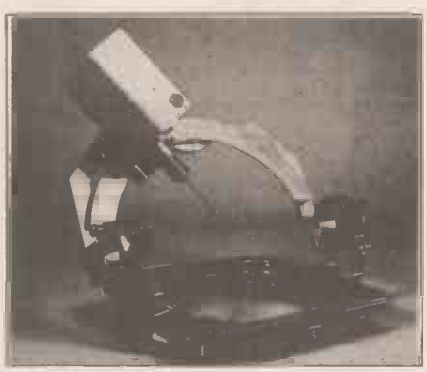
Most tumours were irradiated for less than 30 minutes, and the procedure was well tolerated by all the patients, who suffered no trauma or ensuing complications from the treatment, and were generally discharged from hospital within 24 hours. Trials are now in progress at the Royal Free Hospital in London.

DIAMOND NEEDLE

The most remarkable feature of the battery-powered gun is its 100mm-long diamond-coated needle which accelerates electrons towards the centre of the tumour. The electrons collide with a tungsten target which results in a uniform distribution of X-rays around the target area. Precisely regulated X-ray photons emitted in a spherically symmetric or asymmetric pattern ensure that the entire tumour is engaged. The 33mm-wide gun can be inserted in the same track used to take a biopsy of a brain tumour. The advantage is that all this is taking place within the tumour, and because the rays are absorbed in the tumour tissue there are none left by the time they reach its edge to cause damage to healthy tissue.



The new electronically controlled X-ray gun can be focussed to a precise region within a tumour.



Although it may look like a medieval torture instrument, this apparatus can save lives and is attached to the head ensuring absolute stability of the X-ray needle gun mounted on it.

Dr Enan Thereon, who heads the Norfolk and Norwich Hospital's Radiotherapy Department and is involved in the trials, comments that "The use of the diamond-coated needle is significant, as diamonds provide an inert material there is no interaction – chemical or otherwise – with the brain tissue that it passes through to reach the tumour."

Explaining the use of electromagnetic fields within the gun to steer the X-rays, he said "You have to control the path of the electrons so they hit the right part of the target with absolute accuracy." The gun's ability to match the radiation field to the shape and size of a tumour offers a precision and flexibility never before experienced in brain operations.

The new technique of treating brain cancer appears to compare favourably with existing treatments. It may replace the linear accelerator and gamma knife.

ALL-ROUND BENEFITS

Major advantages over therapy with radioactive implants are also cited, the latter normally requiring much longer treatment times, usually several days. The new device also scores in that its X-ray output remains constant with time. Additionally, it eliminates difficulties in handling and disposing of radioactive materials and the need to shield personnel.

The cost of the equipment to calibrate and run the device is said to be in the region of £330,000 – a sum ten times less than existing brain cancer treatment systems with their inherent disadvantages to skin and tissue. "Our goal is to make life easier for people with cancer by alleviating their suffering and reducing the cost of cancer treatments," says Peter Nomikos. His company is now working on a reconfiguration of the device to treat other cancers.

CHiDE

ELECTRONICS has had a major impact on our world view. Many features of the electronics technology with which we are familiar have their origins in the hidden world of defence electronics, during the Second World War and the military tensions of the following decades. Understanding the history of defence electronics and its relationship with domestic electronics therefore plays a vital part in understanding contemporary history. The new Centre for the History of Defence Electronics (CHiDE) has been established in the Department of Conservation Sciences at Bournemouth University to promote this understanding.

The broad aim of the Centre is to contribute to the study and public awareness of the history of electronics and through this to the public understanding of science. Initially the Centre will concentrate on radar, sonar, communications, and electronic countermeasures together with their wider social consequences.

Innovative approaches in the field of history, museums and the public dissemination of science and technology will be drawn together to provide systematic coverage of a field which has absorbed a major part of UK expenditure on research and development.

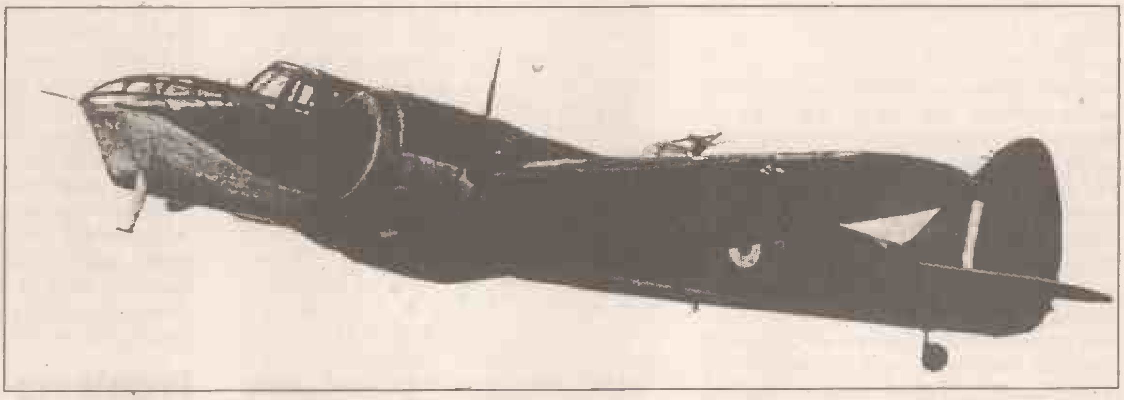
The Centre will place technical history in both a social and military context and show how science and technology impacts on ordinary people.

A Virtual Museum will be created on the Internet (this should go "live" during August) and an interactive CD, providing easy access to the Centre's resources both for the public and for scholars. It will contain an index to relevant sources at other locations, allowing the Centre to become a natural focus for researchers in this field. The latest database technology will store and retrieve material that includes documentary, pictorial and oral archives. The Virtual Museum will feed into schools and libraries to promote better public understanding of science and assist in the teaching of technology.

Recollections of those involved in technical developments will be obtained by the Centre by means of recorded interviews to maximise retention of their unique experiences which would otherwise be lost through the passage of time.

Research will be conducted on specific topics in the history of electronics. The Centre will also pursue three major research themes based on the developments and evaluation of the use of oral and autobiographical records in the communication of technical history; multimedia interactive tools for the representation of technical concepts; multimedia interactive tools for the representation of socio technical history.

The University is looking for both financial and practical support for this project. If you feel you can help in any way, from typing a manuscript to sponsoring research, please contact either Dr John Beavis (Director of the Centre) or Brian James (Manager of the Centre) at Department of Conservation Services, Bournemouth University, Poole, Dorset BH12 5BB. Tel: 01202 595178 Fax: 01202 595255, Internet: **consci@bournemouth.ac.uk**



Blenheim fitted with Air Interception MKIV (supplied by Douglas Fisher FRPS)

FALSE ALARMS

Although security firms talk glibly about burglar alarms which connect direct to the local police station, this is in fact not true. But it is easy to understand how misconceptions arise.

When I phoned the Home Office for comment, the Home Office referred me to the Metropolitan Police Press Office at Scotland Yard. They told me that there was only one person in Scotland Yard who could talk about burglar alarms and he would phone me back "if he has time". Weeks later I had still heard nothing further. Fortunately the Crime Prevention Officer at my local police station was more helpful.

Burglar alarms which automatically dial a telephone number are connected to a central control station, funded and often shared by several of the major alarm companies. When the phone rings at the central station, the controller first phones the householder (whose private phone number is kept on file) to check whether it is a false alarm. If there is no reply, then the alarm is taken to be genuine. The control centre then notifies the police.

The police then, in theory at least, rush to the scene of the crime and check for any sign of forced entry. If there is no sign of forced entry, the call is registered as a "false alarm". The police have no powers to enter premises unless there are clear signs that a burglar has been inside.

If the householder has delegated someone as key holder, for instance a neighbour, then the key holder can open the premises to let the police in.

There is a penalty for too many false alarms. Only four are allowed in any twelve month period, and an excessive number earns a ban on police assistance for three months.

So anyone fitting an electronic alarm should do everything possible to ensure that it is not tripped by household pets, vibration from heavy lorries or extreme changes in the weather.

Barry Fox

Faster PIC

Microchip's new PIC17C43 is the fastest 8-bit microcontroller available, achieving 160 nanosecond instruction times at 25MHz. This high-performance RISC-based microcontroller is a cost effective alternative to more expensive 16-bit microcontrollers and dedicated digital signal processors.

The PIC17C43 includes a 4K × 16 one-time-programmable EPROM memory, and 454 bytes of user RAM. On-chip peripherals include: the fastest PWM outputs in the industry, fast capture inputs, a serial communications interface (USART), and a sophisticated watchdog timer with its own RC oscillator.

The PIC17C43 provides the ideal upgrade path for Microchip's high-end PIC17C42 and mid-range PIC16CXX users. Pin-for-pin plug compatible with the PIC17C42, the PIC17C43 allows users to plug the device into the same space on their printed circuit board and run PIC17C42 software with few changes.

For further information, contact Arizona Microchip Technology Ltd., Unit 6, The Courtyard, Meadowbank, Furlong Road, Bourne End, Bucks, SL8 5AJ. Tel: (01628) 851077, Fax: (01628) 850259.

MORSE COURSE

R.A.E. and MORSE courses are starting again at Wombourne, as follows:

R.A.E. classes on Mondays, 7.00-9.00 p.m. commencing 18 September.

Morse classes on Thursdays, 7.00-9.00 pm. commencing 21 September.

Morse students are taken from beginner's groups to new format 12 w.p.m. Morse Test level. The tutors have been running these courses for many years with a remarkably high success rate.

Enrolment is on 11 and 12 September at: Wombourne Youth and Community Centre, Church Road, Wombourne, Wolverhampton WV5 9EZ. Details from Brian Fereday on 01902 820826.

New Technology Update

Ian Poole investigates the possibilities of the latest developments in SiGe technology and finds that they are no "flash in the pan!"

In recent years there have been many reports in the electronics press about a new silicon/germanium technology. Some reports claim that it will be the most significant development in semiconductor technology for many years. Others say that it will never live up to the extravagant claims made for it, and that it will be just another "flash in the pan".

The new technology uses both silicon and germanium (SiGe) in the structure in a way that improves both the gain and frequency response of the transistors. With current silicon technology it offers an improvement in speed of about two and a half times.

This means that it is fast enough to take on gallium arsenide on this factor alone. However it is much cheaper to use than gallium arsenide, involving relatively slight modifications to the existing silicon processes. This gives it the additional advantage of being able to use existing plant and not require large amounts of investment to set up a new process line.

These advantages make the new technology ideal to cater for the new boom in telecommunications. Cellular phones could use SiGe integrated circuits to provide all their functions, from r.f. signal handling down to all the control and processing required in the phone. This would bring down the cost of this form of communication even further.

The idea behind the technology has been understood for some years. It is based around a hetero-junction bipolar transistor (h.b.t.) Normally transistors use what is called a homo-junction, or one made from the same type of material e.g. silicon/silicon. By adding a second material it is possible to create a hetero-junction, and this creates its own electric field within the structure.

Narrowing the Gap

The improvement in performance can be explained in terms of the band-gap. Germanium has a smaller band-gap than silicon, and introducing a small amount of germanium decreases the band-gap in the transistor. This increases the number of electrons available and hence improves the gain.

The internal electric field also helps the electron mobility, reducing the time for the electrons to travel across the junction. It is this effect which gives the improvement in the frequency response of the devices.

Whilst silicon and germanium have the same shaped crystal structure there is a difference between the lattice spacing between the two materials. The silicon is about 96 per cent that of the germanium. This means that if there was a junction between the two materials the mismatch would cause strains to be set up resulting in defects at the junction, preventing the devices from operating.

To overcome the problem a silicon germanium alloy having a spacing half way between the two substances was developed and used. This enables a junction to be made from silicon and the alloy. Although some stress remains in the structure it is much reduced and with new techniques and careful manufacture no defects are formed.

The exact proportions of silicon and germanium in the alloy have to be carefully chosen. Increasing the amount of germanium improves the performance, but increases the likelihood of defects. Now the balance seems to have been reached using about 30 per cent germanium, and the remainder silicon.

Manufacture

One of the major advantages of the technology is that it is compatible with most of today's processes enabling the new devices to be made with very few modifications to existing plant. In fact it is not just the improvements in specification which make this development so important. It is the fact that they can be achieved by slightly modifying an existing process and using existing equipment.

One method of manufacture uses an ultra high vacuum chemical vapour deposition (UHV/CVD) process. Normal chemical vapour deposition processes operate at temperatures which would damage the structure. By using the new process lower temperatures can be used.

The UHV/CVD stage uses a mixture of the two semiconductors and leaves a thin and very accurately controlled layer of atoms on top of the silicon substrate. This is the basis of the hetero-structure used in the devices.

In other experiments techniques including molecular beam epitaxy have been used. This too operates in an ultra high vacuum, which is required to keep the temperatures down.

Performance

When the first devices were manufactured in early 1990 they achieved speeds which were about twice as fast as anything that was possible with silicon. Now with the technology improving, further advancements are being made and the technology is moving still further ahead of silicon. Speeds of over 100GHz have been reported even now, with higher cut-off frequencies promised for the future.

Apart from speed, these devices offer a high level of gain. Devices operating at around 3GHz have been shown to have a gain of over 20dB. Coupled to this they can enable circuits to operate with a high level of efficiency.

This aspect is a great bonus for anyone designing portable equipment where battery consumption is of crucial importance. Often radio frequency circuits consume large amounts of current so that they can reach the gain and frequency requirements. If the SiGe devices can improve on the existing technologies then this will give them a considerable advantage.

A further advantage of SiGe devices is that they offer a good noise figure. One of the limiting factors in any radio receiver design is the amount of noise generated by the front end circuits.

At the frequencies where these devices will be used the noise generated internally by the set will far outweigh any noise picked up by the aerial. This means that any noise generated in these stages can have the effect of masking out the weaker signals.

Improved noise figure devices will enable more effective circuits to be designed, ensuring that the noise generated within the set is kept to an absolute minimum. Currently noise figures of 0·6dB are being achieved at frequencies around 2GHz.

Problems

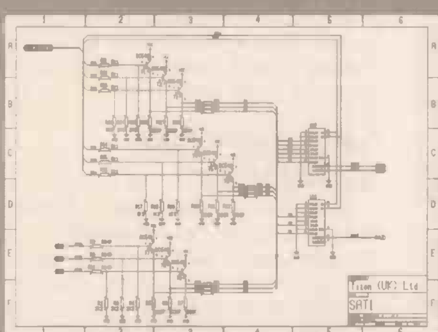
There are many advantages to using SiGe technology, but there are still a few drawbacks associated with it. One of the major worries is associated with its reliability.

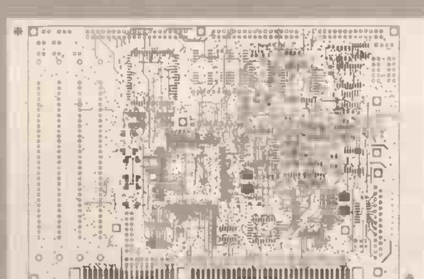
Even with the new alloy there is a strain set up within the crystal structure. This may give rise to long term failures, especially if the equipment is operated at elevated temperatures. To find out whether this is a problem a number of investigations are being performed.

Another difficulty is the low operating voltages which it will sustain. The technology has a low breakdown voltage and this limits many aspects of operation. There is a trend towards ever decreasing supply voltages in the digital areas, and this will present no problem. In fact 3·3V is now becoming the new standard especially for battery powered portable equipment.

However, there are still a number of areas where higher voltages are needed. This is particularly true for transmitting amplifiers where they are needed to ensure that the required power levels can be attained. It is in this area that SiGe devices are lacking. Even if they are kept within their limits whilst operating into a good aerial, if this is removed then damage will almost certainly result.

Enormous possibilities exist for SiGe devices. Work is progressing to overcome many of the limitations, and it is to be expected that real improvements will be seen in the next few years.





LOW RANGE OHMMETER ADAPTOR

STEVE KNIGHT

Increase the accuracy of low value resistance readings on your DVM.

IT IS sometimes necessary to find the value of a resistor or, more particularly perhaps, the resistance of a length of wire, or a small coil, or a current meter shunt, where the actual resistance lies below ten ohms and may well be a fraction of an ohm.

This is where a low range ohm-meter is useful. Such an ohmmeter is also very handy for checking the resistance of printed circuit board tracks, especially where the tracks have to carry appreciable currents, and soldered connections where an extremely small resistance should be expected.

SCALE ACCURACY

If reasonable accuracy in the measurement of a low resistance is needed it is wise not to depend upon analogue ohmmeters unless these have been specifically designed to have a low-resistance range. Ordinary analogue multimeters of good quality such as the Avometer used on the lowest resistance range will certainly provide an indication of values below ten ohms.

However, once the test resistance falls between the scale divisions or gets below one ohm, the eye is forced to judge the position of the pointer against a fraction of the scale length that is devoid of identifying lines.

For example, the author needed to find the value of a shunt resistor which was known to be approximately 0·7Ω; on the Avometer he had to judge the value indication on a blank section of the scale which was about 5mm long and represented zero to one ohm, see Fig. 1.

After taking the test lead resistance into consideration and allowing (again by eye) for the scale non-linearity, the reading *looked* to be somewhere about 0·7Ω, but it could well have been anything from 0·6Ω to 0·8Ω, clearly a hit and miss measurement.

For those who now wonder about using a digital meter, the answer is that a similar problem can arise in general purpose instruments in spite of their much superior resolution over analogue meters. For instance, a 3·5-digit display type of digital meter with a basic 199·9 indication on its lowest resistance range is perfectably readable down to an ohm or so without too much questioning. When going below an ohm, though, some doubt can creep in.

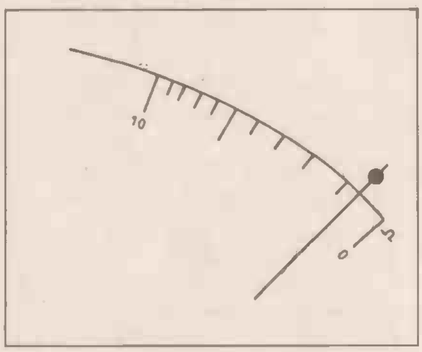


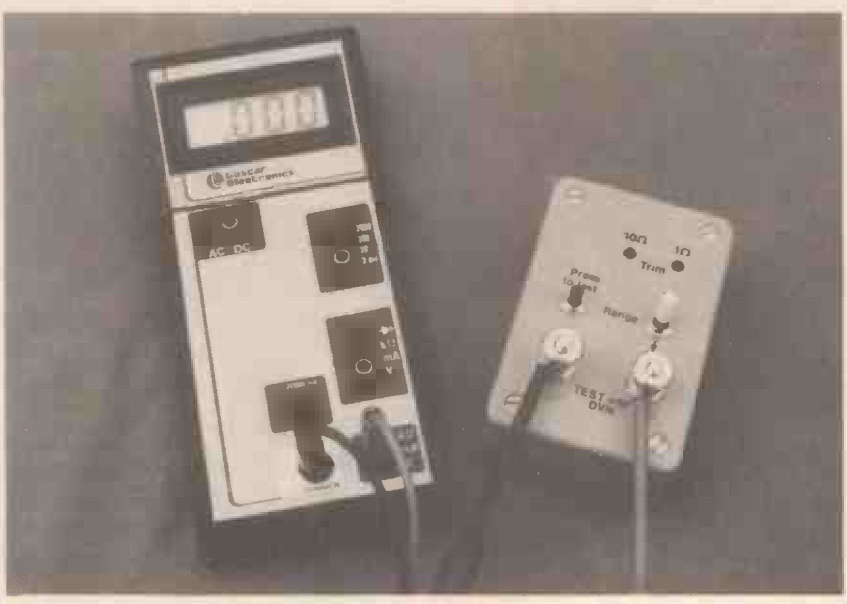
Fig. 1. Low ohms scaling of typical analogue multimeter.

As an example, a reading of 000·5 on the 200Ω range does not mean that the test resistance is exactly 0·5Ω; its value could well lie between 0·45Ω and 0·55Ω, and the display may often be found to flicker between readings of 000·4 and 000·5 or 000·5 and 000·6 on such occasions. Using the digital instrument on the author's shunt resistor simply gave such a result, and once again the actual value could have been between 0·65Ω and 0·75Ω. This was no improvement on the guess-work associated with the Avometer.

Using a very accurate bridge the author actually found the resistor to be 0·737Ω, but it was while pondering on the points discussed above that he got an idea for a simple adaptor which could be used with a digital meter to provide more reasonable accuracy of this sort.

ADAPTOR CIRCUIT

Of course, it is possible to measure the current through, and the voltage across an unknown resistor and then use Ohm's law to calculate the value. This is a bit troublesome since a large current is needed to produce a measureable voltage drop. The problem is then simply switched from the ability to read a small resistance accurately to that of measuring a small voltage accurately.



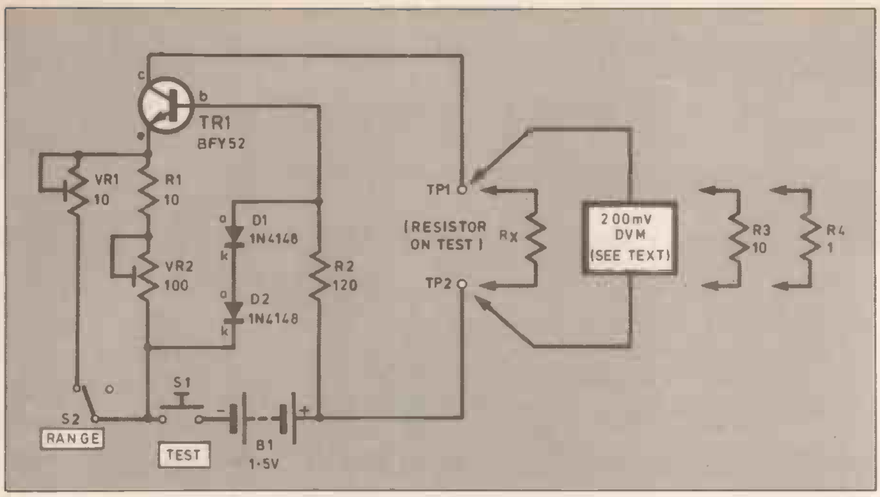


Fig. 2. Full circuit diagram for the Low Range Ohmmeter Adaptor.

With the very simple adaptor described here, an existing 3·5-digit DVM used in the millivolt mode can be made to read between zero and 10Ω in two ranges: 0 to 1Ω and 0 to 10Ω with two (and possibly three) decimal place indication. Using this adaptor, the shunt resistor value was found to be 0·73(4)Ω within the stated accuracy of the voltage range used and that of the calibration resistor used.

The full circuit diagram for the *Low Range Ohmmeter Adaptor* is shown in Fig. 2, where its simplicity is immediately apparent. The source of power supply is a single 1·5V cell and only a single transistor is needed, plus a few resistors and diodes and a couple of multi-turn potentiometers, all readily available and inexpensive.

Transistor TR1 is a constant current generator producing a known current through the test resistor R_X. The voltage developed across the test resistor is then measured by an external DVM which is switched to the 200mV range. Thus, unless Ohm's law has been deceiving us all these years, this voltage will be directly proportional to the value of the test resistance since the current is constant.

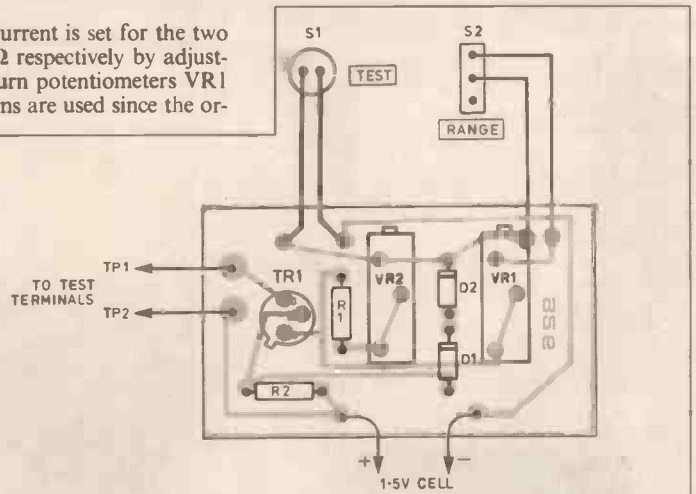
The level of the current is set for the two ranges, 1Ω and 10Ω respectively by adjustment of the multi-turn potentiometers VR1 and VR2. Multi-turns are used since the ordinary carbon rotary types are insufficiently "smooth" to be able to adjust with any accuracy, especially on the 1Ω range.

Once these are set up, no further attention is needed until the battery voltage has changed sufficiently to affect the readings. A couple of "trimmer" holes are provided in the case lid so that small correcting adjustment can be made to the multi-turn pots each time the adaptor is used. When drilling the case lid, position these trim holes so that they are directly above the multi-turn screwheads.

The on-off switch S1 is a push-to-make button type. This type is used because in operation it is pressed *only* when a reading is being taken and so prevents the adaptor from being inadvertently left on after use, the current drain from the cell being quite heavy.

CONSTRUCTION

The adaptor is built on a small printed circuit board which is shown in Fig. 3. There should be no problems in making this up, just make sure of the orientations of the transistor and diodes, with the usual care in soldering. When completed, this board slips vertically into the internal wall grooving at one end of the small case.



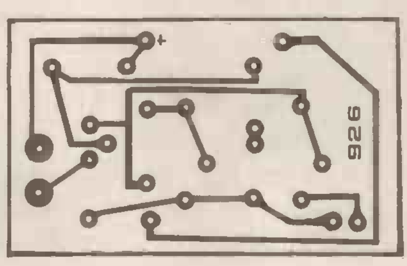


Fig. 3. Printed circuit board component layout and full size copper foil master track pattern. This board is available from the EPE PCB Service, *code 926.*

There is nothing critical about positioning things inside the case, except that the access holes to the potentiometers should be correctly placed. The switch wire lengths are not important but keep the two test terminal leads as short as you possibly can without any tightness or straining.

The test terminals, TP1 and TP2, should be of the all metal types so that the test resistor can be clamped firmly and closely to them. Avoid terminal plugs and sockets as these can introduce small but significant resistance. Terminals could, alternatively be made using a couple of 2BA screws about one inch in length, with nuts and washers as appropriate.

The cut-out pattern for the lid components and the lettering legends are shown in Fig. 4. If you use an alternative case there should be no problem in placing the parts in roughly the same positions. The simple cell is an AA type battery clipped into a conventional holder (with tags) which is glued or screwed to the base of the case. Because of spacing requirements with the small listed case, mount the cell holder diagonally.

CALIBRATION

Calibration is quite simple, but care is needed on the 1Ω range. You will need two accurate test or calibration resistors of 1Ω and 10Ω in value at a minimum one per cent tolerance, but better if you can get them. If you happen to have a standard resistance box (the author has an old ex-Army one which contains a total of 100Ω which can be adjusted in precise 0·1Ω steps) each range can be thoroughly checked with the best possible accuracy.

Set both multi-turn potentiometers, VR1 and VR2, to about mid-travel, set the Range switch to 10Ω and clamp an accurate 10Ω calibration resistor firmly across the test terminals. Now connect your digital meter, switched to the 200mV

COMPONENTS

See SHOP TALK Page

Resistors
R1 10 5% or better
R2 120 5% or better
R3 10 1% or better
R4 1 1% or better
All resistors metal film or better

Potentiometers
VR1 10 0·75in multi-turn
VR2 100 0·75in multi-turn (20 turns or more)

Semiconductors
D1, D2 1N4148 signal diode (2 off)
TR1 BFY52 *npn* transistor

Miscellaneous
S1 push-to-make momentary action switch
S2 s.p.s.t. min. toggle switch
Printed circuit board available from *EPE PCB Service,* code 926; plastic box 85mm x 56mm x 40mm; single AA size cell holder with tag ends; 4mm screw terminal post (2 off); solder tag (2 off); connecting wire; solder.

Approx cost guidance only **£10**

d.c. range, across the test resistor (lead length here is not important). Although the 200mV range of the DVM is being used, it is only used as far as the 100mV point. The reading obtained then corresponds to the unknown resistance value from 0 to 10Ω. Now adjust preset VR2 to give this 100mV meter reading while pressing the button switch. The reading (although strictly in millivolts) corresponds to a resistance value of 10Ω.

You can check the linearity of the scale by connecting one or more intermediate values of resistance to the test terminals. The positioning of the decimal points for any reading has, of course, to be mentally adjusted to suit the scaling.

Repeat the above procedure on the 1Ω range, using your accurate 1Ω calibration resistor at the test terminals, and this time adjusting preset VR1 to give a reading of 100mV, which will now represent a 1Ω resistance value. A reading of, say, 47·5mV would therefore indicate a resistance of 0·475Ω.

It is a bit trickier to set the DVM exactly to 100mV on this smallest range than it is on the larger. This comes about because of slight fluctuation in the otherwise constant current from transistor TR1 and the finite resolution of preset VR1. A flickering of the last decimal place in this case within the range 000·2 does not impede the usefulness of the adaptor, particularly if the calibration resistor is not better than a one per cent type.

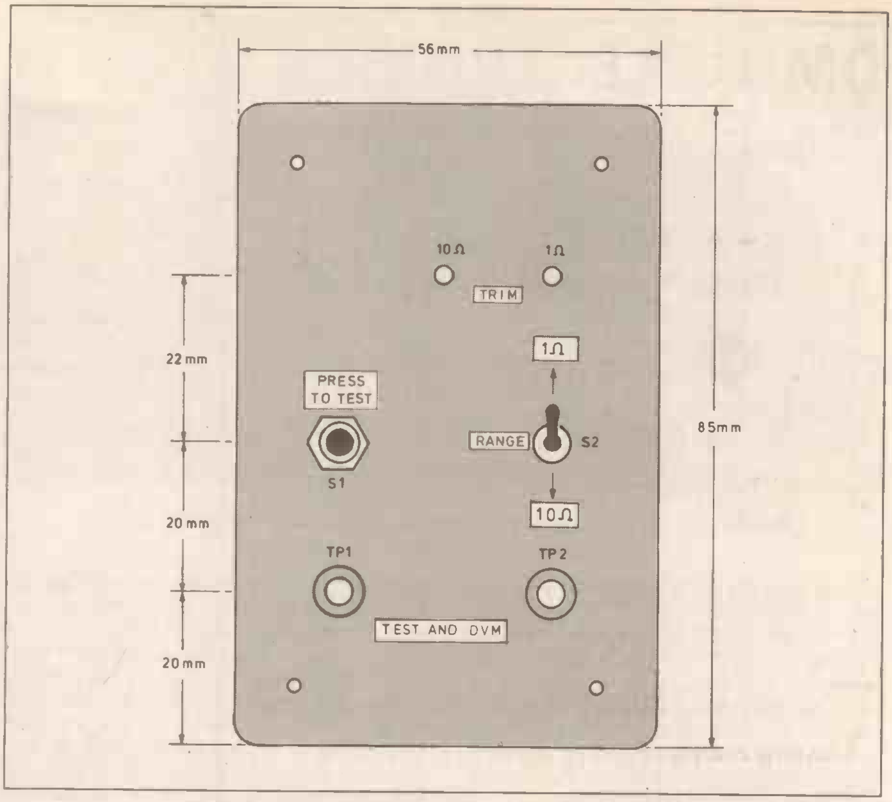


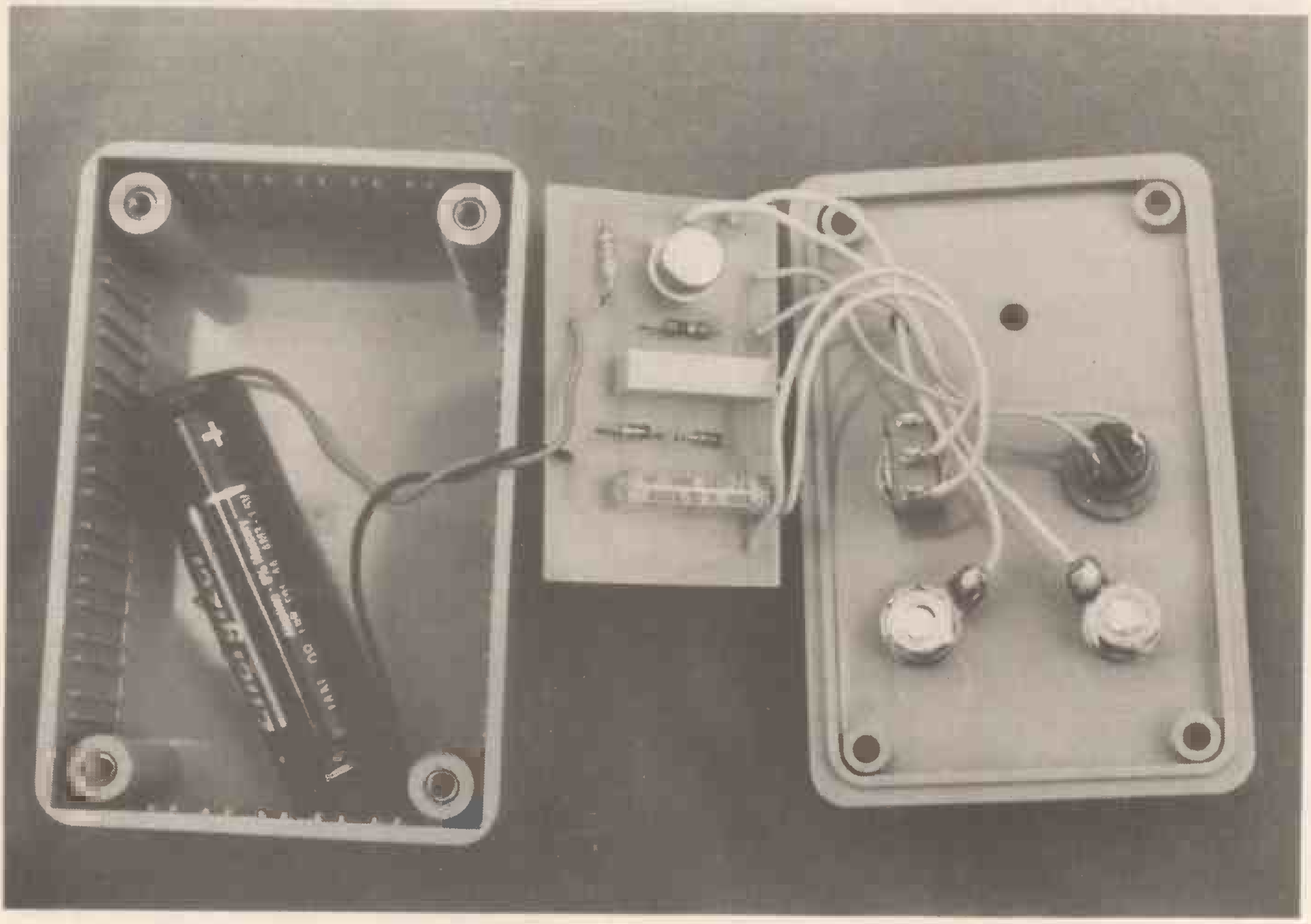
Fig. 4. Layout and drilling details for the case.

OTHER METERS

Some DVMs have a lowest d.c. range of 400mV. These can still be used, adjusting the multi-turn presets to provide a full scale at the 100mV point.

There is no reason why an analogue meter, possibly with an f.s.d. of 100μA to 500μA cannot be used in place of a DVM. However, a lot depends upon the internal resistance and it is possible that anything above a few hundred ohms may not enable f.s.d. to be obtained.

If you have a meter with a lowest range of 100mV, it is worthwhile doing a bit of experimenting with it. By using a larger case, such a meter could be built into it, so making up a compact low range ohm-meter.



COMPREHENSIVE SECURITY SYSTEM

DUNCAN BOYD

All-round protection for the garden shed, garden furniture, garage and the home.

HOUSE break-ins have been a problem for a long time, but in recent years the problem of theft from gardens, garden sheds and garages has escalated dramatically.

This is probably partly due to the fact that a garden shed may be quite easy to break into and therefore offer an opportunity for the thief where there is a low risk of being caught. Furthermore, the average garden shed is now home to a great many expensive items such as mountain bikes, lawnmowers, power tools, etc.

The total value of the items in many cases may well exceed a thousand pounds. Thieves know this, and they also know that they can sell such items quickly for "easy money". Many readers will relate to this problem from bitter personal experience – as does the author, which is how the idea for this project came about.

The design is mains powered but a rechargeable battery is used as a backup if the mains fails or if any of the wires are cut. The battery and the siren are housed outside in a standard alarm bell-box. If someone tries to tamper with the bell-box the siren will sound. An internal buzzer is included. The basic sensor system is in the form of a balanced resistive loop, although provision has been made for passive infra-red (PIR) sensors to be used as well.

HOW IT WORKS

The basic operation of the alarm is shown in the block diagram in Fig. 1. It comprises internal and external sensor circuits, both partly interlinked. Considering the internal section of the alarm first, in which PIR sensors can be used, when the keyswitch is opened there is a 30 second delay before the alarm becomes active. This allows the householder to switch the alarm on and leave the house without it being triggered.

If, after this delay, one of the sensors is triggered, there is a 15 seconds delay before the alarm is set off, which should allow enough time for the householder to switch the alarm off after re-entering the house. If the external siren is set off, it continues to sound for 20 minutes before being automatically switched off.

For the external alarm, a resistive wire loop is used as the sensor. The operation of this circuit is controlled by a switch. When the switch is opened, there is a delay of approximately seven minutes before the alarm becomes active. This allows plenty of time to switch on the alarm, leave the house, take the car out of the garage, and so on, before the alarm becomes active.

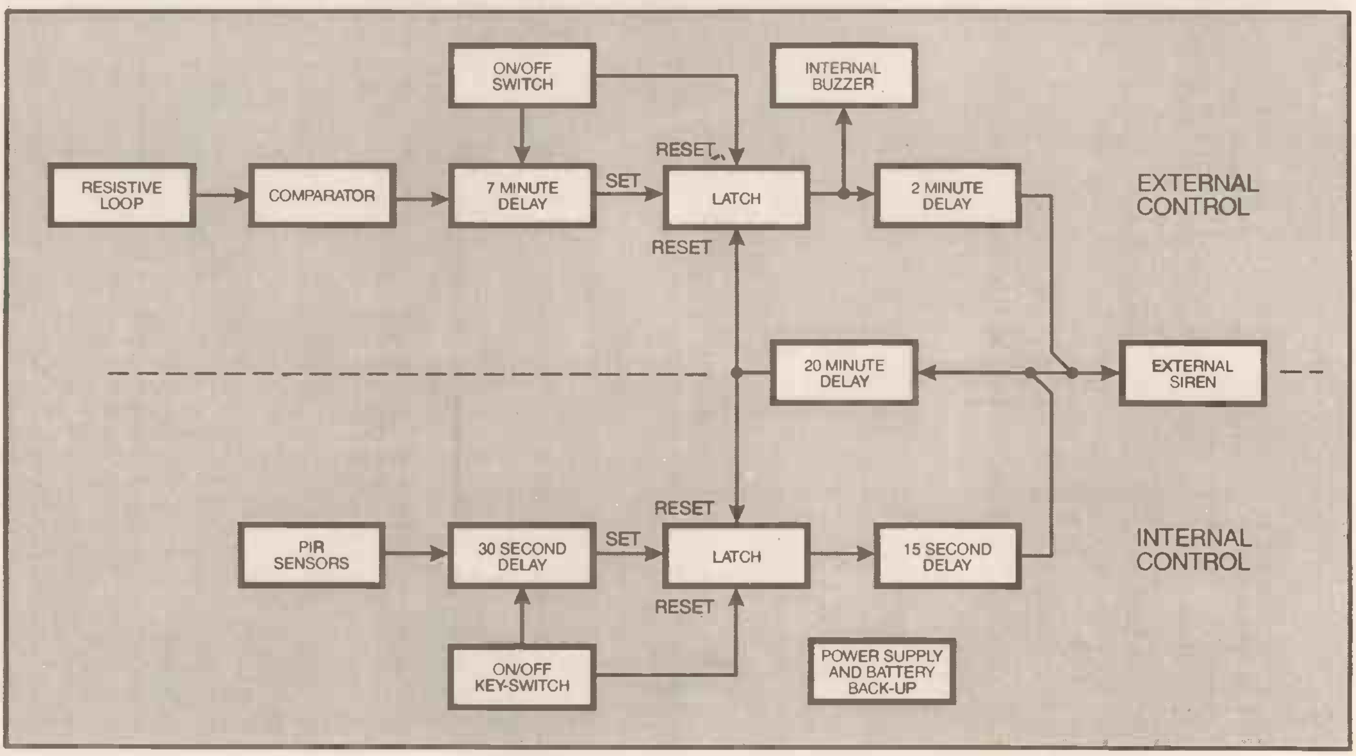


Fig. 1. Block diagram for the Comprehensive Security System.

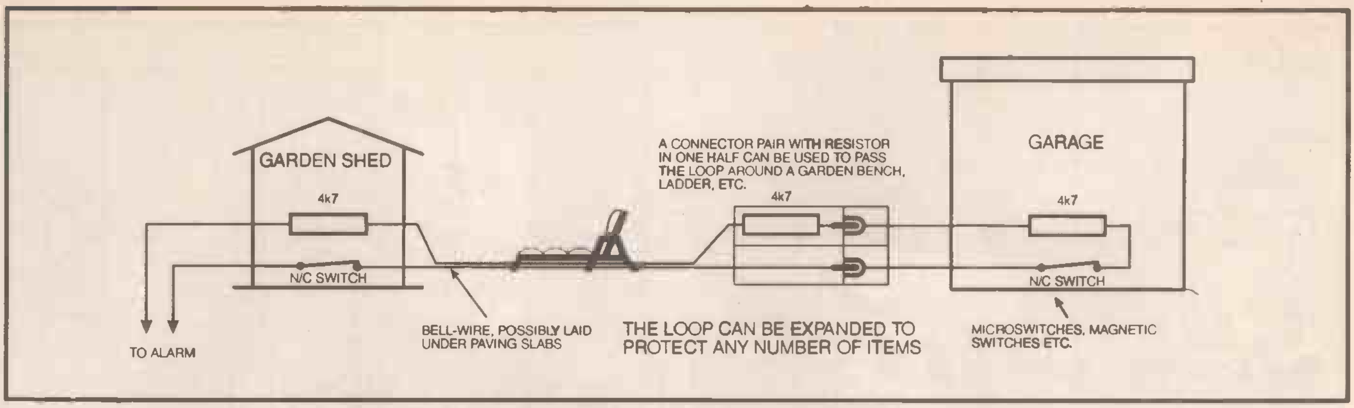


Fig. 2. How the resistive loop might be routed. The options are limitless.

After this period, if the alarm is tripped, the buzzer inside the house will sound, but there will be a delay of about two minutes before the external siren sounds.

There several advantages to configuring the alarm in this way. First of all, it allows time to put the car back in the garage, enter the house and switch off the alarm before the external siren sounds thereby "crying wolf" to the displeasure of neighbours.

Also, if someone raids the garden shed in the middle of the night, the internal buzzer will go off immediately, but the thief will not know that he has been rumbled. There is then a choice: switch off the alarm and telephone the police, hoping they will arrive before the thief disappears with the best power drill. Alternatively, the alarm could be left on, allowing the external siren to sound, which would hopefully encourage the thief to make a hasty retreat.

All delay times can be changed during construction.

SENSORS

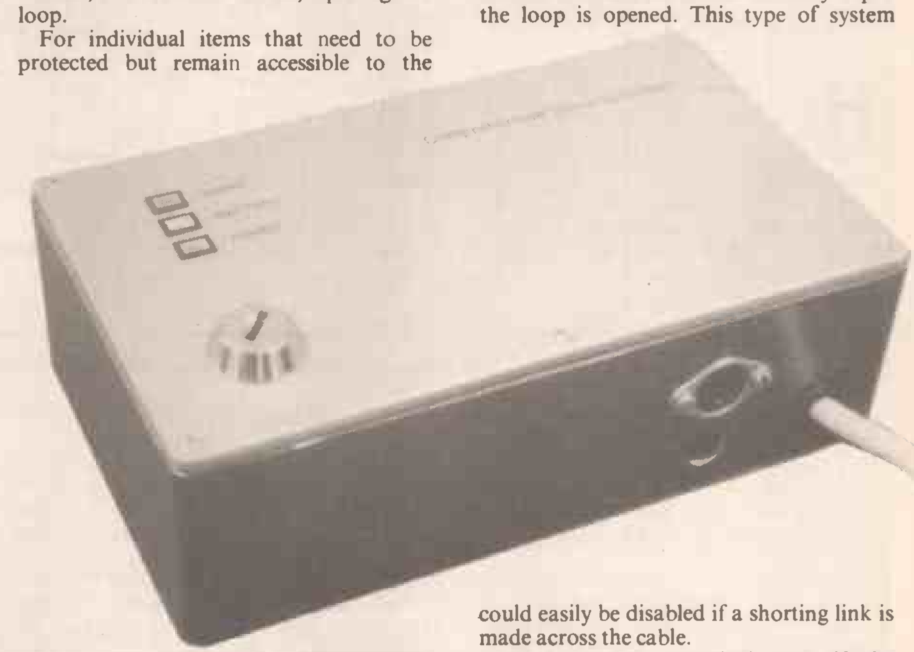
The internal section of the alarm is intended to be used with commercially available PIR sensors. These can be powered from the alarm's 13·8V power supply. The sensors contain normally-closed relay contacts and any number of sensors can be wired in series. Using this type of sensor offers the minimum fuss since there is little wiring. Microswitches, magnetic switches or pressure pads and the like could be used instead.

Externally, bell wire is used to form the resistive loop around the garden shed, garden bench, garage and tools, etc., as shown in Fig. 2. Taking the example of the garden shed, microswitches or magnetic switches can be fitted to the doors (magnetic switches are usually better since they tolerate more play).

If the shed window is large enough to need protecting, conductive tape could be used, or a fine piece of wire stretched across it, supported by nails. If the window is broken, the wire will break, opening the loop.

For individual items that need to be protected but remain accessible to the owner, the garden bench for example, a phono line plug and socket pair can be inserted into the loop. The loop can then be passed through one of the bars in the bench. Each connector pair has a resistor wired into it.

The resistive loop forms one arm of a potential divider, the resultant potential being fed to a "windowed" comparator. In conventional loop alarms, the loop is a short circuit and the alarm will only trip if the loop is opened. This type of system could easily be disabled if a shorting link is made across the cable.



In the system described here, if the loop is opened, shorted or its resistance changed, the potential at the sensing comparator will change and the comparator will trip. Using this technique, almost any item can be protected. It is very difficult to bypass this type of loop.

With the prototype, the bell wire was laid under the garden path, a spade being used to prise up the slabs just enough to tuck the wire underneath. This meant that no part of the wire could be seen, which was desirable though not completely necessary.

There is no reason why the wire should not be suspended overhead, or laid under a hedge, for example. However, it would be a good idea to protect sensitive areas of the wire by passing it through a length of thin-bore plumbing pipe, or similar. This would prevent the local rabbit population from chewing through the loop during the night!

POWER SUPPLY

The circuit diagram for the mains operated power supply used in the alarm system is shown in Fig. 3. The secondary a.c. voltage from transformer T1 is bridge

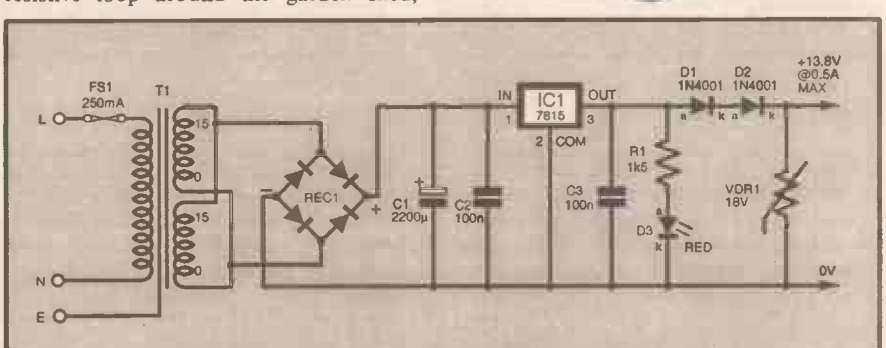


Fig. 3. Power supply and decoupling capacitor details.

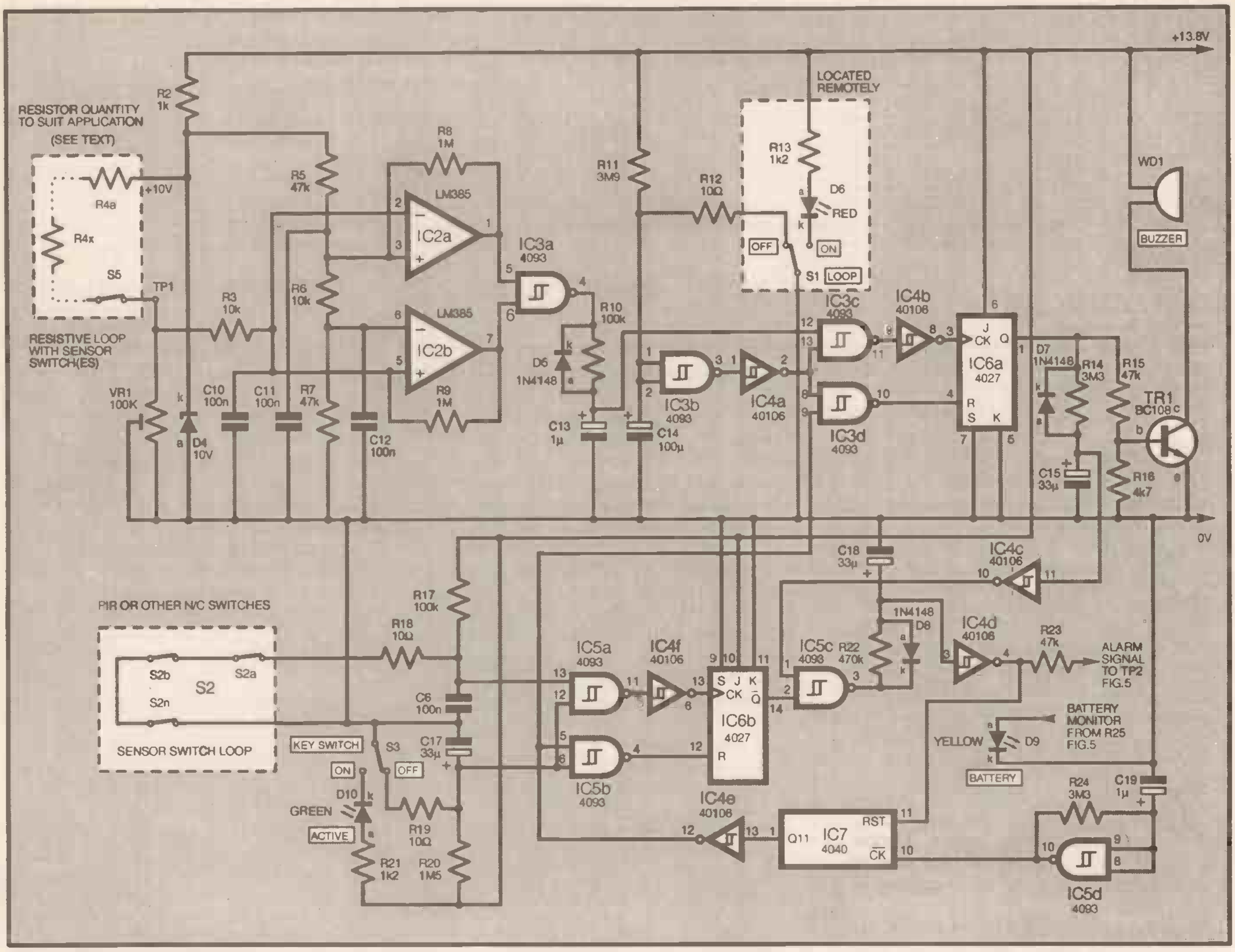


Fig. 4. Circuit diagram for the main part of the alarm sytem.

rectified by REC1, smoothed by capacitors C1 and C2, and regulated down to 15V d.c. by IC1. Diodes D1 and D2 then drop this voltage down to approximately 13·8V, a voltage chosen because it is the recommended float charging voltage for the lead acid back-up battery.

Since spikes could appear on the supply line, which could possibly trigger the alarm, a voltage dependent resistor, VDR1 is included. This is an 18V device which reduces spike levels should they occur, thereby reducing the possibility of a false alarm.

The siren used in the system draws about 300mA when operating. Depending on the type used, the PIR sensors could draw up to 40mA each. The float charging current for the battery is about 10mA.

Using a 15V 12VA transformer, the maximum output current available is a little over 0·5A, which should be adequate for most systems.

Also shown in Fig. 3 are the decoupling capacitors placed across the i.c. power supply pins. The capacitors help to reduce noise and to stabilise the voltage across the devices whilst they are switching.

Unplugging the connector looped around the garden bench will automatically set off the active alarm.

ALARM CIRCUIT DIAGRAM

The circuit diagram for the main part of the alarm system is shown in Fig. 4. Taking the internal section of the alarm first, with the keyswitch S3 in the OFF state, input pin 6 of Schmitt NAND gate IC5b is held low via resistor R19. Regardless of the logic level on the other input, pin 5, the gate's output at pin 4 will be high, thereby holding the JK bistable IC6b reset via its pin 12. In this state, the condition of the sensors has no effect.

When the keyswitch is switched to the ON state, enabling the alarm, capacitor C17 starts to charge up via resistor R20. After around 30 seconds, when C17 has charged up sufficiently, IC5b pin 4 goes low, removing the reset signal from IC6b. This timing forms the exit delay to allow the house to be left after the alarm is switched on. Light emitting diode (l.e.d.) D10 is turned on when the circuit is active, resistor R21 limiting the current drawn.

After this exit delay, if any of the sensor switches (S2a, S2b etc.) are opened, input pin 13 of Schmitt NAND gate IC5a will rapidly rise from logic 0 (low) to logic 1 (high). Since IC5a pin 12 is already held high via resistor R20, IC5a output pin 11 will go low and, via inverter IC4f, send a positive-going clock pulse to IC6b. Capacitor C16 is included to provide filtering of the loop line to protect against minor noise levels.

The clock pulse triggers the bistable such that its $\overline{Q}$ output pin 14 goes low, which in turn causes NAND gate IC5c output pin 3 to go high (IC5c pin 1 is already held high at this time). Capacitor C18 now starts to charge up via resistor R22. After about 15 seconds, when C18 has been charged sufficiently, the output of Schmitt inverter IC4d will go low. This timing forms the entry delay so that the alarm can be switched off after re-entering the house.

When output pin 4 of inverter IC4d goes low (an action which causes the siren to sound), reset pin 11 of counter IC7 also goes low, so enabling the counter. The counter is now clocked via its pin 10 by the output signals from the astable multivibrator formed around Schmitt NAND gate IC5d. Resistor R24 and capacitor C19 set the clock frequency to a little less than 1Hz. (Decreasing the value of either component will increase the frequency.)

Once enabled, counter IC7 counts 1024 pulses and then its output Q11, pin 1, goes high. Inverted by IC4e, output Q11 now causes bistable IC6b to be reset via IC5b. This action propagates through the circuit, resetting counter IC7, and also turning off the siren control line.

When IC5c output pin 3 goes low, capacitor C18 is rapidly discharged via diode D8, so there is no delay in the alarm switching off. The clock frequency as described provides a siren sounding time of around 20 minutes. With the counter once again reset, the alarm is reprimed and ready to be triggered if a sensor is tripped.

OUTDOOR CIRCUIT

Still referring to Fig. 4, the outdoor section of the alarm works as follows:

Resistor R2 and Zener diode D4 set a 10V reference voltage. Via the chain of resistors R5 to R7, this voltage is divided down to provide 5·5V at the non-inverting input of op.amp IC2a (pin 3) and 4·5V at the inverting input of op.amp IC2b (pin 6). Both op.amps are configured as "windowed" comparators, in this instance, the "window" being the 1V differential between the 4·5V and 5·5V reference voltages.

The external loop total resistance is designated as R4 in the dotted box to the top left of Fig. 4. Between them, resistance R4 and preset variable resistor VR1 form a potential divider, whose junction voltage (at test point TP1) is set for approximately 5V. Via resistor R3, this voltage is applied equally to IC2a pin 2 and IC2b pin 5.

Feedback resistors R8 and R9 provide hysteresis for the two comparators so as to ensure a clean switching action. Decoupling capacitors C10 to C12 are used to reduce the possibility of false triggering by noise signals.

With the potential at TP1 set for 5V, the outputs of both comparators are both close to the positive supply line voltage, providing a logic 1 level to the inputs of Schmitt NAND gate IC3a.

If the resistance of the sensor loop is increased, the voltage at TP1 will drop. Should it go below 4·5V, comparator IC2b will be triggered and its output go low. Similarly, if the loop resistance decreases, the voltage at TP1 will rise. If it rises above 5·5V the output of comparator IC2a will go low.

If either comparator output is triggered low, IC3a pin 4 will go high, applying the same level to pin 12 of Schmitt NAND gate IC3c. Resistor R10, capacitor C13 and diode D5 are included to reduce the possibility of a false alarm. Provided that this end of the circuit is active, the high output of IC3a will propagate through IC3c and IC4b providing a positive-going clock signal to pin 3 of bistable IC6a.

When triggered by the clock pulse, output Q of IC6a goes high, turning on transistor TR1 via resistor R15. As a result, buzzer WD1 is activated. Additionally, capacitor C15 starts to charge up via resistor R14. After about 105 seconds, or so, the output from Schmitt inverter IC4c goes low, causing the output from NAND gate IC5c to go high. From this point on, the operation of the circuit is exactly the same as for the internal section of the alarm. Diode D7 speeds up the discharging of C15 at the end of the 20 minutes delay.

The delay caused by the combination of R14/C15 and R22/C18 gives a total delay time of about two minutes between the sounding of the internal buzzer and the sounding of the external siren.

Activation of this part of the circuit is controlled by switch S1. With S1 in the OFF condition, the two inputs to Schmitt NAND gate IC3b are held low via resistor R12. When this circuit section is first switched on by S1, capacitor C14 starts to charge up through resistor R11. Then, after about seven minutes, IC3b output pin 3 goes low, and via inverter IC4a, takes IC3c pin 13 and IC3d pin 8 high. This period provides the required exit delay.

At the end of the delay, IC3d output pin 10 goes low, removing the Reset level from bistable IC6a pin 4. After this, if the loop resistance changes enough to trip either of the comparators, the output of IC4b will go high, triggering IC6a.

SIREN DRIVER CIRCUIT

The circuit diagram for the siren driver is shown in Fig. 5. This uses a windowed comparator in the same way as the loop sensor, formed here around op.amps IC8a and IC8b. The reference voltages are provided by the potential divider formed by resistors R26, R28 and R30. The alarm signal voltage is brought to the junction of resistors R27 and R29 (test point TP2). It is then fed via R27 equally to the two

The siren, its sub-assembly board and back-up battery may be mounted in the same housing.

op.amps. Capacitor C20 mops-up minor noise signals.

If the wire between the main alarm circuit and the siren driver is tampered with, or if the alarm signal line goes low (from IC4d via R23) due to one of the sensors being tripped, the voltage at TP2 changes. One or other of the comparators (depending on the polarity of the voltage change) then trips and its output goes high, turning on MOSFET TR2 and so sounding the siren, WD2. Diodes D11 and D12 prevent conflict between the two op.amp outputs. Resistor R31 provides a discharge path for TR2's gate capacitance.

This section of the alarm, together with the lead acid battery, is housed externally in a bell-box. The fuse protects the battery from short circuit should the wire from the main alarm circuit to the bell-box be cut.

Resistor R25 couples the power rail back to l.e.d. D9 in the main circuit. Together with l.e.d. D3 of the power supply, this gives a positive indication that the supply rail throughout the alarm system is healthy. On the front of the bell-box l.e.d. D13 gives a visual indication to passers-by that the bell-box is not empty! When the siren sounds, l.e.d. D14, which is also on the front of the bell-box, flashes thereby giving a visual fix on where the noise of the siren is coming from.

Diode D15 reduces the voltage across l.e.d. D14 to around 10V. The latter's maximum working voltage is 12V so the 13.8V supply could destroy it if D15 was omitted.

Should someone try to remove the lid-retaining screw from the bell-box, microswitch S4 will close, so changing the voltage at TP2 and setting off the alarm.

DELAY CHANGING

The various delays incorporated into the alarm were designed for a specific user and these delays may not meet the requirements of all readers. Table. 1 shows which components are responsible for the delays and can be used to calculate component values for other timings.

All quoted delays are approximate, especially the seven minute one, since

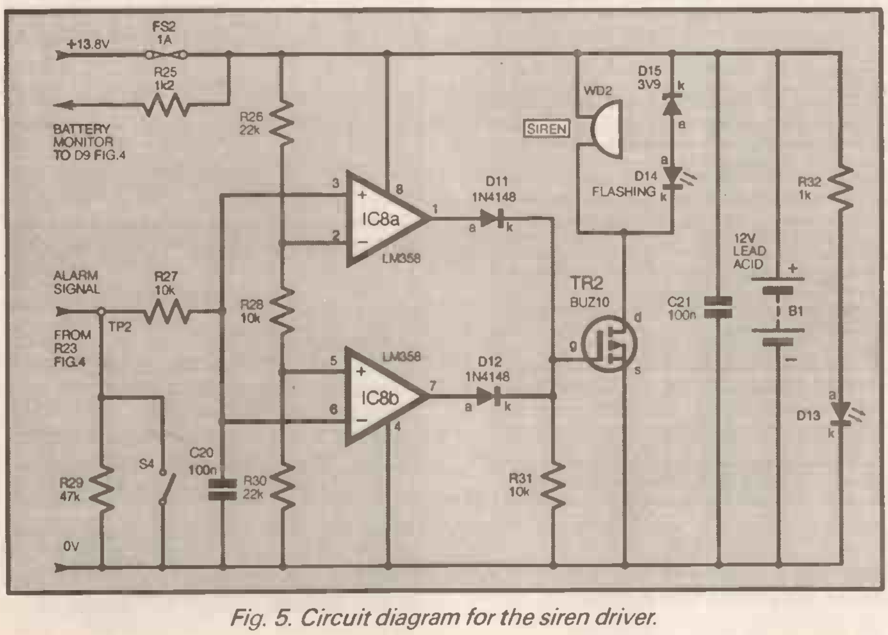


Fig. 5. Circuit diagram for the siren driver.

capacitor tolerances are quite wide and the higher capacitor values have larger leakage currents. Furthermore, the exact delay is dependent on the logic threshold of the Schmitt trigger gates, a level which may vary between devices from different manufacturers and between production batches.

The 20 minutes siren sounding delay can be changed in two ways: one of the other counter outputs could be used instead of output Q11, or the clock frequency generated by IC5d could changed. Smaller values of either resistor R24 or capacitor C19 will result in shorter delay times.

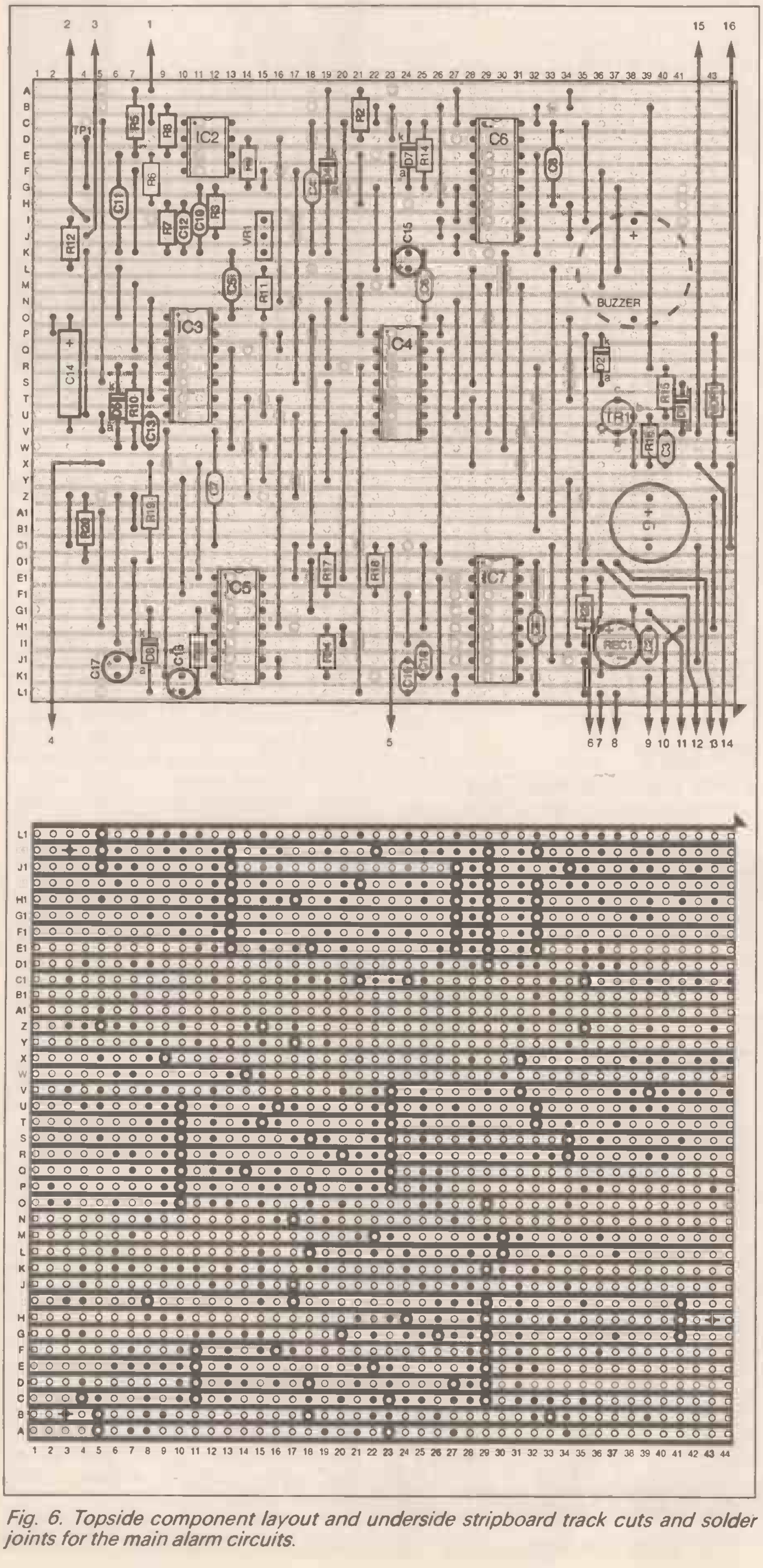


Fig. 6. Topside component layout and underside stripboard track cuts and solder joints for the main alarm circuits.

CONSTRUCTION

The alarm system is constructed on two pieces of 0·1 inch grid stripboard. Component layout, soldering points and track cutting details for the main circuit are shown in Fig. 6. Similar details for the siren driver circuit are given in Fig. 7.

There are many track cuts to be made and it is probably best if they are cut after assembling the components. Beware not to exert too much pressure on the stripboard when making the cuts – it is fragile and could break, especially when several cuts are in line. The use of a proper track cutting tool is recommended. Make sure that the tracks are cut cleanly and that there are no whiskers of copper left dangling loose.

Assembly of the components can be carried out in any order you feel content with, ideally starting with the lowest profile components. Remember to include all of the link wires shown. The use of i.c. sockets is strongly recommended.

Take care over the polarities and orientations of the electrolytic capacitors and semiconductors. Treat all the i.c.s as CMOS devices, taking the usual precautions to discharge static electricity from your body before handling them. Following assembly, thoroughly check that soldered joints are satisfactorily made and that the components are indeed correctly orientated.

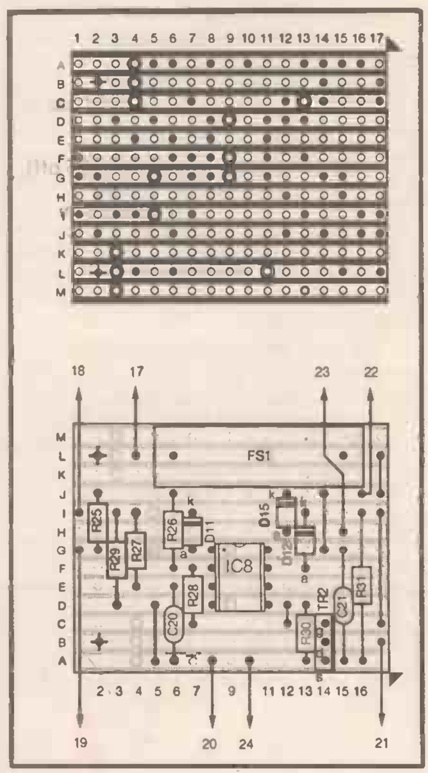
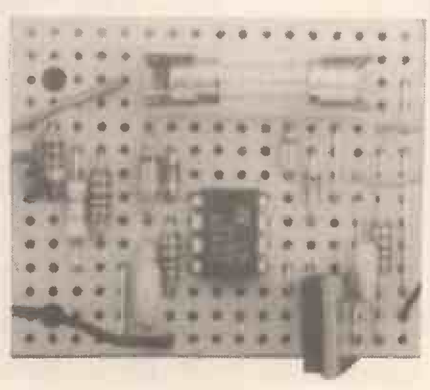


Fig. 7. Stripboard assembly details for the siren driver circuit.



COMPONENTS

See SHOP TALK Page

Resistors
R1 1k5
R2, R32 1k (2 off)
R3, R6, R27, R28, R31 10k (5 off)
R4 4k7 (see text)
R5, R7, R15, R23, R29 47k (5 off)
R8, R9 1M (2 off)
R10, R17 100k (2 off)
R11 3M9
R12, R18, R19 10Ω (3 off)
R13, R21, R25 1k2 (3 off)
R14, R24 3M3 (2 off)
R16 4k7
R20 1M5
R22 470k
R26, R30 22k (2 off)
VDR1 18V voltage dependent resistor

Potentiometer
VR1 100k multi-turn preset

Capacitors
C1 2200μ elect. 25V
C2 to C12, C16, C20, C21 100n (14 off)
C13, C19 1μ elect. 63V (2 off)
C14 100μ elect. 16V
C15, C17, C18 33μ elect 16V (2 off)

Semiconductors
D1, D2 1N4001 diode (2 off)
D3, D6, D10 l.e.d., red (3 off)
D4 BZY88C 10V Zener diode
D5, D7, D8, D11, D12 1N4148 signal diode (5 off)
D9 l.e.d., yellow, 10mm, rectangular plus holder
D13 l.e.d., green, 10mm, rectangular plus holder
D14 l.e.d., red, flashing, 10mm, rectangular plus holder
D15 BZY88C 3V9 Zener diode
TR1 BC108 *npn* transistor
TR2 BUZ10 MOSFET *n*-channel power transistor
IC1 7815 voltage regulator
IC2, IC8 LM385 dual op.amp (2 off)
IC3, IC5 4093 quad 2-input Schmitt NAND gate
IC4 40106 hex Schmitt inverter
IC6 4027 dual JK bistable
IC7 4040 12-stage counter
REC1 50V 1A bridge rectifier

Miscellaneous
T1 15V-0V 15V-0V, 12VA mains transformer
FS1 250mA 20mm fuse and panel mounting fuseholder
FS2 1A 20mm fuse and p.c.b. mounting holder
WD1 buzzer (see text)
WD2 siren (see text)
S1 dual light switch (see text)
S2 see text
S3 s.p.d.t. keyswitch
S4 s.p.c.o. microswitch
S5 see text
SK1 8-pin phono line socket
SK2 8-pin DIN chassis socket
PL1 8-pin phono line plug
PL2 8-pin DIN line plug

Stripboard, 0·1 inch matrix 19 holes x 16 strips, stripboard 0·1 inch matix 45 holes x 40 strips; diecast metal box 190mm x 108mm x 60mm; 12V lead acid battery; commercial detectors as appropriate (see text); bell-box to suit; connecting cable; wire; solder, etc.

Approx cost guidance only **£55**

Table 1. Delay Times.

Delay	Calculation	Time
House Exit	0·6 × R20 × C17 Seconds	0·6 × 1·5M × 33μ = 30 Seconds
House Entry	R22 × C18 Seconds	470k × 33μ = 15·5 Seconds
Loop Exit	1·1 × R11 × C14 Seconds for large C with high leakage 0·6 × R11 × C14 Seconds for small C with low leakage	1·1 × 3·9M × 100μ = 429 Seconds = 7 Minutes
Loop Entry	R14 × C15 Seconds + House Entry Delay	3·3M × 33μ + 15·5 Seconds = 108 + 15·5 = 123·5 Seconds = 2 Minutes

The main alarm circuit board should be housed in a suitable metal box which provides screening. Holes should be drilled to suit the l.e.d.s, keyswitch, mains cable and the DIN socket used to connect to the rest of the system.

Holes should also be drilled to mount the transformer and, if required, to allow the box to be mounted on the wall. Holes are needed as well to allow the buzzer to be heard. The main stripboard can be used as template for the positions of the holes for the spacers on which the board is mounted.

Once all the holes have been drilled and filed as required, the front panel can be finished off. The front panel can be sprayed using car touch-up paint, for example. Rub-down lettering can be used to provide suitable legends on the front panel, then spraying it with a clear protective lacquer.

The board, transformer and the rest of the hardware can now be fitted to box and wired up as shown in Fig. 8. The Live and Neutral wires of the mains cable can be soldered directly to the transformer terminals. The Earth wire should be secured to the case using a solder tag. A locking cable grommet should be used to secure the cable to the case.

If the suggested transformer is used the two secondary windings should be wired in parallel (as shown) to provide the required output current.

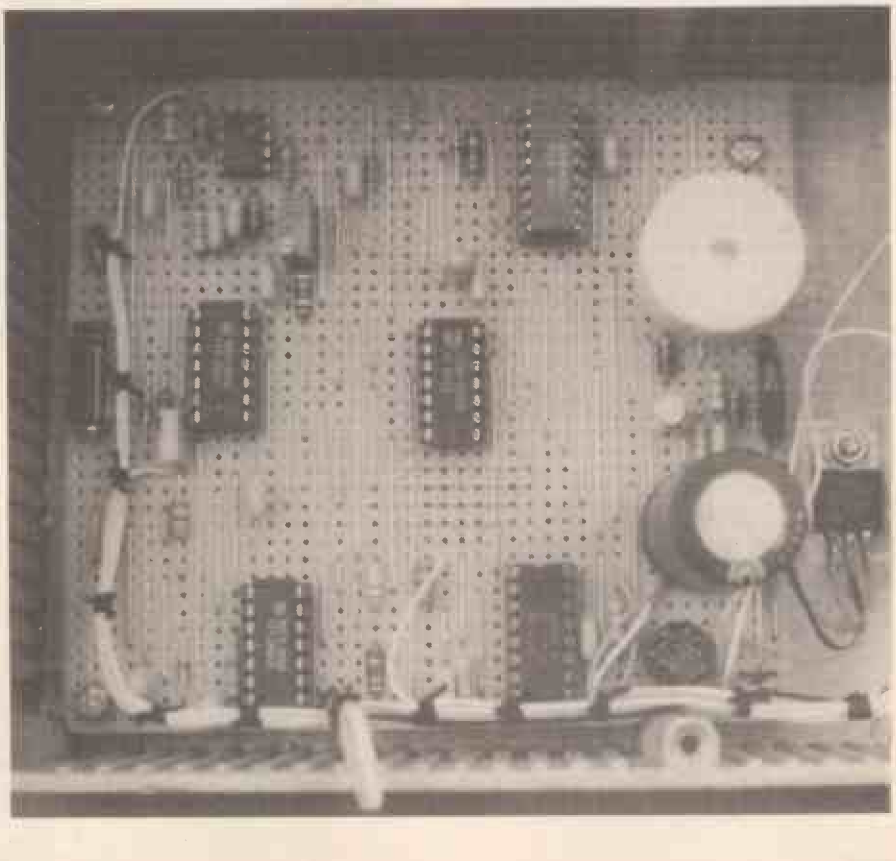
An insulating bush and washer should be used when mounting the voltage regulator to the case. The latter provides heat sinking for the regulator.

EXTERNAL CONTROL SWITCH

With the prototype, a conveniently located domestic wall-mounted switch, normally used to control an outside light, was modified for use as switch S1. The original single-switch unit was removed and replaced with a double-switch unit. One switch was used to control the light as before, the other was used as S1. The switch must be the changeover variety.

A hole was drilled into the switch plate to suit l.e.d. D6. Ensure that the l.e.d. cannot be dislodged and come into contact with the mains wiring of the light switch.

If preferred, S1 could be an ordinary s.p.d.t. toggle switch located in the main alarm box.



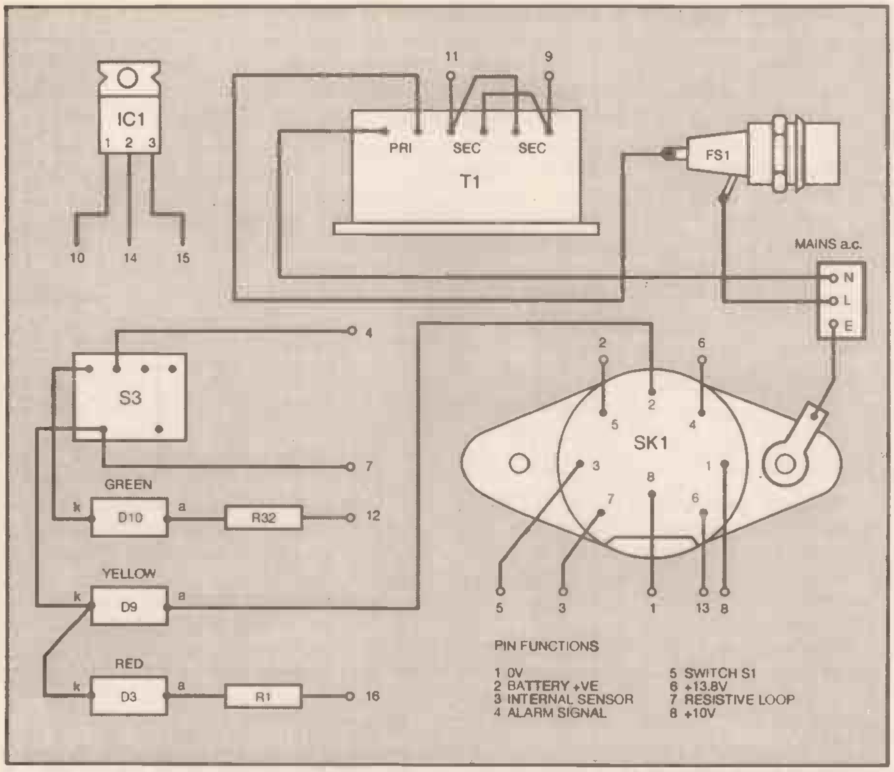


Fig. 8. Wiring details for the control box.

wiring has been completed the unit can be tested. After which the front of the bell-box can be secured.

TESTING

When testing, beware that mains voltages are present. Extreme care should be taken. If in any doubt, consult a qualified electrician.

Before powering up the alarm, the resistance across the d.c. supply lines should be checked. This should be in excess of six kilohms (6k). If it differs greatly check the position and orientation of all components and ensure that all the tracks are correctly cut.

With the keyswitch (S3) and switch S1 turned off, switch on the mains supply. The three l.e.d.s D3, D9 and D13 should light, and there should be no sound from the buzzer. Check that the power supply is delivering an output of 13·8V at the junction of D2 and VDR1.

With the external loop complete – no doors open, etc. – measure the voltage at test point TP1. Adjust preset VR1 until a reading of 5V is obtained. Check that the voltage on IC3 pin 12 is zero (logic 0). The voltage on IC6 pin 4 should be high (13·8V). Open switch S1 and verify that l.e.d. D6 lights and that IC6 pin 4 goes to logic 0 after around seven minutes.

Open and then close the resistive loop and verify that the internal buzzer sounds immediately and the alarm signal line (at TP2) goes low about two minutes later. It might be a good idea to muffle the buzzer during this test!

Open the loop once more and verify that again the buzzer starts to sound. Switch off S1 – the buzzer should stop and l.e.d. D6 should turn off.

Connect the external siren and then switch on keyswitch S3. Check that l.e.d. D10 turns on and that IC6 pin 12 goes low about 30 seconds later. Trip one of the sensors and ensure that after 15 seconds the external siren sounds and that l.e.d. D14 flashes. Switching off the keyswitch should

INSTALLATION

The main alarm box can be located in any convenient position. The prototype was located in the cupboard containing the household mains fusebox and the alarm was wired directly into this.

The siren drive board was housed in a ready-made bell-box along with the backup battery, siren and anti-tamper switch S4. Holes can be drilled to take spacers on which the circuit board can be mounted. It would be a good idea to spray the board with protective coating since it is likely to be exposed to damp conditions outside.

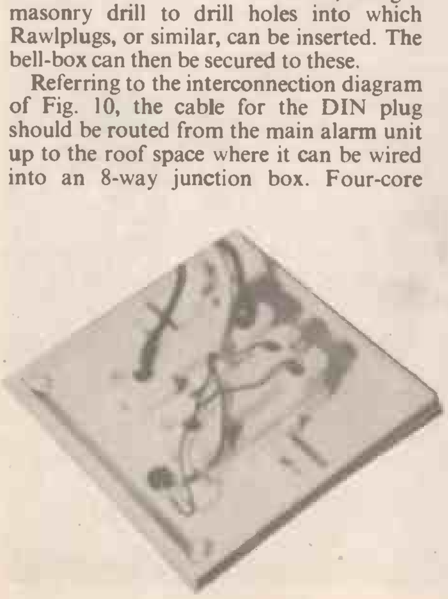
The siren was bolted to appropriate mounting holes in the box and the battery was placed on the shelf provided. An existing hole was used for mounting switch S4. Two holes were drilled in the front of the box to take l.e.d.s D13 and D14.

The inside of the bell-box should be wired as per Fig. 9, but leaving the siren and switch S4 disconnected. The box can be fitted to the side of the house, using a masonry drill to drill holes into which Rawlplugs, or similar, can be inserted. The bell-box can then be secured to these.

Referring to the interconnection diagram of Fig. 10, the cable for the DIN plug should be routed from the main alarm unit up to the roof space where it can be wired into an 8-way junction box. Four-core cable is used to connect between the junction box and the bell-box.

Using a suitable masonry drill, the wire could be passed from the bell-box straight through the wall into the roof space and then to the junction box. If this is not possible, the wire should be routed through the eaves as unobtrusively as possible.

Similar cable can be used to connect PIR sensors, although care should be taken to avoid running this cable parallel to mains wiring. Bell wire for the sensor loop can be brought straight into the roof space and connected up in the junction box. Once the



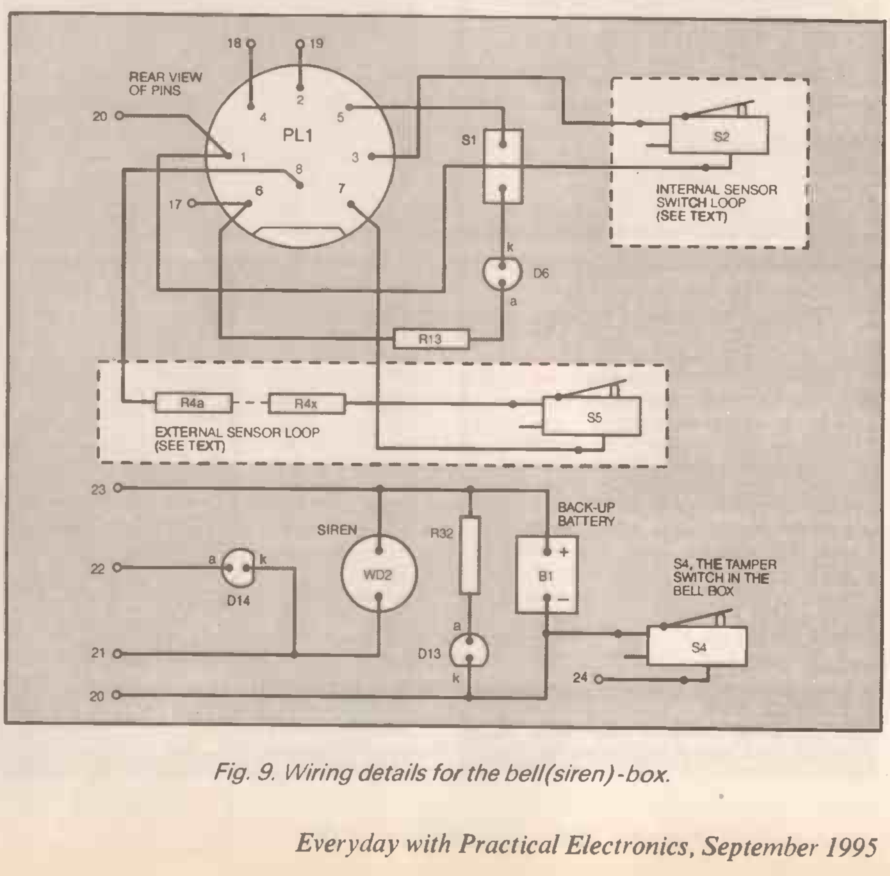


Fig. 9. Wiring details for the bell(siren)-box.

turn off the siren, D10 and D14. Switch off the mains power and verify that l.e.d. D3 goes out.

Anti-tamper switch S4 can now be connected, at which juncture the siren will sound! Ignoring the noise, fit the front panel to the bell-box. Once the main screw is firmly screwed in the siren should become silent.

Note that it is unwise to connect or disconnect the DIN connector whilst the alarm is powered up since this may upset the CMOS i.c.s.

The alarm can now be put into permanent operation.

FINALLY

The author's alarm has been in operation for many months and fortunately there has been no attempted break-in during that time. There was a false alarm during this period but this was found to be due to excessive play in one of the doors of the garden shed. The author thus assumes that the system is extremely reliable, which is an important feature – too many false alarms would destroy the perceived effectiveness of the system.

If the internal buzzer is found to be too quiet it could be replaced by a buzzer located outside the main alarm box, replacing the 8-pin connector by a 13-pin type. Two of the spare pins on the replacement connector can be used to take the buzzer wires through the box. The current consumption of any buzzer should not exceed 100mA.

