DECEMBER 1982-FEBRUARY 1983

PRICE 60p

# Electronics
## THE MAPLIN MAGAZINE

**AS HI-FI TAKES A GIANT STEP FORWARD WE ASK — HAS THE LP HAD ITS CHIPS?**

**CCITT STANDARD MODEM**
**CENTRAL HEATING CONTROLLER**
**SOUNDS GENERATOR FOR ZX81**
**BURGLAR ALARM PANIC BUTTON**
**AND MANY MORE!**

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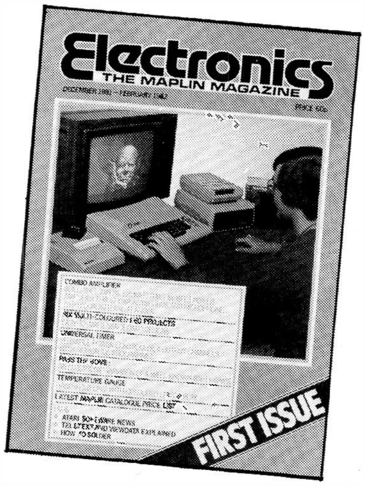


**Universal Timer.** A comprehensive programmable controller for up to 4 mains appliances. There is storage for up to 18 program times, ons or offs and relay outputs. Complete construction details.

**Combo Amplifier.** Superb 120W MOSFET power amp with low-noise BI-FET pre-amp having built-in flanger, inputs for guitars, keyboards or microphones, and five step equaliser. Complete construction details.

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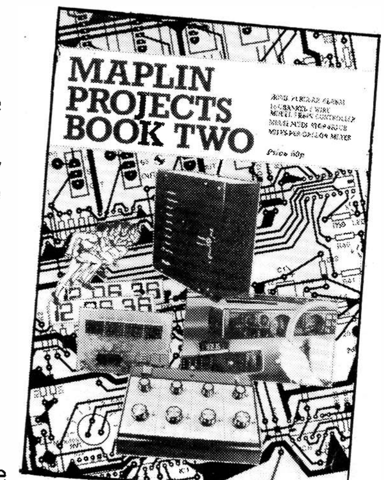
Copies of issue 2 are now sold out, but a reprint of the projects from issue 2 is available and contains:




**Digital Multi-Train Controller.** Our superb digital train controller can control up to 14 locomotives individually on the same track. Any four loco's can be controlled simultaneously. The unit has automatic short-circuit protection and because it uses digital control a DC supply is present all the time for carriage lighting etc. The locomotive modules will fit in most modern 00-scale engines. Complete construction details.

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**Stereo 25W MOSFET Amp.** Supplied as a complete kit including wooden cabinet and printed and punched chassis, this superb 25W rms per channel amplifier has inputs for magnetic pick-up, tape deck, tuner and auxilliary. The kit is extremely easy to build, all but 5 components mounting directly on the pcb. There are only 7 interconnecting wires in all and when completed, no setting-up is required. With its superb frequency response, low noise, low distortion and the grandeur of MOSFET sound, the amplifier is second-to-none at the price.

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**All this for just 60p. Order As XA03D (Maplin Magazine Volume 1 No 3) Price 60p*NV***

# A NEW CATALOGUE FOR 1983

At the same time that this magazine hits the news stands our new catalogue for 1983 will be available. it will be on sale in all branches of W.H. Smith from about 17th November for just £1.25. For 392 pages this represents a page-for-page price increase of just 2% over two years. Considering that inflation topped 15% a year during that period, we're sure you'll agree that the Maplin catalogue is still incredible value for money.

Consequently in this issue of the magazine, the price list in the centre has been re-ordered for use with the new catalogue. If you don't have a copy yet, you can still use the price list with your old catalogue by looking under the appropriate section heading. If the item you are looking for is no longer in the list then it has probably been discontinued as only a few items have been moved from one section to another.

In the new year our dial-up service will be available allowing you to access our computer stock file. In the meantime a service is available that will allow you to test out the modem project. Just dial (0702) 552941 and you will be able to access our computer. The computer is usually available from 9 a.m. to 7 p.m. Mondays to Fridays.

For our trade customers we are introducing a new service that will provide quantity prices if required. If you want to buy the quantity (shown in brackets in the price list) or more then we can offer very competitive prices. And the more you buy, the better the price will be. Take advantage of our quantity price discounts now. Just write to or phone our sales desk.

We've got dozens of exciting new projects lined up for 1983 as well. The most popular project from our first year was the ZX81 Keyboard and our other computer add-on projects were also extremely well-received. We will therefore have lots of new projects on this theme through 1983. In addition we have lots of other novel projects under development and we're sure you'll find your new subscription well worth the money.


# Electronics
## THE MAPLIN MAGAZINE

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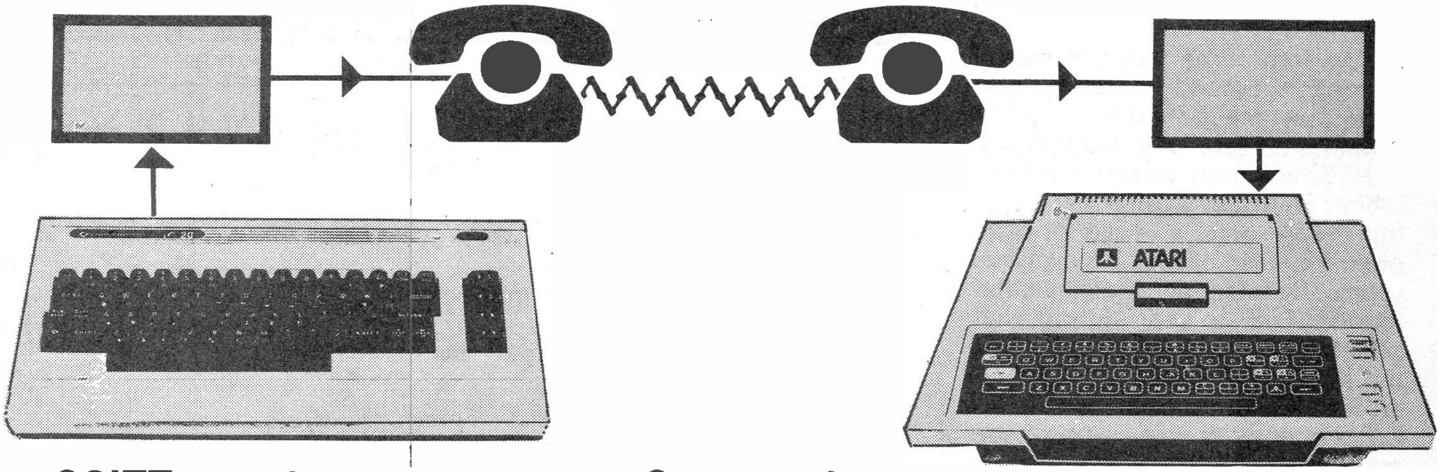
# THE MAPLIN MODEM




**★ CCITT standard MODEM ★ Communicate with other computers**
**★ Easy-to-build ★ Exchange programs with other computer users**

*by Harold Godwin*

This modem will enable a home computer or VDU to communicate with other computers using CCITT standard tones, over the telephone. This means that you will be able to exchange programs with other people and in particular have direct access to the Maplin computer to order components etc. A modem works by converting the data input of marks and spaces, to two different audio frequencies. These audio tones are transmitted down the phone line to the other end where they are converted back to a digital signal by the modem.

So that data can be sent in both directions, four different frequencies are used, two for each direction. In order that two modems can communicate, one must be switched to the originate mode, which transmits 980 and 1180 Hz, and the other must be switched to the answer mode and transmits 1650 and 1850 Hz. Each modem receives the alternate pair of frequencies to those which it transmits.

The lower frequency is the mark condition in each case and it is usual for the terminal that makes the call to be switched to the originate mode. To prevent interference between the two directions of communication, filters are needed to pass the required frequencies in each direction. Although the frequency shift is only 200Hz, the required bandwidth of these filters depends upon the baud rate. At a baud rate of 300 baud and sending alternate marks and spaces, the first sidebands occur +/-150Hz from the carrier which is located midway between the mark and space frequencies. Therefore the minimum bandwidth for the filters is 300Hz.

Unfortunately a signal passing through a filter is delayed in time. All frequency components of the signal should be delayed equally, or jumbling and smearing of the data occurs. This is known as intersymbol or interbit interference. Minimising the delay distortion minimises the interbit interference. This is relatively easy over the centre 2/3 of the passband, but keeping the delay constant near the band edges is difficult, if not impossible to achieve. For this reason the bandwidth is widened. To maintain minimum delay at 300 baud requires an overall bandwidth of 400Hz. The overall performance of the modem is mainly dependant on the response of the filters, particularly the receive BPF (band pass filter).

## Circuit

Two specialised IC's are used in this modem, the first is the 4412VP which is used to generate the required frequencies from a 1 MHz crystal. This IC is capable of transmitting American or CCITT standard frequencies, but pin 14 is earthed for the CCITT standard. The IC is switched between originate and answer by earthing pin 10 for the originate mode. The following pins are permanently earthed. Pin 15 which enables internal pull up resistors, reset pin 5, and pin 13 to inhibit a 2100 Hz tone which is normally transmitted for disabling line echo suppressors. Pin 12 is a carrier disable pin, no tone is

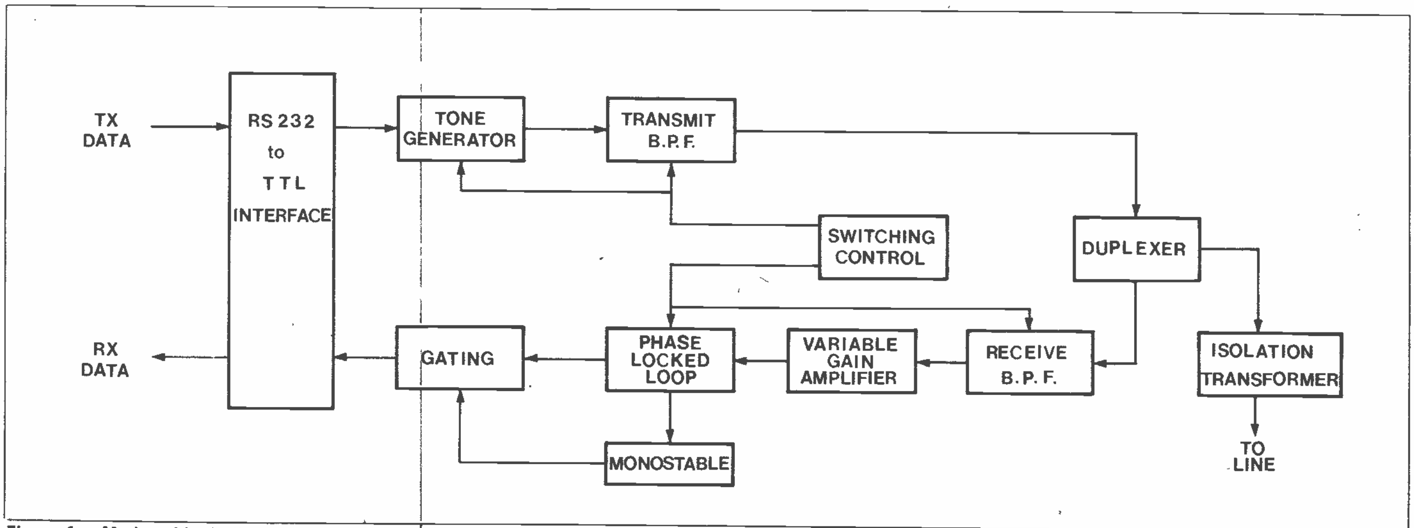
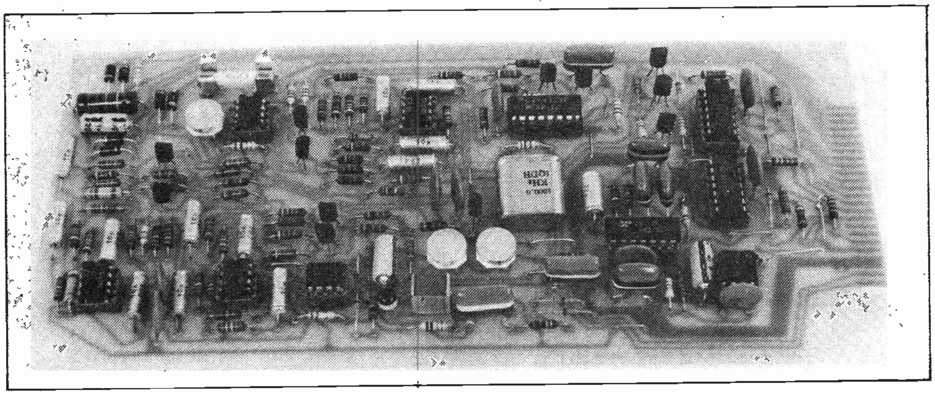
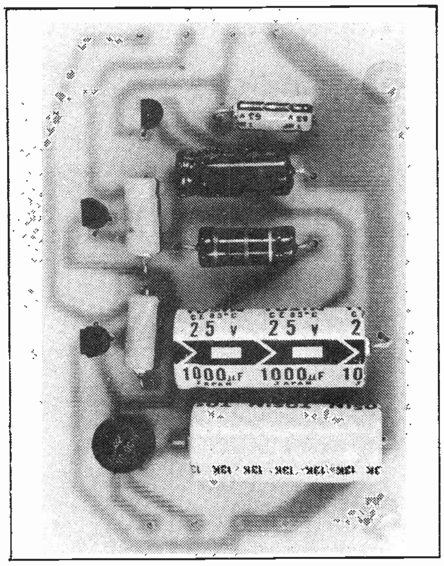



**Figure 1. Modem block diagram**



transmitted when this is earthed, but this facility is not used at present. Data is input to the IC on pin 11 and the audio tone is output on pin 9. The modulator output is an approximated stepped sinewave of 8 amptitude levels. Although each step is optimised so that the waveform has a maximum amount of signal energy at the fundamental frequency, a large number of harmonics are produced. For this reason, and to limit the transmitted bandwidth, the output is buffered by TR1 and passed through the transmit filter. The transmit filter, consisting if IC2 and associated components, is switched between originate and answer frequencies by TR3, 4, and TR1 switches the 4412VP.

There are two methods of connecting a modem to the phone system, acoustic coupling or direct electrical connection. Acoustic coupling has the advantage of being electrically isolated and easy to connect. However, there are problems, one is trying to exclude room noise, particularly if operating in a noisy environment. Another is the fact that the transmit tones will be heard in the telephone receiver considerably louder than the tones that are trying to be received. Although the receive filter would reduce this, there is a problem when operating in the originate mode. When transmitting a mark frequency of 980Hz, harmonic distortion (mainly from the carbon microphone of the handset) produces a second harmonic of 1960Hz. As this is close to the receive band of 1550 to 1950Hz, the receive filter provides little rejection and this interferes with the received signal. For these reasons it was decided to connect the modem to the phone line via a




British Telecom approved transformer.

## Duplexer

The transmit filter output and receive filter input are connected to the line via a duplexer and isolation transformer. This allows the received signal to pass to the receive filter, properly couples the transmit signal to the line, terminates the line and attenuates the transmit signal appearing at the receive filter input. For maximum attenuation R16 = R17 and RV3 should equal the line impedance. RV3 is adjusted for maximum attenuation of the transmit signal. Although the line impedance is nominally 600 ohms, it will have a reactive as well as a resistive component. Therefore the duplexer should be considered as providing about 10db of attenuation, although in many cases better results will be obtained. D1 and D2 protect the modem from voltage surges from the line.

## Receive filter

The receive filter consists of IC4, 5 and associated components. It is switched between the originate and answer frequencies by TR5 to TR8. It is an 8 pole Chebyshev filter and provides 35db of attenuation of the alternate channel. The overall gain of the filter is about 20db (less when receiving 1550 to 1950Hz). Close tolerance components are required for the filters and the resistor values are made up from two resistors in the majority of cases. IC6 is used as a variable gain amplifier to adjust for different receive levels. The output signal is rectified by D3 and used to control TR9 which acts as a variable impedance, adjusting the proportion of the output signal fed back to pin2. D4 and D5 limit the signal fed to IC7 to about 1.5V p to p.

## Phase locked loop

Originally it was planned to use the demodulator section of the 4412VP to decode the received tones. Unfortunately the demodulator has been optimised for 200 baud when receiving CCITT tones, so in order to work at 300 baud it was decided to use an XR2211. This IC is a phase locked loop system especially designed for data communication. Referring to the block diagram for this IC, the input signal applied to pin 2 is amplified, limited and fed to the loop phase detector and quadrature detector. The output from the loop phase detector, at pin 11, is a DC voltage proportional to the phase difference between the VCO (voltage controlled oscillator) and the input signal. This voltage is filtered by C18, R46 and applied to pin 12 to control the VCO frequency. This locks the VCO onto the input signal and the control voltage at pin 11 is dependant on the incoming frequency over the tracking range of the VCO.

The control voltage is filtered by R45, C23 and compared with an internal reference voltage. As the input frequency changes the control voltage above and below the reference voltage, the data output on pin 7 changes. The reference voltage is decoupled by C22 on pin 10, and C19, R47, R48, RV1, RV2 determine the free running frequency of the VCO, which is set midway between the mark and space frequencies. The VCO frequency is switched between originate and answer mode by TR10.

The quadrature phase detector compares the VCO and the input frequency and ouputs a voltage when the VCO is locked to the input frequency. This voltage is filtered and drives the lock detect outputs. IC8 is a monostable which drives the lock detect LED and is gated with the data output from IC7. This allows data to be received only while the VCO is in lock and prevents spurious data filling the screen when there is no input signal.

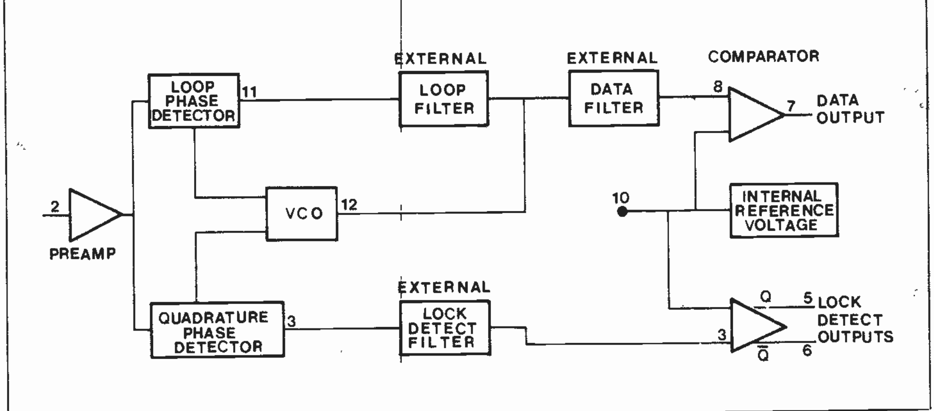



**Figure 2. XR2211 block diagram**

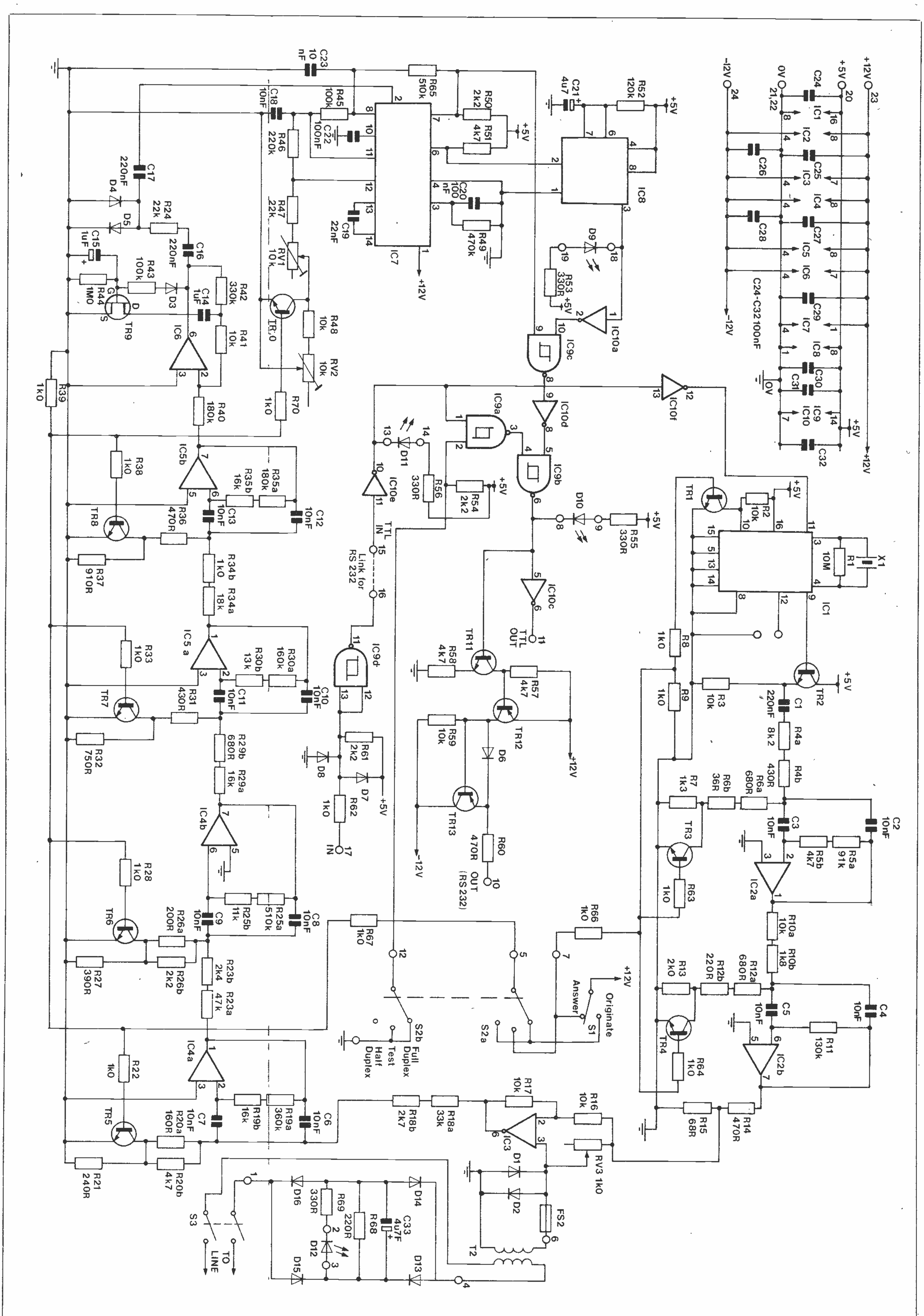
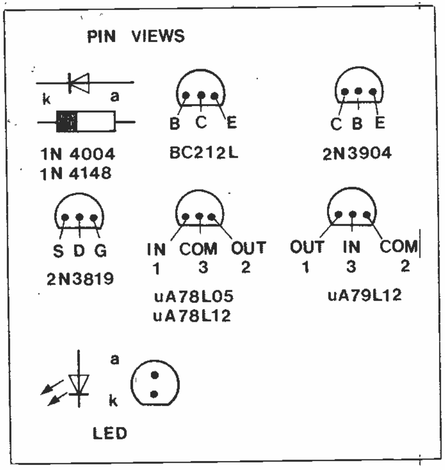



Figure 3. Modem main cct diagram



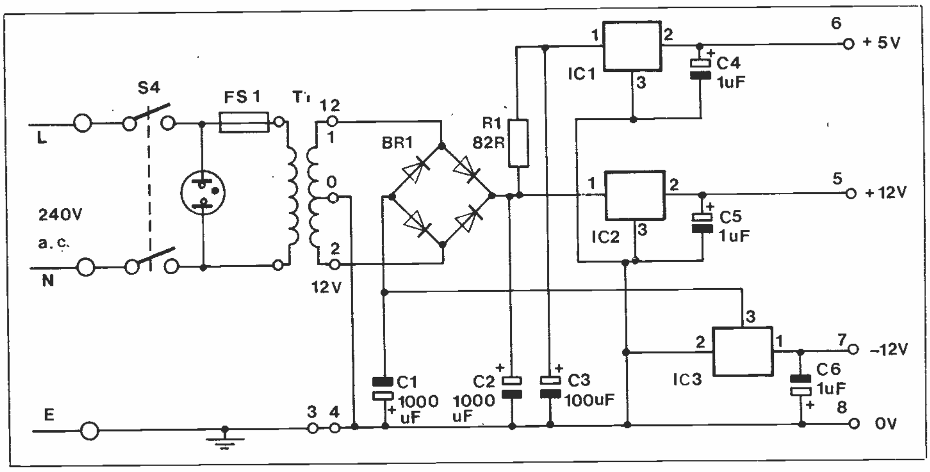



**Figure 4.** **PSU circuit diagram**

S1 switches the modem between originate and answer modes, and S2 switches between full-duplex, half-duplex and test positions. Full-duplex working allows data to be sent in both directions at the same time. Normally this means that the data received at the far end is sent back to the sender on the alternate channel. This is displayed on the senders terminal so that it can be seen exactly what was received at the far end. If the data is not echoed back, the modem can be switched to half duplex. This connects the transmit data via IC9a to the receive direction so that the transmitted data is displayed as well as that received. Obviously data cannot be sent in both directions at the same time as garbled information would be displayed. Note also that a mark condition must be received from the other end to allow the local data to be received via IC9b. The test position switches the BPF and IC7 to receive the same frequencies that are being transmitted locally. This allows the modem to be checked in local via the duplexer. This position could also be used to monitor a simplex transmission, when no signal is being received from the other end.D10 and D11 monitor the receive and transmit data respectively and are lit for a mark condition. IC10c drives the TTL output and TR11 to TR13 convert TTL levels to RS232 interface voltages of +/-12V. At the transmit side D7 and D8 limit the RS232 voltages and IC9d gives TTL level out. The strap must be connected if the RS232 input is used, otherwise IC10 pin 11 is the TTL input. The power supplies of +5V, +12V and -12V are supplied by the three low power regulators and associated components. R1 reduces the power dissipation in the +5V regulator.

## Construction

There are two PCB's to be assembled, the main modem board and the power supply unit. These are printed with the component overlay to make assembly easier. Starting with the modem board, the resistors should be fitted first. It is suggested that the values are checked against the circuit diagram, as a wrong value in the filters would affect the response and would be difficult to find. Next the capacitors should be fitted, checking that C15, C21 and C33 are the correct way round.

It is recommended that IC holders are used and these are fitted next, but the IC's not yet inserted. The leads to the 1MHz crystal are bent so that the crystal lies flat against the PCB. The transistors and diodes are fitted next, checking that they are the correct type and the correct orientation. This leaves just the potentiometers, fuseholder and wire links to be fitted as shown on the legend. The power supply board is assembled in the same way, following the PCB legend.

A suitable case should be chosen from the wide range available that can take the two PCB's and transformers. The front panel should be drilled for the four LED's and switches. The fuse FS1 could be mounted on the front panel or at the back as desired. The 2 transformers should be mounted apart from each other to avoid mains hum. Two connecting sockets will be required to connect to the line and the computer. These are left for the constructor to choose.