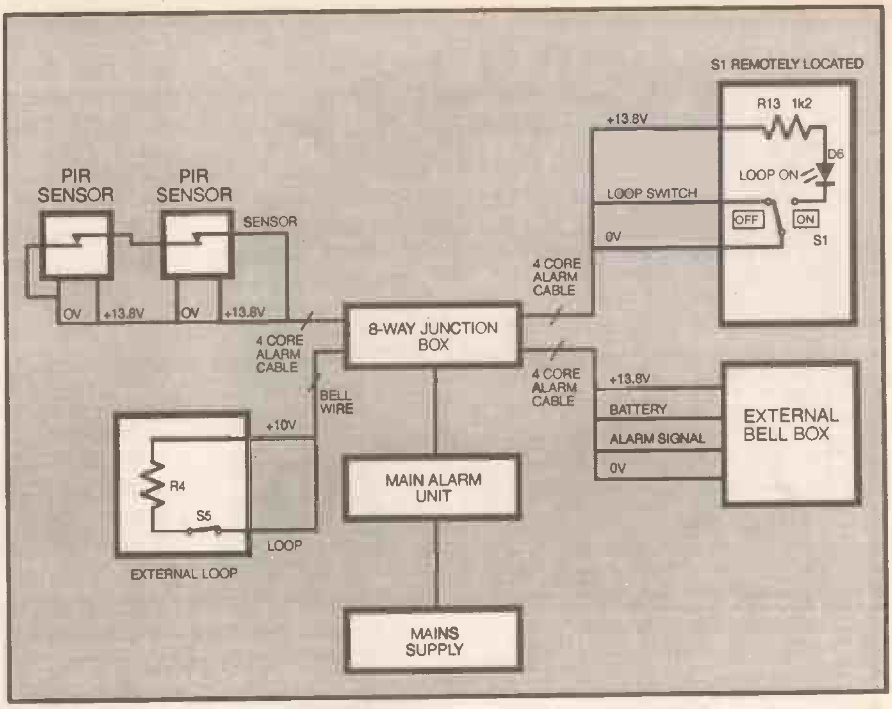
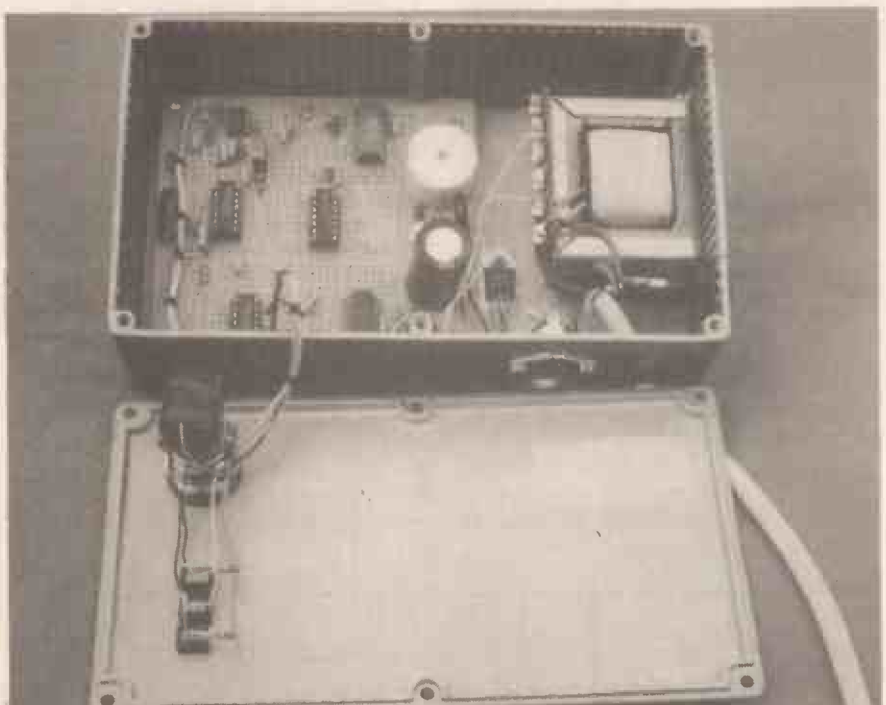


Fig. 10. Suggested system interconnection details.



Usually in alarm systems a strobe light is used instead of a flashing l.e.d. The latter was chosen here because it was much cheaper than a strobe light, although still surprisingly effective. However, if a strobe light is preferred in place of l.e.d. D14, it should be wired in parallel to the siren. In this case both D14 and D15 can be omitted.

The system can be easily adapted to include a panic switch. The normally closed contacts of this switch could be wired into the loop, or the normally open contacts could be wired between the alarm signal line and the 0V line. Similarly, the unit could be expanded to include a fire alarm by using a smoke alarm having relay contacts which should be wired in the same way as suggested for the panic switch. □

NEXT MONTH

Security Tagging – A special feature on the equipment and how it detects shoplifters.

INGENUITY UNLIMITED

Our regular round-up of readers' own circuits. We pay between £10-£50 for all material published, depending on length and technical merit. We're looking for novel applications and circuit tips, not simply mechanical or electrical ideas. Ideas must be the reader's own work and **not have been submitted for publication elsewhere.** The circuits shown have NOT been proven by us. *Ingenuity Unlimited* is open to ALL abilities, but items for consideration in this column should preferably be typed or word-processed, with a brief circuit description showing all relevant component values. Please draw all circuit schematics as clearly as possible.

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Tone Burst Generator
– for cine sync. control

THE device shown in the circuit design Fig. 1 was designed initially for cine work, to create a tape containing tone bursts at a rate of between 18 to 24 times a second. It has flexible input and output arrangements and can no doubt be adapted to other electronic applications, perhaps as a gated signal injector or tone source.

The design is based around two square wave oscillators, each formed from a pair of NAND gates. IC1c and IC1d together form an audio oscillator which operates as follows:

Assuming that both inputs to IC1c are low, the output (pin 10) will be high. IC1d inverts this to low, causing capacitor C2 to charge through resistor R6. When the junction of R6/C2 rises to half the supply rail, pin 10 swings low and consequently IC1d output goes high, causing C2 to start discharging through resistor R6. The outputs eventually change state again, this process continuing at an audio frequency.

The other generator IC1a and IC1b operates in a similar fashion, but at a lower rate which can be adjusted with preset potentiometer VR1. Resistors R1 and R5 pull down the oscillator inputs to 0V which inhibits their operation.

Normally, the output of the lower-frequency generator gates the audio frequency generator. However, by inserting a jack plug into socket SK1, this connection is broken. The user can then control the operation of the unit by providing a high gate signal into the jack socket; connection "A" will gate the slow stage whilst connection "B" controls the audio stage.

The output of the lower frequency gate is also brought out to SK2. Depending on the connection, you can either create an active high arrangement (connection "C") or a "pull down" function (connection "D") where a suitable load maybe returned to either the negative or positive rail respectively.

Socket SK3 offers a high impedance tone output for recording or monitoring with a crystal earpiece. Transistor TR3 offers a visual indication, via l.e.d. D2, that tones are being produced.

In the prototype, l.e.d. D2 was used to strobe perforated tape having 18 holes per 3·75" (18 holes per second). Preset VR1 was then trimmed until the holes appeared static, when the unit was then known to be running at exactly 18 pulses per second.

Chris Brown, Witham, Essex.

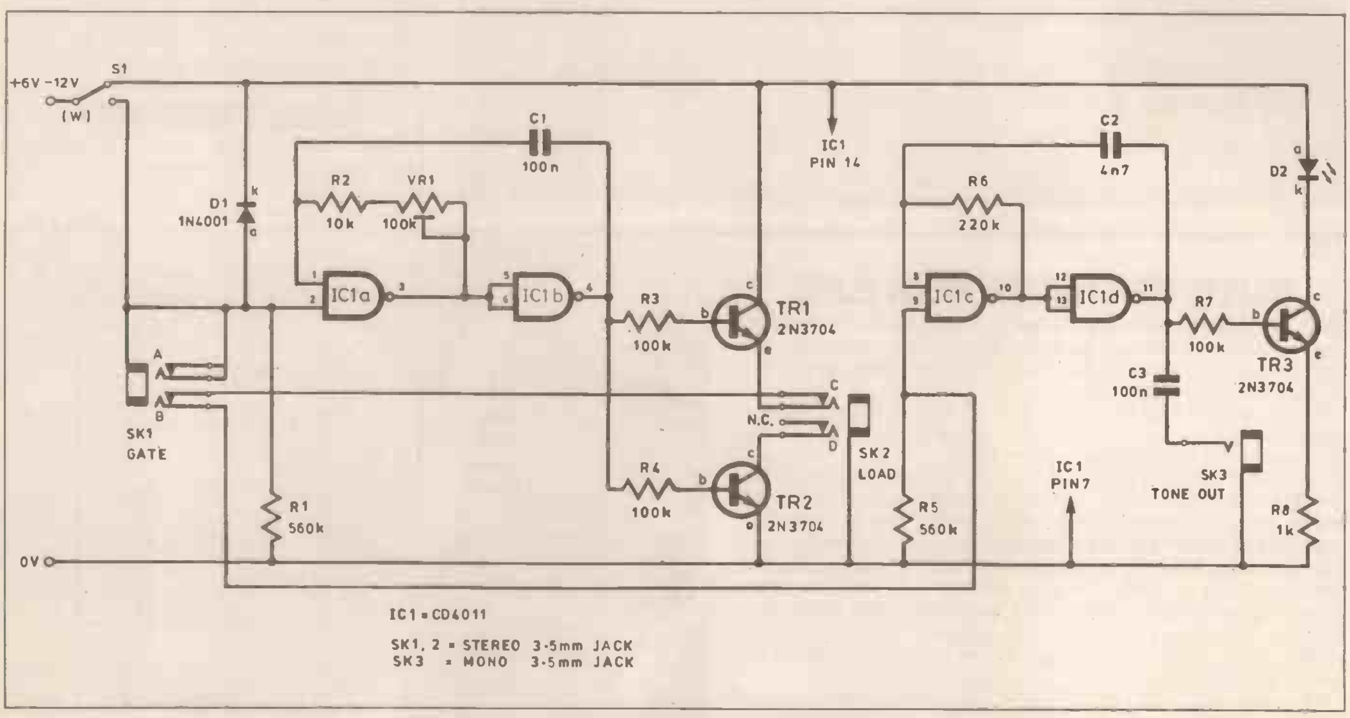

Fig. 1. Circuit diagram for the Tone Burst Generator.

Doorchime Disabler

– ring the changes

ORIGINALLY designed for the "Goods Inwards" bell of a retail outlet, the adaptable circuit of Fig. 2 could be used as a domestic doorbell to prevent the nuisance caused by a caller pressing the bell-push excessively. The circuit consists of a piezoelectric sounder acting as a door chime, along with a modified bell push-switch. The proposed system functions with existing twin-core bell wire, if already installed.

In operation, a green l.e.d. D4 mounted on the bell pushswitch itself, illuminates after the switch has been pressed. A pulsing bleep tone then sounds for approximately 80 seconds, during which time any further operations of the pushswitch have no effect.

At the end of this period, the system resets and the green l.e.d. is extinguished. Alternatively the system can be reset using a separate "manual" pushswitch mounted indoors.

In Fig. 2, in the reset condition the green l.e.d. diode D4 together with diode D5 are reverse biased. On closing the bell pushswitch S2, D3 is forward biased which pulls IC3b output (pin 11) high.

Pin three of IC2 is now clocked which takes its Q output (pin 1) high. This is inverted by IC3c whose pin 4 is now low. This is complemented by pin 3 of IC3d which is now high. Hence l.e.d. D4 becomes forward biased and illuminates, with resistor R5 limiting the current.

An astable formed by IC3a is now enabled, clocking the ripple counter IC1. Transistor TR1 is energised by the Q7 output (pin 6) of the 4020 and completes the circuit to the piezo sounder WD1 which pulses and the red l.e.d. D1 flashes. When Q14 (pin 3) of the counter reaches logic 1, IC1 and IC2 are reset via diode D2.

A "manual" reset can be forced by closing pushswitch S1, diode D2 preventing current sinking into the Q14 output. Resistor R3 prevents false resetting.

The prototype was powered by a PP3 battery. Quiescent current was immeasurably small when reset, rising to 9mA when triggered. For best effect, l.e.d. D1 should be a Superbright red type and the green device D4 a low current type, mounted out of direct sunlight near the bell pushswitch.

David Geary,
London,
SE3

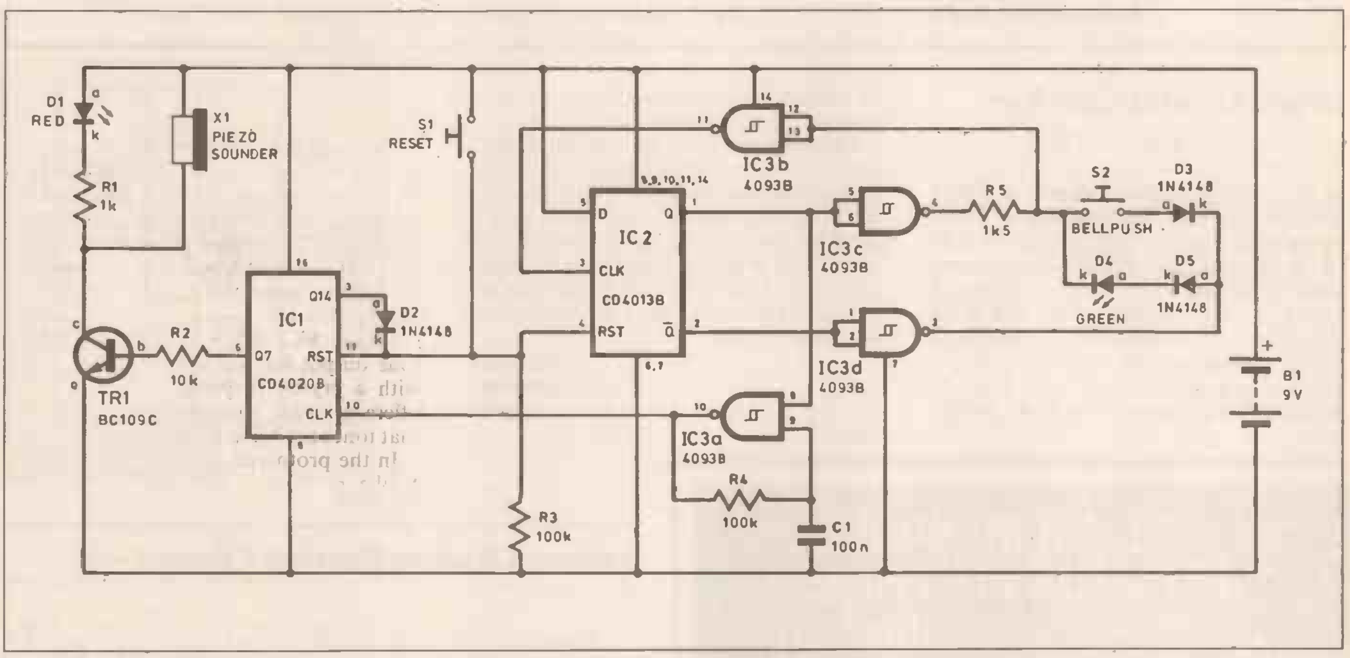

Fig. 2. Circuit diagram for the Doorchime Disabler.

Solar-Driven Battery Recharger

– another bright idea!

HAVING a 12V solar panel to hand, and being interested in renewable energy sources, I designed the simple circuit shown in Fig. 3 to enable my solar panel to be adapted to recharge a set of four nickel-cadmium (NiCad) batteries. I have found it especially valuable when camping, as it kept a lamp and radio powered successfully.

The circuit is based around a constant-current source powered by the 12V 200mA solar array B5. The supply voltage seems to vary from 12V to 15V when charging. This is used to power a constant current source based around transistor TR1.

The four rectifiers D1 to D4 each develop approximately 0·7V across them when conducting, or roughly 2·8V in total. The base-emitter junction of TR1 loses 0·7V of this and the remaining 2·1V appears across resistor R2.

A constant current of 30mA therefore flows through R2. I subsequently added the l.e.d. D6 which illuminates directly from the potential across R2 and draws a further 10mA or so.

A total charging current of 40mA therefore flows through the four rechargeable batteries (B1 to B4), and l.e.d. D6 illuminates when the rechargeable batteries are inserted correctly. The additional diode D5 prevents the batteries from discharging back into the solar panel when the sun goes in. The transistor and rectifiers chosen, happened to be available but substitute types would be fine.

David Dawson AMIEE BSc.,
Barlaston,
Stoke-on-Trent.

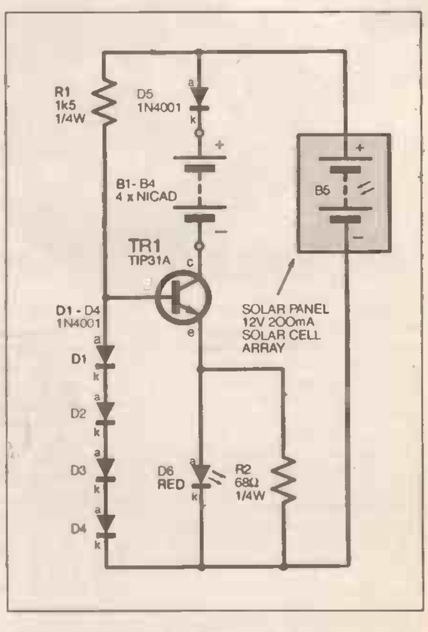

Fig. 3. Circuit diagram for a solar-driven battery charger.

Continuity and L.E.D. Tester – wires buzz off!

THE circuit diagram of Fig. 4 will check the continuity of cables, connectors etc. as well as testing the function of light-emitting diodes (l.e.d.s).

Transistors TR3 and TR4 with associated components together form a transistor astable multivibrator. The piezo sounder WD1 will generate an audible tone when the astable operates.

Transistors TR1 and TR2 act as a switch to energise the audio oscillator. When continuity exists between sockets SK3 and SK4, the transistor switch completes the supply to the astable which will drive the piezo sounder. An l.e.d. test facility is available via SK1 and SK2, with resistor R1 limiting the forward current to about 10mA.

The circuit can be powered from a 9V PP3 battery. No on-off switch is required because only a tiny leakage current flows when the circuit is not in use.

E.W. Fair,
Stoke-on-Trent, Staffs.

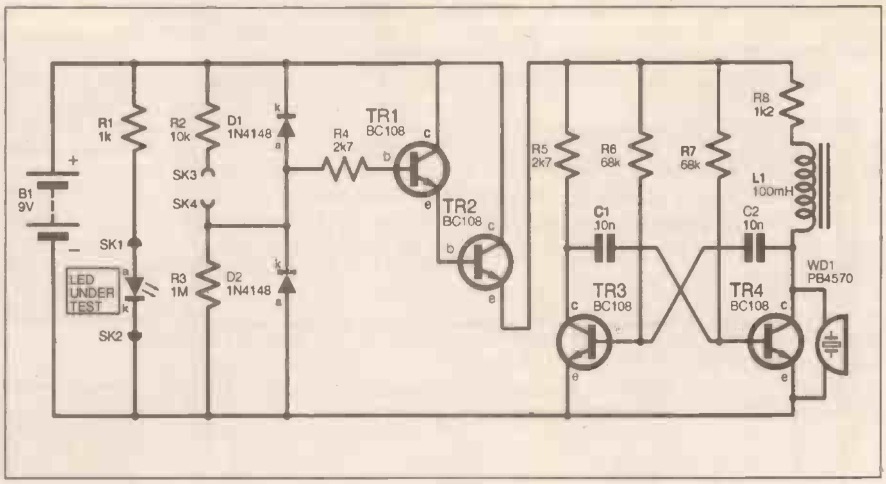

Fig. 4. Circuit diagram for the Continuity and L.E.D. Tester.

Rapid Crystal Checker – go-no-go indicator

MY CIRCUIT diagram shown in Fig. 5 will oscillate with almost any crystal or ceramic resonator. Oscillation is indicated by an l.e.d., which is much more economical than a meter. X1 is the quartz crystal or resonator under test, and if the circuit does not oscillate then the collector-emitter voltage across transistor TR1 is insufficient to illuminate the l.e.d. D1. The diode D2 is a *germanium* type AA119 or similar which decouples the l.e.d. to prevent it from quenching oscillation.

The components shown were "junk box" items, and in practice any silicon transistor should work satisfactorily. The l.e.d. was a 2000mcd high intensity type which gave a good level of light output at very low currents. R.F. precautions are required when constructing the circuit, ensuring leads are as *short* as possible otherwise they can act as a tuned circuit.

W. Gray,
Farnborough,
Hants.

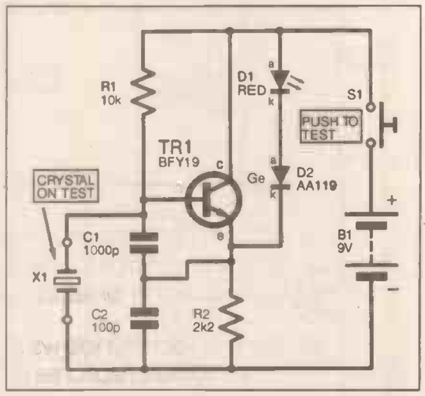

Fig. 5. Rapid Crystal Checker circuit diagram.

Battery Charger Current Control – take charge!

Table. 1.

PL1 connected to:	Charge Current (A)
SK1	6·2
SK2	4·5
SK3	3·0
SK4	1·6
SK5	1·0

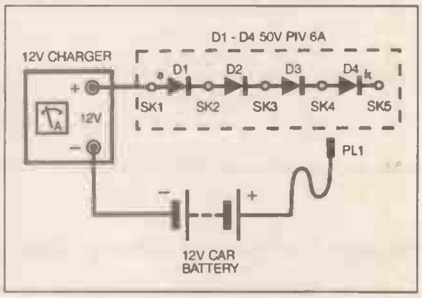

Fig. 6. Battery Charger Current Control circuit diagram.

BUDGET mass-produced car battery chargers do not often have any form of charge current control. Whilst this isn't a problem for ordinary trickle charging, when trying to re-charge a very flat battery, heavy currents flow and it may be desirable to limit the charge current in order to reduce the load on the transformer within the charger. Fig. 6 depicts a very simple means of selecting the charge current. The design is suitable for battery chargers rated up to 5A.

The circuit uses silicon rectifiers as voltage droppers to reduce the voltage applied across the car battery. Each rectifier drops approximately 0·7V when fully conducting. It was found that four rectifiers in series gave sufficient control for normal use with my battery charger, but more could be added if needed.

The appropriate number of rectifiers is selected by inserting PL1, a 4mm wander plug, into the appropriate 4mm sockets SK1 to SK5. Table. 1 summarises the results obtained with a nominal 4 Amp charger. Readers' actual results will depend on the battery's state of charge and the output from the charger itself.

The rectifiers should be well ventilated and *heavy duty cable* MUST be used for interconnections. I suggest 50 PIV 6A rectifiers (e.g. Maplin P600A or similar), each fitted with a high profile TO5 lobe-finned heatsink.

P.C. Cole, Devonport, Plymouth.

FOX REPORT

by Barry Fox

Blumlein Archives Scandal?

Every month or so I get asked the same question. Whatever happened about the Alan Blumlein archives?

The short answer is nothing. The long answer is likely to go down in electronics history as a national scandal. Future generations will look back and ask how anyone allowed it to happen. Believe me a lot of individuals tried to prevent it. But the self-styled "biographer" risks going down in history as the man who buried the reputation of arguably the most brilliant electronics engineer this country ever produced. The UK's IEE, the Institution of Electronics and Electrical Engineers, also risks going down in history as the one official body which could have done something to rescue the archive but chickened out.

While at EMI's Central Research Laboratories in the 1930s Alan Blumlein invented film and disc stereo recording and a host of electronic circuits, for instance for measurement, high voltage control and telephone equalisation. He was a key figure in the teams which built the 405 line all-electronic TV system and then went on to develop the H2S (Home Sweet Home) map radars which helped Britain win the War. He was awarded 128 patents before he was killed on June 7 1942. The Halifax bomber testing his H2S radar system crashed near the River Wye at Goodrich in Herefordshire. Because he was a hands-on researcher, Blumlein was aboard.

Biographical Concern

Francis Thomson of Watford started collecting original papers in 1972, promising to write a biography. He was encouraged by Blumlein's son, Simon. Thomson has never produced the biography but still holds all the papers which people sent in response to published calls. He has ducked questions on progress and what will happen to the papers. Simon Blumlein has grown increasingly concerned.

Early in 1991, Thomson again started asking magazines and journals to publish appeals for yet more biographical material. Those editors who knew what happened, or more accurately not happened since 1972, treated his call with suspicion. Others, for instance, *Television,* the journal of the Royal Television Society, and *Nature,* the science profession's journal of record, published the fresh appeals. BBC Radio even broadcast Thomson's plea.

Later (23 January 1992) *Nature* took the unprecedented step of publishing a note warning readers that it had "since come to light that Mr Thomson is unable to produce evidence of work on such a book, that he has declined to make the material already collected available to others and that readers would be ill-advised to accede to his request for biographical material".

In May 1991, knowing that third party honest broker attempts at guaranteeing the long term security of Thomson's collected papers had failed, I formally requested that the IEE investigate the biographer's behaviour. I drew attention to Thomson's use of IEE membership when publishing further appeals for material. I made very clear that my motive, in asking the IEE to investigate the behaviour of one of its members, was to safeguard the material collected.

"Whatever happened about the Alan Blumlein archives?

"This historical material is too important to risk losing."

It took the IEE over a year, and many nags from me, to come to a decision (in late June 1992). By coincidence this came shortly after the fiftieth anniversary of Blumlein's death. Neatly summing up what the lack of a biography on Blumlein means, the *Times* report of the memorial ceremony did not even mention Alan Blumlein by name.

The IEE's decision was to take no action. The reasons given were marked "Confidential" and the IEE refused my requests to lift this restriction. However the IEE has stated, without seal of confidence, that "the investigating panel received assurances from Mr Thomson that the archival material he has collected will be safeguarded and (the panel) has no reason to doubt this assurance".

Because I had previously raised the question of the Blumlein archive with the Royal Society, I asked the Royal Society if it had any news to tell us. The Royal Society's librarian, Sheila Edwards, wrote:

"I am happy to confirm that I have been in correspondence with Mr Thomson, and that the Officers of the Society have agreed to accept Mr Thomson's generous offer to donate his collection of Blumlein papers to the Society".

Royal Society Secrecy

The Royal Society's rules decree that papers are kept secret until forty years after the death of the subject. As Alan Blumlein died over fifty years ago, this means that the Blumlein papers will be available as soon as the Royal Society has them.

Unfortunately the promise of seeing the Blumlein papers safe in the library of the Royal Society proved to be a false dawn.

At first the Royal Society would say only that it was "still negotiating with Mr Thomson". At a seminar held at the IEE in October 1992, I answered a question on archiving progress with the suggestion that those who are concerned should phone the Royal Society and ask for themselves.

This suggestion did not, however, appeal to the IEE. The Institution's Assistant Secretary, Philip Secker, rose from the audience at the Savoy Hill meeting and warned that to make such approaches would be "counter productive" because "negotiations are at a delicate stage".

Honouring this request I left it several years before contacting the Royal Society again. The time seemed right when I heard that the new *Centre for the History of Defence Electronics* at Bournemouth University refers to Blumlein's work. New generations will be wondering why there is no biography they can read.

In early July I phoned the Royal Society Library to ask if it had ever received the Blumlein archives.

"It doesn't ring any bells", a librarian told me, coming back later to add that "there is no entry in the archive catalogue".

Head Librarian Sheila Edwards then confirmed the bad news. "Nothing has come".

"I must admit I wasn't surprised", she added.

IEE Responsibility

The ball is now firmly back in the IEE's court. The Institution said previously that it saw no reason to doubt the assurance given by Francis Thomson that the collected papers would be safely archived. But after three full years this has still not happened. I suggest it is now the clear responsibility of the IEE to approach Francis Thomson and ask for the promise to be honoured.

This historical material is too important to risk losing. I have written to the Secretary of the IEE to ask for the Institution's attributable view on Francis Thomson's apparent failure to do what he promised three years ago.

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Techniques
ACTUALLY DOING IT!
by Robert Penfold

WHEN recently making attempts to connect my PC to the "super-highway", I was struck by the immense amount of jargon associated with this aspect of computing. It seems to be quite normal for books on the subject to be about 50 per cent glossary!

Much of this terminology is essential, as a great deal of repetition would otherwise be needed, with the same explanations and descriptions cropping up time and time again. On the other hand, it is probably fair to say that many aspects of modern technology are riddled with an excess of terminology, and a lot of genuine "gobbledygook".

Fortunately, electronics is rather less loaded down with gobbledygook than many other aspects of modern technology. As yet we do not "surf the stripboard". There is still a certain amount of necessary terminology for beginners ("newbies?" – *Robert's phrase not ours – Ed*) to deal with. This month we will consider some of the terms that tend to confound newcomers to the hobby.

FALLING OFF A LOG

Potentiometers are available in logarithmic and linear varieties. In components lists and catalogues these are normally just referred to as "log." and "lin." types respectively. There are also anti-logarithmic ("antilog.") potentiometers, but these are not widely available and are little used in practice.

What is the difference between log. and lin. potentiometers, and what happens if you use the wrong type?

A normal potentiometer is a control that is mounted on the front panel of a project. It is a form of "variable resistor" which has three tags. Two of these connect to opposite ends of a resistive track, usually made of carbon, and the third connects to a "wiper" contact that can be positioned anywhere along the resistive track by adjusting the spindle.

If a potentiometer has a value of 100k, then the resistance between the two track terminals will be approximately 100k (kilohms). If the wiper is set at a central setting, there will be about 50k between the wiper terminal and each track terminal – see Fig. 1a. If the wiper is moved so that it is about 25 per cent along the track, there will be about 25k between the wiper and one track terminal, and about 75k between the wiper and the other track terminal (Fig. 1b).

At least, this will be the case if the potentiometer is a *linear* type. If it is a *logarithmic* type the two sections of the track will have very different values with the wiper at a central setting.

The result obtained from measurements taken on a "real life" 100k logarithmic potentiometer is shown in Fig. 1c. The total track resistance is clearly more than 100k, but is within the 20 per cent tolerance rating of most potentiometers.

Of more importance is the disparate resistance in each half of the track. One half has about ten times the resistance of the other half! Results would be much the same for an anti-logarithmic potentiometer, but the two resistances would be swapped over.

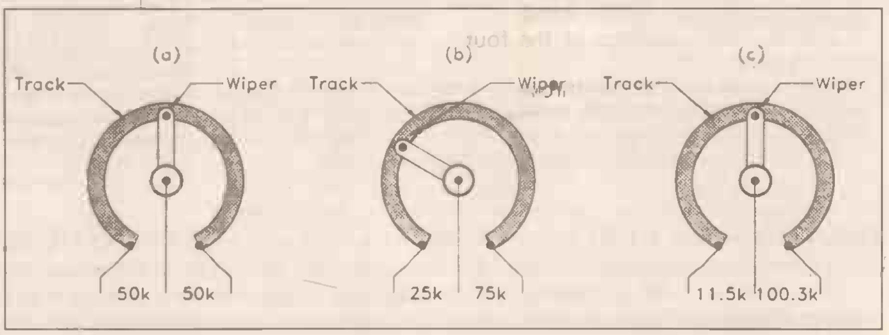

Fig. 1(a) and (b). A linear potentiometer produces the resistances one would expect; (c) a logarithmic potentiometer is very lop-sided.

SENSE OF HEARING

Linear potentiometers are used for the vast majority of applications, such as tone controls, temperature controls on electronic thermostats, and so on. Logarithmic types are designed for use as volume controls, and are used for little else. If a linear potentiometer is used as a volume control, advancing the volume from zero produces a large increase in volume initially, with large changes in the setting of the control having little effect thereafter.

This is not due to a fault in the potentiometer, but is more to do with the way the human hearing mechanism works. As sounds become louder, our hearing effectively becomes less sensitive. A logarithmic potentiometer is designed to counteract this compression effect, and give what appears to be more even variations in volume as the control is adjusted.

A project will work after a fashion if you use potentiometers of the wrong type. The control will have odd characteristics though, making it difficult to use the equipment properly. Using a potentiometer of the wrong type is satisfactory only as a temporary measure if there are supply difficulties with the right component, but is something that should otherwise be avoided.

Readers occasionally complain that components lists do not specify whether "preset" potentiometers should have logarithmic or linear laws. In most component catalogues, even the larger ones, you will not find logarithmic presets listed. Unless stated otherwise, preset resistors can safely be assumed to be linear types.

POLARISED

What is the difference between a polarised capacitor and an electrolytic capacitor? Although these are sometimes taken to be different terms for the same thing, they are not quite the same. An electrolytic capacitor is an example of a polarised capacitor, but not all polarised capacitors are electrolytics.

The only polarised non-electrolytic type in common use is the tantalum variety, which are also known as tantalum "beads", due to their bead-like shape.

Unlike ordinary capacitors, polarised types must be connected into circuit the right way round. Printed circuit mounting types are marked with "+" and "−" signs to indicate their polarity.

Printed circuit mounting capacitors are also known as just "PC" capacitors, and "radial" capacitors. These terms can be applied to practically any component that is intended for vertical mounting on a printed circuit board.

The other standard form for capacitors is the axial variety. These are tubular components having a leadout wire at each end, and intended for horizontal mounting. In other words, components that look rather like resistors, but are usually somewhat larger than normal 0·25W resistors.

The term "axial" can be applied to any component of this general form. Axial capacitors normally have "+" and (or) "−" markings, plus an identation around the body near the positive leadout wire.

IN USE

Using a non-polarised capacitor in place of a polarised type is all right from the electrical point of view, but is not likely to be very practical. Non-polarised capacitors are generally much larger than polarised types having similar values, and are also much more expensive.

Using a polarised component in place of a non-polarised type is definitely not advisable. A polarised capacitor only functions properly if it is subjected to a d.c. signal of the correct polarity, and a suitable signal may not be present. Also, polarised capacitors tend to be much lower in quality than non-polarised types.

It is not a good idea to use an electrolytic capacitor where a tantalum type is called for. Tantalum capacitors are superior to the average electrolytic type in several respects.

They generally have closer tolerances, lower leakage currents, and work better at high frequencies. There are a few high grade and relatively expensive electrolytics which might give good results when used in place of a tantalum type, but it is advisable to err on the side of caution and use the specified type of capacitor.

ALL CHANGE

Switches are often described as something like "s.p.d.t." in components lists and component catalogues. Abbreviations such as this tend to cause a certain amount of consternation amongst beginners, but there are only four of them, and they are really quite easy to understand.

These are the meanings of the four abbreviations:

s.p.s.t. single-pole single-throw
s.p.d.t. single-pole double-throw
d.p.s.t. double-pole single-throw
d.p.d.t. double-pole double-throw

A single-throw switch is a simple on/off type. A double-throw switch is one which provides what is more commonly called a "changeover" action. In other words, there are three tags, and the middle (moving) one connects through to one or other of the other two tags, depending on the setting of the switch.

A single-pole switch has just one set of contacts. a double-pole type has two sets, and is effectively two switches operated in unison.

The circuit symbols for the four types of switch, and how these relate to practical switches, is shown in Fig. 2. The tag arrangements shown are the most common ones, but they are not truly universal. With any switch it is not a bad idea to check what connects to where using a continuity tester (i.e. multimeter set to Ohms range), rather than jumping to conclusions.

In component catalogues you may find that some types of switch are only available as s.p.s.t. and d.p.d.t. types. This rationalisation is possible because a d.p.d.t. switch can be used as a d.p.s.t. or s.p.d.t. type.

Simply ignore tags "d", "e", and "f", and the other three contacts provide a s.p.d.t. switch. Ignore tags "c" and "f," and the other four provide a d.p.s.t. action.

Although toggle switches are well known to those who build electronic projects, few newcomers to the hobby

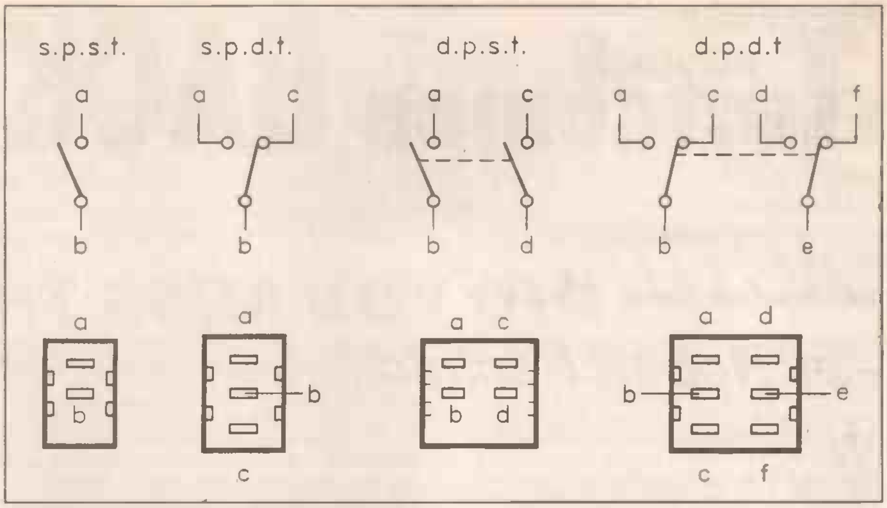

Fig. 2. Circuit symbols and most common tag arrangements for the four basic types of switch.

seem to have heard of "toggle" switches before. They are just switches that are operated via small levers. Believe it or not, the lever of a toggle switch is called a "dolly".

With relay contacts and switches you may sometimes encounter the abbreviations "n.c." and "n.o.", which stand for "normally closed" and "normally open". These terms are used to describe single-throw switches that are *biased* to *one* position.

For example, a pushbutton switch that has contacts which close when it is operated, and open again when it is released, is a normally open switch. A normally closed switch is the opposite of this, with the contacts opening when the switch is operated, and closing when it is released.

CHOKED UP

The word "choke" seems to be rather less used now than it was in the past. Even some relatively experienced constructors seem to be puzzled by references to this type of component.

It is merely an alternative name for an inductor, and it is mainly used when referring to small inductors for use in radio frequency equipment (r.f. chokes). It is occasionally applied to larger inductors, such as those used in mains interference suppressors.

D.I.L. stands for "dual-in-line", and it is a term normally applied to integrated circuits. These mostly have two rows of pins spaced 0·3 inches apart, or 0·6 inches in the case of large devices having more than about 22 pins. Pin spacing is 0·1 inches. The term "d.i.l." can be applied to any component that has two lines of pins, such as banks of miniature printed circuit mounting switches, and integrated circuit holders.

There are also s.i.l. (single-in-line) components which have a single row of pins, but these are relatively rare. The only common examples are banks of resistors, and integrated circuits that are designed to handle high powers. At one time there were also q.i.l. (quad-in-line) integrated circuits, but this type of encapsulation now seems to be obsolete.

When ordering integrated circuits you do not normally need to specify a d.i.l. or (where appropriate) s.i.l. encapsulation. Most integrated circuits are available from manufacturers in a variety of case styles, including various surface mount types. In general, component retailers only offer the plastic s.i.l. or d.i.l. version of a device.

If two versions are available, the article concerned should clearly state which version is required. In most cases the type numbers will be slightly different anyway, with the suffix usually indicating the case style ("CP" for a plastic d.i.l. encapsulation for example).

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Constructional Project

VANDATA

PETER UNWIN

Tow and know! Make sure your caravan or trailer is still on tow with its multiple lighting network intact and functional, and understand more about high current monitoring.

VANDATA is a repeater and monitor system designed to interface between a towcar and a caravan. It should be suitable for most cars with 12V, negative earth electrical systems, and any Caravan or Trailer that has on-board battery charging.

There are two parts to Vandata, a Boot unit, and a smaller Dash Display unit which has light emitting diodes on a remote ribbon cable extension to permit mounting in a restricted space.

In addition to indicating the correct operation of all exterior lights and indicators (except Reverse), it confirms that the caravan refrigerator has been set to 12V operation.

It is not an Alarm system, but a constant monitor giving a pre-journey "cockpit check" and reassurance en route.

DESIGN CONSIDERATIONS

Many points were considered in the design. Reliability was paramount – in some instances, the unit might only be required for a few hours on a handful of days each year. It must impose a low load on the existing wiring, so that normal in-car fault indicating circuits are not confused. The voltage repeaters and current detectors should introduce no appreciable loss, and the complete unit when not in actual use should ideally consume no current.

Any modification to the caravan must be of a very minor nature and not render it incapable of being towed by any non-equipped vehicle. Conversely, the equipment should permit any caravan to be towed, although the full facilities offered by the unit may not then be fully realised.

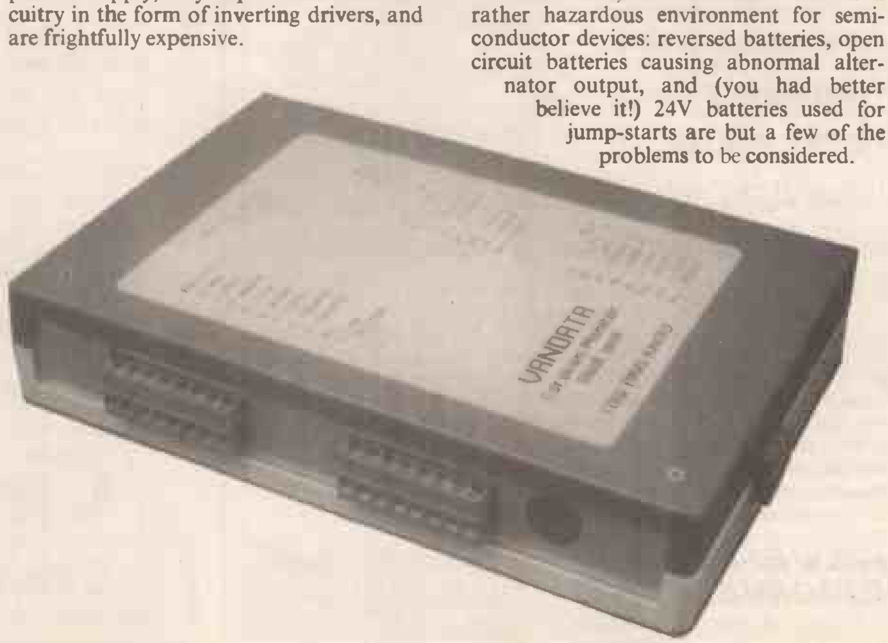
COMPONENT CHOICES

When considering what form the Vandata design should take, the author first examined what he could achieve using modern semiconductor technology. Matters were not straightforward!

In the field of automobile electrics, many major changes have taken place in the past few years, but one of the more subtle is the increasing use of sealed, or semi-sealed batteries, together with very high current output alternators. This has resulted in many manufacturers applying to the system a lower charging voltage with closer control.

The Continentals in particular often work in the 13·6V to 14·2V bracket, i.e. virtually toleranced around the accepted voltage at which lead-acid batteries can be left on permanent charge. Low-voltage, high-current circuits such as those with which we are dealing have a rather intrusive associated problem, namely voltage drop. With a starting voltage of, for example, 13·9V it is quite difficult to ensure a 12·6V supply at the back-end of a caravan, let alone insert additional electronics whilst in transit!

This ruled out the use of emitter-follower devices in the Vandata design, the inherent 0·7V base-emitter drop being unacceptable. Power MOSFETs have a very low saturation voltage when used in common-source mode, but in common-drain, source-follower mode they suffer from an even less acceptable gate-source limit. Although *pnp* power MOSFETs work beautifully in common-source mode and feeding from the positive supply, they require additional circuitry in the form of inverting drivers, and are frightfully expensive.



HIGH SIDE POWER DRIVERS

A fairly recent arrival on the component market, certainly as far as the home constructor is concerned, is the High Side Power Driver. This type of device provides an interface between low power control logic and high current loads. From a first study it has everything one could ask for in the Vandata application, and a prototype was constructed using VN05 and VN20 devices. Several problems soon became obvious.

For the design in mind, nine devices were required together with additional circuitry where change-over functions were planned. The in-built load detection facility would have been useful had the loads been single, but apart from the fridge, all the loads were multiple.

For example, many caravans have one or more low wattage side repeaters in addition to the 21W direction indicators. The high-density 5-pin lead-outs would have made a double-sided p.c.b. virtually essential when planning input and output tracks of between 3A and 10A capacity. Together with the need to heatsink all nine devices, the budget ran at double that for electromechanical relays.

Similarly, load-detector i.c. UL2455 appeared to be the logical choice for current detection, and would have been ideal had the loads been in the range of 5W to 25W, as would be the case within the caravan itself. However, to detect, for example, two 21W Stop lights required a "sense" resistor of the order of only six milliohms. Any higher loads would require "cable drop" sensing, i.e. outside the unit.

Furthermore, an automobile can be a rather hazardous environment for semiconductor devices: reversed batteries, open circuit batteries causing abnormal alternator output, and (you had better believe it!) 24V batteries used for jump-starts are but a few of the problems to be considered.

LO-TECH RULES OK

However, the author had six reed relay switches left over from a burglar alarm design completed some 12 years ago. Consequently, needing to monitor so many amps, he decided to see how they would behave as current detectors.

Although their specifications look wider than the proverbial barn door – 20 to 40 amp-turns (AT) for make, and 8 to 25 AT for break – in the near perfect inductance of a few turns of heavy gauge copper wire, they behave far better than could have been hoped. Not only did they perform almost identically, but a further supply purchased this year were indistinguishable from the twelve year old "spares".

Tests using a simple coil of 16 s.w.g. enamelled wire, single layered on a 9/64in. former around a reed switch, gave reliable "make" at 12 AT, making it straightforward to determine the coils required. The caravan fridge, a single load of approximately 8A (100W) presented no problem, nor did the detection of the presence or absence of one 21W bulb out of two, as represented by the Stop and Fog lamp circuits.

The failure of one 21W bulb when in parallel with a 5W one, as represented by the right and left indicators with a side repeater light fitted, was also reliably detected. In fact, the relays performed every bit as well in this application as the semiconductor circuit.

Furthermore, when not in actual use a relay design need not be connected across the car battery supply, and so draws no quiescent current. Also, open-circuit relay contacts are largely self-protecting.

RIDING LIGHT

The Riding light load presented an entirely different problem. Whereas the lamp circuits already mentioned are fairly standard for a large number of caravans, the low wattage of the individual bulbs and the variable mix of wattages involved in the riding circuits made the loss of one bulb unpredictable.

Caravan input connections are separated into left and right hand sides. The front and rear bulbs are 5W each, but the number plate may be illuminated by one or two bulbs of either 3W or 5W, usually fed from the left. In addition, many makes are fitted with 5W white/red repeaters on the sides. Some rear clusters also incorporate two 5W rear Riding lights on each side, in line with current automobile practice.

The total number of Riding lights on different caravans can vary, some having eight, others might have five, for example. Then it was discovered that four bulbs of one make drew more current than five equally rated bulbs of another. Obviously it would be an extremely complex task to design a current monitor to cope with such varied lighting circumstances.

It was decided, therefore, to settle for a straightforward "Circuit Fail" limit of approximately 2A to the left and right circuits combined. A compromise perhaps, but one which should suit all caravans. A small element of customising was not to be ruled out, but the basic remit was first and foremost a "fit and forget" unit, with doubtful indications being worse than none.

REVERSE ENGINEERING

Already it had been decided that no cockpit monitoring was required for lights which are visible in the driver's rear view mirrors. Reversing lights remained the only circuit left to be considered.

Only recently have caravans started to appear with reversing lamps in the rear clusters, but it is by no means universal and some manufacturers only fit them on certain models. The author does not have them on his caravan, using instead an audible bleeper fitted under its rear, operated by the selection of reverse gear, an arrangement which requires no visual indication.

Consequently, Vandata has been designed without provision for monitoring reversing lights. If they do become mandatory, the author suggests that two Xenon strobe lights and either a bleeper or a recorded message would satisfy all parties – perhaps a good use for the *EPE Voxbox* of July 1994?

TOWING CONNECTIONS

Details of the connections to the two interfacing plug/socket units, usually situated adjacent to the towball, are shown in Table 1. The connectors are mechanically identical, only a different arrangement of "pins" and "tubes" prevents them being interconnected. The 12S connector ("Supplementary") is white (or grey) and the 12N ("Normal") is black.

Note that the 12N terminals 5 and 7 give separate access to the left and right riding lights of the caravan. As far as the author is aware, only cars produced in Germany have this facility fitted as standard. The Vandata unit only offers combined control of these two terminals.

In order that the Vandata unit is only operative when a caravan is coupled, and also as proof to the driver that it IS electrically coupled, it is required that connector 12S/7 (black), currently unallocated, is coupled to the caravan's battery charging circuit via connector 12S/2 (blue). As a short term measure, this could be done at the 12S plug, but is best accomplished at the junction/fuse box, usually in one of the front lockers, where the 12S cable terminates and the interior caravan wiring takes over.

If the connection between these two wires is made at the caravan side of the fuses, two functions may be achieved. Firstly, a check is automatically made on the charging voltage reaching the battery circuit (a battery does not have to be fitted). Secondly, the link may be anything from a few centimetres of wire to several metres, in which case it can be used to convey some additional item of information to the car driver: the author has fitted a magnetic switch adjacent to the caravan handbrake mechanism, only closed when the hand brake is fully off. He used to have a habit of driving away with the brakes not fully released!

Conventionally, 12S/4 and 12S/2 are separately wired: 12S/4 directly from the car battery and 12S/2 via a split-charge relay which also feeds, through separate contacts, the fridge connection on 12S/6. The author is unfamiliar with the device, never having used one, but understands that the recommended circuit is prone to several pitfalls, such as the fridge operating itself from the caravan battery if the common supply fuse blows, and the caravan battery discharging into the car starting circuit if the relay cannot be operated from the alternator.

Table 1. 12N and 12S connector wiring.

12N	Terminal	Colour Code	12S
L-IND	1	Yellow	Reversing Lights
Rear Fog	2	Blue	Batt. Charge
Earth (return)	3	White	Earth
R-IND	4	Green	Int. Lights
R-Side/Tail/Number plate	5	Brown	Not used
Stop Lights	6	Red	Refrigerator
L-Side/Tail	7	Black	Not used

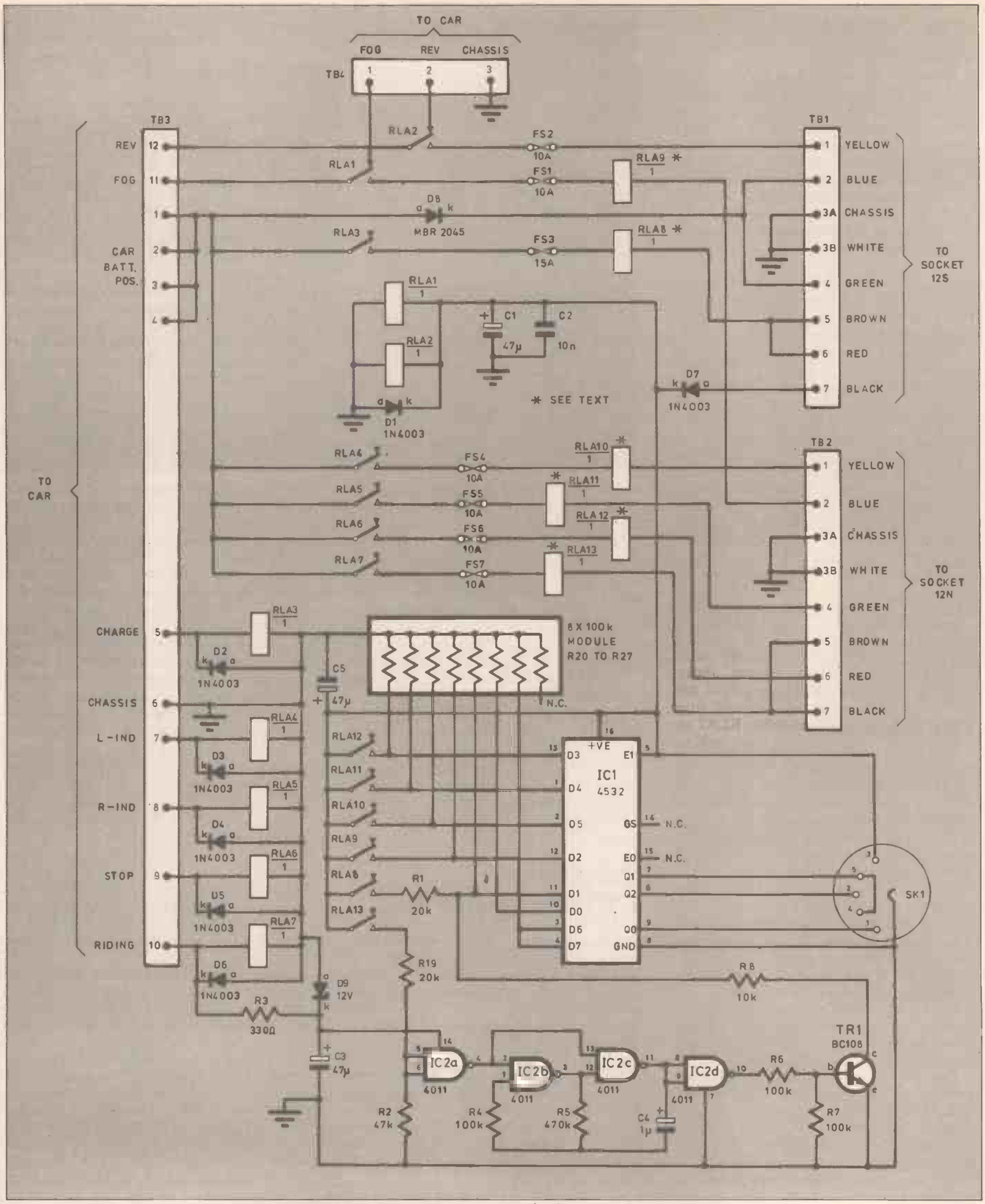


Fig. 1. Circuit diagram details for the current sensing system of Vandata.

The author has always used a diode in the caravan charge/lighting circuit, previously a high-current germanium type (a rare bird these days), but changing to a Schottky diode as soon as their advantages became apparent. These include a lower V_f than conventional silicon diodes, particularly at less than rated current, and a robust ability to withstand surges. With such a diode in circuit there is no possibility of any reverse feed from the caravan battery and connector 12S/2/4 can be commoned in the Vandata unit.

CIRCUIT DESCRIPTION

Generally speaking, from hereon connections to the terminal blocks TB1 and TB2 will be referred to by their destination (towing) socket numbers, 12S and 12N respectively. This enables the same tests quoted to be carried out on the terminal blocks and the car sockets when fully wired up.

Thus a reference to 12S/1, for example, will refer to terminal block TB1 pin 1 when testing the unit in the workshop, but will refer to the car socket 12S pin 1 connection if testing at that end is required. Similarly, 12N/1/2/4 refers to terminal block TB2 pins 1, 2 and 4 as well as the same pins of connector 12N.

Referring to the circuit diagram in Fig. 1, the car battery and associated charging circuits supply power to the Boot Unit via connector TB3 pins 1 to 4. This is a permanent connection, but no current will flow in the quiescent state. When the caravan 12S plug is mated with its connector, usually adjacent to the towing hitch, the car's +12V supply is fed to the caravan battery terminals via Schottky diode D8.

Charging of the caravan battery will only take place when the car alternator (i.e. the engine) is running. The diode prevents any chance of the caravan battery supplying current to the car. By virtue of a wired addition to the caravan already mentioned, and irrespective of whether a caravan battery is actually fitted, this supply is returned to the car and Boot Unit by connector 12S/7. Diode D7 protects against caravan battery reversal.

The returned supply, only present when the caravan is actually coupled, powers the supervisory circuit in the Boot Unit and supplies the dashboard mounted Display Unit via socket SK1. It also operates relays RLA1 and RLA2. The relays provide the optional facility to disconnect the towing vehicle's rear fog and reversing lights when actually towing, to prevent a disconcerting glare reflected from the front of the caravan.

The caravan's rear fog and reversing lights (if the latter are fitted) will be operated irrespective of whether this option is invoked by the car supplies being redirected from inputs TB3/11 and TB3/12 to connections 12N/2 and 12S/1.

When the alternator is running, the charge output is applied to TB3/5 and operates RLA3 supplying current to the fridge, (connections 12S/6 and 12S/5).

It should be noted that the electrical systems of certain cars, notably those of French manufacture, do not always produce this additional voltage output, and RLA3 must therefore be operated from another source. Relays RLA4 to RLA7 are each operated, individually or in combination, when the car's right indicator (R-Ind), left indicator (L-Ind), footbrake (Stop) and side/rear (Riding) lights are respectively selected.

These inputs are on TB3 pins 7 to 10 with the corresponding relayed outputs on connector 12N pins 1, 4, 6 and 5/7. Diodes D1 to D6 limit back e.m.f. from the relay solenoids. All relayed outputs are fused, and although the fuse ratings may seem somewhat high, they are there to protect printed circuit tracks and cableforms, reduce fire risks and introduce as little voltage drop as possible.

REED RELAYS

Reed relays RLA8 to RLA13 have their coils inserted in the current paths of the outputs to be monitored. Satisfactory loading of any selected circuit operates the associated reed switch. The switches have one side commoned to the +12V supply from the caravan. When either or several of these relays are operated, the switches connect the inputs of IC1 (normally grounded by resistors R20 to R26) to a logic 1 level.

Component IC1 is an 8-bit to BCD (binary coded decimal) priority encoder, with only inputs D1 to D5 used. Table 2 shows how the inputs are interpreted, the outputs Q0 to Q2 representing the address of the highest active input, irrespective of the state of the other inputs. This action is used so that only one condition or state, and therefore indication, is displayed by the dashboard unit.

The selection of Riding lights (TB3/10 and RLA7) also powers IC2, via resistor R3. Capacitor C3 provides local decoupling and diode D9 a measure of overvoltage protection.

IC2 is a quad 2-input NAND gate of which two gates, IC2b and IC2c, are configured as a square-wave oscillator running at about 1Hz. The oscillator is normally inhibited by a third gate, IC2a, inverting the logic 1 applied to its pins 5 and 6 by the contacts of RLA13. Oscillation frequency is set by resistor R5 and capacitor C4.

In the event of insufficient or no current in the RLA13 coil, its contacts will not close and so IC2a has its inputs biased low via resistor R2. The high output from IC2a thus allows IC2b/c to oscillate. The output from IC2c, buffered and inverted by IC2d and transistor TR1, modulates the voltage on the D1 input of IC1 (pin 11) provided by the fridge current detector RLA8, resistors R1 and R8 being the effective components.

Note that IC2d output pin 10 is low in both the unpowered and inhibited states. TR1 is required so that IC1 pin 11 is unaffected when IC1 is not powered. Outputs Q0, Q1, Q2 are taken to SK1 terminals 1, 4/5 and 2 respectively.

It could be argued that R-Ind should have a higher priority than L-Ind, but this is of no significance since they are not selectable simultaneously, both having equal status. In the event of Hazard selection, both rear indicators will flash correctly, although the supervisory indication will be L-Ind.

Normal driving, day or night, will be with IC1 output Q0 high. In the event of Riding light failure, it will alternate high and low.

Table 2. Consequential truth table for IC1

CONDITION	INPUT STATE	Q2 OUTPUT STATES	Q1	Q0
IC1 powered	All low	0	0	0
Fridge On	D1 high	0	0	1
Fog lights	D2 high	0	1	0
Stop lights	D3 high	0	1	1
R-Ind	D4 high	1	0	0
L-Ind	D5 high	1	0	1

DISPLAY STRATEGY

The overall Display Indication strategy can best be appreciated after considering the circuit diagram of the Display Unit itself, as shown in Fig. 2. The Display Unit is powered from the Boot Unit, via a DIN-to-DIN cable between sockets SK1 and SK2, and therefore is only powered when the caravan connection is complete. The BCD outputs from IC1 of the Boot Unit in Fig. 2 are applied to pins 10, 13 and 12

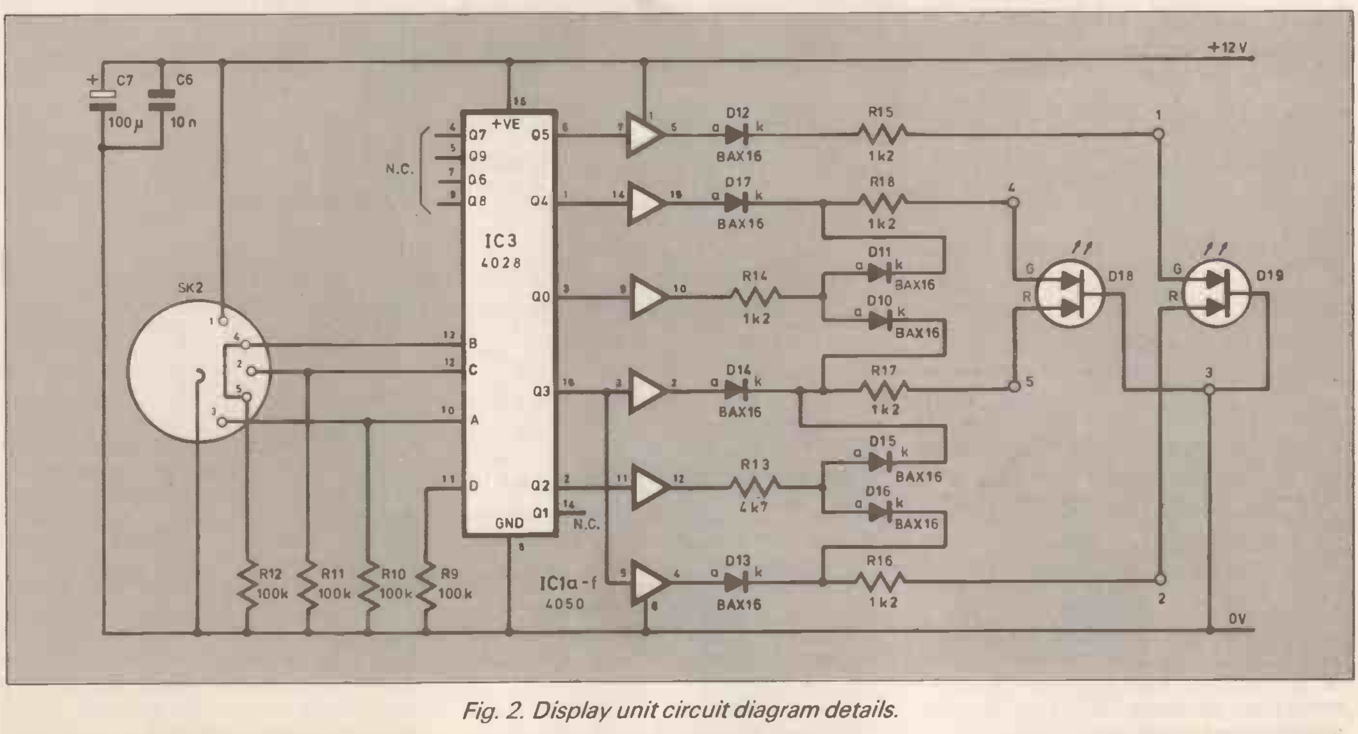


Fig. 2. Display unit circuit diagram details.

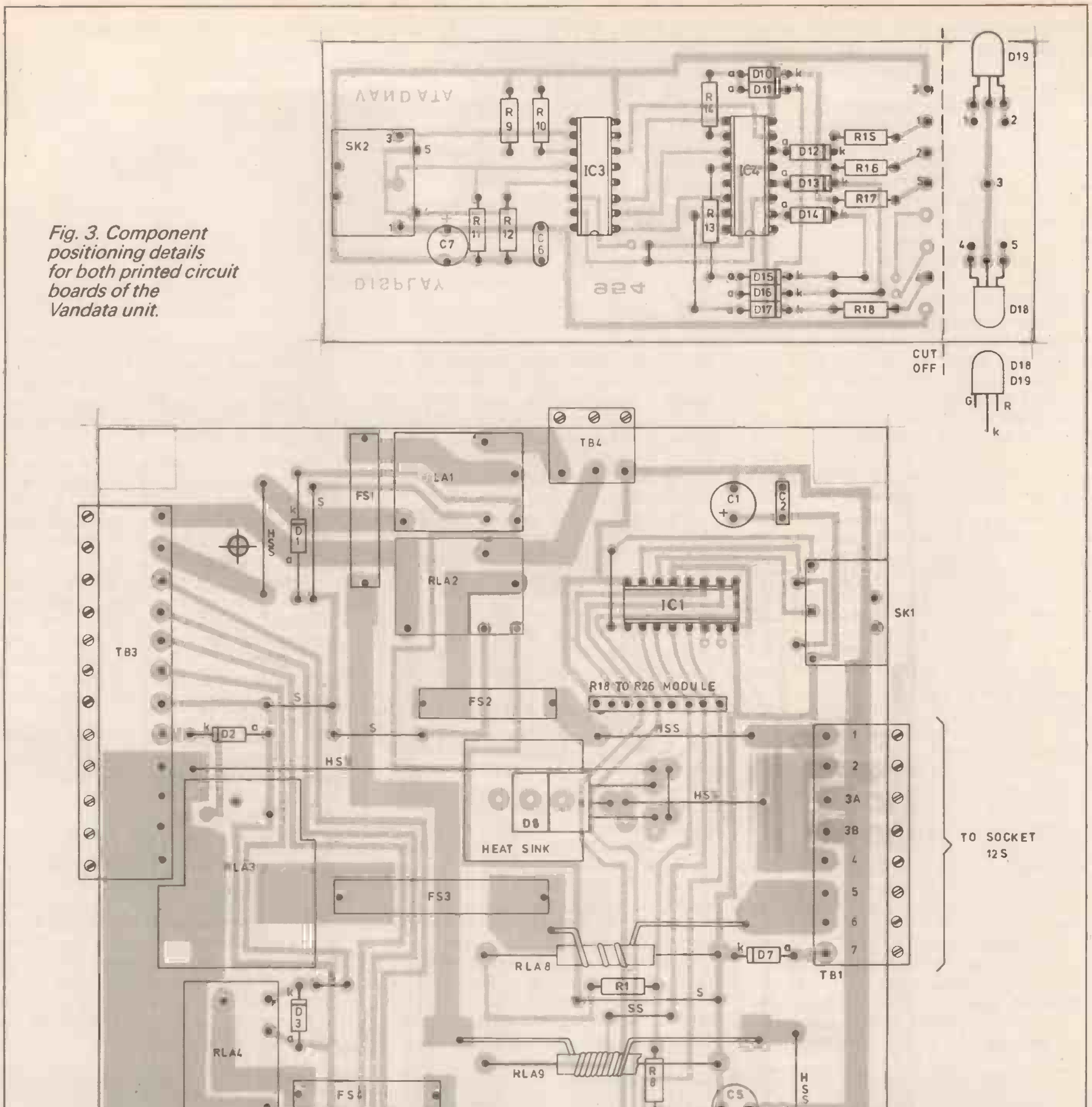


Fig. 3. Component positioning details for both printed circuit boards of the Vandata unit.

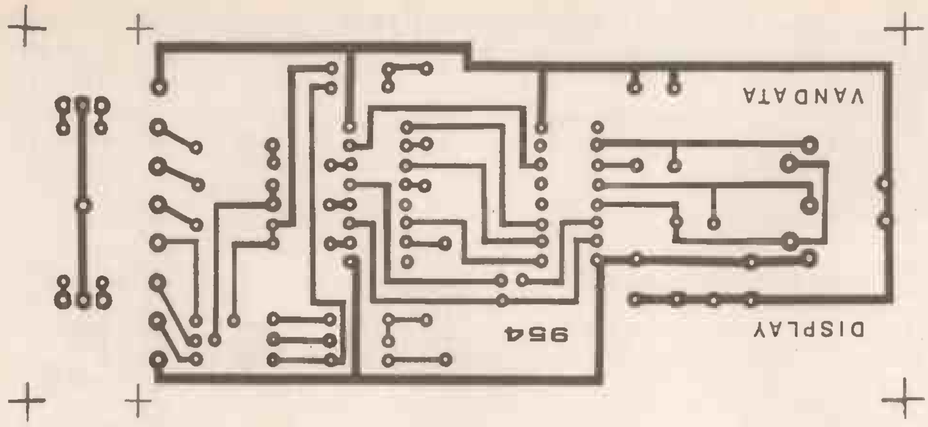
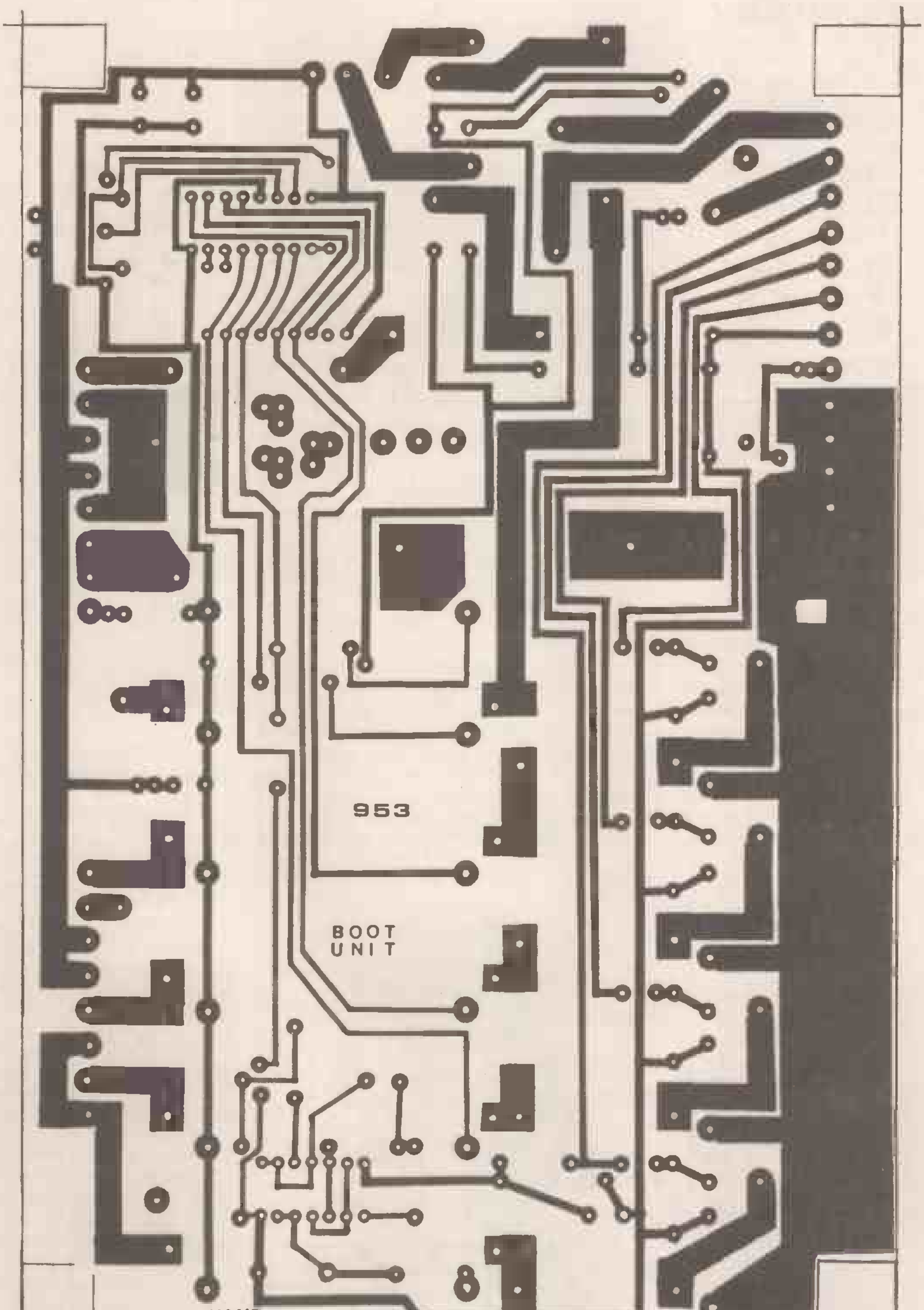


Fig. 4. Full size copper foil track master pattern for both printed circuit boards of the Vandata unit.



(in increasing order of significance) of the BCD to decimal decoder IC3. All of the inputs are normally held low, including the unused pin 11, by resistors R9 to R12. With all inputs low, output Q0 (pin 3) is held high.

Subsequent input code changes will cause the appropriate outputs Q1 to Q5 to go high, only one output being active at a time. The outputs are coupled via hex buffer IC4 to operate the tricolour light emitting diodes (l.e.d.s) D18 and D19 via a series of resistors/diodes. Readers may spot that diode D12 is not really necessary, but it simplifies the calculation for resistor R15!

The display combinations available are shown in Table 3. The centre column describes the output states of IC3 and the component path from IC4.

Table 3. Connector condition, signal state/routing and display indications

	CONDITION	SIGNAL/ROUTING	INDICATION 1
1	Caravan connected Engine Off	output 0 (pin 3) high R14, D10, R17, D18 (red) R14, D11, R18, D18 (green)	D18 amber
2	Engine running Fridge On	output 1 (pin 14) high not used	None
3	Riding Fail	Alternate Cond 1/Cond 2	D18 Flashing
4	Fog lights	output 2 (pin 2) High R13, D15, R17, D18 (red) R13, D16, R16, D19 (red)	D18 + D19 red (Low intensity)
5	Stop lights	Output 3 (pin 15) High D13, R16, D19 (red) D14, R17, D18 (red)	D18 + D19 red (High intensity)
6	R-Ind	Output 4 (pin 1) D17, R18, D18 (green)	D18 green (High intensity)
7	L-Ind	Output 5 (pin 6) high D12, R15, D19 (green)	D19 green (High intensity)

CONSTRUCTION

Details of the component and track layouts for the Boot Unit and Display Unit printed circuit boards (p.c.b.s) are shown in Fig. 3 and Fig. 4. These boards are available from the *EPE PCB Service*, codes 953 and 954, respectively.

The large copper areas on the Boot Unit p.c.b., and the gauge of some component pins make a soldering iron of reasonable wattage essential, the author suggests 45W minimum.

First, carefully cut off the small section of the Display p.c.b. which holds the l.e.d.s. Next, fit the Boot Unit link wires, noting that some should be of heavier duty wire and that some must be sleeved. All small components can now be soldered in. All the i.c.s are CMOS devices and the normal precautions should be taken, ensuring that you discharge static electricity from yourself before handling them, by touching a grounded item first, for example. The use of sockets for the i.c.s. is recommended.

Schottky diode D8 is in a DO220a case and should be mounted flat to the board on its heatsink.

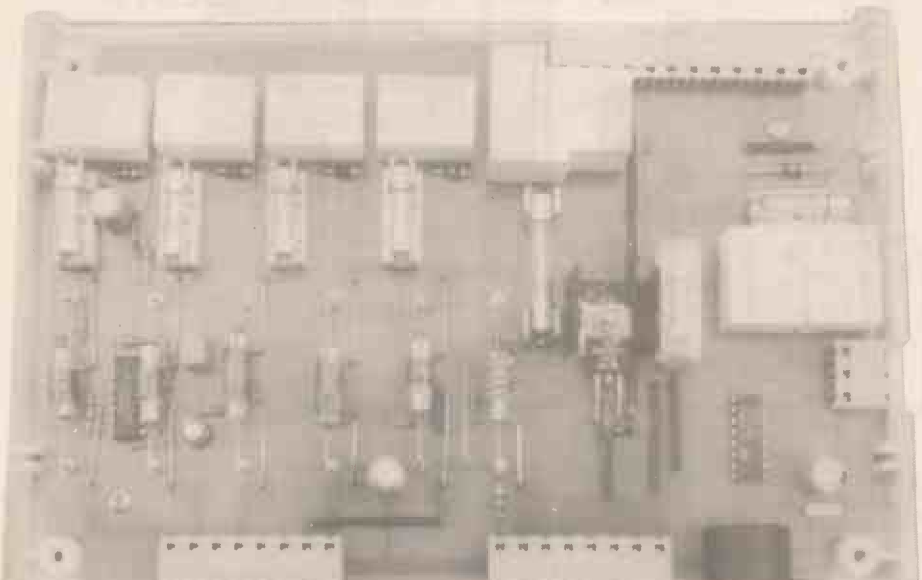
COIL WINDING

The winding of the reed relay coils needs a little care and patience. Coils for RLA9 to RLA13 use 0·9mm (20 s.w.g.) enamelled copper wire, close wound on a 4mm former (drill shank), then slid onto an 18mm length of plastic tubular drinking straw and doped up with 5-minute epoxy. Fig. 5 shows the final shaping. RLA9 and RLA12 require six full turns, RLA13 eight full turns, and RLA10 and RLA11 eleven full turns. The reed switches themselves are slid into the tube of the coil assembly.

Relay RLA8 spans a different board spacing to the others, and should be wound using 1·25mm (18 s.w.g.) enamelled wire; 3·5 turns are required, spaced by a single turn thickness. The two ends of the coils should be thoroughly cleaned and pretinned before fitting to avoid any possibility of a bad joint, since the coils are part of the high current paths.

If specific requirements make it desirable to modify any of the reed relay coils, it must be born in mind that the back of a caravan is a long way from the test bench. Variable voltages under different load conditions, lamps from alternative manufacturers with different consumption, installation variations, cable resistance (and inductance), and thermal inertia, i.e. filaments remaining hot from a previous operation make it prudent to have a minimum current/turns product of about 17.

The reed switches should be soldered directly to the turret pins, not wrapped, and positioned centrally within the coils.



CASE ASSEMBLY

The Boot Unit box should be employed "upside-down", the p.c.b. mounted in the white half. The p.c.b. needs rectangles removed from each corner to make it fit. Cut slots in the box to suit the board mounted connectors.

With the Display Unit box, a slot should be cut to allow the ribbon cable to pass through to the two tricolour l.e.d.s. on their small board. Cable length will depend on the installation requirements.

The interconnecting braided cable between the two units, from SK1 to SK2, uses the same DIN plugs at each end. To enable the lead to work any way round they should be wired "mirror image", i.e. 1-3, 2-2, 3-1, 4-5. On both p.c.b.s, SK1 and SK2 pins 4 and 5 are common. The braiding connects the metal shells of the sockets as a screened Earth connection. To ensure satisfactory Earthing, link the two half shells with a short length of soldered braid.

COMPONENTS

Resistors

See SHOP TALK Page

R1, R19	20k (2 off)
R2	47k
R3	330Ω
R4, R6, R7, R9 to R12	100k (7 off)
R5	470k
R8	10k
R13	4k7
R14 to R18	1k2 (5 off)
R20 to R27	100k x 8 resistor module

All 0·25W 5% carbon film or better

Capacitors

C1, C3, C5	47μ elect. 63V (3 off)
C2, C6	10n polyester 63V (2 off)
C4	1μ polyester 63V
C7	100μ elect. 16V

Semiconductors

D1 to D7	1N4003 rectifier diode (7 off)
D8	MBR2045 Schottky diode
D9	12V 1W Zener diode
D10 to D17	BAX16 signal diode or similar (8 off)
D18, D19	tricolour l.e.d. (2 off)
TR1	BC108 *npn* transistor, or similar
IC1	4532B 8-bit priority encoder
IC2	4011B quad 2-input NAND gate
IC3	4028B BCD to decimal decoder
IC4	4050B hex buffer

Miscellaneous

RLA1, RLA2, RLA4 to RLA7	s.p.c.o. 12V 10A p.c.b. mounting relay (6 off)
RLA3	s.p.c.o. 12V 16A p.c.b. mounting relay
RLA8 to RLA13	reed relay switches (6 off) (see text)
FS1, FS2, FS4 to FS7	10A 20mm fuse (6 off)
FS3	25A 1·25in fuse
TB1	12-way p.c.b. mounting screw terminal block
TB2	3-way p.c.b. mounting screw terminal block
TB3, TB4	8-way p.c.b. mounting screw terminal block (2 off)
SK1, SK2	5-pin DIN p.c.b. mounting socket (2 off)

Printed circuit boards for Boot and Display unit (pair) available from the EPE PCB service, code 953 and 954; 14-pin d.i.l. socket; 16-pin d.i.l. socket (3 off); turret pins for reed switches (12 off); dual-tone case for Boot Unit 205mm x 140mm x 40mm; case for Display unit 110mm x 56mm x 22mm; p.c.b. mounting fuse clips, 20mm (6 off); p.c.b. mounting fuse clips, 1·25in (2 off); 4-way braided cable, length to suit; 5-way ribbon cable, length to suit; 7-way cable, length to suit; slotted heat sink for diode D8, 19mm x 17mm x 20.5mm; 5-pin DIN line plugs (2 off); 18 s.w.g. and 20 s.w.g. enamelled copper wire for coils (see text); interconnecting link wire; solder etc.

Approx cost guidance only **£57** excl. cables

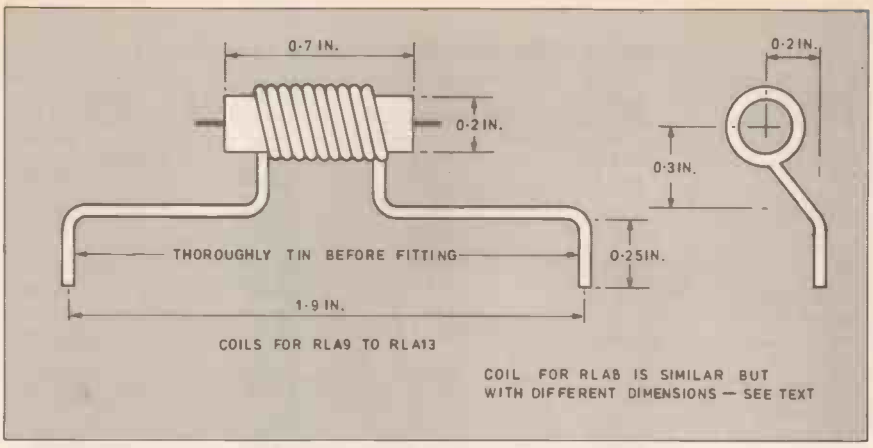


Fig. 5. Details of how the coils are wound.

Close-up detail of two of the coils wound around their reed switches with a plastic former in between.

FIRST TESTS

When installed, the unit will, in all probability be rather inaccessible, and the high currents involved may easily damage a faulty board. A short time spent on some straightforward checks is therefore worthwhile. After cleaning the boards (I.P.A. or Meths) give them a thorough visual inspection. Dry joints are a particular problem with heavy-gauge pins and wire.

Connect a low current 12V supply directly to the Display board, 0V to the Earthy end of one of resistors R9 to R12, and +VE to pin 1 of the DIN socket. Diode D18 should light, amber. With these connections retained, momentarily make the connections between the +12V supply and the following pins of socket SK2, and check that the results are as shown:

Pin 3	No l.e.d.s on
Pin 4	Both l.e.d.s red, low brightness
Pins 3 and 4	Both l.e.d.s red, high brightness
Pin 2	D18 green, high brightness
Pins 2 and 3	D19 green, high brightness

MAIN TESTING

Connect the two boards together using the DIN-to-DIN lead. Examination of the track of the Boot p.c.b. will show that there is no continuity between the Input Earth (TB3/6) and the Output Earths, TB4/3, 12S/3A and 12N/3A. Damage to p.c.b. tracks may result if Earth return currents flow in other than their intended paths. The above mentioned connections should therefore be taken, independently, to the negative side (0V) of the 12V supply.

Now connect a +12V supply to TB3/1/2/3/4. If the source is not protected, the use of an in-line fuse of about 5A is a wise precaution. The units should draw no current at this time and no l.e.d.s should light.

With a multimeter set to the appropriate mode and range check the following connections and results:

CONNECTION	RESPONSE
TB3/12 to TB4/2	continuity
TB3/11 to TB4/1	continuity
TB3/12 to 12S/1	open circuit
TB3/11 to 12N/2	open circuit
12S/1/5/6/7	no voltage*
12N/1/2/4/5/6/7	no voltage*

(*with respect to common negative)

Temporarily connect 12S/2 to 12S/7 and establish that:

Relays RLA1 and RLA2 operate (audible click); D18 lights amber.

Check now:

CONNECTION	RESPONSE
TB3/12 to 12S/1	continuity
TB3/11 to 12N/2	continuity
TB3/12 to TB4/2	open circuit
TB3/11 to TB4/1	open circuit

A selection of short croc-clip to croc-clip jump leads will prove most useful for the following tests:

CONNECTION	RESPONSE
+12V to TB3/5	+12V at 12S/5/6
+12V to TB3/7	+12V at 12N/1
+12V to TB3/8	+12V at 12N/4
+12V to TB3/9	+12V at 12N/6
+12V to TB3/10	+12V at 12N/5/7

Audible indication of relay operation should be heard at each test.

SUPERVISORY TESTS

Temporarily link a bridge wire between the mounting pins of the reed switches as follows:

BRIDGE	RESPONSE
RLA8	D18 extinguishes
RLA8, RLA9	D18, D19 Low brightness red
RLA8, RLA9, RLA12	D18, D19 High brightness red
RLA8, RLA12, RLA11	D19 High brightness green
RLA8, RLA12, RLA10	D18 High brightness green
RLA10 and RLA12 unbridged	D18, D19 off

CONNECTION	RESPONSE
+12V to TB3/10	D18 flashes
RLA13 contacts bridged	D18 off

Table 4. Loaded testing checks and results.

FUNCTION SIMULATED	LOAD WATTS	LOAD CONNECTION	+12V SUPPLY CONNECTION	DISPLAY RESULT
Fridge	21 + 21	12S/6	TB3/5	No change
	add 21	12S/6	TB3/5	D18, D19 off
Fog light	21	12N/2	TB3/11	D18 amber
	add 5 + 5	12N/2	TB3/11	D18, D19 red
Stop	21	12N/6	TB3/9	D18 amber
	add 5 + 5	12N/6	TB3/9	D18, D19 red
L-ind	5	12N/1	TB3/7	D18 amber
	add 5 + 5	12N/1	TB3/7	D19 green
R-Ind	5	12N/4	TB3/8	D18 amber
	add 5 + 5	12N/4	TB3/8	D18 green
Riding	5	12N/5	TB3/10	D18 flashing
	add 21	12N/5	TB3/10	D18, D19 off
	5	12N/7	TB3/10	D18 flashing
	add 21	12N/7	TB3/10	D18, D19 off
Final Riding check – RLA8 contacts bridged:				D18, D19 off

If the supervisory tests all prove to be satisfactory, then it is very unlikely that any fault exists.