The modem PCB plugs into a 24 way connector and is wired up as shown in fig. 5. Lengths of sleeving should be used over the socket connections to prevent short circuits. It is important that the feet are the correct way round, to prevent the PCB being plugged in the wrong way. When the wiring has been completed, the fuses can be inserted and the modem powered up without the IC's in. The power supply voltages should be checked to each IC socket and if correct, the modem switched off. Allow a few minutes for the capacitors to discharge and then insert the IC's and the modem can be tested.

## Setting up and Using the System

The modem can be used with any computer that has a RS232 serial interface or the TTL inputs can be connected direct to a UART, if this is available, as on the Maplin VDU. Only 3 wires are needed between the computer and the modem, Tx, Rx data and 0 volts. If using the TTL inputs, these should be kept reasonably short. With S3 unoperated, connect the 2 line connections across the phone line. Normally there are 3 wires from the phone that connect to a terminal block on the wall. The line wires are the Red and the White.

The modem is most easily set up with an oscilloscope as follows. All signals are measured as peak to peak

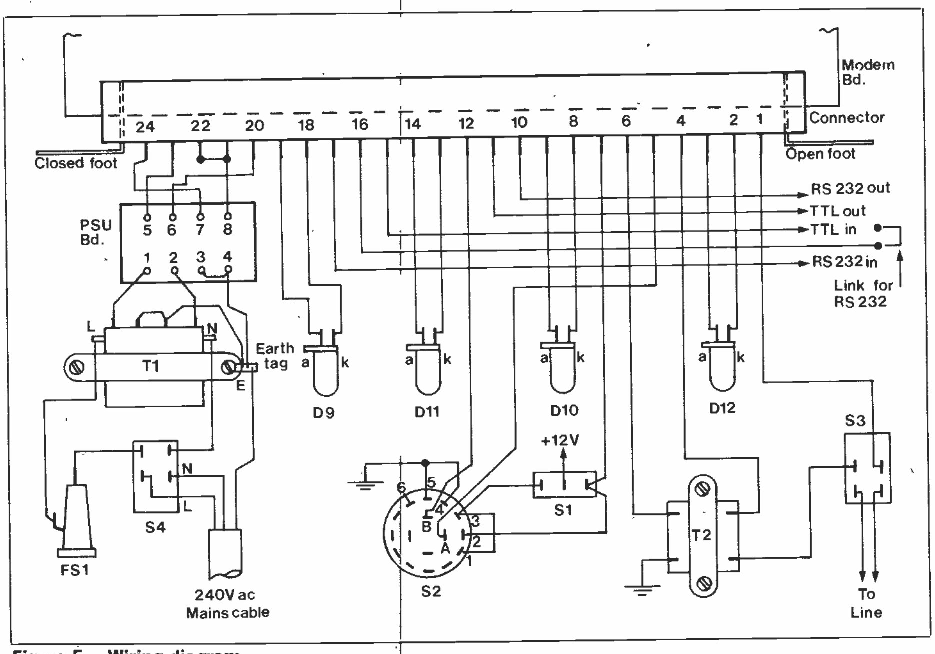


**Figure 5.** **Wiring diagram.**

voltages. The signal at TR1 emitter should be a stepped sinewave of 800 mv. The frequency should change if S1 is operated and if the data input is changed. Check the level at IC2B, pin 7. This should be about 8V when S1 is switched to originate, and 6V for answer mode. Dial a '1' from the phone to clear dialtone, operate S3, replace the handset, and D12 should light, showing that the phone line is being held by the modem. Note that no calls can be received while S3 is operated. People ringing the number will get engaged tone. Switch to originate mode and S2 to test. Measure the signal at IC5B pin 7 and adjust RV3 for a minimum signal at this point. Check the signal level at IC3 pin 3 to be around 500mv p to p. Restore S3 to normal and D12 should darken. IC7 has to be adjusted so that the free running frequency is midway between the mark and space frequencies. The easiest method is as follows. Switch to answer mode and test position, sending alternate marks and spaces, adjust RV1 for equal mark-space ratio at IC7 pin 7. Switch to originate mode and adjust RV2 for equal mark-space ratio. Note RV1 must be adjusted before RV2, as RV2 setting is dependant on RV1. Alternate marks and spaces can be sent by sending the ASCII code for 'U' continuously. The repeat key can be used on a VDU or a short program written for the computer that puts the computer in a loop and outputs ASC(U) to the serial port. The modem is now set up and is used as follows. With S3 normal and D12 unlit, dial the number required. When the number is answered, you must decide which end will be in the originate mode and whether half or full duplex working will be used. Switch the modems accordingly and operate S3 at both ends. The handsets can now be replaced at each end and data sent in each direction. The carrier lock LED will light when the tone is received from the other end and the receive data LED shows the data received. When you have finished, S3 must be restored to normal to clear down the call. When calling a British Telecom modem with automatic answer-in, the call will be answered after a few rings and then 1650Hz will be sent. Your modem should be switched to originate and a mark sent back within about 10 seconds or else the modem at the far end will clear down and you will have to call again. Normally when your mark is received, a signing on message is sent giving instructions on using the system.

## PARTS LIST FOR MODEM MAIN PCB

Resistors - All 0.4W 1% carbon unless specified

| | | | |
|---|---|---|---|
| R1 | 10M | | (M10M) |
| R2, 3, 10a, 16, 17, 41, 48, 59 | 10k | 8 off | (M10K) |
| R4a | 8k2 | | (M8K2) |
| R4b, 31 | 430R | 2 off | (M430R) |
| R5a | 91k | | (M91K) |
| R5b, 20b, 51, 57, 58 | 4k7 | 5 off | (M4K7) |
| R6a, 12a, 29b | 680R | 3 off | (M680R) |
| R6b | 36R | | (M36R) |
| R7 | 1k3 | | (M1K3) |
| R8, 9, 28, 33, 34b, 38, 39, 62, 63, 64, 70, 22, 66, 67 | 1k0 | 14 off | (M1K0) |
| R10b | 1k8 | | (M1K8) |
| R11 | 130k | | (M130K) |
| R12b | 220R | | (M220R) |
| R13 | 2k0 | | (M2K0) |
| R14, 36a, 60 | 470R | 3 off | (M470R) |
| R15 | 68R | | (M68R) |
| R18a | 33k | | (M33K) |
| R18b | 2k7 | | (M2K7) |
| R19a | 360k | | (M360K) |
| R19b, 29a, 35b | 16k | 3 off | (M16K) |
| R20a | 160R | | (M160R) |
| R21 | 240R | | (M240R) |
| R23a | 47k | | (M47K) |
| R23b | 2k4 | | (M2K4) |
| R24, 47 | 22k | 2 off | (M22K) |
| R25a, 65 | 510k | 2 off | (M510K) |
| R25b | 11k | | (M11K) |
| R26a | 200R | | (M200R) |
| R26b, 50, 54, 61 | 2k2 | 4 off | (M2K2) |
| R27 | 390R | | (M390R) |
| R30a | 160k | | (M160K) |
| R30b | 13k | | (M13K) |
| R32 | 750R | | (M750R) |
| R34a | 18k | | (M18K) |
| R35a, 40 | 180k | 2 off | (M180K) |
| R37 | 910R | | (M910R) |
| R42 | 330K | | (M330K) |
| R43, 45 | 100k | 2 off | (M100K) |
| R44 | 1M0 | | (M1M0) |
| R46 | 220k | | (M220K) |
| R49 | 470k | | (M470K) |
| R52 | 120k | | (M120K) |
| R53, 55, 56 | 330R | 3 off | (M330R) |
| R68 | 220R 1W 5% carbon | | (C220R) |
| R69 | 330R ½W 5% carbon | | (S330R) |
| RV1, 2 | 10k cermet | 2 off | (WR42V) |
| RV3 | 1k0 cermet | | (WR40T) |

Capacitors

| | | | |
|---|---|---|---|
| C1, 16, 17 | 220nF polyester | 3 off | (BX78K) |
| C2-13 | 10nF polystyrene 1% | 12 off | (BX86T) |
| C14 | 1uF polycarbonate | | (WW53H) |
| C15 | 1uF 63V electrolytic axial | | (FB12N) |
| C18, 23 | 10nF polyester | 2 off | (BX70M) |
| C19 | 22nF polystyrene 1% | | (BX87U) |
| C20, 22 | 100nF polester | 2 off | (BX76H) |
| C21, 33 | 4 7 63V electrolytic axial | 2 off | (FB18U) |
| C24-32 | 100nF ceramic disc | 9 off | (BX03D) |

Semiconductors

| | | | |
|---|---|---|---|
| D1, 2, 13-16 | 1N4004 | 6 off | (QL76H) |
| D3-8 | 1N4148 | 6 off | (QL80B) |
| TR1-8, 10, 11 | 2N3904 | 10 off | (QR40T) |
| TR9 | 2N3819 | | (QR36P) |
| TR12, 13 | BC212L | 2 off | (QB60Q) |
| IC1 | 4412VP | | (QQ39N) |
| IC2, 4, 5 | 1458 | 3 off | (QH46A) |
| IC3, 6 | uA 741 8 pin | 2 off | (QL22Y) |
| IC7 | XR2211CP | | (QY43W) |
| IC8 | NE555 | | (QH66W) |
| IC9 | 74132 | | (WH03D) |
| IC10 | 7404 | | (QX40T) |

Miscellaneous

| | | | |
|---|---|---|---|
| | PC board | | (GB09K) |
| X1 | 1MHz MP crystal | | (FY79L) |
| | Veropin 2141 | 1 pkt | (FL21X) |
| | Fuse clips | 2 off | (WH49D) |
| FS2 | Fuse 20mm 250mA | | (WR01B) |

## POWER SUPPLY

Resistors

| | | | |
|---|---|---|---|
| R1 | 82R 1W 5% carbon film | | C82R |

Capacitors

| | | | |
|---|---|---|---|
| C1, 2 | 1000uF 25V elect. axial | 2 off | (FB83E) |
| C3 | 100uF 25V elect. axial | | (FB49D) |
| C4, 5, 6 | 1uF 63V elect. axial | 3 off | (FB12N) |

Semiconductors

| | | | |
|---|---|---|---|
| IC1 | uA78L05 | | (QL26D) |
| IC2 | uA78L12 | | (WQ77J) |
| IC3 | uA79L12 | | (WQ86T) |
| BR1 | W005 | | (QL37S) |

Miscellaneous

| | | | |
|---|---|---|---|
| | PC board | | (GB10L) |
| | Veropin 2141 | 1 Pkt | (FL21X) |

## ADDITIONAL PARTS REQUIRED

| | | | |
|---|---|---|---|
| S1 | Switch (Sub. Min Toggle A) SPST | | (FH00A) |
| S2 | Switch rotary 3B (BBM) | | (FF76H) |
| S3 | Switch (Sub. Min. Toggle E) DPDT | | (FH04E) |
| S4 | Switch dual rocker neon | | (YR70M) |
| | Safuseholder 20 | | (RX96E) |
| FS1 | Fuse 20mm 1A | | (WR03D) |
| T1 | Transformer | | (WB10L) |
| T2 | Transformer (Line Isolating) | | (BK57M) |
| D9, 10, 11, 12 | LED red | 4 off | (WL27E) |
| | LED clip | 4 off | (YY40T) |
| | Edge conn. 124 | | (FL85G) |
| | Edge conn. G | | (FL91Y) |
| | Edge Conn. H | | (FL92A) |

A complete kit of parts is available for this project.
**Order As LW99H (Modem Kit). Price £39.95.**

# IMPROVED TIMER CONTROL

*by J. A. Fryer*

This is an explanation of a very simple circuit change for 555 or 7555 timers that improves the precision and stability of variable control over frequency ranges up to 4:1, by adding one extra resistor.

The circuit can be adjusted to work over higher ratios but low-end drift grows exponentially; a need for a wide range of control can be satisfied economically by using this circuit in a 2:1 range to clock a binary counter IC with stage switching with no loss in precision. This extension also allows very low frequencies to be generated without hard-to-obtain or less stable large component values.

These very usefl low-cost timer IC's get their intrinsic clock stability at a fixed frequency because they are controlled by internal reference voltages of 1/3 and 2/3 $V_{CC}$ from a chain of three nominally equal resistors: these drift, but they drift together very closely and the ratio controls the device. This idea can be applied to external control components, so that the maximum to minimum frequency ratio is set by a pair of resistors, and any drift in a low-cost control potentiometer does not affect output. The pot. can be changed at wear-out while preserving the frequency scale, which turns out to be almost linear in frequency.

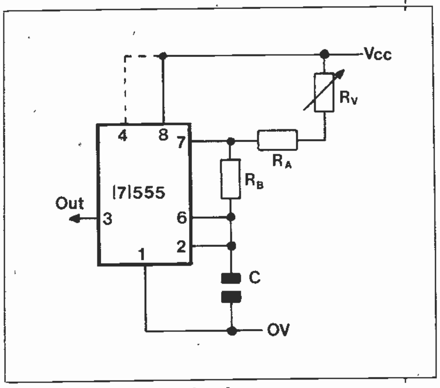



**Figure 1. Simplest circuit.**

The usual circuit, with a simple frequency control Rv, is shown in Fig. 1. The times of the two part-cycles are

$\frac{C \times R_B}{1.46}$ for discharge, and

$\frac{C(R_B+R_A+R_V)}{1.46}$ for charge

of capacitor C. These add and invert for frequency:-

$f = \frac{1.46}{C(R_A+R_V+2R_B)}$ Hz (megohms, microfarads)

The basic device accuracy is ± 2%, with a little more if $V_{CC}$ changes, and a temperature coefficient of 50 parts per million (or ppm) per degree C. In clockwork terms that is 4.32 seconds per day per degree, a performance not given by clockwork at IC prices.

Trying to use a low-cost pot. for Rv causes immediate problems: at ±20%, frequency at the low end is in a 40% band at worst; the pot. drift will exceed that of all the other parts; the scale is linear in period, not frequency, and gets very cramped at one end for high control ratios. There are ways to reduce these problems, but the only way to achieve precision is to use a high-cost potentiometer, and a good one will cost more than a crystal.

Another approach is to use the device "control" terminal (pin 5), which lets an external voltage force the 2/3$V_{CC}$ reference down for a faster cycle or up towards $V_{CC}$ for a slower one. This works, but for stability a lot

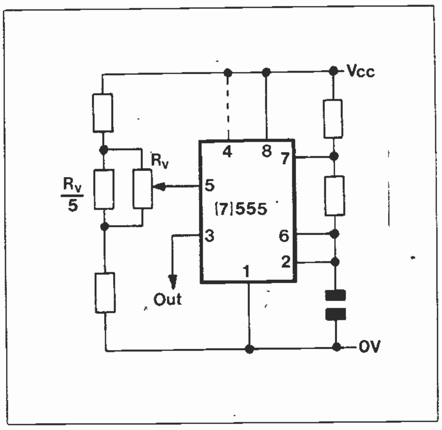



**Figure 2. "Control" system.**

of power is needed from the external voltage source. The internal resistors are of silicon, with a ± 50% production spread, a worse temperature drift than carbon pots., and a quite high voltage variation. An external resistor chain has to "swamp" these variations by having less than one-tenth the resistance of the internal chain for a start. If the external system includes a 20%-grade pot., its variations need another factor of at least five in waste current. With nominal IC chain totals of 15Kohm and 150K (555 and low-current 7555), a design has to start at 300 or 3000 ohms, and less for any real stability. However, the terminal is useful for very wide but not very steady control. Figure 2 shows a fully-padded circuit, which can be simplified with a high-grade pot.

In this "control" mode, capacitor C is charged towards $V_{CC}$ as in the original circuit but the upper trip level is varied. This principle can be inverted, keeping the trip point at 2/3 but altering the charging level at source to something less than $V_{CC}$. If a 70% source were used, C would take several time-constants to reach 67% instead of less than one. There is a control limit at a source of 67%: below this the cycle never completes, and close to it drift and noise become problems. The inverted circuit works quite well for small ranges of control, and is shown in Figure 3.

The extra resistor $R_C$ has been added, and $R_V$ moved. At the high and low ends of the control range the pot. is obviously not in circuit. The top frequency is set by $R_A$ and $R_C$ in parallel, and at the low end C is charged towards a fraction $R_C/(R_C+R_A)$ of $V_{CC}$. The control ratio is given by the resistor ratio in a slightly awkward index equation, which is easier to use when tabulated.

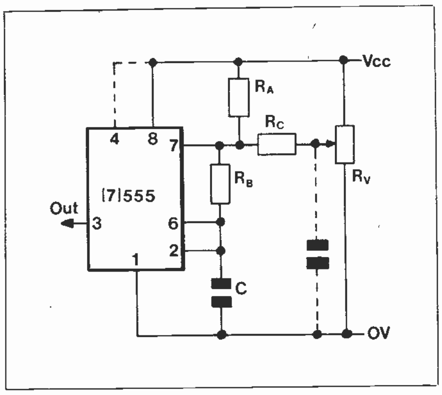



**Figure 3. Modified circuit.**

At intermediate control settings there is clearly going to be some steady change between the two extremes, and without making one more condition it is not clear what form it takes. This extra condition is that $R_V$ must be well below $R_C$; when this is so, the actual value of $R_V$ hardly affects the frequency equation, only its setting fraction of $V_{CC}$. The pot. can be ±20% and subject to drift without disturbing operation.

The condition is easy to achieve: $R_C$ is already at least 2$R_A$, and $R_A$ can be kept very high except at very high frequency. Values of half a megohm will accommodate a 20K pot. with no difficulty, and there is improved stability but not the power loss of the standard "control" system.

There is an equation for frequency against $V_{CC}$ fraction, which is slightly logarithmic. Solving it shows that control is very nearly linear: better than 2% error at 2:1, less than 5% at 4:1. These are about the limits for low-cost pots. with a 0.5 dB or 6% specification. If there is a need for something better, a slightly better pot. has to be used, and it then makes sense to correct the theoretical curvature by one more resistor from ground to slider, which gives total correction at 3 points on the scale.

The table here gives the most useful design ratios:-

| $F_{max}/F_{min}$ | $R_C/R_A$ Theory | $R_C/R_A$ Actual | $R_A/R_T$ |
|---|---|---|---|
| 2 | 3.500 | 3.3 + 0.2 | 1.30 |
| 3 | 2.500 | 2.3 + 0.2 | 1.435 |
| 4 | 2.21.. | 2.15 + 0.15 | 1.453 |

The $R_A/R_T$ column is a design aid; the whole of the table assumes $R_B$ is very low compared with $R_A$. If it is not, stability is not affected, but the frequency ratios are changed and need to be worked out for the actual values, or found on plug-board. If a need for a long pulse makes $R_C$ too close to 2$R_A$, it is better to use a dual IC package weith one half as a fixed monostable triggered by the variable half with low $R_B$.

The design calculations are just as for fixed frequency use except for $R_C$.

(1) Set Fmax and the wanted control ratio.

(2) The original design formula is turned over into the form

$C \times R_T = \frac{F_{max}}{1.46}$ Hz, Mohm, microfarads

**Continued on page 15**

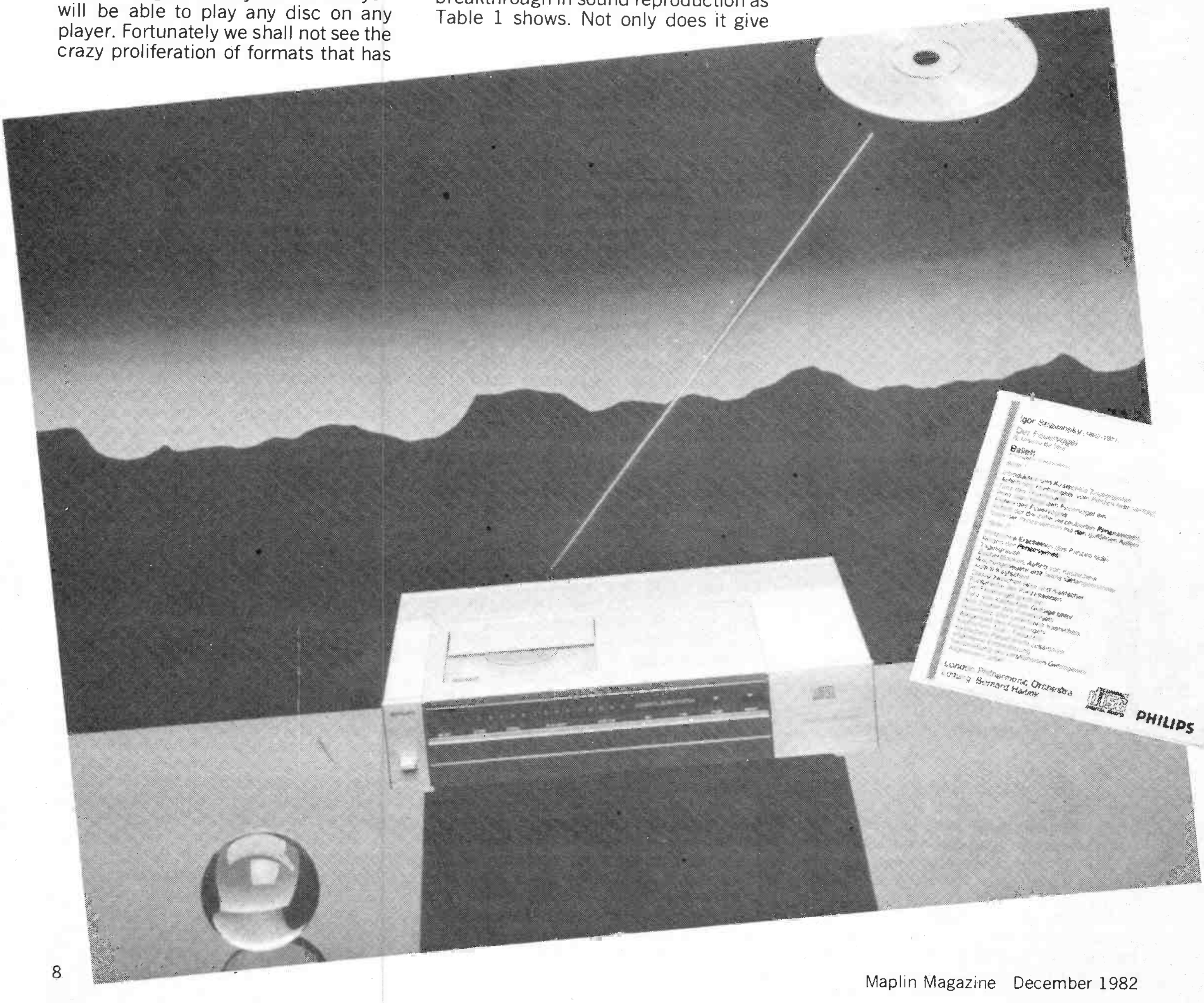
# COMPACT DISC DIGITAL AUDIO

## A NEW WORLD STANDARD

A revolutionary new sound reproduction system that could mark the beginning of the end for the LP, will be launched in the UK in March 1983. Developed over many years by Philips, the Dutch electronics company, the new system is called Compact Disc Digital Audio.

Compact Disc is due to be launched by Philips and several other manufacturers in March 1983 along with about 200 different discs mostly from the Philips group labels. Philips got together with the Japanese electronics giant, Sony, some years ago and the two companies then worked together to create the final format. Philips have now licensed several other manufacturers to make players for Compact Disc and this has ensured that there is only one digital disc system so that you will be able to play any disc on any player. Fortunately we shall not see the crazy proliferation of formats that has bugged the infant video industry - VHS, Betamax and the two Philips formats, to say nothing of Laservision.

The new system is clearly a major breakthrough in sound reproduction as Table 1 shows. Not only does it give almost perfect sound reproduction, but the disc itself is extremely hard wearing. It can be handled quite freely without being damaged at all unlike the microgroove LP which seemed to acquire extra pops and clicks every time you looked at it, let alone touched it. In fact, you could drill a small hole through a Compact Disc (up to about a tenth of an inch (2.4mm) diameter and when played again, there would be no audible difference. Since the discs will



cost about £8 to £10 each, only a little more than the cost of a good quality classical LP, not many people will be in a hurry to try this out, but it does serve to illustrate just how impervious to damage the Compact Disc is.

Immunity to ordinary handling is achieved by coating the surface on which the data are stored with a layer of transparent plastic. How immunity is given to gaps in the data stream caused by opaque dust, scratches or even holes in the disc we will describe later.

## Pocket-sized Discs

The disc itself is relatively small, about 4¾ inches (120mm) diameter and comes in a 5 inch square plastic pack with a hinged lid. "Sleeve" notes will be printed on a removable piece of card in the lid of the box. At first almost all the discs available will come from Philips companies: Polydor, Mercury, Deutsche Grammophon, Barclay, Casablanca, London, Archiv, Fontana, RSO, Polystar, Decca and of course Philips. The major American record companies are refusing to pay Philips the royalty they are requesting on each disc made, but since it is only 3 cents (about 1.75 pence) and there is considerable pressure from the world's top recording artists to have their material available on Compact Disc, there will doubtless be a compromise sooner or later and within a couple of years we should see most LPs available on Compact Disc as well, as soon as they are released.

The disc will hold one hour of audio information on one side. At the present time, the label covers the other side, but it could be used to hold a second hour of recording though the space left for a label (a 17 millimetre (⅝ inch) wide band around the hole in the middle) is rather small! The disc could also hold quadraphonic or surround sound information encoded into four channels, though a different player would be needed.

| | Compact Disc | 12-inch LP |
|---|---|---|
| Frequency range | 20Hz to 20kHz | 30Hz to 20kHz |
| Dynamic range | >90dB | <55dB (at 1kHz) |
| Signal to noise ratio | >90dB | 60dB (approx.) |
| Channel separation | >90dB | 35dB (max) |
| Harmonic distortion | <0.005% | 0.2% |
| Wow and flutter | Nil | 0.03% |
| Playing time | 60 minutes | 20 minutes per side |
| Resistance to damage | Very high | Very low |
| Wear on disc and pick-up | None | Some |
| Instantaneous track selection | Yes | No |
| Can be moved at will whilst playing | Yes | No |
| Sensitive to microphony, shock or vibration | No | Yes |
| Pocket sized disc | Yes | No |

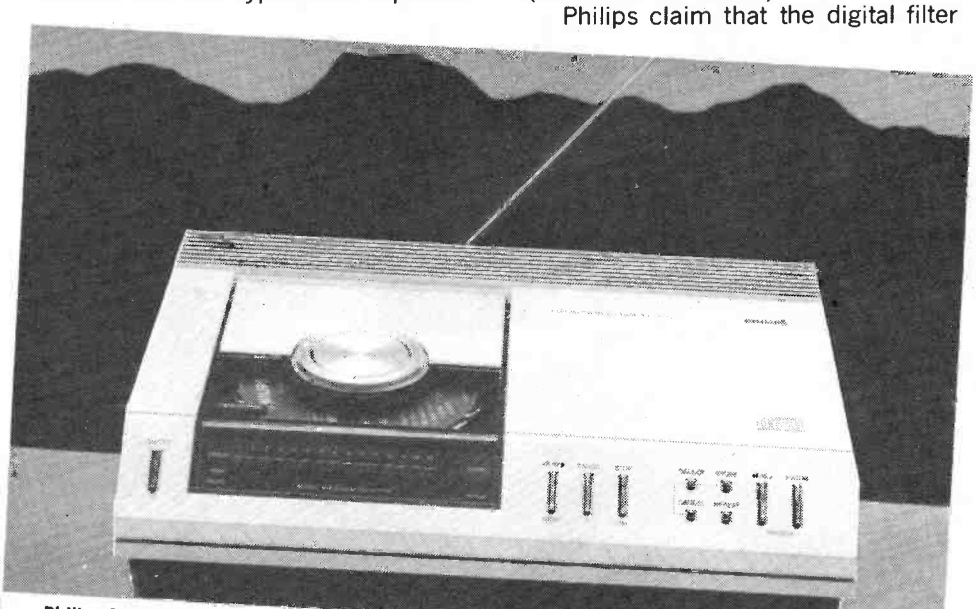
**Table 1. Comparison of Compact Disc with conventional 12 inch LP.**

The surround sound player would, however, still be able to play existing stereo Compact Discs in stereo, while surround sound discs would have a message encoded into the data which would tell the surround-sound player to switch into four-channel mode.