LOADED TESTING

Further tests to check the sensitivity of the reed relay coils and switches can now be made. Car bulbs are the best source of high wattage test loads, a selection of 5W and 21W being necessary.

Testing now requires either a regulated power supply capable of delivering 12·6V at up to 20A, or a 12V car battery. A battery charger is not suitable.

Maintain the Earth connections and connect the +12V supply to TB3/1/2/3/4. Ensure 12S/2 is linked to 12S/7. D18 should light amber.

Connect the loads as detailed in Table 4 using several bulbs in parallel where shown. The bulbs are connected between the designated load connection and 0V (Earth). Remove the bulbs after each path is proved to be satisfactory. **Note: bulbs get HOT!**

At this stage it may be worth considering customising RLA13. If the unit is to be used exclusively for one caravan only, then the exact number of bulbs and total wattage of the Riding lights will be known and the number of coil turns can be re-evaluated. As commented on earlier, though, be aware that bulbs from different manufacturers may draw different currents even though they nominally have the same wattage.

CAUTION

The manufacturer's recommendations on such matters as disconnection of the battery before undertaking any electrical work should be studied, particularly where alarms, immobilisers and processor-controlled engine management systems are concerned.

INSTALLATION

Only general advice can be given about siting the Boot Unit because of the variety of vehicles into which it may be fitted. It should be within the boot or rear area of the vehicle which provides the shortest cable run to the ball hitch, or to the bracket on which the 12S and 12N sockets are fitted. Keep the two runs of 7-core cable as short as possible.

If the muting facility available on Fog and Reversing lights (either or both) is required then these feeds must be located, cut and reconnected to TB4. Any existing split-charge relays or supplementary indicator relays used in a previous installation should be removed.

If efficient operation of the fridge and caravan lights is to be achieved, voltage drop must be kept to a minimum. The four Earth points of the Boot unit should be taken to the nearest manufacturer's Earth point(s) using 28 x 0·3mm cable (offcuts of 12S white), and soundly terminated (TB3/6, TB4/3, 12S/3A and 12N/3A).

CABLING FACTS

Under some circumstances, the current into the unit can be up to 15A, increasing to 18A if fog lights become necessary, plus a further 5A to 6A if an indicator and the stop lights are invoked. The following cable facts become relevant:

For a length of up to four metres, the maximum currnt recommended in either 35 × 0·3mm or 19 × 0·1mm cable is 5A, rising to 10A if the run is two metres or less, even though the nominal rating of either is 21A, with a resistance of 0·0075 ohms/metre. Therefore, a minimum of three runs of such cable should be adequate for most installations, assuming the run to be under four metres.

However, a highly suitable cable is currently available (see Shop Talk) which is primarily intended for in-car hi-fi installations (NOT suitable for starter motors!) but perfect for this application.

It consists of 700 strands of 0·12mm copper, giving a cross section area of 8 sq. mm. Theoretically this gives a rating of 80A, but more importantly a resistance of only 0·002/metre. Connection to this is best made by several pigtails of say 21 × 0·3 or 28 × 0·3 (off-cuts of 12S 7-core) soldered and taped at each end. Connector TB3 accepts four such pigtails.

VEHICLE CONNECTIONS

Connection to the battery positive line should be via a 25A fuse. Any cable runs must be clear of moving parts, sharp edges etc., and should be secured at regular intervals. The author's vehicle has plastic trunking from front to rear under the floor, which makes an ideal path for such cables.

The "Charge" connection also needs to be run to the engine compartment. Any sensible cable (9 × 0·3mm) is suitable, and may well be run alongside the power cable. It should be connected to the supplementary output of the alternator. Some expansion may be required here, in view of more "subtle changes" the automobile industry are springing on the unsuspecting.

The so called "Ignition Warning Light" is usually connected between the ignition switch and the supplementary low current output on the alternator. When the ignition is switched on, the battery circuit is completed through the lamp and the effective ground of the idle alternator. When the alternator starts producing current, this "backs-off" the battery supply, and the lamp goes out. It is this low current source that is conventionally used to provide the current to operate the fridge relay, so that this load is not in circuit unless the engine is running.

Unfortunately, as mentioned above, certain manufacturers, Ducellier, Valeo, SEV Marschal, Paris-Rhone and possibly others, produce alternators with a "Simulated Warning Light" connection in place of the one previously mentioned. This consists of (effectively) a transistor, normally biased on when the alternator is idle, but cut off when the alternator is generating. The effect on the warning light is the same, but obviously it is no longer a source that can be used in the same way.

Note that the makes mentioned do not automatically imply a "Simulated" output. Only examination can ensure a positive identification. (Beware of measuring the leakage through the warning bulb itself!)

OFFICIAL ADVICE

The advice currently being offered by Caravan Associations for conventional fridge/charge relay connections in these circumstances is to operate the relay from the ignition switch. This means that the fridge is in operation if ignition is selected for any one of many car accessories, it also

means that the caravan battery is already in parallel before cranking commences. Without the protection of a suitable diode, very high currents could flow in conductors not designed for starter motor supplies!

Vandata *is ideal under these conditions*, since the Schottky diode (D8) prevents the latter and more serious of the two problems. Dash indications remain as described, except that D18 (amber) should extinguish at "Ignition On" instead of when charging commences.

DISPLAY MOUNTING

The Display unit has been designed with a ribbon cable extension to the two l.e.d.s so that space for the complete box is not required immediately behind the fascia. The l.e.d.s should be fitted in any suitable position on the dash board or centre console where they can be seen at a glance, and the plastic box tucked away into any available nearby space.

The DIN-to-DIN cable also needs to be run from the boot to the rear of the dash area, concealed under the carpet and trims. Because of the design variety of vehicles, it is difficult to be more specific. On completion, one quick check is worth while: if a temporary short is applied between 12S/2 and 12S/7 at the coupling connector the right hand l.e.d. D18 should light amber.

CARAVAN WIRING IMPROVEMENTS

There are two improvements that can be made to conventional caravan wiring. The fridge, operating on 12V, draws between 7A and 10A, depending on size and type. All this current is allocated to one connector 12S/6 and one conductor. Voltage drop and impaired efficiency are inevitable in such a connection, and yet there is connector 12S/5 adjacent to it, unallocated and unused. The Vandata unit commons these two connections, so that anyone wishing to join them (at the locker fuse box) will improve the fridge efficiency.

The second tip concerns the Earth wiring. Both connector 12S/3 and 12N/3 are designated as Earth connections. Both are sourced at the car chassis, yet very few manufacturers actually wire them together in the caravan. Apart from being electrically sloppy, this is a complete waste of good copper. The 12N Earth wire returns for much of the time only the occasional indicator or brake light currents, but if commoned at the caravan it can help to reduce the voltage drop in the 12S Earth from the steady fridge load. It also paves the way for simple refinements. For example, operating any of the exterior lights from the caravan battery.

However, the important point is that the only basic modification actually required for the satisfactory operation of Vandata is the strap, or loop from 12S/2 (blue) to 12S/7 (black), somewhere caravan-side of the plug. □

Ohm Sweet Ohm

Max Fidling

Salad days

The glorious summer weather always tempts me away from the workshop and my attention turns to the garden here at *Fidling Acres*. Standing proudly in one corner of the plot is my beloved glasshouse, by now a veritable production line of juicy red tomatoes! You would think that there was little scope to spice up my horticultural hobby with the addition of a few electronic gadgets, but you'd be wrong . . . and my four-legged fiend Piddles, a member of the animal species *Felinus Cleverdickus Maximus*, still does his best as usual to thwart my latest project!

Pondering this, my mind set to the task of inventing a way to keep my greenhouse well supplied with water – especially as holiday time loomed and my greenhouse would need to look after itself for a spell! Having given the tomato plants a lavish watering with the garden hose, I retired to the workshop to examine the prospects of automating the watering, while Piddles played around near the garden sprinkler which was aimed carefully at the melon patch nearby – strange because he loathed water!

I sought a way of automatically monitoring the dampness of the tomato plants, and turning on the water supply at the appropriate moment. I did have a further incentive because I wanted to cock a snook at my neighbours, and prove just how ingenious and self sufficient we Fidlings are! I could be the envy of my friends at the local horticultural society, too!

Setting to work in the 'shop, I leafed through my pile of yellowing magazines, in search of inspiration. In one of my overflowing boxes of bits I had gathered together a motley collection of washing machine spares, including quite a few water solenoid valves which I recall I had plundered from a defunct dishwasher. I always stored such stuff carefully away, since you never knew when it would come in useful, so I had tons of bits stored in old biscuit tins which were rusting away gradually on the shelves.

The solenoid valves were 240V mains operated, which deterred me not a jot. A simple solid-state moisture sensor, based on a rain alarm design I found in a magazine, was adapted to power the solenoid valve via an old Octal-base mains relay. A probe was assembled from a pointed piece of stripboard offcut.

The valve turned on like a good 'un when the resistance of the probe fell below a certain level. Good! Bridging the copper strips with water (I used my soldering iron sponge) switched the valve off with a loud click.

Gleefully, I fitted the gizmo into an aluminium box, replete with a large bakelite control knob to enable me to set the watering level precisely (well, sort of precisely). The prototype was then fitted into the greenhouse, high up out of harm's way. A water supply was laid on and a variety of valves, all heavily swathed in gaffer tape, was installed via a web of green hosepipe.

Melon-choly

Over the next week or so the system gradually became more elaborate. Very cleverly, I thought, I added an extra circuit which enabled the garden sprinkler to turn on automatically and water the melon patch outside! I had prodded a moisture probe into the greenhouse soil, and another one in the melon patch.

Soon the system settled down so that the tomato plants received an automatic supply of water when the going got hot. I could almost hear them slurping it up in appreciation! Things were not so good in the melon patch nearby, though. Wilting leaves told me that the plumtious plants were not getting in on the act, and melons like nothing more than water – *lots of it!*

Piddles had become accustomed to the sight of the tangle of wiring and hosepipe, this certainly hadn't prevented him from indulging in his daily mousing, and one morning he was rummaging around amongst the melon patch, much to my chagrin, while I was twiddling with the electronics in the greenhouse, trying to coax the sprinkler system into operation. I'd suspected that one of the solenoid valves was misbehaving, so after some ferreting in the workshop I'd searched out another.

Meanwhile, out of the corner of my eye I could see the tail of a certain moggie scooting amongst the melons erratically, like a submarine's periscope searching urgently for a kill. A plan formed . . .

Quickly fitting the hosepipe to the replacement valve and screwing the box back together, I switched on the mains supply and the water again, not wanting to miss this golden opportunity. With a flourish, I twirled the bakelite knob on the controller deftly and the solenoid valve clicked gratifyingly.

Water sputtered out of the sprinkler outside as the melons began to bask in the glorious water. The cat's tail drooped, a head popped up and then Piddles realising what I'd done, shot out of the melon patch at a grand rate of knots! A soggy moggie indeed! If only I'd got my Polaroid, the picture would have had pride of place above the bench!

One of my better days.

*INTER*FACE

Robert Penfold

LAST month's *Interface* article described the "Hamcomm 3.0" shareware program for decoding c.w., RTTY, etc. using a PC. The simple interface circuit described in that article relies upon the computer to handle just about everything. The interface does little more than amplify and clip the audio output from the receiver so that it can drive an input line of an RS232C port.

The interface described in the previous article is slightly more sophisticated than most interfaces of this genre, and it provides some audio filtering. However, it still leaves the vast majority of the signal processing to the computer.

Tone Decoder

Although "Hamcomm 3.0" is able to work well with a simple interface, it also has the ability to operate in conjunction with a "proper" external decoder. In the case of a c.w. decoder this simply has to take the CTS line of the serial port high when a tone is detected, or low when no tone is present. A practical tone decoder normally uses the arrangement shown in the block diagram of Fig. 1.

maintain sufficiently accurate tuning. There can also be problems with ringing effects in the filtering.

A practical system usually has a bandwidth of a few hundred hertz. This is sufficient to prevent the decoder from responding to signals on adjacent channels, but is not so narrow as to make the decoder difficult to use.

The filtering in the tone decoder is unnecessary if the receiver has a built-in c.w. filter. However, few communications receivers seem to have a c.w. filter as standard, and where available as an add-on it tends to be extremely expensive.

The output from the filter is fed to a rectifier and smoothing circuit. This produces a positive d.c. voltage that is roughly proportional to the strength of the output signal from the filter. A strong d.c. bias is therefore produced when the c.w. tone is present, but only a weak signal is produced when it is absent.

A level detector is driven from the output of the smoothing circuit, and its threshold level is set between the tone and no-tone output potentials of the smoothing circuit.

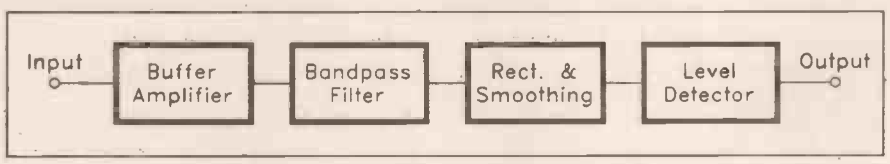


Fig. 1. Block diagram for a basic c.w. tone decoder.

The input signal is first fed to a buffer amplifier which ensures that the next stage is fed from an adequately low source impedance. The buffer stage is followed by a bandpass filter which has a narrow bandwidth. A c.w. signal consists of just a single tone, and it can therefore be accommodated by a bandwidth of just a few hertz.

In practice it is essential to use a wider bandwidth as it is otherwise virtually impossible to tune in a signal properly, and to maintain sufficiently accurate tuning.

Its output therefore goes high when a tone is present, and low when it is not, giving the required tone decoding.

In practice the threshold level has to be something of a compromise. Setting it just above the normal noise threshold gives good sensitivity, but leaves the unit vulnerable to triggering from QRM or any bursts of increased background noise. A higher threshold level results in lower sensitivity, but gives better overall reliability.

Twin Peaks

The circuit diagram for a simple tone decoder for use with "Hamcomm 3.0" is shown in Fig. 2. IC1 acts as a straightforward non-inverting buffer stage at the input, and this feeds into a two stage bandpass filter based on IC2.

The two halves of the filter are essentially the same, but the filter resistors in the second stage (R6 and R8) are slightly lower in value than those in the first stage (R2 and R4). This gives slightly different centre frequencies, and an overall response that it slightly broadened.

The approximate frequency response of the filter is shown in Fig. 3. As can be seen from this, the bandwidth is still reasonably narrow, and the operating frequencies of the two stages are not far enough apart to produce dual peaks.

The overall centre frequency is at a little over 1kHz. The frequency response of the filter is something less than phenomenal, but it is quite good for a simple filter, and it produces good results.

The rectifier and smoothing circuit is a conventional half-wave type based on diodes D1 and D2. The time constant of resistor R11 and capacitor C9 must be long enough to give a large amount of smoothing, but short enough to avoid "smearing" of the c.w. signal. A time constant of about 50ms seems to give optimum results.

A voltage comparator, IC3 forms the basis of the level detector. The output from the smoothing circuit is connected to IC3's inverting input, and its non-inverting input is biased slightly positive of the central 0V supply rail.

The output of IC3 is normally high, but it goes low when the output voltage from the smoothing circuit exceeds the reference level at the non-inverting input. Note that this requires "Hamcomm 3.0" to be set to the "Reverse" keying mode. Resistor R14 introduces some hysteresis which helps to give "clean" switching from one state to the

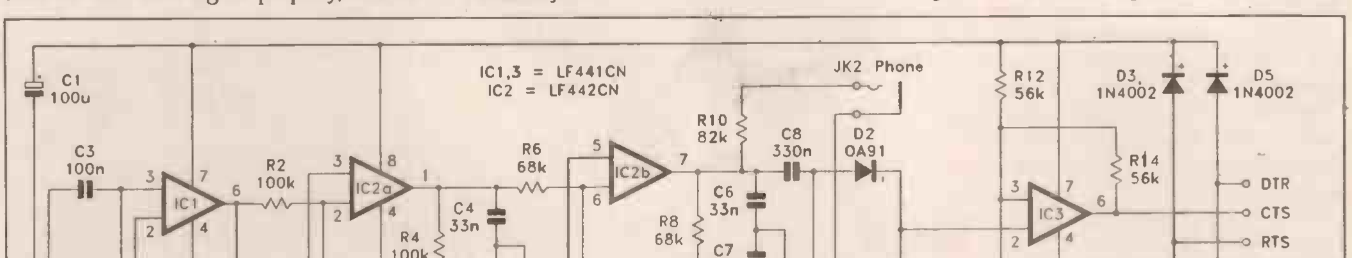


Fig. 2. The c.w. tone decoder circuit diagram.

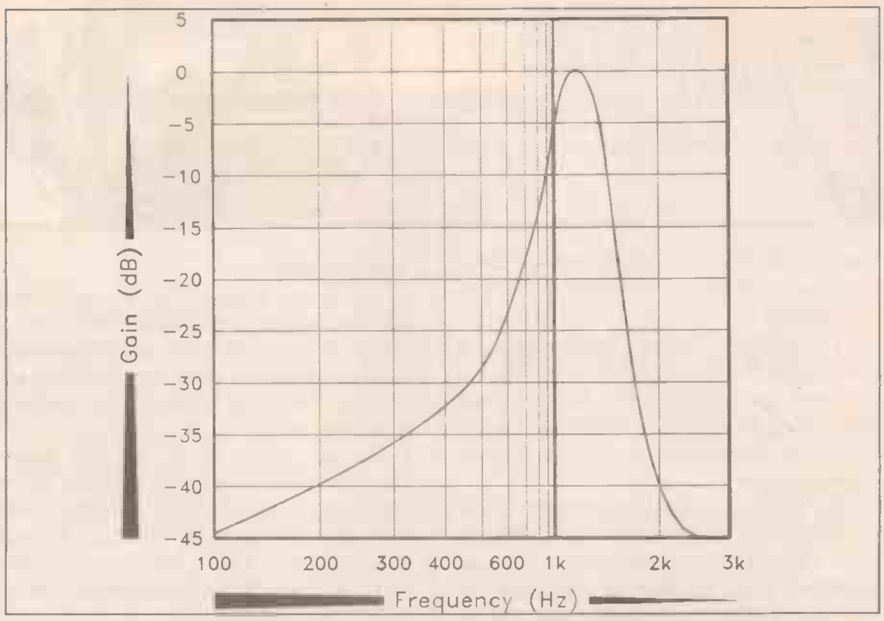


Fig. 3. The approximate frequency response of the bandpass filter.

other when there is a lot of noise on the input signal.

The value of resistor R13 sets the threshold level of IC3. Higher values give higher threshold levels, and lower values give lower threshold voltages.

The specified value gave good results when the decoder was used with the "REC" output of a Yaesu FRG-8800 receiver, but with other receivers it would probably be worthwhile experimenting with different values. It might be worth replacing resistor R13 with a 10k preset to enable the threshold level to be easily trimmed for optimum results.

The circuit is powered from the RTS and DTR outputs of the PC serial port. Diodes D3 to D6 form a bridge rectifier that ensures that the circuit is provided with supplies of the correct polarities. This gives nominal plus and minus 12V supplies, but the loaded supply voltage is likely to be somewhat less than this.

All three integrated circuits are low current types, which ensure that the loaded supply voltages are still perfectly adequate. The total current consumption of the circuit is only a milliamp or so. It is likely that the circuit will not function properly using ordinary operational amplifiers such as the LF351N and LF353N.

In Tune

For the decoder to work well it is essential that stations are tuned in accurately. As pointed out in last month's *Interface* article, "Hamcomm 3.0" has some sophisticated built-in tuning aids. Unfortunately, these are inoperative when an external tone decoder is used.

It is possible to get around this by including a simple interface as well as a tone decoder. This is possible because a simple interface and a tone decoder use different inputs of the serial port (DSR and CTS respectively).

The circuit diagram for a simple add-on interface for the tone decoder is shown in Fig. 4. This is just an open loop clipping amplifier. In use it was found to be not quite as useful as hoped.

The main problem is that the program cannot work using the simple interface and the tone decoder simultaneously. This requires some manipulation of the program settings when switching from tuning to reception, and vice versa, although the program's macro feature could probably make this process much quicker.

A more effective way of obtaining accurate tuning is to monitor the output from the filter using a crystal earphone connected to socket JK2. This enables the receiver's tuning to be set "by ear" for the strongest signal. Note that only a *crystal* earphone can be driven from JK2, and that there is insufficient drive current available for other types of headphone and earphone.

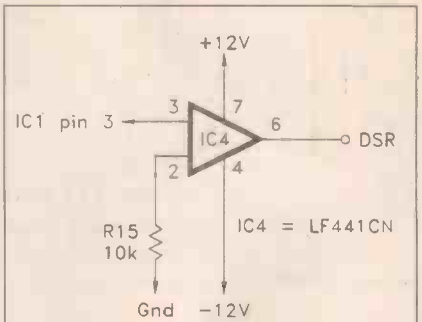


Fig. 4. Circuit for the add-on simple interface.

Construction

Construction of the interface is quite straightforward, and the general layout is not critical. Stripboard construction is perfectly adequate. Take due care when connecting diodes D1 and D2 as these are germanium diodes, and they are more vulnerable to heat damage than silicon types.

Connection details for 25-pin and 9-pin PC serial ports are provided in Fig. 5. In either case the connections are made to the computer via a female D-connector.

When using the interface remember to select "CW" from the "Mode" menu, together with "External Converter" and "Reverse" modes from the "Keying" menu. The external interface seems to give improved results when there are problems with QRM or general background noise. This is not to say that perfect decoding is always obtained.

Using an external decoder does not overcome problems with the software producing frequent "garbage" when decoding Morse code that has ragged timing. With a signal that is reasonably free from fading, and also has quite good timing accuracy, the system does produce copy that is reasonably error-free.

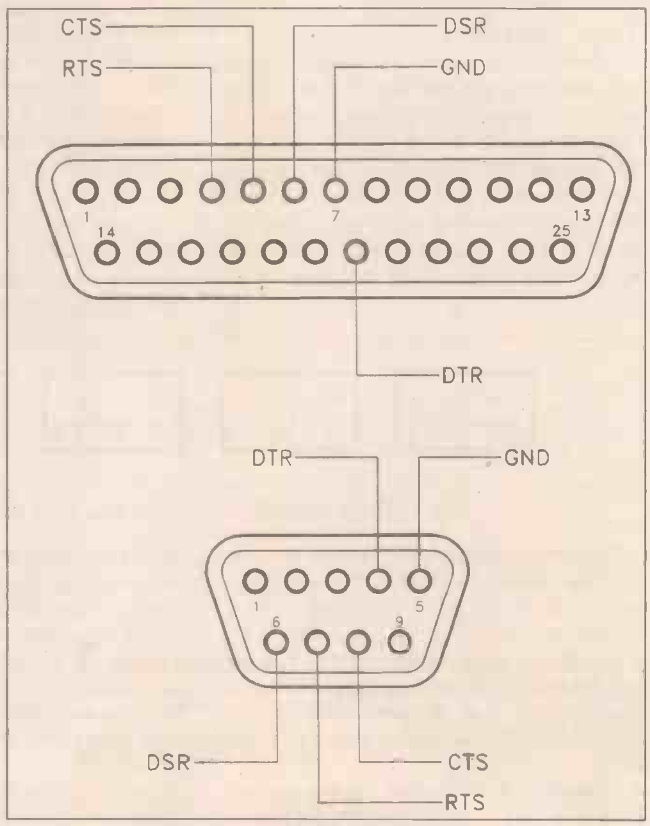


Fig. 5. Connections for 25-pin and 9-pin serial ports.

An advantage of using an external tone decoder is that it is far less demanding on the computer. This method should therefore work perfectly well with practically any PC, including something as basic as an XT type.

The "Hamcomm 3.0" program is available from **The PDSL, Dept EPE, Winscombe House, Beacon Road, Crowborough, Sussex, TN6 1UL** *(Tel. 01892 663298, Fax 01892 661149).*

Special Feature

CAVE RADIO

MIKE BEDFORD

Going underground with Earth-Current Communications – an area where there is plenty of scope for the electronics experimenter. Help explore the secrets of below ground communications and make cave exploration safer.

A LUCKY escape and a longer stay underground than he bargained for when visiting a new kilometre long extension to Ogof Daren Cilau in the Brecon Beacons was experienced by South Wales caver Matt Ward. It was on his way back towards the entrance that a large rock dropped in a narrow section of passage just ahead of Matt and cut him off from the rest of his party. The alarm was raised and thanks to the sterling efforts of the Gwent Cave Rescue Team he was eventually freed from his confinement, remarkably not much worse for his two-day captivity.

The advance rescue team decided to lay a field telephone, normally a reliable choice, especially in unfamiliar territory like these new passages. However, the telephone did not perform well and there was never a successful link end-to-end. This was because the cable became torn apart in the arduous entrance passages.

Ogofone

The alternative communications technology was to use a Cave Radio, known locally as the "Ogofone" (ogof means cave in Welsh), and developed by Bob Williams and Ian Todd. This equipment was taken underground at quite a late stage in the incident whilst another group took the corresponding surface set to the precise spot on the hillside directly above the rock fall. From here the surface people had a line of sight back to the surface controller and could talk to him on a v.h.f. handset. Within five minutes they were also talking to the underground team through 100 metres of solid rock via the Ogofone, albeit too late to be of any help in the actual rescue. This illustrates how the lack of effective communications can often hinder cave rescue teams.

Community Contribution

World-wide, very few people are developing cave communication equipment. However, this lack of interest in the electronic side of potholing is not indicative of the popularity of caving as a sport – in the UK alone, there are an estimated 125,000 trips underground every year. The unfortunate consequences of this are the number of rescues. In 1994, the 15 rescue groups of the British Cave Rescue Council were called out to a total of 48 caving incidents involving 112 people. Sadly, five of these people didn't make it safely back to the surface.

What this means is that there's significant scope for innovation, and large numbers of people are potential beneficiaries of new developments in this area. If you take up the gauntlet, and decide to get involved in underground communication, therefore, you could make a significant contribution to the caving community.

Cave Radio

Orchestrating rescues is surely the most important use of cave radios and is probably the main motivation for people working in this area. Perhaps it's difficult to quantify the benefit of effective communications in emergencies, but there are certainly people walking about today who owe their lives to cave radios.

However, the cave rescue organisations are not the only potential users of cave radios. We could envisage, for example, the use of cave radios to prevent accidents, rather than just helping when they do occur. A caving party in touch with the surface, for instance, could be warned of impending wet weather and so make their exit before being trapped by rising water.

At the moment, cave radios are too expensive for this to be viable, but it must surely be the ultimate aim. However, even if widespread availability isn't currently a practical proposition, cave radios are used outside the rescue groups, primarily by cave surveyors, cave scientists, and, of course, those engaged in research and development of cave communications.

Molephone

Let us step back over a decade. For many years it had been known that the water thundering into the mighty shaft of Gaping Gill in the Yorkshire Dales, emerged some time later from the mouth of Ingleborough Cave, some two miles distant. However, after almost a hundred and fifty years of exploration, no connecting passage had ever been found. The complex surveys of both systems showed a number of points in Gaping Gill apparently close to points in Ingleborough Cave, but exactly which point should cavers explore to find the elusive link passage?

Since the surveyed points at the far extremities of both systems were likely to be in error, this search could have taken forever. Then, in 1983, technology came to the rescue in the form of the "Molefone", developed by Bob Mackin. Operating on 87kHz, and providing voice communication, this cave radio could also be used to pinpoint an underground transmitter from the surface. By providing additional fixed survey points in this way, the survey accuracy was improved and the likely break-through point identified. The link-up expedition was planned with military precision, TV crews and reporters alerted, and the through trip is now history.

More recently, the use of microprocessor-controlled data loggers has made scientists more productive, but frequent underground trips were still necessary to extract the collected data. Clearly the ultimate solution is to interface the data logger to a cave radio. Now, using a laptop computer interfaced to a cave radio on the surface, data can be uploaded via a telemetry link.

Cave Radio Principles

Intuitively, most people wouldn't expect radios to work down caves. After all, a few metres of soil and pre-stressed concrete is enough to blank out car radios in under-passes. In practice, if you were to take an ordinary transistor radio a hundred metres underground, you'd be unlikely to hear anything at all. However, if your radio receiver operated in the lower part of the l.f. band, you'd be able to hear MSF, the National Physics Laboratory's standard time and frequency station, coming in loud and clear on 60kHz.

The reason for this surprising result is that the absorption of radio waves by rock depends on the frequency, with low frequencies being the most efficient at penetrating the ground. Without going into all the theory, it is suffice to say that to achieve communication to a depth of a couple of hundred metres – the maximum depth of most British caves – radios tend to operate in the 800Hz to 150kHz region.

Now, the standard radio antenna, against which the efficiency of other antennas is compared, is called a dipole and is half a wavelength long. OK receiving antennas don't have to be half or even a quarter wavelength long, and telescopic car antennas are indeed far shorter than this at MW and LW. However, the receiving antenna is only one part of the system. The transmitting antenna responsible for radiating the *BBC Radio 4* LW signal is of significant proportions as you'll know if you've driven past the transmitting site at Droitwitch. The fact is that if both transmitting and receiving antennas are significantly shorter than quarter of a wavelength, then the overall system would be grossly inefficient.

Returning to our typical cave radio frequencies, and converting to wavelengths, we get a range of about 2km to 400km, so, we would have to surmise that small portable cave radios are impractical. Huge antennas would be required yet caves are not renowned for their spaciousness.

All that has been said so far relates to "*conventional*" radio, communication by the transfer of power through free space by electromagnetic radiation. However, as an alternative to normal radio, which employs the so called "far field", "near field" communication can be used.

Much closer than half a wavelength from the transmitting antenna, localised magnetic and electrostatic fields exist and can be received by induction or capacitive coupling, respectively. The near magnetic field, referred to as the "induction field" looks particularly promising since it can be generated effectively using small loop antennas.

The induction field is not suitable for long distance communication since it decays with the cube of distance, but it is eminently suitable for cave radios, since it is rarely further than a few hundred metres from a cave to the surface. The technique employed by cave radios, therefore, is referred to as *low frequency induction*. Fig. 1 illustrates the principle of conventional cave radio, and you'll notice the familiar "bar magnet" field lines associated with inductive communications.

Earth Current Signalling

Take a microphone and audio amplifier, feed the output into a step-up transformer, and connect the transformer secondary to a pair of copper rods driven into the ground a few metres apart. Now connect the input of another audio amplifier to two more ground rods a couple of hundred metres away. Attach a pair of headphones and you'll find that anything spoken into the distant microphone will be clearly audible.

Surface signals being received underground using an inductive loop "aerial."

Our heading picture shows caver Rob Gill setting and testing a surface hybrid earth/current baseband transmitting rig.

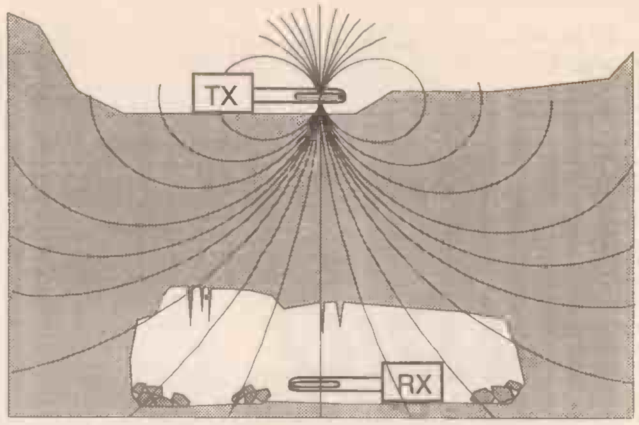


Fig. 1. Conventional Cave Radios operate by low frequency (l.f.) induction. This can be viewed as akin to the operation of a transformer but with very loose coupling between primary and secondary windings.

This technique is called "*earth current signalling*", and was first demonstrated over 100 years ago. Shortly afterwards, Marconi developed radio and so this early form of wireless (in the most literal sense of the word) communications was never developed, except briefly for use on the front line during WW1.

Earth current signalling has continued to fascinate electronics enthusiasts though, and articles have regularly appeared in the amateur electronics press. Its popularity probably lies in the fact that an operating licence is not required, but it is doubtful that many people have found any genuine applications for it.

However, earth current signalling is potentially valuable, specifically in the area of cave communication. Furthermore, it provides plenty of scope for experimentation. First let's take a look at some background information.

As with virtually any communication system, experimenters with earth current signalling will soon find that the signal strength decreases as the distance between the transmitter rods and the receiver rods is increased. Another familiar result is that communications efficiency can be improved by increasing the separation between the two transmitter rods and/or between the two receiver rods.

Of course, all this is what would, intuitively, be expected and is readily explained by assuming that the ground is a two-dimensional network of resistors and that communication is achieved by conduction. What most experimenters don't consider, however, is that the earth isn't two-dimensional, it also has depth. So, if you take the receiving set-up down a cave, and knock the ground rods into the floor of a cave passage you will be able to achieve communication through the earth. In Fig. 2, earth current communications is shown modelled as a 3-D resistor network with a surface transmitter being received both on the surface and in a cave passage.

The other thing most earth current experimenters don't realise is that conduction isn't the only possible communication model. When an alternating current passes through the earth, a magnetic field will be generated, so we could argue that the receiver operates

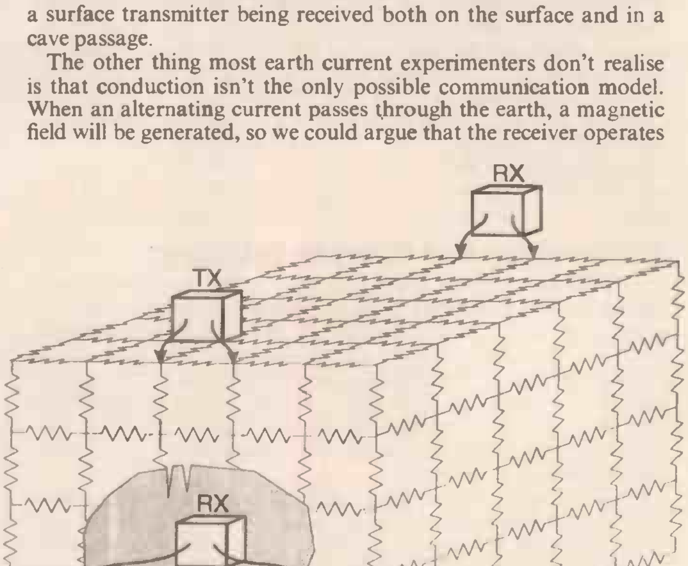


Fig. 2. Earth current communication can be remodelled by considering the earth as a rectangular grid of resistors. However the earth also has depth, so a signal injected on the surface can be received in a cave.

by detecting this magnetic field. For a conventional set-up, this is probably splitting hairs, but if true, there will be other means by which the signal could be detected.

We've already seen that cave radios operate by magnetic induction, so if an earth current signal does generate a magnetic field, it should be possible to detect it using an induction receiver. Similarly, an earth current receiving rig should be able to receive an inductively generated signal. A number of people are now starting to experiment with hybrid earth current/induction radio systems for rescue use and have shown that the technique is viable. The main advantage over pure induction cave radios is that the surface party can achieve coverage over a wide underground area with one widely spaced pair of rods. Using conventional cave radios, at maximum depth, the surface party has to track the underground party across the surface to maintain contact. This, in fact, is one of the main reasons that cave radios are not used universally during rescues in horizontally extensive caves such as that in Daren Cilau mentioned earlier.

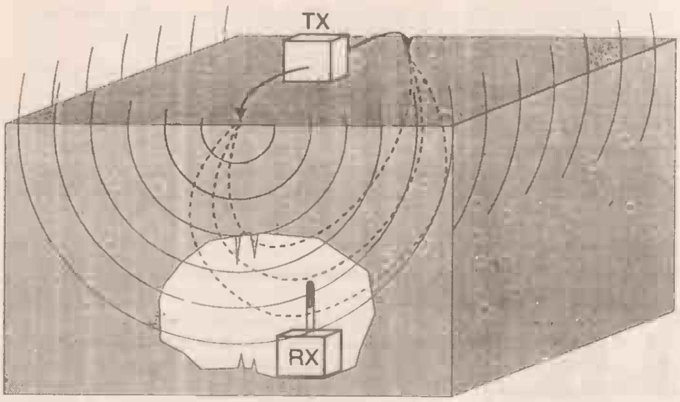


Fig. 3. The current flow in the earth, resulting from injecting a signal into ground rods, forms a series of huge underground loops. Just like an induction transmitter, a magnetic field is therefore generated and can be received underground using an induction loop.

Note that the field pattern differs from the familiar "bar magnet" pattern associated with an induction loop transmitter due to the combined effect of multiple "loops."

In Fig. 3, we see a hybrid system in action. Here, an earth current transmitter is being received inductively underground. It should, perhaps, be pointed out that the magnetic field lines are different from those in Fig. 1 because the current path makes up an infinite number of underground loops, all contributing to the overall field pattern.

So far one important fact has been glossed over. The earth current system outlined in this section operates at "audio frequencies". In technical jargon it is a *baseband* system. You'll remember, however, that the Molefone referred to earlier operated at 87kHz, as does the Ogofone.

Certainly cave radios can operate at baseband, and this was, in fact, the first technique employed. However, in the interests of reduced power consumption, reduced antenna mass, and increased efficiency, these were soon replaced by carrier-based designs. Of course, earth current systems could also operate above the audio band and this would indeed be necessary for inter-operation with cave radios.

Experimental Suggestions

In this section, some areas where the constructor could get involved in experimenting with earth current communication underground will be suggested. However, first some very important safety guidelines must be highlighted. It would be irresponsible to entice inexperienced people into caves without adequate supervision. After all, the main aim in writing this article is to help make caving safer, so it would be wholly inappropriate if the end result was to generate "customers" for the cave rescue groups.

It is probably stating the obvious but potholes provide opportunity for getting lost, getting stuck, being crushed by falling rocks, falling down pitches, drowning, and suffering hypothermia. However, if you're sensible, a trip underground is not especially dangerous, and most of these hazards can be virtually eliminated.

First and foremost, if you're not a caver, being sensible means only going underground in the company of people with caving experience. One approach would be to make contact with a local caving club, although you'll probably find that most of the members won't share your enthusiasm for electronics. More appropriate, given your motivation for going underground, would be to make contact with the Cave Radio & Electronics Group of the British Cave Research Association. Details are provided near the end of this article.

One other introductory comment before we get down to business – licensing. The author chose to offer this article to *Everyday with Practical Electronics* rather than an amateur radio magazine because it concerns an area where non-licensed electronics enthusiasts can take part on the same footing as radio amateurs.

Although you need a licence to experiment with inductive communication, the l.f. band is not covered by the amateur radio licence in the UK, so everyone would have to work under a Test and Development licence. With earth current communications, however, you probably don't need a licence at all, though the situation is far from clear. Certainly it has always been assumed that earth current work doesn't require a licence.

However, since the use of low frequency inductive communication is controlled in the UK, and since we are now admitting to the fact that an earth current does generate an induction field, would the Radiocommunications Agency (RA) now take a different view? So long as you work at baseband, there should be no problem. If you were to experiment at 87kHz in order to interact with an induction radio, on the other hand, it would be wise to check it out with the RA first.

Practical Work

So, warnings and preparatory comments out of the way, what practical experiments on underground earth current communications could you carry out? First of all, let's make it clear that no pratical circuits are going to be presented here. Quite a lot can be done with off-the-shelf equipment, and even when custom equipment is required, very simple circuits can often be used.

For example, to generate a baseband earth current, all you need is a source of an audio signal – a cassette recorder or microphone for example, a standard audio amplifier, a step-up transformer and a pair of ground rods. The underground induction receiver can also be very simple.

In the system demonstrated to the author, the receiver was based on an old transistor radio. All the r.f. circuitry had been bypassed, so that the ferrite rod antenna was connected directly to the audio amplifier. This is by no means an optimum receiver, but even with this simple set-up, quite a lot can be learned.

A number of avenues for experimentation come to mind. For example, how well does a single pair of ground rods "flood" a cave system with an induction field? Does one pair of rods fire most of the signal at right angles to the line between the rods, as dipole antennas do, or does it give an omnidirectional field pattern? If we get directional coverage, can the situation be improved by using extra rods?

We know that signal strength can be improved by increasing the spacing between the ground rods, but there are clearly practical limits to the separation between them. So, what other methods could be used to improve efficiency? Is it best to use longer rods, or thicker rods? It has been suggested that better than either of these options is to replace each rod with a hexagonal array of rods – but does this work in practice?

What has just been described are preliminary but nevertheless important experiments. To go beyond this initial stage, however, you'll probably need to improve the receiver. As with all induction radios, you'll find that there is a pay-off between antenna size and performance.

In general, the easiest way to improve the performance of a loop is to increase its cross-sectional area, although large diameter loops are obviously not suitable for use in small cave passages. For this reason, ferrite rods are sometimes used to increase the antenna's effectiveness. Another means by which loops can be made much more efficient is to tune them to resonance, but for speech communication, the *Q*-factor mustn't be so high as to reduce the bandwidth below 3kHz.

Interference radiated from overhead mains cables on 50Hz and multiples thereof, is another problem, even in the remote areas where most of the UK's caves are located. To get maximum performance out of baseband systems, therefore, notch filters would probably be required.

As already indicated, the ultimate aim with earth current communications must be to obtain interpretability with l.f. induction radios. Since these are relatively sophisticated SSB transceivers, however, this does require a modicum of experience in conventional r.f. circuit design.

However, one other area for experimentation does come to mind. You'll remember that in the section "Cave Radio", it was suggested that if all cavers were to carry radios, they could be warned of impending bad weather and so many rescues could be obviated. Although two-way cave radios offering speech communication will probably always be too expensive for this, there is an alternative. Each underground party carries a cheap compact receiver which can detect an induction field on a specific audio frequency. On receipt of this signal an alarm is sounded.

Slightly more sophisticated, we could envisage a unit which reacted to perhaps three different audio frequencies and illuminated one of three different coloured l.e.d.s. These could be interpreted in various ways, perhaps "get out of there", "get out of there quickly", and "all clear", for example.

With a conventional cave radio transmitter, this system may not be workable. Communication is in one direction only, so unless the underground party keeps exactly to a pre-arranged schedule, the surface party won't know exactly where they are. Since induction-to-induction systems require reasonably accurate alignment of transmitting and receiving loops at maximum range, this wouldn't provide the reliable warning mechanism which is required. However, if an "earth current transmitter" is able to saturate the cave system with signal, then it would be eminently suitable.

The Cave Radio & Electronics Group

Hopefully this article has given you some food for thought and it is the author's hope that some readers might decide to do some experimentation in this area. The major motivation for developing cave communications equipment is surely to help the cave rescue organisations, so it would be a shame if the experimenter were to develop something but didn't have the opportunity for their work to be publicised.

The Cave Radio & Electronics Group (CREG) of the British Cave Research Association (BCRA) is the UK's body dedicated to the development of communication and other electronic equipment for use in caving. Through a quarterly *Journal*, which covers a wide range of topics, the CREG acts as a clearing house for the dissemination of news and ideas, in addition to publishing practical circuits. Also of potential interest to readers, field meetings are held twice a year around the country and provide an opportunity to share ideas in a practical way.

You'll also notice from the short bibliography, that the CREG has already published many practical and theoretical articles relating to induction radio and earth current communications. If you do intend to start experimenting in this area, it might be an idea to take a look at these articles – they could save you from "re-inventing the wheel". For details of membership of CREG please send a stamped, self-addressed envelope to Mike Bedford at 4 Holme House, Oakworth, Keighley, W. Yorks. BD22 0QY. □

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Venturing Underground with VLF Radio, Mike Bedford, Radio Communications, Vol. 71, No. 1 (January 1995).

An introduction to LF induction radio for caving. Describes the use of cave radios for radio-location and gives practical circuits for an 874Hz transmitter and receiver.

An Introduction to Earth-Current Communications, David Gibson, CREG Journal 17 (September 1994).

A mainly theoretical introduction to earth current for use in cave communication. Also discusses earth current/induction hybrid systems. Quite mathematical.

Earth Current/Induction Field Experiments, Rob Gill, CREG Journal 19 (March 1995).

Description of experiments to show the viability of hybrid earth current/induction field systems as postulated by David Gibson in his article above.

SHOP TALK

with David Barrington

Simple Theremin

The small handheld box for the *Simple Theremin* came from **Rapid Electronics** (☎ *01206 751166*), code 30-0270. The printed circuit board is a tight-fit in the case and the edges may need "rubbing down" slightly to fit.

Other handheld cases could be used and most of our component advertisers should be able to offer a suitable alternative. If another case is used it should be plastic and not metal, since this will adversely affect the range of the instrument.

We understand that the BR195 lock-fit transistors and the 100μH inductors are available at a "surplus" price from **Greenweld Electronics** (☎ *01703 236363*). The specified miniature potentiometer seems to be fairly expensive and will take some finding locally. The only listing we have found is from **Farnell Electronic Services** (☎ *01279 626777*) and is carried under the Bourn 50 series range.

Most of our component advertisers should carry stocks of the Philips type trimmer capacitor and can usually be found listed as a "film dielectric" trimmer. The 38mm diameter loudspeaker, with an "alnico" magnet, is another part which should be widely available. It is most important that a speaker with an alnico or colmar magnet be used, as the popular "ferrite" magnet type will be too large for the p.c.b.

The low K metalised or ceramic plate capacitors should be generally available and not cause too much concern. They are certainly currently listed by **Cirkit** (☎ *01992 448899*).

If readers do experience difficulty in locating parts for the *Simple Theremin*, kits and complete units are available from **Longwave Instruments, Dept EPE, 23 Ashley Lane, Hordle, Lymington, Hants SO41 0GB.** (☎ *01425 610849*). Ready made, the Simple Theremin costs £49.99 and a full specification Theremin is available for the sum of £350. A MIDI converter unit will be marketed by them shortly.

The printed circuit board for the *Simple Theremin* is available from the *EPE PCB Service*, code 952 (see page 735).

Comprehensive Security System

Some of the items called up for the *Comprehensive Security System* may prove elusive to locate locally.

If you take up the PIR sensor option you will find prices vary quite considerably and it might be well worthwhile shopping around. A sensor is currently being listed by **Bull Electrical** (☎ *01273 203500*) for the sum of £8 (code Mag8P5) and also by **Mailtech** (☎ *01584 831475*) from £6.50 to £11.75 each. Before ordering check that they have relay outputs.

The small buzzer (code KU56L), keyswitch (CJ94C) and the "staccato" electronic siren (YZ03D) were all purchased from **Maplin**. The 12VA mains transformer also came from the same source, order code DM28F.

An empty alarm bell box, alarm sticker and the 12V 2AHr. lead acid battery were purchased from **Electrovalue** (☎ *01784 442253*). We understand that the range has changed recently. The *n*- channel MOSFET was also purchased from the same source.

The bell wire and the domestic dual light switch, although not listed in their advertisements, are stocked by **Bull Electrical** (see above) and **J&N Factors** (☎ *01444 881965*).

Quite a large number of our advertiser stock security/intruder switches, microswitches and pressure mat switches, all at fairly reasonable prices in comparison to "superstores".

Low-Range Ohmmeter Adaptor

There should be no problems when shopping for components for the *Low-Range Ohmmeter Adaptor.*

The multi-turn potentiometers are usually the cermet type and the most common range usually comes in anything from 18-turns to about 25-turns. The only point to watchout for is that they will fit on the p.c.b., although there is a certain amount of "play" in the connecting wires.

The other points to watchout for are: the "test" terminals *must* be all metal types, and that the pushbutton test switch is a low-profile type so that it does not short circuit any components in the small plastic box.

The small printed circuit board is available from the *EPE PCB Service*, code 926.

Vandata

One or two "special" components for the *Vandata* project need highlighting as they many not be available from local suppliers.

We shall start off by tackling the relays. Although it is quite possible to use other relays, it is suggested that the ones specified be used as others many not fit on the printed circuit board.

The 10A mains relay is listed by **Maplin** as their "Ultra Miniature High Power" type, code YX97F. They also supplied the 16A (12V 170 ohm coil) Automotive type relay, code JM26D (16A/12V car relay).

The reed relay switches are RS components and are available from **Electromail** (☎ *01536 204 555*), their mail order outlet. The code number to quote is 338-147.

The MBR2045 Schottky diode, 5mm multicolour l.e.d.s and a suitable slotted heatsink all came from Maplin. Codes GX35Q, YH75S and FL58N. The heatsink could be fabricated from 40mm × 20mm aluminium plate.

The turret pins for mounting the reed relays were ordered from the above company, code JM04E (two packs required). The screw-terminal locks and 18s.w.g. and 20s.w.g. enalled wire should be available generally.

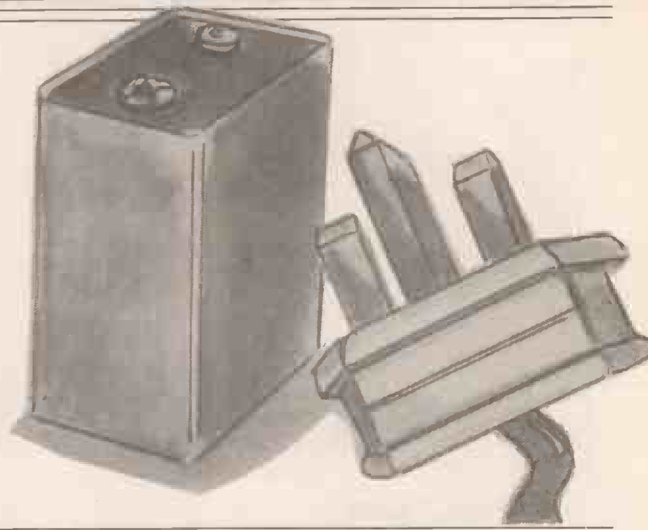
If you wish to use identical cases, these were ordered from Maplin, codes LL05F for the boot unit and KC93B for the display unit.

The two printed circuit boards for the *Vandata* are available from the *EPE PCB Service*, codes 953 (Boot) and 954 (Display) respectively.

Finally, as there are high currents associated with "car electrics", any additional inter-linking wires should be rated identically to the existing coupling cables that many need "breaking" into. These should be available from any good caravan and car accessory shops or garages specialising in caravan spares.

Hum-Free Battery Eliminator

We cannot foresee that any component buying problems are likely to occur for readers wishing to construct the Hum-Free Battery Eliminator project.



HUM-FREE BATTERY ELIMINATOR

ANDY FLIND

Musicians may hum the tune, but never amplifiers and PSUs!

TOWARDS the end of the article describing the guitarists' Personal Practice Amplifier (last month), brief mention was made of using it with a mains power adaptor. Earthing of the negative rail was recommended to increase safety and reduce hum, but at the time this had not been tried with the prototype. At least, not with one of the little plug-in mains adaptors that are so common nowadays.

RIFF, RAFF AND NAFF

The musician for whom this project was designed took it home, boxed it up and wired it very neatly, added a 20mA l.e.d. power indicator, and installed a partly-charged PP3 NiCad battery. Readers can guess how long that lasted, probably not even for the first riff!

Next, he fitted a switched power socket for a 9V 300mA plug-in adaptor. Result: hum. Lots and lots of hum! So the author's phone rang again, and soon the unit was back on the bench for investigation.

The construction of mains adaptors varies with make and use. Some contain just a transformer to produce a low-voltage a.c. output, but general-purpose types usually have a transformer, rectifier and perhaps a decoupling capacitor to generate a d.c. supply. Most have no active regulation and so the output voltage varies with load.

Mains adaptors have to provide the specified voltage at full load. At lesser loads they produce higher voltages, often up to the peak value of the sinewave from the transformer – nearly 50 per cent higher. There is generally some a.c. ripple on the output, which at light loads often has an unpleasant "sawtooth" waveform because the capacitor is charged only at the peaks of each cycle.

It can be difficult to earth the output of one of these adaptors as they normally use the "double insulated" approach to provide an isolated output. The earth pin is often just a plastic dummy provided only to open the protection cover in the mains socket.

HUMBUG

The difficulty with using a mains adaptor with the Practice Amplifier centred upon the TDA2822 output amplifier. Firstly, this becomes more sensitive at higher supply voltages. With around 12V from the (nominally) 9V plug-in unit, much noise and instability became apparent. Secondly, the TDA2822 does not appreciate supply rail hum.

Ripple from the adaptor supply was measured at just 0·1V r.m.s., but this was still enough to render the amplifier quite unusable. Disconnecting the leads from the volume control and shorting them to their screens made no difference, confirming that the hum was entering via the power supply. More decoupling proved unhelpful. A 1000µF capacitor applied close to the chip supply pins had no effect.

SIMPLE HUM-BUCKING

A means of reducing the adaptor supply voltage and ripple was clearly needed to solve the problem. One method tested was an active ripple suppressor. Whilst this was not the solution eventually adopted, it worked quite well. The circuit is shown in Fig. 1 for readers who might like to experiment with it. It works as follows:

Resistor R1 is chosen so that about five milliamps flows through diodes D1 and D2. The voltage drop across these is about 1·2V, providing a voltage with "headroom" beneath the ripple for the active part of the circuit. This still has the full ripple imposed on it so it is smoothed by resistor R2 and capacitor C1, and then

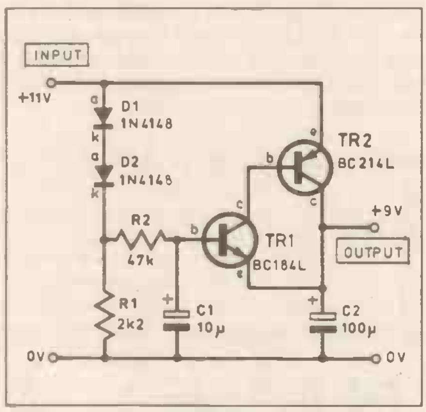
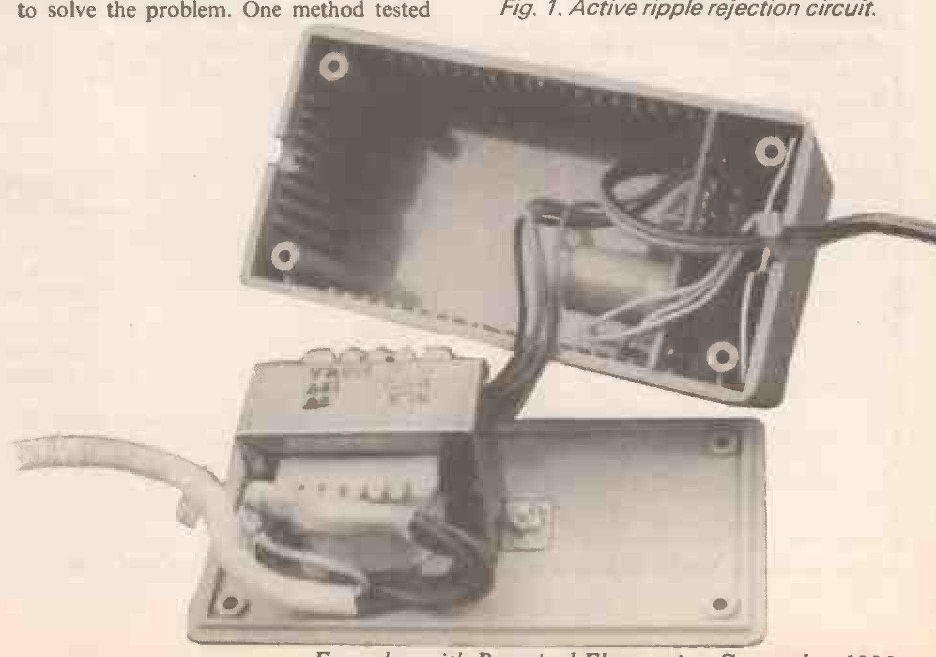


Fig. 1. Active ripple rejection circuit.



buffered by transistors TR1 and TR2 connected as a complementary Darlington pair.

With the component values shown, the ripple is reduced to less than one per cent. It works quite well and could provide a cheap and simple solution. The diodes reduce the voltage a little, as does the base-emitter drop of transistor TR1. The total loss is about 2V.

However, the circuit does not actually regulate the output voltage and may not be suitable for use with some adaptors. Nor does it solve the problem of earthing the output, and, due to the way power socket switches are constructed, it could not easily be housed inside the amplifier's case. Connection somewhere in the lead between supply and project would be required.

CURING THE RIPPLE

Consequently, to achieve reliable and repeatable results, it was decided to design a regulated supply with a much higher performance than found in most commercial units. The full circuit diagram for this is shown in Fig. 2.

Transformer T1 is a 250mA type with 12V-0-12V secondary windings. Diodes D1 and D2 perform full-wave voltage rectification, with capacitor C3 providing d.c. voltage smoothing. The two small-value capacitors C1 and C2 reduce noise generated by the diode switching. Regulator IC1 is an LM317T, an adjustable output voltage type. In Fig. 2, the values of resistors R1, R2 and R3 determine the output voltage, set here to 9V.

Capacitor C6 provides additional output decoupling, although the regulator itself removes nearly all the ripple. The circuit to be supplied will also normally have its own decoupling. Capacitors C4 and C5 are required to ensure regulator stability. The output of this circuit is a stable d.c. voltage of the correct value regardless of load (within the limits of the transformer) and virtually free of ripple and noise, a huge improvement over most commercial adaptors.

Since the circuit is connected to the mains with a standard three-pin plug, it is simple to earth any point of the output as required, either negative or positive rail. Even if a "floating" output is required, the transformer metalwork can be earthed, which again helps to reduce noise.

LM317T REGULATOR

A little additional information may be useful for constructors who would like to know a bit more about the LM317T regulator chip, and perhaps set a different output voltage. The regulator is a 3A

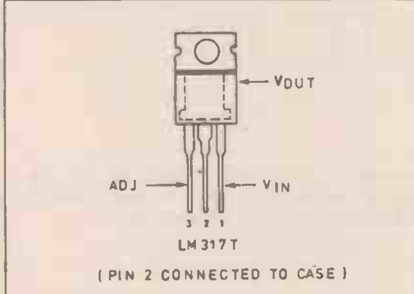


Fig. 3. Pinouts for the LM317T voltage regulator.

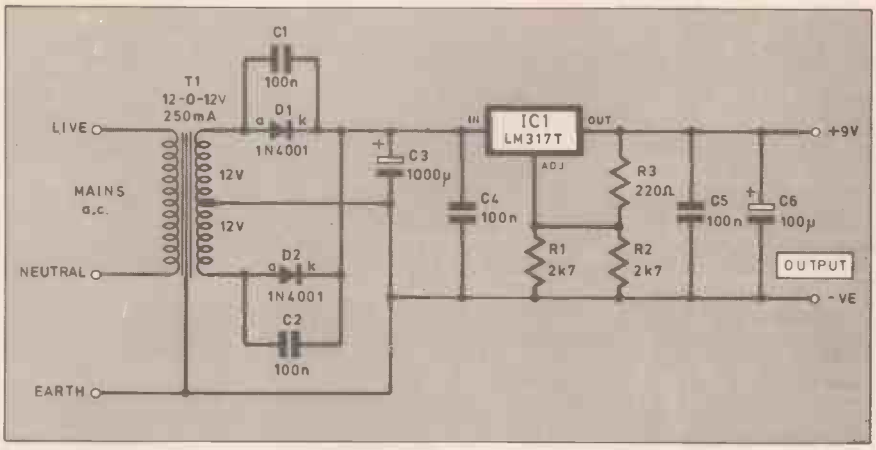


Fig. 2. Complete circuit diagram for the Hum-free Battery Eliminator.

device in a TO220 package, as shown in Fig. 3.

There is also a 100mA version available in a TO92 package for low-power applications. Both devices can accept input voltages up to 40V but need a minimum of 3V difference between input and output pins. However, with high differential voltages across the chip, a watch must be kept on its heat dissipation. Additionally, a minimum load of 5mA should be taken from the output at all times, although this can conveniently be drawn by the voltage determining network.

The output voltage is determined by the ratio of two resistances in a feedback network, as shown in Fig. 4. The usual formula given for determining the resistance values is $V_{out} = 1{\cdot}25 \times (1 + R2/R1)$ volts, but the author prefers a slightly different approach. Essentially, the chip operates by maintaining a constant 1·25V between the output and "adjust" pins. This means that a 220 ohm resistor (R1) between output and "adjust" will draw 1·25/220 milliamps, slightly more than the 5mA minimum load required, leaving only the value of R2 to be selected.

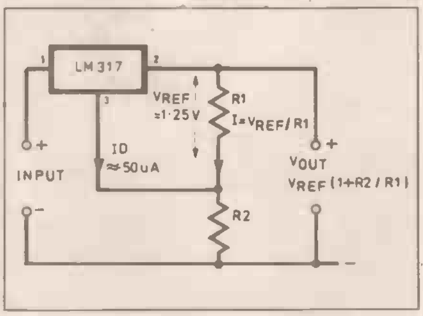


Fig. 4. Simple voltage regulator circuit.

The voltage across resistor R2 is clearly the required voltage less 1.25V, whilst the current which will pass through R2 is that from R1 plus 50µA. The 50µA is the current which flows from the "adjust" pin, ignored in original formula. With the current and required voltage figures known, the necessary resistance can be easily calculated from R = V / I. The precise resistance value can be obtained by using appropriate resistors in series or parallel, or by using a preset potentiometer.

It should be noted that the potential between output and "adjust" may not be exactly 1·25V, in fact the data sheets quote 1·2V to 1·3V, a variation of about four per cent.

(Further information about the LM317T was given in EPE October 1994 issue, page 796.-Ed.)

CONSTRUCTION

Using a printed circuit board for a circuit as simple as this seemed to the author to be "overkill". Instead, most of the components are mounted on a small piece of 0·1 inch grid stripboard having 14 strips by 18 holes, as shown in Fig. 5.

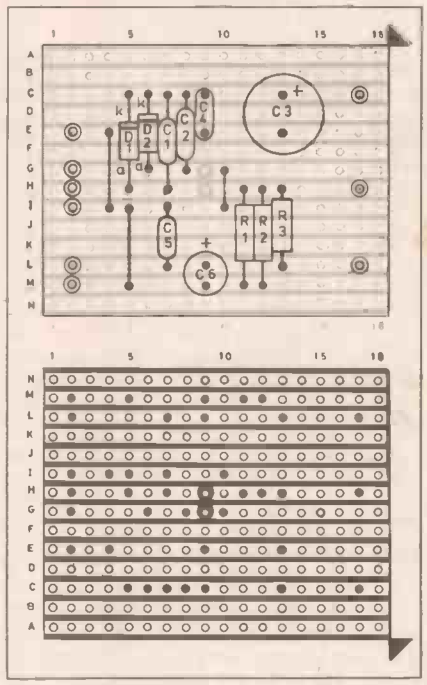


Fig. 5. Stripboard layout and track details for the Hum-free Battery Eliminator.

The stripboard should be carefully cut and filed to fit into the slots at the sides of the suggested case. There are two track cuts to be made in the board, and three link wires.

One of the links appears to connect to a strip that goes nowhere else. In fact, as the "adjust" pin is a point where noise might enter the circuit, the strips to either side of the one connected to "adjust" are also connected to the negative rail to help guard against this.

Little needs to be said regarding construction, save that three of the 100n capacitors (C1, C2 and C5) have their leads bent outwards and this should be done with care as they are fragile. Testing consists of simply connecting up the components, thoroughly checking the assembly when complete, attaching a meter and applying power. **However, be extremely careful as mains voltages are present around the transformer. If in any doubt, consult a qualified electrician.**

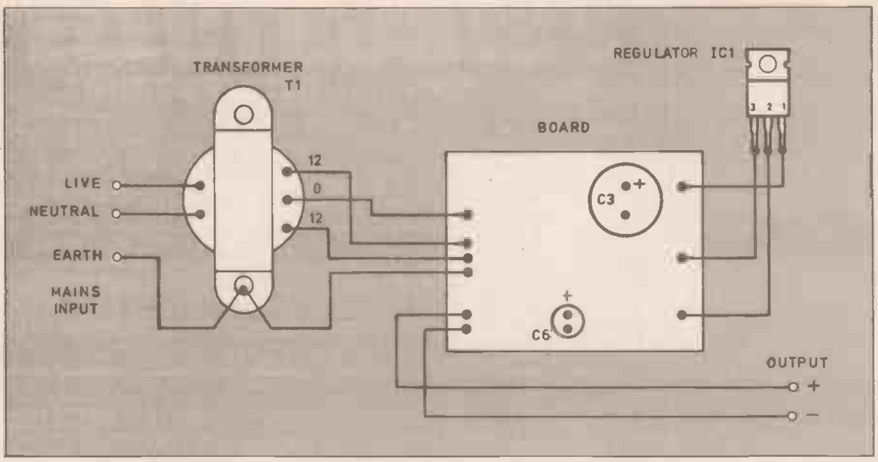


Fig. 6. Connections between board, transformer and regulator.

In the unlikely event of problems, the circuit could be supplied with 12V d.c. from a current-limited supply in place of the transformer whilst trouble-shooting takes place.

CONNECTIONS

Connections between board, transformer and regulator are shown in Fig. 6. The regulator is bolted to a small piece of aluminium which is wedged into the end of the case behind the pillars to which the lid is screwed. The heatsink tab on the regulator is internally connected to the output pin, so it should *NOT* be allowed to come into contact with any other part of the circuit.

The mains earth lead does not have to be connected to the negative rail. It can be connected to positive or, where a double-insulated transformer is used (the type with separate bobbins for primary and secondary windings), it could be omitted altogether. (If a metal case is used, the case MUST be connected to the Earth lead.) All three arrangements were tried with the Practice Amplifier and none produced any audible hum. An l.e.d. could be added to indicate that the unit is operating.

HUMBLE HOUSING

There are many ways in which this power supply can be housed. The prototype was fitted into an ABS plastic box with internal dimensions of 49·5mm × 99·5mm × 40mm. Although the prototype shown in the photograph was built with a mains plug on a short lead, another was constructed as a plug-in unit, with the plug fixed directly to the case. This was awkward to wire though, and is not really recommended.

Cases with moulded plugs are available, but the problem with these is that the Earth pin is usually a plastic dummy. With some types it might be possible to remove this and replace it with a metal pin taken from an ordinary plug.

Ripple from this battery eliminator is practically unmeasurable, and voltage regulation from zero to 250mA is better than one per cent. It has completely eliminated the Practice Amplifier problem experienced by the author's musician friend. With the volume control fully up there is no audible hum.

The unit may well prove beneficial for use with other equipment having problems with mains power supplies, and could also be used as a bench power supply for test equipment, etc. It runs cooler than many commercial units, a two-hour test at 270mA produced only comfortable hand-warmth, mostly from the transformer. □

COMPONENTS

Resistors

R1, R2	2k7 (2 off)	
R3	220Ω	

All 0·25W 5% carbon film or better

See SHOP TALK Page

Capacitors

C1, C2, C4, C5	100n ceramic (4 off)
C3	1000µ radial elect. 35V
C6	100µ radial elect. 25V

Semiconductors

D1, D2	1N4001 rectifier diode
IC1	LM317T adjustable positive voltage regulator, 3A

Miscellaneous

T1	12V-0-12V 250mA mains transformer

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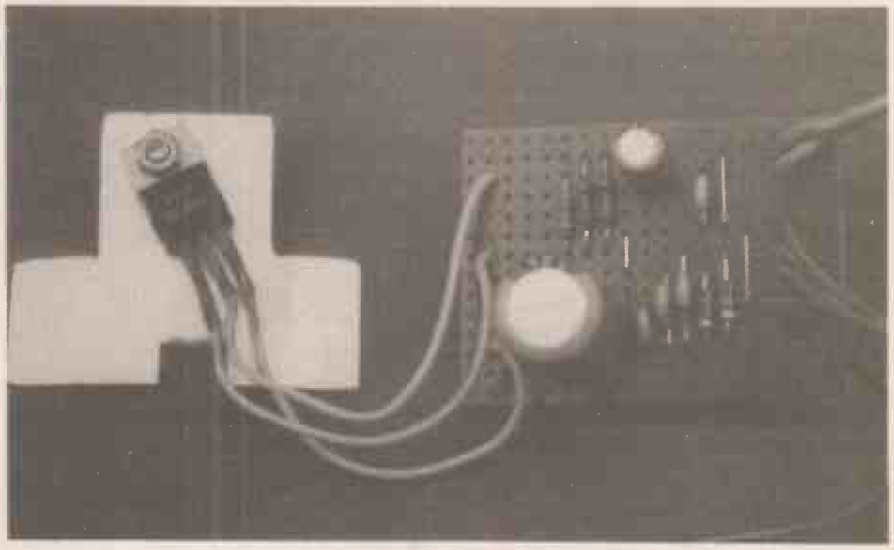

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The nine complete constructional projects are: Versatile Bench Power Supply; Simple Intercom; Bench Amplifier/Signal Tracer; Waveform Generator; Electronic Die; Pulse Generator; Radio Receiver; Disco Lights Controller; Optical Communications Link.
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Alan Winstanley and Keith Dye B.Eng(Tech)AMIEE
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If you are taking electronics or technology at school or college, this book is for you. If you just want to learn the basics of electronics or technology you must make sure you see it. *Teach-In No. 7* will be invaluable if you are considering a career in electronics or even if you are already training in one. The Mini Lab and software enable the construction and testing of both demonstration and development circuits. These learning aids bring electronics to life in an enjoyable and interesting way: you will both see and hear the electron in action! The Micro Lab microprocessor add-on system will appeal to higher level students and those developing microprocessor projects.
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128 pages Order code EP1 £2.45

The books listed have been selected by *Everyday with Practical Electronics* editorial staff as being of special interest to everyone involved in electronics and computing. They are supplied by mail order to your door. Full ordering details are given on the last book page. For another selection of books see next month's issue.

PROJECT CONSTRUCTION

POPULAR ELECTRONIC PROJECTS
R. A. Penfold
Included in this book are a collection of the most popular types of project which, we feel sure, will provide many designs to interest all electronics enthusiasts. All the circuits utilise modern, inexpensive and freely available components. The 27 projects selected cover a very wide range and are divided into four basic areas: Radio Projects, Audio Projects, Household Projects and Test Instruments. An interesting addition to the library of both the beginner and more advanced constructor.
135 pages Order code BP49 £2.50

TEST EQUIPMENT CONSTRUCTION
R. A. Penfold
This book describes in detail how to construct some simple and inexpensive but extremely useful, pieces of test equipment. Stripboard layouts are provided for all designs, together with wiring diagrams where appropriate, plus notes on construction and use.

The following designs are included:–
AF Generator, Capacitance Meter, Test Bench Amplifier, AF Frequency Meter, Audio Mullivoltmeter, Analogue Probe, High Resistance Voltmeter, CMOS Probe, Transistor Tester, TTL Probe.

The designs are suitable for both newcomers and more experienced hobbyists.
104 pages Order code BP248 £2.95

HOW TO DESIGN AND MAKE YOUR OWN P.C.B.s
R. A. Penfold
Deals with the simple methods of copying printed circuit board designs from magazines and books, and covers all aspects of simple p.c.b. construction including photographic methods and designing your own p.c.b.s.
80 pages Order code BP121 £2.50

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
R. A. Penfold
We have all built projects only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.
96 pages **Temporarily out of print**

AUDIO AMPLIFIER CONSTRUCTION
R. A. Penfold
The purpose of this book is to provide the reader with a wide range of preamplifier and power amplifier designs that will, it is hoped, cover most normal requirements.

The preamplifier circuits include low noise microphone and RIAA types, a tape head preamplifier, a guitar preamplifier and various tone controls. The power amplifier designs range from low power battery operation to 100W MOSFET types and also include a 12 volt bridge amplifier capable of giving up to 18W output.

All the circuits are relatively easy to construct using the p.c.b. or stripboard designs given. Where necessary any setting-up procedures are described, but in most cases no setting-up or test gear is required in order to successfully complete the project.
100 pages Order code BP122 £2.95

DESIGN YOUR OWN CIRCUITS
See ELECTRONICS TEACH IN No. 6 above left.

RADIO / TV / VIDEO

ELECTRONIC PROJECTS FOR VIDEO ENTHUSIASTS
R. A. Penfold
This book provides a number of practical designs for video accessories that will help you get the best results from your camcorder and VCR. All the projects use inexpensive components that are readily available, and they are easy to construct. Full construction details are provided, including stripboard layouts and wiring diagrams. Where appropriate, simple setting up procedures are described in detail; no test equipment is needed.

The projects covered in this book include: Four channel audio mixer, Four channel stereo mixer, Dynamic noise limiter (DNL), Automatic audio fader, Video faders, Video wipers, Video crispener, Mains power supply unit.
109 pages Order code BP356 £4.95

SETTING UP AN AMATEUR RADIO STATION
I. D. Poole
The aim of this book is to give guidance on the decisions which have to be made when setting up any amateur radio or short wave listening station. Often the experience which is needed is learned by one's mistakes, however, this can be expensive. To help overcome this, guidance is given on many aspects of setting up and running an efficient station. It then proceeds to the steps that need to be taken in gaining a full transmitting licence.

Topics covered include: The equipment that is needed; Setting up the shack; Which aerials to use; Methods of construction; Preparing for the licence.

An essential addition to the library of all those taking their first steps in amateur radio.
86 pages Order code BP300 £3.95

EXPERIMENTAL ANTENNA TOPICS
H. C. Wright
Although nearly a century has passed since Marconi's first demonstration or radio communication, there is still research and experiment to be carried out in the field of antenna design and behaviour.

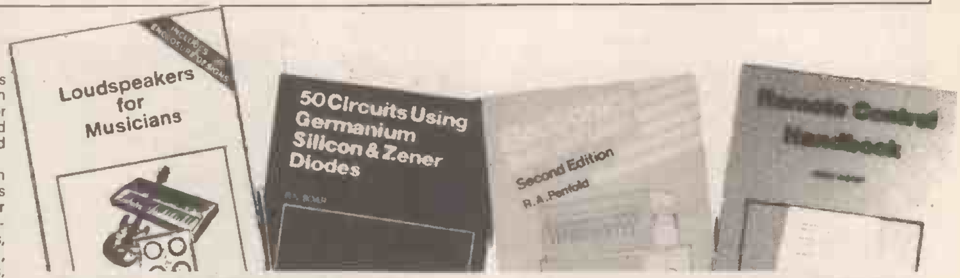
The aim of the experimenter will be to make a measurement or confirm a principle, and this can be done with relatively fragile, short-life apparatus. Because of this, devices described in this book make liberal use of cardboard, cooking foil, plastic bottles, cat food tins, etc. These materials are, in general, cheap to obtain and easily worked with simple tools, encouraging the trial-and-error philosophy which leads to innovation and discovery.

Although primarily a practical book with text closely supported by diagrams, some formulae which can be used by straightforward substitution and some simple graphs have also been included.
72 pages Order code BP278 £3.50

NEWNES SHORTWAVE LISTENING HANDBOOK
Joe Pritchard G1UQW
Part One covers the "science" side of the subject, going from a few simple electrical "first principles", through a brief treatment of radio transmission methods to simple receivers. The emphasis is on practical receiver designs and how to build and modify them, with several circuits in the book.

Part Two covers the use of sets, what can be heard, the various bands, propagation, identification of stations, sources of information, QSLing of stations and listening to amateurs. Some computer techniques, such as computer Morse decoding and radio teletype decoding are also covered.
224 pages Order code NE16 £15.95

TESTING, THEORY, DATA AND REFERENCE



PRACTICAL ELECTRONICS HANDBOOK – Third Edition
Ian Sinclair
A completely updated and revised third edition of this popular title. It still contains a carefully selected collection of standard circuits, rules-of-thumb, and design data for professional engineers, students and enthusiasts involved in radio and electronics, but is now over one hundred pages bigger.
The book covers many areas not available elsewhere in such a handy volume, and this new edition now includes chapters on: **Microprocessors and Microprocessor Systems:** Instruction Registers, Clocking, Memory, Read-Write Memory, Buses, Reading and Writing Actions, Three-state Control, Control Bus, Timing and Bus Control, PC Register and Addressing, Addressing Methods, Interrupts, Inputs and Outputs, Ports, Keyboard Interfacing, Video Interfacing. **Digital-Analogue conversions:** Analogue-to-Digital Conversion, Sampling and Conversion, Digital-to-Analogue Conversion, Current Addition Methods, Conversion Problems, Bitstream Methods, Computer Plug-in Boards. **Computer Aids in Electronics:** The Computer, Linear Circuit and Nodes, PCB Layouts, Circuit Diagrams, Public Domain Software Library. **Hardware Components and Practical Work:** Hardware, Video connectors, Control Knobs and switches, Cabinets and cases, Packages for semiconductors, Integrated circuit packages, Constructing circuits, Surface mounting, Testing and trouble-shooting, Practical work on microprocessing equipment, Instruments for digital servicing work, Logic analysers.
Other chapters cover Passive Components, Active Discrete Components, Discrete Component Circuits, Linear ICs, Digital ICs, Transferring Digital Data and Computer Aids in Electronics.
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MORE ADVANCED USES OF THE MULTIMETER
R. A. Penfold
This book is primarily intended as a follow-up to BP239, (see below), and should also be of value to anyone who already understands the basics of voltage testing and simple component testing. By using the techniques described in Chapter 1 you can test and analyse the performance of a range of components with just a multimeter (plus a very few inexpensive components in some cases). Some useful quick check methods are also covered.
While a multimeter is supremely versatile, it does have its limitations. The simple add-ons described in Chapter 2 extended the capabilities of a multimeter to make it even more useful.
84 pages — Order code BP265 — **£2.95**

ELECTRONIC TEST EQUIPMENT HANDBOOK
Steve Money
The principles of operation of the various types of test instrument are explained in simple terms with a minimum of mathematical analysis. The book covers analogue and digital meters, bridges, oscilloscopes, signal generators, counters, timers and frequency measurement. The practical uses of the instruments are also examined.
Everything from Audio Oscillators, through R, C & L measurements (and a whole lot more) to Waveform Generators and testing Zeners.
206 pages — Order code PC109 — **£8.95**

A REFERENCE GUIDE TO BASIC ELECTRONICS TERMS
F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.
The wonders of electronics multiply unceasingly and electronic devices are creeping relentlessly into all walks of modern life. As with most professions, ours too has a language of its own, ever expanding and now encompassing several thousands of terms. This book picks out and explains some of the more important fundamental terms (over 700), making the explanations as easy to understand as can be expected of a complicated subject and avoiding high-level mathematics.
Through its system of references, each term is backed up by a list of other relevant or more fundamental terms so that a chosen subject can be studied to any depth required.
472 pages — Order code BP286 — **£5.95**

GETTING THE MOST FROM YOUR MULTIMETER
R. A. Penfold
This book is primarily aimed at beginners and those of limited experience of electronics. Chapter 1 covers the basics of analogue and digital multimeters, discussing the relative merits and the limitations of the two types. In Chapter 2 various methods of component checking are described, including tests for transistors, thyristors, resistors, capacitors and diodes. Circuit testing is covered in Chapter 3, with subjects such as voltage, current and continuity checks being discussed.
In the main little or no previous knowledge or experience is assumed. Using these simple component and circuit testing techniques the reader should be able to confidently tackle servicing of most electronic projects.
96 pages — Order code BP239 — **£2.95**

ELECTRONICS-BUILD AND LEARN
R. A. Penfold
The first chapter gives full constructional details of a circuit demonstrator unit that is used in subsequent chapters to introduce common electronic components – resistors, capacitors, transformers, diodes, transistors, thyristors, fets and op.amps. Later chapters go on to describe how these components are built up into useful circuits, oscillators, multivibrators, bistables and logic circuits.
At every stage in the book there are practical tests and experiments that you can carry out on the demonstrator unit to investigate the points described and to help you understand the principles involved. You will soon be able to go on to more complex circuits and tackle fault finding logically in other circuit you build.
120 pages — Order code PC103 — **£6.95**

PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE
F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.
Bridges the gap between complicated technical theory, and "cut-and-tried" methods which may bring success in design but leave the experimenter unfulfilled. A strong practical bias – tedious and higher mathematics have been avoided where possible and many tables have been included.
The book is divided into six basic sections: Units and Constants, Direct-Current Circuits, Passive Components, Alternating-Current Circuits, Networks and Theorems, Measurements.
256 pages — Order code BP53 — **£3.95**

NEWNES ELECTRONICS TOOLKIT
Geoff Phillips
The author has used his 30 years experience in industry to draw together the basic information that is constantly demanded. Facts, formulae, data and charts are presented to help the engineer when designing, developing, evaluating, fault finding and repairing electronic circuits. The result is this handy workmate volume: a memory aid, tutor and reference source which is recommended to all electronics engineers, students and technicians.
Have you ever wished for a concise and comprehensive guide to electronics concepts and rules of thumb? Have you ever been unable to source a component, or choose between two alternatives for a particular application? How much time do you spend searching for basic facts or manufacturer's specifications? This book is the answer, it covers resistors, capacitors, inductors, semiconductors, logic circuits, EMC, audio, electronics and music, telephones, electronics in lighting, thermal considerations, connections, reference data.
158 pages — Order code NE20 — **£12.95**

INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE
A. Michaels
Helps the reader to find possible substitutes for a popular selection of European, American and Japanese transistors. Also shows material type, polarity, manufacturer and use.
320 pages — Order code BP85 — **£3.95**

AN INTRODUCTION TO LIGHT IN ELECTRONICS
F. A. Wilson
Marconi first bridged the Atlantic with radio waves, then of a mere 200 kilohertz. Since then for communication we have moved up the frequency scale through megahertz and microwaves and are now probing light waves. Accordingly no self-respecting electronics engineer can afford not to be conversant with light and its uses in electronics since development of opto-electronic devices and communication systems is proceeding at a truly explosive rate.
This book is not for the expert but neither is it for the completely uninitiated. It is assumed the reader has some basic knowledge of electronics. After dealing with subjects like Fundamamentals, Waves and Particles and The Nature of Light such things as Emitters, Detectors and Displays are discussed. Chapter 7 details four different types of Lasers before concluding with a chapter on Fibre Optics.
161 pages — Order code BP359 — **£4.95**

PRACTICAL ELECTRONIC DESIGN DATA
Owen Bishop
This book is a comprehensive ready-reference manual for electronics enthusiasts of all levels, be they hobbyists, students or professionals. A helpful major section covers the main kinds of component, including surface-mounted devices. For each sort, it lists the most useful and readily available types, complete with details of their electronic characteristics, pin-outs and other essential information.
Basic electronic units are defined, backed up by a compendium of the most often required formulae, fully explained. There are five more extensive sections devoted to circuit design, covering analogue, digital, radio, display, and power supply circuits. Over 150 practical circuit diagrams cover a broad range of functions. The reader is shown how to adapt these basic designs to a variety of applications. Many of the circuit descriptions include step-by-step instructions for using most of the standard types of integrated circuit such as operational amplifiers, comparators, filters, voltage converters and switched-mode power supply devices, as well as the principal logic circuits.
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AUDIO AND MUSIC

INTRODUCTION TO DIGITAL AUDIO (Second Edition)
Ian Sinclair
Digital recording methods have existed for many years and have become familiar to the professional recording engineer, but the compact disc (CD) was the first device to bring audio methods into the home. The next step is the appearance of digital audio tape (DAT) equipment.
All this development has involved methods and circuits that are totally alien to the technician or keen amateur who has previously worked with audio circuits. The principles and practices of digital audio owe little or nothing to the traditional linear circuits of the past, and are much more comprehensible to today's computer engineer than the older generation of audio engineers.
This book is intended to bridge the gap of understanding for the technician and enthusiast. The principles and methods are explained, but the mathematical background and theory is avoided, other than to state the end product.
128 pages — Order code PC102 — **£7.95**

AUDIO
F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.
Analysis of the sound wave and an explanation of acoustical quantities prepare the way. These are followed by a study of the mechanism of hearing and examination of the various sounds we hear. A look at room acoustics with a subsequent chapter on microphones and loudspeakers then sets the scene for the main chapter on audio systems – amplifiers, oscillators, disc and magnetic recording and electronic music.
320 pages — Order code BP111 — **£3.95**

PROJECTS FOR THE ELECTRIC GUITAR
J. Chatwin
This book is for anyone interested in the electric guitar. It explains how the electronic functions of the instrument work together, and includes information on the various pickups and transducers that can be fitted. There are complete circuit diagrams for the major types of instrument, as well as a selection of wiring modifications and pickup switching circuits. These can be used to help you create your own custom wiring.
Along with the electric guitar, sections are also included relating to acoustic instruments. The function of specialised piezoelectric pickups is explained and there are detailed instructions on how to make your own contact and bridge transducers. The projects range from simple preamps and tone boosters, to complete active controls and equaliser units.
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MIDI SURVIVAL GUIDE
Vic Lennard
Whether you're a beginner or a seasoned pro, the MIDI Survival Guide shows you the way. No maths, no MIDI theory, just practical advice on starting up, setting up and ending up with a working MIDI system.
Over 40 cabling diagrams. Connect synths, sound modules, sequencers, drum machines and multitracks. How to budget and buy secondhand. Using switch, thru and merger boxes. Transfer songs between different sequencers. Get the best out of General MIDI. Understand MIDI Implementation charts. No MIDI theory.
104 pages — Order code PC111 — **£6.95**

PRACTICAL ELECTRONIC MUSICAL EFFECTS UNITS
R. A. Penfold
This book provides practical circuits for a number of electronic musical effects units. All can be built at relatively low cost, and use standard, readily available components. The projects covered include: Waa-Waa Units; Distortion Units; Phaser; Guitar Envelope Shaper; Compressor; Tremolo Unit; Metal Effects Unit; Bass and Treble Boosters; Graphic Equaliser; Parametric Equaliser. The projects cover a range of complexities, but most are well within the capabilities of the average electronics hobbyist. None of them require the use of test equipment and several are suitable for near beginners.
102 pages — Order code BP368 — **£4.95**

LOUDSPEAKERS FOR MUSICIANS
Vivan Capel
This book contains all that a working musician needs to know about loudspeakers; the different types, how they work, the most suitable for different instruments, for cabaret work, and for vocals. It gives tips on constructing cabinets, wiring up, when and where to use wadding, and when not to, what fittings are available, finishing, how to ensure they travel well, how to connect multi-speaker arrays and much more.
Ten practical enclosure designs with plans and comments are given in the last chapter, but by the time you've read that far you should be able to design your own!
164 pages — Order code BP297 — **£3.95**

CIRCUITS AND DESIGN

REMOTE CONTROL HANDBOOK (Revised Edition)
Owen Bishop
Remote control systems lend themselves to a modular approach. This makes it possible for a wide range of systems, from the simplest to the most complex, to be built up from a number of relativly simple modules. The author has tried to ensure that, as far as possible, the circuit modules in this book are compatible with one another. They can be linked together in many different configurations to produce remote control systems tailored to switch a table lamp on and off, or to operate an industrial robot, this book should provide the circuit you require.
240 pages — Order code BP240 — **£3.95**

COIL DESIGN AND CONSTRUCTIONAL MANUAL
B. B. Babani
A complete book for the home constructor on "how to make" RF, IF, audio and power coils, chokes and transformers. Practically every possible type is discussed and calculations necessary are given and explained in detail. Although this book is now twenty years old, with the exception of toroids and pulse transformers little has changed in coil design since it was written.
96 pages — Order code 160 — **£2.50**

PRACTICAL ELECTRONICS HANDBOOK – Fourth Edition. Ian Sinclair
Contains all of the everyday information that anyone working in electronics will need.
It provides a practical and comprehensive collection of circuits, rules of thumb and design data for professional engineers, students and enthusaists, and therefore enough background to allow the understanding and development of a range of basic circuits.
Contents: Passive components, Active discrete components, Discrete component circuits, Sensing components, Linear I.C.s, Digital I.C.s, Microprocessors and microprocessor systems, Transferring digital data, Digital-analogue conversions, Computer aids in electronics, Hardware components and practical work, Standard metric wire table, Bibliography, The HEX scale, Index.
440 pages — Order code NE21 — **£12.99**

AUDIO IC CIRCUITS MANUAL
R. M. Marston
A vast range of audio and audio-associated i.c.s are readily available for use by amateur and professional design engineers and technicians. This manual is a guide to the most popular and useful of these devices, with over 240 diagrams. It deals with i.c.s such as low frequency linear amplifiers, dual pre-amplifiers, audio power amplifiers, charge coupled device delay lines, bar-graph display drivers, and power supply regulators, and shows how to use these devices in circuits ranging from simple signal conditioners and filters to complex graphic equalizers, stereo amplifier systems, and echo/reverb delay lines etc.
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R. N. Soar
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most simple and inexpensive of components – the diode. Includes the use of germanium and silicon signal diodes, silicon rectifier diodes and Zener diodes, etc.
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A BEGINNERS GUIDE TO CMOS DIGITAL ICs
R. A. Penfold
Getting started with logic circuits can be difficult, since many of the fundamental concepts of digital design tend to seem rather abstract, and remote from obviously useful applications. This book covers the basic theory of digital electronics and the use of CMOS integrated circuits, but does not lose sight of the fact that digital electronics has numerous "real world" applications.
The topics covered in this book include: the basic concepts of logic circuits; the functions of gates, inverters and other logic "building blocks"; CMOS logic i.c. characteristics, and their advantages in practical circuit design; oscillators and monostables (timers); flip/flops, binary dividers and binary counters; decade counters and display drivers.
The emphasis is on a practical treatment of the subject, and all the circuits are based on "real" CMOS devices. A number of the circuits demonstrate the use of CMOS logic i.c.s in practical applications.
119 pages — Order code BP333 — **£4.95**

OPTOELECTRONICS CIRCUITS MANUAL
R. M. Marston
A useful single-volume guide to the optoelectronics device user, specifically aimed at the practical design engineer, technician, and the experimenter, as well as the electronics student and amateur. It deals with the subject in an easy-to-read, down-to-earth, and non-mathematical yet comprehensive manner, explaining the basic principles and characteristics of the best known devices, and presenting the reader with many practical applications and over 200 circuits. Most of the i.c.s and other devices used are inexpensive and readily available types, with universally recognised type numbers.
182 pages — Order code NE14 — **£13.95**

OPERATIONAL AMPLIFIER USER'S HANDBOOK
R. A. Penfold
The first part of this book covers standard operational amplifer based "building blocks" (integrator, precision rectifier, function generator, amplifiers, etc), and considers the ways in which modern devices can be used to give superior performance in each one. The second part describes a number of practical circuits that exploit modern operational amplifiers, such as high slew-rate, ultra low noise, and low input offset devices. The projects include: Low noise tape preamplifier, low noise RIAA preamplifier, audio power amplifiers, d.c. power controllers, opto-isolator audio link, audio millivolt meter, temperature monitor, low distortion audio signal generator, simple video fader, and many more.
120 pages — Order code BP335 — **£4.95**

CMOS CIRCUITS MANUAL
R. M. Marston
Written for the professional engineer, student or enthusiast. It describes the basic principles and characteristics of these devices and includes over 200 circuits.
All the circuits have been designed, built and fully evaluated by the author; all use inexpensive and internationally available devices.
187 pages — Order code NE12 — **£13.95**

TIMER/GENERATOR CIRCUITS MANUAL
R. M. Marston
This manual is concerned mainly with waveform generator techniques and circuits. Waveform generators are used somewhere or other in most types of electronic equipment, and thus form one of the most widely used classes of circuit. They may be designed to produce outputs with sine, square, triangle, ramp, pulse, staircase, or a variety of other forms. The generators may produce modulated or unmodulated outputs, and the outputs may be of single or multiple form.
Waveform generator circuits may be built using transistors, op.amps, standard digital i.c.s, or dedicated waveform or "function" generator i.c.s.
The manual is divided into eleven chapters, and presents over 300 practical circuits, diagrams and tables. The subjects covered include: Basic principles; Sine wave generators; Square wave generators; Pulse generator circuits; "Timer i.c." generator circuits; Triangle and sawtooth generators; Multi-waveform generation; Waveform synthesizer i.c.s; Special waveform generators; Phaselocked loop circuits; Miscellaneous "555" circuits.
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COMPUTING

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R. A. Penfold
Once you know how, PC interfacing is less involved than interfacing many eight-bit machines, which have tended to use some unusual interfacing methods.
This book gives you: A detailed description of the lines present on the PC expansion bus. A detailed discussion of the physical characteristics of PC expansion cards. The I/O map and details of the areas where your add-on can be fitted. A discussion of address decoding techniques. Practical address decoder circuits. Simple TTL 8-bit input and output ports. Details of using the 8255 parallel interface adaptor. Digital to analogue converter circuits. In fact everything you need to know in order to produce successful PC add-ons.
80 pages — Order code BP272 — **£3.95**

HOW TO CHOOSE A SMALL BUSINESS COMPUTER SYSTEM
D. Weale
This book is for anyone intending to buy an IBM compatible computer system, whether it is their first system or a replacement. There are sections on hardware, application and systems programs, and how to actually make your choice as well as sections on the law, ergonomics and a glossary of common terms. The text contains many useful tips and some warnings (which could save much effort and expense). After having read this book you should have a better idea of what is suitable for your needs, how to obtain it and how to ensure that the system is operated with the minimum of difficulty.
144 pages — Order code BP323 — **£4.95**

HOW TO EXPAND, MODERNISE AND REPAIR PCs AND COMPATIBLES (Revised Edition)
R. A. Penfold
Not only are PC and compatible computers very expandable, but before long most users actually wish to take advantage of that expandability and start upgrading their PC system. Some aspects of PC upgrading can be a bit confusing, but this book provides advice and guidance on the popular forms of internal PC expansion, and should help to make things reasonably straightforward and painless. Little knowledge of computing is assumed. The only assumption is that you can operate a standard PC of some kind (PC, PC XT, PC AT, or an 80386 based PC).
The subjects covered include: PC overview, Memory upgrades; Adding a hard disk drive; Adding a floppy disk drive; Display adaptors and monitors; Fitting a maths co-processor; Keyboards; Ports; Mice and digitisers; Maintenance (including preventative maintenance) and Repairs, and the increasingly popular subject of d.i.y. PCs.
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REPORTING AMATEUR RADIO

Tony Smith G4FAI

RAE CLASSES

Classes for the radio amateurs' examination (RAE) restart in September. These are for the full RAE which leads to a Class B (VHF and UHF only) amateur radio licence or a Class A (all bands) licence. To obtain the latter, applicants must also pass a 12 words per minute Morse test.

The Novice examination (NRAE) is simpler, and has a shorter period of study, leading to the Novice B or A licence (the latter with a 5wpm Morse requirement). Most of what follows relates to the full RAE, and there will be more about Novice entry in a later column.

The RAE has a multiple choice format, and is in two parts. Part one covers the radio regulations, transmitter interference and electromagnetic compatibility. Part two covers operating procedures and practices; electrical theory; solid state devices; receivers; transmitters; propagation and antennas; and measurements.

This need not be too daunting for those set on becoming a radio amateur. I knew little about radio before I took an RAE course, but enthusiasm for my new-found interest carried me through to a good result. Anyone who already has some knowledge of and a interest in electronics would have an even better chance of passing with flying colours.

SUCCESS RATES

The course for the RAE usually runs over one academic year. The exams are held in December and May at technical colleges, evening institutes, local radio clubs and schools across the UK. Those who make good progress often take the December exam and if unsuccessful try again the following May.

In the four year period ending May 1994, 18,190 candidates took the RAE and 12,561 passed, a success rate of 69 per cent. To give an idea of how many people currently participate in amateur radio, there were 61,291 licenses on issue in the UK at the end of March 1995. These comprised 32,715 Class A licences, 26,465 Class B, 188 Novice A, and 1,923 Novice B.

These figures exclude the many enthusiasts studying for the exams at any one time. There are also thousands of shortwave listeners who listen to amateur radio as well as other radio services. Many of these SWLs also have a good understanding of amateur radio but do not feel the need to obtain a transmitting licence.

A HOBBY FOR ALL

Amateur radio is a hobby for all. You can get a licence to immerse yourself in one or more different aspects of radio communication. With the appropriate licence you can use a microphone to talk to people in this country or round the world. You can even talk to astronauts on shuttle flights or in orbiting satellites.

With acquired skills, you can communicate using Morse code, computers, teleprinters or television. With the appropriate equipment, you can reflect your signals to their destination via the ionosphere, repeaters, satellites, meteor showers, the aurora borealis, or the moon.

You can experiment with antennas or ancillary equipment to improve the performance of your station; or modify your rig if you wish. You can build your own transmitter or receiver, or you can invent and try out some new form of improved radio communication – if you can convince the authorities of its potential value!

Again depending on the licence you hold, you can transmit and receive over a wide range of authorised frequencies, from HF to microwaves.

SPECIAL INTEREST GROUPS

You can join special activity groups such as RAYNET, which trains continuously and, when required, provides valuable communications facilities for the emergency services.

There are contest groups, expedition groups, and special groups for virtually all amateur radio interests, as well as others whose members are linked by a common interest outside the hobby. There are such groups or clubs for railwaymen, police, Esperantists, ex- and current members of the armed services, and many others. In a more general sense there are local radio clubs across the country, which are usually very pleased to welcome newcomers to the hobby.

A national society, the Radio Society of Great Britain (RSGB), provides a wide range of services to its members, including a monthly journal *Radio Communication*. It also publishes or sells a large range of specialist books catering for every branch of the hobby from beginner to advanced level.

Within the hobby there are many other publications available from home and abroad, magazines, books, and club journals, again catering for just about every activity.

FURTHER INFORMATION

The Radiocommunications Agency has a free booklet, *"How to Become a Radio Amateur"*, obtainable by 'phoning 0171 215 2352. Copies of the examination syllabus (price £2.00 post free), plus free sample questions, can be obtained from The City & Guilds of London Institute, 46 Britannia Street, London WC1X 9RG. Quote Subject 773 for the NRAE, and Subject 765 for the RAE.

The RSGB will provide more information about all types of entry into amateur radio on request, and has a number of useful publications for RAE and NRAE students. Their address is: Lambda House, Cranborne Road, Potters Bar, Herts EN6 3JE. Tel: 01707 659015.

I should point out that, apart from classes, there are RAE correspondence courses available, while some students successfully devise their own "course", simply using books to learn or revise the subject as appropriate.

If you have been thinking about becoming a radio amateur, now is the time to arrange a September start on a course of study for the RAE. Get the information mentioned above, sign up for a course, and good luck! I look forward to meeting you on the air in the not too distant future!

TROUBLE SPOT

Having written enthusiastically about the attractions of amateur radio, I'm now turning to one of its trouble spots. Many countries permit their national radio societies to broadcast amateur radio news bulletins and where these are limited, as with the RSGB weekly broadcasts, there are usually few interference problems.

In the USA, however, not only does the national society, ARRL, broadcast bulletins daily but other organisations do also. This has led to an enormous row, with some broadcasters accused of interfering with ongoing contacts when they come on the air.

In particular, there is a row about the broadcasts of the International Amateur Radio Network (IARN). Stations broadcasting bulletins do not have allocated frequencies, and are expected to check that a frequency is clear before using it, just like any other amateur station.

Unfortunately, IARN and other bulletin stations believe (wrongly) that by publishing a schedule in advance they may operate on a specific frequency regardless of channel occupancy. Frustrated amateurs dispossessed from such frequencies have retaliated by interfering with the bulletins. The broadcasters have responded by holding what they see as "their" frequencies for long periods with extended broadcasts, and tempers have been running high.

In an effort to alleviate the level of anger and retaliation now on the h.f. bands, one amateur, Fred Maia W5YI, has proposed to the US licensing authority (the FCC) that all news bulletins and code practice transmissions be moved to frequencies above 30MHz.

The ARRL have reacted strongly to this suggestion. Their own broadcasts do not cause problems, and they object to the idea of losing their highly valued news bulletins and Morse practice transmissions from the h.f. bands.

The FCC has received many comments for and against the idea of such a move. It will be interesting to see how the matter is resolved.

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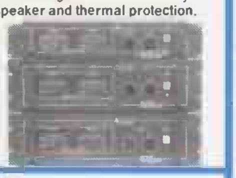

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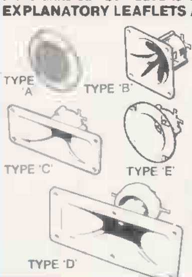

TYPE 'A' (KSN1036A) 3" round with protective wire mesh. Ideal for bookshelf and medium sized Hi-Fi speakers. Price £4.90 + 50p P&P.

TYPE 'B' (KSN1005A) 3½" super horn for general purpose speakers, disco and P.A. systems etc. Price £5.99 + 50p P&P.

TYPE 'C' (KSN1016A) 2"x5" wide dispersion horn for quality Hi-Fi systems and quality discos etc. Price £6.99 + 50p P&P.

TYPE 'D' (KSN1025A) 2"x6" wide dispersion horn. Upper frequency response retained extending down to mid-range (2KHz). Suitable for high quality Hi-Fi systems and quality discos. Price £9.99 + 50p P&P.

TYPE 'E' (KSN1038A) 3¾" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. Price £5.99 + 50p P&P.

LEVEL CONTROL Combines, on a recessed mounting plate, level control and cabinet input jack socket. 85x85mm. Price £4.10 + 50p P&P.

ibl FLIGHT CASED LOUDSPEAKERS

A new range of quality loudspeakers, designed to take advantage of the latest speaker technology and enclosure designs. Both models utilize studio quality 12" cast aluminium loudspeakers with factory fitted grilles, wide dispersion constant directivity horns, extruded aluminium corner protection and steel ball corners, complimented with heavy duty black covering. The enclosures are fitted as standard with top hats for optional loudspeaker stands.

POWER RATINGS QUOTED IN WATTS RMS FOR EACH CABINET
FREQUENCY RESPONSE FULL RANGE 45Hz - 20KHz

ibl FC 12-100WATTS (100dB) PRICE £159.00 PER PAIR
ibl FC 12-200WATTS (100dB) PRICE £175.00 PER PAIR

SPECIALIST CARRIER DEL. £12.50 PER PAIR

OPTIONAL STANDS PRICE PER PAIR £49.00
Delivery £6.00 per pair

IN-CAR STEREO BOOSTER AMPS

THREE SUPERB HIGH POWER CAR STEREO BOOSTER AMPLIFIERS
150 WATTS (75 + 75) Stereo, 150W Bridged Mono
250 WATTS (125 + 125) Stereo, 250W Bridged Mono
400 WATTS (200 + 200) Stereo, 400W Bridged Mono
ALL POWERS INTO 4 OHMS
Features:
★ Stereo, bridgable mono ★ Choice of high & low level inputs ★ L & R level controls ★ Remote on-off ★ Speaker & thermal protection.

PRICES: 150W £49.99 250W £99.99
400W £109.95 P&P £2.00 EACH

OMP MOS-FET POWER AMPLIFIER MODULES

SUPPLIED READY BUILT AND TESTED.

These modules now enjoy a world-wide reputation for quality, reliability and performance at a realistic price. Four models are available to suit the needs of the professional and hobby market i.e. Industry, Leisure, Instrumental and Hi-Fi etc. When comparing prices, NOTE that all models include toroidal power supply, integral heat sink, glass fibre P.C.B. and drive circuits to power a compatible Vu meter. All models are open and short circuit proof.

THOUSANDS OF MODULES PURCHASED BY PROFESSIONAL USERS

OMP/MF 100 Mos-Fet Output power 110 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 45V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 123 x 60mm.
PRICE £40.85 + £3.50 P&P

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

OMP/MF 300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 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.

LOUDSPEAKERS

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

McKenzie and Fane Loudspeakers are also available.

EMINENCE:- INSTRUMENTS, P.A., DISCO, ETC

ALL EMINENCE UNITS 8 OHMS IMPEDANCE

8" 100 WATT R.M.S. ME8-100 GEN. PURPOSE, LEAD GUITAR, EXCELLENT MID, DISCO.
RES. FREQ. 72Hz, FREQ. RESP. TO 4KHz, SENS 97dB. PRICE £32.71 + £2.00 P&P

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

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

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

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

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

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

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

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

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

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

BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED SURROUND

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

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

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

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

FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND

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

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

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

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

TRANSMITTER HOBBY KITS

PROVEN TRANSMITTER DESIGNS INCLUDING GLASS FIBRE PRINTED CIRCUIT BOARD AND HIGH QUALITY COMPONENTS COMPLETE WITH CIRCUIT AND INSTRUCTIONS

3W TRANSMITTER 80-108MHz, VARICAP CONTROLLED PROFESSIONAL PERFORMANCE, RANGE UP TO 3 MILES, SIZE 38 x 123mm, SUPPLY 12V @ 0.5AMP.
PRICE £14.85 + £1.00 P&P

FM MICRO TRANSMITTER 100-108MHz, VARICAP TUNED, COMPLETE WITH VERY SENS FET MIC, RANGE 100-300m, SIZE 56 x 46mm, SUPPLY 9V BATTERY.
PRICE £8.80 + £1.00 P&P

PHOTO: 3W FM TRANSMITTER

POSTAL CHARGES PER ORDER £1.00 MINIMUM. OFFICIAL ORDERS FROM SCHOOLS, COLLEGES, GOVT. BODIES, PLCs ETC. PRICES INCLUSIVE OF V.A.T. SALES COUNTER. VISA AND ACCESS ACCEPTED BY POST, PHONE OR FAX.

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SUPER SUMMER SALE!

1995

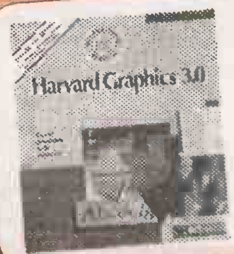
80 PAGE UPDATED EDITION

T216 Glue Gun

SALE PRICE £5.50

(Normally £9.95)

SEE PAGE 55



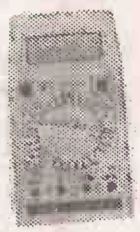
Z7223 Harvard Graphics

SALE PRICE £24.95

(Normally £60)

SEE PAGE 40

M3800 Digital Multimeter

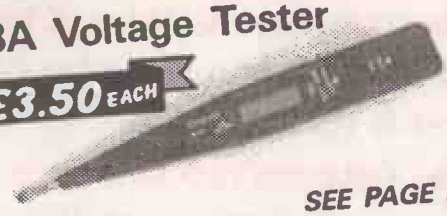


SALE PRICE £29.95

(Normally £36.95)

SEE PAGE 11

Y023BA Voltage Tester



PRICE £3.50 EACH

SEE PAGE 23

DPT001 Saw

35099 Hook & Pick Set

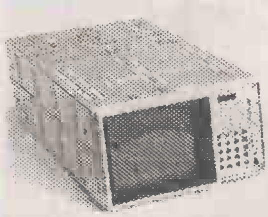
PRICE £4.95 EACH

P2940 Scart to Scart Lead

Length 1.5m

SALE PRICE £2.00

(Normally £4.20)



1255 Vectorscope

PRICE £200 EACH

SEE PAGE 6

Tie in a Tin! Z5820

Navy blue, English made, 100% silk tie with discreet MB (Metal Box) logo. Ideal if your initials are MB or BM! Presented in metal box measuring 200x135x45mm.

PRICE £3.95 EACH

NOTE! As most of the products in this catalogue are surplus, redundant or end of line job lots, it does mean once sold they are rarely repeatable. So to avoid disappointment, don't delay - ORDER TODAY!

1000s of great bargains inside...

GREENWELD ELECTRONIC COMPONENTS

27 Park Road
Southampton SO15 3UQ
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Fax: 01 703 236307

CONTENTS

Welcome to our Super Summer Sale update catalogue. Not only are there 64 pages of incredible bargains with massive reductions, but a further 16 pages of regular lines at our usual low prices have been included. But don't delay - once sold, surplus stock is rarely repeatable, so to snap up the best bargains post, fax or phone your order to us today! We look forward to serving you.

Peter Green

Peter Green
Managing Director

Remember the three rules for all SALE orders:

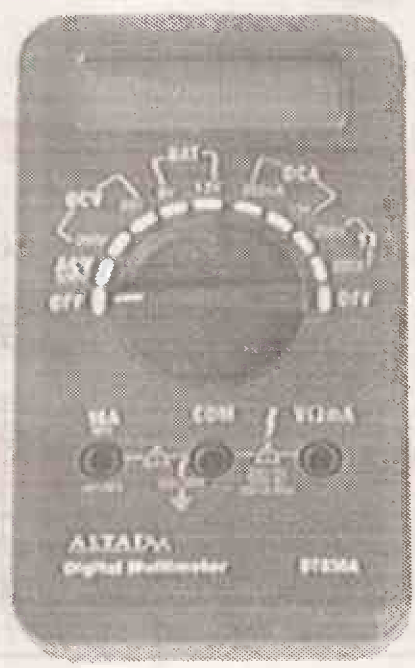
1 Minimum Goods Value **£15** (although this can include goods from any of our lists or catalogues)
2 Post & Packing £3
3 Free Gifts and reduced price offers from previous lists are not available with SALE goods

NEW MULTIMETERS

Y123BC - £11.95

Y123BC (DM830)
DIGITAL MULTIMETER
A sturdy, well-designed multimeter with a large LCD display, offering five functions and 19 measuring ranges. Each test position is easily selceted by turning the single selector switch. Battery, instructions and leads with test probes are included.
DC Volts: 200m / 2000mV / 20V / 200V / 1000V
AC Volts: 200V / 750V
DC Current: 200µA / 2000µ / 20mA / 200mA / 10A
Resistance: 200ohms / 2000ohms / 20kohms / 200kohms / 2000k
power: 9V alkaline or carbon zinc battery PP3 type or equivalent.
Weight: 170g nett.
Dims (mm): 126*70*24
PRICE £11.95

Y123BD (DT830A)
MINI DIGITAL MULTIMETER
A compact yet reliable multimeter that is ideal for engineers or hobbyists. It offers 9 testing ranges and 5 functions, all easily selectable with just one switch.
DC Volts: 20V / 200V
AC Volts: 500V
DC Current: 200mA / 10A
Resistance: 2Kohms / 3Mohms
Battery test: 1.5V / 9V
(10mA load current)
Power: 9V PP3 or equiv.
Weight: 170g nett.
Dims. (mm) 126*70*24
PRICE £10.95



Y123BD - £10.95

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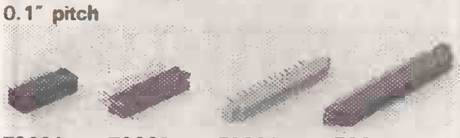
NEW TO THIS UPDATE

OUR VERY LATEST BARGAINS!

NEW TO THIS UPDATE

CONNECTORS

Edge Connectors
(GP - Gold Plated)
0.1" pitch

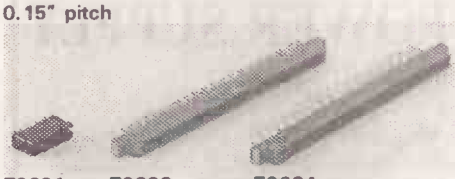


Z9661 Z9662 Z9660 Z9667

Z9661 15 way double sided; pins 1,12 & 14 missing. GP, PC mntg **40p**
Z9662 23 way double sided, pin 3 missing. GP, wirewrap **140p**
Z9663 24 way single sided GP PC mntg **80p**
Z9664 24 way double sided GP PC mntg **140p**
Z9665 25 way single sided GP PC mntg **82p**
Z9660 32 way single sided GP, solder tags **110p**
Z9667 40 way double sided GP, solder tags **220p**

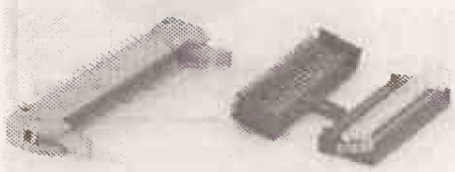
X3237 Bracket for fixing edge conns to chassis (suit Z9662-5). **Pk 20/£1.00**

0.15" pitch



Z9681 Z9683 Z9684

Z9681 8 way, pin 4 missing GP PC mntg **40p**
Z9683 40 way single sided GP Solder tags **140p**
Z9684 40 way double sided GP wirewrap **195p**



Z3763 Z2575

Z3763 50 way GP IDC PC mntg plug with ears. **£1.00**
Z2575 Low cost 20 way plug and IDC socket **70p/pr**

Z1768 Z5327 Z5326

Z1768 13 pin base for CRTs, numicators etc **4/£1**
Z5327 3 pin high current socket by Amphenol type 91-PC31 **£1.00**
Z5326 ITT multipole military connector. Uses 48 small pins and 8 larger, all gold plated, that need to be inserted. Tools included. **£4.00**

X3236 Z3785 Z3037 X3242

X3236 2 pin DIN speaker skt, PC mntg **12/£1.00**
Z3785 XLR mains connector. L & N are sleeved skts, the earth pin is male. **£1.50**
Z3037 50 way IDC D plug, gold plated, with cable strain relief. **£2.00**
X3242 3 pin Bulgin mains line skt (or 50V max where accessible). **75p**

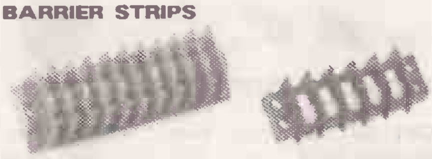
Z1476 Z1477 Z4070

Z1476 Selectro 75R conhex RF connector GP **£1**
Z1477 Selectro 50R SRM RF connector **50p**
Z4070 3 way AMP 0.156" (4mm) skt. **20/£1.00**

Connectors

X3277 3 way PCB 45° PCB mntg terminal blocks. **5/£1.00**
X3278 2.5mm jack plug, plastic **10/£1.00**; 100+ 0.06
X3279 2.5mm open jack socket with break contact. **6/£1.00**; 100+ 0.08

BARRIER STRIPS



X6128 X3239

X6128 10 way. Bit unusual - screws along centre with two solder tags on each side. Chassis mntg. **2/£1.00**
X3239 5 way with solder tags. **4/£1.00**
X3240 2 way with solder tags **6/£1**

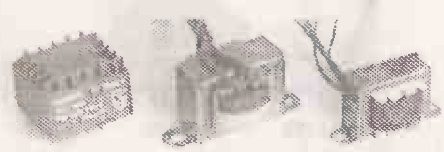
X3238 24 way Centronics/IEEE488 style socket, solder type with cover **£1.00**

X6129 DIN 41612 right angle plug 64W (A and C). Gold plated contacts. **2/£1.00**

Filters, Transformers, etc

Z2644 Z5604 X6165

Z2644 1A PCB mains filter 40x40mm by RS Components Ltd. PCB mntg. Their price 9.24 **Our Price £3.00**
Z5604 7.5A mains filter 63x51x38mm. **£4.50**
X6165 Mains clamp type transformer 55x46x44mm with 12V 500mA secondary. **£1.50**



X3262 X3263 X3264

X3262 Mains pri 14-0-14V 1.8VA 32x27x26 encapsulated PCB mntg. **£1.00**
X3263 Mains pri 12-0-12V 100mA clamp 37x31x31. **£1.30**
X3264 Mains pri 9-0-9V 100mA clamp 30x26x26mm **£1.00**

22276 Ally panel for mounting on Verobloc to hold pots, switches and LEDs etc. The only snag is we don't have any veroblocs left. 'Spose you could use it with other breadboards. **50p**

NICAD BATTERY PACK

X6183 8 brand new AA cells shrink wrapped in a pack with connector. Made by Powersonic, USA. Great value - would cost £9.60 if bought separately.

SPECIAL PRICE: £5.95 100+ 3.95

DATA TERMINALS

Portable Data Terminals made by MSI. These were used by Boots for stock checking. Not enough to check what's inside each.

X6179 36 small keys (inc alphabet), 15 larger.

X6184 28 large keys

X6185 31 large keys

All types same price (state if alternative acceptable) **£10**

BAR CODE WAND

X6180 Bar code wand. These are several hundred pounds each normally, but as we don't have any data, we're offering them at a knockdown price. The lead is terminated in a 9 way D plug **£10**

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NEW TO THIS UPDATE

OUR VERY LATEST BARGAINS!

NEW TO THIS UPDATE

SWITCHES

(a) Slide

Z305 10 pos (1p4w + 1p4w) + 3 pos (2p3w) **5/£1.00;** 100+ 0.10;
Z301 6 pos, 12 tags **5/£1.00;** 100+ 0.10
Z304 5 pos (1p4w) + 5 pos (1p4w) + 3 pos (2p3w) **5/£1.00;** 100+ 0.10

Z306 8 pos (1p8w) + 3 pos (2p3w) **5/£1.00;** 100+ 0.10
Z3760 5 pos (1p5w) **5/£1.00;** 100+ 0.10

Z2364 Ideal for railway modellers - use as a points switch. 2p 3w. Only 18x18mm overall. **5/£1.00;** 100+ 0.10
X3249 4 position (4p4w). 38x11x9mm **4/£1.00;** 100+ 0.12

(b) Push

X3250 Z2361 Z3552

X3250 DP on/off rated 4A 250V ac. **2/£1.00;** 100+ 0.25
Z2361 POPO SPCO heavy duty, 4A 250V ac. **2/£1.00**
Z3552 POPO sp. red top 14mm dia. **3/£1.00**

Z2641 Keyboard switch, push-on, push-off with in-built red LED. Mustard cap. **Pack of 3 £1.00**
Z3760 Interesting microswitch with clip on guard preventing accidental operation. 1m, 1b contacts **2/£1.00**

Z4365 Push button bank; 6 interlocking (1xDPCO, 4x4PCO, 1x6PCO); 2 independant (DPCO). **Only £1.00**

Some more large rocker switches by Arrow. Body size 38x20.5x30mm; 0.25" tabs

X3254 X3255 X3256 X3257 X3258

X3254 Black with lamp legend on rocker. SP 10A **3/£1**
X3255 Black illuminated (red) SP 16A **2/£1**
X3256 White DP 10A **3/£1**
X3257 Black with white rocker. DP 10A **3/£1**
X3258 White dummy switch. **5/£1**

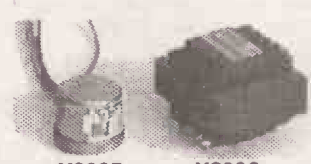
Other switches

X3261 X3269 X3270 X3276 X3305

X3261 Sub min rotary switch. TO5 can with screwdriver adjust. 1p6w. List 2.94. **Our Price £1.00**
X3269 SPCO centre off slide 30x7x5mm. **10/£1;** 100+ 0.06
X3270 DPCO slide round chrome knob 23x7x12mm. **6/£1;** 100+ 0.08
X3276 Push to DPCO biased edge switch 34x10x11mm. **3/£1.00;** 100+ 0.18
X3305 min black rocker, SPCO rated 6A 250V ac. Needs 21x13mm cut-out. **3/£1.00;** 100+ 0.18; 1k+ 0.15

X3272 X3273 X3274 X3275

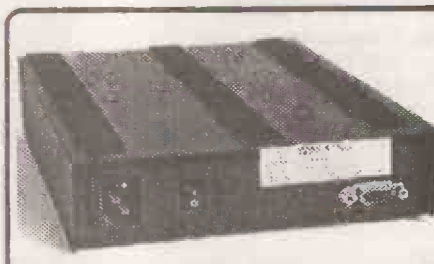
X3272 Lorlin keyswitch with 2 keys - 4p3w wafer. **£2.50**
X3273 Lorlin keyswitch 2A DP biased. **£2.00**
X3274 Rotary wafer switch with splined shaft 4p3w 25mm dia. **2/£1.00;** 100+ 0.25
X3275 Friedland 824 dimex doorbell switch. **£1**



X3295 X3296

X3295 Super little mic transformer in screened case 21mm high x 21mm dia. by Sowter, type 4706. 6 wires. **£2.00**
X3296 PCB mntd mains transformer 39x32x31mm, sec 0-6V, 0-6V 100mA per winding. **£1.50**

X3297 Solenoid with two coils, one 25V and one 50V cont. rated. 10mm travel. Size37x26x21mm **£2.00**

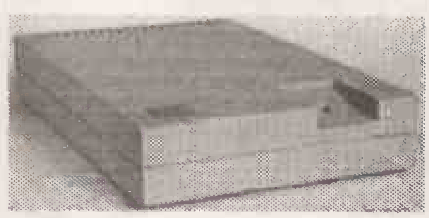


X9021 Systeme SUD electronic module, it says on the 230x165x50mm case. 9 way D skt + fused, filtered and switched mains input on front, 8 way comms skt + 2x6 way DIP switches on rear. Inside is a neat 14.5W SMPSU (+5V 1A, +15V 0.1A, -15V 0.1A). 2 PCBs contain around 30 chips inc 8751, 2764, 8031, 6116 + LS etc. All for **£4**

POWER SUPPLY

X6181 Power Supply by IBM. IEC mains inlet, 18V ac 0.5A output on 2m lead. Size 110x65x55mm. **£4**

RF UNIT



X9020 IBM PC Network Translator. Grey two part diecast case 260x160x45mm. Inside, PCB with screened sections and a number of RF components. Great breakdown value! **£4**

DATASWITCHES

X9022 Dataswitch. three or four different sized cases, but all have same switching capability, 1 in and 2 out (or vv). All 25 D skts **£5**

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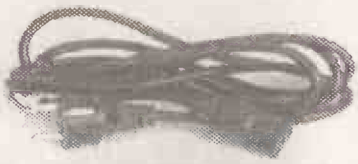
NEW TO THIS UPDATE

Leads and Cable

X6160 50m reel of 7/0.1mm² single screened pick up cable by Adastra type Z21 Normally 23p/m. **Only £3**
X6167 100m reel of white PVC 7/0.2 flex. **£1.50**

X6161 SCART extn lead 5m long (plug one end, socket the other), all pins connected. **£3.95**
X6162 SCART hi-fi lead, all pins connected. Plug both ends + 2 phono plugs. **£2.95**



X6163 1.8m long mains lead - right angle continental 2 pin plug one end, IEC skt the other. **£1.50**
X6164 As above but with straight plug. **£1.50**

X6184 Audio extension lead - 3.5mm jack plug to socket using unscreened lead. Length 6m **£1.00**

X6144 Fuse lead. 2m red/black twin flex (16/0.2) with 1.25" fuseholder and 3A fuse. **3/£1.00**

CURLY PHONE LEADS

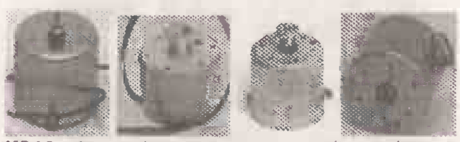
Curly extension leads, 4 way plug one end, 4 way socket the other.
C5013 3m (list £3.20) **£1.50**

X6155 Nylon cord 3.9mm dia 9.5m long (wound on to a plastic holder) with a steel loop one end. **£1.95**

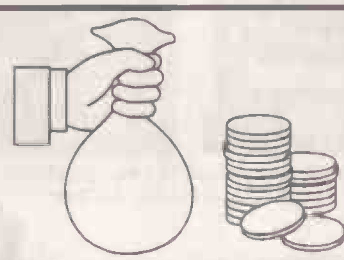
MOTORS

X6168 **X6171** **X6159**

X6168 240V ac motor wired for reversing. No case. 350mA. 12000rpm. Shaft 6mm dia x 15mm long **£4.00**
X6171 Motor, 240V mains. **£2.50**
X6159 Phillips synchronous motor. 25V 500rpm 50Hz. Duty cycle 50%. Size 56mm dia x 32mm. **£6**



K916 Assorted cassette motors, various voltages - 6, 7.5, 9, 12V, many fitted with brass pulleys. Sizes from 30x29 to 38x36. Manufacturers include Sankyo, Mitsubishi, Canon, Matsushita etc. All high quality new stock. **Pack of 10 £10**



We are always interested in buying surplus stock - end of line goods, bankrupt stock, clearance lines etc. Our customers have wide and varied interests, so we'll consider almost anything! Send lists, samples, details to The Managing Director, Greenweld Electronics Ltd, 27 Park Road, Southampton, SO15 3UQ

REMOTE CONTROL

Z6141 Sharp VCR remote control, brand new - 36 soft touch keys. **£2 each)**

IBM PS2 Model 30 286

X9014 Later model than the 'gutted' version. This one has a slimmer case (405x400x100mm), motherboard with 286, 90W PSU, 1M RAM (4x256k SIMMs) and room for 3 cards. However both the hard disk and 3.5" drive have been removed (cages + connecting leads still in place). Super buy at

Only £50

Z9213 Brand new and boxed Hyundai PC XT/AT 95 key keyboard. Superb quality at a great price! French character set.
Z9214 As above, but Norwegian layout.
Either model

£5.00

BAR CODE READER

X9014 The Telxon PTC-790 hand held bar code reader measures 260x110x60mm and uses a metal encased wand to swipe barcodes. Inside the black ABS case are 4 PCBs; one has a 16x2 LCD with drive chips, another has 16xMB8464A-15L surface mount DRAMs + a dozen CMOS chips, whilst the main board houses 3x2764 EPROMs, 1802, 1854, MM58167, 6264 + 15 other logic and linear chips. There are 15 2N4401/3 transistors, 'coin' battery, 32 key membrane keypad, plugs, skts etc. The final board is the wand interface. So lots of useful bits - they may even work! They date from around 1986.

£14.95

X6149 Battery charger for them. Plug in wall type with output on 25D plug. 7V 0.1A. **£3.00**

GREENWELD 27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307

All one off and pack prices INCLUDE VAT; Qty prices don't

NEW TO THIS UPDATE

OUR VERY LATEST BARGAINS!

NEW TO THIS UPDATE

PANEL METER SCOOP

Just taken delivery of a few hundred meters in two sizes. These were in our 1993 catalogue at £9.50/£10.95 each. Now offered at less than half price!

Size 60x46x33mm, require 38mm dia cut out
Y202 100-0-100μA 600R
Y208 0-100mA 0.6R
Y210 0-1A 0.06R

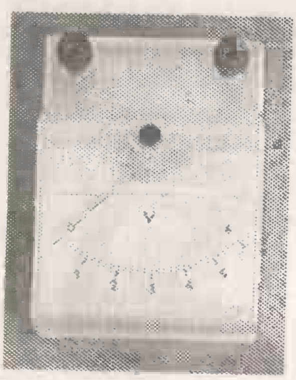
All at £4 each

Size 110x83x38mm, require 59mm dia cut out
Y221 0-200μA 700R

All at £5 each

NEW RANGE OF LOW COST EDUCATIONL METERS

Ideal for the laboratory, these meters have screw terminals that also accept 4mm plugs. Size 120x80x33mm.



TEC0100	0-1A	**£6.95**
TEC0102	0-2A	**£6.95**
TEC0103	0-5A	**£6.95**
TEC0104	0-6V	**£6.95**
TEC0105	0-15V	**£6.95**

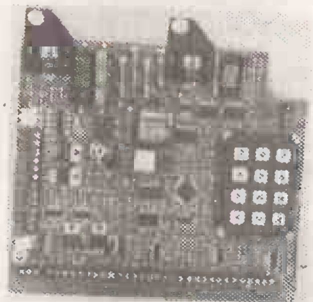
VECTORSCOPE

This high quality instrument is believed to be in working order. Unfortunately, we don't have any further details.

1255 Made by System Video Ltd., this appears a more sophisticated piece of equipment, digitally controlled. Size 210x130x460mm. 150mm dia CRT. Marked NTSC.

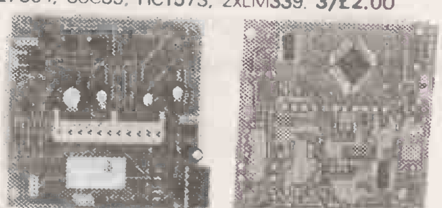
£200

PANELS



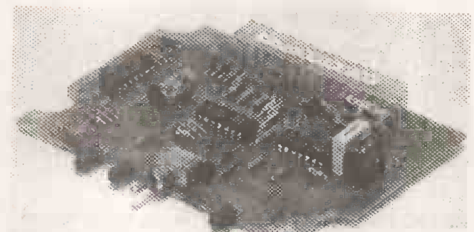
X6123 Lovely panel 190x155mm with a host of interesting parts: BCD keypad, LM317T and 7805 v.regs on heatsinks, 7 seg LED, 3.6V 100mAh ni-cad, 27C256 in skt, 4xTIP110, lots of s/m chips, mainly 74HCT, 15x3w screw terminal blocks, loads of s/m T's, R's and C's. This was the main board for the V100 alarm system, and may be useable as such. **£7.95**

X6124 (Both sides shown) This one has 78L05, BC546, several tants, etc + on the other side s/m 27C64, 80C39, HCT573, 2xLM339. **3/£2.00**

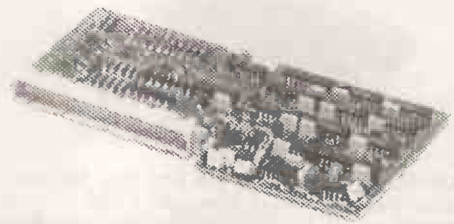


X6125 (Both sides shown) BC546x3,BC556, BC184 78L05, + s/m 80C49, 2xLM339. **5/£2.00**

Couple of smaller panels:
X6119 180x95 with 4503, 4042, 4001, 4093, HC27, 2 red and 2 green 5mm LEDs. **3/£1.00**
X6120 180x90 with a couple of A-D converters - ADC0809, also 32 1N4004, R's, C's etc. **£1.00**



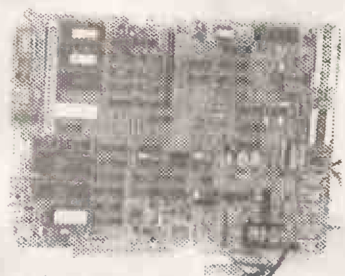
X6145 Panel 110x77mm with SPCO min toggle, 3 x 5mm LEDs, MC3302, 2x4001 CMOS + Rs, Cs etc **2/£1.00**



X6146 Panel 180x90mm with 16 chips 3xULN2803, 6x4024, 556, etc **£1.00**

A parcel of panels from Securicor Alarms being sold for their component value only:

X6116 Valiant mother board. 265x218mm PCB with 9 DIN41612 64 way skts, 2 DPCO min Omron relays, few skts. **£1.00**



X6117 This one's a bit more interesting - PCB 305x200mm with Z80 CPU, 2x27C256, 27C64A, 80C39 all in skts, 40+ other chips, mostly 74HCT, but some linear - 555x2, 556, 339x2 etc. 2 min Clare DPCO relays, memory back-up battery, lots of T's, R's and C's, but the best bit is on the back - a 16x2 character LCD. All this for **£5.00**

X6118 PCB 174x90 with some nice bits on it - 80C31, 27PC256, LT1133, 93C56N all in skts, few other HC/HCT chips, 2x5V 1A regs, 3 min DPCO relays. There's also a ribbon cable with 25D IDC plug. Great vlue at **£2.00**

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NEW TO THIS UPDATE

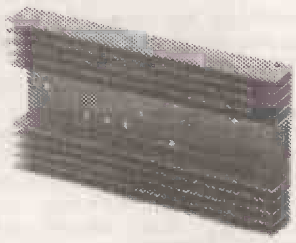
HEATSINKS

Z5296 X6135 X6134 Z3032

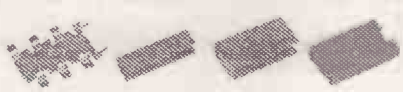
Z2596 Copper clip on type for TO5 devices 19x18dia. **8/£1.00**
X6135 Drilled for TO3. 40x33x25 9°C/W **3 for £1.00**
X6134 Drilled for TO3. 46x46x32 6°C/W **2 for £1.00**
Z3032 Drilled for TO3 46x46x13. **6/£2.00**

X6136 X6137

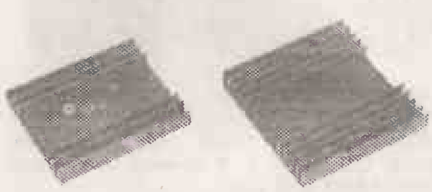
X6136 Drilled for TO3. 80x80x25 4°C/W **£1.00**
X6137 Undrilled. 105x75x25 2.3°C/W **£2.00**



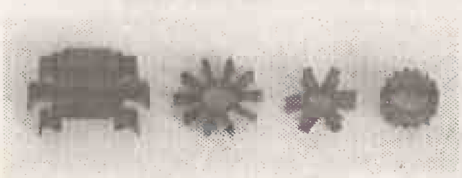
X6138 This sink has 16 holes drilled and tapped M3/M4. 197x97.5x25 1°C/W **£4.00**



X3315 50x34x13mm for TO220 13°/W **5/£1.00**
X3316 50x15x12mm U shape for 2xTO220. **5/£1.00**
X3317 50x25x15mm U shape for TO220 **4/£1.00**
X3321 Finned, 50x29x11mm drilled for TO220 7.2°C/W List 0.91. **Our Price 2/£1.00**
X3320 As above but undrilled. **2/£1.00**



X3322 75x60x15mm finned drilled for TO3. **£1.00**



K918 Small heatsink pack. TO18, TO5, clip-on and bolt on TO220. 5 different types. **Pack of 30 £3.00**

X3323 79x75x15mm finned undrilled. **£1.50**

X3324 100x37.5x32.5mm finned drilled for TO66/TO3.**£1.50**
X6182 45x45x32mm drilled for TO3. **2/£1.00**

Extra large clear poly bags
X9023 These are enormous and very thick (1000g) - and by slitting them down the side you can have a polytarp twice the size. As a bag they measure 2.72x2.33m (8'11" x 7'8")
Price £4.00

X3360 15 way D skt with straight pins. Gold plated by Amphenol. **2/£1.00**

K917 Nicad battery pack. We've recently taken delivery of a parcel of assorted ni-cad packs which have been discarded as they are faulty. Quite often, it's just a single cell that's gone down. Most are from mobile phones and contain AA size cells. Too few of any one type to offer individually, hence this pack of up to 60 individual cells. **10 assorted batteries £10**

MODEM MADNESS

Not new, but believed to be in working order, these modems offer the opportunity to go on line for a fraction of the normal cost! Two cased models + a panel, all at unbeatable prices:

X9015 Racal-Milgo Comlink VIII. 300x210x45mm. Mustard coloured ABS case housing single PCB. Probably 1200 baud. Complete with power supply and 3m lead with 13A plug fitted. **£6.95**

X6148 Rack mounted version of above (no PSU) - uncased. **£4.95**

X9016 BT 4242VSX. Brown ally case 390x230x42mm with integral PSU utilizing toroidal transformer with 12V secondary. Main PCB is loaded with goodies - 5 relays, back up batt, DIP switches, 50 chips etc, etc. Again, probably 1200 baud. The case has finned sides - would make a super heatsink! **£9.95**

A selection of semis that have arrived - if you've any idea what the question marks stand for, we'd be pleased to know!

Code	Type	Description	Qty	DP	Our Price
X3326	26LS31CN	Quad diff driver	20	1.28	**2/£1**
X3327	ADC0804LCN	8 bit A/D converter	92	3.98	**£1.50**
X3328	AM26LS32ACN	Quad diff receiver	41	1.28	**2/£1**
X3329	CP82C55A	CMOS PPI, 8MHz	21	6.74	**£2.00**
X3330	D2164A-15	64k RAM?	30		**£1.00**
X3331	D8086-2	16 bit µP 8MHz	10	12.83	**£3.00**
X3332	D8259A	PIC	28	3.40	**£1.00**
X3333	DAC1222LCN	?	20		**£2.00**
X3334	DG211CJ	Quad SPST CMOS Analogue switch	50	1.36	**2/£1**
X3335	DS1210	Non-volatile controller, 1 RAM	28	4.44	**£1.50**
X3336	DS1232	CMOS µ monitor	33	3.45	**£1.00**
X3337	DS14C88N	Quad line driver	21	1.08	**3/£1**
X3338	DS14C89	Quad line receiver	19	1.08	**3/£1**
X3339	DS3628N	?	9		**£2.00**
X3340	HN462716G	EPROM (blown)	11		**£1.00**
X3341	ICM7170IPG	Real time clock	24	7.08	**£2.50**
X3342	ILQ74	Quad opto isolator	8	2.11	**£1.00**
X3343	IMS2600P-15	?	35		**£2.00**
X3344	LM1881N	Video sync separator	55	4.86	**£2.00**
X3345	MB8118-12	?	18		**£2.00**
X3346	MC1377P	?	5		**£2.00**
X3347	MC1458	Dual 741 op-amp	87	0.71	**3/£1**
X3348	N82S123N	256 bit bi-polar PROM	4	3.67	**£1.30**
X3349	P5164-25	RAM?	50		**£2.00**
X3350	PCF8573P	CMOS clock, calendar	19	8.39	**£2.50**
X3351	SAA5020	?	2		**£2.00**
X3352	SAA5050	?	4		**£2.00**
X3353	TC55328BP-25	RAM?	65		**£2.00**
X3354	TDA4510	?	4		**£2.00**
X3355	TEA2000	?	26		**£2.00**
X3356	TL7702ACP	µP PS supervisor	27	1.87	**3/£2**
X3357	µA308TC	Op-amp	35	0.80	**3/£1**
X3358	µA733	Diff video amp	111	1.54	**2/£1**
X3359	ZNA2L079E	?	14		**£2.00**

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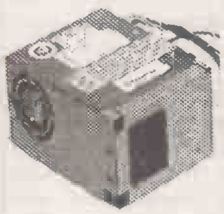
SMPSU Bargain



X9017 Super cased computer PSU 140x113x84mm rated 72.5W. with 60x60mm fan fitted. Fused switched mains inlet. Outputs leads fpr disk drive. Rated +5V 8.5A; +12V 2A and -12V 0.5A. Made by Cherokee Internatinal Inc.

£12.95

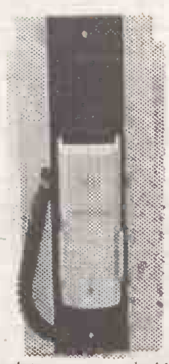
250W SMPSU

X6172 Powerline 250 watt switch mode PSU, slightly unusual in that it has a 9V output. Full Spec: Mains in, Max. outputs: +5V 25A; +12V 12A; -9V 8A. Fully enclosed.
Size 235x160x50mm. Inputs and outputs on DIN41612 power connectors.

£20

K919 Nylon and plastic spacers, 6 sizes from 5-35mm long and 6-10mm dia. **Pack of 100 assorted £2.00**

Subscribers are mailed monthly with details of our latest surplus offers - become one now!



Z5963 Stentofon Intercomm unit. Wall mounted ally panel 280x125mm with speaker pod and couple of small PCBs. On the front is a removeable handset with 12 digit keypad and curly cord. New and boxed. **£7.60**

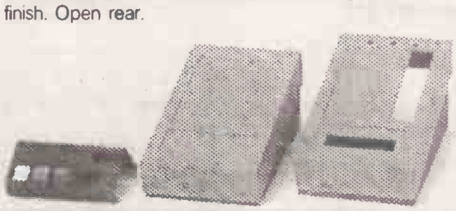
X6127 Bag of 500 M6 steel zinc plated washers **£2.95**

Relays

X3265 X3266 X3267 X3293

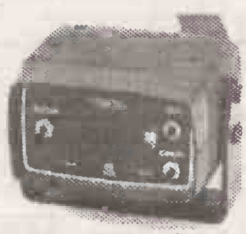
X3265 Omron G2L 28x25x11mm 150R coil, 9V. SPM 8A contact. **£1.00;** 100+ 0.60; 1k+ 0.50
X3266 Omron 7042 22x22x16mm 1600R coil, 24V. SPCO 5A contact. **65p**
X3267 TTL 15x10x10 53R coil, 5V. SPCO 1A contact. **£1.00;** 100+ 0.60; 1k+ 0.50
X3293 Flatpack relay 31x23x10mm by RS Components Ltd. 1135R coil, 24V DPCO 3A contacts. Their price 6.91 **Our Price £2.50**

Two metal two-part cases 160x100x84/50 with a sub-chassis (shown separately). 2 tone grey hammer finish. Open rear.

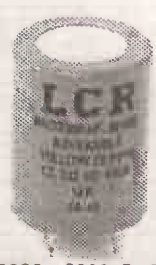


Sub-chassis X6130 X6131

X6130 Unpunched **£2.50**
X6131 Punched as shown **£2.00**

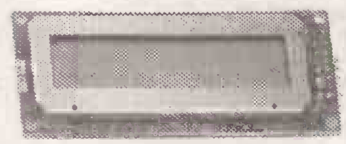


Z5287 Tyrometer. Sensors (not included) came from each tyre on an HGV to give driver audible (buzzer) and visible (11 small 12V lamps) indication of a fault. There's two push to make and a min toggle switch, a coil and few caps Black plastic case 110x100x60mm with mntg bracket. **£3.00**

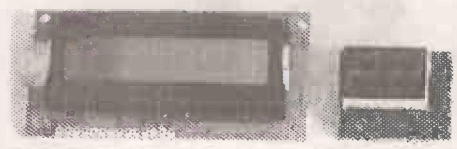


X6089 2200µF 50V reversible electrolytic size 50x45mm. **£1.00**
X6099 Plug in PSU. Output 6.7V 100mA on to 2.5mm jack plug. **£1.50**

X3252 VFD mounted on PCB with chip. Only a handful - no other info. **£3**



X3235 16x2 LCD, ex-equip **£2.00**



X3304 16x2 backlit alphanumeric LCD module by Optrex type DMC16202. List oVer £30. **Our Price £7.95**
X3306 MAN6740 dual seven seg display, red, 15mm digit mounted on small PCB. **6/£1.00;** 100+ 0.08; 1k+ 0.06

Miscellaneous
X3253 Heatsink 38x22.5x28mm. Drilled for TO66. List 61p. **Our Price 3/£1**
X3303 Ferrite magnet - small, but strong. Measures just 10x8x6.5mm. **6/£1.00;** 100+ 0.09
X3281 Fuseholder - 20mm enclosed with finger release. PCB mntg. **4/£1.00**
X3288 Bi-metal thermostat. NC contacts open at 135°F and reclose at 110°F. **2/£1.00**
X3292 Mullard VA1106 thermistor. 2k2 @ 25°C **4/£1**
X6169 Vero potting box 72x50x27mm. Mostly black, few white. **40p**

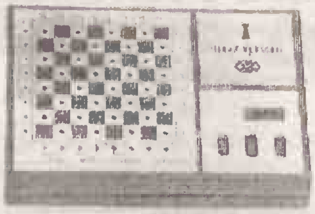
X3308 X3268 X6170

X3308 Small solid dielectric variable capacitor, probably 500+500pF + 4 trimmers. Size 21x20 x20mm. **£1.00** 100+ 0.60
X3268 Suppressor - 0.22µF + 100R 250V ac in case 30.5x20.5x10.5mm. **£1.00;** 100+ 0.60
X6170 330µF 450V electrolytic can 77x40dia by BHC. List around 4.00. **Our Price £2.00**

X3314 BU326A NPN 400V 6A 60W TO3 transistor. **£1.50**

X6178 Switch mode PSU. PCB 210x103 ex-equip. Mains in, outputs +5V 4A; +15V 2A; -12V 0.5A. Super Price - **£5.00**

X3315 SIMM DIP socket 30 way plastic by AMP. List 1.77. **Our Price 2/£1.00**



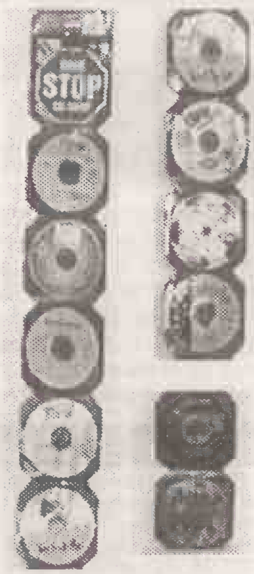
Z5899 Pocket chess computer. This is by the same people as the larger sets we used to sell. Size 180x120x45mm. 16 levels of play.
Untested, possibly faulty: missing bits. **£2.95**

SALE PRICE **£1.95**

Z5610 Back in stock again - after a very long time! The BBC joystick. Rugged design, high speed sensitive performance, 2 fast response buttons, 4 suction cups and an extra long cord.
New & boxed £3.95; 100+ 2.00

SALE PRICE **£2.50**

CD-ROM BARGAIN - 11 FOR £34.95



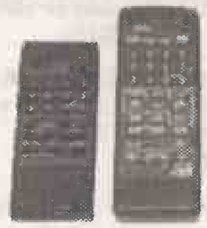
Just taken delivery of a great new collection of software on CD-ROM.
Prices start from £6.95 for individual disks but there's even a better deal on offer at present
-11CD-ROMs for just £34.95.
This collection from Softkey includes the following titles:
CNN Newsroom,
TIME Almanac,
Key Clip Art (5000 TIFF images),
Key Fonts,
Key Gourmet,
MPC Wizard,
Sport Image-World Cup 1994,
UFO (spooky!)
Slob Zone 3D,
Video Cube and Game Empire (over 250 games)

CABLEVISION CALAMITY!!!

Seems like Visionhire became a bit overstocked on their cablevision consoles - we've just purchased a quantity of these superb brand new units which contain some great electronics and as ever can offer them at an absolute Bargain Price!!
Two tone brown case contains PCB 192x195mm with easily removed UHF modulator made by Labgear (Sound and Vision); video pre-amp; stabilized power supply and all the decoding circuitry (9 transistors and TBA673 chip).
On the front of the case is a cable/off air switch and 5 push buttons (4 channels and on/off mains switch). There are 4 cables coming from the rear (these alone are worth what we are asking for the whole thing!) - 2m mains lead, 1.5m 8 core screened cable with 9 pin plug, 2m video in lead with coax plug and 2m video out lead with coax socket. As you would expect from a company like Visionhire, everything is top quality. The case can easily be utilised for other purposes - the dark brown inserts on the front are both easily removable, if required.**Z8939 £6.95** 100+ 3.50 1k+ 2.50
Add VAT to quantity prices

SALE PRICE **£1.50**

REMOTE CONTROL DEAL



X6106 X6108

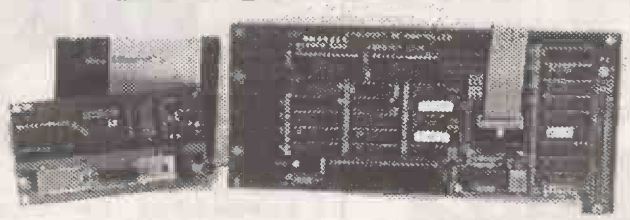
The remaining few hundred TV/VCR remote controls left from a parcel - and what a mixture they are. All brand new, they fall into 3 broad categories - (a) basic; (b) with LCD and (c) the bells and whistles brigade. Unfortunately, most manufacturers seem reluctant to print their name on these handsets, so we haven't a clue for which machines they are intended. Hopefully, the table below will give some idea. Being realistic, we're aware not many of these will be wanted as replacements in any case, but just for the spare parts and the low prices reflect this.

Code	Type	Lang	Description	Price
(a) Basic controller with no display - all take 2 x AAA cells				
X6106	RC07	F	20 buttons	**£2.00**
X6108	RC44	F	37 buttons	**£2.00**

E=English;F=French;

25% OFF LISTED PRICES

ETHERPORT FOR MACINTOSH



X9012 Shiva EtherPort SE. This brand new boxed set of parts from Novell for networking Apple Macintosh computers is fantastic value. You get the Etherport SE Controller Board, the Etherport SE Access Board, the software on a 3.5" disk, an Installation Guide and a User's Guide. Wonder what the original cost was? Our extra special price **£14.95**

SALE PRICE **£11.70**

PORTABLE ALARM SYSTEM

Z9278 This is a great deal - these portable alarm systems are brand new and boxed, but have a design fault. Although they work OK in the test position, the sensor is erratic when in use. Keyswitch with three keys, high power piezo sounder. The PCB uses what seems to be a fairly standard detector. Works off PP3 battery. Size 167x110x70mm. Super buy at just

£4.95

SALE PRICE **£3.75**

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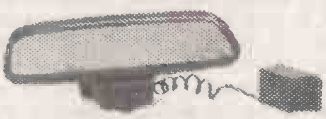
ECLIPSE

ELECTRONIC ANTI-DAZZLE MIRROR

The mirror that dips by itself!

- Reduces eyestrain & tiredness
- Automatic operation
- Safety glass
- Easily fitted
- Uses internal or car battery
- Made in the UK
- Removes headlight dazzle from behind
- Dips in 1/10th second
- Sensitivity selector
- Complete with accessories



ONLY £7.95

SALE PRICE £3.95

Order Code Z5693

BATTERY TESTER

Z5569 We've managed to acquire some more of this popular line - they will test any 1.5V cell inc button cells, and PP3's, too. Still the same price - no inflation at GREENWELD!

SALE PRICE £2.95

X6098 6V constant current ni-cad charger for up to 4 1.2V cells. Red LED indicates charging at 100mA and after 14 hours, the green LED illuminates and charging stops **£3.95**

SALE PRICE £2.95

G027AA Guitar Tuner. 6.35mm skts for electric and built in electret condenser mic for acoustic guitars. Note selection is by up/down push button with LED indicators. Correct tuning indicated by an 'in-tune' target LED. Callibrated for A=440Hz. Uses PP3 batt. Normally £27.95 ***NOW £17.95***

SALE PRICE £9.95

Lithium Batteries

(Lithium batteries have a long shelf life - 10 years, but can only supply a low current. **Do not short terminals**).

Z2451 **Z2450**

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

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

Z2721 **Z2720** **Z3458**

Z2721 Lithium battery by Varta, type CR1/3N. 11mm long x 12.5mm dia. 3V 160mA PC mntg. **£1.20**

Z2720 Lithium battery, Vidor G06/53, 3V 1400mAh PC mounting. 50mm long x15mm dia, individually boxed. DP 6.00. **Our price £2.00**

Z3458 Lithium battery. 3.5V 'D' size by Saft, type LSH20. DP on these is a staggering 17.48. **Our price £3.95;** 100+ 2.00

25% OFF LISTED PRICES

Nicad Batteries

Z4150 **Z4149**

Z4150 Back in stock! The popular ex-radio batteries containing 8xAA NiCads. Generally rejected because of physical damage - but there may be the occasional duff cell. Total capacity: 10V @ 500mA. Same price **£1.60**

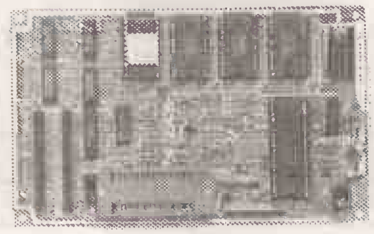
Z4149 Ex-mobile radio NiCad batteries discarded because they either have broken cases and/or the odd duff cell. Pack of 8 cells, like AA but 73mm long, in a tough plastic case. Each cell rated 1.25V 900mA **£3.50**

SALE PRICE £1.00

Micro-Professor

25% OFF LISTED PRICES

A popular teaching aid in use some years ago by Acer, we have some of the add-on options:



Z9197 EPROM Programmer board. This 157x107mm panel has a 28 pin ZIF skt, 8255, 2732 and 3 x HM6116LP-3 RAM chips, all in sockets + 7 other chips. **£3.95**

Z5714 BASIC chip (27C64 EPROM) + programming manual. Again, for use with the Micro-Professor. 12 chapters + 9 appendices - 196 pages of informative text. **£3.95**

Z5715 FORTH chip (2764 EPROM) + programming manual 146 pages of comprehensive information on the FORTH language. **£2.95**

Z9196 Printer board 157x108mm. This is probably the most useful panel, and we hope to supply a disk with it to use with a PC. There's a compact thermal print mechanism on board (20 characters/138 dots per line), together with a 2732 ans 7 other chips. A connecting lead, roll of thermal paper and 32 page handbook are also included. **£7.95**

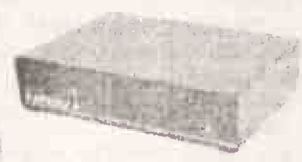
Lithium Coin Batteries

These popular 3V batteries used in calculators and camcorders are offered at a great price.

Z3807 CR1616 50mAh 16x1.6mm
Z3808 CR2320 125mAh 23x2.0mm
Z3809 CR2325 200mAh 23x2.5mm
Z3810 CR2430 280mAh 24.5x3.0mm

80p each or 10 for £6, any mix

INFOTRAC+ ISTEL UNIT



X9009A Two part instrument case 445x330x105mm in blue aluminium containing a multiplexer PCB 290x195mm with Z80B + 7 support chips, 27C512 and 8 x 41256-12 DRAMs all in sockets; also 25+ LS chips, 6MHz xtal osc etc. There are also 10 x 32 way DIN sockets, 6 with matching plugs. Three others have V24 interface panels, each containing 4 x 1489 ICs and terminating in a 25 way D skt. There's a 50 watt switch mode PSU, too - and a 60x60x25mm 12V fan. What a lot you get! - and all for just **£12.95**

SALE PRICE £9.95

EVERYTHING ON THIS PAGE 1/3rd (33%) OFF!
(Except where prices are indicated by SALE flag)

Z3571 Z3872

Z3571 Coil former. OD 38mm. ID 21mm. height 25mm. 2 sections. **Pack of 3 for £1.00**
Z3872 Small wound pot core. 4 windings on 10x10 former. **10/£1.00**

Z3791 Z3748

Z3791 Encapsulated pot core with 2 windings. type 77204. **3 for £1.00**
Z3748 Pulse(?) transformer. Ferrite core 46x36x30mm. No other info. **2/£1.00**

Z5094 Z5095

Z5094 Tripler, made by Konig for Remo type D. 126 for Telefusion and ITT models. **Only £1.50;** 10+ 1.20; 100+ 0.65
Z5095 Tripler. Remo type D125 for 22-26 Korning 429 models. **Only £2.00;** 10+ 1.20; 100+ 0.65

Z2495 Small suppressor 28mm long x 12mm dia by LCR. Rated 250V ac. **2 for £1.00**

Mains Transformers

X6040 Z4248

X6040 Mains transformer 60x50x45mm with 12V 1.5A secondary. **£2.50**

Z4248 Mains transformer. 110/240V input via PCB pins. Secondary. 6.5V @ 8VA; 22V @ 8VA; 22V @ 1VA; 1.5-0-1.5V @ 1VA. Nicely made by Skot. **Price £3.00**

X6034 X6077 X6078

X6034 Encapsulated PCB mounting transformer. 120/240V input. 4 separate outputs; 2 @ 9V and 2 @ 13V each at about 0.5A. By wiring in various ways, a large number of different outputs are obtainable: 9, 13, 18, 22, 26, 31, 35 or 44 volts. **Great value at £3.00**

X6077 Clamp transformer with standard mains input. 16V 3A output. Size 57x69x61mm. **£3.00**

X6078 Clamp construction. mains pri on molex connector. 2 secondaries 9V 3A and 28V 3A. Size 57x69x81mm. **£4.95**

Z5822 X6092

Z5822 Mains transformer 89x75x58mm with 33-0-33V 1A secondary. **£3.95**

X6092 120/240V pri. 9V 0.75A. 9V 0.75A and 18V 0.75A secondaries. **£2.50**

Z5874 Great value on this 60 watt mains transformer, suitable for PCB mntg or bolted to a chassis. Two main windings: 12V 2A and 16V 2A. There are also two low current windings - 5V 50mA and 38V 50mA. Overall size 64x53x65mm. **Only £3.50 - or a box of 20 for just £50!**

2043A 2036 2031

2043A 20-0-20V 500mA **£3.80**
2036 17V 250mA **£2.30**
2031 0-19-25-33-40-50V 500mA **£7.50**

Coils/formers/chokes

Small chokes:

Code	Value	Size mm	Pitch	Type
Z7090	1µH	4.6	5mm	bead
Z7091	1.2µH	6.7x6.5	5mm	radial
Z7092	2.7µH	4.6	5mm	bead
Z3577	3.3µH	10x4	-	axial
Z7093	5.6µH	3x2	-	axial
Z7094	10µH	3x2	-	axial
Z3140	82µH	3x2	-	axial
Z7095	100µH	4	5mm	bead
Z7096	270µH	4.6	5mm	bead
Z7097	330µH	4.5	5mm	bead

All the above the same price - 20 of any **one** value for **£2.00**. 100+ 0.05. 100 mixed, your choice of values. **£7.00.**

2 FOR THE PRICE OF 1

2034 2032 2035

2034 35V 1.7A **£4.90**
2032 0-19-25-33-40-50V 1A **£9.30**
2035 55V 2A **£8.95**

DIGITAL MULTIMETER

- Input Impedance 10MΩ
- 3½ digit 15mm LCD display
- 32 ranges including 20A ac/dc
- Transistor and diode test
- Continuity test with buzzer and LED
- Rugged yellow case
- Test leads with shrouded 4mm plugs
- Carrying case
- Fuse Protection
- Automatic polarity and zero

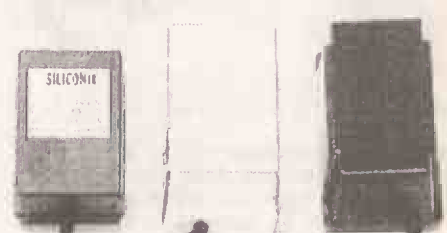
Battery and instruction manual included

Code No: M3800

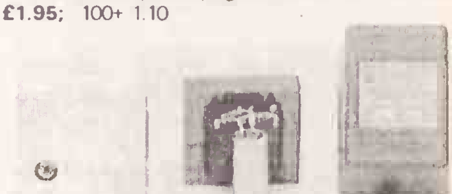
AC volts	0-200m-2-20-200-750Vac±0.8%
DC volts	0-200m-2-20-200-1000Vdc±0.5%
AC current	0-20µ-200µ-2m-20m-200m-2A-20Aac±1.0%
CD current	0-20µ-200µ-2m-20m-200m-2A-20Adc±0.5%
Resistance	0-200-2k-20k-200k-2M-20MΩ±0.5%
Transistor h FE	0-1000 NPN/PNP
Dims	176x88x36mm

SALE PRICE £29.95

Linear PSUs



Z4215 Siliconix mains input. 4.5V DC 150mA output to 3.5mm jack plug on 2m lead. Built-in continental 2-pin plug. Size 62x46x35mm. **Only £1.50**
Z5278 Plug in wall type 24V ac 100mA output on 2m lead. White case. **£1.75** 100+ 1.10.
Z5612 Plug in power supply giving out 10V 300mA ac on a 2.5mm power plug on the end of a 2m lead. **£1.95;** 100+ 1.10



Z5585 PSU with mains input via 1.5m lead. Output 8V 200mA regulated onm unusually, a phono socket. **£2.00**
Z5519 Power supply, ex-equip unboxed. Mains input transformer, bridge rectifier and smoothing cap giving 9V 800mA. **Only £2.00**
Z5143 Plug in power supply giving 7.5V 600mA on the end of a 2m lead with a 2.5mm power plug. **Only £2.50;** 100+ 1.80

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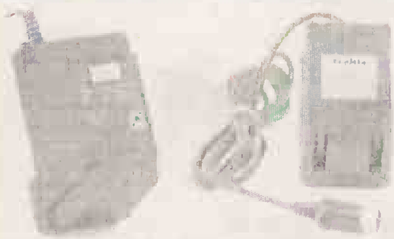
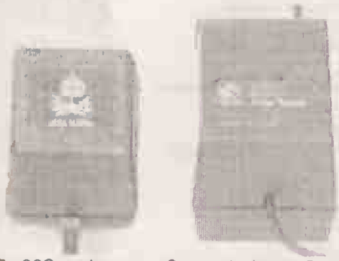


Z5818 Plug in PSU. Output 3V DC 250mA onto a 3.5mm plug via a 2m lead. Double insulated to BS415. Boxed. **£2.50**
Z5611 Plug in PSU by Tandata. Rather strange one this, - has 3 separate outputs, +16V 100mA; +8V 500mA, -8V 40mA terminating on a 4 pin DIN plug on the end of a 2m black lead. **£3.95;** 100+ 2.00



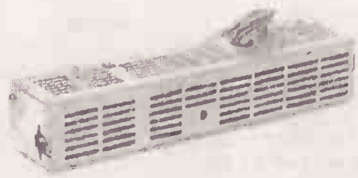
Z5997 220 ac input on 2 round pins. Output 48V ac 312mA on 2m lead with 2 pin skt. **£2.50**
Z5613 Griffin Power Supply. High quality cased unit with 1m mains lead and 1m output lead with a 0.25" stereo plug on the end. Output is 9-0-9V 1A ac. **£4.95;** 100+ 2.65

Z5503 126x76mm PCB. 30 watt unit +5V 4A: -5V 1A. **£4.95**
AA12531 Switch mode PSU by Astec partially cased. 160x104x45mm overall with 160x100mm Eurocard PCB. Inputs and outputs are on colour coded flying leads. Input 115/230V 50/50Hz. Outputs: +5V @ 5A: +12V @ 0.15A. Total wattage 50W. **£6.95;** 25+ 5.43; 100+ 4.53
Conversion Kit
K725 This kit converts the AA12531 PSU into a much more versatile supply, giving +5V @ 2.5A: +12V @ 2A; -12V @ 0.1A and -5V @ 0.55A. Complete set of parts and full instructions **£3.50**
Instructions only **(K726)** **£1.00**

Z5990 Farnell NO55P425 55 watts. Cased +5V 6A; +12V 0.6A; 12V 0.1A; 9V 0.15A. **£6.95**

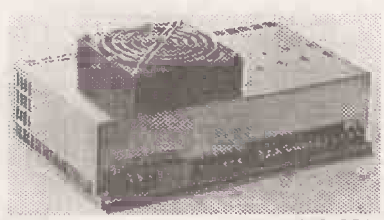
Z8888 Made by STC, this 220x100mm panel is attached to an aluminium chassis. 225x102x65mm and has a single 5V 10V output. Supplied with connection details. **Price Only £8.95;** 10+ 6.50; 100+ 5.20

X6016 Brand new and boxed SMPSU by ASTEC. Mains in, -12V 0.2A +12V 2A and +5V 5A out. 44W max PCB 160x100mm. **£9.95**



X6017
Another brand new unit by Ericsson, ideal shape and size for a PC. Steel and ally case. Mains on/off switch at front, 3 pin IEC mains input at back. Outputs, on a 13 way socket are : +12V 5A; -12V 2A; +5V 10A; 200W max. We purchased these in a job lot at an especially keen price, so are offering them for just **£14.95 each;** 100+ 8.00

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



Z8861 Advance switch mode PSU 110/250V as input, output 5V 50A. Has external fan 120x120mm fitted to case 305x109x75mm. **Only £30.00**

Z9240 (pictured) HSS180. Outputs: +5V 20A; +12V 6A; -12V 6A; -5V 1A; +24V 3A. (Total loading not to exceed 180 watts) DP 232.66. **Our Price £39.95**

ZS9241 SMM500 00 00. This is a fan cooled unit with adjustable fully regulated outputs that can be paralleled. Outputs: 5V 60A; 12-24V 6A; 12-15V 6A; 5-15V 6A; 5-15V 4A. (Total loading not to exceed 500 watts.) DP528.75. **Our price £99.95**

Z5958 Astec SA30-1305 30W unit +5V 2A; +12V 2A; -12V 0.3A **£3.95**

Z5953 Z5952

Z5953 Hitron HSG40-31 40W unit +5V 3A; +12V 0.5A; -12V 0.5A **£4.95**
ZS5951 Astec AC9232 50W unit +12V 2.5A; +5V 6A; 5V 0.5A; 12V 0.5A **£12.95**
Z5952 Astec SA70A-3400 70W unit +5V 8A; +12V 3.5A; -12V 1A; -5V 0.7A **£14.95**

DC-DC PSUs

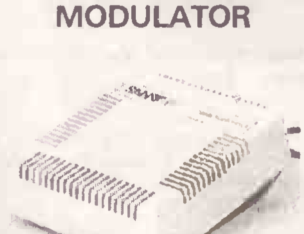
Z5546 Z1893

Z5546 Plug in car power supply - use cigar lighter socket to convert 12V to 6V 1A DC regulated (uses 7805 & zener), 3m long lead with 2.5mm power socket. Super bargain price. **Only £1.50**
Z1893 Input 48V (43-52V). Output 5V 1A. **Price £2.50;** 100+ 1.00

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

Miscellaneous

SAM POWER SUPPLY AND MODULATOR



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

27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307

All one off and pack prices INCLUDE VAT; Qty prices don't

POWER SUPPLIES

Z9157 One of the best power supplies we've seen for the money - this 397 watt switch mode beauty is one of the highest quality, made by Delta Electronics Inc. Removed from equipment, but in excellent condition (less than a year old!) the unit is totally enclosed in a steel case 340x152x152mm.. It has an IEC mains inlet with suppressor fitted and on/off mains rocker switch, and all outputs are on leads with power connectors. Now for the spec:

Inputs: 100-120V @ 10A or 200-240V @ 6A, Outputs +5V @ 40A; +12V @ 15A; -5V @ 1A; -12V @ 1A switchable on front panel. A 12Vdc 120x120mm fan is fitted at the rear of the case. Current distributor price of a unit of this ilk would be around £400.

Normally £29.95

SALE PRICE £15.00

UNINTERRUPTIBLE POWER SUPPLY

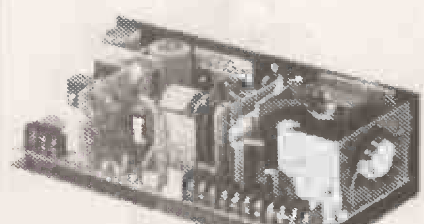
In good working order, offered at a fraction of its original cost. Please note carriage is extra on this item only and will vary with distance; ring for details.

Z9297 Rated 1000VA, this UPS is made by Sola and is supplied with a separately cased sealed lead acid battery of 36 cells.

£500

SALE PRICE £350

200W SMPSU

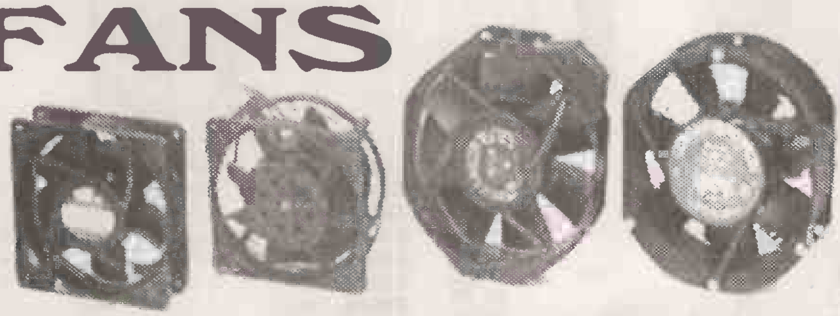


X9007 An excellent opportunity to purchase a brand new 200W multi output SMPSU by Farnell - model NA200P410, their list price over £200! Std input voltages, outputs: +5V 28.5A; +24V 0.5A; +12V 3A; -12V 1A. Great value at

£19.95

SALE PRICE £13.50

FANS



A selection of ex-equip fans at our usual low prices

X6082 120x120x38mm 220V ac, various makes, all diecast frame and metal blades. £3.00 **SALE £2.00**
X6083 As above but 115V ac £2.50 **SALE £1.70**
X6086 170mm dia x 51mm deep, but with flattened sides 150mm across, this fan is made by Comair Rotron. Rated 24V DC 1A £5.00 **SALE £3.50**

Low Voltage Fans

33% OFF LISTED PRICES

Some ex-equip axial flow fans all in good working order at substantial savings over new models.

Z3855 **X6015** **Z5728**

Z3855 Smallest fan we've seen! 42x42 by just 10mm thick. Made by Nitev, model TA150DC. Rated 12V DC 0.11A. **Only £3.00**
X6015 Papst (mostly) 612L 60x60x25mm 12V DC (6-15V) 0.7W fans. List is 27.47. **Our price £3.00**
X6051 12V 120x120x25mm fan, all plastic. Ex-equip. **£3.00**
Z5728 New by Panaflo. 12V. 0.16A. 60x60x25mm. Flying leads. DP 17.00. **Our price £5.00**
X6053 8-16V DC fan by Papst type 8112G. Metal frame. 80x80x38mm. Brand new and boxed. **£6.50**

Z5813 **Z5859**

Z5813 Papst 8124G 18-30V DC 80x80x38mm, ally framed. DP 20.00+. **Our Price £8.00**
Z5959 Papst 4312M-S 12V DC 2.6W 120mm fan. Std 32mm deep. List on this is 23.56. **Our price £4.95**

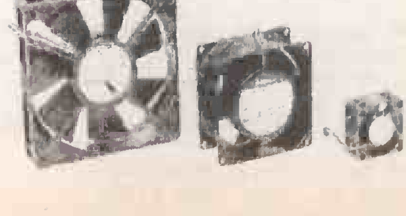
Mains Fans

Z5730 Ex-equip 120x120x38mm, 230V ac, mostly by Papst. Good clean condition. **£5.95**

33% OFF LISTED PRICES

FANS

X6051 12V 120x120x25mm fan, all plastic. Ex-equip. £3.00 **SALE PRICE £2.00**
X6053 8-16V DC fan by Papst type 8112G. Metal frame. 80x80x38mm. Brand new and boxed. £6.50 **SALE PRICE £4.50**



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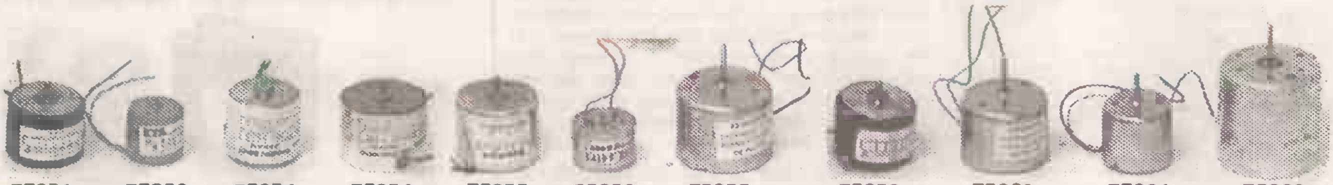
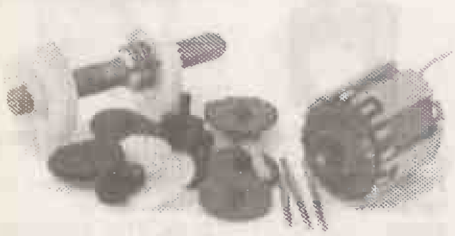
MOTORS



Z7351 Z7352 Z7354 Z7354 Z7355 Z7356 Z7357 Z7359 Z7360 Z7361 Z7362

CODE	TYPE	DIA	HT	SP	V	I	Speed	Dir	Used in	QTY	RRP	Our Price
Z7351	MM330				13.2	140	2400	CCW	Audiola Car Stereo	59	21.95	**£4.95**
Z7352	MM340	23	17	3	4.5			CW	Electronically Governed	57	11.95	**£2.95**
Z7354	MM350	30	22	5	6			CW		28	10.95	**£2.95**
Z7355	MM360	34	22	2	6	165	2000	CW	Far East Imports	30	10.95	**£2.95**
Z7356	MM370	28.5	20.5	2	6	170	2400	CW	Hitachi, Orion and Sharp, Electronically Governed	38	14.95	**£2.95**
Z7357	MM380	22	12.5	1.2	4.5	130	2400	CW	Toshiba, Aiwa, Electronically governed.	92	24.95	**£4.95**
Z7359	MM420	34	22	2	4.5		1520	CW		35	6.95	**£1.95**
Z7360	MM430	34	22	2	4.5		2000/2300	CCW		40	6.95	**£1.95**
Z7361	MM450	34	22	2	4.5		2000/2300	CCW		40	6.95	**£1.95**
Z7362	MM460	34	22	2	6.7		2000/2300	CW		48	6.95	**£1.95**
Z7363	MM480	27	21	2	6.7		2000/2300	CW		13	6.95	**£1.95**

Mains Motors



Z5782 Plastic housing with small (25x23mm dia 2W) mains motor and complex gear chain to give a final speed of 1 rev every 12 hours on to a 0.25" spindle, operating various switch contacts. Nice selection of easily removable plastic gear wheels (10) and spindles (3). **Only £1.50 - or buy a tray of 21 for £20**

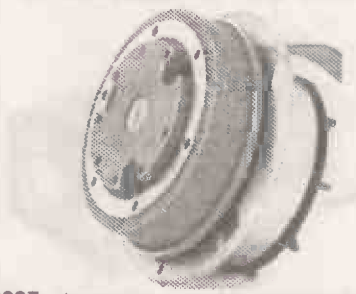
Z9224 Excellent mains motor, 2800 RPM. Thermally protected, 8mm shaft, 11mm long. Size 92x80mm dia. Weight 1750g. **£9.95**
Needs starter cap, about 4µF - we can supply a pack of 10 x 0.47µF 250V ac for **£4.00**

Low Voltage Motors

Z3039 **Z5487**

Z3039 High quality DC motor by Phillips, 32.2mm dia x 24mm high. Spindle 2mm dia x 7mm long. Low noise level, smooth running, designed for cassette machines. Normal V = 6.7V, max 12V 2000 RPM. Full spec on request. **£1.95;** 100+ 1.00

Z5487 Mabuchi hi-torque 9V cassette motor 35mm dia x 25mm. **Only £1.00;**



Z9237 Large economy size brushless DC motor (from a computer deck?) Overall size 122mm x 90mm dia. 10 way ribbon connector. Any ideas? **£5**

TIMER RELAYS and SWITCHES

Type TRE 1610. Similar to TRE1310, but smaller; 22x73x105mm and contacts rated 6A 250V 1500VA.