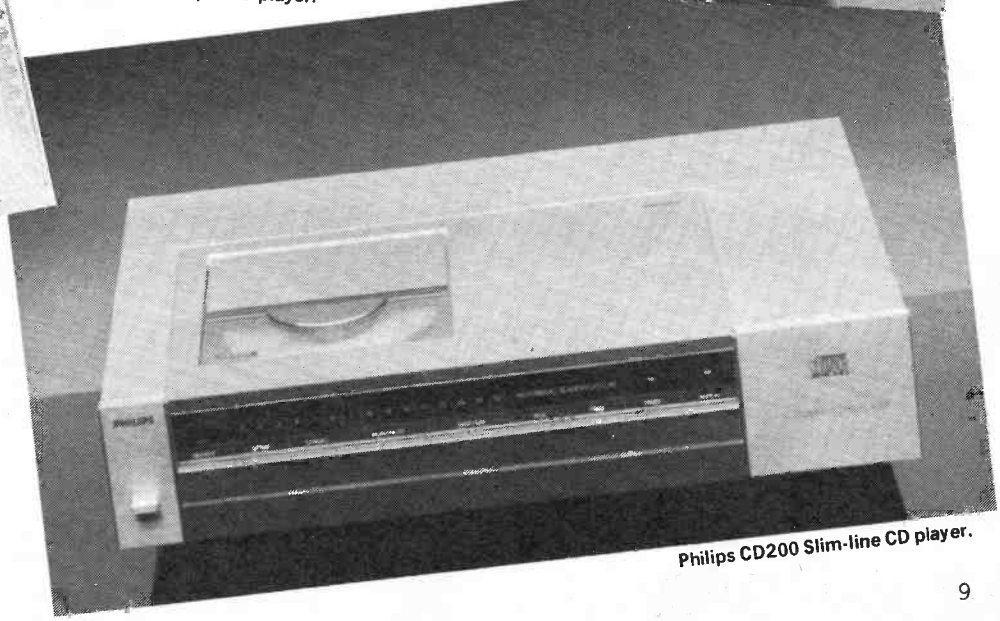
## First Models

The first generation of players to come on the market can be broadly divided into two types. The Japanese models which use an analogue filter in the output and the European models which, in the main, use a more sophisticated digital filter. The use of a digital filter, since it is physically far smaller than an analogue filter, has enabled Philips to make the smallest player on the market. Coded the CD100, this player will sell for about £400. It will also be available under the Marantz name, since Marantz are wholly owned by Philips. It measures just 320mm wide by 75mm high by 255mm deep (12½ x 3 x 10 inches).

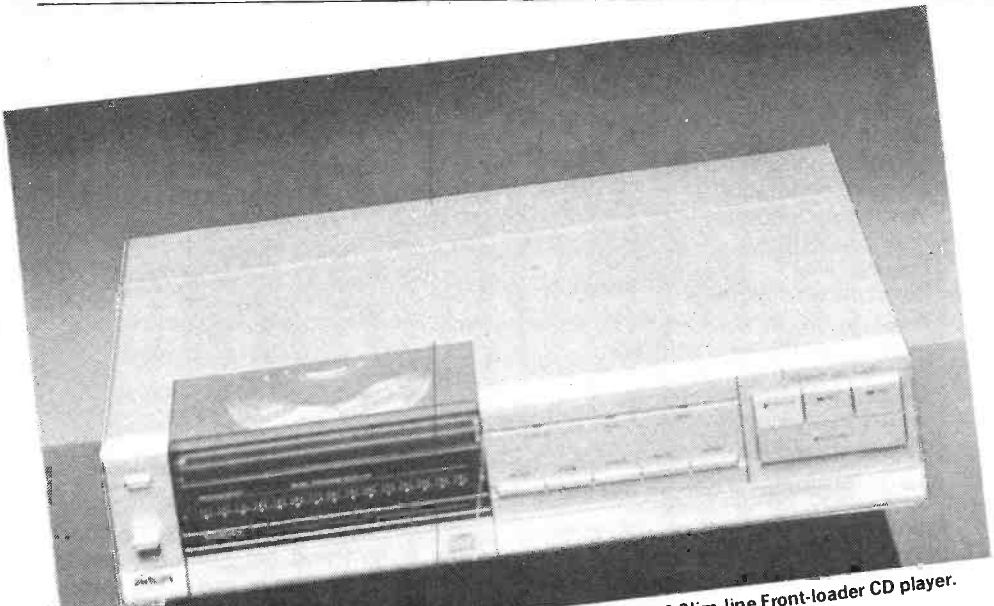
Philips claim that the digital filter



Philips CD100 Super CD player.

Philips CD200 Slim-line CD player.



Philips CD300 Slim-line Front-loader CD player.


Example of a CD player with vertical styling.

gives superior results to the analogue filter and is more stable and reliable. We will take a look at exactly how the filters work later.

All the players will enable you to select the order in which you want the tracks played, or allow you to pick your favourite track and have it play instantaneously (a boon for deejays) and repeat the selection as many times as you wish.

LED's on the player, light to show which track is playing and a button allows you tc skip to the next track if you don't like the one that's playing. There is a fast search mode, either reverse or forward which will help you find your favourite passage, on for example a classical record, where there may not be separate tracks as such. A pause control is also provided.

## Subcoded Messages

Some players will display the elapsed time on a track or how much time is left till the end of the disc. Some companies are planning to market players which when linked to a TV set will display the name of the track playing, or the text of the song, or any other information, the disc manufacturer wishes you to see. Or the information may be displayed on LED's, on the player itself.

But most of that is for the future. At the beginning all the players will be fairly similar in the features they offer. The main differences will be in the styling and here there are 3 main choices. There will be top-loaders, front-loaders where the disc is placed in a tray that pops out, and vertical players.

Once you've got your player home, you'll be able to plug it directly into the


All tastes from pop to classics will be covered in the first selection of music available on Compact Disc.

radio or aux input on your amplifier. And then... perfection, or very nearly. At last you will be able to hear the full dynamic range of a symphony orchestra or your favourite pop group. No longer will the sound of a full orchestra be compressed lest the tracks on the LP get so wide they run into one another, or the sound of a single violin be enhanced by close-miking to ensure that the sound exceeds the inherent noise level of the LP material. Now you can hear it in your own home exactly as the composer and conductor meant it to be. From an inky black silence right up to the majesty of an orchestra at full crescendo, that is if your neighbours and your loudspeakers can take it.

Logo of the new system with the logo of Philips last world-beating idea. The Compact Cassette has virtually wiped out reel-to-reel and cartridge tape players in domestic applications, despite their technical superiority. This time the technical superiority is all on Philips' side.

## Latest Technology

So how is all this magic possible on a disc 120mm diameter and just 1.2mm thick (4¾ inches by less than a twentieth of an inch). In the broadest sense it is made possible thanks to the recent advances in digital and laser technology and the incredible scales of integration now possible in single IC's.

The first step is to turn the analogue signals to be recorded into digital signals and there are already quite a number of recording studios which use digital techniques. The digitising system used is called pulse code modulation (PCM). The incoming analogue signal is sampled about once every 22 microseconds and the voltage level detected at that instant, compared against a library consisting of 65,536 levels. Each level has a different 16-bit code and the code for the level nearest the one detected is output. Thus each stereo channel generates a data stream of 705,600 bits every second.

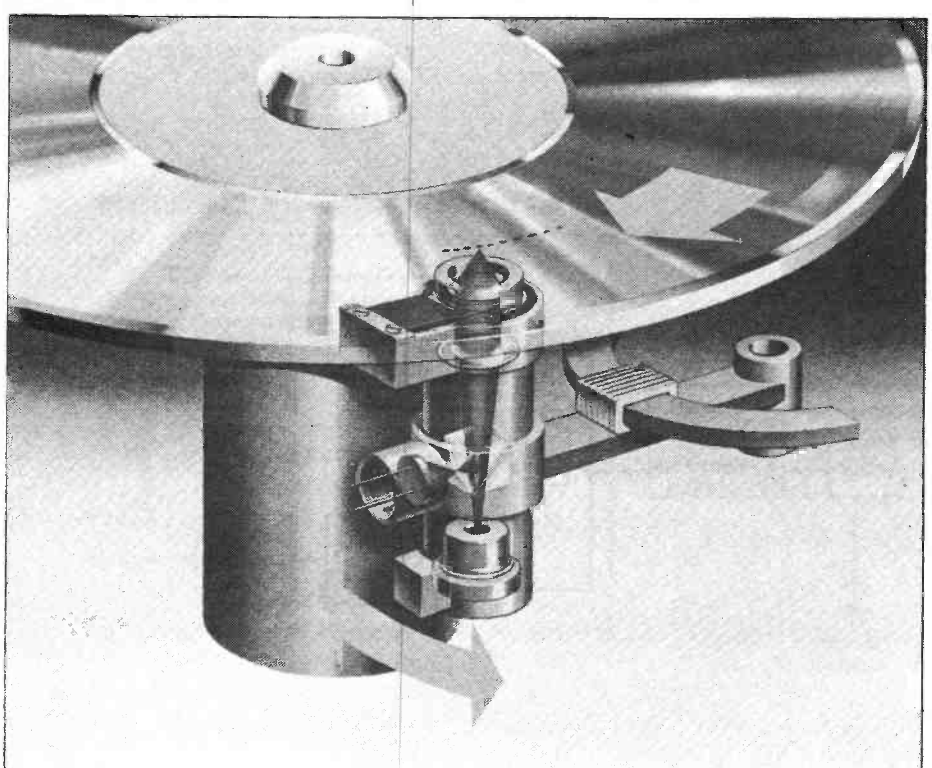
The sampling rate is actually 44.1kHz and is this high because it is essential that it is at least twice the maximum frequency required, 20kHz. Having so many levels available (over 65,000) means that the code describing the voltage is extremely accurate. The difference between the actual voltage and the voltage described by the code will be heard as noise. This noise is called quantisation noise. The best signal to noise ratio possible is equal to 6n + 1.8 dB where n is the number of bits. So in our case the signal to noise ratio will be (6 x 16) + 1.8 or 97.8dB, an order of magnitude better than the best (though rarely achieved) signal to noise ratio possible with an LP.

## High Speed Data

The two stereo channels are now combined into one data stream, each 32 bits comprising one left and one right channel sample for the same instant. Thus channel separation is virtually total since each group of 16 bits is completely independent of any other group. This data stream comprising 1.4112 million bits per second is however not suitable as it stands to put onto the disc for several reasons.

The data will be put onto the disc by a laser that will burn a tiny pit about 0.2 micrometres (um) deep and 0.6 um diameter (about 24 millionths of an inch) for each binary zero into the surface of a very thin layer of aluminium embedded in the plastic.

The data will be read by shining a very fine infra-red light beam onto the disc. The pits will scatter the light in all directions whilst the flat aluminium between the pits will reflect the light like a mirror. An infra-red detecting diode will register zero if no light is received (from the pits) and one, when the light is reflected back.



The disc spins in an anti-clockwise direction as viewed from the side read by the laser.

## 8 To 14 Modulation

The data are recorded in a spiral starting about 25mm from the centre of the disc and continuing to a point about 59mm from the centre. Since there is no contact between the disc and the reading system, the servo-controlled reader can only keep on the correct track if successive zeros are closer together than the pitch of the track. The distance between each track is 1.6 um so if there were two or more ones together the servo would find it difficult to decide where the track continued and could easily continue on the wrong track after a long sequence of ones.

A second reason why the data cannot be put onto the disc as it is, is that after a long sequence of ones the optical detector will have been flooded for a long time and may not turn off fast enough to detect the first zero following a sequence of ones. The detector will read the data at the high speed required much more reliably if the total spectral power is kept low.

The third reason is that since the size of a data bit anywhere on the disc is the same, there are fewer bits in one revolution at the centre of the disc than at the outside. So the disc must spin faster at the beginning (the centre) than at the end when data is being read from the outer tracks. When reading data at the centre the disc spins at about 500 rpm and at the outside about 200 rpm. In order to get the rotation speed exactly right, it must be possible to detect the bit rate from the data.

It turns out that all these requirements are met if there are at least two zeros between any successive ones and never more than ten zeros at one time. There are 16,384 different patterns of 14 bits of which 277 meet the requirements of not less than two zeros between each successive 'one'. Of those, 21 have more than ten consecutive zeros, leaving exactly 256 that meet all the requirements. This is a very convenient number, since there are 256 different patterns of eight bits as well.

The data streams from the 16-bit converters are split into 8-bit sections and each 8-bit byte is converted into a 14-bit word using a look-up table stored in ROM. Three merging bits are added at the end of each 14-bit word so that words can be joined together without violating the two to ten zeros constraint. These bits contain no information and are skipped by the decoder.

## Making The Frames

The data are now arranged into frames each starting with a 24-bit synchronisation pattern and containing twelve 16-bit data words (24 14-bit words after encoding) representing 6 stereo samples, four 16-bit error correction parity words (eight 14-bit words after encoding) and one 8-bit control and display word (one 14-bit word after encoding). With three merging bits between each of the 33 14-bit words, one after the sync pattern and one at the end there are a total of 588 bits in each frame.

The eight bit control and display words can contain information, for instance to mark the pause between tracks to implement search and repeat functions, or to indicate remaining or elapsed playing time, titles or composers etc.

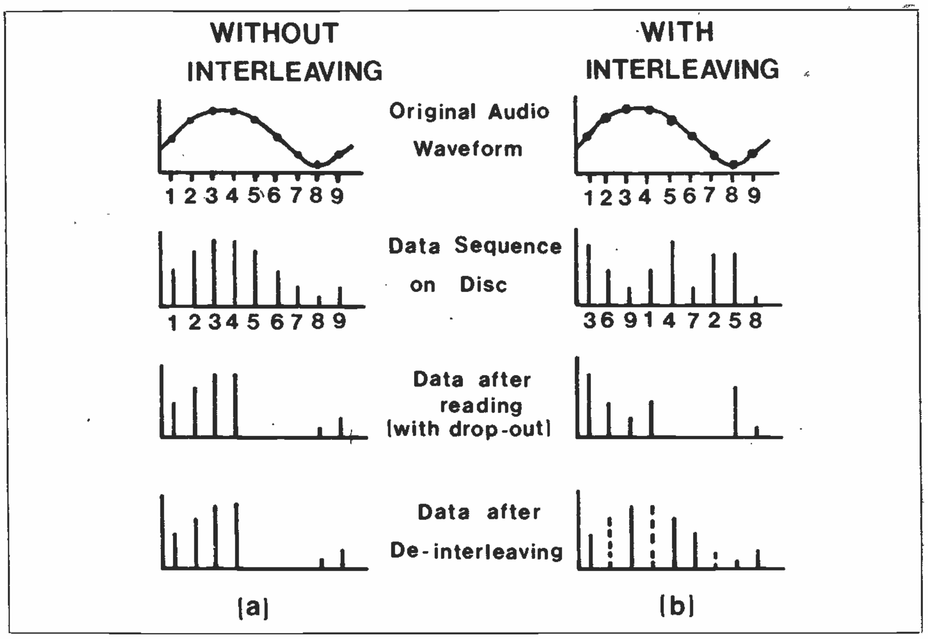



Figure 1. Principle of interleaving as used in Compact Disc's error correcting system.

| No. of Bits | Type of Data | | Total No. of Bits |
|---|---|---|---|
| 24 | Synchronisation Pattern | | 24 |
| 3 | Merging Bits | | 3 |
| 14 | Control and Display Bits | | 14 |
| 3 | Merging Bits | | 3 |
| 14 | Audio Data Bits | Repeated 12 times | 168 |
| 3 | Merging Bits | | 36 |
| 14 | Error Correction/ Parity Bits | Repeated 4 times | 56 |
| 3 | Merging Bits | | 12 |
| 14 | Audio Data Bits | Repeated 12 times | 168 |
| 3 | Merging Bits | | 36 |
| 14 | Error Correction/ Parity Bits | Repeated 4 times | 56 |
| 3 | Merging Bits | | 12 |
| | | Total number of bits per frame | 588 |

Figure 2. One frame of 588 bits in the format in which it is recorded onto the disc.

Before the data are put into frames the audio data are rearranged in time. This interleaving coupled with the parity words forms a powerful error correction system that can correct a loss of up to 3,500 successive bits and compensate by interpolation, a loss of 12,000 successive bits. The principle of

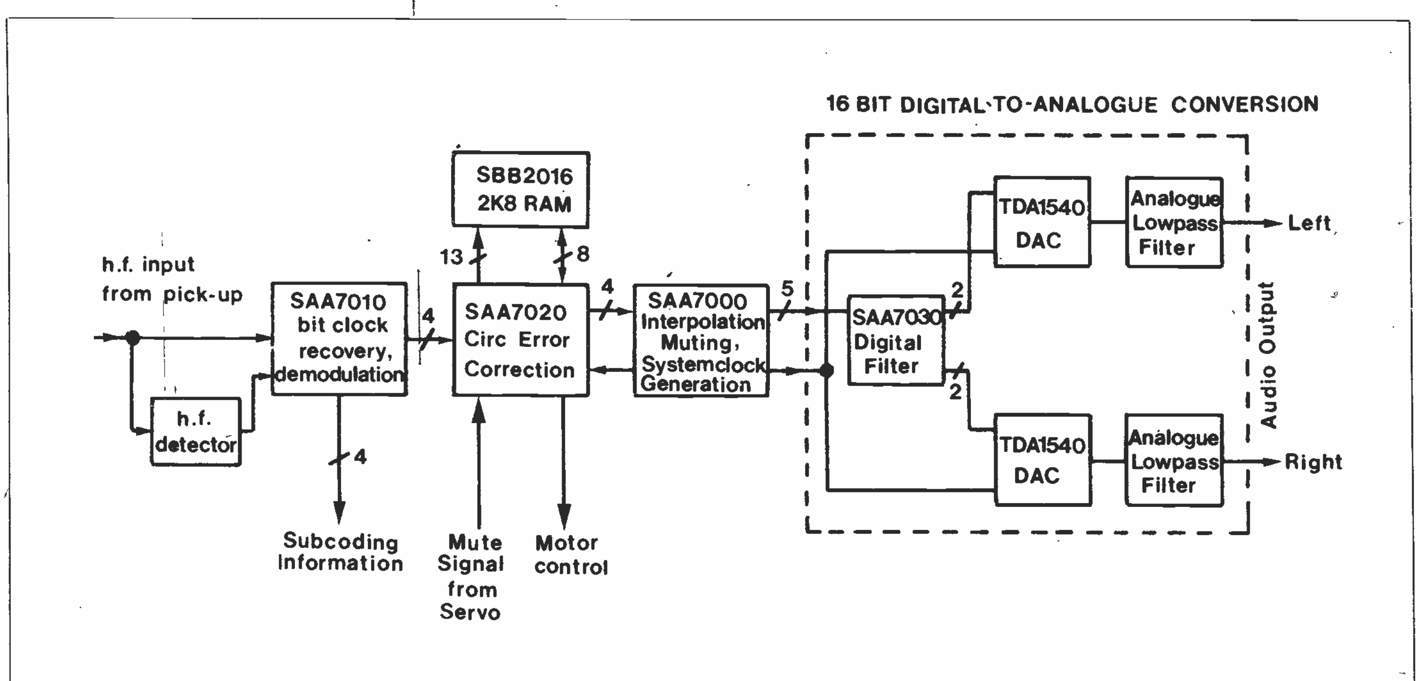
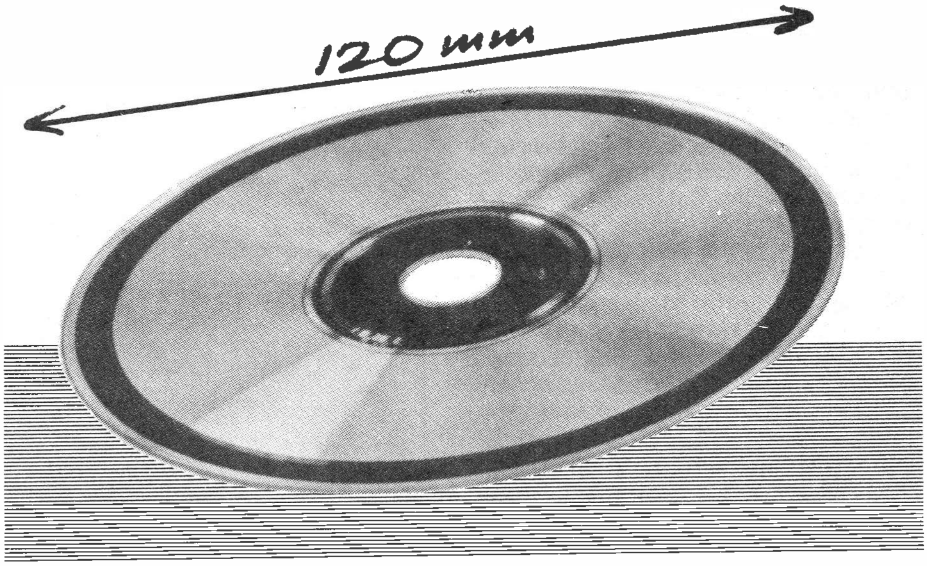



Figure 3. Block schematic of the Compact Disc decoder.

this system, known as a Cross Interleave Reed-Solomon Code (CIRC) is shown in Figure 1.

In 1a three consecutive words are missing making it difficult or even impossible to replace the missing words and be certain they are correct. In 1b, however, after de-interleaving, the missing words are spread out in time and there are now only single errors which can be easily corrected.

This then is the form the data take that are recorded onto the disc (see Figure 2). It is now the job of the Compact Disc player to recover the data from the disc and reconstruct the original stereo audio signals.




**Playing side of a Compact Disc. The other side is covered by the label.**

## Reading The Data

The player contains an Aluminium Gallium Arsenide solid-state laser diode which emits infra-red light at a wavelength of 780nm, just outside the visible spectrum. The light passes through a half-silvered mirror and then a lens which focusses the beam onto the disc. When a digital "one" occurs in the data, the light is reflected back along the transmission beam, but deflected at right-angles when it hits the half-silvered mirror. The deflected beam then strikes a photodiode which registers the pulse of light. This whole optical system is carried on a servo controlled arm which gradually moves across the disc from the inside to the outside.

The high frequency (hf) data stream is recovered from the disc at the rate of 4.3218 million bits per second. The output from the photodiode is first amplified and filtered then passed to the input of the demodulator IC, SAA7010. See Figure 3. The incoming signal is first squared-up by a level detector and Schmitt trigger and then passed to a phase locked loop which regenerates the bit clock. The voltage controlled oscillator of the phase locked loop operates at 8.6436 MHz, twice the incoming data rate, from which a 4.3218MHz master clock for all internal timing is derived.

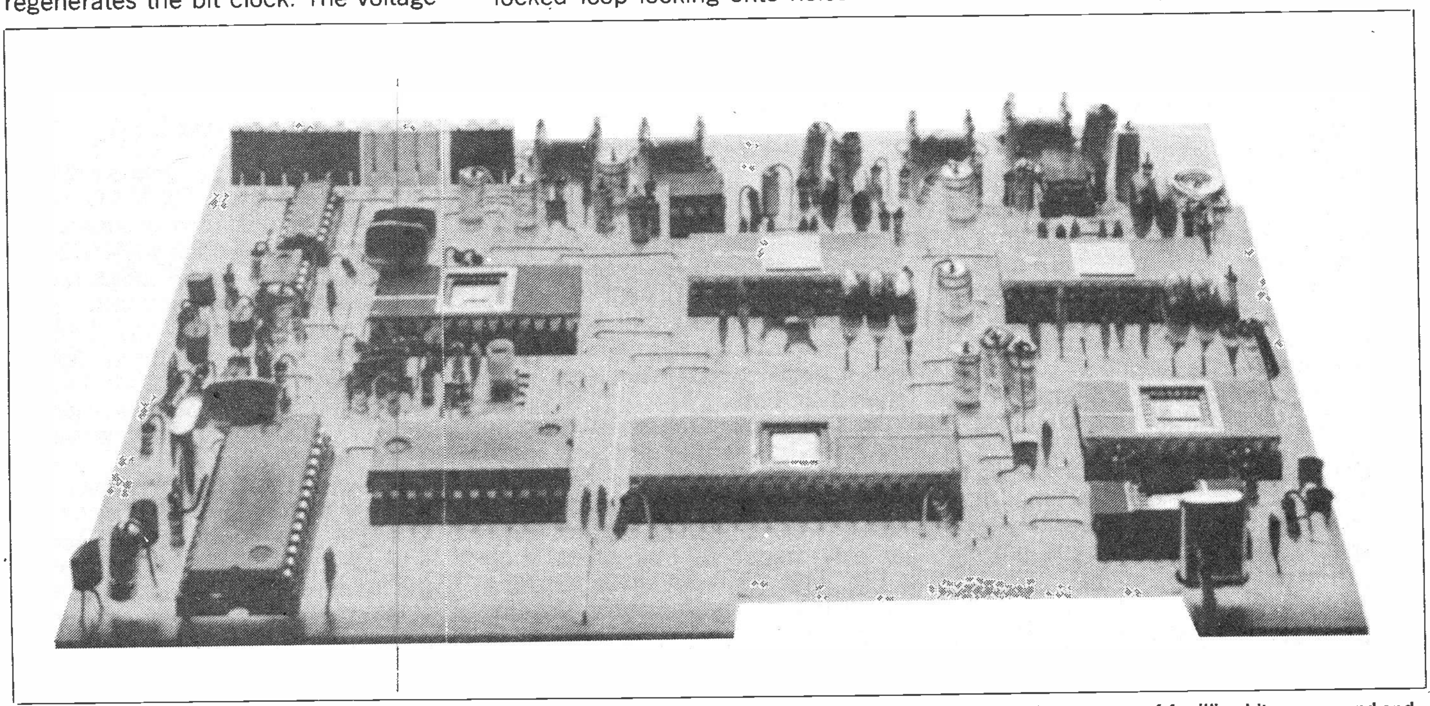
The incoming data are clocked into a shift register within the SAA7010 until the unique synchronisation pattern is detected. Each subsequent 14-bit word is then held in a latch and converted back to the corresponding 8-bit word by a logic array. The first 8-bit word contains the control and display information and is passed to a microcomputer which can deal with the data in whatever way a particular manufacturer desires as explained earlier. The next thirty-two 8-bit words are passed to the error correction IC, SAA7020.