CODE	VOLTS	TIME	PRICE
Z5630	24	sec	**£8.00**
Z5631	240	min	**£8.00**

Type TRE1611. Delayed pulse, size and ratings as TRE1610.

CODE	VOLTS	TIME	PRICE
Z5633	24	6s	**£4.00**
Z5635	240	Tim/T2	**£6.00**

Type TRE1790 Time delay with remote option.

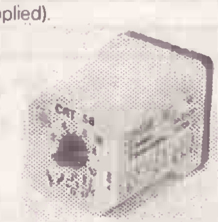
CODE	VOLTS	TIME	PRICE
Z5629	110	30m	**£6.00**

Further data on all these relay on our data sheet Z5623 (free).

These all originate from the largest component distributor in the UK and are in original packing. Sub min 4 pole changeover plug in type, delay before energize. Same as Omron H3Y4 series.

CODE	VOLTS	TIME	DP	PRICE
Z5182	240Vac	5s	25.83	**£5.00**
Z5183	110Vac	5s	25.83	**£4.00**
Z5184	110Vac	10s	25.83	**£4.00**
Z5186	110Vac	5m	25.83	**£4.00**
Z5187	24V dc	5s	24.19	**£5.00**
Z5188	24V dc	10s	24.19	**£5.00**
Z5189	24V dc	5m	24.19	**£5.00**

Plug in time lag relays, octal base type CRT55.58 by ISKRA. Variable time delay adjusts by top-mounted pot. Contacts rated 5A 250V AC, 500VA max. Big variety but only small quantity of each.
List price on these is over £20 each. 12V are DC only, higher voltage are AC/DC 60V version is intended for use on mains with 7K5 12 Watt resistor in series (supplied).



Code	Volts	Time	Type	Price
Z3071	24V	0.15-3m	55	**£3.00**
Z3073	48V	0.7-12s	55	**£3.00**
Z3075	48V	1.5-30s	58	**£3.00**
Z3076	48V	5-100s	55	**£3.00**
Z3077	48V	0.15-3m	58	**£3.00**
Z3079	60V	0.7-12s	58	**£4.00**
Z3087	60V	1.5-30m	55	**£4.00**
Z3088	110V	1.5-30s	58	**£3.00**
Z3089	110V	0.15-3m	58	**£3.00**

Type 55 has DPCO contacts, and has the delay when the supply is switched on.
Type 58 relays are off-delay type, ie the relay remains on for the set period after a set of auxiliary contacts are opened.

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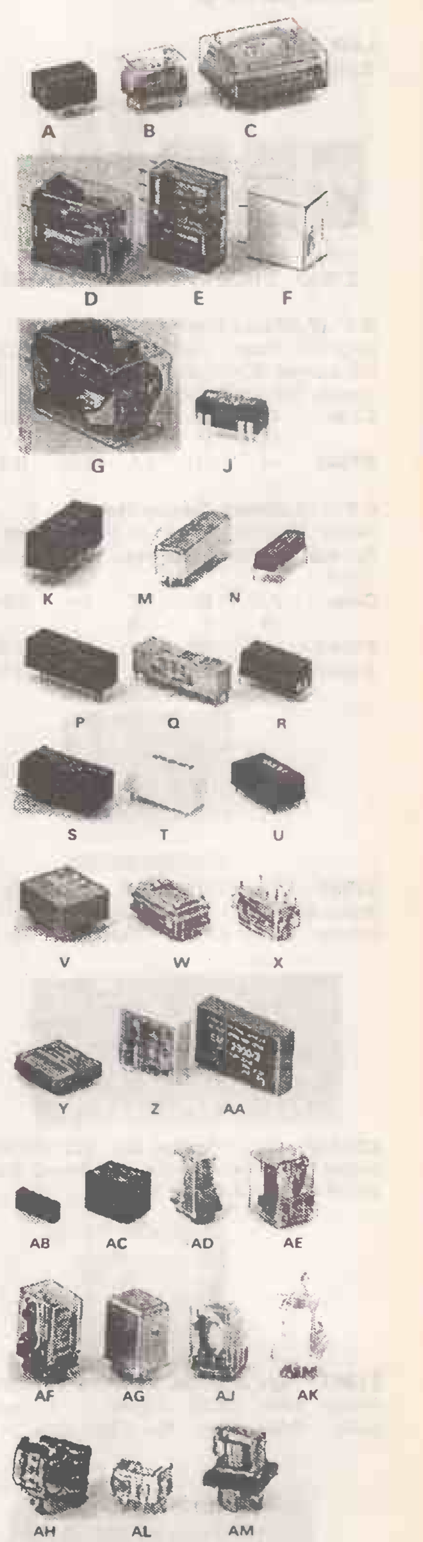
Relays

Code	Man & Type	Size	V	R	Contacts	Pic	Price
Z2554	DIL solid state	28.5x10x10	A		3PCO 40mA	N	2.00
Z1718	Huntleigh, SMT2000/3	43x25x70	B		SPM-4A	AA	1.00
Z2728	Teletone M949 polarized	28.5x10x10	1	18	SPCO 40mA	K	1.60
Z202	Low profile	32x20x11	3	35	SPCO 3A	U	1.00
Z2400	Gentech G42F	33x16x11	3	130	SPB 1A	S	1.00
Z3877	Omron G5A 234P-53/1	16x10x8	4.5	101R	DPCO 1A	A	1.00
Z3632	Clare SIL reed		4-10	500R	500mA	AB	1.00
Z3899	Hamlin HE72 1A5262	19x6.5x7	5	500R	SPM 300mA	J	1.00
Z2310	AX 400F-X091	10.5x32.5x13	5	370	SPB 1A	P	0.50
Z2401	AX 175A-4	32x9.5x15	5	500	SPM 1A	R	1.00
Z2402	Clare CIPV10201	25x10.9x9	5	170	SPB 1A	P	1.00
Z2403	AX 132A-4	20x7x7	5	520	SPM 500mA	J	1.00
Z2405	Clare PRMEL5005AB	20x7x5	5	470	SPM 500mA	J	1.00
Z2406	Elliott 36876/5	32x15x10	5	130	SPB 1A	S	1.00
Z3009	Schrack RP110005	28x24.7x11	5	60	SPCO 8A	V	2.68
Z3057	Clare	35x12.5x10	5	590	SP 1A	P	1.00
Z3058	Clare	35x12.5x10	5	400	DP 1A	P	1.50
Z3762	BT type (our type W831)		9			A	1.00
Z3878	211NC D009-P	16x11x10	9	390R	SPCO 1A	B	1.00
Z2174	Aromat DS4E-S	35x10x10	9	410	4PCO 2A 30V	Q	3.00
Z3533	BT47/9	20x10x10	9		DPCO 2A	A	1.00
Z3879	NEC MR24-12S	30x24x10	12	330R	4PCO 2A	C	2.00
Z3880	KV23/9 PW..	30x24x18	12	550R	DPCO 2A	D	1.50
Z3542	PCB	22x16x16	12		SPCO 2A	AC	1.00
Z2350	Car Type ¼" Crimp	26x24x36	12	680	SPM 15A	AM	1.00
Z2411	AX 481F	32x10x10	12	1500	SPM1A	P	1.00
Z2413	AX 481F	32x10x10	12	1500	SPM 1A	P	1.00
Z2545	Pickering 97-1-A-12	19x11x10	12	1000	SPM 200V 5A	A	50p
Z3023	PCB mounting L Shape	27x22x22	12	140R	SPCO 10A	AL	1.00
Z3561	Compact plug in	30x26.5x25	12	560	6PCO 1A	AE	2.00
Z3042	Iskra TRK3631	28x26x10	12	300R	SPCO 8A	Z	1.00
Z3631	Omron G5A	15.7x9.7x7.9	24	2k88	DPCO	A	1.00
Z3043	Iskra TRK3613	28x26x1	24	1k1	SPCO 8A	Z	50p
Z3881	National NF4-24	30x24x10	24	1k2	4PCO 2A	C	2.00
Z3882	KV 1002-027	28x24x12	24	820R	DPCO 2A	E	1.00
Z3883	Omron LC 1M-US4	22x21x16	24	1k5	SPCO 10A	F	1.00
Z3884	AMF KAP 14 DG24	53x34x34	24	450R	3PCO 6A	G	2.00
Z3559	Enclosed plug in	58x34x34	24	450R	3PCO 10A@115Vac	AJ	2.50
Z2639	Hamlin metal cased reed	32x10x9.5	24		SP 1A	M	1.00
Z275	Releco MR54-2	35x35x55	24	480	DPCO 10A	AK	2.50
Z2048	Octal IMO 60.12	32x35x63	24	435	2PCO 10A	AK	2.50
Z2164	Zetter AZ692-052-52	27.5x25.8x11	24	1200	SPCO 8A	Z	0.75
Z2416	Hamlin HE221A4860	32x10x0.9	24		SPM 1A	M	1.00
Z2419	National AE1324	30x20x10	24	2000	DPCO 1A	W	1.00
Z2941	Plug in continental	34x28x21	24	580R	4PCO 5A	AF	1.00
Z2422	AZ1530-Oay	26X20X10	36	4300	SPCO 1A	T	1.00
Z252	Perivale PC2	30x24x19	48	2500	2PCO 1A	AD	0.60
Z2424	ITT A2446	29X16X13	48	3000	DPCO 1A	X	1.00
Z2496	Omron MY4	27x20x41	48	630	4PCO	AF	1.00
Z3010	V23030-C2026	40x37x9	48	3000	6PCO 1.5A	Y	1.00
Z219	Izumi MY4 RY4S-EC	35x27x21	50	750	4PCO 3A	AF	1.00
Z230	Electrotherm GR1011	20x11x10	50	2600	SPM 1A	P	1.00
Z261	P&B KU11A15	46x36x31	240ac		2PCO 7.5A	AH	3.00
Z2433	Miniature plug in	22.5X29X32	240ac	5k	4PCO	AG	4.75

Notes: (in 'V' col)
A - 3.8 to 32 Vdc 'coil'; 5-250Vac 1A load LA SCR; B - 3 to 32Vdc 'coil'



Bases

Code	Man & Type	Size		Contacts	Pic	Price
Z296	MY4			4PCO		0.30
Z298	Continental			2PCO		0.30
Z299	Continental			4PCO		0.25

Z3560 Suitable base for Z3559. 50p

Z3802 Lovely little solenoid with 5V DC coil. Body size 30x20x17m. Steel plunger has nylon hook screwed into it easily removable. 5mm travel. Tapped fixing holes. 190mm long leads terminated in 2 way IDC type socket. **£1.50;** 100+ 0.85; 1k+ 0.70

Timer

Z2316 Elapsed time indicator by Curtis 0-5000 hours 5V DC 42mm long x 9 x 4mm. Wire ended. **£1.50**

Code	Man & Type	Size	V	R	Contacts	Price
Z2047	Omron H3Y-4-U5	63x30x22	110		4PCO 1-5 Sec Timing Range	2.50
Z2852	TEK8202 5 tap active delay					2/1.00

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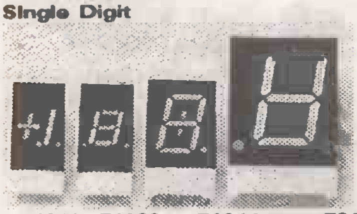
DISPLAYS

LED Displays
Single Digit



Z1940 Z1939 Z1944 Z3001

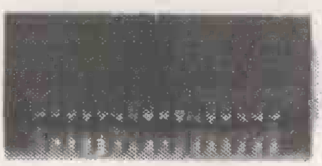
0.3" (7.62mm) Display Height
Height 19.05mm; Width 10.16mm; Depth 5.4mm; Pin spacing 2.54; Row spacing 7.62; Luminous intensity 0.6mcd @ 10mA.

Code	7/ +1	D P	CC CA	1+	25+	100+
Z1940	+1	LH	CA	20p	0.13	0.10

0.5" (12.88mm) Display Height
Height 19.0mm; Width 12.7mm; Depth 8.0mm; Pin spacing 2.54; luminous intensity 0.8mcd @ 10mA.

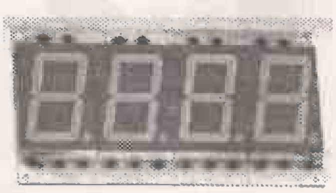
Code	7/ +1	D P	CC CA	1+	25+	100+
Z1943	+1	RH	CA	23p	0.15	0.12
Z1944	+1	RH	CC	23p	0.15	0.12

Z3565 Litronix LTD6940HR dual 7 seg red LED display with RHDO. 14.2mm high digit. Common cathode. **5 for £2.00;** 100+ 0.25; 1k+ 0.15



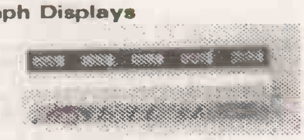
Z2904D Red 3.5 digit 0.5" PCB mounted LED display. Common anode multiplexed output and stackable with full data. **£1.00**

Z1361 Right angle DIL socket for mounting 7 seg displays (takes Z3001, Z3565). Extremely high quality. **Price 40p;** 10+ 0.26; 100+ 0.17.



Z5811 Giant 7 seg display panel as previously sold. Four 2.25" high LC2341 (normally 8.54 each) on panel 195x100mm, with **32x1N4005**. May be slight scratching where panels have rubbed together. Same price as before - **£8.00**

Bargraph Displays



Z3564 Bargraph LED display. 5 5x2.5mm green LED's in a block 40x7x8mm. **2 for £1.00;** 100+ 0.25

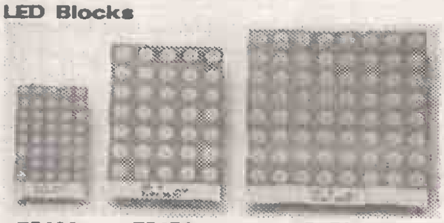
Z3563 Another. 12 5x2.5mm LED's in a block 70x7x8mm. 7 green, 5 red. **£1.00;** 100+ 0.50; 1k+ 0.40.

X3162 TMS3926 10 LED Red bargraph in small ackage (50x10), end stackable. VU function - ideal for power meters, S meters and VU meters in tape recorders. Programmable current drives, will withstand ±35V signal input. **£2.00**

Larger version of above (PCB 50x22)
X3163 TSM39152 Green, log. **£2.00**
X3164 TSM39143 Yellow, lin. **£2.00**

These three are 20 element integrated bargraphs with 20 5x5 LEDs driven by an on board 5450 based driven chip. Direct connexion to LEDs, too.
Z3874 TMS3805 Green **£2.50**
X3166 TMS3806 Yellow **£2.50**
The above bargraphs (X3162-6 & Z3874) all come with comprehensive data.

LED Blocks



Z5469 Z5471 Z5473

Code	Part No	Size mm	Matrix	Col	Price
Z5469	TFB3458C	35	5x8	G	1.60
Z5470	TFB3758C	35	5x8	R	1.60
Z5471	TFB5357C	51	5x7	Y	1.80
Z5479	TFB5757C	51	5x7	R	1.80

The suffix C to the part number indicates common common cathode.

Z2903D Red LED PCB mounted display - 12 bubble digits 0.11" high. Full data supplied. **Only £1.50;** 100+ 0.80

Z2658 LED module. PCB 50x35mm with 7 digit 7 seg red diplay + 3 surface mntg LEDs, one each red yellow and green. SED5031M chip on rear. Probably for use on mobile phone. **Only £1.00**

Z5093 Till display. Plastic housing 200x95x45mm contains PCB 195x70mm with 8 7-seg HP LED's type 5082-7651, red 0.43 CA 16.5mm red LEDs, 8255 programmable interface and other chips, etc. **Price £2.50**

Clock Displays

Z3789 Clock Display. 4 digit 7-seg LED 15mm high in green with colon in centre. Non multiplexed. **£1.00**

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

X6048 Nice display panel 153x35mm from STC Mercator with 8 x 5mm red LEDs and 3 x 0.8" 7 seg displays HE red, CA (HDSP3901). SAA1064 chip and a couple of ZTX450 transistors.£2.00
SALE PRICE £1.00 (NOT 2 FOR 1)

L141A Multilight. Durable 3-in-1 torch. Bright fluorescent tube for emergency lighting. Amber blink light. Strong spot beam using Krypton bulb. A must for DIY and camping enthusiasts. Takes 2X HP2 batteries. **(NOT 2 FOR 1)**
Was £14.99
Reduced to £12.99

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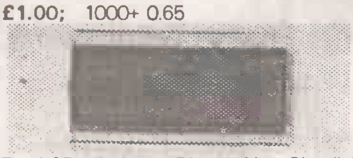
LCD Displays

Z2584 LCD for use with sophisticated hi-fi system. Indicates time, channel (16), track, edit, repeat, blank, random and direction. 28 pin connector. **Only £1.00;** 1000+ 0.65



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

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

X3230 8 digit display 10mm high by Racal, type Boo5T711. No edge connector. **£1.00**

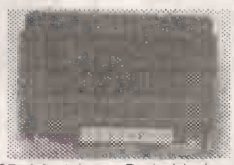
Z4115 8 digit 12.7mm high. LCD and holder. These are 14 segment devices allowing alphanumeric display. Normally costing over £15.00 we are offering these for just **£4.50**

X3173 3.5 digit 12.7mm high LCD and holder. With lo-batt symbol and centre colon for use as a clock display. Model TLCD0530-02 from IIIV. **£2.50**

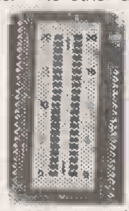
Z3100 Car VFD. This shows the plan view of a saloon and indicates whether doors are shut, lights are on etc. With data sheet. **£2.00**

Z5459 Futaba 16 character x 2 line vacuum fluorescent display type 162-BY-01Z. Supplied with pin out. **Only £2.50**

Z1731 NEC Vacuum. Fluorescent Display FIP8B11, 8 digit multiplexed output 10mm high. Heater voltage 2V, gird/anode voltage 24V. (Uses Z4248 transformer to power).. **Price £3.00**

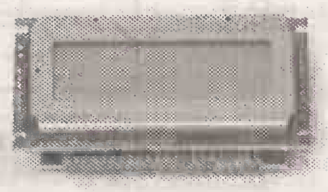


Z2659 LCD Module. Probably intended for use in mobile phones. Size 44x28mm. One row of 10 digits + a load of Japanese characters. Uses 2xOKI M5259 chips. No other data yet. **£2.50**



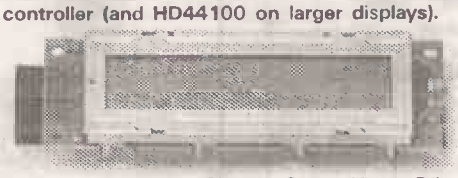
Z5792D Unusual LCD - ideal for use as a stereo bargraph, or digital counter. Supplied with data. **£2.95**

X3115 16x1 display **£3.50**



Z3063 EA-Y 16015A2. 16 Digit LCD module by Epson. On double panel 84x44mm with 22 way connector. **Only £6.00**

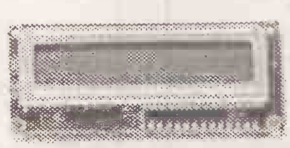
LCD dot matrix modules all with HD44780 controller (and HD44100 on larger displays).



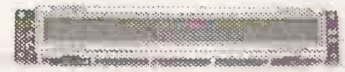
Code	Part No (TLCM..)	Size	Char	Ht	Price
Z5482	162Q	16x2	5x7	4.3	**6.00**
Z5483	1621	16x2	5x7	4.3	**6.00**
Z5484	2011	20x1	5x7	5.2	**4.60**

A data sheet is included in the price.

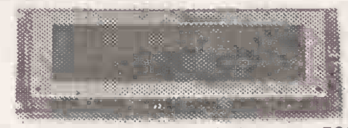
Z2842 Application notes: A 16 page booklet is available: **Price £2.00**



Z5096 16 character x 1 line. Very similar to our Z1814 but slightly larger character - 6.3x3.15 (8x5 dots). Type LCDM16166 by Refac. Supplied with data. Uses Hitachi HD44780A000 chip. **£8.00**



Z5352D Densiron alphanumeric LCD module 40x1 character type H2572HT. Farnell's price £29.28. **Superdeal Price £9.95**



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

FOR CALLERS ONLY

We've bought in a parcel of Crompton lamps, but regrettably unless you can call in for them, you won't be able to take advantage of this deal. Quite a mixture - there may be others we haven't come across yet. Qty's (where known) in brackets after price - if you're interested in taking a lot or all of them, give us a call.

Z5850 Clear twisted candle 230V 40W SES base. 3/£1 (550)
Z5851 Pearl std 115V 15W BC **3/£1** (1625)
Z5852 Pearl std 115V 40W BC **3/£1**
Z5853 Pearl std 115V 100W BC **3/£1**
Z5854 Clear std 115V 150W BC **2/£1**
Z5855 Pearl std 115V 200W BC **£1**
Z5856 120mm Reflector 115V 250W Infra red BC **£1.50**
Z9251 Clear std 230V 1500W GES **£3.00**
Z9252 1.5" dia fluorescent tube 2ft 40W natural **£1** (135)
Z9253 1.5" dia fluorescent tube 8ft 85W warm white **£2** (260)

If there's a particular type you require, ring before coming to check stock is available.

For regular mailings of our lists, become a Subscriber

GREENWELD 27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307
All one off and pack prices INCLUDE VAT; Qty prices don't

EVERYTHING ON THIS PAGE 2 FOR THE PRICE OF 1

Pay the price shown per item or pack - you'll receive double the quantity!

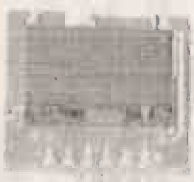
(Except where prices are indicated by SALE flag)

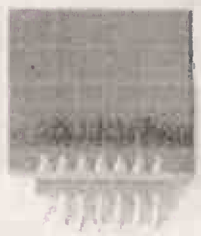
We're re-offering some red LED displays which have appeared in previous lists: now at much reduced prices.

Code	Type	Size (mm)	CA/ CC	DP	Qty	£2 Pack	100 +
Z3001	S806RWB	20mm	CA	RH	792	8	0.12
Z3002	LTS312R	0.3"	CA	Both	1325	15	0.08
Z3003	3719	0.3"	CA	RH	1075	20	0.05
Z3004	3729	0.3"	CA	RH	9807	20	0.05
Z3005	MIP4710	0.43"	CA	RH	1075	20	0.05
Z3007	MIP4720	0.43"	CA	LH	977	20	0.05
Z3008	MIP4920	0.43"	CA	None	3983	20	0.05

LED Integrated Displays

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





Code	Type	Colour	Description	Qty	Price
Z2888	TSM4307	Red	2-Digit 0.3"p	429	£1.00
Z2889	TSM4507	Red	2-Digit 0.5"p	873	£1.20
Z2890	TSM5032	Red	2-Digit 0.3"	543	£1.00
Z2891	TSM5032P	Red	2-Digit 0.3"p	354	£1.00
Z2893	TSM5052P	Red	2-Digit 0.5"p	955	£1.40
Z2894	TSM5232P	Green	2-Digit 0.3"p	654	£1.10
Z2897	TSM5732	He Red	2-Digit 0.3"	663	£1.10
Z2901	TSM6732P	He Red	2-Digit 0.3"p	358	£1.10

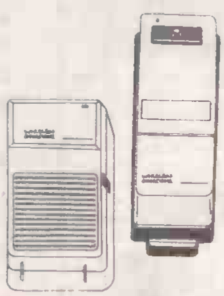
The p suffix indicates pcb with 0.1" pitch pins.
Individual data sheets are supplied with each device and a booklet.

Z2999 is available with applications data + program listing on all the devices. **Price £2.00**
K848 A pack of 10 assorted of the above types. **£5.00**

WIRELESS DOORBELL

T071D Two part wireless doorbell. The transmitter is mounted by the front door and the receiver can be mounted or carried up to 16m (50 feet) away. Provided with self-adhesive pads and screws for mounting (if required). Transmitter requires a PP3 battery, receiver requires two AA batteries.

Dims: 112x40x30mm
Transmitter 93x70x30mm



SALE PRICE £8.95

Seen elsewhere fo £14.95

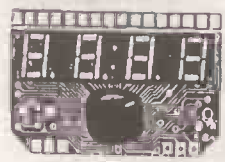
MORE CLOCKS

From the IIIV Systems parcel, some more clocks. Most in quite small quantities. Data supplied.

X3132,5,7

X3136

X3133



X3140

Code	Type	Descrption	Price	SALE
X3131	MA1020UR	Red. Full cct AC 0.84" red lens	£4.95	£2.50
X3132	MA1022UR	Red. Ful cct AC. 0.5" red ens	£3.95	£2.00
X3133	MA1026GZ	Green. Time & temp. AC 0.7" white mylar	£3.95	£2.00
X3135	MA1042LR	Red. basic cct AC 0.5" red lens	£2.95	£1.50
X3136	MA1142GZW	Green basic cct AC 0.5" white mylar	£2.95	£1.50
X3137	MA1142RLR	HE red basic cct AC 0.5"red lens	£2.95	£1.50
X3138	MA1142RZW	HE red basic cct AC 0.5" white mylar	£2.95	£1.50
X3140	MA5036ZW	HE red basic CCt AC 0.3" white mylar	£1.95	£1.00

99P CLOCK

Z3873 Super Offer! A complete clock in a 40x25mm module. 9V operation with sleep & snooze, 24hr alarm, PM, colon and alarm indicators. Simple fast/slow setting controls. 5 display modes, 12/24hr selectable, display brightness control. Full info supplied.

SALE PRICE 99P

If you have found an original use for any of our surplus products, let us know - we will consider it for our monthly newsletter, 'The Greenweld Guardian'.

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Pay the price shown per item or pack - you'll receive double the quantity!

(Except where prices are indicated by SALE flag)

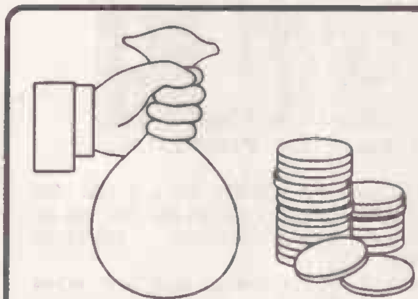
Code	Part No	Colour	Size	Note	Spec	Tu/Du	£2 Pack	100+
Z2673	TLMP6301	Orange	SOT23	1	0.5mcd @ 10mA		15	0.06
Z2674	TLMP6311	Red	SOT23	1	1.6mcd @ 10mA		12	0.08
Z2675	TLMP6401	Yellow	SOT23	1	0.5mcd @ 10mA		15	0.06
Z2676	TLMP6411	Yellow	SOT23	1	1.6mcd @ 10mA		12	0.08
Z2677	TLMP6501	Green	SOT23	1	0.5mcd @ 10mA		15	0.06
Z2678	TFS021	Red/Gr	SOT23	1	0.5mcd @ 10mA		8	0.12
Z2679	TLMP6802	Red/Yel	SOT23	1	1.6mcd @ 10mA		6	0.16
Z2680	TLMP6803	Red/Or	SOT23	1	1.6mcd @ 10mA		6	0.16
Z2923	TF5012	He Red		4			20	0.05
Z3584		Yellow			Top hat		50	0.02
Z2135		Red	1.5mm		5V submin with built in resistor		6	0.16
Z2136		Green	1.5mm		5V submin with built in resistor		6	0.16
Z2691	TFS065	Red	1.8mm	2	2.8mcd @ 10mA		10	0.10
Z2692	TFS066	Red	1.8mm	2	2.8mcd @ 10mA		10	0.10
Z2693	TFS068	Green	1.8mm	2	2.8mcd @ 10mA		10	0.10
Z3574		Green	2mm		Top hat		50	0.02
Z2919	MV54123	Green	2x5mm	4	1.0mcd @ 20mA	TD	15	0.06
Z2926	TLMP5001	Red	2x5mm	4	Interlocking	TD	20	0.05
Z2927	TLMP5301	He Red	2x5mm	4	Interlocking	TD	15	0.06
Z2928	TLMP5501	Green	2x5mm	4	Interlocking	TD	15	0.06
Z2929	TLMP5801	Red/Green	2x5mm	4	Interlocking	TD	10	0.10
Z7201	EL103CD	Green	2mm	5			12	0.08
Z3706	L13EDT	Orange	2mm		Flat top		30	0.04
Z3707	L13GDT	Green	2mm		Flat top		30	0.04
Z3708	L21GD	Green	2mm		Dome top		30	0.04
Z2907	HLMP0401	Yellow	2.5x7mm	4	0.9mcd @ 10mA	TD	12	0.08
Z2908	HLMP0504	Green	2.5x7mm	4	0.9mcd @ 10mA	TD	12	0.08
Z2683	SL35091G	Orange	3mm	4	16 mcd @ 10mA	TU	16	0.06
Z3569		Yellow	3mm				40	0.04
Z3570		Green	3mm				40	0.04
Z7203	HLMP1719	Yellow	3mm				16	0.06
Z7205	TLMP1503	Green	3mm		Diffused		16	0.06
Z7206	LY3140-LP	Yellow	3mm				16	0.06
Z7209	LS3380-GK	Pink	3mm		Wide angle Super bright		16	0.06
Z7210	LY3180-J	Yellow	3mm				16	0.06
Z7215	LT331L	Yellow	3mm				16	0.06
Z2860		Red	3mm		Diffused IR		20	0.05
Z3751	SL3GDH	Green	3mm		80mcd		25	0.05
Z3752	SL3YDH	Yellow	3mm		80mcd		25	0.05
Z2500		Green	3.8x1.75		5V submin with built in resistor		24	0.05
Z2501		Red	3.8x1.75		5V submin with built in resistor		24	0.05
Z3703	L144EDT	Orange	3.9x1.9				30	0.04
Z3704	L144YDT	Yellow	3.9x1.9				30	0.04
Z3705	L144GDT	Green	3.9x1.9				30	0.04
Z2571	HLMP6204	Red	4x1.8mm		Submin array type		6	0.16
Z3494		Green	4.9x2.3				50	0.02
Z2685	HLMP3950	Green	5mm	4	150mcd @ 20mA	TU	12	0.075
Z2686	TLMP7413	Yellow	5mm	4	150mcd @ 20mA	TU	12	0.075
Z2687	TLMP7513	Green	5mm	4	150mcd @ 20mA	TU	12	0.075
Z2689	LST712L	Or/Gr	5mm	4	4mcd @ 20mA	MU	10	0.09
Z2690	XC5549R	Red	5mm	4	4mcd @ 10mA	TU	30	0.04
Z2694	TLMP5401'	Yellow	5x2mm	3,4	4mcd @ 20mA	TU	15	0.055
Z3567		Yellow	5mm				40	0.04
Z2914	HLMP3416	Yellow	5mm	4	20mcd @ 10mA	TU	12	0.08
Z2915	HLMP3517	Green	5mm	4	6.7mcd @ 10mA	TU	14	0.06
Z2917	HLMP3862	Yellow	5mm	4	8.0mcd @ 10mA	TD	14	0.06
Z2920	MV6051	Red	5mm	4	0.4mcd @ 20mA	UD	16	0.06
Z2921	MV64520	Green	5mm	4	12mcd @ 20mA	TU	12	0.08
Z2922	MV6752	He Red	5mm	4	17mcd @ 20mA	TU	20	0.05
Z2924	TF5031	He Red	5mm	4	6.3mcd @ 10mA	TD	25	0.05
Z2930	TLMP7003	UB Red	5mm	4	200 mcd @ 20mA	UU	10	0.10
Z2931	TLMP7005	UB Red	5mm	4	300 mcd @ 20mA	UU	8	0.12
Z1932		Red	5mm		Square with rounded corners		30	0.04
Z2091	LTL9223A	Red	5mm		Square		24	0.05
Z2095	HR44DL	Red	5mm		Square with rounded corners		24	0.05
Z2097	MV57123	Red	5x2mm		Rectangular		24	0.05
Z2182		Red	5mm				36	0.03
Z7217	HLMP4700	Red	5mm		Hi Eff		20	0.05
Z7218	TLMP7005	Red	5mm		Hi Int. Clear		20	0.05
Z7219	TLMP7313	Red	5mm		Hi Int. Hi Eff		16	0.06
Z7220	TLMP4945	Red	5mm		Hi Eff. CC Reg		12	0.08
Z7221	TLMP3300	Red	5mm		Hi Eff diff		20	0.05
Z7225	LR5360-G	Red	5mm				16	0.06
Z7226	LR5380-J	Red	5mm		Wide Angle		12	0.08
Z7229	LG5360-H	Green	5mm				16	0.06
Z7230	LR5460-FJ	Red	5mm				20	0.05
Z7231	LY5180-H	Red	5mm		Wide Angle Super		16	0.06
Z7232	LS5180-J	Red	5mm		Wide Angle Super		16	0.06
Z7233	LG5180-H	Green	5mm		Wide Angle		16	0.06
Z7235	LT1811	Red	5mm		Super bright		25	0.045
Z7242	LN81RCPH	Red	5mm		Hi Eff		20	0.05
Z7243	EL331LD	Red	5mm		Hi Eff		30	0.04
Z7245	LT5211-41	Red	5x2mm		Hi Eff		10	0.10
Z3709	L503GDT	Green	5x5mm		Flat top		30	0.04
Z3750	L53LGD	Green	5mm		Low 1.2mcd		25	0.05
Z7244	EL533YD	Yellow	5x2.4mm	6			16	0.06
Z3571		Red	6x1.2mm				34	0.04
Z3572		Yellow	6x1.2mm				29	0.04
Z3573		Green	6x1.2mm				29	0.04
Z1845	LMP301	Red	7x2.5mm		Rectangular		24	0.05
Z2098	SE6511D	Red	7x2.5mm		Rectangular		24	0.05
Z3753	SY241AC	Yellow	9x2mm		Bar		30	0.04

LEDs

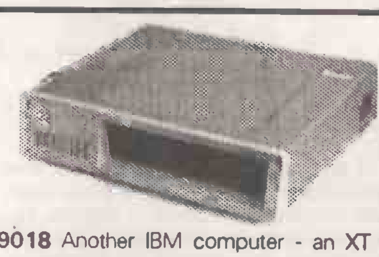
We've amalgamated all our single point LEDs into this table, in size order:

Notes

General See page 26 for assorted packs of LEDs
1. SOT23 is a surface mount package, size 2.9x1.1x1.4mm
2. These are **axial**
3. These have an interlocking moulding incorporated to enable accurate alignment when stacked
4. TU/DU = Tinted/Untinted/Diffused/Undiffused (M=Milky)
5. Cylindrical
6. Tombstone



We are always interested in buying surplus stock - end of line goods, bankrupt stock, clearance lines etc. Our customers have wide and varied interests, so we'll consider almost anything! Send lists, samples, details to The Managing Director, Greenweld Electronics Ltd, 27 Park Road, Southampton, SO15 3UQ



X9018 Another IBM computer - an XT PC type 3270. This contains a motherboard with 640k RAM, 20M hard disk, MGA video card, 5¼" 360k floppy drive and a 130W PSU in a case 500x380x140mm. There's also a number of other cards fitted inc.a network PCB designed to link in to an IBM3270 mainframe computer. Believed working.

SALE PRICE £35

GREENWELD 27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307

All one off and pack prices INCLUDE VAT; Qty prices don't

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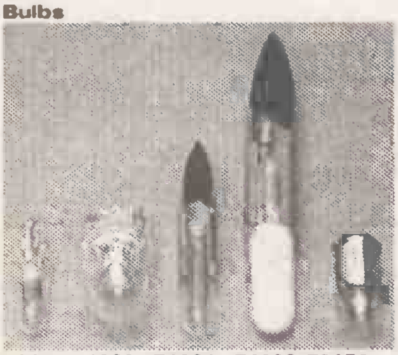
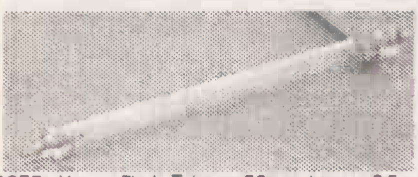
MISCELLANEOUS

Bulbs



Z1466 Z1929 Z1924 Z1923 Z3176

Z1466 GI lamp type 286-002, this is a 12V 1.2W wedge lamp 18mm long x 4.8mm dia. (DP 23p ea) **Our Price 12p;** 25/£2.50; 100/£7.00; 500/£25.00
Z1929 T3/4 (10mm) wedge base 28V 60mA **Price 5/£1.00**
Z1923 Slide (PO type) 220V **5/£1.00**
Z1924 Small Slide base 48V 25mA T5.5 **5/£1.00**
Z1926 Small Slide base 60V 20mA T5.5 **5/£1.00**
Z3176 6V 100mA T1.75 fitting lamp. **Pack of 20/£1.50**



Z1655 Xenon Flash Tubes; 56mm long x 3.5mm. No other data at present. **Price 2 for £1.00**

Indicators

Z712 Amber indicator 12V 80mA 35mm long. Needs 8mm hole. **Price 25p**
Z4314 Indicator. 14V 40mA Opal. DP 97p **Our price 2/£1.00**

A parcel of IMO Neon indicators and various other lamps offering the hobbyist a selection of top quality components at rock-bottom prices! Why are they so cheap? They're all for 110/120V! However, that's no problem because with every indicator we supply a suitable resistor for mains operation.

Type A Type C Type D

Type A - Panel mounting 33x15mm with 0.25" tags. Clip fix requires 25x12.5mm cut-out.
Z1899 Green **5 for £1.00;** 100+ 0.10; 1k+ 0.06

Type C - Small round face 10mm dia. Clip fix requires 9mm dia hole.
Z1905 Red **5 for £1.00;** 100+ 0.10; 1k+ 0.06

Type D - Large round face 13.5mm dia. Clip fix requires 12.5mm dia hole.
Z1912 White
Price (any mix) 5 for £1.00; 100+ 0.10; 1k+ 0.06

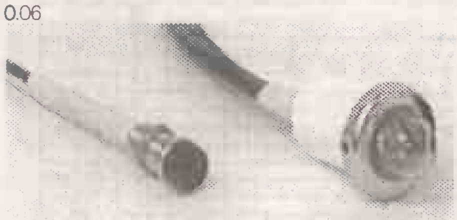
Type E Type F1 Type F2

Type E - Small square face 10.5mm dia. Clip fix requires 9.5mm dia hole.

Z1915 Amber
Z1912 White
Price (any mix) 5 for £1.00; 100+ 0.10; 1k+ 0.06

Type F1 - Large square face 13.5mm dia. Clip fix requires 12.5mm dia hole.
Z1918 Green
Price (any mix) 5 for £1.00; 100+ 0.10; 1k+ 0.06

Type F2 - Large square face 13.5mm dia. Clip fix requires 12.5mm dia hole. ¼" tabs
Z2063 Green
Price (any mix) 5 for £1.00; 100+ 0.10; 1k+ 0.06



Z1921 Z2066

Type G - Small round face 7.5mm dia, threaded body, requires 6.5mm dia hole. ¼" tabs
Z1921 Red **5 for £1.00;** 100+ 0.10; 1k+ 0.06
Type H - Body dia 17.5mm - chrome bezel. Wire ends.
Z2066 Clear **5 for £1.00;** 100+ 0.10; 1k+ 0.06

Z5839A Z5836A etc

Clip in mains indicators
Z5836A Amber, 0.25" tabs, needs 30x24mm cut out. **5 for £1.00**
Z5837A Red ditto **5 for £1.00;** 100+ 0.10
Z5838A Clear ditto, except 28x24mm cut out. **5 for £1.00**
Z5839A As Z5836A only no lens. **10 for £1.00;** 100+ 0.05

Lampholders

Z5960 Superb quality ES spotlight lampholder in mushroom by Erco that can be twisted to any angle, complete with universal bracket for screwing to wall or attaching to lighting bar. Ideal for shop or showroom. Max 60W. 63mm dia. ~~**£4.95;** 25+ 3.00~~

SALE PRICE £3.95

Z1743 Z1499

Opto Slotted Switches

Z1743 TIL143 Opto slotted switch. These have cropped leads and some are ex-equip, but are all working. **Pack of 3/£1.00**
Z1499 Opto slotted switch on small (25x26mm) panel. Type P850 **85p**

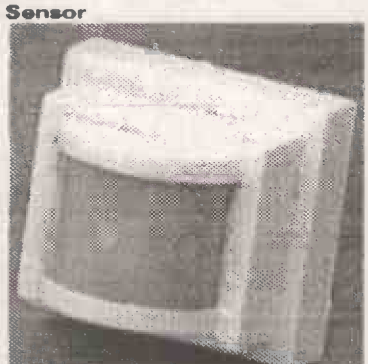
Phototransistors

Infra Red phototransistors in TO18 hermetically sealed cases.

Code	Part No	ImA	mW /²cm	£2 pk qty	100+
Z2769	TDET803	4	5	10	10
Z2770	TDET804	7	5	10	10

Z1847 4 Phototransistors SDP8405 with data. **Price £1.00**
Z2506 HCPL2630 dual optically coupled high speed logic gate. DP 5.24. **Our price £2.00**

PIR Sensor



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

SALE PRICE £7.50

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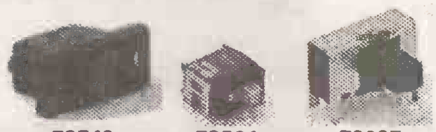
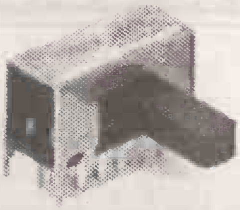
SWITCHES

SLIDE SWITCHES



Z3742 Z3531 Z3027

Z3742 Heavy duty SP slide switch rated 2A 250V. Panel mounting, 30mm FC. **40p**
Z3531 Excellent quality SPCO slide switch, PCB mount. Body size 9.6x9.1x5.4mm. **Pack of 10 £2.00;** 100+ 0.12; 1000+ 0.08.
Z3027 DPCO, PCB right angle mounting slide switch. **10 for £1.00**



Z3865 4PCO right angle slide switch, PCB mounting. Body 21x10x10mm. **Pack of 4 £1.00;** 100+ 0.10

ROCKER SWITCHES

Z3861 Z5840 Z2493

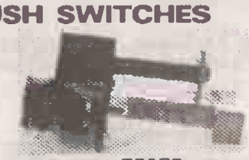
Z3861 Standard DPDT illuminated rocker, clip fix, rated 10A 250V. **Super Price! 3/£2;** 100+ 0.35
Z5840 Standard single pole on/off green illuminated rocker, clip fix. **3/£1;** 100+ 0.20
Z2493 Very large light action rocker switch, SPCO. Lever is 43mm square. Clip fix mounting. **£2.00**

ROTARY SWITCHES

Z4185

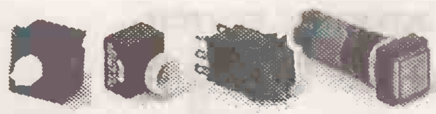
Z4185 Switch, high current, 11 terminal device, its 6 positions give a variety of connections. Data supplied. Standard 0.375" bush and ¼" spindle. Rated 2A 250V, 3A, 125V or 10A 20V ac. **60p**

PUSH SWITCHES



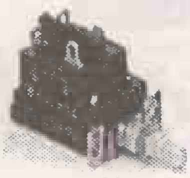
Z5975

Z5975 Assembly with SP 4A 250V push-on, push-off switch and 5 x 2.5mm green LED. **3/£1.00**

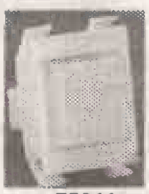


Z2167 Z3528 Z1837 Z2498

Z2167 Keyboard switch, single pole clip in type with standard + stem for cap 13.6 x 12.9mm. 7.5mm pitch. DP 75p. **Our low price 6 for £1;** 100+ 0.10
Z3528 Illuminated push switch (no tops), size 18.5mm square by FR. SP reed 13mm long operated by magnet 8 x 3 x 1.5mm. Bi-pin T1 (1.27mm) 12V lamp is 3.7mm dia x 9mm long . **Pack of 5 £2.00;** 100+ 0.20
Z1837 Lightweight push button switch. Double pole momentary action. 15.8mm sq cut-out. Uses T13/4 wedge lamps. Supplied with our Z1466 12V 1.2W. Lens available in white, red, green, blue or yellow. Normally £10.28 complete. **Our low price £2.50.**
Z2498 Unimax high quality illuminated push switch, DP contacts. Needs 16mm dia fixing hole and takes wedge lamps. Available with green **(Z2498G)**, orange **(Z2498R)**, or black **(Z2498B)** bezel. **£1.00**



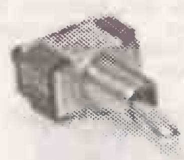
Z1689



Z5841

Z1689 Push on push off power switch rated 5A 250V. Mounting by 2 tapped holes on 20mm centres. No knob. **3 for £1.00.**
Z5841 Double pole illuminated push to make rated 10A 250V ac, clip fix. (no lamp fitted) **4/£1.00**

TOGGLE SWITCHES



Z3629 Wayco SPCO biased miniature toggle switch rated 3A 250V. Body size 13x9x8mm. Gold plated solder terminals. **3 for £2.50;** 100+ 0.50.

MICROSWITCHES

Z2488 Z2491 Z2492

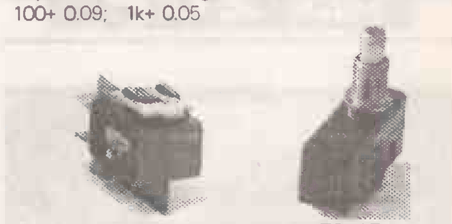
Z2488 Standard 5A microswitch with roller lever on steel bracket with steel plunger. **£1.20**
Z2491 Single pole heavy duty push switch with screw terminals made by Burgess, type KB5-A2 **2 for £1.00;** 100+ 0.30
Z2492 The above switch mounted in a plastic box 49x54x18mm with plunger assembly. **£1.60**

Z3801 Z2499 Z2165

Z3801 Excellent microswitch - unusually this has 4 pins on 15 x 5mm centres for PCB mntg, with a 30mm lever. Rated 5A 250V ac, the body size is 18.5 x 10 x 6.5mm. Contacts: 1 pair make, 1 pair break. **4/£1.00;** 100+ 0.15; 1k+ 0.10.
Z2499 Neat limit switch with lever and microswitch action, 1 pair make and 1 pair break contacts. 18.5x10x7.8mm. Lever is 30mm long. **4 for £1.00;** 100+ 0.14; 1000+ 0.10.
Z2165 Omron miniature type SS rated 3A 250V. Single break contact operated by bent lever. **5/£1;** 100+ 0.12; 1k+ 0.08

Z2084 Z3868 Z2166

Z2084 Skeleton microswitches. SPCO, 5A rating. Two 3.5mm mounting holes on 10mm centres. They are designed to be mounted side by side - in theory the number is only limited by the length of bolts available! (each switch is 5mm thick). **Pack of 4 for £1.00**
Z3868 V4 type microswitch rated 3A 250V ac. List price 1.12. **Our price 2/£1.00;** 100+ 0.25
Z2166 Omron standard type VL631C. These are for signal switching, contact rating 0.1A 125A AC/30V DC. Single make contact. **6/£1;** 100+ 0.09; 1k+ 0.05



Z3862 Z2487

Z3862 2 SPCO microswitches riveted together with single lever. 6A 250V ac contacts. **£1.00**
Z2487. Honeywell heavy duty with brass screw terminals and brass threaded plunger. SPCO rated 15A 380V ac. **£1.50**

A couple of microswitches for use in high temperature applications.

Z5978 Z5979 Z5158

Z5978 Entirely sealed in metal case 50x18x17mm. Lever (65mm) operated. 3 high temp wires 350mm long. **£1.50**
Z5979 Honeywell DPCO, metal body, panel mounting. Needs several kg of pressure to operate. The 6 Tersil GBX BBW-20 wires are 2m long. **£2.50**
Z5158 High current microswitch by Siemens, model 3 SE3 rated 10A 380V ac. Fully shrouded screw terminals (4); 1 pair make and 1 pair break terminals. Overall size 28x30x32. **Price £1.50**

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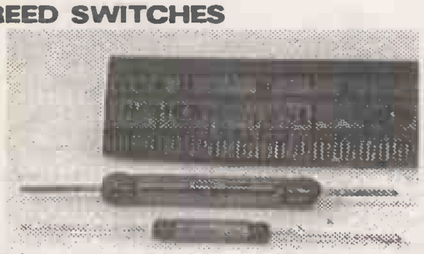
DIL SWITCHES

Z2341

Z2341 Low cost 4 pole changeover DIP switch, 16 DIL. Use screwdriver to change position to 1, 2 or off. Amazing value! **Pack of 5 £1.00;** 100+ 0.10; 1k+ 0.07

REED SWITCHES

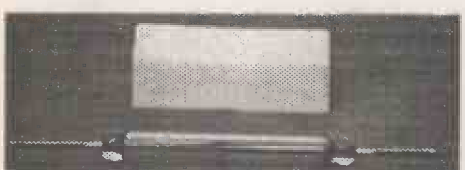


Miniature reeds, ideal for model railway enthusiasts

W901 14mm long **SALE PRICE 20p;** 100+ 0.12

W902 27mm long **SALE PRICE 20p;** 100+ 0.12

SALE PRICE 20P



Z798 Large reed switch, 50.8mm long body. Rated 5A, 400V max. **Pack of 10/£1.50;** 25+ 2.60; 100+ 8.70; 250+ 17.40; 1k+ 60.90.

Z3029 Useful encapsulated magnet, for use with reed switches. White block, 38x15x10mm with 2 fixing holes, has a strong magnet inside 25x5mm dia easily removable if required. They normally cost around 70p each. Will operate all reed switches listed. **Our special low price - 5/£2**

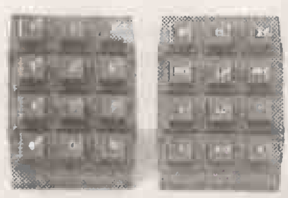
DIGITAL SWITCHES

Z3863 Cherry 0-9, A-F (16 position). Hexadecimal coded output. List 8.35. **Our price £1.50**

JOYSTICK SWITCH

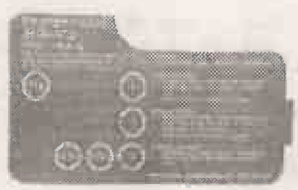
Z004 Skeleton Joystick, switch type. Good quality, made by AB. Brass spindle has 44mm long black plastic handle attached. Body has 4 mounting holes. These really are a fantastic bargain!!. **Only £1.00**

KEYBOARDS/KEYPADS

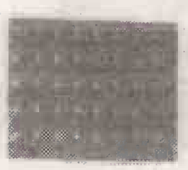


Z5440 2 keypads. These are packed in pairs - both have 12 keys, but the legends are different (a) 0-9, * and # and (b) MO LI MU B LO S F WU A and a couple of symbols. They have the graphite coated rubber membrane, but no PCB. **Only £1.50.**

Miniature Keypads



Z4116 24 way (8x3) membrane keypad. Large (200x90mm) area - these were originally used as a teaching aid. Overlay template and pinout supplied. **Now only £2.00.**



Z3735 40 way keypad by Texas Inst. with data. Membrane keys. Size 86x68mm. **£3.00**

Z8848 Keyboard by Cherry. Room for 104 keys, all normal keys (65) fitted. Chips on board: LS373x2; LS374; LM3086x2; LS138x3; LS08; 6805. Size 442x75mm. **Price** ~~£10.00~~

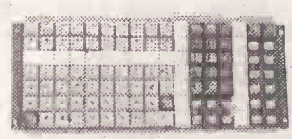
SALE PRICE £2.00

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

SALE PRICE £2.00

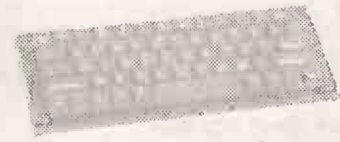
Z8863 Keyboard. High quality unit made by Micro Switch, 69 pale grey and blue keys. 6 red 5mm LED's 15 various LS chips, and socketed D8048 by Intel. Output via 7 way plug and there's a 4 way edge connector too. Keyboard frame is 317x128mm. PCB on which its mounted is 285x170mm. **Price** ~~£10.00~~

SALE PRICE £2.00



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

SALE PRICE £2.00



Z9210 Spectrum Keyboard. Complete keyboard for the +3 model - keytops, membrane and cover. 2 flexible connectors. Spanish version. **£2.95**

SALE PRICE £1.00

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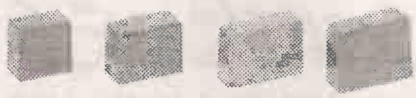
KNOBS FOR Z2602etc PUSH SWITCHES:



Z2627 Z2625 Z2624 Z2623

Code	Colour	Qty	Size hxdxw
Z2623	Black	20,000	12.4x7.7x20
Z2624	Red	669	14x8x19.7
Z2625	Black	1,400	10.5x7.4x14.8
Z2626	Red	1,508	10.5x6.9x14.8
Z2627	Black	11,454	10.3x6.9x12
Z2628	Red	1,137	10.3x6.9x12

All the same price: 10 for £1.00; 100+ 0.06; 1k+ 0.04; 10k+ 0.03

CIRCUIT BREAKERS

Z5086 **Z5191/2**

Z5086 Klippon SAKR 240V 10A isolating switch 4mm. DP 1.17 each. **Price - Box of 80 £5.00;** 1k+ 0.03

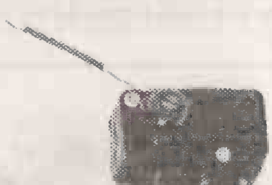
Thermal circuit breakers. Voltage rating 32V dc. 250V ac. Right angle PCB mounting with manual of/reset button and aux contact. Size 20x6x10. DP 4.33

Z5191 2A rating **£1.00;** 100+ 0.40
Z5192 3A rating **£1.00;** 100+ 0.40

Z5157

Z2353 As above but rated 3A **£8.00**
Z5157 MCB single pole rated 16a 240/415V ac. Standard DIN rail fixing. Siemens model no SN1. **Price £4.00**

MICROSWITCH

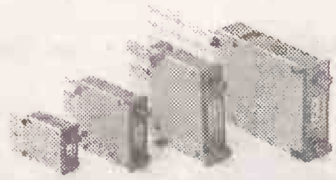


Z5888

Cherry ultra sensitive microswitch type E53. 31x17.5x14mm. Hair spring lever 65mm long requires less than 1gm force to operate switch which is SPCO 0.1A 125V on 0.25" tabs. **£2.00**

SALE PRICE £1.00

Professional Digital Switches



Excellent quality digital switches in various sizes. Push button type by Hartmann Geratebrau in decimal, BCD and Hexadecimal (BCH). Available in 4 sizes - mostly black, few grey. (DP - distributor prices).

Code	Type	Output	Size HxWxL	DP	1+	10+	100+
Z2188	PICO-D-301-AK2	BCH	14x7.5x26	4.73	**£1.00**	0.60	0.40
Z2189	SMC-D-301-AK2	BCH	22x7.5x34	6.62	**£1.00**	0.60	0.40
Z2192	SMC-137-AK2	BCD	22x7.5x34	6.14	**£1.00**	0.60	0.40
Z2194	DPS9-301-AK2	BCH	30.5x7.5x41	6.00	**£1.00**	0.60	0.40
Z2195	DPS9-111-AK2	DEC	30.5x7.5x41	6.00	**£1.00**	0.60	0.40
Z2197	MICO-131-AL2	BCD	30.5x10x81	6.00	**£1.00**	0.60	0.40

L132G PIR FLOODLIGHT 150W
A 150W security floodlight with PIR sensor for detection of body heat providing positive protection against intruders. Lamp is mounted on a ball-joint for adjustable vertically and horizontally through 180°. R.R.P. £23.95

SALE PRICE £16.95

VOLTAGE TESTER

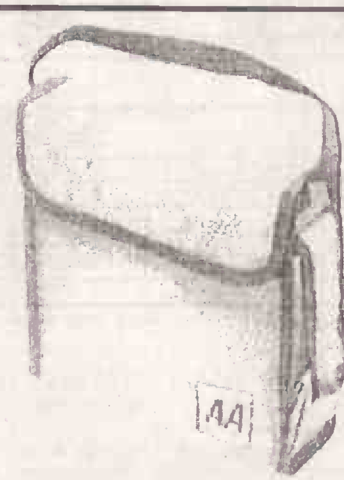
Y023BA Dual function screwdriver type circuit tester. Used as an inductance tester. It will detect buried live cables, breaks in cables etc. Touching a live part with the tip will indicate the voltage level on the LCD screen. AC or DC up to 250V max.

SALE PRICE £3.50

20+ £2.27

Subscribers are mailed monthly with details of our latest surplus offers - become one now!

REMEMBER! Light Pollution is annoying - site your floodlight with care. Information sheet supplied with all these products, or free on request
(SAE please, if not ordering anything)



X6147 Versatile soft padded instrument case measuring 250x250x80mm, with expanding side pocket 175x80x90mm. Both have velcro fasteners. On one side are two apertures, one 15x15mm and the other 80x40mm covered by a leatherette flap. Strong carrying handle. Grey material with black edging. Stacks of uses - tool-bag, electrical/electronic equipment, sandwiches/drinks, knitting, cassettes (holds 36), CDs (14), school books...

SALE PRICE £2.95

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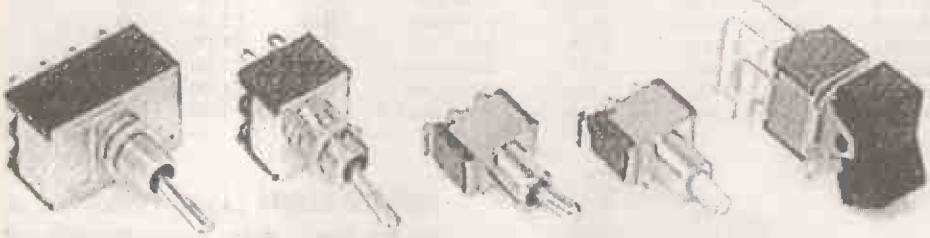
Switches

A parcel of high quality switches for small signal applications, mostly gold plated, made by NDK Japan. Contacts rated 0.5VA except where otherwise stated.

X3002 X3005 X3018 X3028 X3021



X3031 X3029 X3033 X3032 X3035

Code	Part No	Type	Body	Contacts	Pos	Bush	Lever	Mount'g	Qty	Price
X3007	US2P-1	S	10x10x8	DPCO	NFN	0	Slide	V	100	**3/£1**
X3008	US2P-2	S	10x10x8	DPCO	NFN	0	Slide	H	100	**3/£1**
X3009	UT1D-1GE	T	8x8x6	SPCO	NN	0	Pear5	V	250	**3/£1**
X3010	UT1D-2GE	T	8x8x6	SPCO	NN	0	Pear5	H	500	**3/£1**
X3011	UT1D-2-6GE	T	8x7x6	SPCO	NFN	6	Pear9	H	200	**5/£2**
X3018	UT2N-1GE	T	10x8x8	DPCO	NN	0	Pear5	V	700	**5/£2**
X3019	UT2N-2GE	T	10x8x8	DPCO	NN	0	Pear5	HH	180	**5/£2**
X3023	UT2R-2-6GE	T	10x8x8	DPCO	NFB	6	Pear9	HH	100	**5/£2**
X3025	UT2S-2-6GE	T	10x8x8	DPCO	BNB	6	Pear9	H	100	**5/£2**
X3028	M-2013	P	13x10x8	SPCO	NFN		see*	V	300	**6/£2**
X3029	3207-T00-S00	T	13x13x10	DPCO	NFB	6	Pe'r11	ST**	50	**£1**
X3219	3208-T00-S00	T	13x13x10	DPCO	BN	6	Pe'r11	ST**	200	**£1**
X3030	6303-T00-S00	T	18x13x12	3PCO	NFN	6	Pe'r11	ST**	50	**£1.50**
X3032	8121	P	12x10x7	SPCO	BN	0	5x3di	H***	900	**4/£1**
X3033	7108	T	12x10x7	SPCO	BN	0	Pear5	H****	220	**4/£1**
X3034	7101	T	12x10x7	SPCO	NN	0	Pear5	H****	20	**4/£1**
X3035	U21	R	13x12x10	DPCO	NN	0	17x9	HV****	800	**3/£1**

*This switch needs a clip-on rocker. (now supplied) **Rated 3A 250V ac ***Rated 1A 120V ac ****Rated 2A 250V ac

Notes:

Pos: N=On, F=Off, B=Biased. i.e. NFN means 3 position, centre off; NB means 2 position, biased

Bush: 0=Unthreaded bush; 6=6mm dia threaded bush

Lever: Type followed by length

Mntg: Some switches have bushes but are also designed to be PC mntg. V=vertcal mntg HV=horizontal mntg. vertical switching HH=horizontal mntg. horizontal switching

K902 An assorted selection of slide switches, X3001-8. **Pack of 50 £7.95**

K903 An assorted selection of miniature toggle switches, X3009-X3027. **Pack of 50 £9.95**

Yet another parcel of miniature switches - just five different types, but reasonable quantities. Made by Arrow, they are al rated 2A 250Vac

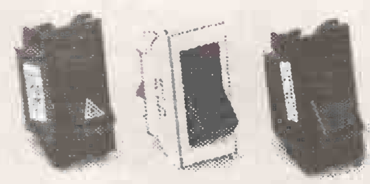
Code	Type	Size	Contacts	Pos	Mntg	Qty	Price	100+
X3070	A13HAO	13x10x7	SPCO	NB	PCBH	1150	**3/£1.00**	0.15
X3071	A12GVAO	13x10x7	SPCO	NN	PCBV	1000	**3/£1.00**	0.15
X3072	A14SAO	13x10x7	SPCO	Push	PCBV	900	**3/£1.00**	0.15
X3073	A24AO	13x10x12	DPCO	NFN	ST	3600	**5/£2.00**	0.20

SWITCHES

Lovely Switch Parcel by Arrow. Most intended for the automotive industry. All require same size cut out, 40x21mm. All have 0.25" tabs.

These 3 are all black, three position switches with 5 tabs:

X6059 Heater 3/£1.00 **SALE 3/50P**



X6062 Two position, 6 tabs with 12V lamp fitted for hazard light indicator. 2/£1.00 **SALE 2/50P**

X6063 Three position, 6 tabs. White body, black rocker. Rated 16A 250V ac. 2/£1.00 **SALE 2/50P**

X6064 Two position, 4 tabs with 250V amber lamp fitted. 2/£1.00 **SALE 2/50P**

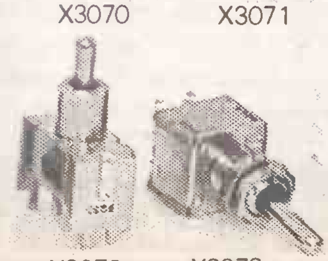
X6065 Two position, 3 tabs with 12V amber lamp fitted. 2/£1.00 **SALE 2/50P**

X6066 Two position 6 tabs. Black body with red rocker. Rated 10A 250V ac 2/£1.00 **SALE 2/50P**

X6067 Amber indicator, 250V ac. 3/£1.00 **SALE 3/50P**

X6068 Red indicator, 250V ac 3/£1.00 **SALE 3/50P**

X3070 X3071



X3072 X3073

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These are all Arrow-Hart sub min components

X3045 X3046 X3047 X3048 X3049

X3050 X3051 X3052 X3053 X3054

X3055 X3056 X3057 X3058 X3059

X3060 X3061 X3062 X3063

X3065 X3066 X3067 X3068

Code	Part No	Type	Contacts	Pos	Lever	MNTG	Qty	Price	100+
X3046	D12FS	T	SPCO	NN	Flat10	V	1120	3/£1	0.15
X3047	D12FH	T	SPCO	NN	Flat10	H	300	3/£1	0.15
X3048	D12PS	P	SPCO	NN	Paddle	V	1480	3/£1	0.15
X3049	D12RS	R	SPCO	NN	Rocker	V	1375	3/£1	0.15
X3050	D13FS	T	SPCO	NB	Flat10	V	590	3/£1	0.15
X3051	D13PS	P	SPCO	NB	Paddle	V	1900	3/£1	0.15
X3052	D14FS	T	SPCO	NFN	Flat10	V	740	3/£1	0.18
X3053	D14TH	T	SPCO	NFN	Pear6	H	590	3/£1	0.18
X3054	D14PS	P	SPCO	NFN	Paddle	V	1040	3/£1	0.18
X3055	D14EH	S	SPCO	NFN	Slide	H	900	4/£1	0.12
X3056	D22FS	T	DPCO	NN	Flat10	V	1750	5/£2	0.22
X3057	D22FH	T	DPCO	NN	Flat10	H	440	5/£2	0.22
X3058	D22TS	T	DPCO	NN	Pear6	V	4600	5/£2	0.22
X3059	D22TH	T	DPCO	NN	Pear6	H	268	5/£2	0.22
X3060	D22PS	P	DPCO	NN	Paddle	V	435	5/£2	0.22
X3061	D23FS	T	DPCO	NB	Flat10	V	1150	5/£2	0.22
X3062	D23FH	T	DPCO	NB	Flat10	H	350	5/£2	0.22
X3063	D23TS	T	DPCO	NB	Pear6	V	900	5/£2	0.22
X3065	D23RS	R	DPCO	NB	Rocker	V	1200	5/£2	0.22
X3066	D24FS	T	DPCO	NFN	Flat10	V	2050	4/£2	0.25
X3067	D24TH	T	DPCO	NFN	Pear6	H	300	4/£2	0.25
X3068	D24RS	R	DPCO	NFN	Rocker	V	450	4/£2	0.25

Notes: All switches in this table size: 10x5x8mm. All PC mntg and do not have a threaded bush.
Lever: Shape followed by length
Mntg: V=Vertical, H=Horizontal (parallel to PCB)

DIP SWITCHES

Code	Part No	Style	Pins	Switching	Qty	Price
X3036	SGT2	Slide	8DIL	2xDP ON/OFF	100	40p
X3037	SGT3	Slide	12DIL	3xDP ON/OFF	100	50p
X3038	SGT4	Slide	16DIL	4xDP ON/OFF	100	60p
X3039	B-2AGT	Slide	4DIL	2xSP ON/OFF	30	30p
X3041	BP4	Piano Key	8DIL	4xSP ON/OFF	100	40p
X3042	BP6	Piano Key	12DIL	6xSP ON/OFF	100	60p
X3043	BP10	Piano Key	20DIL	10 Off down	100	80p
X3044	BT10	Piano Key	20DIL	10 Off up	100	80p

SUPER SWITCH SENSATION!

K838 ALPS high quality push switches as used with mounting brackets. Enormous variety from DPCO to 10 pole changeover locking and non locking including PC mounting + solder tag, all on standard 4mm mounting. Different colours too. Big selection of buttons to fit them, round, square, oblong etc in red and black.
100 assorted switches + 100 assorted knobs £7.95.
Pack of 1,000 switches + knobs £49.95
Pack of 10,000 switches - no knobs 300.00.

Switches and knobs in K838 available separately as follows:

Code	C'tact	Pins	L/M	£2 pack	100+	1k+	Qty
Z2602	8PCO	PCB/ST	M	16	0.08	0.056	815
Z2603	6PCO	PCB/PCB	L	20	0.07	0.044	6k4
Z2604	6PCO	PCB/PCB	M	20	0.07	0.044	2k4
Z2605	6PCO	PCB/ST	L	20	0.07	0.044	9k4
Z2606	4PCO	LPCB/ST	M	25	0.05	0.034	4k4
Z2609	4PCO	PCB/ST	M	25	0.05	0.034	7k1
Z2611	4PCO	PCB/PCB	M	25	0.05	0.034	3k8
Z2612	2PCO	EPCB/ST	L	40	0.03	0.022	12k
Z2613	2PCO	EPCB/ST	M	40	0.03	0.022	4k2
Z2614	2PCO	LPCB/ST	L	40	0.03	0.022	5k9
Z2617	2PCO	PCB/ST	M	40	0.03	0.022	10k3

Codes used:
Contacts: number of changeover switches
Pins: (4mm pitch; contacts both sides as listed)
PCB — CB mounting
LPCB — stand of PCB mounting (8.5mm)
EPCB — stand of PCB mounting (24mm)
ST — solder tags
L/M: locking or momentary (non locking)
£2 packs: Qty of switches for £2
QTY: Total quantity in parcel.

Subscribers are mailed monthly with details of our latest surplus offers - become one now!

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HARDWARE

HEATSINKS & WASHERS

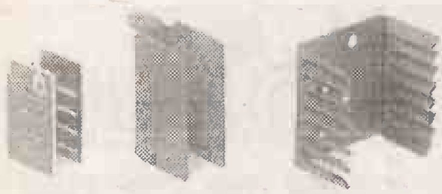
Z3527 Z2590 Z2330 Z3843

Z3527 Clip on transistor heatsink for TO5 devices 11mm high x 18mm dia. **Pack of 40/£2.00;** 100+ 0.03; 1000+ 0.02

Z2590 Copper heatsink, formed into TO5 shape using 0.3mm thick copper sheet. 17mm dia x 20mm. **Pack of 8 for £1.00**

Z2330 Heatsink - TO220 type 30°C/W 11x22x19. DP 53p. **Our Price 5 for £1.00;** 100+ 0.09; 1k+ 0.06

Z3843 Clip heatsink for plastic power devices 28x20x20mm with PCB fixing lugs. **2/£1.00**



Z1524 Z3737 Z2636

Z1524 Heatsink 32x23x15mm. **Price 5/£1.00**

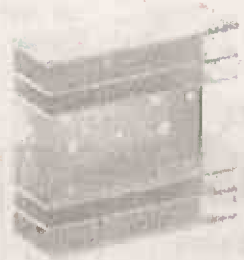
Z2636 Heatsink for single TO3 device, 7.1#C/W. Twisted vane type, 42x38x25mm. Like Farnell 170-077 - their price 50p. **Our Price 4 for £1.00;** 100+ 0.18

Z2069 Z356

Z2069 Thin heatsink (1.2mm) 57x57 formed to accept single TO3 device. **Price 5 for £1.00**
Z356 Heatsink 80x50mm for TO3. **Price 4/£1.00**

X3142 Z6000

X3142 TO3/TO66 heatsink 46x46x19mm. **3 for £1.00**
Z6000 Black ally finned sink 32x41x33mm drilled for TO66/TO3. **3/£1.00;** 25+ 0.25; 100+ 0.18



Z5999 Bright ally finned sink 75x65x27mm drilled for 2xTO3 transistorrs, also 2 fixing holes. Bargain at £1.00; 25+ 0.70; 100+ 0.55

Mica washers:

Code	Size	Hole Dia	Pk of 100
Z3718	13 dia	3.5	£1.00
Z3719	16 dia	5.5	£1.00
Z3720	20 dia	3.8	£1.00
Z3721	22x13	3.8	£1.50
Z3722	18x14	3.0	£1.50
Z3723	24x18	3.0	£2.00
Z3724	38x25	3.0	£3.00
Z3725	25x23*	3.0	£3.00
Z3726	TO66		£3.00
Z1379	TO3		£2.50

*Shaped for TOP3 devices.

LABELS & TAPES

Z5414 'CAUTION - static sensitive device' self-adhesive labels. Black print on yellow background, size 89x64mm. Come in sheets of 9. **5 sheets for £1.00.** Box of 2000 labels £20.00
Z23221 Antistatic adhesive labels. Sheet of 45 18x12mm. Black print on yellow background. **Price £1.00**
Z23222 As above, but includes wording 'CAUTION - static sensitive. Observe precautions.' Sheet of 21 45x13mm. **Price £1.00**

Z592 Z4282 Z4283

Z4282 High insulation adhesive tape, like brown translucent sellotape. 3m reel x 12mm wide. **Price 70p**

BACK IN STOCK!

Z5789 We've been very lucky to secure a further few hundred of this extremely popular and useful gear set - and at the same price, too! There are 7 items:
(a) Steel 56.6mm dia 3.7mm thick with boss 13.4mm dia and 7.7mm thick. 5mm hole.
(b) Two of these: steel, 31.5mm dia, 6mm thick with boss 13.4mm dia 9.4mm thick. 6mm hole.
(c) & (d) Steel rack 86mm long and pinion with 9mm hole
(e) & (f) Plastic bevel gears giving right angle drive. The larger is 36.4mm dia with steel boss 9mm dia and 5mm hole, and the smaller is 18.5mm dia with 2mm hole.
As can be seen from the pic, they can all be put together in a chain if required. **Complete set for:**

SALE PRICE £2.95

MISCELLANEOUS

Z5889 Vacuum cleaner extension brush. Probably fits most models - has a 34mm dia connector. Brush can be retracted. A snip at **£2.00**
Z343 Ceramic insulating beads. **Pack of 100/£1**
Z2438 White plastic oblong stand off (for 7 seg LED's) 19.5x10.2x12.2mm high. **Pack of 100/£2**

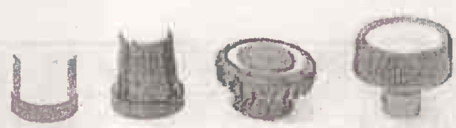
Z9185

Z9185 Microwave oven door. Double skinned perspex with perforated metal screen. Large plastic handle. Size 355x220x25mm. Useful for the perspex sheet. **£2.50**

KNOBS

Z3731 Z3830 Z3828/9 Z3838

Z3731 Small slider knob, silver/black. **Pack of 15 for £1.00**
Z3830 Slider 15x11x7mm black. **12/£1**
Z3828 Slider 26x16x9mm. Black with white line. **6/£1**
Z3829 Slider 26x16x9mm. White with black line. **6/£1**
Z3838 Push on black knob for 6.35mm spindle. 14mm high x 15mm dia. Use **Z3833** caps. **Price 10/£1**



Z3143 Z4198 Z718 Z3831

Z3143 Small aluminium front and sides knob, push-on 18mm dia x 17mm high. **8p**
Z4198 Knobs - bargain price on black plastic control knobs with coloured tops, similar to K9. 19mm high x 20mm dia. Top available with indent in white, pale blue, beige mushroom, or green K9 + cap with line costs 30p; these are substantially cheaper, even in small quantities. Only sold with cap: 1-9 **20p each;** 10-24 **15p each;** 25-99 **12p each;** 100+ **10p each**
Z718 Knob. Black plastic with ally insert. 27mm dia x 15mm high, for use with 4mm shaft with flat. (Fits inner of Z716.) Have you seen a cheaper knob than this? Sample free. **Price 20/£1.00;** 100/2.60; 1k/17.40; 10k/87.00.
Z3831 Push on black knob with silver insert for 6.35mm spindle. 27mm dia 10mm high. Bush extends by further 15mm. **10/£2**

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Z3141 Z3142 Z3238

Z3141 K8 Black plastic with aluminium insert size 25x12. **10p**

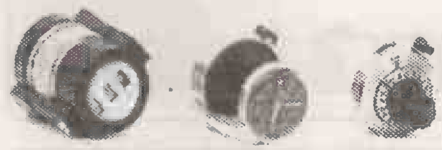
Z3238 Suitable high quality matt black collett knob 22mm high x 15.5mm dia with cap, both with white line to fit above 4mm pot. **Pack of 6 for £2.00**

Z3834 Z4054 Z3165

Z3834 Knob 17.2 high x 21.5 dia for 4mm spindle. **5/£2**
Z4054 High quality collett knob in matt black finish for 6.35mm (0.25") spindle. 36mm dia. Clip on black cap and pointer. **Price 40p;** 10+ 0.26; 100+ 0.17
Z3165 Flexible spindle coupler, 2x0.25" bushes with grub screws mounted on either side of a nylon spacer. Use to extend pot shafts or insulate from front panel. **Pack of 5 for £2.00**

Collett knob accessories by Sifam.
Z3833 Caps for Z3832/8 (now sold out) black, red, blue or yellow (state 2nd/3rd choice). **16/£1**
Z3835 Skirt numbered 1-12 **10/£1**
Z3836 Skirt numbered 13-24 **10/£1**
Z3837 Caps for above, black only **10/£1**

A selection of precision dials by Bentron for 10 and 15 turn pots. DP on these is up to £14 each



Z3227 Z3230 Z3226/31

Code	No	Sp dia	Type	Price
Z3226	2006	3mm	A 15	£4.00
Z3227	2014	3.17	D 10	£7.00
Z3231	2005	3.17	A 15	£4.00

NUT, SCREWS, WASHERS & BOLTS

Z1848 Terry Clips. Bright chrome finish by Lewis. Spring type 100/17. 27mm dia. **Pack of 10/£1**
Z3026 Crimp rings M3.5, uninsulated for up to 6.5mm dia cable. Sample on request. **Pack of 100 for £2.00;** 1000+ £15
Z5513 Cap clip - 61-66mm vertical mnt. **Pack of 5 for £2.00**
Z5453 Diecast ally cable clamp for cables 12-18mm dia. With fixing nut. **£1.00**
Z582 Stick on feet (3M bumpons) 10mm dia x 4mm thick. **Price Sheet of 56/£1.70;** 10/12.20; 25/26.10; 100/87.00
Z3727 Pack of 25 nylon countersunk 4BA screws 6mm long. **30p**

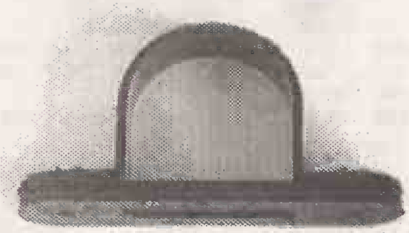
Z2372 3/8"x1.25" set screws, hex head. **A pack of 6 for £1.00**
Z2369 ¼"x1.5" UNF hex head high tensile steel screws. **Pack of 25 for £1.50.** Box of 200 £8.50
Z2370 ½"x½" as above. **Pack of 10 for £2.00** or a box of 50 for £8.00
Z2367 5/8" UNC half nut. **Pack of 10/£1.00**
Z2374 M16 Half nuts, steel. **Pack of 8 £1.00**
Z2371 5/16"x1" UNC hex head bolts. **A pack of 10 costs £1.00**
Z4393 Ferrite tube 9.5mm long 4mm OD 2.6mm ID. **Pack of 25 for £1.00;** 1k+ 0.015

MISCELLANEOUS

Z3580 Woodruff key 12.2x5.0x2.4mm. **Pack of 10 for £1.00**
Electrolube Aerosols:

Some black plastic conduit fittings that have been around for some time:

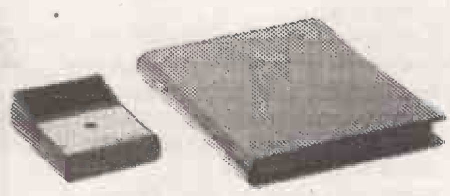
Z5349 Bracket to hold 32mm OD pipework in place **5/£1.00**



Z5350 Compression T piece for 20mm OD pipe. **£1.50**

Z2568 1.5mm right angle bend DP 1.75. **£1.00**
Z1417 Right angle plastic tube connector, dimensions as shown. **Price Pack of 12/50p**
Z1416 Concentric pulley wheel 38mm dia with lever. Useful for operating switch. **Pack of 6/50p**

ENCLOSURES



Z635 Z5142

Z635 Digital multimeter case DP2010, 110x80x20mm with cut outs for switches and terminals. Aluminium fascia plate. **2 for £1.00**

Z5142 Vacuum moulded case 225x175mm. Ideal for storing software/audio cassettes, etc. **3/£1.00;** 100+ 0.22

METAL BITS

Z2334 Z2335 Z2336 Z3841

Z2334 Right angle steel bracket 38x22.5x10. Length drilled with 2x4.8mm holes; width drilled with 7mm dia hole. 2mm thick. **Pack of 10 £1.00;** 100+ 0.06; 1k+ 0.045
Z2335 Stand off insulated terminal 24mm high with 3.5mm threaded insert. **Pack of 6 for £1.00**
Z2336 Stand off insulated terminal 11mm high with 2.5mm threaded insert. **Pack of 10 for £1.00**
Z3841 Odd profile ally strip 50mm long with 2 small tapped holes. Handle? **10/£1**

SOUND EFFECTS CD's

10% OFF LISTED PRICES

Absolutely essential for all drama groups & video producers - this set of 5 CD's will ensure the right effect is available! Full list of tracks on request.

EFX001 Frights of the Night - MIDNIGHT GONGS, GHOSTLY SOUNDS, CREAKING DOOR OPENS, DEMONIC LAUGHTER and many more.

EFX002 101 Sound Effects - CHILDREN PLAYING, CHILDREN LAUGHING, MEN CHEERING, ROLLER COASTER, FIRECRACKERS and many more.

EFX003 Outer Space - VARIOUS BATTLES, GUNS, CREATURE NOISES, SPACECRAFT TAKING OFF AND LANDING, DEADLY EXPLOSION and many more.

EFX004 Workshop of Sound - ANIMALS, WALKING, OFFICE EQUIPMENT, DIY EQUIPMENT, LAUGHTER, HOUSEHOLD, BOATS and many more.

EFX005 Musical - OPENS AND ENDS, STRINGS, TEXTURES, SOLO HORNS, TEMPOS, MOODS, BASS AND DRUMS, ELEC PIANO, BRIDGES and many more.

All 5 Disks at **£4.95** each - set of 5 for **£19.95**

GREENWELD 27 Park Rd, Southampton, SO15 3UQ
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SECURITY

Alarm Boxes

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

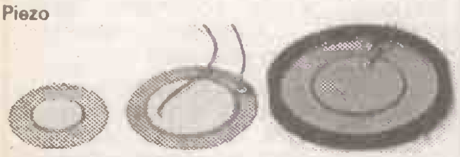
Z5397 24V LES lamp with red bezel mounted in MK switch box 80x78x40mm with red fascia plate **£2.00**

Z5400 MK surface mounting box in red with 24V buzzer and lamp. Red fascia plate marked 'Fire Alarm'. **Only £3.50**

Z5564 Fire alarm control box. Steel case 170x145x80mm painted bright red and contains circuitry to wire to detectors. Front panel has 6 position key operated switch (2 supplied). LED indicator for Fire, Supply and Fault, under zone control and Fire and Fault LEDs for selectors. Needs special resistance wire to cable to sensors and 24V supply. The 2 PCBs contain some nice parts - lots of CMOS, 2 reed relays, a dozen or so transistors. Supplied with circuit diagram and other info. **Only £12.95**

Transducers

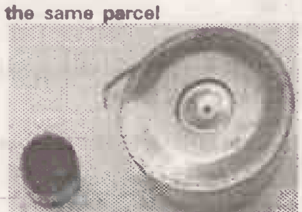
Piezo



Z3795 27mm dia plain disk **10/£1;** 100+ 0.05
Z3796 35 mm dia plain disk with wires attached **6/£1.00;** 100+ 0.08
Z1429 50mm dia plain disk with protective edge and wires attached. Murata type VSB4 1D25-07AR FR 500-20000Hz; Z=1k2@ 1kHz Max input 200mW. Normally £2.33. **Our Price 75p;** 100+ 0.40

Z3797 PB2720 - our A363, normally 80p. **Our price 2/£1.00;** 100+ 0.25
Z2176 25mm dia x 7mm thick cased with 3 pins. Murata type PKM25-6AO. **4/£1.00;** 100+ 0.10
Z2180 16mm dia x 13.5mm high cased. Star QMB-112 (magnetic). **3/£1.00;** 100+0.20
K899 Pack of the above six types - 20 assorted **£3.95**

Also in the same parcel



Z3799 Murata MA41L 1S, believed to be 40kHz ultrasonic transducer 16mm dia x 12mm high **£1.00;** 100+ 0.60
Z3798 24V DC buzzer, same style as our A391. Catalogue price 80p. **3/£1.00;** 100+ 0.20

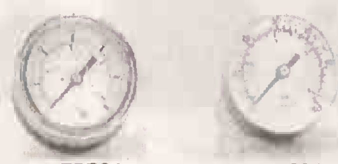
Panel Meters

All by SEW in various styles:
Z3845 VU meter 60x60mm. **£4.00**

Model MR65P 85x78mm
X6012 1A **£5.00**

Z3236 Edgewise panel meter scaled 0-15 watts. 6.4k coil. FSD 31.1μA(!). Fitted with green 12V 100mA lamp for illumination. Requires 35x12mm

PRESSURE GAUGES



Z5764 Z5765

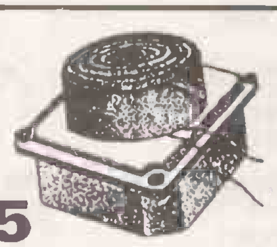
Z5764 Scaled 0-60PSI in black and 0-4 bar in red, these have a chrome surround. Rear entry input via 10mm threaded connector. 53mm dia x 30mm deep. **£3.95**
Z5765 Scaled 0-60PSI and 0-4 bar in black. All plastic. 10mm threaded rear connector. 50mm dia x 33mm deep. **£2.95**

PORTABLE ALARM SYSTEM

Z9278 This is a great deal. These portable alarm systems are brand new and boxed, but have a design fault. Although they work OK in the test position, the sensor is erratic when in use. Key switch with three keys, high power piezo sounder. The PCB uses what seems to be a fairly standard detector. Works off PP3 battery. Size 167x110x70mm.

£4.95 SALE PRICE **£3.95**

SUPERB ALARM SYSTEM



Z5651 Consists of:
A. Weatherproof metal case with a plasticised finish, 100x100x50mm.
B. Alarm module (open & closed loop) with delay on PCB. Needs 12V supply that drives strobe and/or audible alarm via relay and charges PP3 back-up Nicad
C. Highly visible red Xenon strobe light 75mm dia.
Supplied with wiring diagram and circuit details.

£12.95

Parts available separately as follows:
Z5653 Box 100x100x50mm **£2.50**
Z5654 Box 80x80x50mm **£2.00**
Z5655 Strobe light **£4.95**
Z3102 Alarm module for Z5651 **£4.95**
Z3103 Alarm module for Z5652 **£2.95**

25% OFF LISTED PRICES

Z5652 Similar smaller version consisting of:
A. Case as Z5651 but 80x80x50mm
B. Alarm trigger module on 55x55mm PCB
C. Strobe light as Z5651
Supplied with wiring diagram and circuit details.