Before going on to this IC, we will just mention the hf detector shown in Figure 3. When the amplitude of the hf signal is small, for example, during loss of data, the hf detector switches off the phase and frequency detectors in the SAA7010 and this prevents the phase locked loop locking onto noise which would otherwise have caused clock jitter.

Data entering the SAA7020 are stored in a shift register and a first-in-first-out (FIFO) register. The FIFO acts as a jitter reduction circuit and since it can compensate for up to ±2.25 frames, totally eliminates wow and flutter in the system. The data rate at the output of the SAA7020 is determined solely by the clock signal from a crystal oscillator. Any difference between this frequency and the frequency derived from the detected bit rate, generates an error signal which controls the speed of the motor driving the disc.

## Reed-Solomon Decoders

The data are now de-interleaved by storing the 32 words of one frame in a 2K by 8 RAM along with the 28 output words of the first Reed-Solomon decoder. This decoder can correct one erroneous word, but if more than one



**This single small circuit board contains nearly all the electronic circuitry in a Compact Disc player, yet it can process data at a rate of 4 million bits per second and convert it to perfect audio.**

word is shown by the first four parity words to be incorrect then the 28 words (the first four parity words now being discarded) are written back to the RAM unchanged, and a flag is set which marks the 28 words of this frame as unreliable. If the data was correct or corrected, the 28 output words are written back to the RAM but the flag is not set. The output words of the first decoder are further de-interleaved by means of the RAM and fed to a second Reed-Solomon decoder. This decoder can correct up to two erroneous words, and the correct or corrected frame of 24 words (the second four parity words now being discarded) is written back to the RAM. If the data are still incorrect a second flag is set and the uncorrected word returned to the RAM.

After 30 stereo samples have been stored in the RAM the first sample is output from the SAA7020 in a 16-bit burst followed by an 8-bit interval then a second 16-bit burst and so on. If a sample is incorrect a flag is passed with it. If two consecutive errors are detected a flag is sent in the 8-bit interval as soon as it is detected, that is 30 samples before it is actually passed on to the interpolation and muting IC, SAA7000.

## Muting Bad Data

Serial data from the SAA7020 are entered into a shift register and the left and right channels then descrambled. If there are no unreliable data flags then the data passes through the SAA7000 unchanged. If a single unreliable sample is flagged then the SAA7000 reinstates the missing sample by linear interpolation. If a flag arrives in one of the 8-bit intervals, the SAA7000 immediately starts to reduce the value of the samples so that they will produce a zero volume audio output after 30 samples. As soon as the flag stops appearing in the 8-bit intervals, the SAA7000 starts to increase the value of the samples until they return to their true value after 30 samples. This system ensures that incorrect samples are never heard and is gradual so that clicks are not heard in the output.

Since muting will not occur until 12,000 consecutive bits are lost, this should not be a common occurrence and even then should be of such a short duration that it will be scarcely noticeable. For example, 24,000 consecutive bits lost will cause muting for less than one hundredth of a second.

The output of the SAA7000 is now 16-bit words for right and left channels exactly as they were when they were original encoded by the 16-bit analogue to digital encoders at the time of recording. It is now only necessary to regenerate the original analogue information from the 16-bit codes.

## Digital To Analogue Conversion

In the Japanese players the 16-bit codes are fed to a 16-bit digital to analogue converter (DAC) and the resulting analogue signals filtered using a complicated analogue filter. This filter can cause phase distortion in the audio signal and will reduce the slew rate. In addition, 16-bit DAC's and the complex filter are both expensive.

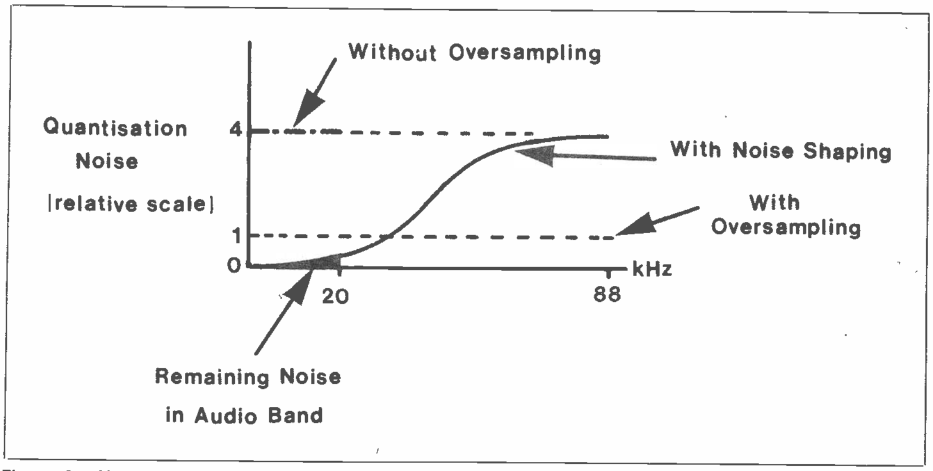


**Figure 4. How 16-bit signal-to-noise ratio is obtained from a system using 14-bit DAC's.**

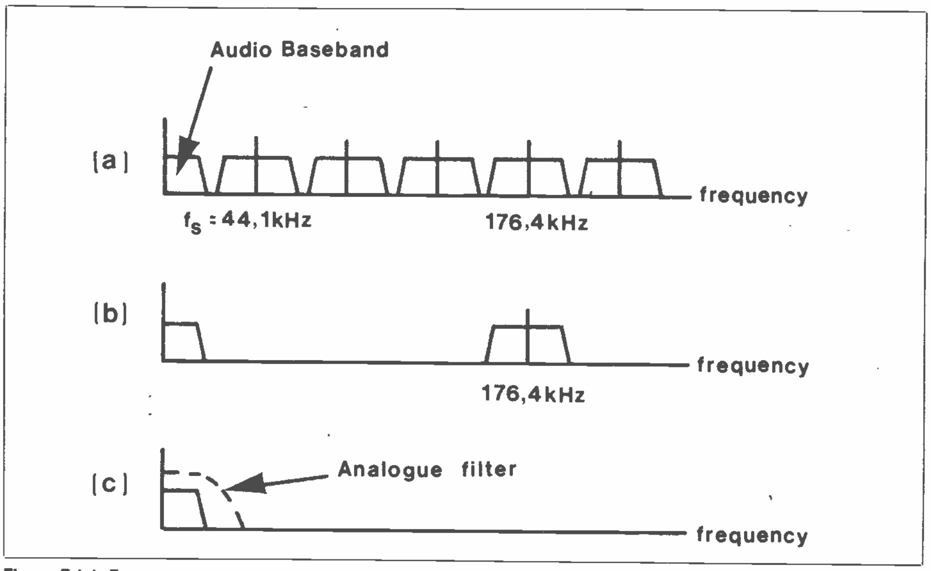


**Figure 5 (a) Frequency spectrum of output of 16-bit DAC.**
**(b) Frequency spectrum of output of SAA7030.**
**(c) Frequency spectrum of output of TDA1540.**

In most of the European players and in all Philips models a more sophisticated system is used which does not suffer from any of the problems mentioned above. A relatively cheap 14-bit DAC is used, yet the signal-to-noise ratio is only about 1dB worse than the 16-bit system (97dB instead of 97.8dB) it has only a simple low-cost analogue filter which does not affect the phase response of signals under 20kHz and doe not reduce the slew rate. In addition, it virtually eliminates intermodulation distortion.

In this system the outputs of the SAA7000 are fed to a digital oversampling filter, SAA7030. The two 16-bit data streams (left and right) are fed into shift registers which quadruple the sampling frequency from 44.1kHz up to 176.4kHz. Quadrupling the sampling frequency also quadruples the effective audio bandwidth, from 22kHz up to 88kHz and the noise is spread out with it. See Figure 4. Since 75% of the noise is now above the audio band, it can be suppressed by filtering.

The 16-bit words entering this digital filter are output as 28-bit words and stored in an accumulator. The most significant 14-bits are then output to a 14-bit DAC. The SAA7030 contains two identical filters, one for each stereo channel and there are two identical 14-bit DAC's, again, one for each channel.

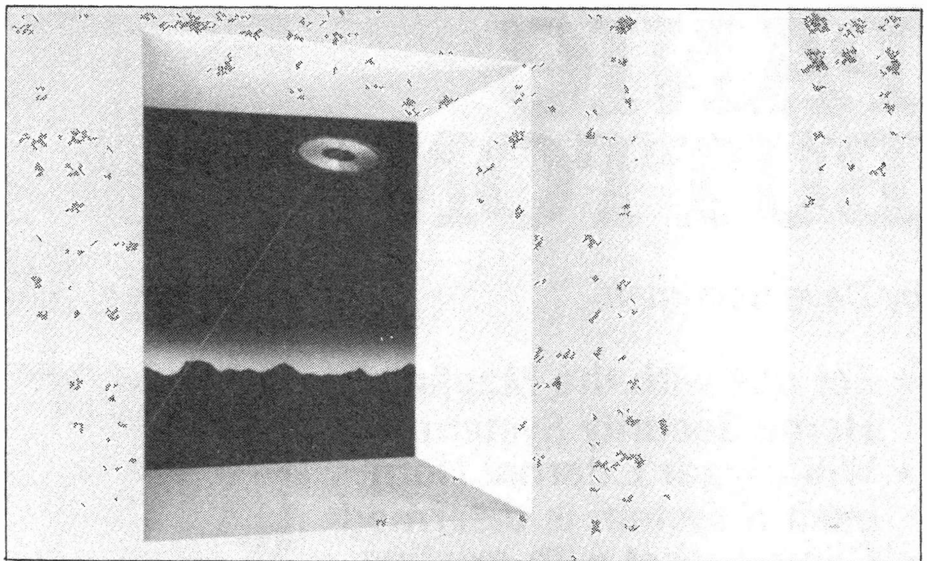
## Simple Filters

A 14-bit DAC will give a signal-to-noise ratio of about 84dB. Oversampling and digital filtering add about 6dB to that figure. In addition the SAA7030 contain a noise shaper which redistributes the quantisation noise so that more noise occurs in the 22kHz to 88kHz region than in the audible region. This noise shaper adds a further 7dB to the signal-to-noise ratio giving a total of 97dB, almost the same as for a 16-bit system.

The 14-bit digital samples now arrive at a rate of 176.4kHz at the DAC, TDA1540. The input data are used to activate 14 switches which determine the output current. This output current is held between conversions by latching a flip-flop in the DAC. The hold function results in an output response which has a null at 176.4kHz where the first harmonic of the sampling frequency would otherwise have occurred.

Thus with reference to Figure 5(c), it is clear to see how a very simple analogue filter can now be used to filter off any remaining frequency components outside the audio band. On the other hand Figure 5(a) shows that a very high order filter will be needed to filter out the spectral lobe stretching from 22kHz to 66kHz, generating all the problems inherent in high order filters as previously described. Also since the sampling frequency is so close to the audio band some intermodulation distortion will occur in the audio band. In the oversampled system, intermodulation products are well outside the audio band.

The current output of the TDA1540 is converted to a voltage by an NE5532 dual op-amp. This op-amp is also used as the filter which is a third order low-pass Bessel filter with a cut-off frequency of 30kHz. A Bessel filter is used as it has a linear phase response. The output of the filter is a 1V rms max. voltage which can be connected to any hi-fi amplifier.



## The End Of The LP

When Compact Disc is launched most of the potential purchasers will be those who already have expensive hi-fi systems. For them £400 is comparable with the cost of a top quality cartridge, tone-arm and turntable. And the superb quality possible will be irresistable.

However, the Compact Disc is inherently very simple to make. The Laser and servo system are far less complex than the mechanics of a video tape recorder and the simple circuit board containing just twelve IC's and a few other components is very easy to make. Once production gets into full swing, prices are bound to fall and I would be surprised if they are not under £200 within two years.

Clearly, as the price falls and the numbers of discs around increases, more and more people will choose a Compact Disc player rather than an inferior record-player. There is little doubt that the days of the LP are numbered. Within 10 years the LP will have gone the way of the 78. And just as LP's are available now containing the best of the music recorded on 78's usually after re-recording from the old masters, so Compact Discs will be released containing the old favourites originally released on LP's. And that will be the final nail in the coffin for the LP.

But I for one will not be mourning the LP too much. The exasperating imperfections of the LP will at last be a thing of the past. The launch of Compact Disc heralds the new era in hi-fi, with the near-perfect reproduction that enthusiasts have been striving for over the years. But there is already signs of discontent in the hi-fi magazines, with die-hards questioning the quality of Compact Disc. In the meantime the rest of us can just sit back at last and listen to the music itself uninterrupted by the pops, clicks and bangs of those dreadful LP's!

# IMPROVED TIMER CONTROL

**Continued from page 7**

and the time constant found. $R_T$ is the effective timing resistance of $R_A$ and $R_C$ in parallel.

(3) Pick a trial value of C, and find $R_T$ to match it. As a guide, keep C low and R high within reason: C under 1 nF makes strays important, R over about 470K may present problems of selection from a limited standard range. If both C and R look too high at low frequencies, consider using a fast oscillator and divider: this could be more stable, smaller and cheaper with no waiting for special-value parts.

(4) Use the table to get $R_A$ from $R_T$, and then work out Rc as well. These are not directly usable values: there are called "design centre values", before allowing for adjustment of tolerances.

(5) Tolerancing:-

| | | |
|---|---|---|
| IC | | ±2% |
| $V_{CC}$ | effect | ±0.25% for 0.25v regulator offset |
| C | | ±1% |
| R | | ±1% |

Worst-case sum ∓4.25%

There is no need to use 1% parts: other grades can be just as stable, but they alter the tolerance sum.

Take away the tolerance allowance from the design centre RA, and compare this result with available preferred values. If close, just continue; if far away, either:

or (a) try a different C.

(b) use the next lower value and add the difference to the adjuster design

or (c) try a sum of two fixed resistors: a small extra one need not be of 1% grade for 1% results.

When settled, allow twice the tolerance fraction of RA as the necessary range of adjustment, adding on any rounding-up if $R_A$ has been reduced much to a standard value.

(6) Check the required adjuster range against standard values, remembering the adjuster may be ±20% itself. With a design using wide-spec. parts, the adjuster may end up very large, and selecting a fixed resistor on test for part of the adjustment will improve stability.

So far this is exactly what is done for a fixed-frequency oscillator with the standard circuit.

(7) $R_C$ needs an adjustment allowance first of all equal to $R_A$'s, and then an extra 5-6% for worst-case IC tolerances. With 1% parts, this means taking 10% from the design centre $R_C$, and allowing for up to 20% adjustment range.

One of the resistor adjustments can be replaced by capacitor adjustment, but often a full range of parts is not available.

When built, setting-up is easy enough: adjust $R_A$ at $F_{max}$, then $R_C$ at $F_{min}$, and repeat to overcome a slight interaction.

There are no special layout problems: six plugboards and two PCB's have worked well, despite trying to bundle wires and adding short antennas to suspect points. Take "reset" (pin 4) to $V_{CC}$ if not in use; for the 555, 100nF and 10nF supply and "control" decoupling. The 7555 does not need supply decoupling, and usually control will behave without it. If the control pot. is remote, prepare to decouple the DC end of $R_C$. Otherwise, just keep everything cool and check Vcc regulation for real stability. If in doubt, use a local 78L05 with steady load.

The output will drive two standard loads — 74/LS/ALS/CMOS — via 470-820 ohms; a resistor helps in any later fault diagnosis and prevents faults spreading through a system, if speed is not critical.

The expected stability can be found in worst-case from the component sums:—

| | |
|---|---|
| IC | ±50 ppm per degree C |
| $V_{CC}$ | negligible, 78L05 |
| C | - 150 ppm/degree (polystyrene) |
| R | ± 100 ppm/deg.C |

and it is very unlikely drift will exceed 0.1% for a 5 degree case temperature change. This is about as good as can be had from an RC oscillator with no oven or special components.

For interest, R in the circuit can be replaced by two fixed resistors: their junction with Rc is then a good linear FM input terminal for a 20% voltage swing. A dual IC can be used for sweep — with care not to upset its timing — or frequency shift keying. A simple D-to-A converter allows other codings.

Their 4:1 circuit makes a very useful metronome with a range of 70-280 pulses per minute: good as clockwork and easier to set, with more range.

# PANIC BUTTON

*by Dave Goodman*

- ★ **For use with the Maplin Home Security System**
- ★ **Will trigger External Horn even if system is disarmed**
- ★ **Can be reset with existing alarm unit keyswitch**

This project has been designed specifically in response to the many requests we have had for a 'Panic Button' addition to our Home Security System.

The requirement is for a button placed close to the front or back doors, inside the home, or even by the bedside. In any emergency pressing the button would trigger the alarm, setting off sirens, lamps, etc., and hopefully attracting attention and dissuading potential burglars. The Panic Button PCB caters for up to four switches, which should prove adequate for most applications, and complete instructions are given for connection to the Burglar Alarm PCB.

## Circuit Description

With reference to figure 1, two diodes, D1 and D2, are wired to the spare change-over contacts on the Burglar Alarm keyswitch (figure 3). Either of these diodes will always be forward biased, allowing D3 only to conduct when the contact changes over. The keyswitch contacts are break-before-make, so that during switching a positive pulse appears at D3, which will, in turn, trigger the monostable IC1b and IC1c. This lengthened trigger pulse forward biases D4 and resets the latch IC1d and IC1e.

The output from IC1d is held low by R9 and a high output from IC1e. This may be thought of as a loop. IC1a and

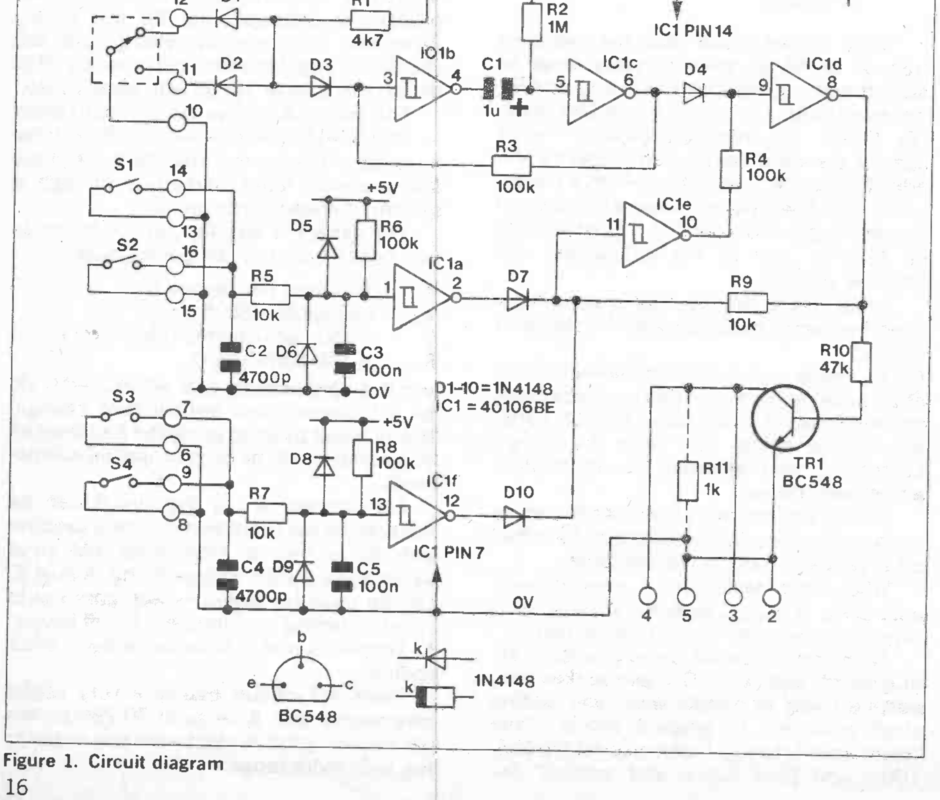


Figure 1. Circuit diagram

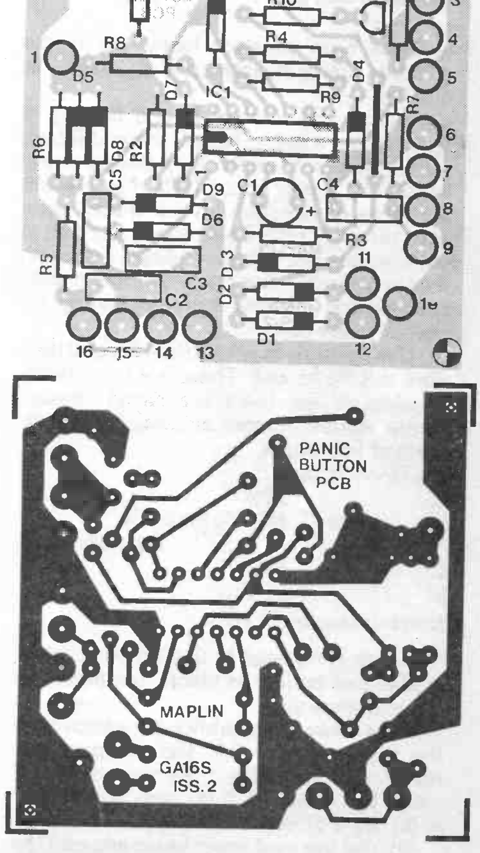


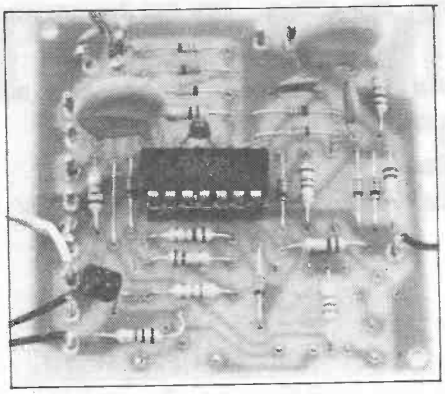
Figure 2. PCB layout and legend

IC1f are input buffers for the panic buttons. These are arranged into two input groups, with provision for two switches per group, allowing up to four switches to be connected. D5, D6, C2, and C3 slow the switching action to avoid contact bounce problems, and give protection from false triggering from RF voltages and spikes induced along connecting cable runs. D8, D9, C4 and C5 perform the same function for the other group.

Both buffer inputs are held high, by R6 and R8, and D7 and D10 will be reverse biased. Pressing button 1 will take IC1a input low and D7 will conduct. IC1e output will go low and IC1d output will switch high. TR1 will then conduct and remain in this state, due to the latching action of IC1d and e, even when button 1 is released. TR1 collector and emitter are wired across the external horn pins on our Burglar Alarm PCB (figure 4), and will now trigger the external horn. If the burglar alarm is in 'set' mode this too will be triggered. To reset the panic button and/or the main alarm/external horn keyswitch S9 must be switched from one position to the other, but it does not matter which way or how many times this is done. Associated circuitry for buttons 2 to 4 functions in the same way.

## Assembly

Bend and insert the one link, between D4 and R7, and insert resistors R1 to R11. All ten diodes can now be fitted, making sure that their black tips align with the white bar on the legend. Fit the five capacitors, noting that C1 is polarised. Finally place TR1 and the 14-pin IC socket in position and solder all components carefully. If you are using



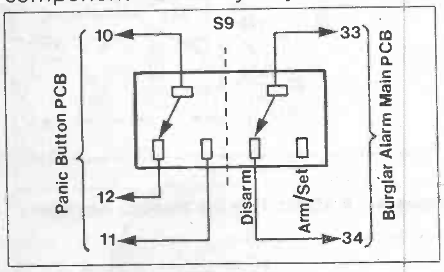



Figure 3. Keyswitch connections

them, fit all sixteen veropins and solder those too. Cut all excess leads and check for dry joints and short circuits. Insert IC1 into the holder and proceed with testing the board.

## Testing

Refer to figure 4 before attempting to connect the PCB to your alarm unit, first switching off mains and removing batteries, if fitted. This will cause the external horn to trigger, so disconnect the external wiring from pins 29 and 30 (if used), and reconnect the wire ends to a 4.5V battery. If the horn still sounds, reverse battery connections to these wires and the horn will stop. Of course, the batteries may be removed from the external horn cabinet, but this may prove to be inconvenient in practice.

Connect three wires from the Panic Button PCB to the Burglar Alarm PCB as follows:

| Panic Button PCB | | Burglar Alarm PCB |
|---|---|---|
| pin 1 | | +5V |
| pin 4 | to | pin 30 |
| pin 5 | | pin 29 |

also connect pins 10, 11, and 12 to keyswitch S9, as shown in figures 3 and 4.

Re-apply power to the alarm system and turn key-switch S9 to SET. After any time out period the alarm should not trigger. If it does you may have left the micro switch (mounted on PSU) released. Simulate the panic buttons with a piece of wire connecting pins 13 and 14. The alarm will trigger, and continue to sound until the keyswitch is turned to DISARM. Remove the short on pins 13 and 14. Now return the keyswitch to SET and short pins 6 and 7 together. Again, the alarm should sound continually. Remove the short on pins 6 and 7.

The next check is made with an external horn connected to the panic button PCB. Either the external horn or the programmable timer PCBs can be used. Figure 4 shows wiring connections for both, so choose the one appropriate to your system. On the panic button PCB R11 must be completely removed, remembering to remove all power sources before you do so.

Reconnect power, sirens, etc., and turn the keyswitch to SET. Short circuit pins 15 and 16 on the panic PCB. Both internal and external horns should sound. Turn key to DISARM. Remove short from pins 15 and 16 and short pins 8 and 9. This time only the external horn should sound, and it should continue sounding until the short is removed. Turn the keyswitch to SET and then back to DISARM to reset the external horn. Tests are now complete and the system is ready for use.

## The System In Use

Mount the PCB in the burglar alarm cabinet and connect the wiring as shown in figures 3 and 4.

The type of switches used for the panic buttons will depend on personal preference, but switches ideal for this purpose appear in the parts list. A make-when-pressed action is required, and up to four buttons can be used.

Some points to remember are:—

1. Connect the external horn circuitry direct to the panic PCB, and *NOT* to the burglar alarm PCB as it was previously.
2. The normal burglar alarm functions have not changed in any way.
3. The panic facility will function whether the burglar alarm is set or not. The only difference between the two modes is that although both internal and external horns sound in the ARMED mode, only the external horn will sound in the DISARMED mode.
4. Either type of external horn PCB will function with this project.