ONLY £9.95

GREAT VALUE COMPONENT PACKS AT EVEN GREATER SALE PRICES!

All our packs contain top quality brand new full spec components (unless otherwise stated) and represent incredible value for money! How do we do it? By purchasing bankrupt stocks and manufacturers' and distributors' surplus product. It's too costly to sort and catalogue all these parts, hence these outstanding packs at extraordinarily low prices - so stock up now!

Please note most packs are calculated by weight and the quantities quoted are approximate, but we do try to ensure contents are at least the number specified

Wound Products

K561 Coils and Chokes. Pot cores, IF cans open wound coils, chokes etc from a few µF upwards in a wide variety of sizes and values.Price 50/£2.80 **SALE PRICE 50/£1.95**

K579 This pack contains 10 assorted battery powered motors (mostly 3V) + 90 gears etc 16-60mm dia + worms and shafts. Amazing value. Price £7.95 **SALE PRICE £6.95**

K866 225 Inductors - 25 each of the following values: 1, 2.2, 2.7, 5.6, 10, 100 270 and 330µH Price £14.95 **SALE PRICE £9.95**

K835 New transformer pack. All mains primary, secondary range from 6-35V, 0.5 to 3A **Price** - Pack of 12 for £10.00 **SALE PRICE 12/£6.95**

Opto

K701 110V indicators. This pack of neon indicators comprises round and square panel mounting types in red, green, amber and clear, supplied with resistors for mains operation. Price - Pack of 20 for £2.50. **SALE PRICE 20/£1.50**

K801 Seven segment LED pack. Big variety of sizes in this pack. Includes red and green also overflow/polarity displays, single/double digit also 7/8/9 digit magnified displays. Sizes from 0.11" to 0.8". **£3.95 SALE PRICE 20/£1-95**

K846 Opto Darlingtons. Mixed Pack. Price - 25 for £3.95 **SALE PRICE 25/£1.95**

K524 Opto pack. A variety of single point and 7 segment LED's (incl dual types) of various colours and sizes, opto isolators, numicators, multi digit gas discharge, displays, photo transistors, infra-red emitters and receivers. Price - 25 asstd £4.50 **SALE PRICE £2.25**

K806 LED pack contains only red LED's - round, square, rectangular etc from 3mm to 7x2.5mm. 100/£5.00 **SALE PRICE 100/£3.00**

K848 LED Integrated Displays. A pack of 10 different, selected from Z2888 to Z2901. (details elsewhere in this brochure). With data Price £5.00 **SALE PRICE £2.50**

K539 LED pack. Not only round but many shaped LED's in this pack in red, yellow, green, orange and clear. Fantastic mix. 100/£6.50 **SALE PRICE 100/£3.95**

K873 Shaped LED's. Amongst Bi-Pak's stock were a number of shaped LED's - square, rectangular, cylindrical, oblong in red, green and yellow, from 3-5mm. Excellent selection. Price - Pack of 100 for £8.95 **SALE PRICE 100/£5.95**

Semiconductors

K547 Zener diodes. Glass and plastic 250mW to 5W ranging from 3V to 180V. All readily identifiable with list supplied. 100 for £4.95 **SALE PRICE 100/£2.50**

K710 SCR's & TRIACS. Big mixture - could include all types from TO92 plastic up to DO5 stud mounting with a chance of everything in between. 25V to 1000V, 100mA to tens of amps. Marvellous value. 25 for £5.95 **SALE PRICE 25/£3.95**

K517 Transistor pack. 100 assorted full spec marked plastic devices PNP, NPN RF, AF. Type numbers include BC114, 117, 172, 182, 183, 198, 239, 251, 214, 255, 320, BF198, 55, 394, 2N3904 etc, etc. Retail cost £16.00+ Price £5.95 **SALE PRICE £3.95**

K711 74 Logic Pack. All brand new full spec devices from basic gates to complex logic. May include 54 and 64 types as well as 74 in L, LS, S ALS, H, HC, HCT, etc. Pack of 100 for £6.50 **SALE PRICE 100/£3.95**

K708 Voltage Regulators. This is an excellent pack, made up from a huge variety of +ve and -ve fixed and variable regulators from 1.2V to 37V, 100mA to 5A plastic and metal. 25 for £6.95 **SALE PRICE 25/£4.95**

K709 Bridge Rectifiers. Another superb value pack - could include anything from half amp to 35A, 25V to 1000V plastic and metal. 20 for £6.95 **SALE PRICE 20/£4.95**

K858 Lumpy SCR pack. A selection of stud mntg/TO66 thyristors to include devices up to 20A and 800V 20/£6.95 **SALE PRICE 20/£4.95**

K868 Pack of 200 transistors 25 each of these types: 2SA933S, 937M, 950, 952(C)T; 2SC1740S, 1906, 2058S and 3331. Supplied with data sheet. Price - £6.95 **SALE PRICE £3.95**

K575 Plastic power pack. Mainly TO126 and TO22 transistors, SCR's' Triacs etc. All new full spec marked devices offering fantastic value. Lots of TIP and BD types. 50 for £7.95 **SALE PRICE 50/£4.95**

K872 Plastic power transistors - about 30 different types, mostly TO220 with some TO126 and TO202 etc. Types included TIP30A/B/C, TIP110, 111, 120, BD132, 175, 185, 235/6. 240/C, 508, 677, BDW93/94, MJ
E340, 371, 521, 2N5285, 5294, 6121, 6289, 6388, 2SC2068 etc. 50/£7.95 **SALE PRICE 50/£4.95**

K871 TO18 metal can transistors, around 25 different types including 2N708, 718, 720, 726, 914, 929, 964, 2185, 2220, 2221, 2368, 2906/A, 2907A, 4212, BC178, 186, BCY72, BF181, BSX19, BSY95A. 100 for £9.95 **SALE PRICE 100/£6.95**

Surface Mount

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

KS106 Surface mount LED's. This really is an excellent pack, containing a great selection of red, green, yellow and orange LED's including some dual types (red/green and red/yellow) mostly SOT23 package. Ideal for scale model enthusiasts. 100 for £8.95 **SALE PRICE 100/£5.95**

KS108 Excellent mix of IC's - all sorts here, from 8 pin to 40 pin, linear and logic - around 50 different. Lots of HC and HCT + some we don't recognise. Pack of 100/£5.95 **SALE PRICE 100/£3.95**

Hardware

K909 Largish quantity of small metric screws, some self tappers. They are all plated steel and range from M2 to M4, lengths 5 to 12mm. Over half have washers fitted. About 30 different types. **Pack of 1000 £3.00**

K910 HARDWARE PACK The contents of this pack originate from a company that dismantles electronic products to resell or scrap. Mostly metric screws, nuts, washers etc with a fair sprinkling of miscellaneous brackets and other odds and ends. Sold by weight - **1Kg Pack for £3.00**

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

K832 M12 Bolts. Mostly high tensile hex head. Lengths from 40-15mm. Pack of 10 for £2.40 **SALE PRICE 10/£1.50**

K564 PCB stand offs. A mixture of 8 different styles and sizes from 4.5 to 12.7mm high. 100 £2.95 **SALE PRICE £1.50**

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

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Tel 01 703 236363; Fax 236307
All one off and pack prices INCLUDE VAT; Qty prices don't

K717 Keyboard caps - a wide variety of sizes and colours from 17x16mm to 25x25mm. Some long ones too. Most have words - some numbers. Pack of 100 assorted £3.50 **SALE PRICE 100/£1.95**

K843 Heatshrink sleeving. this normally expensive sleeving offered at a fraction of normal trade prices. A pack of 10m, black and clear with at least 5 different sizes from 3.5 to 42mm dia for just £3.95 **SALE PRICE £2.95**

K909 PTFE sleeving in 1mm only - 3 colours. 60m assorted £8.00 **SALE PRICE £4.95**

K820 Large bolts and set screws. Could weigh as much as 150g each (up to 16mm dia x 90mm long). Practically all are steel. Many different heads. Parcel weighing 5kg £10.00 **SALE PRICE £6.95**

K527 Hardware Pack. This has a large variety of PK (caps) and self tapper screws from 2x1.5" up to 8x1.25 also washers some BA metric and whit. Screws plus other miscellaneous brackets, captive nuts and bits and pieces 1kg (up to 1000 pieces). 1Kg for £4.00 **SALE PRICE £2.95**

K875 Drive belts. Pack containing 25 different belts. Total RRP - £49.70! Price £6.95 **SALE PRICE £4.95**

Connectors & Leads

K880 Patch lead 500mm long - 10 different colours terminated with gold plated 1.5mm plugs both ends. £2.50 **SALE PRICE £1.95**

K837 Lead pack. Assortment of signal and power leads terminated with a variety of plugs and sockets. 25 for £3.95 **SALE PRICE 25/£2.50**

K562 Edge connectors. Mostly 0.1 pitch, some 0.15, 0.156 and 0.2 as well. Single/double sided, tinned/gold plated, solder/wirewrap/PC connections. Pack of 20/£3.95 **SALE PRICE 20/£2.95**

K803 PCB IDC connectors pack. With/without ear, straight and right angle from 10 to 64 way. Price - Pack of 20/£5.50 **SALE PRICE 20/£3.95**

K705 PCB Headers. SIL & DIL PC mounting header plugs straight and right angle mostly 0.1" pitch in a variety of ways from 3 to 30. Price - Pack of 100/£6.00 **SALE PRICE 100/£3.00**

K802 Pack of DIN41612 connectors. These popular PCB connectors come as 32/64/96 way. Both plugs and sockets, some with pins missing normally consisting £1-£3 each. Pack of 25 £8.00 **SALE PRICE 25/£4.95**

K836 DIL Socket pack. A super selection of DIL IC sockets from 8 to 64 way, low profile and standard mntg, turned pin tinned, gold plated, wirewrap and solder terminals. 100 for £14.95 **SALE PRICE 100/£9.95**

K887 Header pack - double row PCB gold plated headers by Harwin in everything from 6 to 50 way, easily broken down if required. Pack of 1000 pins £9.95 **SALE PRICE 1000/£7.50**

Resistors

K505 Assorted Potentiometers. All types including single, ganged, rotary and slider. 20 for £2.30 **SALE PRICE 20/£1.25**

K531 Precision Resistor Pack. High quality close tolerance R's with an extremely varied selection mostly ¼W and ½W, tolerances from 0.1% to 2% - ideal for meters, test gear etc. Price 250/£3.00 **SALE PRICE 250/£1.50**

K503 Wirewound Resistors. From 1W to 12W in vitreous enamel, ceramic and cement coated with a good range of values. Price 100 for £3.50 **SALE PRICE 100/£1.95**

K572 Resistor networks. Both SIL and DIL in here, from 6 to 16 pin. Enormous range nearly every value you can think of! Plenty of popular values, too. Pack of 100 for £4.50 **SALE PRICE 100/£1.00**

K525 Preset pack. Big, big variety of types and sizes - sub-min, min and std, MP, slider, multitum and cermets are all included. Wide range of values from 20R to 5M. 100 assorted. Price £6.75 **SALE PRICE 100/£3.95**

K867 200 of the highest quality plastic film presets, 25 each of the following values: 10k and 100k 0.1W, 1k, 5k, 10k, 20k, 100k and 200k 0.2W 200 for £13.95 **SALE PRICE 200/£7.50**

Miscellaneous

K574 Wire link pack. A wide range of sizes from 3mm to 50mm for use with Breadboards or PCBs. some are bare, a few are not preformed. Pack of 250 £1.00 **SALE PRICE 2 PACKS £1.00**

K713 Fuse holders. Panel and chassis mounting from basic clip to high current enclosed types for 15, 20 and 32mm fuses. Pack of 50 for £4.00 **SALE PRICE 50/£2.95**

K712 Crystals. mostly HC60 and HC18U in a wide variety of frequencies from a few hundred kilohertz to many megahertz and the odd crystal oscillator module or two. 20 for £4.95 **SALE PRICE 20/£3.50**

K541 Printed Circuit boards. A wide variety of high quality printed circuit boards including audio, RF digital etc all covered in components - resistors, capacitors, transistors, IC's LED's switches etc.. A big pack of 2kg. Price £7.00 **SALE PRICE £5.00**

Switches and Relays

K907 Assorted miniature toggle switch identifiers. These plastic lever covers come in 2 sizes - 2.5 and 7mm long, and 8 colours. **Pack of 100 mixed £2.00**

K520 Switch pack 20 different assorted switches - rocker, slide, push, rotary, toggle, micro etc. Amazing value. Price £2.50 **SALE PRICE £1.50**

K542 Reed Relays. Mostly DIL single pole and double pole also some changeover, these are manufacturers rejects, but a good proportion work. 5V to 50V coils. 50 assorted. Price £3.30 **SALE PRICE 50/£1.65**

K715 DIP Switch pack. Tremendous selection of DIP switches everything from 2-9 way at an astonishingly low price. Pack of 20 for £3.25 **SALE PRICE 20/£1.95**

K532 Relay pack. We've now built up enough surplus relays to offer this popular pack once more. Could contain anything from 2V to 250V coils, SP to 6 pole contacts switching up to 10A. 20 for £6.95 **SALE PRICE £3.00**

K904 An assorted selection of miniature toggle, paddle and rocker switches types X3045-X3068. (see elsewhere in this brochure for details) May also include similar types we have in quantities too small to be listed. Pack of 50 £9.95 **SALE PRICE 50/£8.95**

Capacitors

K518 Disc Ceramic Caps. Big variety of values and voltages from a few pF to 2.2µF; 3V to 3kV. 200/£2.00 **SALE PRICE 200/£1.50**

K546 Polystyrene/Mica/Ceramic Caps. Lots of useful small value caps up to about 0.01µF in voltages up to 8kV. Good variety. 100/£2.75 **SALE PRICE 100/£1.95**

K849 Axial Polyesters. Mixed Pack. 100/£2.95 **SALE PRICE 100/£1.95**

K530 Assorted Polyester Caps. All new modem components radial and axial leads. All values from 0.01 to 1µF at voltages from 63 to 1000!! Super value at 100/£3.00 **SALE PRICE 100/£1.50**

K548 Tant bead capacitors. About a dozen different types from 0.1µF to the rather pricey 100µ F, voltage from 6-50V. 50/£3.00 **SALE PRICE 50/£1.95**

K869 Axial ceramic capacitors. Have been around for a long time. Nice quality bandoliered, size 6x2.5mm. Offered in packs of 600 - 100 each of the following values: 5.6, 12, 15, 22, 27 & 33pF. Price £3.50 **SALE PRICE £2.95**

K582 Polystyrene Caps. An amazing range of values from a few pF to 0.01. Tolerances 2-20%. Voltages to 500V. Pack of 200/£4.00 **SALE PRICE 200/£1.95**

K528 Electrolytic Pack. Axial and radial some ready cropped for PCB mounting. This pack offers excellent value for money. Good range of values and voltages from 0.47µF to 1000µF, 6V to 100V. 100/£4.50 **SALE PRICE 100/£2.25**

K544 Mullard polyester caps - cosmetic imperfections, electrically OK. Wide range of values from 0.01 to 0.47µF in 100, 250 400V working. 200/£4.75 **SALE PRICE 200/£1.95**

K874 Solid Tantalum capacitors. A mixture of around a dozen types from Plessey and ITT of axial leaded metal cased caps, from 1µF to 100µF in voltages from 15 to 50V. 50/£5.95 **SALE PRICE 50/£4.95**

K906 200 sub min electrolytics, mostly 6.8x3.6mm. 7 values from 0.1 to 10µF, 6-50V £5.00 **SALE PRICE £3.95**

K864 280 electrolytics, 10 each in a range of values from 0.1 to 1000µF, 6.3-50V (details on page Z14 of BL102 - copy on request) £7.95 **SALE PRICE £6.95**

£17.50 PARCELS
(Originally £25 Parcels)

K911 Massive panel parcel - mostly PCBs from audio & video equipment. Huge variety, amazing value. **10kg for £17.50**

K912 Power Supply Parcel. Only switch mode types, though. Some new, some working ex-equipment. Anything up to 300W, these are types we have too few of to list. Yours for just 2p per watt - yes 1000 watts total. Probably between **10 and 20 units for £17.50**

K913 Fans. Similar story to the above - a mixture of all sizes and types, 12, 24, 48, 110 and 240V, ac and dc in all sizes but mostly 60, 80 and 120mm. **20 for £17.50**

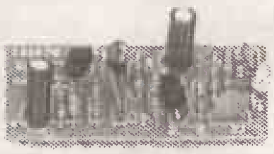
EVERYTHING ON THIS PAGE 2 FOR THE PRICE OF 1

Pay the price shown per item or pack - you'll receive double the quantity!

(Except where prices are indicated by SALE flag)

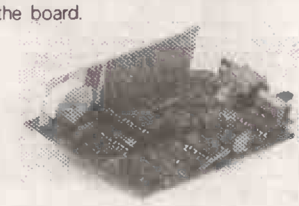
PCB's

Z5618 Panel 110x92mm with 16 E-line T's 2x4724, 40106, R's C's etc. **Pack of 3 for £2.00**

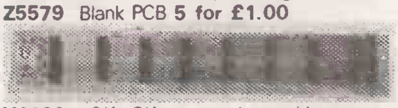


Z5621 Panel used in light gun - size 50x20mm. These have 3 or 4 2N3904/BC183 transistors, R's, C's etc - its a small amp for the IR LED fitted to some of the PCB's. **Pack of 20 panels for £2**

A parcel of Spectrum programmable joystick interfaces by Fox Electronics Ltd - in various states of repair. Some are complete and cased, others are uncased. Most are believed to be returns, so no guarantee that they work, but there are some useful bits on the board.



Z5575 Complete PCB - no case. These look new. **£1.75**
Z5576 Complete PCB - no case with fault label attached. **£1.25**
Z5577 PCB with battery missing. **£1.00**
Z5579 Blank PCB **5 for £1.00**

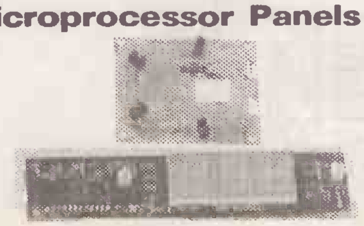


X6020 OK, OK, so we know it's not much use, but there must be **somebody** who needs a panel like this: 365x57mm with these edge connectors - 7x13 way (pin 6 missing), 1x17 way (pin 3 missing), 1x15 way (pin 2 missing). All double sided 0.1" pitch gold plated. **Yours for £1.00**

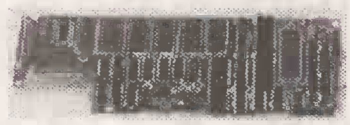
Z4298 **Z4318**

Z4298 Panel 95x57mm with 18 way D/S 0.156" edge connections plus 50 way IDC plug. Also 8 way DIL switch. **Price £1.00**
Z4297 Panel 95x57mm with 2x18 way D/S 0.156" edge connectors plus 34 way IDC plug. **Price £1.00**
Z4318 Ex BT tone divider PCB. Panel 84x69mm has on it 2559 tone divider chip, 3.579545 Xtal, 7 small signal transistors, tants, R's C's etc. Produces required tones for telephone system. **Price £1.00** 100+ 0.30

Microprocessor Panels



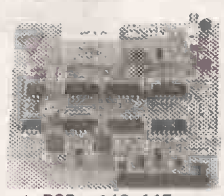
Z5843 Dartboard rotation assembly - 100x100mm PCB has 4 opto slotted switches + PCF8574P I/O expander chip. **£1.50**
Z5842 The scoring PCB - 3 x 20mm 7 seg LED's, 8x5mm LED's couple of ZTX450 and SAA1064. **£1.95**



Z4286 Partially assembled panel for Liberator Contains 20 LS chips D70008C; HN61364; TC5517BPL-20. None of these are soldered in. **Price £5.00**

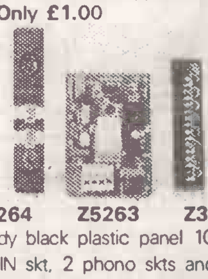
Z5844 Main PCB 350x203mm. Lots of useful bits - complete power supply (less transformer) using L4960 1-40V 2.5A reg, 79M15 and 78M12, all on heatsinks; 3.6V 100mAh back up battery; 68008P8 microprocessor chip, 2x68230P8 and 68681 support chips, 6264 RAM; + another 2 dozen assorted chips in ZN429, ZN448, TL071, TL074. First 40 orders will also get 27C512 EPROM too!. **Great value at just £9.95**

Motor Panels



Z653 Control PCB, 140x115mm with 2x4013, 4020, 4011, 4081, 4071, 8211, LM3909, 2AF 02.003TIP130, 5x2N3906, switch, C's R's, LED etc. **£1.50**

Z5823B Tuner panel from cable TV unit Although the power supply components have been removed, there are a few useful bits on the 190x132mm PCB: IR receiver, TDA5390, 4093 8 x BC184/214, min switches, presets, etc, plus of course the tuner unit with coax output skt to TV which uses the TSA5511 1.3GHz PLL freq synth chip. (TSA5511 - Pin out + block diagram + brief data supplied - Full set of data 50p extra). **Only £1.00**

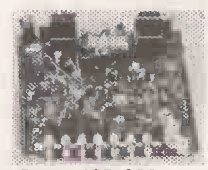


Z5264 **Z5263** **Z3048**

Z5264 Handy black plastic panel 102x22mm with 5 pin 180° DIN skt, 2 phono skts and a single wire aerial/earth socket. **Pack of 10 for £1.00;** 100+ 0.05; 1k+ 0.035
Z5263 Panel 80x60mm with FPT100A phototransistor, LM324 quad op amp, 24V SPCO heavy duty relay, BC546 diodes, R's and C's. Smashing little board. **Only £1.00**
Z3048 Tuning panel from a TV consisting of 8x100k multiturn pots with knurled wheel adjustment in a 81x21x13mm PC mntg module. **3 for £2;** 100+ 0.25

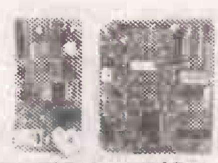
Z914 Audio amp panel 95x65mm with TBA820 chip. Gives 1W output with 9V supply. Switch and volume control. Just connect battery and speaker. Full details supplied. **Prices Only £1.50;** 25+ 0.80; 100+ 0.60

Z5735 Panel from VCR component parcel. The PCB 130x120 is entirely enclosed in a screened case, and is stuffed full of small modern components, in surface mount chips - M65114, A19211, 9508, A11544, 3006Sx2, HA11535x2, 74HC04, and some SIL chips, too - MSM4C500L and BA7604Nx2. No idea what any of them are for. Presumably the whole is a module for a VCR. **£3.00**



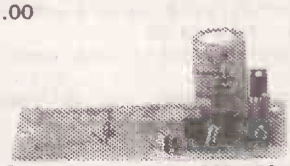
Z5649 Audio Board 195x200mm. Apart from a complete stereo amp using 2xTDA1908A 8 watt chips, there's an awful lot of additional (unknown) circuitry on board. Bank of 7 push switches. Other chips include M104B1, LM1036N, TDA3810. **All this for £3.20**

Power



Z3740 **Z3741**

Z3740 80x45 PSU panel with BD138, 7805, 555, LM358, WO2, trimpots, switch etc. **£1.00**
Z3741 82x75 with 4093, 4521, 9400, 1015, LM358, 5xTo92 T's, 2xTO126 T's, 2 trimpots, tants etc. **£1.00**



Z5210 Power supply panel - PCB 150x65mm that has been partially assembled but not soldered. Contains 79M05, 741, BDX339, FRC730, 4x1N4001, 10,000 µF 10V cap + R's, C's etc. (No transformer). **Only £1.00**

Z5783 Ringer Generator Panel. The best thing about this PCB is the power transistors - TIP35C & TIP36C (25A 90W 100V - over £5 a pair!) on heatsinks. Also on the main board 220x195mm are 4x100µF 63V caps, 'continental' relay, LM358, LM339, around 20 plastic transistors, R's, C's etc + a DIN 41612 connector and 9x10 way DIL header plugs. A sub panel 132x35mm contains 8x 74HC chips + an SGS 28640(/) 68 pin PLCC chip. **£4.95**

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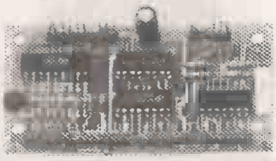
EVERYTHING ON THIS PAGE 2 FOR THE PRICE OF 1

Pay the price shown per item or pack - you'll receive double the quantity!

(Except where prices are indicated by SALE flag)

Z9205 Backplane. Massive PCB 480x250mm with gold plated wirewrap edge connectors, each 50 way double sided 0.125" pitch. Worth a fortune. **Our price £10.**

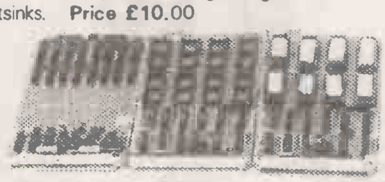


Z5619 Panel 93x47mm with TD62083; HC14; HC165; HC4094; **10 for £2.00**

Miscellaneous

Z492 M Module 11 pin in model in 80x50x50mm case PCB within contains 5xBC184L + TO5 transistor, R's, C's etc. Useful housing for small projects. **£1.00**
Z493 D Module. As above but PCB has 3xBC184L, BD124, R's C's etc. **£1.00**

Z4296 Metal chassis 310x230x25mm with 9x50 way double sided 0.1 edge connectors + 9xLM309k steel 5V 1.2A/TO3 voltage regulators on small heatsinks. **Price £10.00**



Z5100 Z5102 Z5262

Z5092 8xHM3-6514-9 (1kx4?) RAM plus few other chips. **Price £1.00**
Z5100 16xHM6167LP-8 + few other odd bits **£2.00**
Z5102 Same as Z5091 but with EPROM chips removed. **50p**
Z5262 This one has 8x2764 in sockets + 10 74LS chips. **Only £4.00**

Z1699 Mini inverter - this handy PCB 31x23mm uses a 2 transistor circuit to provide a 60V peak ac supply (20V dc @ 1mA) from a 3-7V dc input. Can be used to drive Z1637 LCD or for powering vacuum displays. Originally used in Newbrain computer. **Price 3/£1.00**

Z4133 Corgi telecontrol. Neat 2 part black plastic case 100x60x25mm with 3 red control switches, 2W, 3W and 8W believed to come from a low cost game. 1m long 5 core lead attached. **60p**

COMMUNICATIONS

TELEPHONE

Z2640 IDC telecomm/computer 8 way line plug normally selling for around 60p. **Our special low price 4 for £1.00;** 100+ £0.15; 1k+ 0.09.

Z2563 Z2058 Z2372

Z2563 PC mntg 6 way telephone line jack socket 605A. DP 0.90. **2 for £1.00**
Z2445 Data connector - like BT socket- 6 way PCB mounting for right hand plug. **2 for £1.00;** 100+ 0.30
Z2058 6 way telecom type socket. PC mounting (as used with some computers). **Pack of 3 for £1.00**
Z3732 Old type BT plug. 5 way. **£2.50**
Z2725 64 way Amp PC mntg plug. **Only £2.00**

COMPUTER

Centronics/IEEE488 style
Most of these available in matching pairs at a fraction of normal cost. All are IDC except *

Z3604	24 way plug	**£1.00**
Z2004	24 way socket	**£1.00**
X3238	24 way socket*	**£1.00**
Z3605	36 way plug	**£1.50**
Z3606	36 way socket	**£1.50**
Z3607	50 way plug	**£2.00**
Z3608	50 way socket	**£2.00**
Z3609	64 way plug	**£2.50**
Z3610	64 way socket	**£2.50**

Z350 Amp 50 way panel mntg skt. IEEE488 type £1.00

CONNECTORS

Z1768 Z5327 Z5326

Z1768 13 pin base for CRTs, numicators etc **4/£1**
Z5327 3 pin high current socket by Amphenol type 91-PC31 **£1.00**
Z5326 ITT multipole military connector. Uses 48 small pins and 8 larger, all gold plated, that need to be inserted. Tools included. **£4.00**

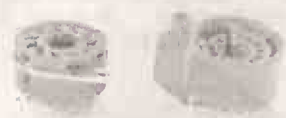
X3236 Z3785 Z3037

X3236 2 pin DIN speaker skt. PC mntg **12/£1.00**
Z3785 XLR mains connector. L & N are sleeved skts, the earth pin is male. **£1.50**
Z3037 50 way IDC D plug, gold plated, with cable strain relief. **£2.00**

Z1476 Z1477 Z4070

Z1476 Selectro 75R conhex RF connector GP **£1**
Z1477 Selectro 50R SRM RF connector **50p**
Z4070 3 way AMP 0.156" (4mm) skt. **20/£1.00**

MISCELLANEOUS



Z1402 Z1555

Z1402 11 pin relay socket, solder pins. Normally 58p. **Prices 10/£3.00;** 100/17.40; 1000/130.50
Z1555 CRT socket 10 way moulded green plastic. **Price 4/£1.00**

Drive Belts

An awful lot of these in all shapes and sizes, for cassette, turntable and video decks. We'll sell them individually, but for best value, buy a mixed pack!

Code	Type	Description*	Qty	RRP	Our Price
Z7314	AS6037	36/116/2	397	95p	**40p**
Z7320	AS6051	51.5/162/1.4	335	95p	**40p**
Z7321	AS6071B	71/223/1.9	1994	1.45	**75p**
Z7322	AS6075	75.5/237/1.9	254	1.45	**75p**
Z7324	AS6104	104/327/2.4	240	1.45	**75p**
Z7325	AS7030	30/94/0.8	298	1.45	**75p**
Z7327	AS8071	71/223/0.6/4	271	2.25	**£1.00**
Z7328	AS8073	72.5/228/0.8/4.5	150	2.25	**£1.00**
Z7329	AS8077	77/242/0.8/5	227	2.25	**£1.00**
Z7330	AS8082	82/258/0.8/4.5	509	2.25	**£1.00**
Z7331	AS8088	88/276.5/0.8/4.5	452	2.25	**£1.00**
Z7334	AS8158	158/496/1.0/8.0	594	2.95	**£1.40**
Z7338	VS9050	50.5/159/2	160	1.45	**75p**

*Dia/Inside Circumference/Thickness/Width
Substantial discounts on large quantities.

✶ GREAT REGULAR LINES ✶

The following sixteen pages contain a selection of products that are stock items which can be obtained on a regular basis, unlike other "SALE" products that are generally end of line or surplus and therefore of limited availablity. For further details of our great regular product lines see our main catalogue.

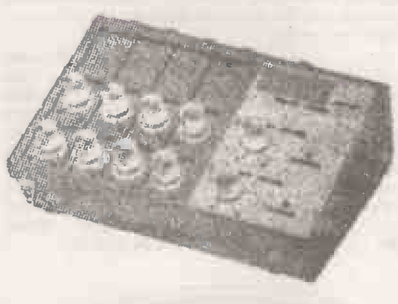
Mixers

G105 4-channel mono microphone mixer. Inputs via 6.35mm mono sockets with individual volume control. On/off switch and LED on indicator. Tough steel case. Powered by 9V battery. Complete with 1.5m patch lead, instructions and circuit.

Input impedance	600Ω
Output impedance	1.2kΩ
Output level	90mV (for 5mV input)
Power	9Vdc (PP3)battery

G105 Mixer £19.95 10+ 13.31

Stereo Mixers



G105D STEREO MIXER
4 channel stereo mixer. Inputs and outputs via 6.35mm sockets with individual volume controls. Powered by 9V battery or AC mains adaptor. Complete with two 1.4m patch leads.

Input sensitivity	1mV
Input impedence	600
Output impedence	1.5k
Output level	90mV(at input 5mV)
Frequency response	Mic 20-20000Hz
Power	9Vdc(PP3) or AC mains adaptor
Price	£38.95

MICROPHONES

Metal coated body with silver mesh head. Low, high, off switch. 5m lead fitted with 4-pin dual impedance plug. Holder included.

Type	Uni-directional. Dynamic
Impedance	500Ω and 50Ω (dual)
Response	80-12000Hz
Sensitivity	-77dB(500Ω) at 1kHz -60dB(50kΩ at 1kHz
Head dia	51mm
Length	178mm (excluding connector)

G155 £14.55 10+ 9.31

G133A On/off switch for remote control. Desk stand. 1.4m lead fitted with 2.5mm and 3.5mm jack plugs.

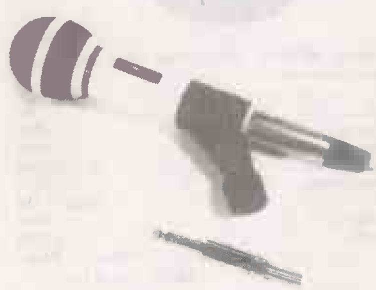
Type	Omni-directional.Dynamic
Impedance	200Ω
Response	100-10,000hz
Sensitivity	– 78dB @ 1kHz
Dimensions	45mm(dia.) x 152mm

G133A £2.75 25+ 1.81

G133 On/off switch for remote control. Desk stand. 1.5m lead fitted with 2.5mm and 3.5mm jack plugs, as used on most cassette recorders.

Type	Omni-directional. Dynamic
Impedance	200Ω
Dims	28mm(dia)x108mm

G133 £1.99 25+ 1.35

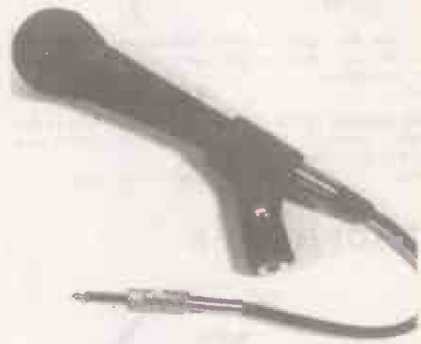


G148E A high performance dual impedance mic in white. Heavy metal construction. Colour matched 6m lead with cannon type plug. On/off switch. Holder included.

Type	Uni-directional. Dynamic
Impedance	500Ω and 50kΩ
Response	60-12000Hz
Sensitivity	500Ω -78db @ 1kHz 50kΩ -56dB @ 1kHz
Head dia	51mm
Length	155mm (excluding connector)
Prices	£17.95 10+ 11.59

G132DA Set of 5 black foam windshields suitable for most dynamic microphones.

Internal diameter	40mm
Prices	£2.95 10+ 2.12



Balanced dynamic microphone of exceptional quality and value. Deep brown body and mesh head with on/off switch. 6m noiseless lead fitted with XLR plug and 6.35mm mono plug. Holder included. Supplied in foam lined rigid plastic case.

Type	Uni-directional Balanced Dynamic
Response	70-20,000Hz
Impedance	500R
Sensitivity	77dB @ 1kHz
Head dia	54mm
Length	165mm

G147 £35.95 10+ 23.41

Microphone Stand

G119C FLOORSTAND
Heavy, professional quality, all metal mic. stand with boom arm. Fully adjustable for height, angle and extension. Three foldaway legs. Standard 5/8" fitting with 3/8" adaptor. Chrome and matt black finish.

Height	1.57m(max)0.93m(min)
Boom extension	0.63m
Leg length	0.35m
Price	£22.95

Telephone Pick Up Coil

Attaches by suction to most phones (no wiring required). Fitted with 3.5mm plug. 20mm dia x 17mm

A171 £1.20 25+ 0.73

GREENWELD

27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307

All one off and pack prices INCLUDE VAT; Qty prices don't

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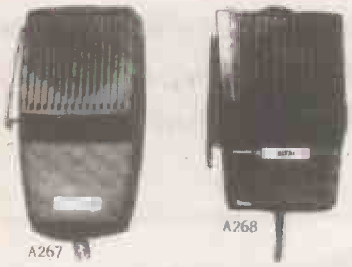


CB mic dynamic 600R impedance. Freq res 300-4500Hz. Push to talk switch, black curly lead. 100 × 54 × 40mm.

G171 £4.95 10+ 3.00

A268 Dynamic Power mic rotary control. Push to talk switch. Impedance 1k-10k. Freq res 200-5000Hz, curly lead. 97 × 63 × 42mm.

G179A £8.95 10+ 5.75

HEADPHONES

A087C Lightweight mono headphones with adjustable electret condenser boom microphone. Tough plastic ratchet adjustable headband. Soft padded earpieces containing high quality mylar transducers for clearer sound reproduction. Fully adjustable flexible mic boom arm with wind shield. Headphones can be converted to stereo by replacing the mono plug with a stereo plug. Mic powered by a watch type battery contained within the mic plug.

Headphones:

Type	Mylar transducers
Impedance	600Ω
Response	20-20,000Hz
Power	100mV

Microphone:

Type	Unidirectional electret condenser
Impedance	200Ω
Sensitivity	-62dB ± 3dB @ 1W

General:

Lead	1.4m straight screened
Plugs	2×6.35mm mono
Weight	145g

A087C £15.95 10+ 10.25

A087F STEREO HEADPHONES WITH BOOM MIC
Lightweight stereo headphones with adjustable dynamic boom mic. Tough plastic headband with stainless steel adjusters. Foam packed earpieces containing high quality samarium cobalt transducers for clear sound reproduction. High sensitivity miniature dynamic mic cartridge with foam windshield. Straight screened lead terminates in 6.35mm stereo plug for headphones and a 3.5mm mono plug for mic

Headphones:

Type	Mylar transducers
Impedance	32R
Response	20-20000Hz
Power	150mW

Microphone:

Type	Omni-directional dynamic
Impedance	250R
Sensitivity	-78dB @ 1kHz

General:

Lead	2.5m straight screened
Plugs	6.35mm stereo & 3.5mm mono
Weight	80g

PRICES: £8.95 10+ 5.15

FULL RANGE HI-FI LOUDSPEAKERS

Code	LS018A

Full range speaker. Foam edged paper cone with chrome HF dome.

Size	3" round
Impedance	8Ω
Power nominal	10W
Power maximum	20W
Frequency response	60-16000Hz
Resonant frequency	120Hz
Output SPL	88dB @ 1W
Magnet weight	5.3oz
Overall weight	400g
Dims	78(dia) × 40mm

LS018A £4.20 20+ 2.68

Code	LS026B

Compact full range driver. Foam rubber edged paper cone. 1" aluminium voice coil.

Size	6½" round
Impedance	8Ω
Power nominal	45W
Power maximum	60W
Frequency response	56-20000Hz
Resonant frequency	38Hz
Output SPL	94dB @ 1W
Magnet weight	20oz
Overall weight	1265g
Dims	165(dia) × 76.5mm

LS026B £9.50 12+ 6.00

Code	LS032C

Full range driver. All black. Foam rubber edged paper cone. 1" aluminium voice coil.

Size	8" round
Impedance	8Ω
Power nominal	40W
Power maximum	60W
Frequency response	38-18000Hz
Resonant frequency	40Hz
Output SPL	89dB @ 1W
Magnet weight	18oz
Overall weight	1310g
Dims	205(dia) × 94mm

LS032C £9.95 10+ 6.19

Code	LS034A

Professional quality full range driver. Foam rubber edged paper cone with centre HF cone. All black.

Size	10" round
Impedance	8Ω
Power nominal	40W
Power maximum	60W
Frequency response	35-12000Hz
Resonant frequency	35Hz
Output SPL	86dB @ 1W
Magnet weight	20oz
Overall weight	1735g
Dims	255(dia) × 105mm

LS034A £17.95 8+ 11.62

BASS UNITS

Code	LS027F

A Hi-Fi woofer with paper cone and rubber surround giving fine low frequency response and clean, uncoloured mid. Suitable for small, high quality 2-way systems.

Size	6½" round
Impedance	8Ω
Power nominal	30W
Power maximum	60W
Frequency response	50-8000Hz
Resonant frequency	50Hz
Sensitivity 1W 1m	89dB
Magnet weight	35oz
Overall weight	1.1kg
Dims	165(dia) × 72mm

LS027F £9.70 20+ 6.21

Code	LS032D

A high quality woofer with steel basket, rubber surround, coated paper cone and textile dust cap. The treatment of the cone reduces potential resonance problems. Ideal for two- and three-way systems.

Size	8" round
Impedance	8Ω
Power nominal	45W
Music Power	60W
Frequency response	30-4200Hz
Resonant frequency	30Hz
Sensitivity 1W 1m	93dB
Magnet weight	35oz
Overall weight	1.5kg
Dims	205(dia) × 96mm

LS032D £13.95 5+ 8.62

Code	LS035

High power woofer. Foam edged paper cone. Black steel basket.

Size	10" round
Impedance	8Ω
Power nominal	100W
Power maximum	200W
Frequency response	30-3000Hz
Resonant frequency	35Hz
Output SPL	96dB @ 1W
Magnet weight	40oz
Overall weight	3415kg
Dims	254(dia) × 108mm

LS035 £29.95 5+ 19.87

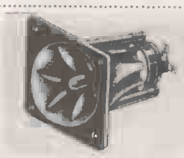
See page 63

(g) TWEETERS

Code ... LS053
Compact 2 hole fitting.
Size ... 2" round
Impedance ... 1000Ω @ 1kHz
Power nominal ... 17V
Power maximum ... 37V
Frequency response ... 4kHz-30kHz
Output SPL ... 92dB
Weight ... 9g
Dims ... 51(dia) × 18mm
LS053 £2.25 80+ 1.36

Code ... LS053A
Front mounting with black mesh grill.
Size ... 2½" round
Impedance ... 1000Ω@ 1kHz
Power nominal ... 18V
Power maximum ... 30V
Frequency response ... 2kHz-40kHz
Output SPL ... 100dB
Weight ... 25g
Dims ... 76 × 76 × 25mm
Prices ... £2.95 25+ 1.80

Code ... LS055
Fitted with front grill.
Size ... 3½" round
Impedance ... 1000Ω @ 1kHz
Power nominal ... 15V
Power maximum ... 35V
Frequency response ... 2kHz-30kHz
Output SPL ... 92dB
Weight ... 33g
Dims ... 65 (dia) × 19mm
Prices ... £4.50 45+ 2.75



Code ... LS052
Flush flange. Exponential horn.
Size ... 90mm dia
Impedance ... 1000Ω @ 1kHz
Power nominal ... 16V
Power maximum ... 35V
Frequency response ... 3kHz-25kHz
Output SPL ... 100dB
Weight ... 62g
Dims ... 85 × 85 × 74mm
Prices ... £4.95 80+ 2.67

Code ... LS054
Size ... 2" × 6"
Impedance ... 450Ω @ 1kHz
Power nominal ... 20V
Power maximum ... 35V
Frequency response ... 2kHz-30kHz
Output SPL ... 95dB
Weight ... 132g
Dims ... 178 × 95 × 115mm
LS054 £8.95 50+ 5.75

Discounts and lower postage rates for GOLD Subscribers - see page 63

(h) P A HORNS

Code ... PS105
Weatherproof black metal horn speaker with adjustable fixing bracket.
Horn diameter ... 90mm
Output ... 8W
Impedance ... 8Ω
PS105 £7.95 20+ 4.68

Brackets

SPEAKER BRACKETS

BT1 Pair of wall mounting speaker brackets which allow left and right swivel of speakers and 18° of tilt. Pack contains 2 speaker brackets plus all necessary fixings. Holding capacity 10kg. Black glass filled nylon.... £7.95

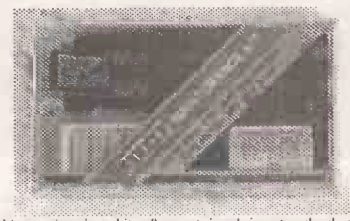
SPEAKER SWITCHES

A098B Designed for mounting on the rear of the amplifier. Allows 2 pairs of speakers to be used where the amplifier normally allows only one pair. Inputs via phono sockets, speaker connections via spring terminals. Parallel resistive protection.
Dims ... 110 × 58 × 30mm
Price ... £7.95 10+ 4.45

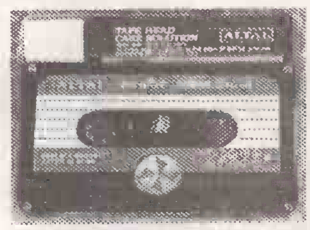
A098 A beautifully finished control box provides facility for using 4 pairs of speakers where stereo amplifier allows only one pair. 1, 2, 3 or 4 pairs may be used in any combination. Quick-action spring terminals. Series and parallel resistive protection.
Dims ... 148 × 85 × 50mm
A098 £13.95 10+ 9.37

TDK90 Back in stock - these popular cassette tapes form TDK. D90 low noise high output, type I. **£1.00 each - Box of 10 £8.00**

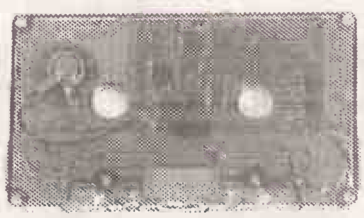
CASSETTE CLEANING



A451 Neat cleaning kit all contained in standard cassette case. Nylon bristled brush, inspection mirror and head cleaning tool. Cleaning fluid and 6 spare pads. Ideal present.
Price ... £1.30 20+ 70p



A156A Head cleaner and demagnetizer - just pop this casstte in your machine for a few minutes and listen to the result!
Price ... 99p 48+ 58p
A454 As above but cleans only ... 45p 100+ 25p



HD07 Electronic demagnetizer. Solid state electronics inside cassette makes this particularly easy to use - just insert in recorder, press play for one or two seconds and the jobs done. Full details supplied.
Price ... £6.50 10+ 4.38

TAPE REPAIR KIT

A165 Audio/video tape repair kit . Rocker clamps tape firmly in place during splicing. Safe blde storage. Complete with blade and 4 rolls of splicing tape.
Price ... £3.60 10+ 2.31

GREENWELD
27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307

All one off and pack prices INCLUDE VAT; Qty prices don't

C

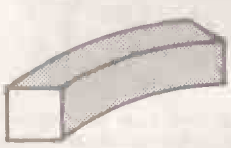
A170A TAPE HEAD DEMAGNETIZER
A compact and easy to use tool. Simply plug the demagnetizer in, press the red button and place the tip gently in contact with the tape head. Rotate the tip across the surface and withdraw slowly. Use every 50 hrs of play time to improve sound quality. Power: 220/240 V ac
Price.. **£2.95** 10+ 1.93

A160 Compact disc cleaning kit which cleans the disc with a radial action as recommended by CD manufacturers. Strong plastic case with hinged lid to retain CD chamois pad for cleaning. Kit also contains 1 bottle CD cleaning liquid and pad cleaning brush.
Price.. **£4.95** 25+ 3.35

A163A CD RACK
A unique storage system which will hold up to 20 CDs in their cases allowing them to flip back and forth. Free standing and interlocking
Price.. **£1.95** 40+ 1.03

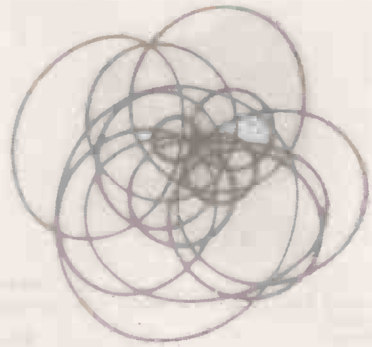
A162B CD CASE
Replacement CD storage case in packs of 2
Price.. **£1.05** 50+ 0.66

CASSETTE BELTS



Square section high quality rubber available in the following diameters: 19, 21, 25, 27, 30, 32, 35, 40, 43, 46, 51, 54, 57, 60, 63, 66, 70, 75.5, 78, 83, 86, 90, 94, 100, 110mm. All one price.
Order Code .... A424 + size
Price, one size .... 65p each 25+ .20 100+ .14
Prices, mixed sizes ... 65p each 25+ .40 100+ .26

BELT KITS



A421 All have 1.2mm square sections. Contains 13 belts 1 each size 19, 30, 35, 46, 57, 61, 66, 71, 76, 80, 83, 90, 110mm.
Price .... £3.95 10+ 1.50
A422 Shorter belt kit. 1 each 19, 30, 35, 40, 43, 46, 51, 57, 61mm.
Price .... £2.95 10+ 1.20

BATTERIES

BUTTON CELLS

A range of popular button batteries. Long life alkaline manganese cells. Rated voltage 1.5V. Packed in individual compartments on attractive display card holding 10 batteries.

Code	Equivalents	Dims	1+	10+	100+
AG2	397, 536	7.9 × 2.6mm	45p	0.30	0.09
AG3	192, BSR41H, 10L125	7.9 × 3.6mm	45p	0.30	0.09
AG7	395, 523	9.5 × 2.6mm	60p	0.40	0.12
AG8	391, 533	11.6 × 3.0mm	45p	0.30	0.09
AG10	LR1130, RW89, V10GA, 89A, 4274, BSR54H, 10L122	11.6 × 2.1mm	45p	0.30	0.09
AG12	LR43, RW84, V12GA, 86A, 4278, BSR43H, 10L124, 186	11.6 × 4.2mm	45p	0.30	0.09
AG13	LR44, RW82, 76A, A76, V13GA, 4276, BSR44H, 10L14, 186	11.6 × 5.4mm	45p	0.30	0.09
*SG1	364, SR621SN, V364, RN320	6.8 × 2.1mm	45p	0.30	0.09
*SG13	A76, LR44, V13GA, RW82,	11.6 × 5.4mm	£1.20p	0.70	0.25

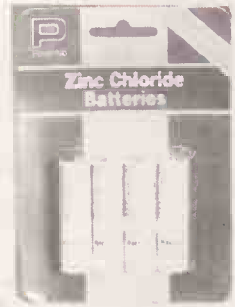
*Silver Oxide

Lithium Batteries
Popular 'coin' type, as used for memory back-up in camcorders etc. Individually blister packed

Code	1-9	10+
CR2016	£1.00	0.66
CR2025	£1.00	0.66
CR2032	£1.00	0.66

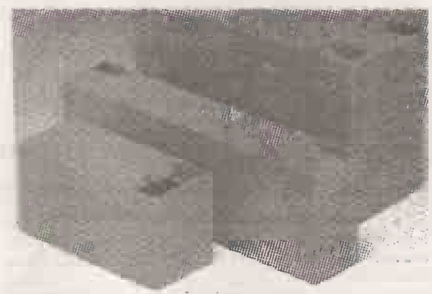
Alkaline Batteries for heavy duty use:

Code	Description	1+	20+	100+
X121	LR6/MN1500	75p	0.40	0.32
X122	LR03/MN2400	75p	0.40	0.32
X123	6LF22/MN1604	£2.99	1.58	1.26
X124	LR20/MN1300	£1.99	1.05	0.84
X125	LR14/MN1400	£1.60	0.84	0.68



Code	1+	25+	1C
X1070 AAA Cells			
Price per pack of 4	£1.10	0.70	0.56
X1090 AA cells			
Pricre per pack of 4	97p	0.62	0.50
X1092 C cells			
Price per pack of 2	39p	0.25	020
X1093 D cells			
Price per pack of 2	61p	0.39	0.31
X1095 PP3 cells			
Price each	51p	0.33	0.26

Code	Rating	Size	1+	25+	100+
X131	180 mAH	AAA	**£1.46**	0.93	0.75
X132	500 mAH	AA	**£1.20**	0.81	0.65
X133	1.2 AH	C	**£2.60**	1.79	1.44
X134	1.2 AH	D	**£2.60**	1.79	1.44
X135	110 mAH	P3	**£4.50**	3.60	3.30



RECHARGEABLE LEAD-ACID BATTERIES
A range of rechargeable lead-acid batteries suitable for high cyclic and stand-by applications. Constructed in sealed, rectangular high impact plastic cases with 5mm spade connections.

P013A	12V, 1.2Ah	96 x 451 x 50mm	0.54Kg	£11.95
P013B	12V, 6Ah	150 x 65 x 93mm	2.69Kg	18.95
P013C	12V, 1.9Ah	177 x 34 x 60mm	0.95kg	£13.95

P011 BATTERY CHARGER
A compact plug-in charger for up to 4 'AA' NiCad rechargeable batteries. The unit plugs directly into the mains socket and can charge 2 or 4 cells simultaneously. Each charging section has an LED indicator.

Inpt voltage	220/240Vac 50Hz
Charging current	2 x 60mA
Charging time	12 hours
Battery type	AA NiCad
Dims	98 x 36 x 73mm
Price	£4.50

Unregulated Power Supplies

P006D Plug in power supply with 6 output voltages. Polarity switch and output via a 4-way spider plug and 1.3mm dc Walkman plug.

Input voltage	220/240Vac 50Hz
Output Voltage	3,4.5,6,7.5,9 & 12Vdc
Output curmet	300mA max
Stability	40%
Dims	75 x 52 x 54mm
Price	**£3.95**

P006E Plug in powwer supply with 6 output voltages, polarity switch and LED indicator. Output via a 4-way spider plug and 1.3mm Walkman plug. Thermal fuse protection.

Input voltage	220/240Vac 50 Hz
Output voltage	3,4.5,6,7.5,9 & 12Vdc
Stability	40%
Ripple	1V
Dims	96 x 67 x 62mm
Price	£5.95

P006F Plug in power supply with 6 output voltages. Polarity switch and LED indicator. Output is via a 4-way spider plug and 1.3mm Walkman plug. Thermal fuse protection.

Input voltage	220/240Vac 50Hz
Output voltage	3,4.5,6,7.5,9 & 12Vdc
Output current	1000mA max
Stability	40%
Ripple	1V
Dims	97 x 67 x 56mm
Price	£6.95

Regulated Power Supplies

P006G A plug in regulated power supply, 3-12Vdc output switchable. Reverse polarity switch and LED indicator. Designed for radios, walkmans, calculators, keyboards, toys etc. Supplied with 6 DC adaptor plugs. Features include:

IC regulated output
Automatic thermal cut off
Short circuit protection
Automatic overload cut off.

Input voltage	220/240Vac 50Hz
Output voltage	3,4.5,6,7.5,9 & 12Vdc
Output current	300mA max
Stability	2%
Ripple	1V
Dims	87 x 62 x 62mm
Price	£6.50

P006Y A plug in regulated power supply for use with the Commtel COM 203 and COM 204 scanners.

Input voltage	220/240Vac 50Hz
Output voltage	9Vdc
Output current	350mA max
Stablity	2%
Ripple	10MV
Dims	80 x 56 x 55mm
Price	£7.95

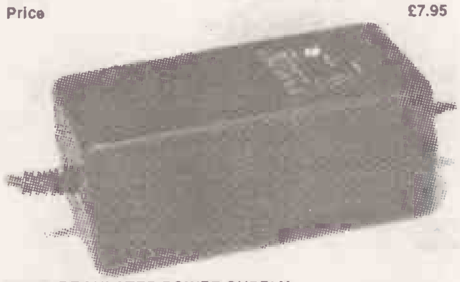
P006K POWER SUPPLY-REGULATED
Plug in regulated power supply 3-12Vdc switchable output. Polarity switch and LED indicator. Complete with 6 DC adaptor plugs. Features include:

IC regulated DC output
Automatic thermal cut off
Short circuit protection
Automatic overload cut off

Input voltage	220/240Vac 50Hz
Output voltage	3,6,9 & 12Vdc
Output current	1200mA max
Stability	2%
Ripple	10mV
Dims	120 x 75 x 63mm
Price	£8.95

P006Z POWER SUPPLY-REGULATED
A plug in regulated power supply designed foir use with the Commtel COM 102 scanner.

Input voltage	220/240Vac 50Hz
Output voltage	9Vdc
Output current	350mA max
Stability	2%
Ripple	10mV
Dims	80 x 56 x 55mm
Price	£7.95



P007V REGULATED POWER SUPPLY
Superior quality regulated power supply. Several output voltages selected by a rotary swith with a current rating of 1.2A (1200mA). Input via a 3-core mains. Output via a fitted lead with 4-way spider plug, 9V battery snap and walkman plug.

Output power	1.5, 3, 4.5, 6, 7.5, 9 & 12Vdc
Power input	220/240Vdc
Output current	1.2A (1200mA)
Dims	150 x 77 x 62mm
Price	£14.95

P006V REGULATED POWER SUPPLY
Superior quality regulated power supply. Several output voltages selected by a rotary switch, with a current rating of 1A (1000mA). Input via a 3-core mains lead. Output via a fitted lead with 4-way spider plug, 9V battery snap and a walkman plug.

Output voltage	3,6,9,12,13.5,17 & 18Vdc
Power input	220/240Vac 50Hz
Output current	1A (1000mA)
Dims	150 x 77 x 62mm
Price	£16.95

CB Power Supply

A115 Stabilized power supply unit for use with CB rigs, auto accessories, etc. High stability electronic regulation with internal fuse protection.
Manuafactured according to the requirements of the Electrical Safety Regulations for Domestic Use.

Input voltage	240Vac 50Hz
Output voltage	13.8Vdc
Output current	3A continuous
Stability	5%
Ripple	10mV
Connections	4mm banana socket/screw terminals
Dims	175×92×138mm
A115	£17.95 4+ 11.18

A116 High current regulated power supply for use with CB rigs, auto equipment. Good stability circuitry with high surge current capability. Overload protection. Manufactured according to the requirement of the Electrical Safety Regulation for Domestic Use.

Input voltage	240Vac
Output voltage	13.8Vdc
Output current	5A continuous, 7A max
Stability	1%
Ripple	25mV
Connection	4mm banana socket screw terminals
Dims	195×140×90mm
A116	£22.95 4+ 14.96

0-24V DC 3A

A112 Variable stabilized power supply with over-load protection. Meter reads voltage or current (switched). Two voltage ranges: 0-12V and 12-24Vdc. Ideal for laboratory use.

Input voltage	240Vac 50Hz
Output voltage	0-24Vdc (2 ranges)
Stability	0.2%
Ripple	2.5mV
Dims	180×110×180mm
A112	£84.95 4+ 58.69

0-24V DC 5A

A113 Variable stabilized power supply with over-load protection. Meter reads voltage or current (switched). Two voltage ranges; 0-12V and 12-24Vdc. Ideal for laboratory use.

Input voltage	240Vac 50Hz
Output voltage	0-24Vdc (2 ranges)
Stabillty	0.2%
Ripple	4mV
Dims	180×180×110mm
A113	£99.95 4+ 69.75

5-15V DC 4A

A114 Variable stabilized power supply with over-load protection. Meter reads voltage or current (switched). Output voltage adjustable between 5 and 15Vdc. Output and power on/off switches. Ideal for laboratory use.

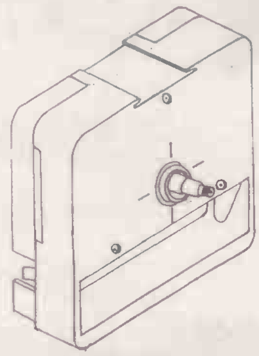
Input voltage	240Vac 50Hz
Output voltage	5-15Vdc variable
Output current	4A continuous
Stability	0.1%
Ripple	5mV
Dims	190×132×101mm
A114	£62.95 4+ 41.88

F065 Spike Protector. Safely eliminates dangerous voltage spikes and surges. The essential plug in protector for domestic and professional appliances. Can either be plugged in next to appliance or wired directly to it.
Prices .... £12.95 5+ 9.89

CLOCKS

A new quartz clock movement with a wide range hands, dials, chapter rings and accessories, all at extremely competitive prices.

(a) Quartz movement

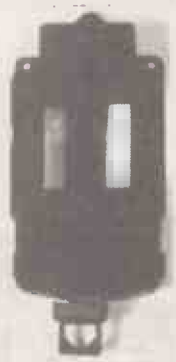


Kienzle Model W716. Facility for hour, minute and second hand. Takes single AA cell. Typ current 80µA. Accuracy to within 1 sec/ day. Size 58 × 50 × 16mm weight without battery 26g.

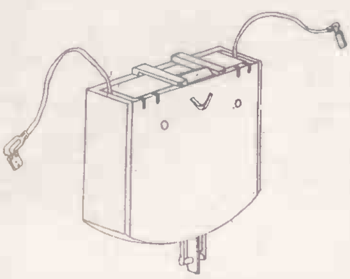
Code	Spindle Lengths H	M	S
V1101	11.5	16.3	20.5
V1102	6.0	11.5	15.5
V1103	6.8	8.1	11.0

Prices ...... £3.50 10+ 2.34 25+ 1.87 100+ 1.50

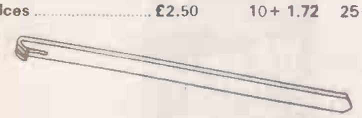
(b) Pendulum additions



V1121 Haller pendulum attachment. A plastic moulding with hanging hook containing pendulum, electromagnet and battery holder with room for the clock movement to be mounted. Size 109 × 60 × 32mm.
Prices ...... £3.50 10+ 2.34 25+ 1.87 100+ 1.50



V1122 Shontek pendulum. These clip on to the base of the quartz movement. Size 48 × 43 × 18mm.
Prices .... £2.50 10+ 1.72 25+ 1.38



V1127 Suitable rods for either of above.
Prices .... 50p 10+ 0.34 25+ 0.28

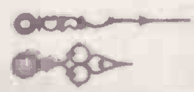
V1128 Suitable bobs for either of above.
Prices .... £1.00 10+ 0.72 25+ 0.58

(c) Hands

A selection of modern and traditional hands, all of which will fit either movement described.

Code	Length* Hour	Minute	Colour	1+	25+	100+
V1201	28	42	Black	38p	0.25	0.19
V1202	28	42	Brass	42p	0.28	0.21

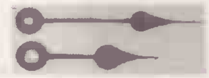
Code	Length* Hour	Minute	Colour	1+	25+	100+
V1203	60	80	Black	48p	0.31	0.24
V1204	60	80	Brass	52p	0.34	0.26



Code	Length* Hour	Minute	Colour	1+	25+	100+
V1205	47	68	Black	48p	0.31	0.24
V1206	47	68	Brass	52p	0.34	0.26

Code	Length* Hour	Minute	Colour	1+	25+	100+
V1207	34	46	Black	36p	0.23	0.18
V1208	34	46	Brass	40p	0.26	0.20

Code	Length* Hour	Minute	Colour	1+	25+	100+
V1209	58	77	Black	50p	0.33	0.25
V1210	58	77	Brass	54p	0.36	0.27



Code	Length* Hour	Minute	Colour	1+	25+	100+
V1211	53	75	Black	48p	0.31	0.24
V1212	53	75	Brass	52p	0.34	0.26

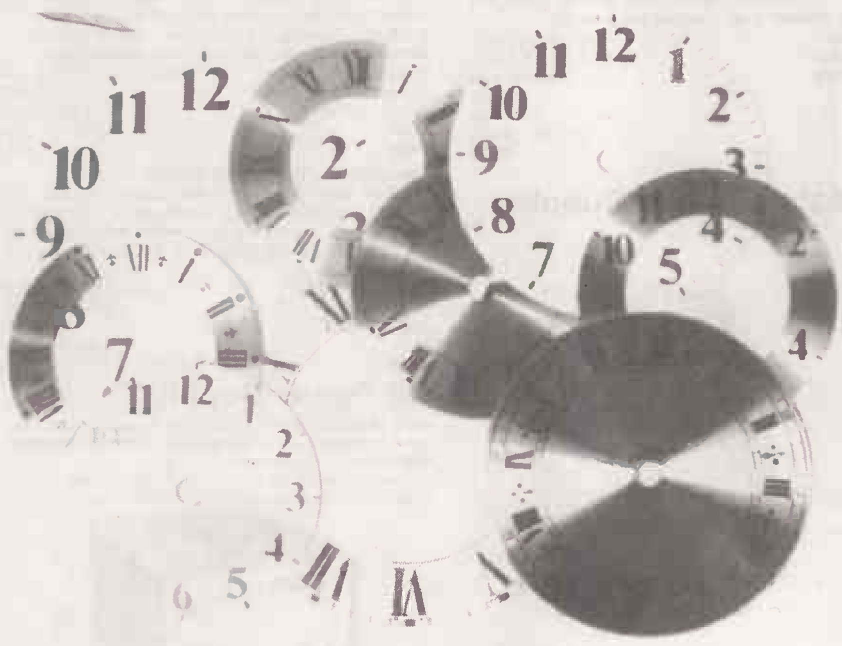
Code	Length* Hour	Minute	Colour	1+	25+	100+
V1213	35	44	Black	46p	0.30	0.23
V1214	35	44	Brass	50p	0.33	0.25

* Measured from spindle centre to end

Second Hands

Code	Length	Colour	1+	25+	100+
V1296	60	Red	28p	0.18	0.14
V1297	60	White	28p	0.18	0.14

Code	Length	Colour	1+	25+	100+
V1298	80	Red	28p	0.18	0.14
V1299	80	White	28p	0.18	0.14



(d) Dials

Code	Colour	Size	Numerals	1+	25+	100+
V1301	White	4"	Arabic	£1.75	1.18	0.94
V1302	Silver	4"	Arabic	£1.75	1.18	0.94
V1303	Brass	4"	Arabic	£1.75	1.18	0.94
V1304	White	4"	Roman	£1.75	1.18	0.94
V1305	Silver	4"	Roman	£1.75	1.18	0.94
V1306	Brass	4"	Roman	£1.75	1.18	0.94
V1307	White	5"	Arabic	£1.84	1.25	1.00
V1308	Silver	5"	Arabic	£1.84	1.25	1.00
V1309	Brass	5"	Arabic	£1.84	1.25	1.00
V1310	White	5"	Roman	£1.84	1.25	1.00
V1311	Silver	5"	Roman	£1.84	1.25	1.00
V1312	Brass	5"	Roman	£1.84	1.25	1.00
V1313	White	6"	Arabic	£1.96	1.32	1.06
V1314	Silver	6"	Arabic	£1.96	1.32	1.06
V1315	Brass	6"	Arabic	£1.96	1.32	1.06
V1316	White	6"	Roman	£1.96	1.32	1.06
V1317	Silver	6"	Roman	£1.96	1.32	1.06
V1318	Brass	6"	Roman	£1.96	1.32	1.06

(e) Chapter Rings

Code	Colour	Size	Numerals	1+	25+	100+
V1401	White	4"	Arabic	£1.75	1.18	0.94
V1402	Silver	4"	Arabic	£1.75	1.18	0.94
V1403	Brass	4"	Arabic	£1.75	1.18	0.94
V1404	White	4"	Roman	£1.75	1.18	0.94
V1405	Silver	4"	Roman	£1.75	1.18	0.94
V1406	Brass	4"	Roman	£1.75	1.18	0.94
V1407	White	5"	Arabic	£1.84	1.25	1.00
V1408	Silver	5"	Arabic	£1.84	1.25	1.00
V1409	Brass	5"	Arabic	£1.84	1.25	1.00
V1410	White	5"	Roman	£1.84	1.25	1.00
V1411	Silver	5"	Roman	£1.84	1.25	1.00
V1412	Brass	5"	Roman	£1.84	1.25	1.00
V1413	White	6"	Arabic	£1.96	1.32	1.06
V1414	Silver	6"	Arabic	£1.96	1.32	1.06
V1415	Brass	6"	Arabic	£1.96	1.32	1.06
V1416	White	6"	Roman	£1.96	1.32	1.06
V1417	Silver	6"	Roman	£1.96	1.32	1.06
V1418	Brass	6"	Roman	£1.96	1.32	1.06

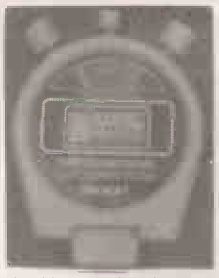
The White and Silver dials are made from aluminium.

F

GREENWELD

27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307

All one off and pack prices INCLUDE VAT; Qty prices don't



V1017 Stopwatch - this sports timer has an amazing number of features at an exceptionally low price:

★ Hours, mins, secs.
★ Day, date, month.
★ 1/100th sec chrono with lap/ split control.
★ 4 year calendar.
★ Beep alarm with chime and snooze.
★ 30 sec correction for synchronization.
★ 12 or 24 hour display.
★ Will count to 23:59:59.
★ Complete with instructions (you'll need them!).

All this for just .... **£3.95** 10+ 2.95

DIGITAL CLOCK **Y137W**

Large LCD digital alarm clock with snooze control and LCD illuminating light. The snooze control silences the alarm for 7 minutes before re-sounding it. Compact and easy to use. Batteries included.

Power	2 x AAA batteries
Dims	95 x 65 x 68mm
Price	**£7.99** 10+ 5.19

COUNTDOWN TIMER **Y137S**

Simple to use electronic countdown time with 19 hours, 59 minutes 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	19 hours 59 minutes
Power	P009H button cell
Price	**£4.25** 10+ 2.76

COUNTDOWN TIMER **Y137T**

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 or magnetic mounting.

Timing period	19 hours 59 minutes
Power	AAA battery
Price	**£6.70** 10+ 4.36

DIGITAL CLOCK/TIMER **Y137U**

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.

Dims	87 x 82 x 45mm
Power	1 x AAA battery
Price	**£9.50** 10+ 6.18

2-CHANNEL DIGITAL CLOCK **Y137V**

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 batteries
Price	**£10.95** 10+ 7.11

STRIPBOARD

Fully pierced single sided copper strips 0.1" pitch. Available in the following sizes:

Code	Size	t x h*	1+	25+	100+
G4010	25 × 64	9 25	22p	0.14	0.11
G4020	64 × 95	24 37	74p	0.48	0.37
G4030	95 × 127	36 50	£1.50	0.98	0.75
G4040	95 × 432	36 170	£4.50	3.08	2.37
G4050	119 × 455	46 179	£5.95	4.06	3.12

* Tracks and holes

TRACK CUTTER

G4310 Low cost version .... **£1.95** 10+1.31

Protobloc 1

G7080 Protobloc 1 has a total of 400 tie points consisting of two sets of 30 rows of 5 interconnected sockets plus 5 rows of 25 interconnected sockets running alongside, suitable for use as power supply rails. All contact positions are clearly defined on an alphanumeric grid. ABS polymer board mounted on an adhesive foam base. Will accommodate up to three 16 pin devices. An ideal introduction to solderless circuit development systems. Size 80 × 60mm.

Prices .... **£2.60** 25+ 1.65

Protobloc 2

G7110 Protobloc 2 has a total of 840 tie points consisting of two sets of 64 rows of 5 interconnected sockets plus 4 rows of 50 interconnected sockets running alongside, suitable for use as power supply rails. All contact positions are clearly defined on an alphanumeric grid. ABS polymer board mounted on an adhesive foam base. Will accommodate up to seven 16 pin devices. Size 172 × 64mm.

Prices .... **£4.50** 25+ 3.25

SOLDER TERMINAL PINS

Sold in packs of 100

	1+	25+	100+
G4110 Single sided	64p	0.42	0.32
G4115 Double sided	£1.38	0.90	0.69

T113S Scart lead kit consisting of:
1 lead scart plug to 5 pin DIN plug and 2xphono plugs. 1.5m 1 lead 6 pin DIN plug to 5 pin DIN socket and phono socket. 0.2m
2 phono sockets to BNC plug adaptors
2 phono sockets to PL259 plug adaptors
2 phono sockets to 3.5mm plug adaptors

Prices £9.88 25+ 5.59 100+ 4.20

JUMPER LINKS

G7352 A set of 25 colour coded leads with specially designed plugs to minimize wear on connector. Supplied in packs of 25, 5 of each of 50, 70, 100, 150 and 200mm lengths, assorted colours.

Prices .... **£5.95** 10+ 4.31

Jumper Wire Kit

G7355 Attractive hinged plastic case 270 × 122 × 30mm with 14 compartments housing 25 each of the following sizes jumper wires, all colour coded:
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9
1.0 2.0 3.0 4.0 & 5.0 inches

Prices .... **£7.95** 10+ 5.31

GREENWELD

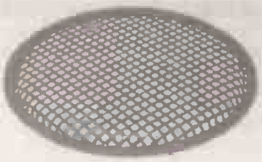
27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307

All one off and pack prices INCLUDE VAT; Qty prices don't

Car Equipment

25W mobile PA amplifier with dual mic and aux inputs with volume controls. Built-in siren and fog horn warning tones operated from momentary switch. Neat metal case with plastic facia. Complete with mounting hardware

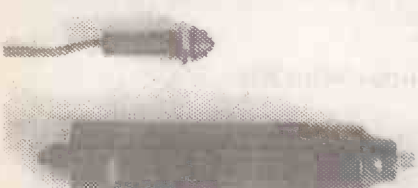
Output power 25W
Output impedance 4-16Ω
Inputs:
Mic 3.5mV 20-50kΩ
Aux 85mV 10kμ
Power 11-16Vdc
Dims .... 150×140×40mm
P101 £39.95 3+ 26.25



CABINET GRILLES
Black finish metal mesh speaker grille with black rubber surround. Robust construction made from 1.1mm thick steel. Grille pitch 11mm x 11mm.

L091A	5"	£1.75	24+ 0.87
L091B	8"	£2.20	24+ 1.15
L091	10"	£2.95	10+ 1.47
L093	12"	£3.95	10+ 1.93
L095	15"	£4.95	10+ 2.55
L095A	18"	£8.75	10+ 4.90

DC/DC CONVERTER
A plug in DC/DC converter with 3, 4.5, 6, 7.5, 9 and 12V outputs at 800mA. Plugs directly into a car cigar lighter socket. Output via a polarity reversible lead to a +spider+ plug with 1.3, 2.1 and 2.5mm DC power plugs and a 3.5mm plug
Input voltage 12Vdc nom
Output voltages 3, 4.5, 6, 7.5, 9 and 12Vdc
Output current 800mA max
B034BA £2.95 24+ 1.87



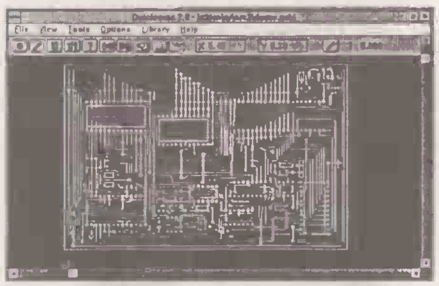
F158Q FLASHING LED
A flashing LED in a mounting bezel designed to mount in the dashboard to indicate that an alarm is armed (even if no alarm is installed) Fitted with a 1.5m lead. Power 12V dc.
Price .... **£1.75** 10+ 0.87

B200Z PLUG-IN FLASHING LED
A flashing LED built into a car cigar lighter plug to give a visual warning that an alarm is activated (whether or not an alarm is fitted). Simply plugs into the car's cigar lighter socket.
Price .... **£1.95** 20+ 1.14

Schematic and PCB CAD Software.

More and more home designed circuits require construction on printed circuit board. Until the introduction of CAD software most designs were built with stick down pads and crêpe tape - a time consuming and tricky operation. The first CAD packages were very expensive and limited to professional organisations but thanks to the presence of computers in every home the prices have tumbled.
We can now offer you a range CAD software that is ideal for the home constructor and the professional.

Quickroute



Quickroute 2.0 For Windows 3.x

Powerware software design

One of the most outstanding value for money PCB CAD packages available.
Featuring:-

⇒ Button bar for instant access to powerful object selection
⇒ Improved editing features
⇒ Built in help
⇒ Rapid zoom and pan
⇒ Filled polygon object type for earth planes
⇒ Support for 150 printers and plotters
⇒ Schematic capture tool
⇒ Simple autorouter
⇒ Schematic and PBC symbol libraries
⇒ Gerber drill control file support (Professional version only)

Reviews of first edition:
"... exceptional value for money" - Everyday Electronics Sept 1992
"Cheap.. it may be. But..Quickroute's performance puts it in an altogether bigger league" - EW&WW May 1992.

Price

Quickroute for Windows Professional Edition £99.00

Floppy Disks

Budget Range

High quality soft secored unformatted disks at an extremely attractive price. All disks certified 100% error free and performance exceeds ANSI, ECMA and ISO standards. Supplied with sleeves and write protect tabs (5.25") and labels (3.5" & 5.25")

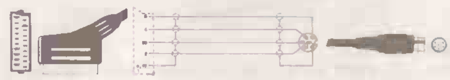
Specification
Double sided, 80 track, 135 TPI (3.5") 96 TPI (5.25")
Supplied in boxes of 10

				1+	10+	25+
A637	3.5"	DSDD	1MB	**£4.22**	3.33	3.12
A638	3.5"	DSHD	2MB	**£7.43**	5.32	5.00
A657	5.25"	DSHD	1.6MB	**£4.40**	3.33	3.12

QUICKTEST CONNECTOR

P6250
(13A rated) A tough mains connector with neon indicator lamp. Can be used loose or wall mounted. Power is only connected when lid is shut
Price .... **£9.95** 25+ 8.40 100+ 6.70

Scart Leads



P2990
Scart plug to 6 pin DIN plug. Length 1.5m
Price .... **£3.44** 25+ 1.94 100+ 1.46

P2950
Scart plug to 6 phono plugs. Length 1.5m
Price .... **£3.50** 25+ 1.98 100+ 1.49

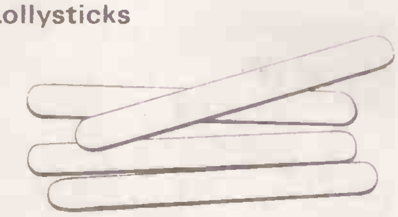
CRAFT PRODUCTS

A range of products suitable for making working models with minimal labour and expense.

Matchsticks

Standard headless matches in packs of 1000.
CDT1001 .... **Per pack 96p** 5+ 0.60 25+ 0.48

Lollysticks



Standard lollysticks 140mm long ×10mm wide supplied in packs of 100
CDT1003 .... **Per pack 75p** 5+ 0.47 25+ 0.38

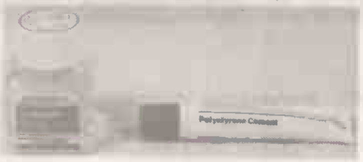
GREENWELD 27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307
All one off and pack prices INCLUDE VAT; Qty prices don't

ADHESIVES

A wide range of adhesives from Humbrol to cater for most craft and modelling needs.

(a) Cyanoacrylate (Super glue). High strength bond between plastics, rubber, metals and ceramics. Bonds in seconds at room temperature with only contact pressure required.

Code	Size	1+	12+	36+
CDT231	3gm tube	85p	0.54	0.43
CDT232	5gm bottle	95p	0.59	0.47



(b) Polystyrene cement. Non-stringing adhesive for assembling plastic models.

Code	Size	1+	12+	36+
CDT236	12ml tube	54p	0.39	0.31

Liquid poly - specially formulated adhesive supplied in bottle with brush for easy application.

Code	Size	1+	12+	36+
CDT237	30ml	80p	0.58	0.46

(c) Balsa cement. A clear rapidly bonding cement for balsa and other soft woods.

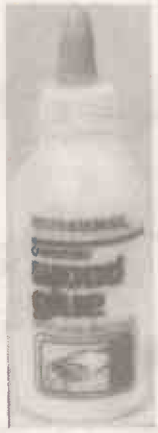
Code	Size	1+	12+	36+
CDT248	24ml tube	99p	0.71	0.57

(d) Superfast Epoxy. A twin pack adhesive that gives a rapid and strong bond, even on difficult surfaces. Dries to a clear waterproof film.

Code	Size	1+	12+	36+
CDT241	2 × 12ml tubes	£2.40	1.59	1.27

(e) Stix-it. All purpose water based adhesive for wood, metal, card, paper, plastic, vinyl, carpet and fabrics. Water resistant when dry. Unique 'twist and clean' cap on 250ml size; 120ml size has brush in bottle cap. Replaces 'School glue'.

Code	Size	1+	12+	36+
CDT251	120ml bottle	£2.15	1.56	1.24
CDT252	250ml bottle	£3.50	2.54	2.03

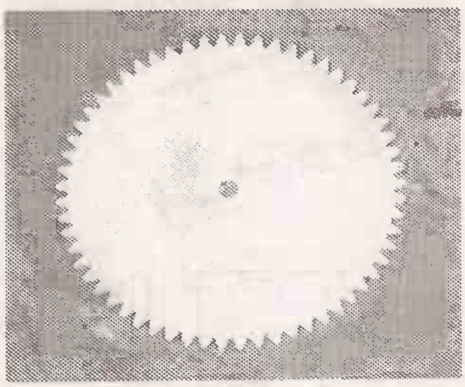


(f) Carpenters wood glue. An advanced rapid drying PVA woodworking adhesive with aliphatic resins for 'fast initial grab'.

Code	Size	1+	12+	36+
CDT256	125ml bottle	£2.15	1.42	1.14

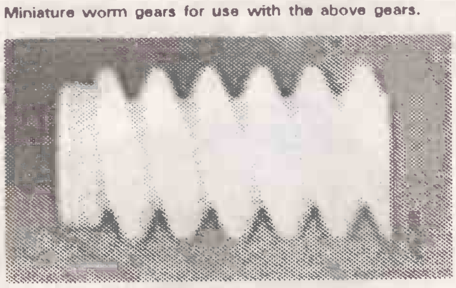
Gears

A range of miniature gears to use with small motors. Available in individual sizes or mixed packs as shown. All have 1.9mm base for tight fit onto 2mm spindle.



Code	OD Teeth	ID Teeth	OD	ID	Pack of 10	100+	1k+
G5381	16	-	9	-	28p	0.016	0.012
G5382	32	-	16	6	37p	0.021	0.016
G5383	42	-	22	6	48p	0.027	0.021
G5384	60	-	31	6	67p	0.038	0.029
G5385	30	-	16	5.5	37p	0.021	0.016
G5386	42	-	22	5.5	48p	0.027	0.021

Miniature worm gears for use with the above gears.



Code	Dia	Length	Pack of 10	100+	1k+
G5387	6	6	32p	0.018	0.014
G5388	6	10	44p	0.025	0.019

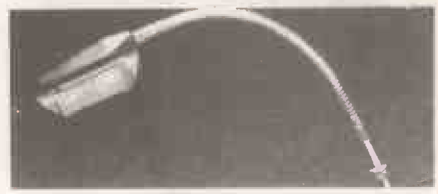
Steel Shaft for use with above worms and gears, 2mm dia x 75mm long.

G5389..........Pack of 10 23p 100+ 0.013 1k+ 0.01

G5380..........Pack of 10 each of all listed items above
Total 90 items..........£2.95 10+ 1.90

Disco Equipment

Console Lamp



L100 For disco consoles, Hi-Fi equipment, CB rigs, etc where extra illumination is essential. 12V lamp in enclosed head with switch. Flexible chrome gooseneck on mounting plate with screw holes. Flying leads for connection to external 12Vdc supply.

Length 300mm
Lamp .... 12Vdc 5W tubular filament
Prices .... £2.95 10+ 1.60

PAR36 SPOT

PAR36 High quality PAR36 spot lamp with mounting bracket. Can contains safety isolating transformer and screwdriver release fuseholder. Lamp supplied separately.

Power 240Vac 50Hz
Weight 1.25kg
G008U £13.95 5+ 10.70

MINI STROBE G011A

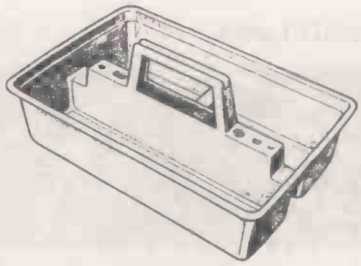
Top quality mini strobe with a very high light intensity for its size. Flash rate adjustable up to 15 flashes per second. Black steel case with adjustable mounting bracket.

Flash rate	15 per second max.
Max tube power	15W @ 15 flashes/second
Power	220/240Vac 50Hz
Dims	125 x 85 x 55mm
Price	£22.95 10+ 14.92

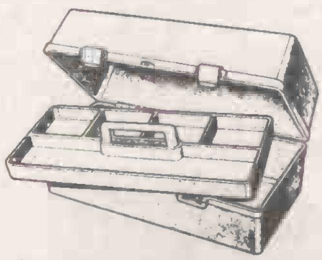
L300 Strobe light with circular reflector housed in veneered wooden cabinet. Variable speed control.

Power .... 240V ac 50Hz
Dims .... 150 × 150 × 120mm
G012 Strobe £24.95 5+ 16.00

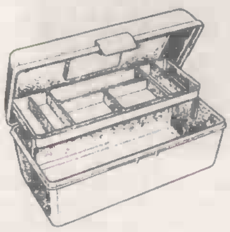
STORAGE CONTAINERS



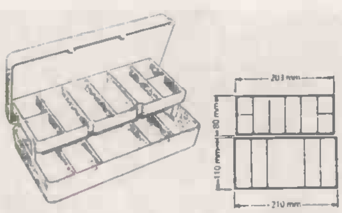
7050 Tool tray 380x250x100mm £1.95



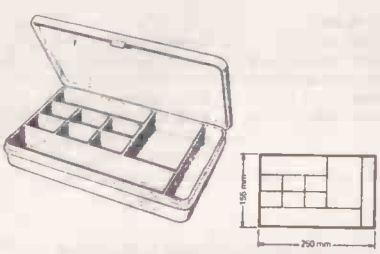
001 Tool Box with lift out tray 430x190x180 £12.95



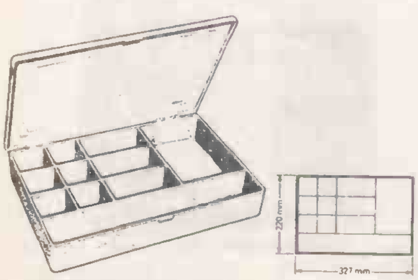
004 Single tray cantilever tool box 342x165x145mm £3.95



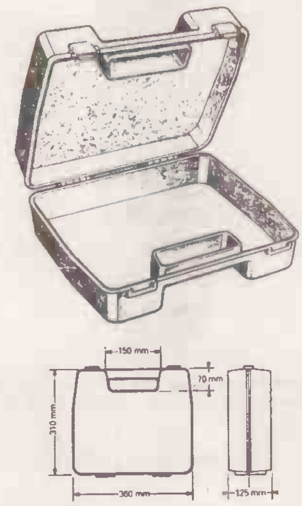
7033 Storage box with open out cantilever tray. 13 compartments. 210x110x50mm £1.99



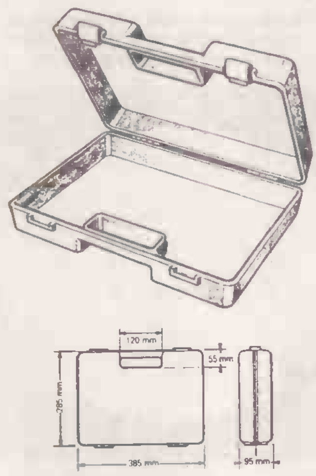
7034 Storage box with 10 compartments. 250x155x35mm £2.50



7035 Storage box with 11 compartments. 327x220x48mm £3.25



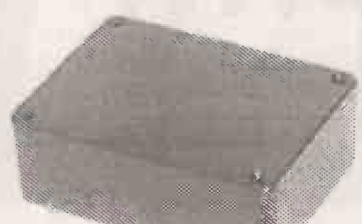
010 Tool & hobby case £5.95



020 Tool & Hobby case £5.50

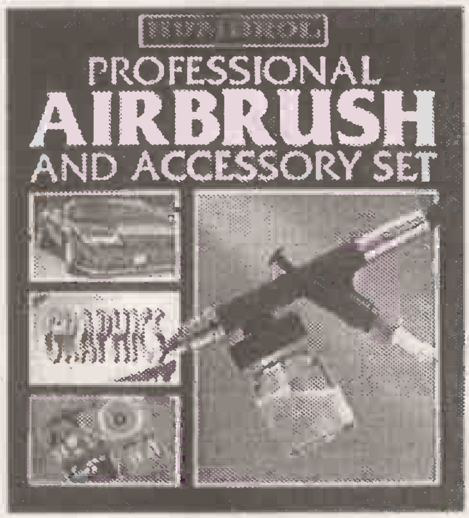
ABS Boxes

Professional quality versatile boxes for use where both cost and finish are important. Moulded in high impact ABS, they are easily punched or drilled to produce a professional looking end product. The lids are retained by machined screws into brass inserts. Printed cicuit board slots are provided (except T3 and T4 which use self tapping screws. Available in black.



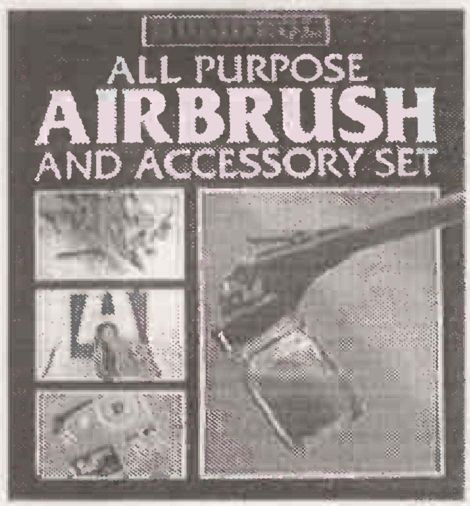
Type	Code	External Dimensions	1+	25+	100+
V207	T3	75 x 51 x 25	**74p**	0.51	0.41
V208	T4	111 x 57 x 22	**92p**	0.64	0.51
V210	MB1	79 x 61 x 40	**£1.40**	0.98	0.78
V213	MB2	100 x 76 x 41	**£1.55**	1.08	0.86
V216	MB3	118 x 98 x 45	**£1.76**	1.23	0.98
V215	MB8	150 x 80 x 50	**£2.25**	1.56	1.25
V217	MB5	150 x 100 x 60	**£2.52**	1.75	1.40
V220	MB7	177 x 120 x 83	**£3.49**	2.43	1.94
V218	MB4	216 x 130 x 85	**£5.36**	3.73	2.98
V219	MB6	220 x 150 x 64	**£4.14**	2.28	2.30

GRAPHIC STATIONERY



300065 Professional Airbrush & Accessory Set. Contains airbrush, 3 paint pots, extension for paint cup and power pack. **£46.50**

Power Units
302014 Standard size, 250ml **£3.25**
302021 Large size, 440ml **£5.35**



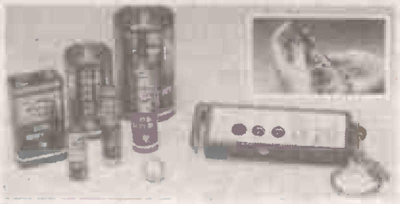
300034 All Purpose Airbrush & Accessory Set. Contains airbrush, 3 paint pots, power pack and instructions **£19.95**

The Ultimate Laser Copy Paper

After trying dozens of different papers to obtain the best possible copy quality, we've found a superb paper from one of the larger paper merchants. It's called Huntsman Silk and its 115gsm weight just oozes quality. You need to see and feel it to appreciate its worth, so ask for a sample sheet if your interested in buying some.

HS115 50 Sheets **£2.50**
HS115B 200 Sheets **£8.00**
HS115 Ream of 500 sheets **£16.00**

INSTRUMENTATION



BATTERY TESTER Y126A
Compact universal battery tester on a keychain. 3 LED's indicate battery charge level. Tests all types from button cells to PP3.
Price .... £3.20 20+ 2.08

Y126 BATTERY TESTER
A compact dry cell battery tester capable of testing 15 voltage battery types from 1.35V hearing -aid batteries to 22.5V batteries. Test leads store in rear of case.
Dims 105 x 64 x 32mm
Price £3.95

Y126B BATTERY TESTER
A compact battery tester capable of testing most of the popular dry cell types under actual load conditions. Easy to read meter indicates battery condition at a glance. Tests PP3 (9V),AAA,AA,C,D,4sr44(6V), 1.5V button cells and NiCad batteries.
Weight 190g
Dims 157 x 81 x 37mm
Price £4.95

Y126C BATTERY TESTER
An easy to use dry cell battery tester capable of testing a range from 1.5V up to 22.5V.
Dims 130 x 90 x 42mm
Weight 145g
Price £7.95

Y137N DIGITAL THERMOMETER
Dual channel inside/outside comparative temp with dual read out display. Dual thermocouple, one internal and one on a 3m extn lead. Free standing or mounted with Velcro strips supplied.
PRICES: £12.50 5+ 7.50

Y137M DIGITAL THERMOMETER
A dual sensor instrument designed for comparative measurement - eg inside/outside. Free standing or mounted with Velcro strips supplied. Remote sensor fitted with 3m lead. Built in digital clock
Range -20° to +70°C ±1°C
Resolution 0.1°C
Power P009H button cell
PRICES: £9.95 5+ 6.03

DIGITAL THERMOMETER/CLOCK Y137Q
A dual sensor digital thermometer for comparative temperature measurement, for example inside/outside temperature. 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.
Temperature range -50 to +70°C
Power 1 x AAA battery
Dims 107 x 25 x 13mm
Price .... **£8.50** 10+ 5.52

AQUARIUM THERMOMETER Y137P
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.
Temperature range -50 to +70°C
Resolution 0.1°C
Power P009H button cell
Price .... **£7.99** 10+ 5.19

LIGHTING

Fluorescent Lamps

Attractive white fitting with ribbed perspex diffuser. On/off switch. Transistorised cicuitry. Fitted cable. keyhole fitting.
Power......12Vdc 8W tube Dims.......360 x 62 x 37mm

L1652 Single tube...................**£7.95** 10+ 5.31
L1655 Double tubes.................**£9.95** 10+ 5.93

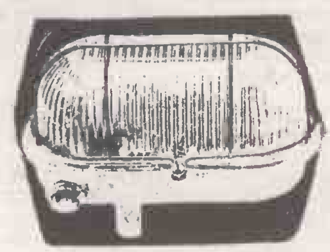
XENON STROBE

Low profile, fully sealed weatherproof flasher containing a high intensity long life xenon tube. Reverse polarity protected. Typically used on alarm boxes as a visual backup. Blue lens. Two bolt fixing.
Power output...1W
Voltage ....12V DC
Currency 150mA
Flash rate ....120/ min
Dims .... 70(dia) × 64mm
Fixings .... 2 × M5 screws on 56cm centres
L118A **£8.50** 10+ 5.18

Low cost torch

L120A QUARTZ HALOGEN SPOTLIGHT
Hand held quartz halogen spotlight with a 55W bulb, producing more than 250,000 candle power, directed by a concave, electro plated reflector. Supplied complete with hanging loop and 3.6m coiled lead with cigar lighter plug.
Power 12Vdc 55W
Dims 125 x 125 x 140mm (approx)
PRICES: £7.95 10+ 4.97

Outdoor Light



L1600 Weather resistant design with domed clear glass lens. 60W max. 190 × 120 × 100mm.
Price .... **£4.50** 10+ 2.48

PACKS AND KITS

Kit 1. THREE DIGIT PANEL METER and COUNTER MODULE Basic low cost counter. Two or more counter modules may be plugged together with 6-pin sockets & harness provided. Uses a single-unit 3-digit LED display. Built around the 14553 & 14551 chips. Box & battery provided. The separate COUNTER MODULE shows how to use the Kit as a counter. Has COUNT & RESET switches with debounce circuit built in to eliminate problems from noisy switches. 9V battery operation. **£16.53**

Kit 2. LCD TEMPERATURE METER Introduces 3 1/2 digit LCD and the very popular 7106 IC. This IC has been used in low-cost multimeters for over 13 years. We use it to measure temperature using a ordinary signal transistor as the sensor. Data sheets provided. Breadboard area so you can extend the circuit to build your own voltmeter, ammeter, resistance meter or extended-range temperature meter. Takes away the mystery of how multimeters work. Box provided. 9V battery operation. **£29.80**

Kit 3. LED DICE WITH SLOWDOWN. A kit to introduce you to electronics and circuit analysis. Seven LEDs arranged like a real dice face. Push the switch and the dice rolls then slowsdown. Ingenious circuit design used to minimise components. Uses 14017 & 555. Box included. 9V battery operation. **£9.70**

Kit 4. INTRODUCTION TO A POWER SUPPLY Batteries soon become an expensive way to power your electronic kit and electronic games. This is a basic power supply using two 7805 regulators. Input up to 20V AC from a transformer or power pack. Two regulated outputs - fixed 5V, the other variable. Box provided. Good introduction to electronics. **£11.48**

Kit 5. STAIRWAY TO HEAVEN. A game of skill to turn on the Stairway of 6 LED's as the bi-colour LED flashes. Introduces you to several electronics basic circuits with a surprisingly difficult game to play. Box included. Good introduction to electronics. 9V battery. **£9.79**

Kit 6. ROULETTE LED. Electronic game. Ten LED's in a circle. One LED is turned on at a time to simulate the spinning of a roulette ball around the wheel. Uses voltage controlled oscillator circuit. 'Ball' gradually slows down and stops on a number. 'Ball' speed can be adjusted. Uses 9V battery. **£12.44**

Kit 7. 3V FM TRANSMITTER. The most powerful 'bug' available for its size, 3V supply and number of components. Guaranteed to transmit over 100 meters within buildings and to 500 meters in the open. Easily tunable in the FM band. Greater range at higher voltage and better aerial. **£4.95**

Kit 8. LIGHT ALARM. Detects very small amounts oflight and sounds the piezo alarm. Put it in your cash box or cupboard. Uses Darlington photo transistor MEL12 and 14011 IC. Educational kit. **£5.74**

Kit 9. OSCILLATOR BUILDING BLOCKS. A learning module. Build and experiment with the Astable, Monostable and RS flip-flop Multivibrators on the one PCB. 6 LED's & 9V battery powered.. See and understand exactly how each works. Good introduction to electronics. **£5.65**

Kit 10. TOUCH and CONTACT SWITCH. Both types of switch are built onto the one PCB so you can see and explore how each type works. A battery can power the touch switch (2 contacts) but a mains power supply (like DIY Kit 4) must be used for the touch plate (1 terminal) to work. High quality 12V relay rated at switching 240V/3A supplied. Uses 14011 IC. **£8.05**

Kit 11. INTRODUCTION TO LM3909. CONTINUITY TESTER & LONG-LIFE FLASHER. Most IC's operate in the 4V to 40V range. The LM3909 from National Semiconductor changed this. Two PCB's supplied. A 1.5V D cell will flash an LED for over two years. Use as an imitation car alarm. A second PCB connects the chip as a 1.5V continuity tester. Seven pages documentation provided from National Semiconductor. **£7.83**

Kit 12. AUDIO-TO-LIGHT MODULATOR. Introduces the Optocoupler-triac MOC3010 and triac. Complete electrical isolation between input audio signal (low voltage circuit) and output light modulation (mains supply voltage levels) is achieved. **£7.27**

KIT 13. SOUND ACTIVATED SWITCH FOR TAPE RECORDER. Can be adjusted to turn on your tape recorder through its REMOTE plug. Has feedback and delay circuit for robust operation. Very sensitive. Proven circuit. Needs 6V plug pack for most stable operation. **£7.52**

KIT 14. 220V/240V STROBOSCOPIC LIGHT. Kit contains Xenon Flashtube as found on aircraft, camera flash units, signal beacons and disco lights. Adjust to flash from 1 every three seconds to 3 flashes per second. Caution: connects directly to mains power supply. Must be put in a suitable enclosed box before using. **£13.94**

KIT 15. 6V TAPE SWITCH FOR TELEPHONE. Record your phone conversations. Turns tape recorder on when the handset is lifted. Easy to connect to your phone line. Plugs into REMOTE & MIC jacks of your tape recorder. Best for 6V tape recorders. Educational Kit, not for illegal use. **£7.27**

KIT 16. FM TELEPHONE TRANSMITTER. Miniature transmitter which attaches in series to one of the two lines to your telephone. Transmits over 200 meters to an ordinary FM receiver. Transmits further if the FM receiver is near the phone line. Tune with ceramic trim cap. Uses the phone line as an aerial and power source. Not for illegal use. **£4.95**

KIT 17. LM386 AUDIO AMPLIFIER MODULE. This Kit is designed as a building block in other projects where a battery powered, variable gain audio amplifier is required. Data sheet from National Semiconductor included. **£4.22**

KIT 18. 9V FM TRANSMITTER. More powerful FM transmitter 'bug' than Kit 7. Tank oscillator coil built into the circuit board. Can be tuned anywhere in FM band. 9V battery operation. Over 400m range in the open depending on aerial used. **£5.95**

KIT 19. MAINS LIGHT DIMMER. Text-book light dimmer circuit using diac and triac. This circuit operates better than some commercial units. Does not flicker at low light levels. A choke and capacitor used to reduce RF noise which comes from the non-zero switching of the triac. Caution: connects directly to 220V/240v mains power supply. Must be put in a suitable box for regular operation. **£8.05**

KIT 20. 40kHz ULTRASONIC MOVEMENT DETECTOR CRYSTAL LOCKED. Matched 40 KHz transmitter/receiver pair of transducers detects movement at over 7 meters. Separate PCB for mounting the active units. Latch/reset PCB mounted switch on board. Sensitivity control. 9V battery operation. Transmitter is crystal locked using 40kHz crystal for maximum efficiency. **£20.44**

Kit 21. TWO STATION INTERCOM / HARD WIRED 'BUG'. Simple two wire intercom. Each unit with its own speaker, microphone and amplifier (LM386.) Can be modified to a hard wired 'bug'. With 4 strand ribbon cable the power to bug can be sent to the remote 'bug' unit from the receiving unit. **£15.19**

Kit 22. 9V XENON TUBE FLASHER. 9V battery powered xenon tube flasher. Transformer supplied. Wire is pre-wound on the bobbin but you must do the final winding of two outer coils. Full instructions provided. Trimpot to vary flash rate. Useful & educational. £13.99

Kit 23. LOW COST OPAMP FUNCTION GENERATOR. Cheap and simple circuit to generate square, (pseudo)sine and triangle waveforms in the audio range. Uses quad opamp LM348. **£5.22**

KIT 24. LOGIC PROBE. This is the most important piece of equipment for testing and measuring digital equipment. It is usually used in fault finding and testing but can also assist in design work and to find out how digital equipment works. Switch for either TTL or CMOS. Our own modem design using a PUT. Includes detection circuit for very fast pulses. Gives visual (3 LED's) and audio (piezo buzzer) response. **£9.13**

Kit 25. 220/240V MAINS TIMER. A 1 to 5 minute timer for the mains 200/240V power supply using standard electronic building blocks. Uses LM358 and BT136 triac. Has START & RESET buttons. Educational Kit mounts on box provided to show how it works. Caution: uses mains 200/240V power supply. Kit must be safely placed in closed box for routine use. **£12.14**

KIT 26. FIBRE OPTIC AUDIO LINK. Allows you to send sound through plastic 1mm fibre optic cable. Matched transmitter/receiver pair from Motorola. Two circuit boards with a microphone at one end and a speaker at the other. 14 feet fibre optic cable supplied. Will work over 200 meters. **£28.06**

KIT 27. TDA7052 1W AMPLIFIER MODULE. A 1W power amplifier building block designed to be part of a larger project needing a low power battery operated operation into an 8 ohm speaker. **£4.87**

Kit 28. SOUND ACTIVATED FM TRANSMITTER A sound activated switch and an FM transmitter joined together to make a sound activated FM Tx. Set the level of sound that it will respond to. Two stage transmitter needs tuning to get best results. Tuning Kit & instructions enclosed. Transmits up to a Km in the open depending on the aerial used. **£8.95**

KIT 29. COMBINATION LOCK. An introduction to a basic but fully working combination lock. Separate touch pad with 9 pads. Lock is reset if an incorrect digit is pressed. Relay capable of switching 240V supplied. 12V operation. Robust and versatile. **£11.31**

Kit 30. PIR MOVEMENT DETECTOR Modem design for PIR detector. Uses movement IC to replace the usual collection of op-amps & amplifiers. Has PCB mounted Fresnel lens. IC has circuits to turn off detector in day light. Two levels of sensitivity. **£30.45**

Kit 31. 9V SIREN A surprisingly loud siren for such simple circuit. Uses voltage controlled oscillator. Half watt, 8 ohm speaker supplied. 9V operation. Ideal to attach to an alarm system which needs an sound module. **£4.23**

Kit 32. TWO STAGE FM TRANSMITTER Our most powerful FM 'bug' to date. A two stage FM transmitter with an RF transistor (2N3563 or ZTX320) in its output stage. 9V operation. On/off switch mounted on the PCB. **£6.95**

Kit 33. LOW VOLTAGE TAPE RECORDER SWITCH Kit 15 was designed to switch on a standard 6V tape recorder when the phone was used. This is a redesign using an FET to switch low voltage tape recorders as low as 1.5V. Tape recorder will turn on when the phone is used. Plugs into REMOTE & MIC jacks of recorder. **£6.09**

RAILWAY MODELLERS PROJECT KIT

Many hundreds of these popular kits have already been sold since being published in our 'Modellers Guide to Electronics'. This gives full constructional details of all projects and is free on request. The kits are supplied with all necessary components and circuit board. Boxes are not included as in many cases projects will be built into existing equipment.

K621 Power Supply Unit. Uses train transformer to provide a 'clean' stabilised 12V supply for projects form 15Vac.
Price .... £2.75 10+ 1.82

K622 Flickering Fire. Simple circuit that created the effect of flickering flames in engine fire boxes or trackside bonfires.
Price .... £1.50 10+ 0.99

K623 Simple signalling system. Reed switches in the track are operated by loco; signals are changed from green to red as train passes. Manual reset/ over-ride.
Price .... £2.95 10+ 1.95

K624 Level Crossing Lights. As a train approaches the crossing the red LED's will flash. A second reed placed in the track after the crossing will turn them off.
Price .... £2.60 10+ 1.72

K625 Two Tone Horn. A simple circuit operated by a changeover switch.
Price .... £2.95 10+ 1.95

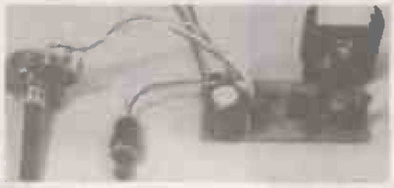
K626 Points Controller. Another small circuit that allows the heavy current required by points solenoids to be controlled by a small switch.
Price .... £3.10 10+ 2.05

K627 Steam Whistle. This is a more complex circuit, but simulates the sound quite accurately. Needs an amplifier and speaker.
Price .... £3.50 10+ 2.31

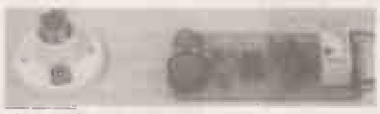
K678 1 Watt Amplifier. A simple IC based circuit designed to run off 12V. Use with steam whistle and chuffer kits.
Price .... £3.50 10+ 2.35

Following on from the initial 7 kits, another 8 have been designed and a booklet giving circuitry and constructional details of these is now available, price 50p, or free with any project.

K671 Simple Controller. Basic kit with one output that will enable a trains speed and direction to be controlled. Case supplied.
Price .... £11.95 10+ 8.00



K672 Advanced Controller. This kit simulates the inertia of a train, by providing slow acceleration even if the speed control is turned rapidly, and also allows the train to 'coast' when the power is turned back to zero. For more rapid braking, there is a stop button. Supplied with case.
Price .... £9.95 10+ 6.65



K673 Optical Sensor. An alternative to magnets and reeds - this kit uses a lamp one side of the track and a sensor the other. When the train interrupts the beam, a relay operates.
Price .... £4.50 10+ 3.02

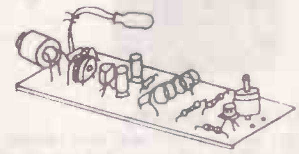
K674 Infra Red Sensor Transmitter. A more sophisticated version of the above kit.
Price .... £1.75 10+ 1.17

K675 Infra Red Sensor Receiver. Use with above Transmitter.
Price .... £4.95 10+ 3.32

K676 Chuffer Sound Effect. A novel kit accurately reproducing the chuffing noise of a steam loco. Needs amp and speaker.
Price .... £2.50 10+ 1.68

K677 Automatic Chuffer. A more sophisticated version of the above kit - the kit controls the chuffing rate by sensing the track voltage, so the faster the train goes, the faster it chuffs. Needs amp and speaker.
Price .... £2.95 10+ 1.98

K679 Automatic Reverse. This kit will reverse the direction of a train when it passes over a sensor in the track. Ideal for non-circular layouts.
Price .... £4.00 10+ 2.68



K647 9V FM transmitter kit. PCB 59x21mm. All parts and instructions to build this transmitter that operates on 88-108MHz and has a range of up to 1 mile. Powered by PP3 barttrery. **£6.95**

K648 Sub min FM transmitter. PCB only 33x15mm. All parts and instructions to build this transmitter that operates on 88-108MHz. Powered by a single watch cell (supplied). **£6.95**

K690 Electronic Rev.Counter. 2 range model, 0-1000 + 0-10,000 RPM with direction indicator. Requires 15-0-15V supply. **£19.95**

Adventure with Electronics Kit

Based on the book by Tom Duncan, the carefully chosed selection of parts enables the complete beginner in electronics to make working projects on the 'breadboard' supplied. No soldering is required, as the components simply push in the holes in the S-Dec breadboard to make contact. Apart from showing how to build specific projects, the book contains a wealth of information on the subject generally, all written in a very readable manner. All parts are supplied in a strong compartment tray with hinged lid. Things to make include simple lamp and battery circuits, parking light; rain detector; fire alarm; flashing lamp; morse buzzer; burglar alarm; organ; metronome; siren; intercomm; 3 radios. timer; computer counter, everything supplied including wire and sleeving – you just need a 4.5V battery.

BP651 Book £6.95
K651 Kit .... £22.95 10+ 15.30

Adventures with Microelectronics Kit

As with the previous kit, this includes all the parts to build numerous projects, all based on integrated circuits. Again a breadboard is used so no soldering is required, and all the parts can be used again and again. All parts are supplied in a strong compartment tray with hinged lid. Things to make include two tone door bell; warbling wailing siren; two octave organ. light counter, reaction timer; MW/LW radio etc. All that is required is a 9V battery.

BP652 Book £6.95
K652 Kit .... £31.95 10+ 21.30

Adventures with Digital Electronics Kit

This kit is based on the above book, details of which are shown on P17 All parts are included and supplied in a strong hinged plastic case.

BP653 Book £6.95
K653 Kit .... £52.95 10+ 35.30

K644 10 in one Kit. Mini electronic kit ideal for beginners – no soldering required. Build 10 exciting projects – kit contains breadboard and all parts needed to build any of the following great projects! Signal Injector, Battery tester, Audio amplifier, Continuity tester, Light activated switch, Siren, Morse buzzer, Organ, Reaction game, Metronome. All for **£9.95**

De Luxe Etching Kit

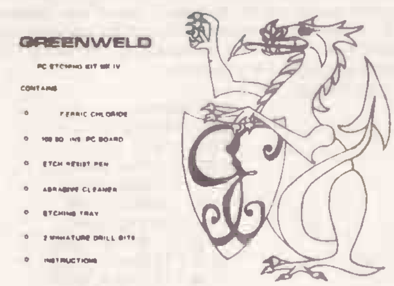
High quality plastic tray 285 × 165 × 42mm with clip-on lid for both etching boards and keeping kit together. Contains 2 packs Ferric Chloride, abrasive polishing block, etch resist pen with spare tip, two sheets of single sided photo resist coated board 160 × 100mm, 2 sachets developer, 200 sq ins, assorted single and double sided copper clad board, 1 pack DEK99 transfers, full instructions.

Order Code K662
Price .... £15.95 10+ 11.39

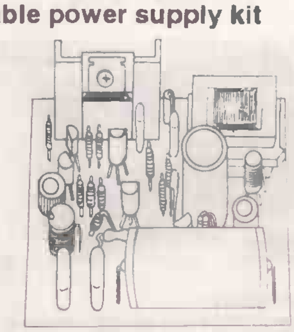
PC Etching Kit Mk V

Many thousands of these popular kits have now been sold, establishing it as one of the most successful. Each kit contains an etching tray, Ferric Chloride, Etch resist pen, 100 sq ins assorted copper clad board, abrasive cleaner and full instructions.

Order Code K661
Price .... £5.95 10+ 4.25



Variable power supply kit



Simple kit using our Z660 power supply to give a 10 watt variable output from 4-20V, fully stablized. Only needs 2 components added! Input must be at least 3V above max required output. Circuit features overload/short circuit protection and thermal cut-out.

SPECIFICATIONS:

Input .... 7-25V DC, 1.5A
Output .... 4-20V DC variable 10 watts max
Size 50x50x21mm
Weight 37.7g
Order code K642
Price £5.95

GREENWELD 27 Park Rd, Southampton, SO15 3UQ Tel 01 703 236363; Fax 236307

All one off and pack prices INCLUDE VAT; Qty prices don't

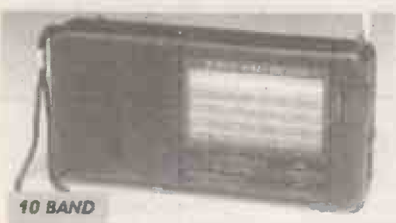
M

RADIOS

B118G MULTI-BAND RECEIVER
A compact, high sensitivity multi-band radio receiver covering Air, PB, WB, TV1, FM & CB bands. Rod antenna, earphone jack and DC adapter jack. Takes 4 x AA batteries (not included). Complete with carrying strap.
Frequency coverage:

CB	1-80 Channels
TV1	58-87 MHz
FM	88-108 MHz
Air	108-136 MHz
PB	145-176 MHz

B118G **£18.95**



10-BAND RECEIVER **B118CA**
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 transmissions. The tuning LED lights when a strong signal is present.
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 (41m)	
SW4	9.45 – 9.90MHz (31m)	
SW5	11.50 – 11.95MHz (19m)	
SW6	15.10 – 15.55MHz (19m)	
SW7	17.45 – 18.00MHz (16m)	
Power	3Vdc 150mA (2 x AA batteries)	
Dims	160 x 78 x 35mm	
B118CA	**£17.95**	6+ 10.62

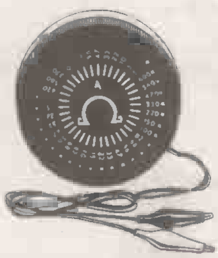
MULTI-BAND RECEIVER **B118E**
A compact 4-band radio receiver with PLL synthesised tuning, auto frequency scan, LCD frequency display, clock, alarm and 20 programmable frequency memories. AM/FM/LW and SW receiving. The tuning LED lights when a strong signal is present.
Frequency coverage:

AM	531 – 1602kHz	
FM	87 – 108MHz	
LW	146 – 281kHz	
SW	5.95 – 15.60MHz	
Power	4 x AA batteries (not supplied)	
Dims	195 x 40 x 120mm	
B118E	**£37.95**	3+ 24.93

15-BAND RECEIVER **B118F**
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 a telescopic rod aerial receives the FM and SW transmissions. 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 (75mm)	
SW3	4.5 – 5.1MHz (60m)	
SW4	5.85 – 6.23MHz (49m)	
SW5	6.95 – 7.42 (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	4 x AA batteries (not supplied)	
Dims	200 x 140 x 50mm	
B118F	**£23.95**	5+ 15.63

SUBSTITUTION BOXES



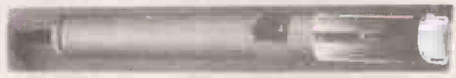
T222 A neat swivelling disc provides close tolerance substitution resistors of 36 preferred values from 5R to 1M. Simply fix clips into circuit and swivel until optimum result is achieved.
T222 **£8.95** 5+ 5.93

NIGHT SECURITY SENSOR **F603A**
Swivel mounted passive infra red sensor for the detection of body heat. The mounting arrangement allows horizontal and vertical swivel of 180°, allowing difficult to reach areas to be covered by the beams. A built-in adjustable photo detector prevents daylight operation. Adjustable timed on period. Provided with a walk test LED.

Detection range	200°C (fan shaped) 15m	
Auto reset time	9 secs to 10 mins (adjustable)	
Lighting load	2kW incandescent, 1kW fluorescent	
Power	220/240Vac 50Hz	
F603A	**£24.95**	6+ 16.00

SOLDERING IRONS AND EQUIPMENT

Solder Suckers

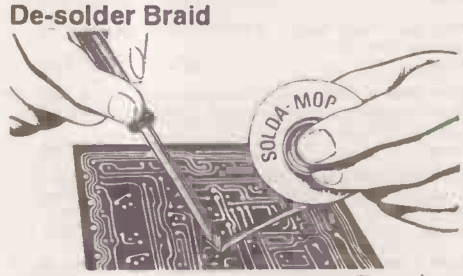


T133 High suction pump with automatic ejection. Finest quality all-metal construction. Heavy duty return spring and close tolerance manufacture give extra-high suction. Teflon nozzle. Gold and black.
Dims .... 19(dia) × 192mm
T133 **£3.95** 10+ 2.41

T135 Standard quality pump for general use. All metal body. Teflon nozzle. Red and black.
Dims .... 20(dia) × 195mm
T135 **£2.95** 20+ 1.56

T136 Replacement nozzle for desoldering pumps T133 and T135. Heat resistant Teflon.
Price .... 85p 20+ 0.43

De-solder Braid



G035 Desolder braid. 'Solda Mop' by Servinol. 1.5m length of braid in plastic dispenser.
G035 **£1.30** 50+ 0.81

60/40 tin/lead resin cored solder for electrical/electronic soldering.

Solder

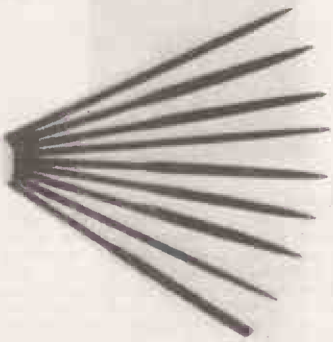
G001 500gm reel 18g multicore solder.
Price .... £5.50 10+ 4.28 25+ 3.43
G002 500gm reel 22g multicore solder.
Price .... £5.95 10+ 4.65 25+ 3.72
G018 Card containing 1.83 of 18g multicore.......... 70p
G022 Card containing 2½m of 22g multicore solder 70p

Y061Z SOLDERING AND SERVICE AIDS
The SK30m 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	320 x 250 x 70mm
Weight	1.48kg
Price	**£22.95**

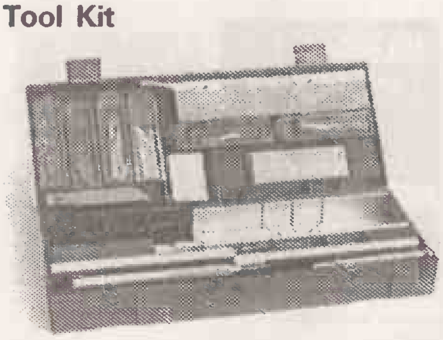
TOOLS

Files



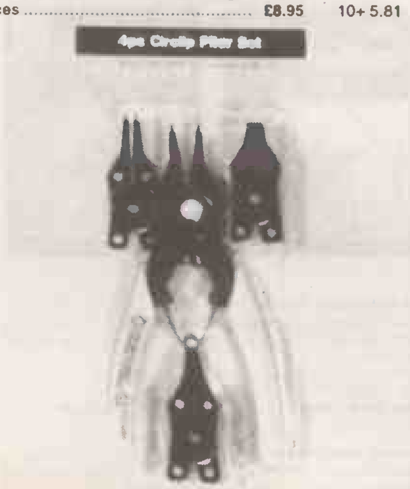
T1595 Needle Files. A pouch containing 10 various profiled files 140mm long for precision work at an economical price.
Prices .... £2.30 10+ 1.50

Tool Kit



N2688A A model making 30 piece tool kit, containing: 3 knife handles (light, medium and heavy duty), fine blade handsaw, sanding block, mitre block, scriber, tweezers, miniature screwdriver, 24 knife blades. All contained within a compact plastic case.
Price.. **£13.95** 10+ 9.18

YOO4B 16 Piece precision knife set consisting of 2 lightweight blade holders, one heavy duty blade holder and 13 blades in a variety of shapes and sizes. All contained within a hinged plastic case with magnetic blade holder.
Prices .... £8.95 10+ 5.81



Price .... £6.95 10+ 4.35
T213 Circlip pliers with 4 detachable heads for internal and external use. 2×180°, 90°, and 45° Effective range 10-50mm. Indispensable tool.

Wire Strippers

T1265 Automatic wire strippers. Will cope with insulated wire up to 6mm ^{2} dia and will strip up to 20mm. Incorporates cable cutter.
Prices .... **£2.95** 10+ 2.00

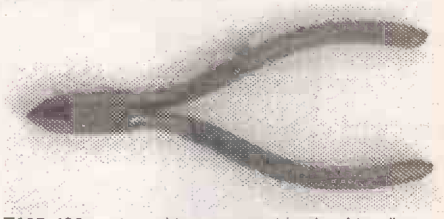
Low Cost G-Clamps

Now available in two sizes
1512 6" **£3.95**
1515 8" **£4.95**

Y006C PRISMATIC MAGNIFIER
Credit card size fresnel lens, plastic
PRICES: 35p 100+ 0.20

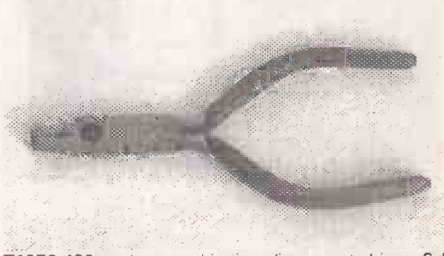
Y006E PRECISION MAGNIFIER
Fixed focus lens fits over graduated scale for magnified measurement. Metric and Imperial scales. All metal construction that folds flat. Vinyl wallet supplied. Size 53x48x39mm
PRICES: £7.20 10+ 4.68

Miniature Tools

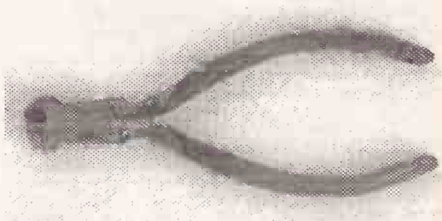


T105 120mm long side cutters, red insulated handles.
Prices.. **£1.95** 25+ 0.95

T106 125mm long snipe nose pliers, red insulated handles
Prices.. **£1.95** 25+ 0.95



T1073 120mm long combination pliers, serrated jaws. Side cutters. Red insulated handles.
Prices.. **£1.95** 10+ 0.95

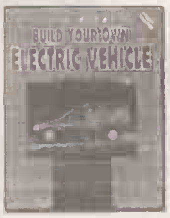


T1074 120mm long end nippers with red insulated handles
Prices.. **£1.95** 10+ 0.95

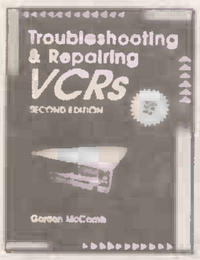
MD316 Mini Drill Precision geared plastic mini drill. Brass chuck will hold bits up to 1.2mm. Drill bit storage in handle. Length 115mm
MD316 £1.95 36+ 1.10

T170 Precison PCB mini-drill. Nominally 12V DC, but works from 5-14V. Supplied with collett or 0.8-1.2mm bits, +1mm bit. Power input via. 3.5mm plug. On/off switch. Current 250mA no load to 3.5A stalled. 6000rpm no load speed. 35mm dia ×165mm long
T170 £6.95 10+ 4.06

BOOKS



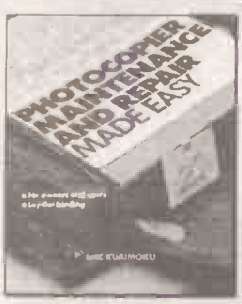
Build Your Own Electric Vehicle
Bob Brant - This book owes its shape to Stacey Pomeroy, the How-To Acquisitions Editor at Tab/McGraw-Hill. Stacey and the marketing team reasoned that, beyond actually building an electric vehicle it was also important to address the broader issues and expand on the past, present, and future of electric vehicle technology.
187x234mm, 310 pages, Softcover, 1994
ISBN 0 8306 4231 5
Order Code: MH232 **£13.95**



Troubleshooting and Repairing VCR's 2nd Edition
Gordon McComb - A guide to fault finding, maintenance and repair of video recorders, for non-experts. This book takes you through all the basic cleaning and repair techniques, that do not appear in the user manuals. Sections on what to tweak and what not, when to consult a professional, what to do when coffee is split inside a VCR, etc. Save a fortune on unnecessary repair shop visits
190x240mm, 400 pages, soft cover, publication date 1991
Order Code: MH102 **£23.95**

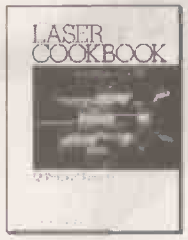
Troubleshooting and Repairing Audio & Video Cassette Players and Recorders
Homer L. Davidson - A guide to repairing domestic equipment of all levels from cleaning to component level fault finding. Items covered include peronal stereos, ghetto blasters, portable cassette recorders, car and home CD players, VCR's and camcorders. Hint and tips are available for all makes of equipment plus complete schematics for selected items and manufacturers. This coupled with a clear text and diagrams make this book a must for any repair technician, or anyone else who has lost hope of having domestic equipment repaired.
190x240mm, 414 pages, soft cover
Order Code: MH161 **£15.95**

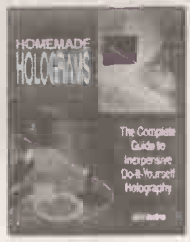
Compact Disc Player Maintenance and Repair Manual
Gordon McCombs - Specific guidlines for maintaining and repairing more than a 100 brands of CD players. Packed with quick and reliable answers to the problems of maintaining and repairing CD players, this illustrated do-it-yourself guide takes the apprehension out of first-time repairs. "A valuable accompaniment to a CD purchase . . should be in the reference library of anyone who owns or is planning to own a CD player" (Midwest Book Review)
190x235mm, 244 pages, soft cover, publication date 1987
Order Code: MH137 **£11.95**



Photocopier Maintenance and Repair Made Easy
Eric Kuaimoku - Although your photocopier might look like a complicated bundle of machinery, you can keep it running trouble free without the help of costly professionals. No experience is necessary! With this money-saving guide and a few lo-cost tools and, cleaning supplies, you'll be able to locate and solve most of the problems you'll ever encounter. Step-by-step instructions and dozens of helpful illustrations show you how to troubleshoot and repair the basic components found in virtually all photocopiers.
189x234mm, 197 pages, Softcover, 1994
Order Code: MH229 **£11.95**

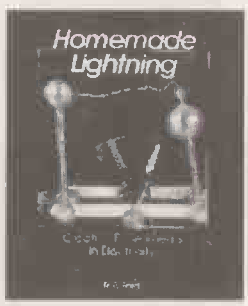
All Thumbs Guide to Telephones & Answering Machines
Gene B. Williams - Keep your telephones running trouble free with this money-saving All Thumbs Guide - no experience necessary! Gene B. Williams' clear step-by-step instructions make it easy to safely troubleshoot, test, and repair problems with virtually every type of telephone and answering machine
188x285mm, 129 pages, Softcover, 1994
Order Code: MH226 **£7.95**



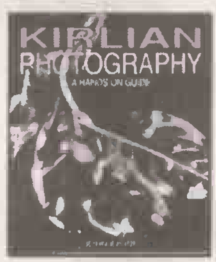


The Laser Cookbook
Gordon McComb - A hands-on introduction to laser theory and operation, with over 80 practical and easy-to-follow projects. These projects range from simple acoustic modulation of laser beam to super-accurate interferometres that precisely measure the speed of light, light wave-lengths, and light frequencies. It is well written, amply illustrated, and lots of fun." (Modern Electronics).
190x235mm, 404 pages, soft cover, publication date 1988.
Order Code: MH133 **£18.95**

Homemade Holograms: The Complete Guide to Inexpensive, Do-it-Yourself Holography
John Lovine - This is an ideal 'first step into the fascinating world of holograms. The author describes new procedures - using equipment readers can make themselves - that take the complexity out of producing simple white light reflection and transmission holograms of people, as well as computer graphics, and solid objects.
190x235mm, 235 pages, soft cover, publication date 1990.
Order Code: MH144 **£11.95**

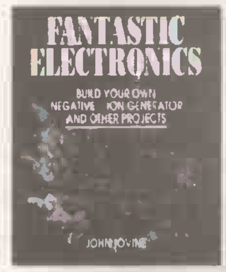


Homemade Lightening: Classical Experiment in Electronics
R A Ford - This electronics enthusiast's guide to designing, building, and using classic high-voltage generators and associated equipment. There is a facinating collection of experiments that reveal the wide-ranging impact of electrostatics on such topics as motor design, aerodynamics, gravity, photography, and meteorology.
190x235mm, 194 pages, soft cover, publication date 1990.
Order Code: MH149 **£11.95**



Kirlian Photography
A Hands-on Guide
John Iovine - In *Kirlian Photography*, John Iovine gives you all the hands-on-guidance you need to produce Kirlian photographs using standard 35mm or video cameras. You'll also learn about the history of electrophotography and many of its possible applications in medicine, industry, and the military. Especially illuminating is his discussion of the "phantom leaf" aura that continues to baffle scientists.
ISBN 0-8306-4457
187 x 233mm, 133 pages, Softcover, 1994
Order Code MH 222 **£14.95**

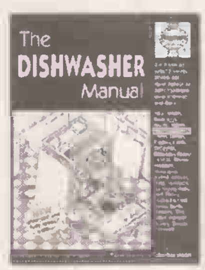
The Secret Life of Quanta
Dr M Y Han - Less than one hundred years ago life was simple: a wave was a wave and particle a particle. At the turn of the century, however, things became more complicated when it was found that waves could be particles and particles could be waves - and so was born quantum mechanics one of the most significant and successful scientific theories. The Secret Life Of Quanta explores this fasinating theory in a user friendly manner and some of its uses in a range of fields from biology to electronics.
237x158mm, 183 pages, Hard Cover.
Order Code: MH168 **£14.95**

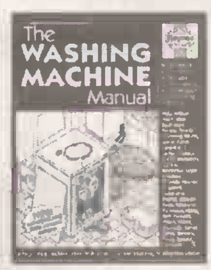


Fantastic Electronics
John Lovine - An eclectic blend of twenty three science and electronics projects for anyone who has an interest in the world around them. Topics covered range from genetics - recombinant DNA and genetic engineering in the home laboratory - to Kirlian Photography (auras and other such peculiarities), taking it along the way of negative ions, bio-feedback, ELF, Geiger, counters, magneto, hydrodynamics, plasms, air pollution, holography, and much more. Not to be missed off any book list
190x240mm, Soft Cover, Publication date 1993
Order Code: MH165 **£14.95**

Microwave Oven Repair
(3rd Edition)
Homer L Davidson
A step by step guide to repairing microwave ovens that covers all aspects of modern ovens from magnetron replacement to mending defective switches and performing leakage tests. Includes dozens of circuits used in many oven made by various manufacturers, and specific solutions to more than 200 common microwave oven faults
ISBN 0-07-015678-6
1994 Paperback, 215 x 235mm, 455 Pages.
Order Code MH261 **£20.95**

Electric Motors and Control Techniques
(Second Edition)
Irving M Gottlieb
Perfect for anyone who works with or is interested in electric motors, this practical guide explains how different type of motor operate, and how electronic control devices can be used to improve efficiency in a wide range of applications. Update and expanded to cover state of the art digital stepper motors and microprocessor controls, as well as new motors and control techniques for electric vehicles.
1994 Paperback, 215 x 235mm, 294 Pages.
ISBN 0-07-024012-4
Order Code MH253 **£20.95**





The Dishwasher Manual *(New Edition)*
Graham Dixon-Comprehensive guidance on DIY repair and maintenance of all makes of dishwasher machine, in a step-by-step guide.
Hardback, 270x210mm, 132 pages, 225 Illustrations
ISBN 1 85010 866 8
Order Code: HP115 **£12.99**

Washing Machine Manual *(2nd Edition)*
Graham Dixon - Comprehensive guidance on DIY repair and maintenance of the household washing machine.
Hardback, 270x210mm, 192 pages, 326 Illustrations.
ISBN 1 85010 860 9
Order Code: HP118 **£12.99**

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Pay the price shown per item or pack - you'll receive double the quantity!

(Except where prices are indicated by SALE flag)

CONNECTORS

AUDIO/VIDEO

PHONO

Z3525 Z3813 Z5760 Z3811 Z3812

Z3525 Phono plugs - the old fashioned type with 2 part hard plastic cover held on with metal sleeve. **Pack of 40 £2.00;** 1000+ 0.03

DIN

Z3813 4 pin plug with pivot. **10/£1;** 100+ 0.06
Z5760 Standard 5 pin 180° black. Normally 44p each. **Pack of 100 £15;** 1000+ 0.07
Z3811 5 pin 240° plug and in-line socket. Normally 85p/pair. **6 pairs for £2;.** 100+ 0.20
Z3812 5 pin 240° in line socket. **10/£1;** 100+ 0.06

Z1715 Z1716 Z2055 Z1868

Z1715 PC mounting 6 pin DIN socket made by Cliff. **100/£10.00**
Z1716 PC mounting 7 pin DIN socket. **100/£10.00**
Z2055 8 pin DIN socket, PC mounting. **Price 6/£1**
Z1868 5 pin DIN 180° socket. Panel mounted by means of a press on clip at the back. **Price 10/£1.00**

Z2025

Z2025 14 way DIN type line sockets with locking sleeve. **Price £1.00**

JACK

Z2059 Z5791 Z2820

Z2059 3.5mm Chassis socket, 3 terminals 8mm nut is missing. **Pack of 20 for £1.00**
Z5791 Super quality mono 3.5mm switched socket with chrome fixing nut, at a give away price. **Pack of 15 £2.00;** 100+ 0.09; 1000+ 0.07

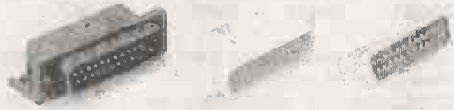
D

X3130 Z3518

X3130 15 way D plug, right angle PCB mounting. Gold plated. **4/£1.00;** 100+ 0.15
Z2429 15 way 'D' connector sliding lock retainer by ITT type DA51220-1. DP ??? **Only £1.00;** 100+ 0.40
Z3518 15 way right angle gold plated socket. **4/£1;** 100+ 0.15

Z3519 Z1505 Z2397

Z3519 25 way right angle gold platedsocket **3/£1;** 100+ 0.25
Z1505 25 way angled solder socket **60p**
Z2397 25 'D' type shells. Can be used as either plugs or sockets, according to pins fitted. (No pins available). **Pack of 6 for £1.00**



Z5080 Z2005 P1944

Z5080 Right angle PCB mounting 25w 'D' Plug in plastic housing by AMP; HDP-20. Gold plated contacts. **Price Pack of 24 £5.00;** 100+ 0.10; 1000+ 0.06
Z2005 25 way 'D' PC right angle mounting plug. **Price 50p**
P1944 23 pin D plug, solder bucket for use with the Amiga. **£1.50;** 25+ 0.90
Z5144 Pack of 10 25 way 'D' hoods with clamps and screws. **£1.50**

Z3520 Z2430 Z3038

Z3520 37 way right angle gold plated socket **2/£1;** 100+ 0.35
Z2430 37 way 'D' type plug, IDC type. **Only £2.00;** 100+ 1.00
Z2003 37 way 'D' cover, plastic. **Price 80p**
Z3038 50 way D type IDC socket by Thomas & Betts. **£2.00**

X5729 Set of 3 back to back connectors - one each of:
25W D socket - 25W D socket
25W D socket - 25W D plug
25W D socket - 36W Centronics plug.
These are not 'straight through' connectors, but covers are easily removable to wire in any way desired. **Price for all 3: £3.95**

SALE PRICE £2.95

CO-AX

Z3526 Z2854 Z2022 Z2040 Z2849

Z3526 Panel mntg (flush) plastic coax socket. **Pack of 25 £2.00;** 100+ 0.06; 1000+ 0.04
Z2854 Coax joiner - this is a back to back plug. Nice quality. **Pack of 10/£2.00**
Z1406 Flush mounting coax socket with plastic surround. Normally 32p. **Prices 10/£1.50;** 100/8.70; 1000/60.90

BNC, TNC, etc

Z3014 Standard 75R BNC Plug. Cat price 99p. Superdeal **5 for £2.00;** 100+ 0.25; 1000+ 0.20
Z2113 BNC free plug. **Only 75p**
Z3794 BNC twist on straight plug from RS Components Ltd. Their price 2.48. **Our Price £1.00**
Z2022 BNC PCB mounting socket. 50R by Belling Lee. **Price £1.00**
Z2021 Right angle PCB mng 50R BNC socket. **£2.50**
Z2040 BNC Bulkhead Socket 50R. DP £4.44. **Our Price £2.00**
Z2849 TNC-SMA Adaptor by Astrolab type 29068-2. Square flange 4 hole fix chassis mounting. High quality gold plated individually bagged. **£2.00**
Z1987 75R Sealectro miniature RF connector type 50-107-0000. List price £3+. **Our Price £1.00**

MULTIPLE PLUGS & SOCKETS

SIL & DIL

Z3449 Z2158 Z1892 Z1684 Z3170

Turned Pin SIL sockets and plugs
These are made by Harwin and can easily be broken into a smaller number of ways if required.
Z3449 12 way. **Pack of 15 £2**
Z2159 Turned pin SIL socket, 7 way notched so can be easily broken into any number of ways. Gold plated. **Pack of 25 for £1.00**
Z1548 32 way turned pin header plug, gold plated. List £2.40 each. **Our prices 80p;** 10/5.20; 100/39.15
Z1571 10 way, 0.1" pitch header plug, gold plated. List 51p. **Our prices 20p;** 10/1.30; 100/8.70

Square Pin
4030-03 3 pins. **Price 10/60p;** 100/3.50; 1000/26.00

X3241 Track pins - for connecting tracks on opposite sides of a PCB. They come in strips of 50 pins which snap apart upon insertion. For 0.84mm dia holes. **Pk/100 £1.00**

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DIP Sockets

Z1892 14 way gold plated wirewrap DIL sockets **Price 20p**
Z5239 18 way GP wirewrap by Vero. Tube of 10 **£3.00**
Z1684 24 pin IC socket. **Pack of 10 for £1.00**
Z3170 DIL to QIL socket 16 pin. **Pack of 20/£1**


Z2007 Z739

Z2007 IDC 14 way DIL plug. Normally £1.00. **Price 3/£1.00;** 100+ 0.17
P5430 14 pin DIL header plug, gold plated solder type. As listed in our catalogue at 65p - special purchase price **3 for £1.00;** 100+ 0.16; 1k+ 0.12.
Z739 40 way DIL header plug, gold plated. **3 for £1.00**

PLCC & PGA


Z3601 Z3442

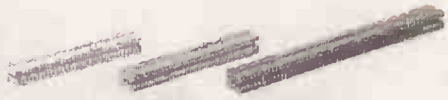
Z3699 44 way PLCC socket. Std 0.1" grid. List 3.61. **Our Price £1.00**
Z3442 PLCC socket. 68 pin. DP 3.50. **Our Price £1.50;** 25+ 1.00
Z2871 PLCC socket 13x13 114 pin DP 5.18. **Our price £2.00**
Z3601 PGA sockets, 16x16 159 way. **£3.00;** 25+ 2.00
PGA sockets in various numbers of ways. These normally sell for around 3.50-8.00 each. Now look at our prices!

Z3443	68 way	10x10	£1.00
Z3444	68 way	11x11	£1.00
Z3445	121 way	13x13	£2.50
Z3446	169 way	17x17	£3.00

EDGE CONNECTORS
(GP = Gold Plated)
0.1" pitch


Z2155 Z2114 Z5083 Z2061 Z2426

Z2155 Back to back 0.1 pitch card edge connector. The plastic moulding has room for 12 double sided contacts, but only numbers 3, 4, 5, 6, 7, 8, 9 and 10 are fitted. Gold plated. **Price for pack of 10 £1.00;** 100+ 0.05
Z2114 34 way IDC card edge socket. **2/£1.00;** 100+ 0.25;
Z5083 40 way IDC ribbon cable terminating card edge connector. Gold plated. **Price for pack of 10 £2.00;** 100+ 0.10; 1k+ 0.06
Z2061 Edge connector, 0.1 DS 25 way. Right angle PC mounting. **Price £1.50**
Z2426 25 way double sided 0.1" pitch edge connector, gold plated, solder tags. **Only £1.00**


Z1828 Z3611 Z3612

Z1828 31 way double sided 0.1" pitch gold plated PC mntg. **£1.00**
Z3611 0.1" pitch 36 way double sided. **£1.50;** 100+ 0.85
Z3612 Bit of an odd one this - 0.1" pitch 60 way. 6 ways either end are double sided, rest are single sided. No pin at position 7. **£1.50**
Z742 Polarising key. **Pack of 10 for 50p**


Z2154

Z2154 29 way double sided 0.1 pitch, gold plated edge connector (pin 5 missing) for right angle PCB mounting clipped onto plastic bracket. **Price £1.00;** 25+ 0.60; 100+ 0.35


Z9661 Z9662 Z9660 Z9667

Z9661 15 way double sided; pins 1,12 & 14 missing. GP. PC mntg **40p**
Z9662 23 way double sided, pin 3 missing. GP. wirewrap **140p**
Z9663 24 way single sided GP PC mntg **80p**
Z9664 24 way double sided GP PC mntg **140p**
Z9665 25 way single sided GP PC mntg **82p**
Z9660 32 way single sided GP, solder tags **110p**
Z9667 40 way double sided GP, solder tags **220p**

X3237 Bracket for fixing edge conns to chassis (suit Z9662-5). **Pk 20/£1.00**

0.15" pitch


Z9681 Z9683 Z9684

Z9681 8 way, pin 4 missing GP PC mntg **40p**
Z9683 40 way single sided GP Solder tags **140p**
Z9684 40 way double sided GP wirewrap **195p**

0.156" pitch
Z9703 18 way single sided GP solder tags **90p**


Z3763 Z2575

Z3763 50 way GP IDC PC mntg plug with ears. **£1.00**
Z2575 Low cost 20 way plug and IDC socket **70p/pr**


Z3613 Z2594 Z3614

Z3613 0.125" pitch 40 way double sided, right angled. **£1.50**
Z2594 50 way DS 0.125" pitch edge connector. PCB mntg. **Only £1.00**
Z3614 0.125" pitch 50 way double sided. **£1.90**


Z2428 Z2540 Z2313

Z2428 PC mounting edge connector, 13 way double sided 0.15" pitch. Gold plated. **Pack of 2 for £1.00;** 100+ 0.25
Z2540 Edge connector, 10 way DS 0.156" pitch, gold plated with fixing holes. **2 for £1.00**
Z2313 12 way DS edge connector for C64 computers (0.156") **£1.00**


Z2382 Z5082 Z3615 Z5299

Z2382 Double row 0.1 socket PCB/chassis mounting 16 way x 2 but only 1 row of pins. **Pack of 5 for £1.00**
Z5082 DIN 41612 right angle plug 64W (A and B). Gold plated contacts. **Price Box of 50 £10.00;** 250+ 0.10; 1k+ 0.06
X6129 As above but A and C. **2/£1.00**
Z3615 DIN 41612 96 way socket, right angle PCB mntg. DP around 4.00. **Our price £1.00**
Z2158 6 way terminal socket for 1mm plug. **Pack of 25/£1.00;** 250+ 0.01
Z5299 Here's a great pair of connectors for anyone using a large number of wires - ideal for railway modellers. DIN41612 style 96 way matching plug and socket. The plug is shrouded and right angle mounting - the socket can be wirewrap or PCB mounted. The DP on these is quite high, as they are used where reliability is important - you're looking at about a fiver for the pair. We've got about 200 in stock now at **£2.00 a pair.**

Z2156 PCB right angle mounting, card edge connector. 15 way double sided with pin 6 missing. **Price for pack of 10 £1.00.** 100+ 0.05

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PCB MOUNTING

Z5085 Z5088 Z3574 Z3572

Z5085 11 way single sided PCB mounting edge connector. 0.1 pitch. Sample free. **Price for pack of 250 £5.00;** 1k+ 0.015; 10+ 0.01
Z5088 14 way 0.1" locking socket. Insert flexible wiring and push on clamp to lock into position. Sample free. **Price Pack of 10/85p;** 100+ 0.04; 1k+ 0.02
Z3574 Connector strip. PCB mntg. Right angle DIL socket on 3mm pitch. 62 way. **3 for £1.00**

BARRIER STRIPS

Z3572 High quality, heavy duty barrier strip. 9 way screw terminals. PCB mntg, but needs 2.2mm dia holes. **3/£1.00**
X3239 5 way with solder tags. **4/£1.00**
X3240 2 way with solder tags **6/£1**
X6128 10 way. Bit unusual - screws along centre with two solder tags on each side. Chassis mntg. **2/£1.00**

PCB PINS

Z2026 Cambion PCB pins. High quality double sided. Needs 1.8mm hole. Free sample available. **Packs of 1000 £8.50**

5342-26 5342-40 Z2149 Z1863

Molex headers 0.1" pitch. Ideal for Veroboard etc at amazingly low prices.
5342-26 26 pin boxed header plug. **3/£1.00;** 100+ 0.15
5342-40 40 pin boxed header plug. **3/£1.00;** 100+ 0.15
Z2150 Amphenol connector. Right angle, 60 way plug. **Only £1.00**
Z1863 33 way x 2 right angle PCB plug **2/£1;** 100+ 0.35

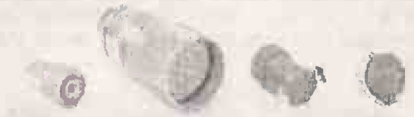
Z3182 Z3617 Z2012 Z743

Z1382 10 way commoning block, 2 x 5 way 0.1" pitch by Amp. **Prices 10/£1.00;** 100/6.10

Printed circuit connectors for mounting directly on to a PCB, 0.2" pitch:
Z3617 6 way plug. **4/£2.00**
Z2011 12 way plug (1.84) **80p**
Z2012 12 way socket (2.82) **£1.20**
Z743 24 way socket, connections on 5mm centres. (DP £4.74). **Our Price £1.50**

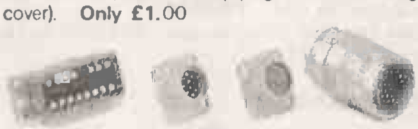
PROFESSIONAL

Z5804 RS Components Ltd modular backshell shielded side entry block. **3 for £1.00**



Z769 Z1999 Z2140 Z2141

Z769 BNP plug (it says on the packet 101.BNP/PTFE/7C) so if you're desperate for one of these we've got them! **Price 50p**
Z1999 9 pin plug, circular. 8 pins around the edge, the 9th is a thicker centre pin. Made by Contact. Very solid housing. **Price 3/£1.00**
Z2140 Amphenol 4 way socket, cable mounting with cover. **Only £1.00**
Z2141 Amphenol 5 way plug, cable mounting (no cover). **Only £1.00**



Z5078 Z2142 Z2143 Z2144

High quality plugs and sockets as used on military equipment, at a fraction of normal prices.
McMurdo Red Range
These are red nylon connectors with a low insertion/withdrawal force. Current rating 5A. Op voltage 800V. Pitch 4.7mm. Sockets have floating bushes. 90mm fixing centres. DP in brackets.
Z5077 8 way socket (5.00) **£1.00**
Z5078 16 way socket (7.92) **£1.50**
Z5079 32 way socket (17.48) **£2.00**
Z1485 RC4200-8S 8 way gold plated socket - matches McMurdo red range, but blue. **£1.50**

Z2142 Amphenol 11 way plug, chassis mounting. **Only £1.50**
Z2143 Amphenol 12 way socket, chassis mounting. **Only £1.50**
Z2144 Amphenol 24 way plug, chassis mounting. **Only £2.00**

Z2145 Z2146

Z2145 Amphenol 15 way plug, chassis mounting. **Only £1.50**
Z2146 41 way socket, McMurdo Microconnector. Arranged in 2 rows of 14 and 1 row of 13 sockets.. **Only £2.00**

POWER

CRIMP CONNECTORS

Z3618 Right angle 0.25" red receptacle. **Pack of 100 for £6.00**
Z2555 Crimp connector socket, 0.6mm square. **Pack of 100 £2.00**
Z1870 Crimp sockets for above pins. **Price 25/£1.00**
Z1988 3.2mm receptacle, brass. **Pack of 50/£1**
Z1989 5.0mm receptacle, brass. **Pack of 50/£1**
Z1990 ¼" receptacle, tinned. **Pack of 50/£1.50**
Z1991 ¼" locking receptacle, tinned. **Pack of 50/£1.50**
Z1992 ¼" blade, copper (for use with above). **Pack of 50/£1.80**
Z1546 Crimp terminal, box type for use on header described below. Gold plated. **Prices 100/£3.00;** 1000/19.15

DC - LOW VOLTAGE

Z576 Z2344 Z2345 Z5340 Z2031

Z576 2.1 power socket, chassis mounting. **Price 10/£1.00;** 25/1.75; 100/6.10; 1k/43.50
Z2344 High quality 2 pin + earth socket, cable mounting. Made in Germany, type no STAK20, rated 250V 6ADC, 16AAC. **Only £1.00**
Z2345 As Z2344 but chassis mounting. **Only £1.00**
Z2346 2 pins + earth cable mounting plug to fit Z2344/5. **Only £1.50**
Z5340 Hubbell, 3 Phase Twistlock receptacle 3 pole 4 wire rated 20A 250V US 3 phase socket. **£1.50**
Z2031 Continental style 3 pin plug. **£1.00**

MAINS

Z5733 Z598 Z5859 Z5860

Z5733 PC mntg IEC 3 pin plug. List £1.00. **Our price 4/£2.00;** 25+ 0.30, 100+ 0.20
Z598 PCB mounting 6A IEC power plug by Switchcraft. British made. **50p**

Pair of standard Bulgin ECC mains connectors - chassis plug with 0.25" tabs and right angle main socket. Rated 6A 250V.
Z5859 Chassis plug **5/£2;** 100+ 0.25; 1k+ 0.20
Z5860 Line socket **3/£2;** 100+ 0.40; 1k+ 0.30
Z5862 Z5859 Plug and Z5860 socket. **£1 per pair**

Z692 Z2027 Z5815

Z692 Fused mains inlet/outlet. Extremely useful for equipment - allows 'linking' between units, thus avoiding numerous mains leads. Normally costs around £2.50. **Our price £1.00**

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LEADS & CABLE

AUDIO/VIDEO LEADS

T178 Z5254 Z5524

T178 7 pin DIN plug to 3 pin DIN plug and 2.5mm jack plug. Colour grey. Length 1m. **5 for £1.00.**
Z5254 2m long 4 core sheathed cable fitted with a sleeved grommet. 4 pin DIN socket to open end. **4 for £1.00;** 100+ £0.12.
Z5524 2 core lead 4.5 long with 3 pin DIN plug either end. **£1.50**

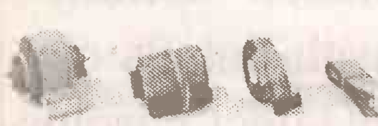
Z5034 Z4353

Z5034 PL259 + 2 phono plugs to phono plug + 5 pin 180° plug. **£1.95** £0.98.
Z5053 PL259 + phono plug to 2 phono plugs. **£1.72** £0.86
Z5037 PL259 + phono plug to BNC plug + 3.5mm plug. **£2.46** £1.23
Z5038 Pl259 + phono plug both ends. **£2.12** £1.06.
Z4353 6 way DIN lead; 1.5m lead terminated one end with a 6 pin DIN plug. Bare wires the other end. **Pack of 4 for £1.00;** Pack of 100 for £12.00; Pack of 1000 for £90.00

Z5974 Video lead. 5 pin 180° plug one end connecting (a) via a 2m lead to a phono plug and (b) via a 5m lead to a BNC plug. Intended for the C64. **£2.00**

T120B Video/audio dubbing kit. Screened lead 5 pin DIN plug to two phono skts; screened lead - 6 pin DIN plug to 4 phono sockets; 1.2m. twin screened lead - 2 phono plugs to 2 phono plugs; 2 adaptors - phono socket to PL259 (UHF plug). 2 adaptors - phono socket to BNC plug. 1 adaptor - phono skt to 0.25" mono jack plug. Normal price £7.95 **Special Price £4.95**

COMPUTER LEADS



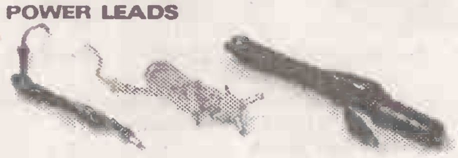
Z2303 Z4339 Z5265 Z2161

Z2303 Computer printer lead - 36 way centronics plug to 20 way IDC socket, 1m long. **£2.00**
Z4339 BBC Printer Lead. 1m long with 34 way card edge connector one end and 34 way IDC socket the other. **£1.95**
Z5265 9 way ribbon cable just under 1m long with 10 pin DIL plug (0.1 pitch) one end and 9 way header socket the other. Pack of 10 leads **£2.00.**
Z2161 14 way ribbon cable 500mm long terminated both ends with 14 pin DIL header plugs. **£1.00**

X6025 Z5973 Z5264

X6025 Printer lead. 24 way Centronics plug one end, 36W Centronics plug the other. 1.75m long. **£2.95**
Z5973 Computer lead 1.5m long. 15 core cable terminated one end with 36W centronics socket and other with DS 12W 0.156" edge connector. Intended for the C64. **£2.00**
Z2564 Lead BNC plug to gold plated SMB socket 310mm long. **£1.00**

POWER LEADS



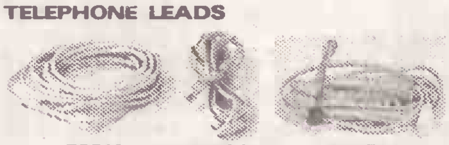
Z5251 Z5401 Z5367

Z5251 1m long twin flex, 2.5mm power socket to open end. Fitted with sleeved square grommet. **Pack of 3 for £1.00;** 100+ £0.18
Z5401 Spider leads - like our PO650 at 99p, but they are grey, 2m long and have a 1.3mm power plug (for Walkmans) as well as the normal 2.1 and 2.5 power plugs, and 2.5/3.5 jack plugs. **2 for £1.00;** 100+ £0.24; 1k+ 0.16
Z5367 Car power lead - cigar plug one end, 2.1mm power plug the other. 2m long. **£1.75;** 100+ £1.00

Z5848 1.9m 10A 125V lead with US style plug one end, IEC socket the other. **£1.00;** 100+ £0.60

X6024 Megger lead. Large insulted crocodile clip one end, then single core lead splits into 2, terminating in a 4mm plug and spade terminal. Over 3m long. **£1.50**

TELEPHONE LEADS



Z5527 Z5531 Z5673

Z5531 3m 6 core flat grey lead fitted with IDC line plug both ends. **£2.95**
Z5673 Telephone Lead. 2.5m straight + 2m curly with 4 way BT plug one end & 4W IDC socket the other. **3 for £1.00;** 100+ £0.20.

Z5529 Z5530 Z5526/8

Z5529 Telephone line cord. Flat grey 6 way with standard BT plug one end, open the other. Fitted with square grommet. 3m long (our 2m long version of this costs £2.95). **ONLY £1.50** 100+ £0.75.
Z5530 As above, but fitted with a 6 way socket on open end. **£1.60** 100+ £0.80

Z5526 8 telephone core cable 15m long. **£1.95**
Z5527 8 telephone core cable 10m long. **£1.30**
Z5528 8 telephone core cable 5m long. **80p**

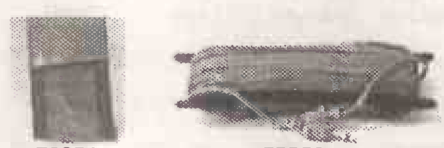
WIRE

Z1806 Z5793 Z5770

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

Z5793 Some fairly useless bits of twin speaker cable - 10 x 390mm lengths of black 16/0.2mm, both ends stripped and tinned. **Total 3.9m for 20p.**

Z5770 40gm (4.5m) reel of 23SWG enamelled copper wire (solder thru type). Would normally cost around 80p. **Special low price 5 for £2.00;** 100+ £0.25.



Z8851 Z5553

Z8851 Screened and jacketed 50 way ribbon cable. Found a few more reels of this popular item. DP £200+ **£2.50/m**

Z5553 Intercom lead - 15m of twin flex wound on a handy frame with a 2.5mm plug either end. **Great value at 60p;** 100+ £0.25; 1000+ £0.20.

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

Z2062 1.74m long thin multistrand steel cable with loop at both ends. 0.7mm dia. Very strong and flexible. **Price £1.00**
X3098 Some very soft tinned copper wire 0.2mm dia. 30g made by Degussa 4oz reel. **£5.00**

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X6079 Adastra M51 dynamic mic (Foster DF-1X). Omnidirectional model, 100-10kHz, -59dB+/- 3dB at !kHz. Imp 50k. Supplied boxed with mic holder, desk stand and neck strap. Great value at **£7.95**

SALE PRICE £5.95

MICROPHONE

Z5964 Audix HM230S/Tact UDM 100 professional dynamic mic with on/off switch and cardioid characteristics. 5m lead with XLR socket fitted mic end. Impressive spec! 600R impedance. Supplied with clip and adaptor, individually boxed. List price £44.06

SALE PRICE £14.95

MICROPHONE

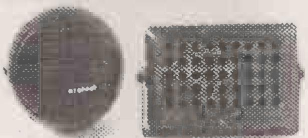
Z5961 Shure 527B professional fist microphone with push to talk switch. Superb quality and value with all these features:
- **A.** Dynamic
- **B.** Triple flex curly cord
- **C.** Noise cancelling
- **D.** Low impedance

List Price ia an incredible £71.67!

Individually Boxed
Our Price: **£29.95**

SALE PRICE £19.95

2 GREAT COMMS SPEAKER OFFERS!



X6013 **X6014**

X6013 Stomo speaker LS6001 113mm dia. Clever design enables case to be swivelled to allow straight or angled mounting. Case houses 8R 5W unit. 2m lead. **£4.95**

X6014 Rectangular solid plastic case, 150x95x50mm with wall mounting bracket. Contains 5x3" 4R 5W speakers with leads brought out to screw terminals on rear of case. **£4.95**

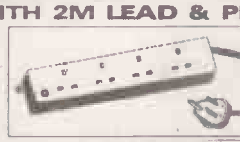
25% OFF LISTED PRICES

AERIAL EXTENSION LEAD

T104BA 10m coaxial aerial extension lead on a compact wind-on reel. Reel contains a built-in TV/radio splitter. Stocks are limited, so buy early!
Usually £5.95

SALE PRICE £2.50

4 WAY TRAILING SOCKET WITH 2M LEAD & PLUG



Order code P3525

Just £6.95!

MONO AMP

A001 15w audio amplifier module. Inputs for tuner, phono, mic etc. Requires external volume control.

Output power	15W
Circuit	IC with protection
Frequency response	50Hz - 25KHz
Output impedance	4n
Power source	10 - 18V dc
Dimensions	80x50x22mm

Usually £14.95

NOW £7.50

WATERPROOF SPEAKERS!

Z5690 These are entirely submersible, having a clear plastic sealed cone. Have music in your bath....literally!
88mm diameter, rated 12watts, 8R. 60mm diameter magnet.
Superb Quality & Value

£2.95 each
25+ £1.70 100+ £120

2 FOR THE PRICE OF 1

HEADSET INTERFACE

X6069 Interface for use between headset and transceiver. Talk switch and vol control, power lead and in/out connectors.

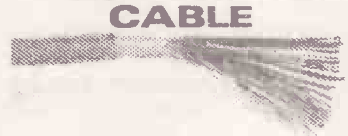
£3.00

SALE PRICE £1.50

SPEAKER CABLE

W007 100m reels 7/0.2 twin white with marker stripe **£4.95**

MULTI COMPUTER CABLE

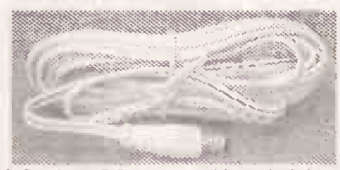


F053G 36w x7/0.16mm (0.14mm2) tinned copper conductors. Aluminium foil screen with 7/0.19mm (0.16mm2) tinned copper tracer ground. **£44.95 per reel. £1.00 per metre.**

25% OFF LISTED PRICES

Microphones

Z5993 Stick mic 500R 100-8000Hz - 76dB sensitivity. With stand. **Only £1.50**
Z3814 13" flexible gooseneck. Cat price £2.95. **Special clearance price: £1.99;** 100+ 1.20



X6104 3m long DC power cable with 2.1mm plug fitted one end. **3/£1**

2 FOR THE PRICE OF 1

MDR20 Personal stereo headphones. Again, top quality using somarium cobalt transducers. Spec as CD04. Attractively packaged with spare covers.

£3.95

SALE PRICE £2.95

GREENWELD 27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307

EVERYTHING ON THIS PAGE 2 FOR THE PRICE OF 1

Pay the price shown per item or pack - you'll receive double the quantity!

(Except where prices are indicated by SALE flag)

AUDIO

Headphones


Z3182

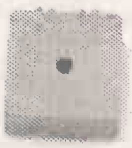

Z4135

Z3182 8R Earpiece with unusually 2x4mm plugs on end of 1m lead. **3/£1.00**
Z4135 Super stereo headphones, fitted with 0.25" plug. As previously advertised - to clear at **£1.00**

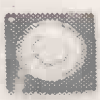
Speakers


Z533

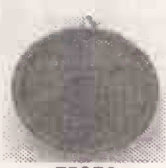
Z533 Danavox transducer - used as a speaker in pocket pagers. Impedance 50R. 20mm dia leads 90mm long. Extremely high quality unit. **Prices - 50p;** 10+ 3.65; 50+ 14.80


Z2553

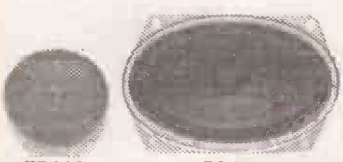
Z2553 Transducer by Digisound, type B/C17 in grey plastic housing. 25x26x8mm. **Pack of 3/£1**


Z578

Z578 Super flat speaker 30x30x3mm by Fuji, rated 16R 0.4W, DP £1.50. **Our Price 60p;** 25+ 0.35; 100+ 0.22; 1k+ 0.15

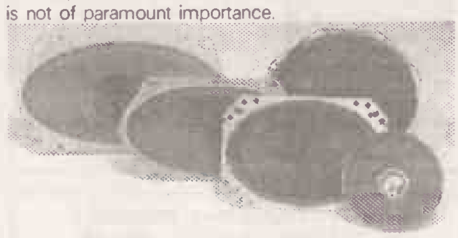

Z5976

Z5976 8R 0.5W 50mm speaker with short lead terminating in two way socket. **3/£1.00**


Z5419 Z945

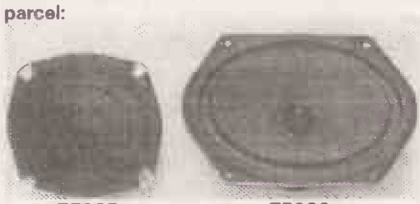
Z5419 Super little speaker bargain 63mm dia. **3/£1.00**
Z945 5" x3" 80R 1W Speaker **Only £1.00**

These loudspeakers are as used in cheap TV's. Perfectly OK for extension speakers or where quality is not of paramount importance.



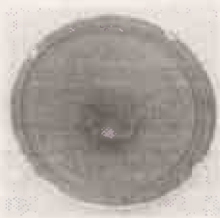
Z5669	90mm dia 4R 1W	£1.00
Z5670	7"x3.5" 80R 5W	£1.50
Z5675	6"x4" 8R 2W unit	£1.50
Z5671	6" 8R 10W	£2.00
Z5672	8"x4" Elac unit 8R 20W	£2.50
Z5876	7x4" 8R 3W speaker.	£2.00

Some high quality units from the Audix parcel:


Z5965 Z5966

Z5965 5" 8R 8W speaker. FR 80-10000Hz **£2.00**

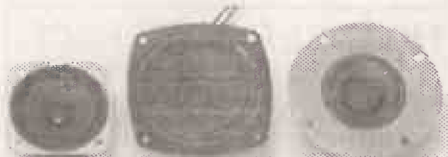
Z5966 7x5" elliptical speaker with foam rubber surround. 8R 10W FR 45-16000Hz **£4.00**


Z5968

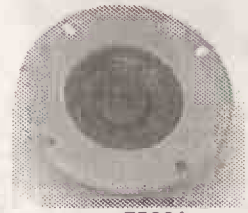
Z5968 Audix 8" 8R 10W speaker with paper cone. FR 60-15000Hz **£4.00**


Z5962

Z5962 5" celing speaker with white metal grille. 8R 8W and fitted with 100V line transformer tapped at 0.25, 0.5, 1, 2 and 4W. Aluminium dome provides full protection and screening. **£8.00**


Z5516 Z5662 Z5661

Z5516 55mm 3R5 40W tweeter. **£4.00**
Z5662 4" 4R 10W tweeter by ITT. Use with Z5663 **£2.50**


Z5661

Z5661 2" 4R 5W tweeter by Foster **£1.50**


Z5663

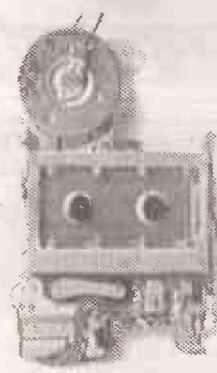
Z5663 6.5" 4R 10W bass driver by ITT. **£3.50**


Z9235

Z9235 6" 4R 10W Silver Dome **£3.95**

Cassette Decks & Heads

Z1701 Stereo cassette head. **Only £1.00**


Z5716

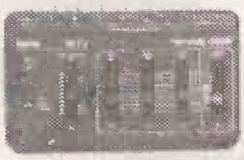
Z5716 Extremely high quality compact mini cassette deck. Overall size only 89x57x16.5mm. 3V operation. Motor has tacho sensor. Combined 4 track record/playback/erase head. Another motor with worm drive just 14x11mm dia used to engage the pinch roller with the capstan. Brass flywheel, diecast frame. No electronics, but flying leads from motor, head and switch. **Superb value at £4.95**

VIDEO

Camera

Z5983 Smallest video camera we've seen - ideal for surveillance and security operations. All the electronics are in the body - there's a 1V composite video signal output on a screened lead; and it needs 7-12V DC at 30mA. Made by Comotec
Spec as follows:
Size: 51x35x35mm
312x287 pixels
Auto exposure - 40,000:1
AGC (up to + 10dB)
Auto black level calibration
2 lux at f1.2
Lens - variable focus C mount, 12mm 4 element
Mount -0.25"/20 UNC
These are brand new boxed units, originally sold for £235. **Our Price £175**

Mixers & Processors

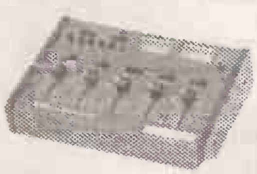


VM516 Stereo Video Mixer. Desk type video mixer with enhancer. Allows separate smooth adjustment and mixing of original video sound with 3 external sources (mic, cassette etc). Master output control. Also continuously adjustable slider corrects video signal when copying. Supplied with 12V mains adaptor. **Our special low price £29.95**

SALE PRICE £19.95

SM502 Stereo Mixer. 4 Channel audio mixer with inputs for mic, mag/cer phono and tape/tuner. Outputs for headphones and to amplifier. Freq Res 20-20000Hz. S/N ratio >55dB. Supplied with 9V mains adaptor. **Our special low price £44.95**

SALE PRICE £29.95



SM507 Stereo Mixer. Big brother of SM502 - this one has all the facilities of the above mixer + twin VU meters and an additional record/replay DIN socket. As can be seen from the inset pic, the socketry on the rear is excellent. **Our special low price £69.95**

SALE PRICE £49.95

AV140 Video film copying is child's play with the HAMA AV140. Two Euro-AV sockets establish the contact between the playback and recording units. And there is no longer any replugging if the copying direction is to be reversed. Simply push the input key to decide whether copying is from unit 1 to unit 2 or vice versa. Two LED's indicate the selected direction and with the by-pass switch you can decide whether the signals require enhancement or not. Everything is under you complete control, and the results can always be checked on the monitor which displays either the original or the enhanced picture. Corrects the video colour signals from the recorders or camera while copying from tape to tape. Both colour intensity and contrasts can be continuously changed. A record player, CD player or cassette deck can be connected to add a new source of sound to the original sound in any variable mixing ratio. A microphone connection is also provided. A significant benefit. Two copies can be simultaneously produced! List price £179.99
Our price £79.95

SALE PRICE £59.95

Tuners & Modulators

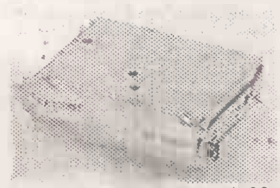
Z3493

Z3493 UHF modulator, video only. Phono skt. **£1**

Z5499

Z5499 UM1233 Astec UHF modulator, brand new, full spec. Currently being sold for around £6. **Our price £2.95**

2 FOR THE PRICE OF 1



Z3143 TV tuner (in screened case) 90x68x20mm. TBA 120U & TDA400 on board + usual R's, C's etc. **£1.00**

2 FOR THE PRICE OF 1

Video Belt Kits

Z7374 Type VK9181. Sharp 6300, 6500 (349). RRP 5.95. **Our Price £1.95**
Z7375 Type VK9204. Sony SLT9ME/J9 (83). RRP 5.95. **Our Price £1.95**
Z7392 Type VK9244. Toshiba V7540 (127). RRP 5.95. **Our Price £1.95**
Z7391 Type VK9241. Toshiba V5250/80 (4). RRP 5.95. **Our Price £2.95**

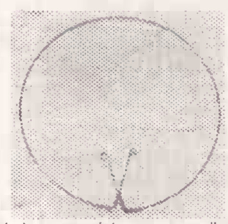
2 FOR THE PRICE OF 1

Miscellaneous

Z3142 Part of a video head motor - brushless DC type, but no bearings or spindle. PCB has M517215L chip and hall effect sensor. **2 for £1.00**

2 FOR THE PRICE OF 1

Aerials



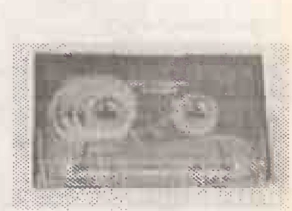
Z5368 TV loop aerial, as supplied with small portables 180mm dia. **2 for £1.00;** 100+ 0.25

Telescopic Aerials
Z7379 Type RA650 Length open 150mm; closed 640mm; No of sections 5; dia 7; fixing 3mm hole. RRP 3.95. **Our price £2.00**

Z7384 Type RA685 Length open 155mm; closed 640mm; no of sections 5; dia 7; fixing M4 tapped hole. RRP 3.45. **Our price £2.00**

Miscellaneous

Z5776



Z5638

Z5776 Bib static eliminator kit - pump action dispenser + 2 large cloths. **2 kits for £1.00;** 100+ 0.25
Z5638 Head cleaning cassette **3/£1.00;** 100+ 0.20

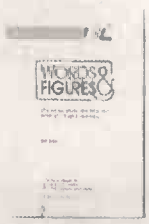
2 FOR THE PRICE OF 1

EVERYTHING ON THIS PAGE 1/3rd (33%) OFF!
(Except where prices are indicated by SALE flag)

SOFTWARE

Z5495 Another super software deal! We've purchased a number of the best selling CROSSTALK XVI data comms packages. New and sealed, containing a 5.25" disk and 182 page manual. PCDOS V3.61, last selling for around £60. **Our special low price just £17.95.**

We have some multiple Microsoft Excel packs for education. They are licensed for 10 users, contain dual media and 5 sets of manuals each. Not sure this is the sort of thing any of our customers need, so if there's no interest, we'll split the packs and sell the manuals separately.
Z9255 Excel V3.0 10 user pack 300.00
Z9256 Excel V4.0 10 user pack (list price over £1500). **£500.00**



Words & Figures by Lifetree. 546 page manual, spread out menu, disks, boxed. Features include:

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

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

Auditor
- Toggle from worksheet to audit display
- Pinpoint circular references
- Identify source of other errors.

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

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

Requirements: DOS 2.0 or higher 256k RAM; Printers: Text - over 200 including Epsons; IBM; Tandy; HP Laser Jet and many others. Graphics - Epson; HP LaserJet, Postscript printers and others. 3½" disk version available
Z5442 5.25" version **Only £14.95**
Z5443 3.5" version **Only £14.95**

Z5445 Learn to Type 5.25" **£3.95**
Z5447 Learn to type - 5.25" disk only. **£1.95**
Z5448 Learn to use DOS 5.25" **£3.95**
Z5449 Learn to use DOS 3.5" **£3.95**
Z5451 Learn to use your PC 5.25" disk only **£1.95**

For the Spectrum, these titles for use with Light Guns:

Z5564 Magnum (48k) 50p
Z5565 Rookie + Missile Ground Zero (+2) 50p
Z5566 Solar invasion + Robot Attack (+2) 50p

BBC 'B' Software

Z4326 Music Master - comprises microphone to attach to recorder and processing/interface device. 5.25" disk and 12 page handbook. Originally £52.78
40 track disk **£14.95**

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

Micro Maestro - Comprises 5¼" disk + computer tape: 16 page handbook; C60 stereo cassette with backing tune of popular tracks like 'Ghostbusters.' 'Chariots of Fire.' and 'Superman'. Original price £17.95
Z4333 Concert Pitch **£4.95**
Z4334 B; **£4.95**

PC, AMIGA, ATARI, ACORN & MAC

SALE OFFER **- Any ten disks for £4.95 (Please give substitutes)**
These are the cover disks given away on the front of many of the computer mags. The software itself is free - the charge is for the disk and promotion costs.