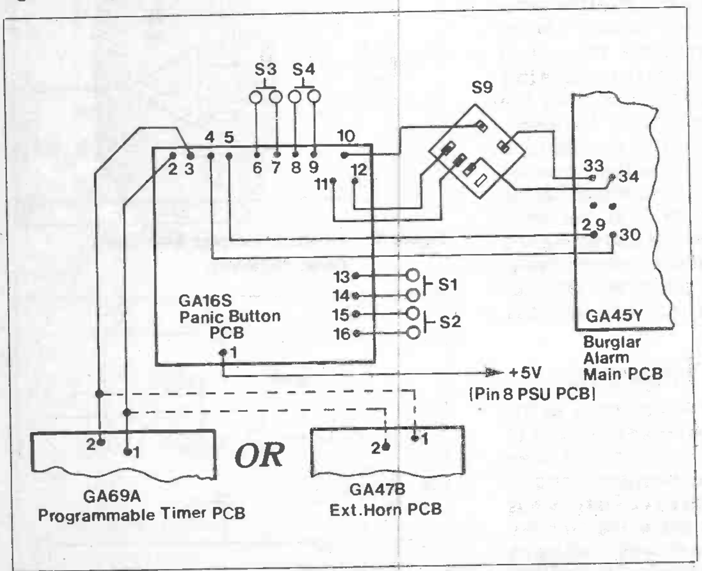



Figure 4. Wiring to Burglar Alarm and External Horn PCBs

## PANIC BUTTON PARTS LIST

| | | | |
|---|---|---|---|
| **Resistors** - All 0.4W 1% metal film | | | |
| R1 | 4k7 | | (M4K7) |
| R2 | 1M | | (M1M) |
| R3, 4, 6, 8 | 100k | 4 off | (M100K) |
| R5, 7, 9 | 10k | 3 off | (M10K) |
| R10 | 47k | | (M47K) |
| R11 | 1k | | (M1K) |
| **Capacitors** | | | |
| C1 | 1uF 35V Tantalum | | (WW60Q) |
| C2, 4 | 4700pF 1000V Disc | 2 off | (HY18U) |
| C3, 5 | 100nF Disc Ceramic | 2 off | (BX03D) |
| **Semiconductors** | | | |
| TR1 | BC548 | | (QB73Q) |
| IC1 | 40106BE | | (QW64U) |
| D1-10 inc. | 1N4148 | 10 off | (QL80B) |
| **Miscellaneous** | | | |
| | Panic Button PCB | | (GA16S) |
| | Veropin 2141 | 1 Pkt | (FL21X) |
| | 14 pin DIL skt. | | (BL18U) |
| S1, 2, 3, 4 | Lrg push button SPST | (up to 4) | (RK82D) |

A complete kit of parts, including one panic button, is available for this project. **Order As LW97F (Panic Button Kit). Price £4.50.**

# WORKING WITH OP~AMPS

**Part 4**

*by Graham Dixey C.Eng., M.I.E.R.E.*

Filtering is the act of separating what is wanted from what is unwanted. In electronics this usually means some form of separation on the basis of signal frequency. In the simplest case, signals are divided into two 'bands' known as 'low frequencies' and 'high frequencies', separated quite arbirarily by the 'cut-off' frequency. The fact that capacitive reactance depends upon frequency is often used to obtain such separation. This idea leads to simple filters of the 'inverted-L' type, known as 'low-pass' and 'high-pass' filters; these, together with their characteristics, are shown in Figure 1.

The characteristics of these simple filters show that, soon after the cut-off frequency is reached, the filter cuts off with a constant slope which is never greater than -6dB/ octave (i.e. -20dB/ decade). This is a basic limitation where a high degree of separation is required. Also, there is no gain at all, even at the wanted frequencies. These filters are said to be 'passive'. By using the op-amp with its high gain and differential inputs, filters can be designed to have real gain and high degrees of rejection of the unwanted frequencies: these are known as 'active filters'.

## The Op-amp as an Active Filter

To see how the op-amp can be used as the basis for an active filter, consider a now familiar circuit, the inverter. This is shown in Figure 2, where the circuit is drawn twice (a) and (b), each case illustrating how either the input component or the feedback component can be represented by a 'block' which could contain literally anything. For example, if these components are a resistor R1 and another resistor R2 respectively, the circuit is then just an inverting amplifier with a gain of R2/R1, this gain being quite independent of frequency, at least within the limitations of the op-amp itself. But, if either block contains frequency-conscious 'components, then the situation will be entirely different. The gain of the amplifier will vary with frequency and in such a way that it is under the designer's control by his choice of network components, either at the input or in the feedback path or both. Thus, a number of different configurations for active filters are possible, based on this idea.

## The Twin-tee Selective Amplifier

One example of a frequency-conscious network is the twin-tee filter. This has the characteristic that at a particular frequency, given by $f=1/(2\pi RC)$, its impedance is very high. If the impedance of the network is called Z2 and it is used in the feedback path, then it will give a gain of Z2/R1 (if the input circuit is a simple resistor of value R1); this gain will be a maximum at the frequency quoted above. The circuit is obviously selective and in fact behaves rather like a high-Q resonant circuit, but at low frequencies instead of radio frequencies. The frequency that it selects depends upon the values of R and C used in the twin-tee network. A

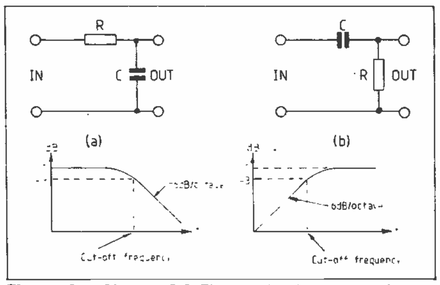



**Figure 1. Simple RC Filters: (a) Low-pass filter (b) High-pass filter.**

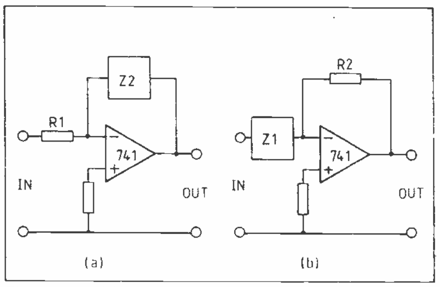



**Figure 2. The Basic Idea of an Active Filter.**

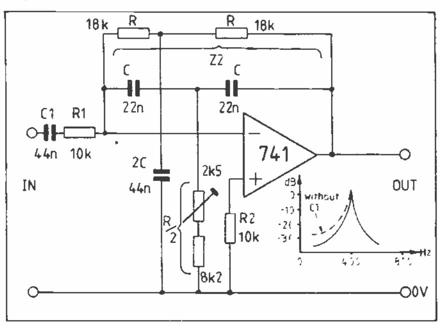



**Figure 3. A 400hz Twin-tee Selective Amplifier.**

selective amplifier of this type is shown in Figure 3, together with a sketch of relative output (in dB) as a function of frequency, for a design frequency of 400 Hz. To use the amplifier at some other frequency, it is only necessary to assign new values to R and C (giving new values to R/2 and 2C at the same time of course). The R/2 branch should contain a pre-set part since the circuit selectivity is best when the resistance of this branch is actually slightly less than the nominal value of R/2 calculated. The selectivity can be improved further by adding a little 'bass-cut'. This is provided by the series input capacitor C1, a value equal to 2C being about right. Using 22nF for C, 2C becomes 44nF; this value can be realised by wiring two 22nF capacitors in parallel or, alternatively, opting for the nearest preferred value of 47nF. The latter choice may well be close enough.

## The Twin-tee Rejector

Instead of selecting a frequency at the expense of all others, the opposite course of action may be taken. The circuit is then made to reject just one frequency and to pass all others (ideally anyway). The obvious way of doing this is to place the twin-tee network in the input of the op-amp, calling its impedance Z1 now, which will give a very low value of gain, R2/Z1, the feedback network being a simple resistor R2. This gain is a minimum at a frequency given by the formula already quoted, as is fairly obvious. A possible circuit is shown in Figure 4, additional components being provided so that the gain 'off the centre frequency' is defined by R2/R1 (giving unity gain in this case) as well as giving some degree of control over the shape of the rejection curve. For example, increasing the value of R2 increases the gain away from the centre frequency but does so at the expense of the sharpness of the curve. At the centre frequency, the situation is more complex because then R3 comes into play as well; it also has some effect on the sharpness of cut-off but, if its value is made too large, use of RV to obtain maximum rejection of the centre frequency is more difficult. It is a point worth experimenting with. For the values given in Figure 4 and a design frequency of 400 Hz, a sketch of the characteristic with RV adjusted as well as possible is also shown.

For both of these twin-tee filters, note that the sharpness of cut-off is considerably greater than that of the simple filters mentioned earlier.

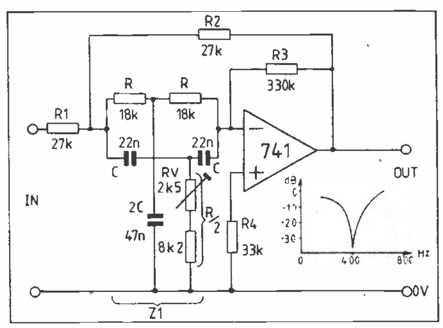



**Figure 4. A 400Hz Twin-tee Rejector Amplifier.**

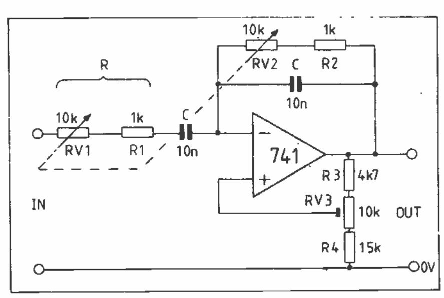



**Figure 5. A Tuned Acceptor Amplifier (Wien Network).**

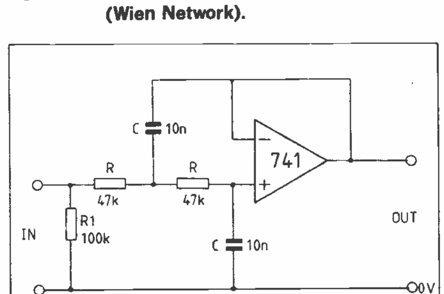



**Figure 6. Second-order Low-pass Filter.**

## The Wien Acceptor Amplifier

An acceptor amplifier is a useful circuit in that it allows analysis of a complex signal i.e, one containing a number of harmonics, which can then be separated into its constituent parts and each measured individually. An obvious example of this is the measurement of harmonic distortion in audio signals. If the fundamental frequency

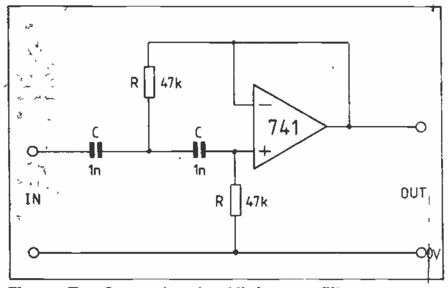



**Figure 7. Second-order High-pass Filter.**

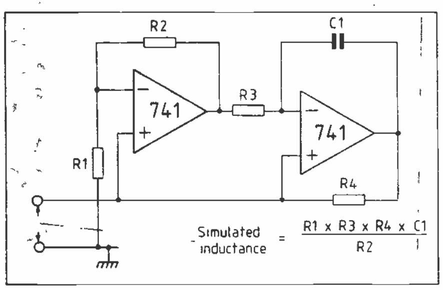



**Figure 8. The Gyrator Circuit.**

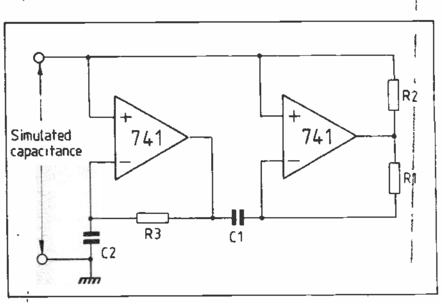



**Figure 9. The FDNR (Frequency-Dependent Negative-Resistance) Circuit.**

and harmonics of a distorted signal are selected separately by a filter, each can be measured by an electronic voltmeter to give information about the percentage of the various components in the signal. Obviously, such a filter must be variable and the twin-tee is not particularly useful in this application because of the need to vary three components at once. For this reason, the Wien network is a better proposition and a selective amplifier based on this approach is shown in Figure 5.

The circuit uses positive feedback from the output to the non-inverting input, and negative feedback from the output to the inverting input. The amount of positive feedback can be controlled by RV3 and is independent of frequency. On the other hand, the negative feedback is provided by the Wien network and therefore depends upon frequency. If RV3 is adjusted correctly, both types of feedback cancel out at one particular frequency, given by $f=1/(2\pi RC)$, and the gain of the circuit is very high. At all frequencies above and below this value the negative feedback predominates and the gain is low. With the values of R and C given in Figure 5 the circuit can be tuned to accept any frequency in the range 1.6-12.5kHz. Switching values of C would allow several ranges to be covered.

## Low-pass and High-pass Filters

Both the circuits of Figure 6 and Figure 7 are known as 'second order' filters because they double up on the use of the previously mentioned inverted-L filter sections. As a result, the ultimate cut-off slope is 12dB/octave instead of being only 6dB/octave. The circuits are arranged to give unity gain over the passband but substantial attenuation outside the passband.

The filter elements for Figure 6 and Figure 7 are R and C and, for the single inverted-L section, the cut-off frequency (-3dB) is obtained when $R=1/(2\pi fC)$ which, by transposition, means that the cut-off frequency $f=1/(2\pi RC)$. However, the use of two identical sections means that the attenuation is actually -6dB at this frequency so that the true -3dB frequency is rather different than give by the above formula for a single section.

For example, in Figure 6, the cut-off frequency for a single section works out at 339Hz but the actual value obtained for the second order circuit is nearer 200Hz.

Similarly for the circuit of Figure 7 while the cut-off frequency for a single section works out at 3.386kHz, the actual cut-off frequency for the second order circuit was found to be about 5kHz.

## An Alternative Approach

So far each active filter presented has consisted of a well-known passive filter used in conjunction with an op-amp, the filter type being quite clearly identifiable e.g. as in the Wien circuit.

Now a completely different approach will be demonstrated which shows even more

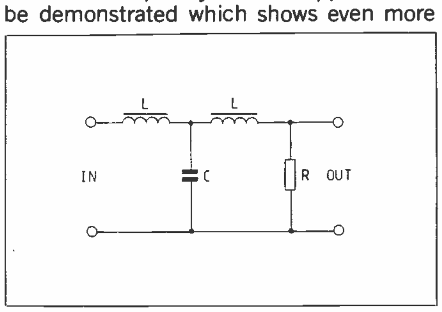



**Figure 10. A Low-pass Passive RLC Filter.**

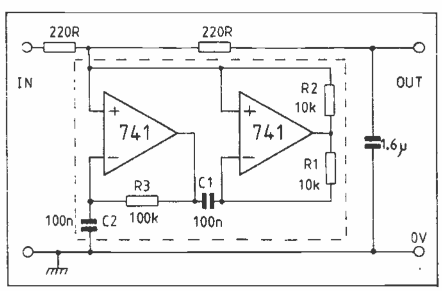



**Figure 11. Design for a FDNR-based Low-pass Active Filter.**

clearly the clever tricks that can be played with the aid of op-amps.

The starting point is the idea that inductors and capacitors can be 'simulated' by any circuit that produces a 'lagging' or 'leading' phase angle between applied voltage and the resulting current respectively. To illustrate the first case, Figure 8 shows how two op-amps can be connected to produce a 'gyrator' circuit or simulated inductor. This apparent inductor appears between the terminals shown and the major advantage is that a costly, heavy and bulky component is replaced by a handful of small, cheap ones; also the inductance value is readily changed. Thus, any real filter that contains an inductor could contain a gyrator circuit instead. However, inductors in LCR filters are often in series with the signal and the gyrator simulates an inductor which has one terminal earthed, a slight disadvantage.

This limitation of the gyrator is overcome by the circuit arrangement of Figure 9, which is known as the 'frequency-dependent negative-resistance' circuit or just FDNR for short. This circuit simulates a capacitor but, and here is the clever bit, when a passive filter normally comprised of L, C and R is synthesised by a circuit arrangement based on the FDNR, not only is C replaced by the FDNR but R is replaced by a capacitor C' and L is replaced by a resistor R', the following relations being used to find the component values in the synthesised circuit.

New capacitance C' (Farads) = 1/R (R in ohms)

New resistance R' (Ohms) = L (L in Henries)

Note that the final synthesised circuit contains no inductors, just resistance, capacitance and FDNRs.

The component values for the FDNR circuit to replace a given value of capacitance C are obtained from the relation,

C = (R1 x R3 x C1 x C2)/R2

(capacitance values in Farads, resistance values in Ohms).

What this implies is that it is possible to design any conventional filter based on R, L and C and then translate the required passive values into those for the FDNR circuit, using the relations given above. To conclude, an example of a design using this approach will now be given.

## Low-pass FDNR Filter

Figure 10 shows a T-filter using high value series inductors. Such components are inconvenient because of cost, weight, size, etc., and the use of an FDNR-based filter allows them to be eliminated. Suppose that the filter is to cut off at 500Hz, the values of the passive components being found from the following two simple formulae.

(1) Cut-off frequency = $1/(\pi\sqrt{2LC})$

(2) R = $\sqrt{2L/C}$

As a starting point, let L be equal to some arbitrary value and then evaluate C for the cut-off frequency of 500Hz; if C turns out to have a ridiculous value then choose another value of L and try again. Suppose L is 200H, then the formula (1) gives a value of C of about 1nF, a perfectly reasonable value. Now R can be evaluated from formula (2) and is found to be 632k.

Thus, for the passive circuit, the values are L = 200H; C = 1nF and R = 632k. These are the values that must now be transformed into the values for the synthesised circuit.

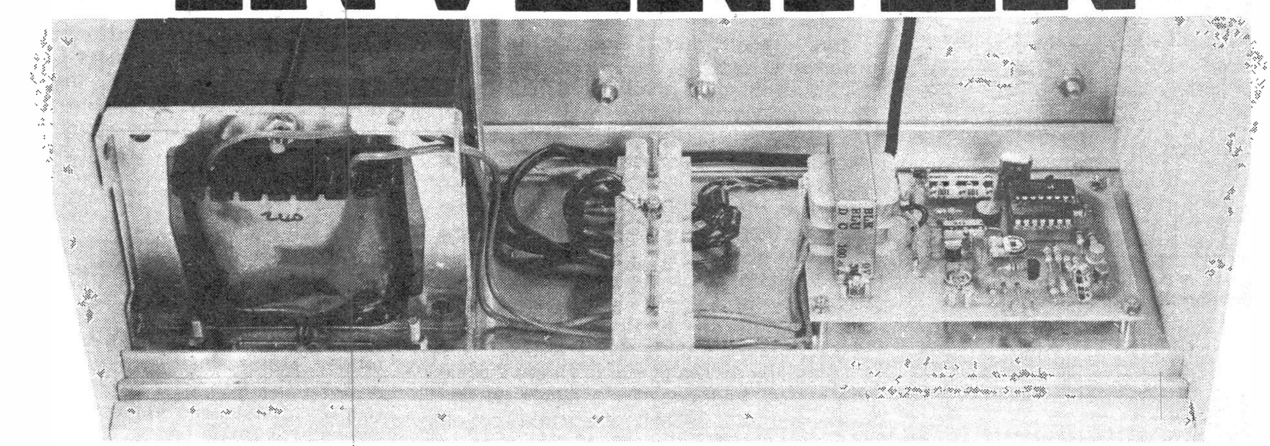
Thus, for the FDNR-based circuit, C' = 1/(632 x $10^3$), = 1.6uF; R' = 200 ohms and the values for the FDNR circuit are related by the expression

C = 1 x $10^9$ = (R1 x R3 x C1 x C2)/R2

Again an initial choice has to be made. Suppose that a guess is made at reasonable values for the numerator e.g. R1 = 10k; R3 = 100k; C1 = C2 = 100nF, this leaves R2 as the only unknown and by substituting these values into the expression just given and transposing it, R2 is found to be 10k, which is perfectly reasonable. It is obvious that a certain amount of judgement and/or experience is invaluable in this sort of design. The complete circuit is shown in Figure 11.

This example has been presented to illustrate the unique nature of this type of active filter design. The same type of approach can be applied to other circuits employing passive components.

# 220/240V AC INVERTER



*by Dave Goodman*

- ★ **Runs small domestic appliances such as televisions, hi-fi and lights**
- ★ **Supplied from a standard 12V car battery**
- ★ **Ideal for camping and caravanning**

Now that winter is well on its' way, bringing the threat of power cuts, a standby power source can be extremely useful. Central heating pumps can be kept running, or the family can be entertained by connecting a television to the inverter.

The need is for a 220-240V AC (50Hz) supply at 100 Watts to be derived from a 12V car battery. The power available should be adequate for most small domestic appliances, providing that their total power requirement is less than 100W.

## Circuit description

The crystal XI and IC1 produce a stable 100Hz square wave, which is further divided by IC2 to give two 50Hz waveforms, one of which is 180 degrees out-of-phase with the other.

The transistors TR1 and TR2 both drive the MOSFETs TR5-8, which alternately switch the windings of T2 to the 12V battery supply. D4 and D5 become forward biased if the battery is wrongly connected, blowing the fuse FS1. D6

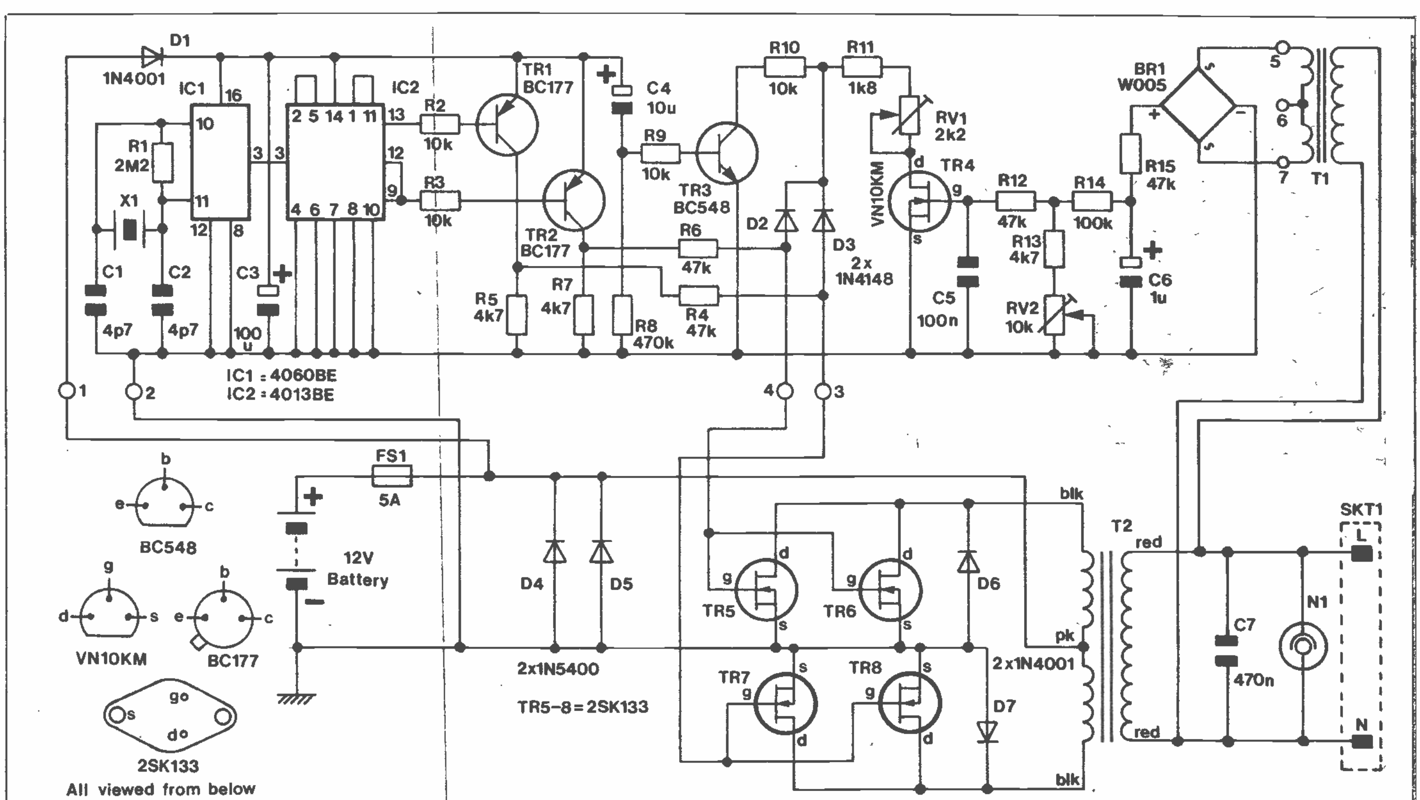



**Figure 1. Inverter circuit diagram.**

and D7 prevent reverse voltage spikes, developed across T2 primary windings, from damaging the MOSFETs. Transformer T2 has been specially developed for use in this system, and steps up the voltage on its primary windings from 17.5V rms to 250V rms across the secondary. Because of the fast switching action that use of the MOSFETs provides, the waveform appearing at T2 secondary under load is a good square wave, whose high harmonic content may cause problems with some equipment connected to it. C7 removes many of the upper harmonics, 'rounding off the edges' of the square wave and producing a more sine wave like waveform.

To produce a high power output, T2 turns ratio is about 20:1. With reference to the primary voltage (17.5V) this would produce 350V rms with small loads connected to T2. To control this voltage T1 monitors the supply output, producing 12V AC across pins 5 and 7 for 250V input. This voltage increases to 15V AC for 350V input, and is rectified by BR1 to produce a small DC biasing voltage at TR4 gate. TR4 acts as a voltage controlled resistor in this circuit, and the drain to source resistance decreases in proportion to a positive value voltage applied to its' gate. RV2 and associated resistors determine the bias voltage to TR4. With

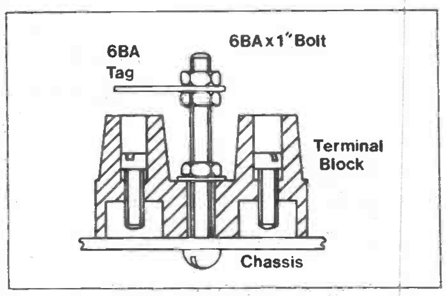



**Figure 3. Chassis connection**

TR4 low resistance diodes D2 and D3 both conduct, and the drive signals to the MOFSETs TR5-8 is reduced. With reduced drive T2 output voltage drops, and the monitoring voltage drops, causing TR4 to increase in resistance. D2 and D3 start to turn off, to a point where the drive to the MOSFETs is maintained and held, so the output from T2 is determined by RV2. This monitoring circuit can be likened to A.V.C. (Automatic Voltage Control). When first switched on no voltage output appears from T2 for a short period of time, this is due to the conduction period of the MOSFETs and primary windings.

When a voltage first appears C6 starts to charge, and TR4 bias is developed as before, therefore the A.V.C. being delayed allows an initial 350V AC to appear at the output. TR3 prevents this surge voltage by conducting immediately a battery is connected. D2 and D3 are forward biased by R10, and the drive signals from TR1 and TR2 are reduced. When C4 is charged, via R8, TR3 then switches off. This charge time allows the A.V.C. to be developed, and the T2 output voltage gradually rises to 240V over a one second period. The

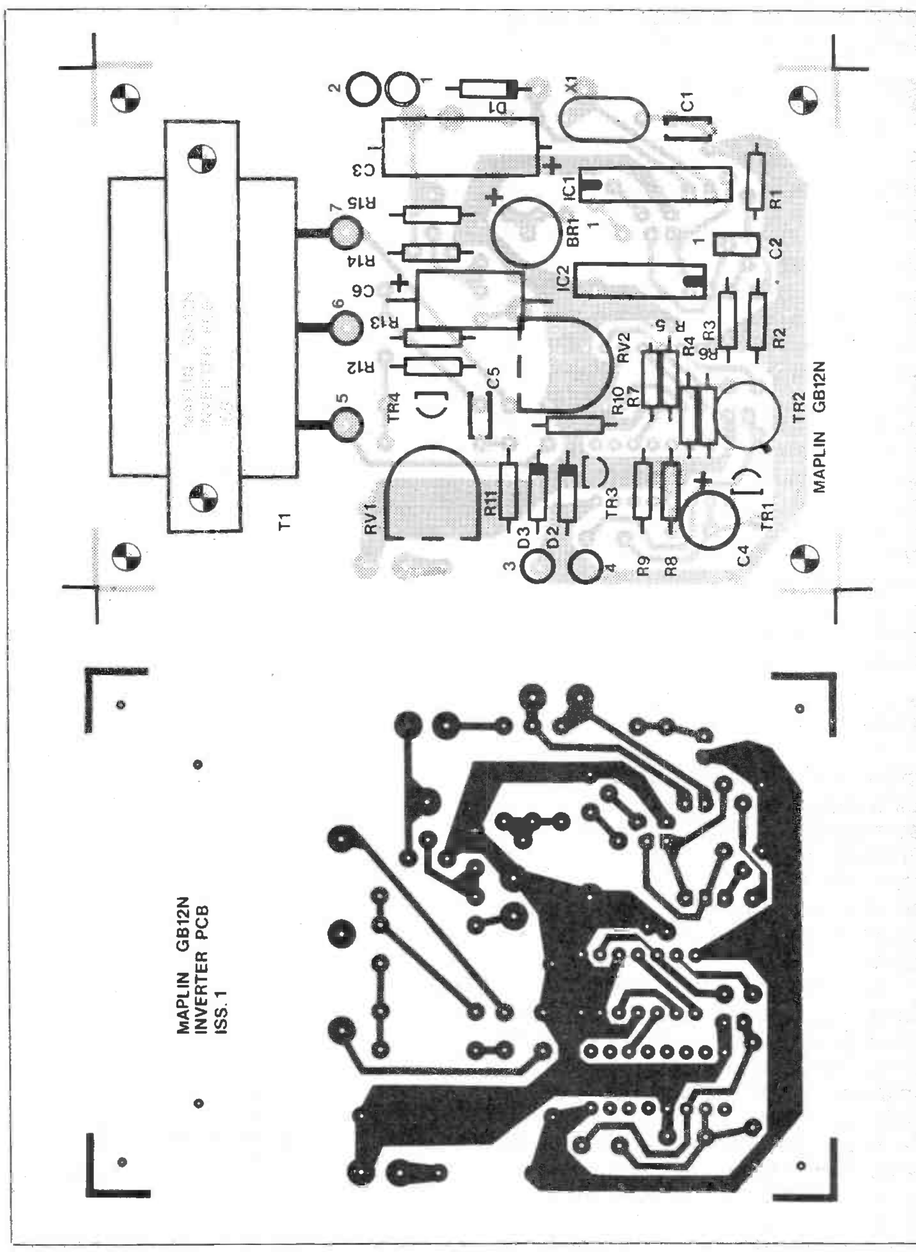



**Figure 2. Legend and artwork**

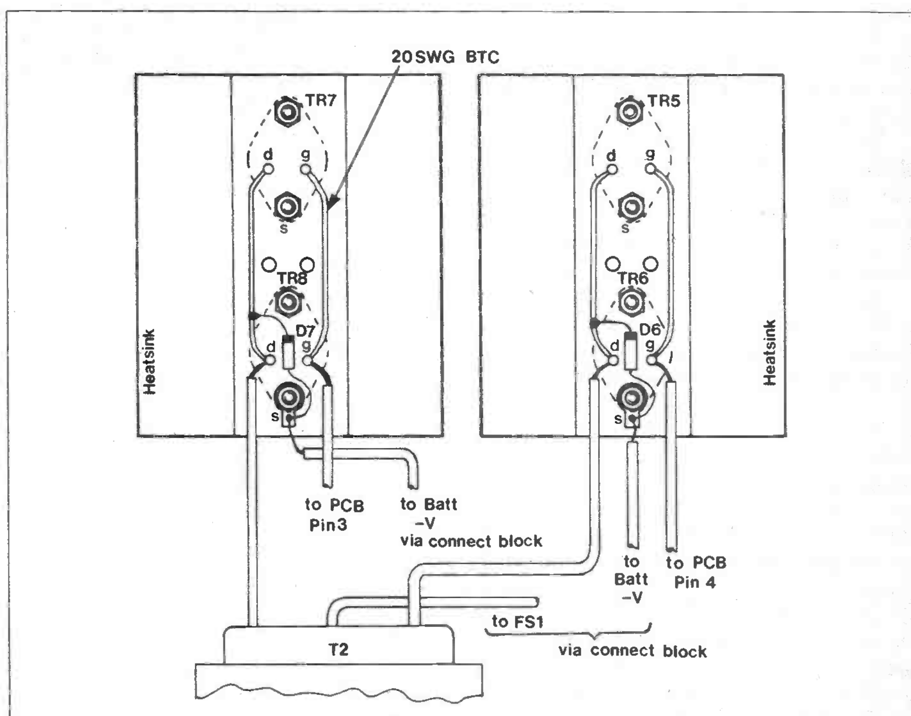



**Figure 4. Heatsink and MOSFET assembly**

neon lamp N1 indicates that a high voltage is present on SKT1.

## PCB assembly

Refer to the parts list and figure 2. Fit R1 to R14 and diodes D1 to D3. Insert BR1. The bridge will have either a plus sign or one lead longer than the other three. In either case this must go into the hole next to the plus sign. Fit RV1 and RV2, followed by transistors TR1 to 4. TR4 has a metal plate on top, and TR1 and 2 cases have a small pip on the side which must line up with the legend. Fit C1 to 6. C3, C4, and C6 are polarised, and you must ensure correct orientation. Fit IC1 and IC2 sockets, and crystal X1. Now solder all components in, and cut all spare leads. Fit veropins P1 to 7 from the track side, then solder in. Mount T1 with two 6BA x ¼in. bolts, nuts and washers, and connect the secondary leads to pins 5 to 7. Recheck all components and look for bad joints and shorts on the track face.

## Main assembly

If using the box recommended for this project figure 6 shows the holes to be drilled to enable all components to be mounted. Note that the two sides finished in black will be the top and front, and the plastic covered panel will be the rear (with the plastic facing inwards and the metal facing outwards).

The plain aluminium sheet is the base, and once it is drilled the PCB can be mounted using four 6BA x ½in. nuts, bolts, washers, and four 6BA x ¼in spacers. T1 end of the board should be innermost. Next, fit the eight way connecting strip using three 6BA x 1in bolts, nuts and washers (figures 3 and 5). This lies across the base from front to back. Use two 6BA nuts and a 6BA solder tag fitted to the centre bolt for the chassis connection to the battery negative.

Mount T2 to the left side of the base panel. Use four 2BA x ½in bolts, nuts and washers. This completes the base panel assembly.

Drill the black top panel (figure 6). Mount the 13A socket pattress using two 2BA x ½in CSK bolts, nuts and washers. Neon N1 fits into hole D, and the 1¼in fuseholder fits into hole E. This completes the top panel assembly.

Next, mount TR5 and 6 to a pre-drilled heatsink. Use a suitable silicon grease for good heatsink conduction. No mounting kit is required here. The FETs will only fit one way round (figure 4). Use four 4BA x ½in bolts and nuts with 4BA washers fitted under the heads of three bolts and a 4BA solder tag under the fourth. The fourth bolt is at the bottom of the drawing and the tag fits on the heatsink side. Use 20 swg copper wire to join Drain pin to Drain pin and Gate pin to Gate pin. Diode D6 mounts under the heat sink, with the cathode (bar end) connected to Drain and the anode connected to the solder tag. Repeat this assembly for TR7 and 8. These two heatsinks will eventually

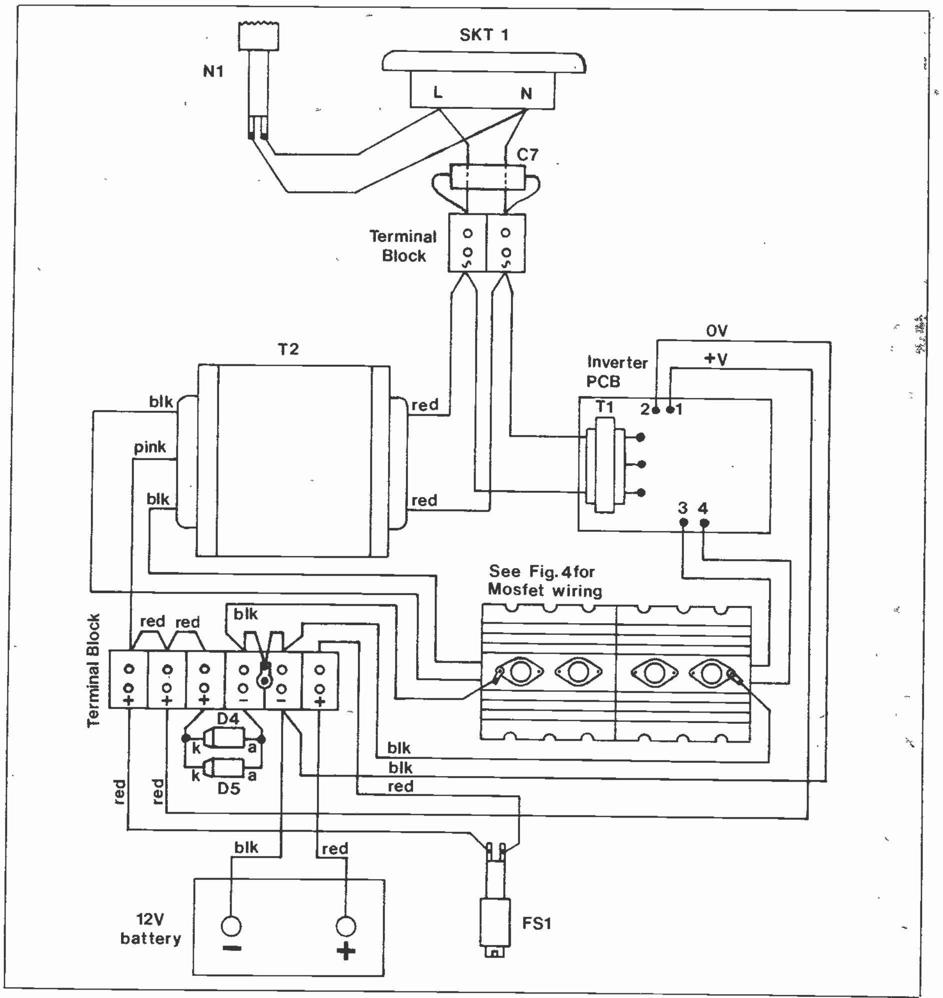
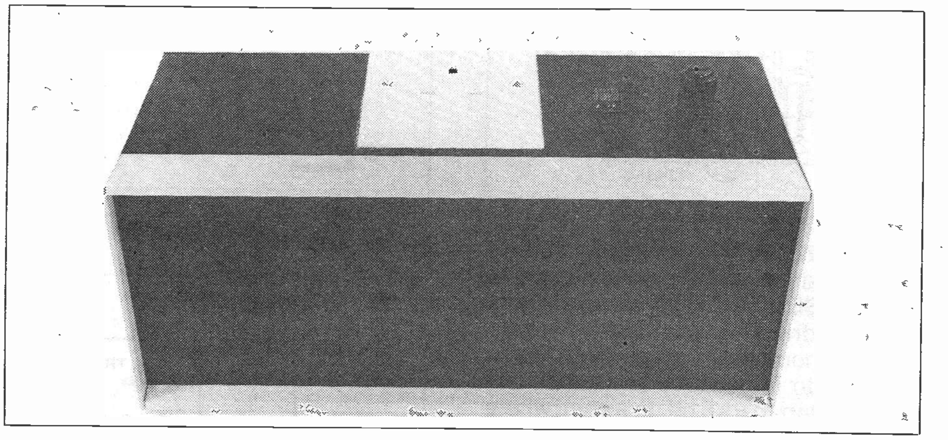



**Figure 5. Wiring assembly**



bolt onto the outside of the back panel (metal face).

## Wiring assembly

Figure 5 shows the wiring arrangements. The centre (pink) wire of T2 primary fits directly into the tag strip, whilst the other two (black) primary wires go through the back panel holes and solder onto the Drain common bus bars (one wire to each bus bar), as shown in figure 5. Use 5A rated cable to join TR5 and 6 Gate bus bar to PCB pin 4, and repeat for TR7 and 8 to PCB pin 3.

Keep these last two cable runs as short as possible. Use two lengths (300mm each) of black 20A rated cable, and pass through each of the two holes in the back panel beneath each heatsink. Place the heatsinks onto the back panel and fit with six 2BA x ½in bolts, nuts and washers. Solder one end of each cable onto the solder tag fitted on each heatsink. The other ends of the cable go into the two centre connecting strips. Fit two short lengths of 20A cable into the same strips and solder their other ends to the 6BA solder tag chassis connection (figure 5).

Assemble the back panel and base panel along with the two side plates and three extrusions. Leave the top and front open for now. Complete the rest of the wiring as shown. Use red 20A cable to and from the fuse FS1 and 20A black and 20A red cables with crocodile clips to the battery.

Capacitor C7 may be fitted directly into the connector strip providing that systoflex sleeving is placed over both bare leads. The same applies to diodes D4 and 5. The cathodes (bar ends) go to positive and the anodes go to negative.

## Testing

Set RV1 fully clockwise and RV2 to halfway. Insert a 5A fuse into the holder. Remember you are dealing with 250V AC and that you should treat this with the same respect you would have for normal mains supply. Connect the battery. If you have an ammeter capable of reading up to 15A DC connect this in series with the battery positive and red connecting lead. Neon N1 should come on and the transformer may quietly buzz. The supply current should be approximately 500mA with no load connected.

Connect a voltmeter set to read 250V AC across the 13A mains socket. There should be about 250V AC present. Turn RV2 fully clockwise. The reading should drop to 190V AC, and neon N1 may flash. Turn RV1 fully anticlockwise and the voltage reading should increase to 280/300V AC. This proves the A.V.C. is working correctly. Note that these voltage readings may vary from unit to unit. Next you will need a 15W pygmy lamp and a 60/100W lamp.

Remove the battery supply and plug a 15W lamp into SK1. Turn RV1 fully clockwise again and reconnect the battery. Both neon and lamp will flicker. Turn RV2 anti-clockwise until there is a reading of 250V AC on the meter. Now remove the 15W lamp. The reading should stay at 250V AC. If it does not, turn RV1 anti clockwise until it does. This sets up the required voltage of 250V (RV2) and the A.V.C. (RV1). Connect a 60/100W lamp to SK1. The reading will drop down to 230/240V, but all is well. If you check the battery supply current now a reading of between 7 and 10A DC can be expected! The inverter is now working.

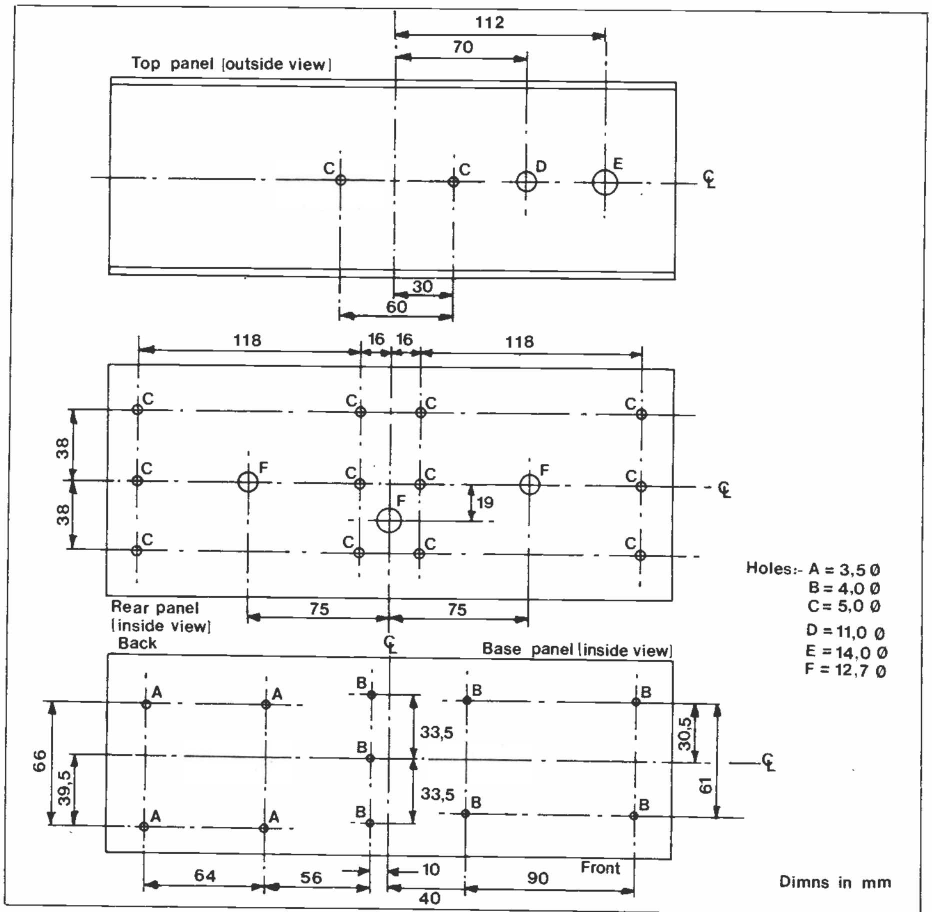



**Figure 6. Chassis and drilling sizes**

Finally, slot the top panel in place, followed by the blank black front panel. Fit the metal extrusion into both panels and screw to the side plates. The assembly is now complete.

The prototype has been used successfully on televisions, spot lamps, hi-fi, tuner, cassette recorders, soldering irons and AC induction motors, although the latter requires high battery current. Some time switches or synchronous motors may not run correctly on this system, and a high current choke may need to be connected in series with T2 primary centre-tap to produce a waveform suitable for operating such appliances. This will be a matter for experimentation, and outside the scope of this article.

## INVERTER PCB PARTS LIST

Resistors: All 0.4W 1% Metal Film

| | | | |
|---|---|---|---|
| R1 | 2M2 | | (M2M2) |
| R2,3,9,10 | 10k | 4 off | (M10K) |
| R4,6,12,15 | 47k | 4 off | (M47K) |
| R5,7,13 | 4k7 | 3 off | (M4K7) |
| R8 | 470k | | (M470K) |
| R11 | 1k8 | | (M1K8) |
| R14 | 100k | | (M100K) |
| RV1 | 2k2 Hor-sub min Preset | | (WR56L) |
| RV2 | 10k Hor-sub min Preset | | (WR58N) |
| **Capacitors** | | | |
| C1,2 | 4p7F Ceramic | 2 off | (WX40T) |
| C3 | 100uF 25V Axial Electrolytic | | (FB49D) |
| C4 | 10uF 35V P.C. Electrolytic | | (FF04E) |
| C5 | 100nF Minidisc | | (YR75S) |
| C6 | 1uF 63V Axial Electrolytic | | (FB12N) |
| C7 | 470nF IS Cap | | (FF58N) |
| **Semiconductors** | | | |
| D1 | 1N4001 | | (QL73Q) |
| D2,3 | 1N4148 | 2 off | (QL80B) |
| TR1,2 | BC177 | 2 off | (QB52G) |
| TR3 | BC548 | | (QB73Q) |
| TR4 | VN10KM | | (QQ27E) |
| IC1 | 4060BE | | (QW40T) |
| IC2 | 4013BE | | (QX07H) |
| **Miscellaneous** | | | |
| BR1 | W005 | | (QL37S) |
| X1 | Crystal 3.2768 MHz | | (FY86T) |
| T1 | 6-0-6 Sub-min Transformer | | (WB00A) |
| | 14 Pin Dil Skt | | (BL18U) |
| | 16 Pin Dil Skt | | (BL19V) |
| | Veropin 2141 | 1 pkt | (FL21X) |
| | Inverter PCB | | (GB12N) |

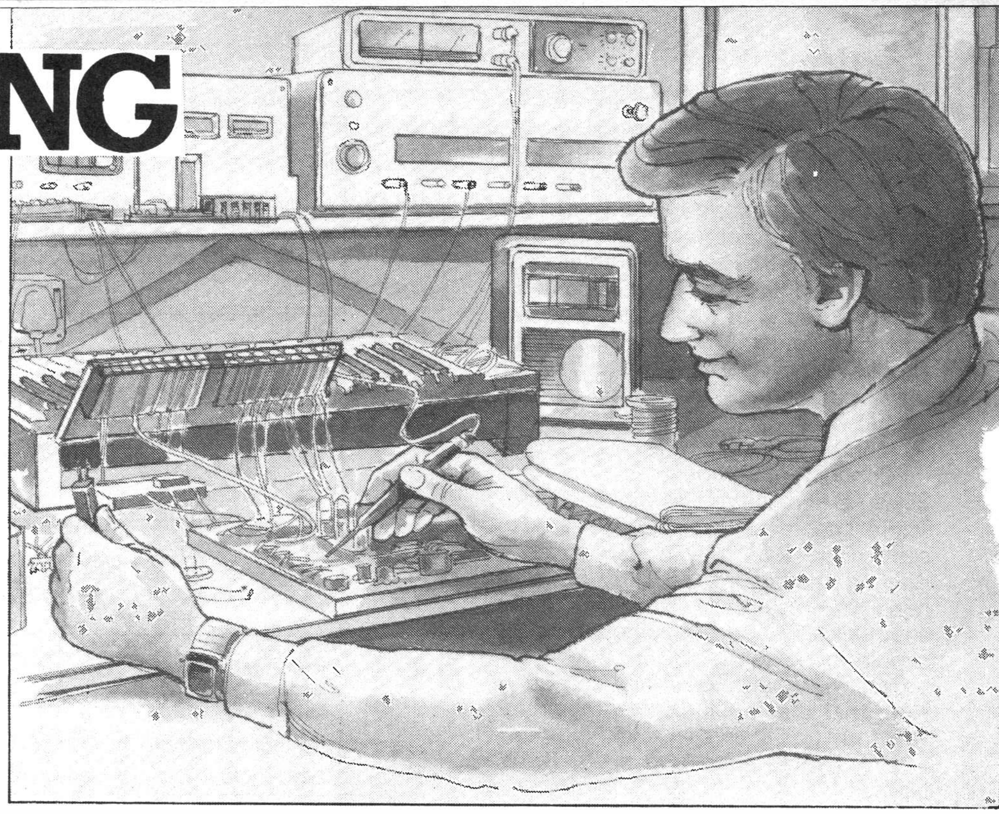
## ADDITIONAL PARTS LIST

| | | | |
|---|---|---|---|
| **Semiconductors** | | | |
| D4,5 | 1N5400 | 2 off | (QL81C) |
| D6,7 | 1N4001 | 2 off | (QL73Q) |
| TR5-8 inc. | 2SK133 | 4 off | (QQ36P) |
| **Miscellaneous** | | | |
| T2 | Inverter transformer | | (XG29G) |
| FS1 | 5 amp fuse x 1¼" | | (WR15R) |
| | Safe fuseholder 1¼" | | (RX97F) |
| SKT1 | Single skt unswitched | | (HL68Y) |
| N1 | Square neon red | | (RX81C) |
| | Terminal block 15A | | (HL54J) |
| | Heatsink 10 DNDR | 2 off | (FL55K) |
| | Surface Pattress 29mm single | | (YB15R) |
| | Charger clip | 2 off | (HF26D) |

| | | | | | |
|---|---|---|---|---|---|
| 4BA solder tag | 2 off | (BF28F) | Bolt 6BA x 1" | 3 off | (BF07H) |
| 6BA solder tag | | (BF29G) | Nut 6BA | 9 off | (BF18U) |
| Bolt 2BA x ½" | 12 off | (BF00A) | Washer 6BA | 7 off | (BF22Y) |
| Nut 2BA | 14 off | (BF16S) | Spacer 6BA x ¼" | 4 off | (FW34M) |
| Washer 2BA | 14 off | (BF20W) | Systoflex 2mm Ø | 150mm | (BH06J) |
| Bolt 4BA x ½" | 12 off | (BF03D) | 20A cable blk | 1M | (XR57M) |
| Nut 4BA | 12 off | (BF17T) | 20A cable red | 1M | (XR59P) |
| Washer 4BA | 10 off | (BF21X) | Large grommet | 3 off | (FW60Q) |
| Csk bolt 2BA x ½" | 2 off | (LR54J) | 20 SWG B.T.C. | 500mm | (BL13P) |
| Bolt 6BA x ½" | 4 off | (BF06G) | BOX NM3 | | (YK43W) |

A complete kit of all parts excluding the case is available for this project. Order As LW95D (Inverter Kit). Price £49.95. The case suggested for this project is the NM3, shown on page 71 of our 1983 catalogue. Order As YK43W.

# STARTING POINT



*by R. Penfold*

**Introducing the fundamentals of electronics for the constructor.**

## UJTs, FETs and SCRs

In this final article in the "Starting Point" series we will consider some of the semiconductor devices which have not been covered by previous articles in the series. The devices that will be discussed here are unijunction transistors (UJTs), junction field effect transistors (Jfets), VMOS transistors, and silicon controlled rectifiers (SCRs).

## UJTs

Unijunction transistors used to be quite popular, but are not often used in new designs due to the availability of inexpensive integrated circuits such as the 555 timer device which give more predictable results and greater versatility. Unlike other forms of transistor a UJT cannot be used as an amplifier, and these devices are in fact normally only used as the basis of relaxation oscillators. A UJT is analogous to two resistors and a silicon diode connected in the manner shown in Figure 1. The total resistance through the resistors is several kilohms and the upper resistor is normally somewhat lower in value than the lower one.

A UJT is used in the oscillator configuration shown in Figure 2, and this provides three output waveforms (which are shown in the diagram). A UJT is a three terminal device like ordinary bipolar types, but the terminals have different names, these being base 1, base 2 and emitter. In the circuit of Figure 2 there is initially an extremely high input impedance at the emitter of Tr1 as there is effectively a reverse biased silicon diode here, and C1 is therefore free to charge by way of R1. When the charge on C1 reaches something in the region of 65 to 90% of the supply voltage (depending on the particular device used), the voltage at the emitter becomes slightly higher than the voltage at the junction of the two resistances within the UJT, and the silicon diode then becomes forward biased.

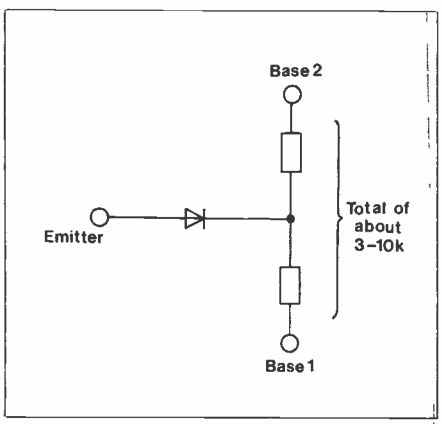



**Figure 1. A UJT is analagous to this circuit.**

At this point a current flows into the emitter of the device, and a regeneraive action within the UJT causes the input impedance to the emitter to fall to a very low level. At the same time the resistance between the base 1 and base 2 terminals falls substantially. C1 largely and rapidly discharges into the emitter of Tr1 until the charge voltage is no longer high enough to sustain the regenerative action, and the device then reverts to its original state. C1 then starts to charge again, and this process continues with a nonlinear sawtooth waveform being produced across C1. This signal is at a fairly high impedance, especially if R1 has a high value. As C1 discharges, positive pulses are produced at the base 1 terminal and negative pulses are generated at the base 2 terminal. These are both at a low impedance.