(a) for the PC

Z3091	PC Today	Sept 93	Fastrax & Overstamp	DD	£1.50
Z3092	PC Today	Sept 93	Tracker 3, diabel, Brix, Image	DD	£1.50
Z3093	PC Today	Aug 93	Show Business(2disks): Everyday Adventure, Buyers Guide, Bananold	DD	£3.00
Z3094	PC Plus	Aug 93	4DOS, EC Constitution(!) + utilities, games, spreadsheets/mailmerge tutorials + lots more	DD	£1.50
Z3095	PC Format	Aug 93	Yo! Joe, Winrisk, Bullfrog, C	DD	£1.50
Z3096	PC Com Buyer		Defender, Bullfit, PSearch, Ripbar, Winzip, Macsee, Srdsk202	DD	£1.50
Z3107	PC Review	Sept 93	Even more incred. machine, Volutare	DD	£1.50
Z3108	Windows User		FreshINI, Logoff, Metamouse, Winclock, Mouse Odometer, Minesweeper + 7 more	DD	£1.50
Z3112	Windows Mag	No 6	Describelt, Fractions, KwikDraw, Quick dex, SmartAccs, WinDock	DD	£1.50
Z3114	What Personal Com	Sept' 93	Personal print shop, Comcob 3D + Free screen wipe	DD+ wipe	£1.50
Z3116	Computer Shopper		1st Press for Windows	HD	£2.50
Z3119	PC Format	Sept 93	Incredible Machine, Neopaint 2	DD	£1.50
Z3120	Computer Buyer		Zool	DD	£1.50
Z3122	What Personal Com	Oct 93	Quicken for Windows	HD	£2.50
Z3123	What Personal Comp	Oct 93	Business Plan Master, Action Pro + others	DD	£1.50

(b) for the Amiga

Z3097	Amiga Action		Stardust, Universal Warrior	DD	£1.50
Z3098	Amiga Action		Tensal, Grav Attack, Jump'n'Roll	DD	£1.50
Z3099	Amiga Format		Deluxe Music, Insectolds2, Amos Source Code	DD	£1.50
Z3120	CU Amiga	62	Interworld	DD	£1.50
Z3122	CU Amiga	64	Advantage	DD	£1.50
Z3123	CU Amiga	65	Soccer Kid, F117A + more	DD	£1.50
Z3125	The One	Sept 93	Bubba'n'Stix, Overdrive	DD	£1.50
Z3126	Amiga Format	51a	Second Samurai	DD	£1.50
Z3127	Amiga Format	51b	TurboPrint2, Skidmarks	DD	£1.50
Z3128	Amiga Power	29	F117A, Blob, Squigs	DD	£1.50
Z3129	Amiga User Int	Sept 93	Dash, DiskSalv2, PrintGuide, STP, Translate + 8 more	DD	£1.50
Z3131	Amiga Comp		F117A, Abackup, Disksalv, Tool Manager	DD	£1.50
Z3132	Amiga Comp		Calgari, 10/10, Amos	DD	£1.50

(c) for other machines

Z3133	Atari ST Review	17	Prospero C, Critical Mass	DD	£1.50
Z3134	Mac Format	4	Address Book, Accounts, Columns 2, Icon Quest, Classic Daleks	DD	£1.50
Z3135	The Mac		Applicount prof 2.6, + 7 games	DD	£1.50
Z3136	Acorn User	Oct 93	Xenon 2, Omnidesk, Morpheus	DD	£1.50
Z3137	Archim. World	Sep 93	Simone, Error throwback, Spricht, ProcFunc, DBFind + More Clip Art	DD	£1.50

EVERYTHING ON THIS PAGE 1/3rd (33%) OFF!

(Except where prices are indicated by SALE flag)

SUPER SOFTWARE SCOOP!

Job lot of top name software, all in original packaging at prices way below list!. Some is labelled 'educational', which means it was sold at a lower price on the basis no 'help line' was available. This parcel is a couple of years old, so don't expect the very latest model

Z5806

Z5751

Z5760

Code	TITLE	Price*	Our Price
Z7200	Adobe Illustrator 5 User Pack for PC V4	869.50	400.00
Z7201	Adobe Illustrator Wind V4	468.00	200.00
Z7202	Adobe Streamline for Windows	70.50	40.00
Z7205	Autosketch 5 Pack for Dos 3.5" V3	188.00	80.00
Z7209	Claris Mac Write II	82.25	50.00
Z7324	DBase IV v1.5 lab pack. Dual		75.00
Z7212	DBase IV v1.5 Lan Pack 1-User Dual		70.00
Z7215	EXP V2.1 Scientific WP Dual	188.58	100.00
Z7216	First Publisher Dual	52.87	35.00
Z7217	Foxpro 2.5 for Windows 20 User MLP	£4447#	£2500
Z7218	Harvard Draw for Windows 3.5"	115.03	60.00
Z7219	Harvard Graphics Evaluation Copy Dual	52.94	30.00
Z7220	Harvard Graphics for Windows 1 User Pk		60.00
Z7221	Harvard Graphics for Windows 5.25"	115.03	60.00
Z7222	Harvard Graphics for Win Single Node	60.80	40.00
Z7223	Harvard Graphics V2.3 to V3 upgrade**	SEE FRONT COVER	
Z7224	Harvard Graphics V3 3.5"	150.98	100.00
Z7225	Lotus 123 for Windows 5 Pack 3.5"	447.24	250.00
Z7226	Lotus 123 for Win Server Upgrade 3.5	87.24	50.00
Z7228	Lotus 123 V3.1 10 User Pack 5.25"	766.68	300.00
Z7230	Lotus 123 Windows V1.1 3.5"	127.78	80.00
Z7232	Lotus Magellan Dual	43.18	30.00
Z7233	Lotus Smart Suite 3.5"	171.84	100.00
Z7234	Lotus Smart Suite 5.25"	171.84	100.00
Z7235	Lotus Symphony V3 5 Pack 3.5"	447.24	250.00
Z7236	Lotus Works V3 Dual	43.18	30.00
Z7237	M/S Access for Windows MLP[1] (S'gle user)		50.00
Z7238	M/S Excel V4 for Windows MLP[1] (Single user)		50.00
Z7239	M/S Lan Man Conn'tivity Services for Mac	417.71	250.00
Z7240	M/S Office V3.0 for Windows MLP[1] (Single user)		50.00
Z7242	M/S Visual Basic Pro Toolkit for Win V1.0	57.28	40.00
Z7244	M/S Word V2.0 for Windows MLP[1] (Single user)		50.00
Z7245	Mass breakout Dual Media	146.87	80.00
Z7249	Microsoft Lan Man. V2.1 10 user add pk	280.23	170.00
Z7250	Microsoft Lan Manager Server Pack	560.47	350.00
Z7251	Microsoft Mac Works V2 3.5"	60.81	40.00
Z7252	Microsoft Powerpoint for Win 3.5"	127.78	70.00
Z7253	Microsoft Project V3 for Windows 3.5"	127.78	70.00
Z7260	Microsoft Windows V3 5.25" Single User	44.06	20.00
Z7267	Microsoft Works V2 5.25"	60.80	35.00
Z7269	More V3.1 3.5" Mac	46.53	30.00
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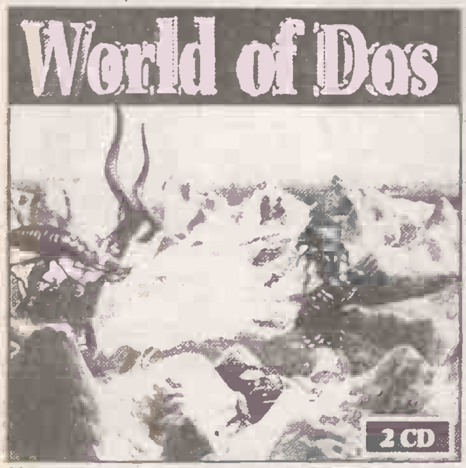

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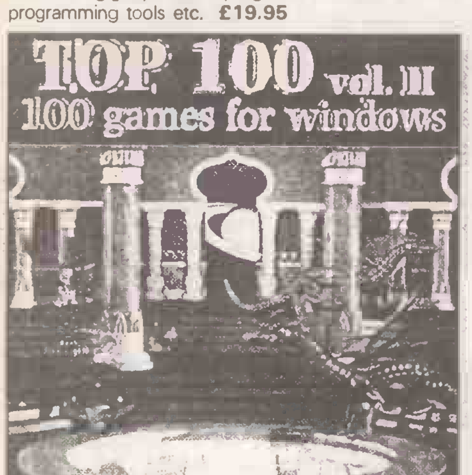

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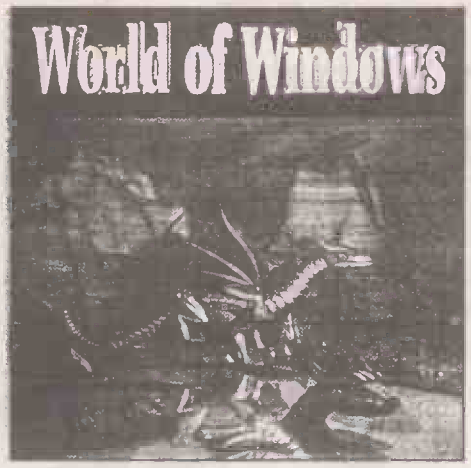

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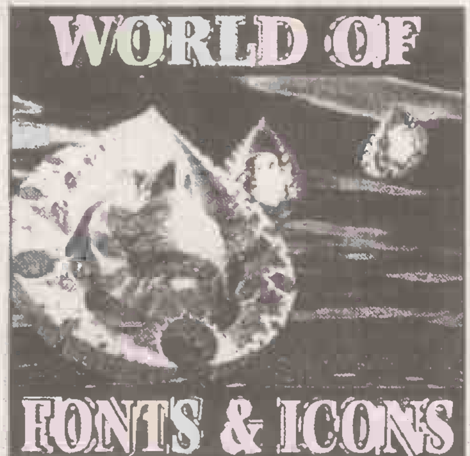

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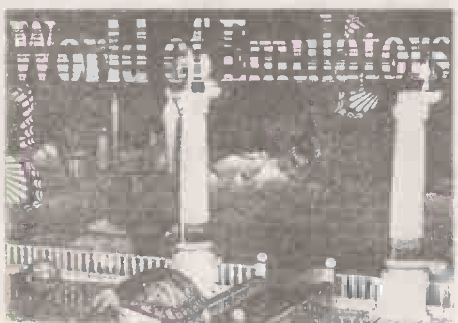

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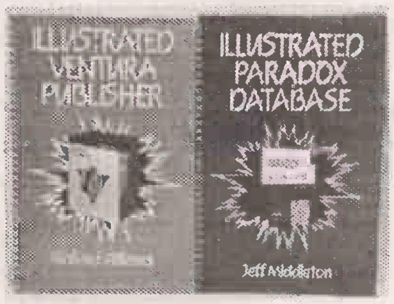

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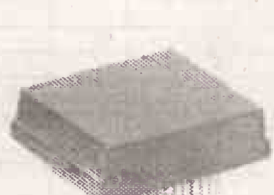

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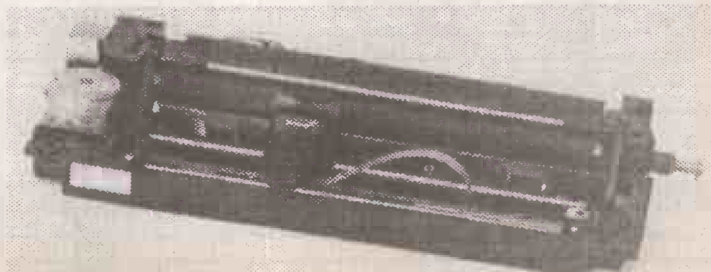

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	74S40				0.15
	74S64				0.15
	74S74			£1.29	0.60

Code	Type	Qty	Description	DP	Price
Z3641	75177		Repeater chip (RS Components Ltd)		3/£1.00
X3147	75188 (1488)	30		0.59	5/£1
Z3690	75ALS171	350	Surface mount ?		4/£1
Z3146	75LS1557		83/84 date code (Fairchild/National)		25/£2.00
Z3295	80A 5251			4.84	£2.00
Z3296	80A 5500			4.84	£2.00
Z3297	81A 020			4.82	£2.00
Z6172	8ILS95				£1.00
Z3582	A80387DX		Intel 387 chip 16		£25.00
Z3583	A80387DX		Intel 387 chip 16-33		£32.00
Z2516	AD517JH		TO99 Converter		£3.00
Z6254	AD534LD		Analogue Multiplexer		£5.00
Z2519	AD667JN		28 DIL D/A converter 12 bit µP compatible	28.18	£10.00
X3155	ADC0816 CCN	1	8 bit A/D converter	12.0	£5.00
Z3620	AM25L252		1 PC		£1.00
Z6184	AM26LS31		16 Pin Dil		£1.00
Z6187	AM26LS32				£1.00
Z3332	AM8085A PC		8 bit CPU	23	£1.00
Z6188	AM9122-25				£1.00
Z6175	AM9517A-4DC		40 Pin Dil		£1.00
Z6241	AWL-3870				£2.00
Z3364	AY-5-8116	11			£1.00
Z3545	BA5406		Amplifier chip 12 pin SIL		£1.50
Z7122	BA7703KI	400	Surface Mount		£1.00
Z7118	BA7740S	129			£1.00
Z3700	BTS432E TO220/5		N channel power MOSFET 42V 125W 40A		£2.50
Z7119	BU2822s	210			£1.00
Z3660	CDP1802A CE	60	8 bit microprocessor 3.2MHz	12.13	£5.00
Z3661	CDP1851C E	50	?		£3.00
Z3662	CDP1852C E	3	i/p - o/p port and buffer	8.75	£3.00
Z6143	CDP1871A CE		RC IC?	13.86 ?	£5.00
Z3663	CDP1879C EI	29	?		£3.00
Z6260	CNY17-1		Opto coupler		3/£1.00
Z3652	CNY17-III	1000	5kV transistor opto isolator	0.69*	4/£1
Z3325	COM2502			50	£1.00
X3149	COM8116	1	Dual baud rate gen	7.53	£4.00
Z6119	COM816		Dual board rate generator	4.37	£2.00
Z6271	CP82C59A		CMOS PIC		£1.50
Z6265	CRT8002				£1.00
Z6211	CRT8002A 005				£1.00
Z3374	CY1010		Encapsulated PCB mntg 38x38x10mm		£2.00
Z3375	CY1011		Encapsulated PCB mntg 38x38x10mm		£2.00
Z3376	CY1011A		Encapsulated PCB mntg 38x38x10mm		£2.00
Z3377	CY1020		Encapsulated PCB mntg 38x38x10mm		£2.00
Z3378	CY1021		Encapsulated PCB mntg 38x38x10mm		£2.00
Z3383	CY2035				£3.00

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Z3379	CY2136		8 Bit DAC Ad & DA Converter		**£3.00**
Z3380	CY2136		10 Bit DAC Ad & DA Converter		**£4.00**
Z3382	CY2737				**£4.00**
Z3381	CY3735D		4 Digit ADC Ad & DA Converter		**£5.00**
Z6272	D41416C-12		16k x 4 RAM		**2/£1.00**
Z3656	D446C-2	175	16K STATIC RAM		**4/£3**
Z3328	D71051C		CMOS 8251 PCI	10	**£1.50**
Z3327	D71071C			70	**£1.50**
Z3345	D7261AD	10			**£1.00**
Z6266	D8086-2		CPU		**£2.00**
Z3506	D80C39HC	7	8 Bit CMOS CPU 128bytes RAM	7.58	**£2.50**
Z3329	D80CPU		CPU	10	**£1.50**
Z6238	D8237AC-5		Prog. DMA Controller	4.23	**£2.00**
Z3693	D8279C-2	20			**£1.00**
Z3322	D8755A			21	**£1.00**
Z3339	D9306AC	47			**£1.00**
Z3776	DG507ACJ	4	8 ch. DP CMOS analogue mutiplexer	8.13	**£4.00**
Z6239	DP8409AN		Multimode DRAM	18.80	**£3.00**
Z3495	DS14C88	40	Quad CMOS RS232 Line Driver	2.26	**£1.00**
Z6213	DS75453		Dual + ve OR power driver	0.46	**3/£1.00**
Z3338	EA7316c	17			**£1.00**
Z6200	ET12BC		A-D converter		**£1.00**
Z3342	FDC9797	20			**£1.00**
Z3351	GAL20V8A-15LP	198	20 I/P, 8 Prog		**£1.00**
Z3352	GAL22V10-15LP	60	22 I/P 8 Prog		**£2.00**
Z6242	HD64B180R0				**£2.00**
Z3649	HEF40373	8	Octal latch	2.33	**£1.00**
Z6244	HM3-2064U-S				**£2.00**
Z3774	HM50256P-20	155	256k static RAM	6.42	**£3.00**
Z3456	HM6116LP-4/D446C-2		16k static Ram: 1M (64 chips)		**£29.95**
Z3348	HM6167HP-55	76	Ram		**£1.00**
Z3694	HM6264P-15	15	64k static RAM	3.90	**£1.50**
Z3775	HM6264P-15	45	64K static RAM	3.90	**£2.00**
Z2739	HN58064P-25		64k NMOS Eprom	10.57	**£3.00**
Z6267	I3-201-5				**£1.00**
Z3363	ICL8250CPE	32			**£1.00**
Z6124	ICM7170IPG		CMOS µP real time clock - µs to years	8.95	**£4.50**
Z6237	ICM7170IPG		µP Real time clock 1/100 sec to years	8.95	**£3.00**
Z3497	ICM7218IJL	10	?		**£2.00**
Z3668	ICM7218IJI	9	8 digit LED driver	7.77*	**£3.00**
Z3669	ICM7224IPL	4	4.5 digit decoder driver for LCD's	13.55	**£5.00**
Z3670	ICM7231BFI	11	?		**£3.00**
Z6257	ILQ1		Opto coupler		**2/£1.00**
Z6127	L4885CX		?	0.82	**3/£1.00**
Z7306	LA1365	244	14 DIL IC	2.45	**3/£2.00**
Z7307	LA3350	190	16 DIL IC	2.45	**3/£2.00**
Z7308	LA6458	671	8 DIL IC	1.50	**5/£2.00**
Z7120	LA7393A	882			**£1.00**
Z3792	LB1004AC	1000	AT&T telecomm chip	?	**10/£1.00**

Z2472	LF398N		8 DIL	3.94	**£2.00**
Z6273	LF411ACN		Bi-FET Op amp	1.64	**£1.00**
X3093	LM1964V		20 pin PLCC by National		**10/£1.00**
Z3650	LM231AN	22			**£1.00**
X3159	LM2931	50	TO92 5V 100mA reg	0.69	**3/£1**
Z3360	LM293N	125			**£1.00**
Z2582D	LM319N		Dual high speed comparator, 80ns response time	2.80	**3/£2.00**
Z6283	LM331		Precision VF converter		**£3.00**
Z6247	LM348		14 Dil op amp		**5/£1.00**
Z2734	LM3524N		Switch mode PSU chip		**£1.00**
Z6218	LM388N-1		1.5w Audio power amp	3.51	**£1.00**
Z6233	LM710		14 Dil Voltage Comparator	2.05	**£1.00**
Z3298	LME052xD				**£2.00**
Z6133	LP365N		Quad low power programmable comparator 4000ns	0.90	**2/£1.00**
X3094	M31AR42M02		8 DIL chip		**3/£1.00**
Z3655	M3732L-20RS	60	4K RAM		**4/£1**
Z7123	M5223FP	11,000	Surface Mount		**£1.00**
Z3672	M5L8251AP	7	PIA		**£1.00**
X3151	M5L8259AP	10	8MHz programmable PIC	3.39	**£1.00**
Z6245	M5W1793-02				**£2.00**
Z3330	M80C85A		8 bit CPU	15	**£1.00**
Z3353	Max 238CNG	90	Quad RS232 Tx/Rx		**£2.00**
Z3508	MAX666CPA	4	Volt Reg 8DIL 2-16.5V 40mA	3.24	**£1.75**
Z3673	MC14469P	3	?		**£1.00**
Z6259	MC34231		Psu IC - o/v 2.6-4.5V		**2/£1.00**
Z6135	MC3486P		Quad RS232 line driver	0.45	**4/£1.00**
Z6105	MC8500P				**£2.00**
Z6174	MCM6064P12		28 Pin Dil		**£1.00**
X3146	MCM60L256AP12	19	?		**£2.00**
Z7124	MEL75217	4915	Surface Mount 64 pin (19x13)		**£1.00**
Z6177	MJ2813		28 Pin Dil		**£1.00**
Z6195	MK3885N-4				**£1.00**
Z6191	MK3887N-4				**£1.00**
Z6232	MM58174AN		µP Real time clock 1/10 sec to years	13.86	**£5.00**
Z3779	MN3101	750	2 phase clock gen	1.32	**2/£1.00**
Z6270	N82S131N		2k Prom		**£2.00**
Z3654	N82S185N	40	8k (2048x4) PROM	9.69	**£3.00**
Z3452	NJM2245L		8 Pin SIL		**6/£1.00**
Z6151	NMC1630		Quad translator 5-15V logic isolation	10.10	**£5.00**
Z3300	NMI 1608				**£3.00**
Z3515	OP200	5	Dual Op-Amp (Improved OP07)	6.42	**£3.00**
Z3499	P80C51BH	55	8 bit CMOS CPU 256bytes RAM	15.28	**£3.00**
Z3500	P8228	28	8080A Sustem Controller	5.33	**£2.00**
Z3507	P8243	32	I/O Expander	3.50	**£1.50**

GREENWELD 27 Park Rd, Southampton, SO15 3UQ
Tel 01 703 236363; Fax 236307

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Z6170	P82510		High intergration CMOS UART	19.27	£5.00
Z3504	P8253-5	12	Prog Interval Timer	4.37	£1.50
Z6269	P8259A		Prog. Interrupt Cont.		£1.00
Z3496	P82C206	12	?		£5.00
Z6182	PAL10H8CN				£1.00
Z6250	PAL10L8CN		Prom		£1.00
Z6227	PAL16R6		HEX 16 I/P reg AND/OR gate array	1.00	2/£1.00
Z6206	PAL20R6BCNS		Hex 20 input and/or Gate Array		£1.00
Z6189	PALC18U8Q-25CN				£2.00
Z3778	PALCE22V10H-25PC/4	6	CMOS elec erasible PLD	5.24	£2.50
Z6156	PALCE29MA 16H-25		29 input, 16 prog output		£5.00
Z6253	PM7545		12 BIT D/A		£3.00
Z6159	S17660DJ		?		£1.00
Z6121	SAB3036				£1
Z6264	SAB8237A		Prog. DMA		£1.50
Z3337	SCL25411E	80			£1.00
Z3151	SCN2674BCAN40		Graphics chip - advanced video display controller 4MHz	6.73	£3.00
Z3333	SCP1854LD		Prog UART to 200k	18	£2.50
Z6276	SFF96821E				£2.00
Z2661	SFG460B		Murata ceramic filter		12/£1.00
Z3362	SG34237	70	Overvoltage crowbar protection		£1.00
Z1962	SLP-4-100V25		Delay line by MCG Electronics		2/£1.00
Z2736	SN75122		Line driver		2/£1.00
Z6251	SN75173N		Quad diff line rx		£1.00
Z3509	SN75176A	30	Diff Bus Transceiver	2.71	£1.00
Z2471	SN75372		Interface		50p
Z6212	SN75454BP		Dual + ve NOR power driver	0.32	4/£1.00
Z3653	SN75492	372			3/£1
Z3323	SND8002E			156	£1.00
Z733	SP0256A-AL2		Speech chip. (with LA05 high speed CMOS ULA & R0984CS index chip)		£3.00
Z3343	SY6551	10	ACIA		£1.00
Z7310	TA7061	907	7 DIL IC	2.95	3/£2.00
Z3513	TA79012S	100	12V TO220 plastic V.Reg		4/£1
Z1465	TC5517APL-2		2kx8 Ram		40p
Z6235	TC5562P-35				£2.00
Z2535	TCL271		8 pin DIL CMOS programmable op-amp	0.69	£1.00
Z7121	TDA3856	4000			£1.00
Z6160	TIBPAL22V10A		22 input 1 time prog PLD	£5.35	£2.00
Z6282	TL497AZN		Switching DC - DC converter		£1.00
Z6161	TL7705ACP		+5V uP power supply supervisor	£1.75	£1.00
Z6249	TLC2654ACN		CMOS op amp		£1.50
Z6164	TLC272CD		dual do	1.17	3/£2.00
Z3671	TMP8251AP	25	PIA	2.11'	£1.00

Z3592	TMS4500A-15NL	30	64k Dram Controller		£3.00
Z3658	TMS4532-20NL	31	4K RAM		4/£1
Z6215	UA9638CP		Dual RS232 diff line driver	1.32	2/£1.00
Z6167	UC3524AN		Enhanced SMPSU circuit	1.53	3/£2.00
Z3361	UC3903N	60	Quad supply & line monitor		£1.00
Z6219	UDN6118A		Fluorescent driver 8 NPN	1.00	2/£1.00
Z3793	ULA2C224E1	500	Plessey 24pin chip	?	3/£1.00
Z6230	UPB828LC				£2.00
Z2663	VC004E01		Motorola		£1.00
Z6198	VT7C122-12				£1.00
Z6173	VT7C122-15		22 Pin Dil		£1.00
Z2942	X60G2		Ceramic filter - similar to Z2661		10/£2.00
Z732	XK1444		CMOS buffer 7 in 1 chip		6/£1.00
Z3355	XR205N	32			£1.00
Z3356	XR2204	8			£1.00
Z3358	XR2208N	20			£1.00
Z3359	XR2240CP	15			£1.00
Z3585	Z80	40	CPU		£2.00
Z6192	Z80A CTC				£1.00
Z3696	Z80A CTC	10	Counter timer controller		£1.00
X3154	Z80A-CTC	25	counter timer controller	2.22	£1.00
Z6263	Z80ADART				£1.50
Z6278	Z80ADART				£1.50
Z3651	Z80BPIO	53	Interface	2.44	£1.00
Z3318	Z80CTC		(MK3882-4)		60p 70/£25
Z6240	Z80DMA		Multimode DRAM controller/driver	4.11	£2.00
Z3319	Z80PIO		(MK3881-4)		60p 70/£25

RESISTORS

Wirewound

Code	Value	Tol	Watts	Description	Price
Z1877	0R1		11W	CGS C14 vitreous enamel	6/£1.00
Z1967	0R1	1%	3W	Low value close tolerance	5/£1.00
Z3185	0R22		4W	Wirewound cement coated	10/£2.00
Z1878	0R27		11W	CGS C14 vitreous enamel	6/£1.00
Z2103	0R47		5W	WE cement coated	20p
Z1966	0R5	1%	5W	Low value close tolerance	5/£1.00
Z5208	10k		2.5W	PR52 wire wound	500/£5.00
Z2859	1k	5%	25W	Metal clad wire wound	3/£2.00
Z5209	1k2		2.5W	PR52 wire wound	500/£5.00
Z4401	1R		5W	PC cement coated	20p
Z4402	1R		25W	TAGS cement coated	70p
Z2707	1R	5%	10W	Metal clad wire wound	4/£2.00
Z5827	1R2	5%	3W	Axial Wirewound	200/£1.00
Z5828	1R5	5%	3W	Axial Wirewound	200/£1.00
Z2106	225r		23W	TAGS cement coated	50p
Z2713	250R	5%	10W	Metal clad wire wound	6/£2.00
Z2703	330R	5%	5W	Metal clad wire wound	10/£2.00
Z4403	370R		17W	WE cement coated	40p
Z5829	56R	5%	5W	Axial Wirewound	50/50p
Z2708	5R	5%	10W	Metal clad wire wound	6/£2.00
Z2701	6R8	5%	5W	Metal clad wire wound	10/£2.00
Z2710	75R	5%	10W	Metal clad wire wound	6/£2.00
Z988	7R		3.4W	RS power section 0.7A	3/£2.00
Z2702	8R2	5%	5W	Metal clad wire wound	10/£2.00

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RESISTORS

Thermistors

CODE	VALUE	DESCRIPTION	PRICE
Z3044	V250k10	Voltage dep - 250Vrms; 320V dc; 390V nominal; 2.5A peak; 55J max energy: single pulse 8/20µs.	8/£2.00
Z1983	VA1040	Thermistor	£2.00
Z2447	P6350	Dual Thermistor	10/£1.00
Z3011	5k/500R	Thermistor similar to 61-0200. 5k@25°C 500R@100°C	15/£2.00

Miscellaneous

Z141	30M	10%		10/£1.00
Z5830	2k2	5%	1W Carbon film bandoliered	1k/£2.00
Z1469	5M0	1%	H2 25ppm	£1.00
Z1468	10k	0.1%	H2 25ppm	3/£1.00

0.125W Bandoliered

All 5%,carbon film size 3.2x1.9mm. All the same price: £2/1000; 10k+ 1.50/k; 100k+ 1.20/k

Code	Value	Qty
Z7060	5R6	50k
Z7061	15R	80k
Z7062	18R	125k
Z7063	22R	5k
Z7064	39R	200k
Z7065	47R	5k
Z7066	56R	40k
Z7067	82R	30k
Z7069	120R	10k
Z7071	270R	5k
Z7072	390R	5k
Z7073	560R	110k
Z7132	1k2	29k
Z7074	1k4	12k
Z7075	1k5	34k
Z7078	8k2	15k
Z7079	12k	10k
Z7080	16k	8k
Z7081	18k	8k
Z7083	43k	60k
Z7084	180k	18k
Z7085	200k	28k
Z7086	300k	12k
Z7087	330k	9k
Z7088	430k	16k

DIODES

CODE	TYPE	DESCRIPTION	QTY	PRICE
Z7115	EQA0217.8V	17.8 Zener 400mW	40k	200/£2.00
Z2866	50SMI	50V 1A		100/£2.00
Z2867	MR1121	100V 12A stud mntg rectifier		8/£2.00
Z2858	M41800R	800V 40A stud mntg rectifier		£1.50
X3123	BYW29/50	TO220 50V 1A switching diode		10/£1.00
	BAV20	Signal Diode		100/£2.00
Z2111	1N279			10/£1.00
X3096	BY214-200	Rectifier		5/£1.00
X3100	L4947R	TO220 5 pin regulator		£2.00
X3121	1N3827A	5V6 1W zener		10/£1.00
Z2328	BAX16	Signal		25/£1.00
Z3148	SKB1.5/02	200V		12/£2.00
Z3149	SKB1.5/04	400V		12/£2.00
Z3150	SKB1.5/08	800V		10/£2.00
Z3138	BYW20	200V 20A with 0.25" tabs		£1.00
Z2756		SD2 pair of rectifiers		400/£2.00
X3125	1N4733A	5V1 1W Zener		10/£1.00
X3092		1A 5x2.5mm dia		50/£1.00
Z3728	MVAM109	TO92 Tuning - 400-520pF. Q - 150 @1V & 1MHz 15V		3/£1.00
Z3729	BC237/8	NPN Silicon		40/£1.00
Z3730	EP432	TO126		6/£1.00
Z3711	AAZ13			50/£2.00
Z3712	BA144			50/£2.00
Z3713	BA154			50/£2.00
Z3714	BA173			50/£2.00
Z3716	ZTK33B			50/£2.00
Z3717	1S44			50/£2.00
Z2746	ITT907			500/£5.00
Z2747	ITT920			500/£5.00
Z2748	ITT12601			500/£5.00
Z2749	XK3117			500/£5.00
Z2750	BAX12A			500/£5.00
Z2751	OAZ201			500/£5.00
Z2752	TI621425			500/£5.00
Z2753	1N5361A	Plastic 27V 5W zener		6/£1.00
Z2755	1S5056	Stud mntg zener 10W 5.6V		3/£1.00

VOLTAGE REGS

CODE	TYPE	CASE	DESCRIPTION	PRICE
Z3876	7805	TO220	5V 1A fixed to aluminium panel 125x28x2mm	3/£1.00
Z2507	L4962	TO220	1.5A switching 5.1-40V	£1.50
Z3805	78L12	TO92	12V 100mA	10/£2
Z3409	SG200	TO39	2-30V 20mA	50p
Z3411	LM3501	TO39	15V 200mA	50p
Z3412	LM309	TO39	5V 200mA	50p
Z3413	LM305	TO39	4.5-30V 12mA	50p
Z3301	LM320-5	TO39	5V 500mA	50p
Z3302	SG320T12	TO39	12V 500mA	50p
Z3303	SG320T15	TO39	15V 500mA	50p
Z3417	SG7808AK	TO3	+18V 1.5A	£1.00
Z3418	SG7808CK	TO3	+8V 1.5A	£1.00
Z3419	SG7812AK	TO3	+12V 1.5A	£1.00
Z3420	SG7812CK	TO3	+12V 1.5A	£1.00
Z3421	SG7812K	TO3	+12V 1.5A	£1.00
Z3275	SG7824AK	TO3	+24V 1.5A	£1.00
Z3276	SG7824CK	TO3	+24V 1.5A	£1.00
Z3277	SG7912AK	TO3	-12V 1.5A	£1.00
Z3279	LM220K12	TO3	+12V 1.5A	£1.00
Z3280	LM220K15	TO3	+15V 1.5A	£1.00
Z3281	SG109K	TO3	+5V 1.5A	£1.00
Z3282	SG117K	TO3	1.2-37V 1.5A	£1.00
Z3283	SG209	TO3	+5V 1.5A	£1.00
Z3284	LH315K	TO3		£1.00
Z3287	LH324K	TO3	1.5A	£1.00
Z3305	LM120K12	TO3	+12V 1.5A	£1.00
Z3306	SG120K15	TO3	+15V 1.5A	£1.00
Z3308	SG140K15	TO3	+15V 1.5A	£1.00
Z3309	LM320K-15	TO3	+15V 1.5A	£1.00
Z3310	LM320K-12	TO3	+12V 1.5A	£1.00
Z3314	SG340K8	TO3	+8V 1.5A	£1.00
Z3773	LM2931CT	TO220	3-24V 0.1A	£2.50
Z3772	LM336Z5.0	TO92	5V v.ref diode,	£1.20
Z6281	78M06CT	TO220	6V 500mA	£1.00
Z6168	7905CT	TO220	-5V 1A	8/£2.00
Z6284	ICL7663	8DIL	+ 1.6 to 16V (40mA)	£1.50
Z6107	SH3011	TO3	8 Pin device. Voltage ?	£1.50
Z6101	LM305H	TO99	+4.5V to +40V 45mA	3/£1.00
Z6248	LM336B25		5V ref diode	£1.00

EVERYTHING ON THIS PAGE 2 FOR THE PRICE OF 1

(Except where prices are indicated by SALE flag)

Pay the price shown per item or pack - you'll receive double the quantity!

POTS & PRESETS

CODE	VALUE	W	DESCRIPTION	PRICE
Z3237	47k		Lin (17mm dia dual PCB mntg pot with 4mm dia spindle	12/£2.00
Z756	5R		Convergence wirewound	10/60p
Z755	1k		Convergence wirewound	10/60p
Z1535	1k		Convergence type with knob.	6/£1.00
Z5795	50k		Slider log single - 60mm travel 88x12x11mm	15/£2.00
Z5796	100k		Slider log single - 45mm travel 73x12x11mm	10/£2.00
Z5797	10k		Slider log single - 40mm travel 68x16x10mm	20/£2.00
Z2394	50R		TO5 case cermet trimpot type 81E	6/£1.00
Z2359	1k lin		Minature pot 17mm dia with 6.75mm bush and splined spindle, PC mntg	4/£1.00
Z2388			Plastic stand-off for ¾" trimpot (our 75CER type)	50/£1.00
Z5868	25k	1W	Large moulded carbon pot 30mm dia, ¼" spindle 50mm long.	4/£1.00
Z5869	100k	1W	Large moulded carbon pot 30mm dia, ¼" spindle 50mm long.	4/£1.00
Z5871	500k	1W	Large moulded carbon pot 30mm dia, ¼" spindle 50mm long.	4/£1.00
Z5872	500R	3W	Wirewound pot from RS Components Ltd	£2.00
Z7099	10k	0.1 W	Plastic film 6.4x6.4; Pitch 5x5;	15/£2.00
Z7100	100k	0.1 W	Plastic film 6.4x6.4; Pitch 5x5;	15/£2.00
Z7103	5k	0.2 W	Plastic film 6.8x6.8; Pitch 5x5;	15/£2.00
Z7104	10k	0.2 W	Plastic film 6.8x6.8; Pitch 5x5;	15/£2.00
Z7105	20k	0.2 W	Plastic film 6.8x6.8; Pitch 5x5;	15/£2.00
	100k	0.2 W	Plastic film 6.8x6.8; Pitch 5x5;	15/£2.00
K867			25 each of Z7099-7106	150/£10
Z3536 +value	4k7; 22k; 220k		Single log Radiohm - 20mm dia 55x6.35mm plastic spindles &9.5mm bush	30p
Z3537 +value	22k; 47k 470k 1M		Dual lin Radiohm - 20mm dia 55x6.35mm plastic spindles &9.5mm bush	60p
Z3538 +value	22k; 100k; 470k;		Dual log Radiohm - 20mm dia 55x6.35mm plastic spindles &9.5mm bush	60p
Z3540 +value	4k7 lin 10k lin		Miniature - 16mm dia body, 40x4mm plastic shaft - 6.8mm dia bush. PC tags	30p
Z3541 +value	4k7 log 10k log		Miniature - 16mm dia body, 40x4mm plastic shaft - 6.8mm dia bush. PC tags	30p
Z3869	25k + 25k lin		Dual pot with concentric spindles 67/77mm long. PC mntg and 0.375" bush	4/£1.00
X3069	47R	2W	Speaker volume control - wirewound pot. Splined spindle with wires attached.	2/£1.00
Z3158	4k7 lin	0.25 W	PN18-EZ Enclosed type Horizontal mntg 18x10mm pitch	£4/box
Z3159	10k lin	0.25 W	PN18-EZ Enclosed type Horizontal mntg 18x10mm pitch	£4/box
Z3160	470k lin	0.25 W	PN18-EZ Enclosed type Horizontal mntg 18x10mm pitch	£4/box
Z3161	2M2 lin	0.25 W	PN18-EZ Enclosed type Horizontal mntg 18x10mm pitch	£4/box
Z3162	10k lin		Citec type PN10Z, fully enclosed vertical mntg - 5x3mm pitch. Body size 12.5x10x5mm.	250/£5
Z5532	470k lin		Dual pot - ¼" shaft	5/£2.00
Z5533	1M lin		Dual pot - ¼" shaft	5/£2.00
Z5534	2M lin		Dual pot - ¼" shaft	5/£2.00
Z5535	2k7 log		Dual pot - ¼" shaft	5/£2.00
Z5537	2M2 log		Dual pot - ¼" shaft	5/£2.00
Z5538	47k log		Switched dual pot - ¼" shaft	5/£2.00
Z5539	220k log		Switched dual pot - ¼" shaft	5/£2.00
Z5540	470k log		Switched dual pot - ¼" shaft	5/£2.00
Z5542	2M2 log		Switched dual pot - ¼" shaft	5/£2.00
Z5543	47k lin		Switched dual pot - ¼" shaft	5/£2.00
Z5544	1M lin		Switched dual pot - ¼" shaft	5/£2.00
Z5545	2M2 lin		Switched dual pot - ¼" shaft	5/£2.00
Z1575	470R	0.1 W	Piher - horizontal mntg, carbon type	25/£1.50
Z1578	1k	0.1 W	Bourn VA05 - horizontal mntg, cermet type	25/£4.00
Z1579	4k7	0.1 W	Bourn VA05 - horizontal mntg, cermet type	25/£4.00
Z1580	4k7	0.1 W	Piher - horizontal mntg, carbon type	25/£1.50
Z1581	10k	0.1 W	Bourn VA05 - horizontal mntg, cermet type	25/£4.00
Z1584	220k	0.1 W	Bourn VA05 - horizontal mntg, cermet type	25/£4.00
Z1574	2M7	0.1 W	Piher - horizontal mntg, carbon type	25/£1.50
Z1728	10k	1W	Spectrol multiturn pot. 25mm long body. Adjusting spindle can be accessed from either end.	2/£1.00
Z320	10R	1W	Wirewound pot	60p
Z531+ value	250R 500R 25k	4W	Colvern Wirewound pot with 1½" spindles. Type 4001/22.	80p
Z1971	200R		Bourns 3296W (11mm sq multiturn)	2/£1.00
Z1972	5k		Bourns 3296W (11mm sq multiturn)	2/£1.00
Z2096	1k		Bourns 3296W (11mm sq multiturn) Side screw	2/£1.00
Z1974	25k		Bourns 3006W (¾" multiturn)	3/£1.00
Z1998	50R		Murata 3321H (6.6mm dia single turn)	2/£1.00
Z577	5k		Edgewise pot with switch, no knobs	10/£1.00

SCR's + TRIACS

CODE	TYPE	CASE	DESCRIPTION	QTY	PRICE
Z3364	BN4002	TO66	200V 6A	100	3/£1.00
Z3366	BN4200	TO48	100V 10A	225	3/£1.00
Z3367	BN4204	TO48	400V 10A	50	2/£1.00
Z3368	BN4208	TO48	800V 10A	22	£1.00
Z3369	SC40D	TO48	400V 10A	44	2/£1.00
Z3370	BTR/1000	TO39	100V 1A	70	6/£1.00
Z3372	CI106B1	TO202	200V 4A	2300	3/£1.00
Z3436	C20D	TO48	400V 7.4A	100	2/£1.00
Z2523	TICP106D	TO92	400V 100mA		6/£1.00

EVERYTHING ON THIS PAGE 1/4 (25%) OFF!

(Except where prices are indicated by SALE flag)

New crystal list.

June 95. Updates previously listed types still available and includes a number of new devices.

CODE	FREQ'Y in MHz	TYPE	QTY	PRICE
Z2522	0.032768	H		50p
Z3487	0.132	H	1000	50p
Z3485	0.352	A	200	£1.00
X3075	1.000	C	20	£2.50
X3076	1.024	E	1036	£1.00
Z3237	1.8432	A	200	£1.50
Z3274	1.8432	E	15	£1.50
Z3238	2.000	C	600	£1.50
X3120	2.097152	E	300	£1.00
X3077	2.34340	C	1400	50p
Z1653	2.4576	E	395	50p
Z2844	3.000	B		£1.50
Z3239	3.000	E	300	£1.50
Z3486	3.6	A	3600	50p
Z3243	3.6864	A	40	60p
X3251	3.6864	F	150	60p
Z3244	4.000	A	830	60p
Z3488	4.433619	A	100	50p
Z3245	4.440	A	18	£1.50
Z3484	4.69945	A	2150	50p
Z3246	4.9152	A	100	60p
Z3247	4.9562	A	50	60p
Z3248	5.0688	A	476	60p
Z3249	5.120	A	21	60p
Z3460	5.90904	B	366	£2.00
Z3250	5.9904	A	733	£1.00
Z3491	5.9904	B	16	£2.00
X3119	6.000	K	50	£2.00
Z3492	6.0288	A	50	£1.00
Z3251	6.144	A	692	£1.00
Z3469	6.804	A	312	60p
Z3482	7.8164	A	89	60p
X3078	7.98720	A	1806	60p
Z3252	8.000	D	60	£1.00
Z3479	8.064	A	100	60p
Z3462	8.680000	B	1090	£2.00
Z1654	8.863256	A		50P
X3079	8.86723	A	90	60p
Z3477	9.360	A	70	60p
Z3475	9.449	A	208	50p
Z3472	9.60	A	213	50p
Z3253	9.8304	A	19	60p
X3080	11.9808	A	822	60p
Z3493	12.16	A	200	60p
Z2079	14.000	A	700	60p
Z3473	14.976	A	500	50p
Z3461	15.00000	B	993	50p
Z3476	16.40	A	573	60p
Z3256	16.58880	A	25	60p
Z2696	16.800	B		£2.00
Z3470	17.06	A	369	60p
Z3489	17.73447	F	502	60p
X3081	18.000	B	50	£1.00
Z3480	18.1272	A	78	£1.00
Z3258	19.6608	A	25	£1.00
Z2845	20.000	B		£1.50
Z3465	20.79	A	359	60p
X3082	21.29375	G	574	60p
X3083	21.30	B	650	60p
Z3260	22.032	A	50	60p
Z3467	22.9068	A	103	60p
Z3262	23.6840	A	1	£1.50
Z3263	23.400	A	50	£1.00
Z2698	24.000	B		£2.00
X3084	24.192	B	48	£1.00
Z3266	25.000	B	100	£3.00
Z3466	28.1088	A	498	60p
X3085	30.7200	A	50	£1.00
X3086	40.0	B	16	£1.00
Z3468	45.0	A	68	£1.00
Z3474	48.000	A	900	£1.00
Z3464	50.0	A	83	£1.00
Z3272	50.000	B	200	£2.00
Z2665	55.000	J	100	£1.00
X3087	57.000	B	1000	£1.00
Z3273	60.000	B	200	£2.00
Z3463	64.0	A	736	£1.00
Z3433	71.429	B		£2.00
Z3471	84.375	A	100	£1.00
Z3490	177.0	A	50	£1.00

A	HC49 - 13x10x3.7(W)	F	HC49/4 10x3.5x4mm(W)
B	OSC. 4 PIN PACKAGE(P)	G	8.7x6.8x2.1mm(W)
C	HC6 - 19x18x8(P)	H	8.8x2.9diaW
D	Plastic 3 pin SIL 16x7.5 x4.5(P)	J	Crystal Filter 8x7x2mm
E	HC6 -19x18x8(W)	K	Like HC49, only 5mm high (W)

W= Wire ended P= Plug In

BOOKS

TEKTRONIX MANUALS

Dating from 1958, this collection covers a wide variety of test equipment. Manuals supplied will be originals in some cases where we have sufficient stocks, otherwise photocopies.

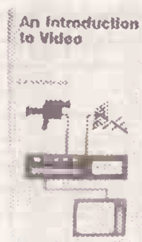
Code	Model	Price
(a) Oscilloscopes		
Z1001	465 early	£25
Z1002	465 B250000+	£25
Z1003	517A	£15
Z1004	520	£25
Z1005	524AD	£15
Z1006	526	£15
Z1007	535A	£20
Z1008	543/543A	£20
Z1009	535/535A	£20
Z1010	544	£20
Z1011	545	£20
Z1012	545A	£20
Z1013	545B	£20
Z1014	547	£25
Z1015	551	£20
Z1016	564	£15
Z1017	564B	£20
Z1018	575-175	£20
Z1019	581A	£25
Z1020	585	£15
Z1021	585A	£20
Z1022	661	£20
Z1023	7603	£25
(b) Probes		
Z1024	6006	£3
Z1025	6008	£3
Z1026	6010	£3
Z1027	6011	£3
Z1028	6012	£3
Z1029	6028	£1
Z1030	6054	£4
Z1031	6054A	£3
Z1032	6075A	£3
(c) Plug-in Modules		
Z1033	B	£10
Z1034	CA	£10
Z1035	D	£10
Z1036	H	£10
Z1037	L	£10
Z1038	M	£10
Z1039	W	£10
Z1040	Z	£10
Z1041	1A1	£10
Z1042	1A2	£15
Z1043	1A7	£20
Z1044	1A7A Diff Amp	£20
Z1045	2B67 Timebase	£15
Z1046	3A1 Dual trace amp	£15
Z1047	3A6	£10
Z1048	3A72	£10
Z1049	3B1	£10
Z1050	3B3	£15
Z1051	7A18	£15
Z1052	7B53A/AN Dual timeba	£20
Z1053	53/54B	£10
Z1054	53/54D	£10
Z1055	53/54G	£10
Z1056	82	£15
Z1057	86	£10
(d) Current Probe Amplifiers		
Z1058	134	£10
Z1059	131/P6016	£10
(e) Time Mark Generator		
Z1060	184	£15
(f) Calibrators		
Z1061	067-0521-00	£10
Z1062	067-0523-00	£10
Z1063	Calibration fixtures	£10
(g) Miscellaneous		
Z1064	RC815 UHF FM Tx/RX	£25
(h) Operators Book		
Z1065	434	£3
Z1066	465/DM40-43 meters	£5

Some surplus books we've had in stock for some time, now being cleared at silly prices

MOD1 The Car Modeller's Handbook by Mat Irvine. Comprehensive guide to all aspects of building and finishing model cars, mostly to 1:24 or 1:25 scale. Published at £6.95. **Our Price £2.50**


MOD3 Make the most of your pocket calculator. A slim volume by Lars Johnson - more of historical interest now as it was published in 1977. **50p**

MOD5 Microcomputers by A.J.Dirksen. Yes, well... They weren't too micro when this was published in 1978. Nevertheless, it does show just how far we've come. Contains lots of info on the 8080 chips... **£4**



BP100 An Introduction to Video by D.K.Matthewson. Even though published in 1983, still contains some useful info, and interesting from a historical point of view. **£1.50**

and one new addition to to the Workshop Practice Series...

No22 Covers everything from fitting a 13A plug to wiring a new workshop building. Also includes chapters on security systems, telephones and TV aerials. **£6.95**

£6.95

EVERYTHING ON THIS PAGE 2 FOR THE PRICE OF 1

Pay the price shown per item or pack - you'll receive double the quantity!

(Except where prices are indicated by SALE flag)

CAPACITORS

Electrolytics

Axial, Low voltage (up to 200V)

Code	Value/ Volts	£2 pack
Z3820	0.47/160	50
Z3822	1.5/63	50
Z5906	1/100	50
Z2971	1/50	35
Z3821	1/63	50
Z2972	1/63	35
Z3827	10/16	50
Z2975	10/16	35
Z2976	10/25	35
Z3828	10/250	20
Z3835	100/10	50
Z5910	1000/10	16
Z2987	1000/16	16
Z2988	1000/35	12
Z2989	1000/40	12
Z2990	1000/56	10
Z3836	150/6.3	50
Z2973	2.2/50	35
Z2974	2.2/50	35
Z2978	22/25	30
X3110	22/350	12
Z3829	22/40	40
Z3837	220/10	40
Z2983	220/10	30
Z3838	220/16	30
Z5908	220/25	30
Z5378	2200/16	10
Z5911	2200/35	5
Z5379	2200/35	5
Z2991	2200/6.3	20
Z3823	3.3/25	50
Z3830	33/10	50
Z3831	33/16	50
Z2979	33/16	50
Z3832	33/25	50
Z3833	33/40	40
Z5907	33/63	30
Z3839	330/10	25
Z5461	330/100	10
Z5375	330/100	10
Z5909	330/63	15
Z3840	3300/16	6
Z3824	4.7/25	50
Z3826	4.7/63	40
Z2980	47/10	35
Z2981	47/10	35
Z2984	470/10	25
Z2985	470/16	20
Z2986	470/50	20
Z5912	4700/10	6
Z5913	4700/16	5
Z5382	4700/16	5
Z5384	4700/25	4
Z3834	68/16	50
Z429	750/16	25
Z788	8/25	50

Radial

Code	Value (µF) / Volts	£2 Pack
Z3801	0.22/50	200
Z3802	0.33/50	200
Z3803	1/50	200
Z5322	1/50	200
Z3806	10/10	200
Z3807	10/50	100
Z4420	100/100	40
Z5904	1000/10	40
Z5376	1000/40	10
Z3816	150/25	50
Z428	1500/40	15
Z3808	22/16	100
Z3809	22/25	80
Z5901	220/100	20
Z3817	220/35	50
Z5905	2200/10	25
Z5377	2200/16	10
Z3804	3.3/25	200
Z3811	33/16	100
Z3812	33/25	100
Z5374	33/25	100
Z3813	33/63	50
Z5902	330/63	25
Z5380	3300/16	10
X6044	3300/25	6
Z3805	4.7/25	100
Z5373	4.7/50	50
Z3814	47/10	200
Z3815	47/100	50
Z3294	47/16	100
Z5323	47/16	100
Z2319	47/25	40
Z5324	470/10	50
Z5903	470/35	20
Z5325	470/35	20
Z3818	470/6.3	50
Z5732	4700/16	8
Z5866	4700/16	20
Z5383	4700/16	12
Z3061	4700/25	6

Ceramic Caps

Code	Value/ Volts	£2 pack
Z1965	0.01µF/	80
X3112	0.01µF/ 200	40
Z7023	0.01µF/25	100
Z1709	0.01µF/50	60
Z781	0.02µF/50	100
Z7024	0.022µF/ 16	100
Z7136	0.033µF/ 25	100
Z7026	0.039µF/ 16	100
Z7027	0.047µF/ 50	100
Z3440	0.1µF	40
Z3437	0.1µF/	20
Z7028	0.1µF/25	100
Z2812	0.1µF/50	50
X3111	0.22µF/50	12
Z3438	0.47µF/	15
Z3439	0.47µF/25	20
Z3046	1.5µF/50	50
Z7019	1200pF/16	200
Z7013	120pF/50	200
Z7020	1500pF/16	200
Z1541	2200pF/	40
Z7008	22pF/50	200
Z7021	2700pF/16	200
Z7022	3300pF/25	200
Z7015	330pF/50	200
Z7002	3pF/50	200
Z7003	4.7pF/50	200
Z7009	43pF/50	200
Z5812	4700pF/ 500	100
Z7017	470pF/50	200
Z7010	47pF/50	200
Z1769	680pF/ 2000	30
Z7004	6pF/50	200
Z7007	8.2pF/50	200
Z7018	820pF/50	200
Z7012	82pF/50	200

Polyester Caps

Code	Value/ Volts	£2 pack
Z2955	0.001µF/	20
Z2956	0.0015µF/	20
Z2957	0.0022µF/	20
Z2958	0.0033µF/	20
Z2959	0.0047µF/	20
Z2960	0.0068µF/	20
Z7030	0.015µF/ 50	200
Z2962	0.015µF/	16
Z2963	0.022µF/	16
Z2964	0.033µF/	16
Z7031	0.039µF/ 200	200
Z2965	0.047µF/	12
Z5387	0.047µF/ 400	40
Z7032	0.056µF/ 50	200
Z2966	0.068µF/	12
Z4423	0.1µF/100	100
Z1766	0.1µF/250	8
Z2320	0.1µF/250	12
Z2968	0.15µF/	10
Z2969	0.33µF/	8
Z2970	0.47µF/	5
Z3205	0.9µF/250	40
Z3206	1.0µF/250	6
Z5388	1.0µF/400	10
Z5389	1.0µF/630	8
Z4426	1µF/63	40
Z3827	10µF/	3
Z3201	1000pF/50	400
Z2950	1500pF/ 100	100
Z7028	1800/50	200
Z7133	1800/50	200
Z3825	2.2µF/	6
Z4428	2.2µF/63	5
Z3826	2.2µF/63	6
Z7029	2200/50	200

Solid Tant Caps

Code	Value/ Volts	£2 pack
Z3853	1µF/40	30
Z3633	100µF/10	6
Z3852	150µF/6	10
Z3848	22µF/15	20
Z3851	220µF/10	6
Z3634	220µF/10	3
Z3849	33µF/10	20
Z3854	6.8µF/50	20
Z3851	6.8µF/6	40

Tants Caps

Code	Value/ Volts	£2 pack
Z3441	10µF/16	20
Z2562	100µF/6.3	4
Z3549	15µF/50	12

New range of high voltage radial electrolytics. We are frequently asked for these caps, particularly now valve equipment is back in vogue.

10% OFF

Code	Value/Volts	lxd	Pitch	1-24	25-99	100+
NK1001	1µ 450V	12x8	3mm	33p	0.21	0.17
NK1002	2.2µF 450V	13x10	5mm	35p	0.22	0.18
NK1003	4.7µF 450V	20x10	5mm	49p	0.31	0.25
NK1004	10µF 400V	25x13	5mm	57p	0.36	0.29
NK1005	22µF 450V	27x16	7.5mm	109p	0.70	0.56
NK1006	47µF 400V	36x16	7.5mm	214p	1.37	1.10

GREENWELD

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X3215 33µF 250V, size 25x16. **5/£1.00**
X3191 100µF 160V, size 40x25. **3/£1.00**
X3189 100µF 400V, size 31x25. DP 3.89 **£2.00**
X3221 150µF 385V, size 48x36. DP 388 **£2.00**
X3190 470µF 350V, size 51x30. DP 6.00 **£3.00**

Sub min electrolytics

Superb quality product at a remarkably low price. All are 6.8 x 3.6mm dia axial, except 10µF 6V which is 5.5 x 3.2mm dia radial.

Code	Value	Volts	Pack of 200
X3109	0.1µF	50V	£5.00
X3103	1µF	50V	£5.00
X3104	2.2µF	50V	£5.00
X3105	3.3µF	50V	£5.00
X3106	4.7µF	25V	£5.00
X3107	6.8µF	25V	£5.00
X3108	10µF	6V	£5.00

Some surface mount caps, all 50V size 2x1.2mm

Z7125	22F	**3k/£10.00**
Z7126	68pF	**3k/£10.00**
Z7127	82pF	**3k/£10.00**
Z7128	100pF	**3k/£10.00**
Z7129	180pF	**3k/£10.00**

Some electrolytics from a recent parcel. Most have been mixed into our K528 packs, but we,ve selected a few to sell individually.

X3101 Phillips 10µF 16V disc 7.5mm dia, 5mm pitch. **Packs of 200 £2.00 Box of 1000 £7.50**
X3102 Phillips 1µF 40V disc 7.5mm dia, 5mm pitch. **Packs of 200 £2.00** Box of 1000 £7.50
X6044 3300µF 25V radial 31x16mm, 7.5mm pitch. **Bag of 50 £10.00**
X3111 0.22µF 50V multilayer ceramic 7.5x7.5x2.5mm 5mm pitch. CK06 list 0.94 **Our Price 6/£1.00** 100+ 0.10 1k+ 0.07
X3112 0.01µF 200V multilayer ceramic 5x3x2mm, 2.5mm pitch. **20/£1.00** 100+ 0.03 1k+ 0.02

SUPER DEAL ON NEW, FULL SPEC TO92 TRANSISTORS!

GREAT SALE PRICES!

One of our suppliers is clearing stocks of the following popular small signal transistors.

BC182LB	BC214C	BC559A	MPSA6532
BC183	BC337	BC559B	MPSA6571
BC183A	BC338	BC560A	2N3710
BC183B	BC347A	BF195	2N3711
BC183C	BC415	MPSA43	2N3903
BC183LC	BC446	MPSA55	2N3905
BC184LC	BC548A	MPSA2907	2N4400
BC213LA	BC548B	MPSA6522	2N4402
BC213LB	BC550B	MPSA6523	2N4403

Packs of one type:
100 £3; Any 10 £25
K900 Mixed packs - approx equal numbers of all above types
100 £3.50; 300 £9.50; 1000 £30

TRANSISTORS

CODE	TYPE	CASE	DESCRIPTION	QTY	PRICE
Z2886	2N3019	TO39	Transistor	30	2/£1.00
Z2548	2N3232	TO3	60V; 7A; 117W. Hfe 18-55 @3A npn		2/£1.00
Z2549	2N3792	TO3	80V; 10A; 150W. Hfe 40-150@1A pnp	200	£1.00
Z2484	2N3903	TO92	Transistor		12/£1.00
Z721	2N397		2 matched alloy transistors PNP		40p
Z6138	2N4392	TO18	TO18 FET, N, 40V 300mW		3/£2.00
Z2884	2N4905	TO3	Transistor	90	£2.00
Z2885	2N5108A	TO39	Transistor	156	2/£1.00
Z2550	2N6385	TO3	darlington ??V; 10A; 100W. Hfe 1000@5A. npn	389	£1.50
Z2851	2N6520	TO92	High voltage 350V 0.5A, 625mW Hfe 20-100 @ 50mA PNP		10/£2.00
Z2881	2S323	TO18	Transistor	1300	£2.00
Z2882	2S324	TO18	Transistor	500	£2.00
Z7301	2SC1449	TO126	Transistor	295	4/£2.00
Z7302	2SC1675	TO92	Transistor	540	8/£2.00
Z7304	2SC2001	TO92	Transistor	834	8/£2.00
Z7303	2SC2028	TO126	Transistor	147	4/£2.00
Z7111	2SC2413K		surface mount	33k	50/£2.00
Z7138	2SC331	TO92		2k8	50/£2.00
Z7305	2SC829	TO92	Transistor	1729	20/£2.00
Z1770	2SC945		Small signal siliconNPN		250/£8
Z2878	40430	TO39	Unknown	750	5/£1.00
Z2660	83R10		Murata Filter		£1.00
Z2883	BC177A	TO18	Transistor	275	10/£1.00
X3124	BC212A	TO92	Small signal PNP		100/£3
X3231	BDW93	TO220	40V; 80W; 12A. Hfe 750@5A darlington		40p
X3232	BDW94	to220	40V; 80W; 12A. Hfe 750@5A darlington		40p
Z724	BDX88A	TO3	darlington 80V; 12A; 117W; Hfe 7540 @6A pnp		2/£1.00
Z3888	BDY60		Mullard		£1.00
Z3889	BDY62		Mullard		£1.00
Z3890	BFX29		Mullard		5/£1.00
X3122	D44H10	TO220	Transistor 80V NPN		10/£1.00
Z2324	DTS701	TO3	Silicon rated 800V 1A 50W		£3.00
Z3891	GET111		Mullard		3/£1.00
Z3891	GET113		Mullard		3/£1.00
Z3892	GET115MP		Mullard		£1.00
Z2384	MPSA13	TO92	Darlington 30V;Hfe10,000 @ 0.1A		8/£1.00
Z3894	OC169		Mullard		£1.00
Z3896	OC201		Mullard		£2.00
Z3897	OC35		Mullard		£3.00
Z3898	OC45		Mullard		4/£1.00
Z3681	TIP110		Pack of 5 with mntg kits from RS Components Ltd.		£1.50
Z3768	TIP30A	TO220	60V 1A 30W	800	8/£1.00
Z3766	TIP41	TO220	40V 6A 65W NPN	850	5/£1.00
X3233	TIPP31	TO92	40V; 2A npn TO92		8/£1.00
X3234	TIPP32	TO92	40V; 2A npn to92		8/£1.00
Z2514	ZTX751	TO92	Rated 80V, 2A, 1W PNP		5/£1.00

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A01 Mini maths set - clear zipped pencil case with rule, protracter, rubber and sharpener. **99p**
Q8E Small maths set - colorful rule, two set squares, protracter and a pair of compasses. **99p**

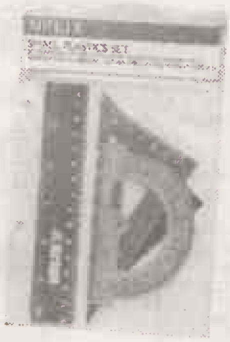
Ink & Leads
Z01158 Tube of 12 x 2H leads 2mm dia. **Price 25p;** 10+ 0.17; 50+ 0.12
Z01268 Staedtler/Mars lumochrom leads. Pack of 12 in dispenser. Blue 2mm. Fits all standard lead holders. **Prices 30p;** 10+ 0.20; 50+ 0.15
Z01159 Tube of 12 Green leads 2mm dia. **Prices 30p;** 10+ 0.20; 50+ 0.15
Z23186 Drawing Ink, Staedtler/Mars 23ml plastic bottle (green). **Only £1.00 each;** 10+ 0.70
CO3010 This attractive case come with 24 FTL plastic crayons in different colours. **Price £1.50**

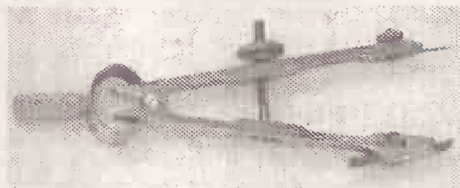
HELIX MATHS SET

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

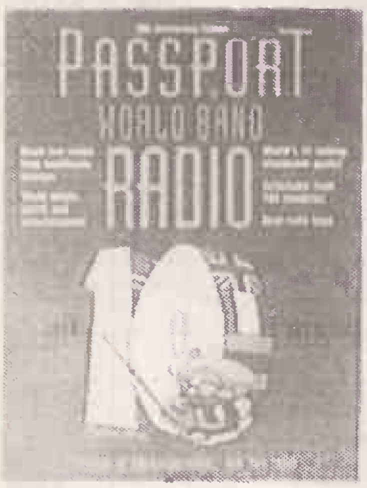
Big Discounts for quantity!
100+ 0.45
1000+ 0.35

99p
Order Code Q86013





Z314 A pair of spring bow compasses 85mm long. Will draw circle up to 64mm dia. **Only £1.00**



PASSPORT TO WORLD BAND RADIO

Not just another listings book - this 432 page 254x178mm tome is a shortwave listeners delight. Beautifully produced on quality paper it is truly international. It is divided in to several distinct sections:
(a) How to Listen: Includes time zone map, best news stations for 1994, top entertainment shows for '94, and Compleat Idiot's Guide to Getting Started.
(b) What to Listen With: Extensive reviews of 122 receivers, priced in several currencies. Digital/analogue portables, car, tabletop from £15 to over £4,000
(d) Where & When: What's on tonight?, Worldwide broadcasts in English, Voices from home and beyond, Address list + times, future plans, fax/freephone nos, Channel by channel - 186 pages in frequency order from 2310 to 25905kHz
(e) A Glossary of Terms.

Whether you're an experienced short wave listener or especially if you're just taking up the hobby, you'll find this volume a mine of information, well set out and easy to read. A book that won't disappoint!

Order Code GAZ101 (NOT 2 FOR 1) **£14.99**

THE VE DAY COMMEMORATIVE COLLECTION

Each collection contains three AIRFIX kits:
Supermarine Spitfire Mk IX
Messerschmitt Me262
American P51D Mustang
Plus
4 enamel paints
1 tube poly cement
1 paint brush

£14.99
(NOT 2 FOR 1)
Order Code L8423

SOUND EFFECTS CHIPS

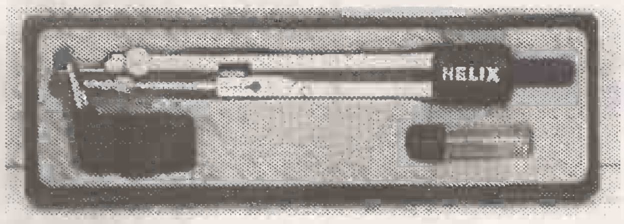
Code	Description	Prices 1-24	25-99	100+
SG1	Four train noises	£3.04	1.52	1.01
SG2	Phone tones	£1.58	0.80	0.53
SG3	16 door chime tunes	£2.84	1.43	0.95
SG4	Three sirens and machine gun!	£1.89	0.95	0.63
SG5	Ding-dong door chime	£1.79	0.90	0.60
SG6	Melody IC in T092 package	£1.60	0.80	0.53
SG7	As SG6, but complete with battery, slide switch, and piezo on adhesive card to use in book or greetings card	£2.10	1.05	0.70
SG8	28 second solid state message recorder	£11.76	5.88	3.92

25% OFF THESE LISTED PRICES

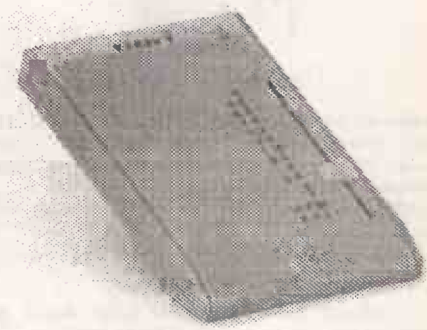
EVERYTHING ON THIS PAGE 1/4 (25%) OFF!
(Except where prices are indicated by SALE flag)

HELIX PRODUCTS

TECHNICAL COMPASS SET

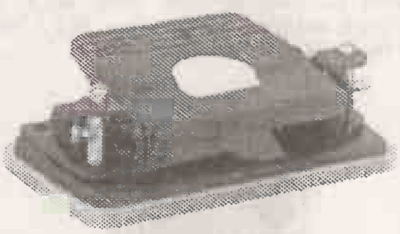


T71010 140mm long compasses with adaptor to take pen or pencil. Spare leads supplied. **PRICE £2.25**



MINI TELEPHONE INDEX

N04020 Compact pop-up index for pocket or handbag. **PRICE 75p**

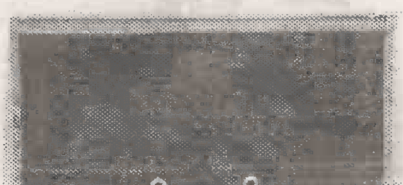


HOLE PUNCHER

Q51040 Perforator for punching holes 80mm apart to fit standard ring binder. **PRICE £1.25**

MATHS SET

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



13" PENCIL CASE

M72890 Nylon ring binder pencil case 330x150mm with strong zip. **PRICE £1.50**

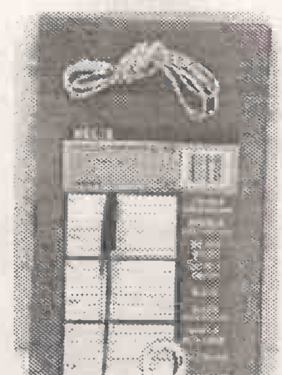
SELF ADHESIVE LABELS

F05011 12 sheets of coloured labels 31x18mm. Total of 216. **PRICE 75p**
F05010 12 sheets of white labels. Total of 132 in three sizes: 31x19mm, 46x28mm, 94x28mm. **PRICE 75p**

H40 Lettering guide value pack. Contains 4 popular sizes: 5mm and 10mm upper and lower case; and 20mm and 30mm upper case only. Supplied in compartmented clear plastic case. **PRICE £1.99**

PLASTIC CRAYON SET

C03010 Plastic wallet containing 24 different "fun to learn" plastic crayons. **PRICE £1.50**



PARCEL WRAPPING KIT

F10750 Useful kit containing a roll of selotape, string, adhesive labels, ballpoint pen and two sheets of strong brown paper, each 1.2x0.9m. **PRICE 75p**

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BREADBOARDS & TOOLS

Easiwire - an exciting new product from BICC-VERO which enables you to construct electronic circuits quickly, easily and cleanly - without solder - by using a wrapping technique.
Easiwire is supplied in kit form and is complete with everything required to construct a circuit.

- ∝ A high quality wiring pan with built-in wire cutter.
- ∝ A flexible injection mould wiring board.
- ∝ An unwrap tool. A double ended device for anchoring the wire that needs to be changed.
- ∝ Two sheets of double sided, self-adhesive material.
- ∝ Spring-loaded terminals and jacks for off board connections.
- ∝ Spare spool of wire.
- ∝ A clearly written instruction book.

428-63625
£4.95

SALE PRICE £2.95

Spares:
Z3171 Easiwire adhesive sheets. Pack of 6/£1.50
SALE PRICE 75P

Z2315 Allen key, 4mm 27mm x 110mm. **25p**

Breadboards

Z5725 Protoboard 100. Do it yourself version of Z5723, but only 760 tie points and only 2 terminals. Baseplate 152x114mm. List 13.87 10 years ago. **Only £8.**00

Socket Set

Z9155 40 piece socket set by 'Grafter'. Good selection of sockets at a modest price - 5/32: 9/16"; & 4-14mm + handle extn adaptor etc all in a hinged metal case. **£6.95**

SALE PRICE £4.95

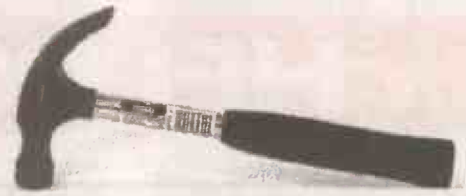
BACK IN STOCK - MINIATURE DRILL PACKS!
REDUCED SHANK TUNGSTEN CARBIDE

These were very popular when last advertised and sold out quite quickly. Don't miss out this time - although we have plenty of 0.95mm, the other sizes are in short supply.
All have 3.15mm shank. They normally cost around £3 each
Available in the following packs:
K901 8 drills - 0.35, 0.85, 4 x 0.95, 1.10 and 1.15mm for £5.95 **SALE PRICE £4.50**
These sizes **only** available separately:
Z3233 0.95mm **50p;** 25+ 0.40; 100+ 0.30
Z3234 1.10mm **75p;** 25+ 0.50; 100+ 0.40

DRAPER
THE TOOL COMPANY

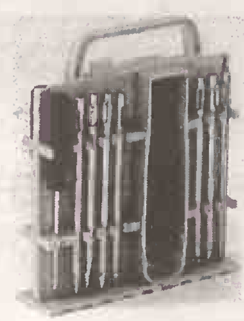
Combination Wrench Sets
19512 10 pce open end spanner set made from hardened special alloy steel in metric and AF sizes, each set held in a steel clip. Sizes 10, 11, 12, 13, 14, 15, 16, 17,18 & 19mm; 1/4; 5/16; 3/8; 7/16; 1/2; 9/16;1 9/32; 11/16; 5/8 & 3/4". **£5.95**
19511 12 pce combination wrench set covering popular AF and metric sizes. CV steel. Held together in hinged clip. Sizes 10, 11, 12, 13, 14 & 17mm; 3/8; 7/16; 1/2; 9/16; 5/8 & 3/4". **£7.95**

Adjustable Spanner set
32998 3pce adjustable spanner set. The three tools (150, 200 and 250mm) give a total range from 0-31mm. **£13.95**



Claw Hammer
31392 16 oz claw hammer with a hardened steel shaft and rubber handle. **£5.95**

Colour Coded Screwdriver Set
14078 6 pce colour coded screwdriver set. Red handled plain slot in 5x38, 3x65, 6x100 and 8x150mm, and green handled pozi in No1 x 75mm and No 2 x100mm. **£9.95**



Screwdriver and nut runner set
31156 17 pce screwdriver and nut runner set, all contained in handy plastic case. 4 straight blade, 5 pozi, 6 nut runners from 5 to 10mm and bradawl **£13.95**

Glue Gun

T216 A hot melt glue gun suitable for home and industrial use. Electronically controlled heating element which melts the long stick of glue when inserted into the back of the gun. A smooth flow of adhesive is controlled by the trigger feed. Suitable for a wide range of materials including most metals, PVC, concrete and asbestos. Supplied with two FREE sticks of glue!

SALE PRICE £5.50

NEW FROM TRING - BUDGET VIDEOS

In line with their policy of providing great products at low, low prices these videos are just

£3.99 EACH

TVA001 Golf - The lighter side. All the hilarious and unbelievable moments from the big names in golf.

TVA002 The history and traditions of golf, From the sports origins in Scotland through to the present day.

TVA004 Golf - The lighter side 2. The golfing elite as you've never seen them before.

TVA005 40 years of science fiction. From the beginnings to the present day, the best and the worst of Science Fiction.

TVA018 Getting married. Claire Rayner offers useful tips on getting, and staying married!

TVA019 Woman and her body. Claire Rayner gives sensitive guidance.

TVA020 Health is happy. Claire Rayner offers advice on all aspects of living a healthy life.

TVA021 Stepping out. Essential advice on those teenage years from Claire Rayner.

TVA022 Experiencing pregnancy. The fact and the joy presented by Claire Rayner.

TVA023 Good sex, safe sex. From contraception to satisfaction, Claire Rayner offers essential advice.

TVA024 1978 - The year of your birth. All the important events from the year you were born.

TVA025 1979 - The year of your birth. All the important events from the year you were born.

TVA026 1980 - The year of your birth. All the important events from the year you were born.

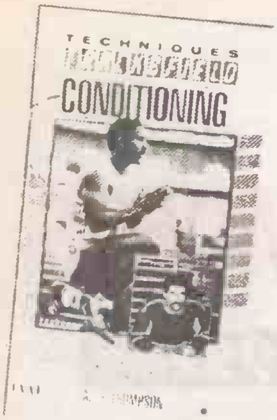
TVA027 1981 - The year of your birth. All the important events from the year you were born.

TVA028 1982 - The year of your birth. All the important events from the year you were born.

TVA029 1983 - The year of your birth. All the important events from the year you were born.

TVA030 1984 - The year of your birth. All the important events from the year you were born.

TVA031 1985 - The year of your birth. All the important events from the year you were born.



PY2001 Conditioning Techniques.

PY2002 Shot Put Techniques.

PY2003 Hurdles Techniques.

PY2004 Middle Distance Running Techniques.

PY2007 Sprinting Techniques.

PY2011 Road Running Techniques.

PY2021 The Professionals. Foxhole on the roof.

PY2022 The Professionals. Operation Susie.

PY2023 The Professionals. Purging C.I.S.

PY2024 The Professionals. The female factor.

PY2025 The Professionals. Involvement.

PY2026 The Professionals. Wild justice.

PY2027 Moonlighting. Gunfight at the So-So corral.

PY2028 Moonlighting. Read the mind - See the movie.

PY2031 Moonlighting. The murders in the mail.

PY2032 Moonlighting. Brother can you spare a blonde.

PY2033 Moonlighting. My fair David.

PY2034 Moonlighting. The dream sequence always rings twice.

PY2036 The New Avengers. The eagles nest.

PY2037 The New Avengers. The last of the cybernauts...?

PY2038 The New Avengers. Sleeper.

PY2039 The New Avengers. Target.

PY2040 The New Avengers. The gladiators.

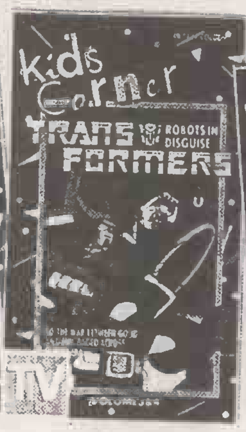
PY2041 The New Avengers. Faces.

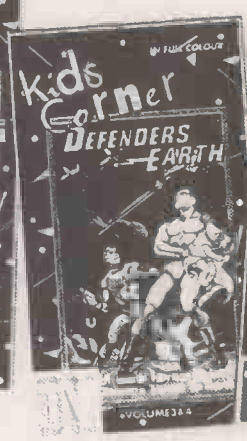
PY2044 Dempsey and Makepeace. Lucky Streak.

PY2045 Dempsey and Makepeace. The Squeeze.

PY2046 Dempsey and Makepeace. Hors de Combat.

PY2047 Dempsey and Makepeace. Given to acts of violence.





PY2052 Transformers. Volumes 3 and 4.

PY2053 Transformers. Volumes 1 and 2.

PY2054 Transformers. Volumes 5 and 6.

PY2055 Visionaries. Volumes 5 and 6.

PY2056 Defenders of the Earth. Volumes 5 and 6.

PY2057 Defenders of the Earth. Volumes 3 and 4.

PY2058 Defenders of the Earth. Volumes 1 and 2.

PY2059 The Bluffers. Volumes 1 and 2.

PY2060 The Bluffers. Volumes 5 and 6.

PY2061 Raggedy Ann & Andy. Volumes 1 and 2.

PY2062 Ghostbusters. Further adventures of the famous ghostbusters.

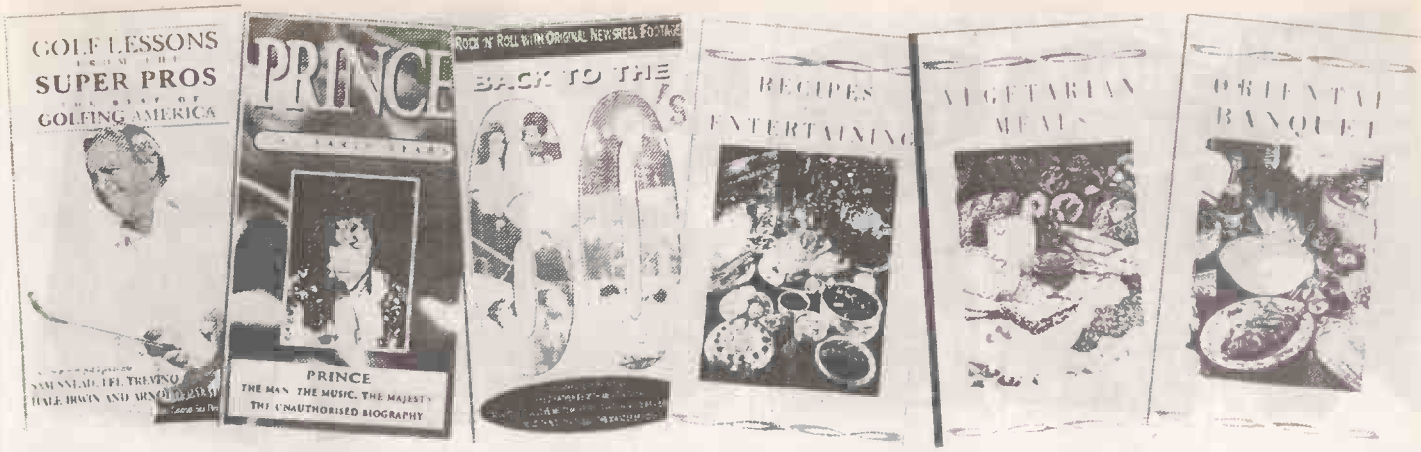
PY2063 Saber Rider. Volumes 1 and 2.

PY2064 Thunder Sub. Volumes 1 and 2.

PY2065 Gigi and the Fountain of Youth.

PY2066 Denver. The most loveable dinosaur.

PY2067 Houndcats. Volumes 1 and 2.



TVB034 Golf lessons from the super pros. Shave strokes of your game in a weekend!

TVB037 Prince - The early years. A memorable video portrait of pop's most influential artist.

TVB039 Back to the 60's. Space travel, Vietnam, Peace rallies and all the music!

TVB043 Recipes for entertaining. Impress your friends with this step by step guide.

TVB044 Vegetarian meals. Inspirational ideas on recipes and how to present them.

TVB045 Oriental banquet. A taste of the Orient with these easy but exotic recipes.

TVB046 Microwave cooking. Use your microwave for more than simply re-heating frozen meals!

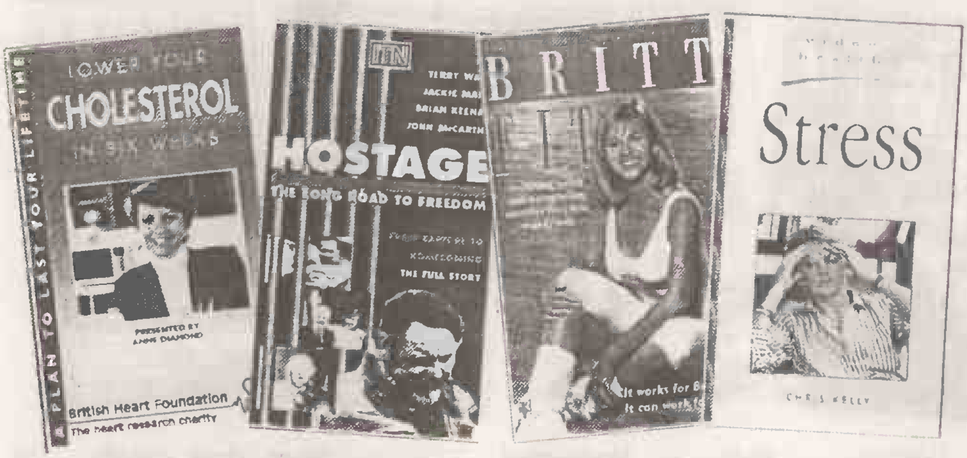
TVB047 The spice of India. Traditional and tasty Indian recipes by Meera Taneja.

TVB048 Jane Asher's world of cakes. Who better to advise than Jane Asher on cakes for every occasion.

TVB050 The Thatcher years. ITN footage of the most controversial Prime Minister in history.

TVB051 The Yorkshire ripper. ITN footage of the most complex investigation ever.

TVB052 Space - The final frontier. ITN footage covering three decades of mans greatest challenge.



TVB053 Lower your cholesterol. Anne Diamond presents information everyone will need to know.

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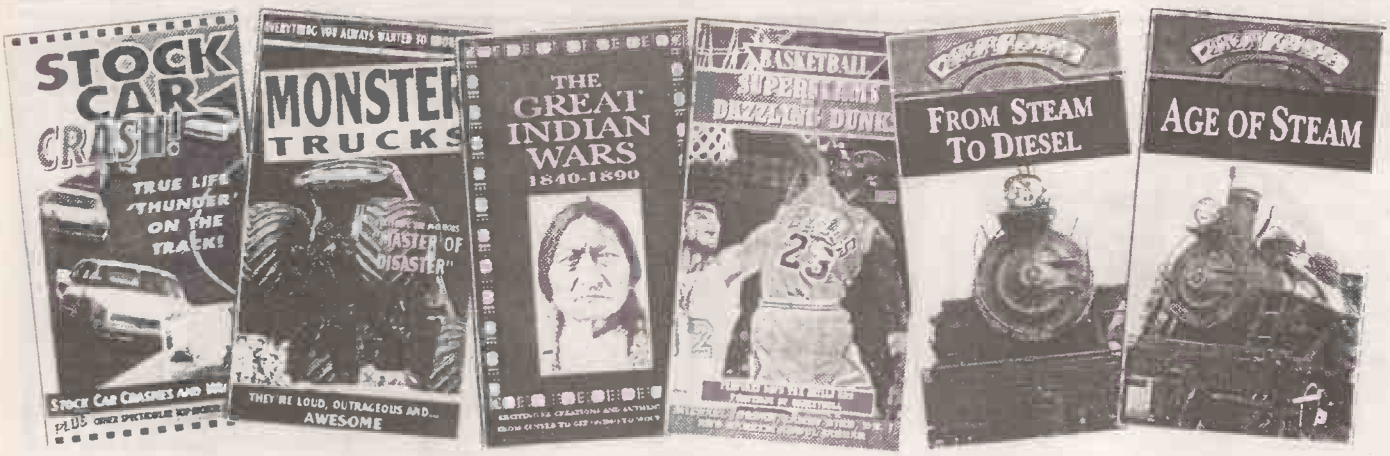

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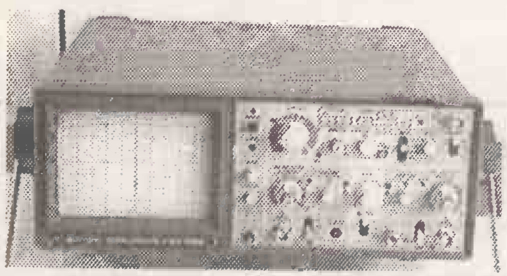

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