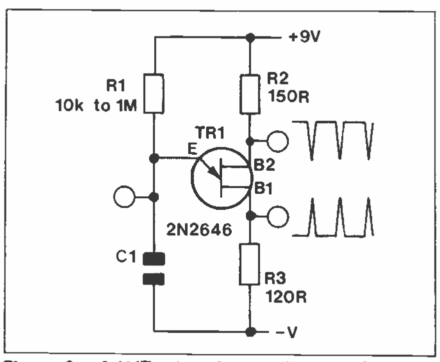



**Figure 2. A UJT relaxation oscillator and output waveforms.**

It is important to realise that you cannot produce a UJT by simply connecting two resistors and a diode in the configuration shown in Figure 1. A UJT actually consists of a bar of silicon which forms the two resistances, with a single semiconductor junction on the bar to form the diode. It is from this single junction that the name unijunction is obtained. Two resistors and a diode connected in the manner shown in Figure 1 will not produce the regenerative action required to trigger the UJT to the on state.

R1 should not have a value of less than about 10k or it will supply enough current to hold Tr1 in the on state and oscillation will be blocked. Similarly, if R1 is made more than about 1 megohm in value it will not supply enough current to trigger Tr1 properly, and oscillation will not take place. Another point to bear in mind is that R2 and R3 must be very low in value or they will prevent the circuit from operating.

## Jfets

The three terminals of a Jfet are called the gate, drain, and source, and these roughly correspond to the base, collector, and emitter of bipolar transistors. Jfets are depletion mode devices, and they require bias circuits that are subsequently different to those employed with bipolar transistors. However, like bipolar transistors they can be used in three amplifying modes which are the common source, common drain (or source follower), and common gate modes. The equivalent bipolar configurations are the common emitter, common collector (or emitter follower), and common base modes respectively.

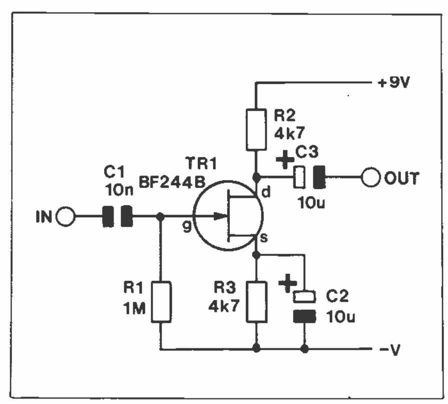
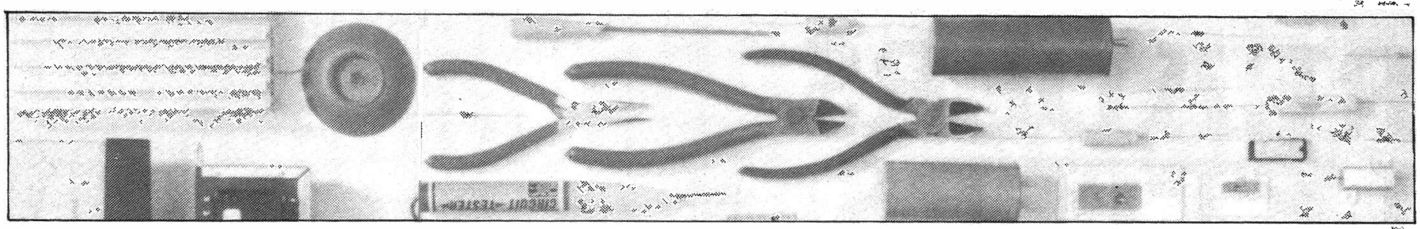



**Figure 3. A simple JFET common source amplifier.**

Figure 3 shows the circuit diagram of a simple common source amplifier which helps to highlight the difference between Jfet and bipolar devices. Whereas ordinary transistors are normally switched off and require a forward bias to enable them to be used as amplifiers, Jfets are normally in the on state and require a reverse bias in order to partially switch them off so that they can act as linear amplifiers. In Figure 3 the gate of Tr1 is biased to the negative supply potential by R1, while R2, the drain to source



resistance of Tr1, and R3 form a potential divider across the supply lines. The potential developed across R3 takes the source terminal of Tr1 about two or three volts positive, and the gate is therefore about two or three volts negative of the source and has the required reverse bias.

An important difference between bipolar a field effect devices is that the latter have a very high input impedance and consume very little input current. The input impedance of a Jfet is typically about one thousand megohms at low frequencies (the input capacitance gives reduced input impedance at high frequencies), and some field effect devices have an input impedance of over a million megohms. The gain of a field effect transistor is not therefore specified as a certain current gain since such a figure would be of little practical value, but instead it is the transconductance that is specified. This relates the

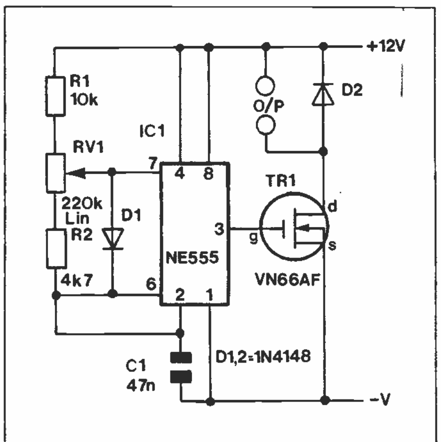



**Figure 4. A motor speed controller using a VMOS transistor.**

change in input voltage to the change in output current, and in data sheets "gm" is the abreviation often used for transconductance.

Transconductance is usually specified in milli-mhos, and this unit is equal to a one volt change in input potential giving a change in output current of 1 milliamp. Transconductance is equal to output current divided input voltage which is the opposite of the formula for finding resistance in ohms, and it is from this that the name 'mho" is derived. Milli-mho is sometimes abbreviated to m ℧. Transconductance is sometimes specified in micro-mhos, and this unit is simply a thousandth of a milli-mho. A Jfet has a gm of something in the region of 2 to 7 mhos.

The circuit of Figure 3 has a voltage gain of only about 20dB (ten times) which is only about a tenth of the voltage gain obtained using a high gain bipolar transistor. However, by making R1 high in value a high input impedance can be achieved with a figure of approximately 1 megohm being obtained in this case. This is about one hundred times higher than the input impedance achieved using a high gain bipolar transistor.

The BF244B is an N channel device which is comparable to an npn bipolar device. There are also P channel devices such as the 2N3820, and these have the same circuit symbol apart from the arrow in the gate part of the symbol, and this points in the opposite direction for a P channel type.

## VMOS devices

Until recently there were no field effect power devices available to the amateur user, and there were in fact no really practical power f.e.t.s. at all. Power Jfets are now produced, but are difficult to use and are not available to amateur users. There are other types of power f.e.t. though, and the most common type is the VMOS transistor.

These are enhancement mode devices, and are similar to bipolar transistors in that the device is cut off with a gate bias voltage of zero, and does not begin to conduct until a gate potential of about 0.8 to 2 volts is reached. Like all field effect devices, the input impedance of VMOS transistors is very high and they are voltage rather than current operated. They have transconductance figures which are much higher than those of Jfets, and they obviously need to be since they are power devices which might need to control output currents of a few amps with an input voltage change of just a few volts. Most VMOS devices have a gm of about 250 mhos, which means that a 4 volt change in the input potential gives a 1 amp change in output current! High power types have gm values in excess of 1000.

VMOS transistors can be used in the output stages of audio power amplifiers and other high power linear applications, and their freedom from secondary breakdown and thermal runaway plus their excellent high frequency response make them in many respects ideal for such applications. They are also useful for switching applications such as the simple pulse type motor speed controller circuit of Figure 4. VMOS transistor Tr1 can be driven direct from the output of the 555 timer I.C. without the need for any current limiting resistor since Tr1 is

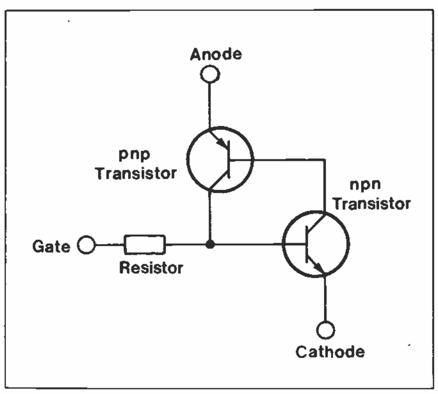



**Figure 5. An SCR is analagous to this circuit.**

voltage and not current operated. For the same reason there is no need to have a low impedance drive circuit capable of supplying a few hundred milliamps, and although the VN66AF can handle drain currents of up to two amps it can be driven from a fairly high impedance source (such as a CMOS logic device) unless the input frequency is quite high. The input capacitance of most VMOS transistors is only about 50pF and it is really only at radio frequencies that the input impedance of these devices falls to a fairly low level.

VMOS transistors are susceptible to damage by high static voltages and many types (including the VN66AF) have a 15 volt zener protection diode connected between the gate and source terminals. Obviously the gate potential should not be allowed to exceed 15 volts or a high input current could flow with the device being damaged in consequence.

Power MOSFETs are another type of high power field effect devices. They are primarily intended for use in very high quality audio power amplifiers, and designs of this type have been featured in previous issues of this magazine.

## S.C.R.s

Silicon controlled rectifiers or "thyristors" as they are popularly known, are switching devices and cannot be used for linear amplification. These are analogous to the circuit shown in Figure 4.

Initially both transistors will not receive any base current and will be switched off, but if a forward bias of about 0.6 volts is applied to the gate terminal the npn transistor will begin to conduct and supply a base current to the pnp transistor. This device then supplies a base current to the npn transistor, and a regenerative action results in both transistors switching hard on. They

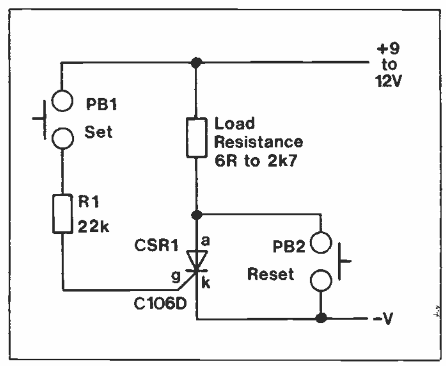


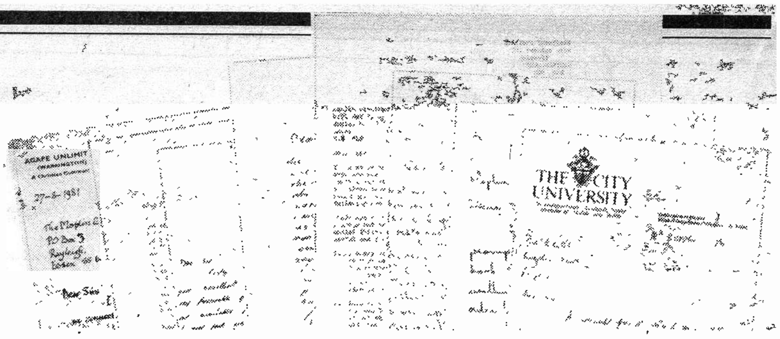

**Figure 6. A simple bistable circuit using an SCR.**

remain in this state even if the forward gate bias is removed, and the device conducts between the anode and cathode terminals with a voltage drop of about one volt or so between the two.

The simple bistable circuit of Figure 6 demonstrates the basic properties of an S.C.R. Power will not be supplied to the load until PB1 is operated and a gate current is fed to CSR1 through current limiting resistor R1. The C106D device specified for CSR1 is a sensitive device which requires a gate trigger current of no more than 0.2mA, but most thyristors require a trigger current of as much as 20 or 30mA. When PB1 is released CSR1 remains switched on provided the current through the load is high enough, and the hold-on current for the C106D is no more than 3mA. Again this is lower than the figure for most types, and a hold-on current of about 20 to 35mA. is more common. Apart from a few special types it is not possible to switch off a thyristor by reverse biasing the gate, and the only way to switch off the device is to take the anode to cathode current below the hold-on level. In this circuit this is achieved by momentarily operating PB2 so that the current flow is briefly diverted from CSR1.

A triac is similar to a thyristor, but it will operate with gate and load voltages of either polarity (they can even be of opposite polarity). Triacs are mainly used to control A.C. loads in applications such as lamp dimmers and drill speed controllers.

# READERS LETTERS




## CB Transceiver

Dear Sir,

After receiving the last issue of my year's subscription to the 'Maplin Magazine' I must say that I am very pleased with the projects and articles that have been published over the year.

However, I am slightly disappointed that the '2m/CB transceiver' project which was to be published in the first year has not yet appeared — nor is it due to appear in issue 5! After all, it was originally on the strength of this project that I subscribed to the magazine.

I wonder if it would be possible to inform readers, in the magazine, when this project is likely to appear.

CHRIS WALKER
Darwen, Lancs

*When we first conceived this project, there was a great deal of interest in CB, but over the months interest has waned considerably. Also we were surprised at the cheapness of the ready-made transceivers and it is unlikely that our kit would have been competitive. In the meantime, prices have fallen even further, making our potential project of less and less interest. In view of these factors we decided not to go ahead with the project. However, most of the design work that was done will be utilised in a new major radio project that we are hoping will be ready for issue 7.*

## Centripetal Not Centrifugal

Dear Sir,

Many of my pupils take your magazine. I myself do not, but I am sure it is an excellent publication. My pupils assure me of this.

However, I do not feel that your article featuring Fig. 1 of the September issue shows a gross error on basic physics. In the diagram mentioned you show a satellite orbiting the Earth in which there are two equal and opposite forces acting on it. Such a satellite would not orbit the Earth but would move in a straight line to infinity, or until it encountered something, in accordance with Newton's first law. Your satellite should have an unbalanced *centripetal force*, equal to the force of gravity. The centrifugal force shown in your diagram should not exist. There is no such thing!

D. STIRZAKER
St. Benedict's School,
London

## BBC Micro vs Atari

Dear Sir,

I was very annoyed to see how you replied to a letter in the June-August edition of the Maplin Magazine. I am referring to what you said about the BBC micro.

Certainly, the BBC micro could be used as a business machine. This is because of its extremely good operating system and basic interpreter, and its superb facilities for expansion. But this does not make it unsuitable as a home computer, for which it was originally designed.

As for your comment about software backup, you are totally wrong here. The BBC micro will have a far better software backup than any other home computer in a short while. This is because the BBC are showing programs for the BBC micro on CEEFAX (and you do not have to buy the special equipment to load it directly if you don't mind a bit of typing. Also, the features I mentioned which make the BBC Micro suitable for business will also attract software writers and companies to produce software for it. I know this because the school I go to has a BBC micro and I have been able to compare it with the Commodore PETS we have. I also know some very unsatisfied owners of Commodore VICs and can assure J. G. Ashdown that the BBC Micro is by far the best home computer available at the moment.

Remember that any magazine which misleads its readers in this way concerning a very good British-made computer is doing serious damage to the British economy.

E. T. GRIMLEY EVANS
Gosforth, Newcastle-on-Tyne

*We never said the BBC Micro was not a good machine; it is an excellent machine. What we did say was that for home use, the Atari is a much better proposition. Much is made of the vaunted Tube on the BBC micro that allows a second processor to be added so that computing can be separated from input/output work (i.e. keyboard, VDU, printer, cassette, disk, user ports). Great!*

*The Atari, however, already has three chips other than the 6502 which do all this and more. One of them called ANTIC is a true microprocessor with its own program, that handles screen displays. Another is the GTIA chip that also assists ANTIC with screen displays and handles the comprehensive sound system. The third chip is called POKEY and this deals with I/O from the keyboard, paddles and other peripherals. Each of these chips is as complex as the 6502 itself.*

*On software, the BBC micro just doesn't stand a chance of ever having the back-up that Atari has. In America more than 30 software houses in addition to Atari themselves are writing for Atari. And they've already produced well over a hundred different titles. More titles are coming fast and furious as software houses adapt Apple programs for Atari (Atari is now outselling Apple in the States). In addition there are over a hundred titles available through APeX (the Atari Program Exchange). The few people writing for the BBC just don't stand a hope of ever catching up.*

*And anyway what sort of software is being planned for the BBC Micro: Unix, UCSD Pascal, Fortran, Cobol, LISP. With the exception of Pascal and LISP, the others are not suitable for home use. They're big, business or university, multi-user systems and Cobol and Fortran only come into their own on giant programs.*

*On the other hand Advanced BASIC, Forth, LISP, Tiny-C and Pilot are already available for the Atari and are languages that can be used at home to give meaningful results. Everything about the BBC micro is BIG. So if you want a giant system at home and can afford it, you may be pleased with the BBC micro, but don't expect the basic machine to be able to do what the Atari can do for the same price or you'll be very disappointed.*

## Additions To 25W MOSFET Amp

Dear Sir,

Congratulations to Dave Goodman on designing the Superb 25W MOSFET Amp, however I have a couple of questions about the design.

Firstly, why were DIN input sockets used, as nearly every piece of hi-fi equipment is supplied with leads terminating in phono plugs. DIN sockets and plugs are generally only used in tape record/playback leads.

Secondly, why wasn't a source/monitor switch provided as this enables quick comparison between the music source and the recording. Also having this switch prevents oscillation when the record control is depressed on the tape deck while having the input switched to tape.

I realise these additions would have meant extra wiring and components not mounted on the PCB, but surely the improvement in convenience would make it worthwhile. Thank you for an otherwise good project.

R. JONES
Buckden, Cambs

*It is relatively easy to make simple phono to DIN adaptors, but much more difficult to fit phono sockets on the back panel and wire them to the circuit board. Each phono socket makes just one connection whereas a DIN can make two or more, so they take up more space and require more complex holes with screw-heads showing unless a sub-panel is used. The extra space used would have made it difficult to fit the remote control unit.*

*Extra facilities could have been provided of course, but a source/monitor switch is just one of many. Any of them would have added to the cost and complexity, and these we wished to avoid.*

## Universal Timer Builder

Dear Sir,

Thank you for the third issue of your magazine in which you include a request for more letters, so we hereby oblige! First I agree with most of your customers/readers that your delivery service is very good, which, as well as the goods, is what we pay for. I, too, like the magazines for the wide variety of subjects dealt with.

Recently I completed L. H. Harrold's "Universal Timer" which is now working well, but, my goodness, the trouble I had with those wretched 10 way sockets!?* I was getting all sorts of horrific effects until I bent each pin and coated them with solder. Couldn't you sell a made up version?

Also I had to find an old metal meter case to house the unit in order to heat sink the mains transformer. It gets pretty warm!

By the way, I found that a 13 amp outlet socket on a surface mounting box with the relay panel housed in a further box bolted underneath it is excellent for each remote controlled point.

Yes thank you. I'm glad I joined the club and look forward to our future.

D. C. EMMERSON
Northampton

## Atari Is A Dinosaur

Dear Sir,

Your reply to J. G. Ashdown on the BBC Micro left me speechless. How you can call a £645 dinosaur a "home computer" is beyond me. Just look at the popular computing press and show me where the adverts are for Atari software (apart from yours). I belong to the East Antrim Computer Club and none of our considerably large membership has ever seen an Atari. Many of us have sold our machines to buy BBC Micros and ZX Spectrums. I used to own an 8K PET before I bought my BBC Model B and so the mere mention of "Commodore back-up" had me in fits of laughter. £396 for a single disc drive for the VIC? Come on Maplin, just who do you think you're kidding. Seriously though, I honestly believe your choice of machines leaves much to be desired and unless Atari/VIC prices fall dramatically then you will be left with egg on your faces.

ALLISTER MURPHY
Carrickfergus
Co. Antrim

*We have to agree that Atari's own marketing of their computers has, up to now, been abysmal. But since you've never seen an Atari how can you compare it with others? I can tell you that its streets ahead of the BBC micro and the ZX Spectrum (see our reply to Mr. Grimley Evans letter below). We stock the Commodore VIC20 as a lower cost alternative to the Atari, though we agree that their disc drive is overpriced, but you can't say they have no back-up – they even publish their own magazine packed with programs and information.*

## Suggestions For New Stock

Dear Sirs,

Might I suggest a few additions to your excellent range of electronic components?

(1) 4mm plugs with 4mm cross-hole (I believe they are called "Bunch Plugs"). (2) I.C.s CA 3130 and CA 3140 in DIL package. (3) 10M 1% resistors. Circuits for electronic multi-meters often specify them. (4) 2mm plugs with tips long enough to suit multimeters such as the Super-tester 680R etc.

While writing, I would like to thank you for replacing the faulty 'scope probe so promptly a month ago.

L. W. DEWHURST
Leamington Spa, Warwickshire

# CIRCUIT MAKER

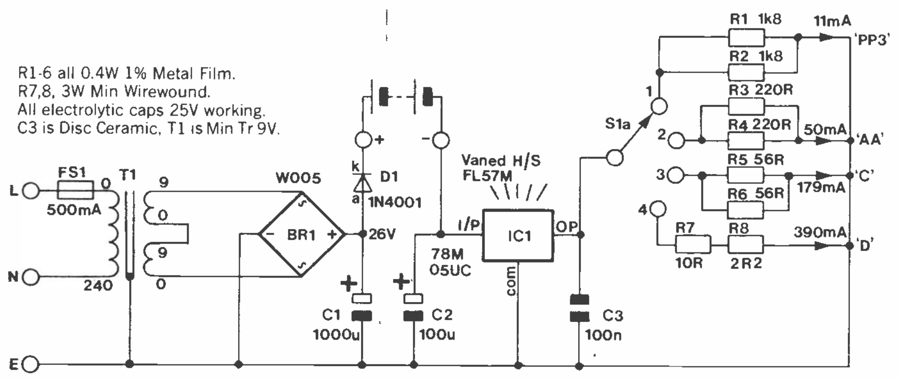
## Simple NiCad charger

*J. R. Smith, Paignton, Devon*

Most commercial NiCad chargers have connections for the A to D range of cells, but do not include PP3 type batteries. This circuit will charge from 1 to 6 standard 1.2V NiCads or one PP3 type in ten hours. If more than one cell is being charged then they should be connected in series, and the charging connection is made between positive and negative pins at IC1 input.

Switch S1 selects the appropriate range for the cell to be charged, and this must be chosen before applying mains power.

Resistors R1 to 8 determine the current flowing through IC1, which is a constant voltage regulator. The total current flowing through the NiCad will therefore be resistor (load) current and IC1 drive current (3 to 4mA). Bolt the IC onto a suitable heatsink when charging C or D type cells.

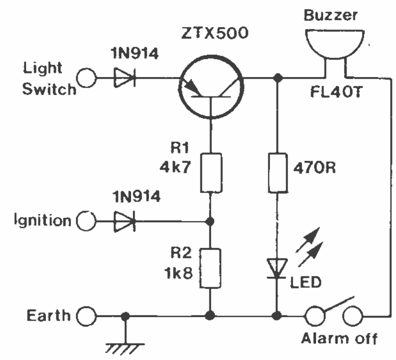



## Simplified car lights reminder

*J. M. Dunnett, Prestatyn, Clwyd*

This circuit uses less components than the one published in Issue 1.

With the ignition off, the base of the transistor is held sufficiently low via R1 and R2 to cause it to conduct. If the lights are also on, 12V from the lighting circuit will pass through the conducting transistor and activate the buzzer.




If the ignition is switched on, the transistor base is taken high, it no longer conducts, and the alarm ceases.

The switch and LED are optional and are intended to cater for situations where the lights have to be left on with the ignition off.

# ATARI VIDEO GAME

## NEW CARTRIDGES FOR ATARI VIDEO GAME

Over the next three months, five new cartridges will be released by Atari for the Video Game Console.

**Star Raiders**

At last the most popular of Atari's Computer games becomes available for the Video Game. A vicious star battle in the glory of 3D, this game will be even more popular than Pac-Man or Space Invaders. The cartridge comes complete with its own keypad controller. For one player only, a joystick controller is also required.

**Order As BC53H (VCS Star Raiders)**
**Price £29.95**

**ET - The Extra-Terrestrial**

ET needs your help! The lovable little alien is stranded on the planet Earth, and just like in the movie, he needs an interplanetary phone to contact his friends for rescue. Help him find the parts he needs. Call Elliott to guard him and help ET return to the planet he loves. Contains 3 games, played with a joystick controller.

**Order As BC54J (VCS ET) Price £29.95**

**Volleyball**

Superb graphics on this the first of Atari's new series of Sports Games offering a high degree of realism.

**Order As BC55K (Volleyball) Price £29.95**

**Also Coming**

Due for release in January 1983 are Raiders Of the Lost Ark and Frog Pond.

**Order As AC76H (Raiders Of Lost Ark)**
**Price £29.95**
**BC56L (Frog Pond) Price £29.95**

# PRICE LIST

## All prices shown in this price list are valid from 15th November 1982 to 12th February 1983

## Please note new telephone number for Sales Only (0702) 552911

Prices shown in this list include VAT at 15% where applicable. Items marked *NV* are rated at 0% and the price shown applies both to inland and export orders. Overseas customers should add up the total cost of all items except those marked *NV* and deduct 13% to arrive at the total price excluding VAT. Alternatively multiplying the total price (except *NV* items) by 0.87 will give the total price excluding VAT. Please add extra for carriage on all overseas orders. Carriage will be charged at cost.

Although postage charges to customers living in the Republic of Ireland and in the UK, but not on the UK mainland, are the same as to mainland addresses we regret that we must levy an additional charge of £5 on each order containing any items marked "Delivery by Carrier".

Will customers from the Republic of Ireland please add 40p and then 35% to the cost of their order now that the Irish pound is not equivalent to sterling, to cover the rate difference and negotiation fees. We will refund any difference; please state cheque or credit note. Alternatively if you pay by bank draft drawn in pounds sterling on a London bank, then you need add nothing extra. Bank drafts drawn in pounds sterling on a London bank should be readily available from your local bank.

All prices are for the unit quantity shown in the catalogue (unless shown otherwise on this list) i.e. each, per pack, per metre etc. All prices include postage and packing. There is a 50p handling charge which must be paid on all orders having a total value of under £5.00.

The price list is intended for use with our 1983 catalogue and applies to all mail orders. Prices in our shop are generally lower on heavy items as mail order prices include postage and packing costs.

Copies of manufacturers' data sheets are available for most IC's — price 40p each.

| | |
|---|---|
| NYA | Not yet available |
| NA | Not available |
| DIS | Discontinued |
| TEMP | Temporarily out of stock |
| OOP | Out of print |
| FEB | Out of stock, new stock expected in month shown |
| † | While stocks last |
| *NV* | Indicates that item is zero rated for VAT purposes |

* The Aerial Rotator is not supplied with cable. Use 4-core Mains XR48C. Make no connection to terminal 2 of the controller. The wire from terminal 3 of the controller must be connected to terminals 2 and 3 at the rotator.

### TRADE QUANTITIES

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity. Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.
Most items in the price list have a letter in brackets after the price which indicates the trade quantity as follows:

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|---|---|---|
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| (C) | Trade quantity | 25 |
| (D) | Trade quantity | 50 |
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| (F) | Trade quantity | 250 |
| (G) | Trade quantity | 500 |
| (H) | Trade quantity | 1000 |

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| BW58N | Aerial Switch | £4.35 (C) |
| LB09K | 75/300 Balun | £1.30 (D) |
| RK47B | 3dB Attenuator | £1.95 (D) |
| BW59P | Attenuator 6dB | £1.95 (D) |
| BW60Q | Attenuator 12dB | £1.95 (D) |
| LB11M | FM Tape Aerial | 60p (E) |
| YG20W | Ferrite Rod 810 | 29p (E) |
| YG21X | Ferrite Rod 814 | 46p (F) |
| YG22Y | Ferrite Rod 101 | 45p (F) |
| YG23A | Ferrite Rod 102 | 69p (E) |
| LB12N | MW/LW Aerial | £2.35 (C) |
| **Page 25** | | |
| RK48C | 8-Section Antenna | £1.15 (D) |
| RK49D | 6-Section Antenna | £1.15 (D) |
| LB10L | Telescp Aerial 1.22m | £3.30 (C) |
| YL43W | TVI Filter | £5.25 (B) |
| *XB54J | Aerial Rotator | £39.95 (A) |
| **BATTERIES** | | |
| **Page 26** | | |
| YG00A | Ni Cad AA | £1.25 (D) |
| YG02C | Ni Cad C | £3.95 (C) |
| YG03D | Ni Cad D | £5.99 (B) |
| HW31J | Nicad PP3 | £5.95 (B) |
| RK46A | PCB Mountg 3.6V Bat | £2.45 (C) |
| WY22Y | Ni-Cad Charger | £7.85 (B) |
| **Page 27** | | |
| YK31J | Univsl Ni-Cad Chrger | £9.95 (B) |
| HW32K | PP3 Nicad Charger | £6.95 (B) |
| YB23A | AC Adaptor MVA31 | £9.95 (B) |
| XX09K | AC Adaptor BR300 | £4.45 (C) |
| HF27E | Clips PP9 | 14p (G) |
| HF28F | PP3 Clip | 9p (H) |
| RK43W | Heavy Duty Clips | 25p (F) |
| YR59P | 1.5V Batt Box | 16p (G) |
| YR60Q | 3V Batt Box | 15p (G) |
| YR61R | 4.5V Batt Box | 30p (F) |
| HF29G | 6v Batt Box | 22p (G) |
| HF94C | Long HP7 Batt Box | 22p (G) |
| HQ01B | 9v Batt Holder | 34p (F) |
| YR62S | Long 9V Batt Box | 32p (F) |
| RK44X | 12V Battery Box | 65p (E) |
| RK45Y | 12V NiCad Batry Box | 49p (F) |
| HF95D | HP11 Batt Box | 39p (F) |
| HF97F | HP2 Batt Box | 79p (E) |
| **Page 28** | | |
| HY32K | Large Batt Hldr | £1.85 (D) |
| YX92A | Dummy Battery | 20p (G) |
| XX33L | PP3 Battery Holder | £1.25 (D) |
| **BOOKS** | | |
| **Page 29** | | |
| WA27E | Basic Elec & DC Ccts | £12.64*NV* (A) |
| WA28F | Basic AC Ccts | £10.95*NV* (A) |
| RL27E | Book NB147 | £6.95*NV* (B) |
| WG10L | Book JW787 | £7.34*NV* (B) |
| RH64U | Book NB047 | £2.85*NV* (C) |
| RL31J | Book NB157 | £4.35*NV* (C) |
| RL29G | Book NB152 | £2.56*NV* (C) |
| RQ22Y | Book NB245 | £4.99*NV* (C) |
| RR02C | Book NB200 | £2.82*NV* (C) |
| **Page 30** | | |
| XW31J | Book MM639 | £1.95*NV* (D) |
| XW12N | Book NB386 | £4.10*NV* (C) |
| RH55V | Book NB048 | £3.90*NV* (C) |
| WG71N | Book BP94 | £2.10*NV* (C) |
| XW00A | Book FT882 | £6.90*NV* |
| WA44X | Undrstndng Auto Elec | £4.95*NV* |
| RL13P | Book NB099 | £2.55*NV* |
| XW21X | Book NB344 | £6.08*NV* |
| RF19V | Book NB286 | £4.20*NV* |
| RL06G | Book NB0740 | £4.74*NV* |
| RH05F | Book BP7 | 50p*NV* |
| RL02C | Book NB059 | £5.15*NV* |
| RH04E | Book BP6 | 85p*NV* |
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| RQ23A | Book BP53 | £3.20*NV* |
| RH21X | Book BP27 | 65p*NV* |
| RH53H | Book BP160 | FEB |
| XW53H | Book NB454 | £3.96*NV* |
| XW63T | Book JM671 | £2.75*NV* (C) |
| WA51F | Book BP107 | £2.45*NV* |
| WA55K | Book BP113 | £2.45*NV* |
| RL19V | Book NB126 | £4.55*NV* |
| WA20W | Understdng Electrncs | £4.95*NV* |
| XW64U | Book NB449 | £4.84*NV* |
| WA21X | Undrstdng Dig Elec | £4.95*NV* |
| WG11M | Book JW748 | £6.65*NV* |
| **Page 32** | | |
| RR06G | Book NB209 | £7.46*NV* |
| RH63T | Book NB041 | £2.75*NV* |
| RF10L | Book BP228 | £1.50*NV* |
| RL33L | Book NB188 | £6.95*NV* |
| XW87U | Book AG530 | £4.25*NV* |
| WA24B | Undrstdng Communctns | £4.95*NV* |
| RH00A | Book BP1 | £1.50*NV* |
| RH11M | Book BP14 | £2.15*NV* |
| WG30H | Book BP85 | £3.25*NV* |
| RR39N | Towers Transistor Bk | £10.75*NV* |
| RL34M | Book NB189 | £6.85*NV* |
| WA52G | Book BP108 | £2.45*NV* |
| RQ68Y | Book FT938 | FEB |
| **Page 33** | | |
| RQ24B | Book BP41 | £3.25*NV* |
| RQ69A | Book FT986 | £7.75*NV* |
| RF11M | Book BP40 | JAN |
| RH35Q | Book BP202 | FEB |
| XW56L | Book FT1037 | £14.95*NV* |
| RL25L | Book NB145 | £4.35*NV* |
| RR17T | Book NB327 | £6.65*NV* |
| RR26D | Book NB1619 | £2.75*NV* |
| RL32K | Book NB185 | £12.38*NV* |
| WA11M | TI Voltage Regulator | £5.65*NV* |
| WA19V | TI Linear IC Guide | £3.35*NV* |
| WA10L | TI Linear Control | £5.25*NV* |
| WA13P | TI Interface Data | £9.54*NV* |
| WA14Q | TI TTL Data | £10.00*NV* |
| **Page 34** | | |
| WA18U | TI Dig IC Guide | £4.50*NV* |
| WG58N | Book FT1199 | £8.45*NV* |
| WA12N | TI Bipolar Micro | £5.75*NV* |
| WA15R | TI 9900 Data | £11.99*NV* |
| RQ54J | Z80 Data | TEMP |
| WG23A | Book JW568 | £16.95*NV* |
| WA07H | TI Bipolar Memo Data | £1.45*NV* |
| WA06G | TI MOS Memory Data | £4.95*NV* |

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Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.

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| WG87U | Book BP101 | 65pNV |
| RQ25C | Book NB278 | £4.78NV |
| RL07H | Book NB076 | £6.55NV |
| RL17T | Book NB115 | £2.75NV |
| RQ26D | Book NB319 | £5.98NV |

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| RR28F | Book NB2028 | £14.25NV |
| WA29G | Book BP88 | £2.25NV |
| RQ67X | Book BP51 | £1.05NV |
| RB25C | Book BP225 | £1.45NV |
| RR21X | Book NB879 | £4.68NV |
| RR37S | Photocell Apps Book | £4.15NV |
| RF12N | Book BP42 | £1.50NV |
| WG43W | Book BP87 | £1.50NV |
| WA26D | Undrstdng Optonics | £4.95NV |
| WA09K | Opto Theory/Practice | £7.50NV |
| WA08J | TI Opto Data | £5.25NV |
| LY05F | Book BP45 | £1.90NV |

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| XW34M | Book BP67 | £2.05NV |
| XW62S | Book BP82 | £2.25NV |
| WG85G | Guide To Solar Elect | £4.95NV |
| RR03D | Book NB201 | £3.96NV |
| RR27E | Book NB2026 | £4.15NV |
| RR04E | Book NB203 | £3.55NV |
| XW90X | Book AG475 | £3.95NV |
| WG01B | Book NB447 | £4.70NV |
| WG44X | Book AG600 | £3.95NV |
| RR09K | Book NB229 | £4.20NV |
| RF09K | Book BP227 | £1.75NV |
| RR10L | Book NB230 | £4.15NV |
| XW89W | Book AG437 | £3.85NV |

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| RR11M | Book NB231 | £4.15NV |
| WA53H | Book BP110 | £2.15NV |
| RH17T | Book BP23 | 95pNV |
| RQ28F | Book BP48 | £1.92NV |
| WA34M | Book BP92 | £1.75NV |
| RQ29G | Book BP49 | £1.65NV |
| XW67X | Book BP80 | £2.25NV |
| WG86T | Book BP98 | £2.25NV |
| WA35Q | Book BP99 | £1.95NV |
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| WG57M | Book FT1300 | £12.99NV |
| WG28F | Book BP83 | £2.15NV |

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| RB21X | Book BP221 | £1.45NV |
| RH29G | Book BP36 | £1.50NV |
| RR19V | Book NB864 | £5.82NV |
| RF08J | Book BP39 | £1.90NV |
| RH30H | Book BP37 | £1.92NV |
| RL05F | Book NB074 | £5.99NV |
| XW17T | Book HD760 | £7.24NV |
| RL36P | Book NB345 | £4.10NV |
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| RH25C | Book BP32 | £1.95NV |
| WA37S | Book BP105 | £1.95NV |
| XW52G | Book BP76 | £2.05NV |
| WG72P | Book BP93 | £2.10NV |

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| WG50E | Book NB500 | £3.95NV |
| WG18U | Book HD748 | £6.45NV |
| WG35Q | Book HD893 | £5.46NV |
| WG94C | Book FT1349 | £9.45NV |
| WA49D | Book BP104 | £2.45NV |
| WG91Y | Book FT1261 | £5.45NV |
| RH18U | Book BP24 | £1.35NV |
| RL30H | Book NB153 | £5.95NV |
| WA50E | Book BP106 | £2.15NV |
| LY04E | Book BP44 | £2.10NV |
| XW38R | Book NB480 | £4.75NV |
| RQ27E | Book BP50 | £1.60NV |

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| RB23A | Book BP223 | £1.45NV |
| WA30H | Book BP97 | £1.95NV |
| XW20W | Book BP65 | £1.75NV |
| RL01B | Book NB058 | £5.25NV |
| RH28F | Book BP35 | FEB |
| WG29G | Book BP84 | £2.15NV |
| RB24B | Book BP224 | £1.55NV |
| RQ66W | Book BP59 | £1.75NV |
| RR07H | Book NB216 | £5.35NV |
| RL44X | Book BP58 | £1.72NV |
| WA62S | Book NB769 | £5.25NV |
| RL43W | Book BP56 | £1.95NV |
| WG54J | Book NB535 | £3.95NV |

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| RB10L | Book NB269 | £5.45NV |
| RF20W | Book HD734 | £6.21NV |
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| XW44X | Book BP71 | £1.90NV |
| RL42V | Book NB346 | £4.05NV |
| WG51F | Book NB501 | £3.95NV |
| XW10L | Book NB383 | £4.05NV |
| XW08J | Book BP60 | £1.65NV |
| WG46A | Book BP90 | £2.15NV |
| XW46A | Book MM513 | £2.90NV |
| RL40T | Book NB338 | £3.95NV |

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| RH52G | Book BP220 | £1.05NV |
| RH22Y | Book BP29 | £1.20NV |
| XW37S | Book BP69 | £1.85NV |
| WA51F | Book NB379 | £4.10NV |
| RH51F | Book BP219 | £1.05NV |
| XW47B | Book MM396 | £2.19NV |
| WG53H | Book NB529 | £3.95NV |
| XW51F | Book BP75 | £2.00NV |
| RH50E | Book BP218 | £1.05NV |
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| RQ30H | Book NB353 | £5.45NV |
| WG60Q | Book BP95 | £2.15NV |

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| RQ80B | Book FT926 | £6.21NV |
| WG00A | Book FT1021 | £6.31NV |
| XW39N | Book BP73 | £2.25NV |
| XW66W | Book BP79 | £2.05NV |
| XW06G | Book FT1071 | £6.65NV |
| RL46A | Book HD681 | £9.98NV |
| XW28F | Book FT841 | £5.35NV |
| XW73Q | Book FT1241 | £6.25NV |
| WG92A | Book FT1341 | £9.75NV |
| WG65V | Book JW928 | £5.75NV |
| WG61R | Book HD192 | £9.99NV |
| WG47B | Book FT1191 | £7.50NV |

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|---|---|---|
| WA60Q | Book FT1076 | £6.15NV |
| WA59P | Book FT1391 | £7.60NV |
| †RL04E | Book NB071 | £9.99NV |
| RR00A | Book NB195 | £7.45NV |
| XW86T | Book AG471 | FEB |
| WG34M | Book NB472 | £4.20NV |
| WA90X | Book NB112 | £4.85NV |
| XW54J | Book NB439 | £3.00NV |
| WG59P | Book BP91 | £2.15NV |
| XW92A | Book WDXG | £5.55NV |
| XW27E | Book NB402 | £5.77NV |

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| XW99H | Book FT1054 | TEMP |
| RB22Y | Book BP222 | £1.45NV |
| RB26D | Book BP226 | FEB |
| RF18U | Book BP43 | £1.75NV |
| WG52G | Book NB502 | £3.95NV |
| WG95D | Book FT1305 | £7.45NV |
| WG93B | Book FT1235 | £9.45NV |
| WG80B | Book FT1185 | £5.96NV |
| RQ58N | Book BP55 | £2.00NV |
| XW43W | Book NB467 | £4.20NV |
| XW91Y | Book WRTV | £11.53NV |

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| WA97F | Book NB156 | £6.85NV |
| RQ33L | Book BP52 | £2.25NV |
| WA61R | Book FT1409 | £7.55NV |
| XW96E | Book FT933 | £2.60NV |
| WG20W | Book AG652 | £5.40NV |
| WG97F | Book KN035 | £3.85NV |
| WG70M | Book KN400 | £4.45NV |
| WG73Q | Book BP96 | £2.10NV |
| RH59P | Book RB016 | £4.86NV |
| RH66W | Book NB054 | £2.80NV |
| RQ31J | Book NB268 | £9.99NV |
| LW28F | Book BP46 | £1.60NV |

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|---|---|---|
| RH57M | Book NB001 | £9.60NV |
| RL24B | Book NB144 | £5.74NV |
| WG89W | Book NB132 | £7.95NV |
| XW88V | Book AG569 | £3.70NV |
| XW32K | Book BP70 | 60pNV |
| RQ59P | Book NB367 | £2.75NV |
| RQ77J | Book FT732 | £5.75NV |
| XW84F | Book AG353 | £6.62NV |
| RL10L | Book NB084 | £4.68NV |
| RL14Q | Book NB101 | £4.74NV |
| RR24B | Book NB970 | £5.60NV |

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| RH58N | Book NB014 | £2.80NV |
| WA89W | Book NB444 | £8.80NV |
| XW29G | Book NB378 | £7.29NV |
| RH62S | Book NB033 | £10.17NV |
| RL12N | Book NB089 | £11.55NV |
| RL21X | Book NB134 | £11.45NV |
| RF17T | Book NB240 | £12.45NV |
| RL23A | Book NB137 | £10.38NV |
| RH27E | Book BP34 | £1.70NV |
| WA94C | Book NB577 | £4.85NV |

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| WA57M | Book BP100 | £2.15NV |
| WA96E | Book NB166 | £5.95NV |
| WA95D | Book NB506 | £11.95NV |
| WG77J | Book NB553 | £2.85NV |
| WG02C | Book NB475 | £6.90NV |
| RF14Q | Book NB274 | £4.40NV |
| XW26D | Book NB336 | £9.84NV |
| LW29G | Book BP47 | £1.50NV |
| WG69A | Book AG602 | £8.75NV |
| XW85G | Book AG510 | £6.56NV |
| RR14Q | Book NB238 | £4.62NV |
| RF13P | Book NB244 | £4.74NV |
| XW83E | Book AG512 | £5.95NV |

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| RF15R | Book NB252 | £11.25NV |
| RF16S | Book NB253 | £12.24NV |
| RQ36P | Book BP51 | £1.82NV |
| RR16S | Book NB262 | £4.45NV |
| RQ79L | Book FT546 | £4.85NV |
| WG09K | Book JW266 | £13.45NV |
| WG40T | Book HD753 | £23.82NV |
| XW55K | Book AG695 | £5.15NV |
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| XW09K | Book NB391 | £3.84NV |
| XW40T | Book BP74 | £2.05NV |
| RH38R | Book BP205 | £1.15NV |

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| RR01B | Book NB196 | £13.43NV |
| RQ34M | Book NB369 | £4.85NV |
| WG82D | Book FT1364 | £6.45NV |
| RH26D | Book BP33 | £1.75NV |
| RF07H | Book BP38 | 90pNV |
| RQ37S | Book BP54 | £1.65NV |
| WA23A | Undrstdng Calc Maths | £4.95NV |
| WA00A | Computers For People | £8.25NV |
| †WG06G | Book HD116 | £8.25NV |
| XW41U | Book ITN1 | £8.77NV |
| RQ00A | Book Sybex C200 | £8.15NV |
| WG76H | Book NB555 | £2.75NV |

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| WG96E | Book C400 | £11.70NV |
| RQ40T | Book HD678 | £9.75NV |
| XW14Q | Book MM604 | £5.75NV |
| RQ38R | Book NB359 | £4.68NV |
| XW33L | Book BP66 | £2.05NV |
| WG68Y | Book AG601 | £4.95NV |
| WA22Y | Undrstdng Micros | £4.95NV |
| RQ01B | Book Sybex Q201 | £12.75NV |
| WA87U | Book NB579 | £4.85NV |
| RQ12N | Book Sybex M1 | £7.75NV |
| RQ13P | Book Sybex M11 | £11.94NV |
| WG79L | Book NB580 | £5.75NV |

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| WA25C | Undrstdng Comp Scnce | £4.95NV |
| XW45Y | Book BP72 | £1.95NV |
| XW25C | Book NB414 | £4.67NV |
| WG78K | Book NB496 | £5.75NV |
| WA17T | TI Microsystems | £4.95NV |
| WG17T | Book HD897 | £13.25NV |
| WG24B | Book HD165 | £10.49NV |
| XW65V | Book BP78 | £2.05NV |
| XW15R | Book HD813 | £3.75NV |
| WA58N | Book FT1200 | £7.65NV |

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| XW98G | Book FT1070 | £7.85NV |
| RO02C | Book Sybex C207 | £14.25NV |

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| WA92A | Book NB129 | £5.80NV |
| WA41U | Advanced 6502 I/Face | £11.45NV |
| WA02C | Book MM495 | £8.99NV |
| XW57M | Book HD177 | £6.89NV |
| WG81C | Book FT1330 | £6.95NV |
| XW19V | Book HD166 | £7.99NV |
| XW80B | Book C202 | £11.95NV |
| XW81C | Book D302 | £10.25NV |
| WA05F | 6502 Assembly Subs | £14.90NV |
| WA45Y | Beyond Games | £13.00NV |

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| WG63T | Book HD183 | £6.85NV |
| XW70M | Book M3 | £12.75NV |
| RQ06G | Book Sybex L2 | £9.24NV |
| WG88V | Book BP102 | £1.95NV |
| WA04E | 68000 Assembly Prog | £14.20NV |
| XW69A | Book M2 | £12.75NV |
| RQ15R | Book Sybex M13 | £6.95NV |
| WG66W | Book JW009 | £8.96NV |
| WG21X | Book HD167 | £6.75NV |
| WA54J | Book BP112 | £2.95NV |
| RL39N | Book Sybex L8 | £5.99NV |
| XW71N | Book M4 | £13.25NV |

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| XW72P | Book C280 | £13.55NV |
| RQ17T | Book Sybex M15 | £7.83NV |
| XW78K | Book C281 | £12.98NV |
| XW58N | Book NB415 | £4.95NV |
| WA88V | Book NB120 | £4.65NV |
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| WA93B | Book NB184 | £4.85NV |
| WG12N | Book JW500 | £8.30NV |
| XW49D | Book MM304 | £3.95NV |

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| XW50E | Book MM286 | £4.85NV |
| RL45Y | Book HD106 | £10.91NV |
| RQ42V | Book HD585 | £9.95NV |
| WG13P | Book JW204 | £6.75NV |
| WA69A | Microsoft Basic Book | £8.95NV |
| XW04E | Book FT1055 | £4.63NV |
| WG98G | Book HD534 | £6.95NV |
| WG31J | Book B250 | £10.45NV |
| WG39N | Book JW412 | £7.00NV |
| WG84F | Book JW415 | £6.95NV |
| WA16S | TI Sftwre Dvlpment | £14.92NV |
| RQ41U | Book NB528 | £6.60NV |
| WG67X | Book JW729 | £11.75NV |

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| XW42V | Book HD115 | £5.25NV |
| WA70M | Little BASIC Style | £6.95NV |
| WA72P | Book JW932 | £7.85NV |
| WA64U | Pascal for Humans | £4.50NV |
| WG03D | Book P310 | £10.75NV |
| WG26D | Book JW180 | £6.24NV |
| WG32K | Book P320 | £12.15NV |
| XW24B | Book HD124 | £7.65NV |
| RQ43W | Book HD682 | £8.38NV |
| WA68Y | Discover FORTH | £11.80NV |
| WG25C | Book JW609 | £13.45NV |

### Page 59

| | | |
|---|---|---|
| XW79L | Book C300 | £12.45NV |
| WG15R | Book JW011 | £6.65NV |
| XW59P | Book HD154 | £10.34NV |
| WG90X | Book FT1369 | £10.50NV |
| WG19V | Book HD180 | £5.85NV |
| WG38R | Book JW410 | £4.75NV |
| WG08J | Book JW341 | £13.46NV |
| WG48C | Book HD162 | £10.20NV |
| WA71N | BASIC for Scientists | £12.95NV |
| XW60Q | Book HD762 | £10.37NV |

### Page 60

| | | |
|---|---|---|
| XW94C | Book FT1095 | £4.52NV |
| RL48C | Book HD112 | £9.68NV |
| RQ21X | Book Sybex R4 | £6.92NV |
| XW48C | Book R6 | £6.84NV |
| RL47B | Book HD109 | £9.28NV |
| WG49D | Book B245 | £12.99NV |
| XW18U | Book HD170 | £5.48NV |
| WG27E | Book HD476 | £13.45NV |
| WG07H | Book HD181 | £8.60NV |
| XW05F | Book FT1085 | £6.25NV |
| XW75S | Book FT1062 | £6.25NV |
| XW23A | Book HD155 | £15.35NV |

### Page 61

| | | |
|---|---|---|
| XW82D | Book G402 | £11.35NV |
| WA77J | Visicalc Companion | £12.65NV |
| WA67X | Word Processing | £12.45NV |
| WG41U | Book M46 | £13.95NV |
| WA65V | Book FT1394 | £7.55NV |
| WG45Y | Book FT1275 | £6.25NV |
| WG14Q | Book JW466 | £7.70NV |
| WA73Q | Book JW644 | £8.75NV |
| WG64U | Book HD182 | £8.25NV |
| WA01B | Book HD496 | £8.25NV |
| WG05F | Book JW496 | £7.65NV |

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| | | |
|---|---|---|
| WG55K | Atari Basic-Rowley | £6.24NV |
| WA47B | Games For The Atari | £4.45NV |
| WA39N | Book JW593 | £8.25NV |
| WA40T | Your Atari Computer | £13.45NV |
| XH57M | Master Memory Map | £4.00NV |
| WA46A | Op Sys Users Manual | £17.96NV |
| WG56L | De Re Atari | £16.95NV |
| WA63T | Get Acquainted Atom | £7.15NV |
| WA76H | 39 Programs for Atom | £5.65NV |

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| | | |
|---|---|---|
| WA43W | Book JW414 | £6.95NV |
| WK04E | BBC Micro Book | £6.55NV |
| WA66W | Let BBC Micro Teach | £5.90NV |
| WA31J | Learn Prog VIC | £2.50NV |
| WA33L | VIC Prog Ref Guide | £9.95NV |
| WA99H | Gtg Acq wth VIC 20 | £6.20NV |
| WA32K | VIC Revealed | £10.00NV |
| WA75S | VIC20 Symphony | £6.25NV |
| WG33L | Book NB017 | £4.75NV |

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| | | |
|---|---|---|
| WG74R | Book NB178 | £5.95NV |

| 1983 Catalogue Page No. | | VAT inclusive PRICE |
|---|---|---|
| WA81C | Making Most of ZX81 | £7.85NV |
| WG83E | Book JW413 | £5.95NV |
| WA91Y | Book NB223 | £5.80NV |
| WA83E | Get Acquainted ZX81 | £5.40NV |
| WA85G | 34 ZX81 Games | £4.45NV |
| WA79L | Explosive Games ZX81 | £5.35NV |
| WA80B | 20 ZX81 Projects | £5.70NV |
| WA42V | 30-Hour BASIC | £6.62NV |
| WA38R | Book BP109 | £1.95NV |
| WA56L | Book BP114 | £2.70NV |
| WG99H | Book MM973 | £7.45NV |

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| | | |
|---|---|---|
| WA84F | ZX81 Companion | £8.75NV |
| WA03D | Peek, Poke, Byte & RAM | £6.25NV |
| WG75S | ZX81 ROM by Logan | £9.95NV |
| WA82D | ZX81 Machine Code | £6.85NV |
| WA86T | Sinclair Machine Cde | £9.85NV |
| WK01B | Spectrum Sinclair | £6.55NV |
| WK00A | Prog Your Spectrum | £6.55NV |
| WK02C | Spectrum Programmer | £6.65NV |
| WK03D | Spectrum Games Book | £6.55NV |
| WA78K | 20 Prog For Spectrum | £7.85NV |
| WA98G | 60 Games Spectrum | £4.45NV |

## BOXES

### Page 66

| | | |
|---|---|---|
| LH56L | Potting Box Min | 13p (G) |
| LH57M | Potting Box Small | 19p (G) |
| LH58N | Potting Box Medium | 25p (F) |
| LH59P | Potting Box Large | 28p (F) |
| LF01B | Box PB1 White | £1.45 (D) |
| LH14Q | Box PB1 Black | TEMP |
| BK00A | Box PB1 Grey | £1.45 (D) |
| YK48C | Snap Box B1 | £1.10 (D) |
| YK49D | Snap Box B2 | £1.40 (D) |
| YK50E | Snap Box B3 | £1.90 (D) |
| YK51F | Snap Box B4 | £2.30 (C) |
| LH20W | ABS Box MB1 | £1.10 (D) |
| LH21X | ABS Box MB2 | £1.26 (D) |
| LH22Y | ABS Box MB3 | £1.49 (D) |
| LH23A | ABS Box MB4 | £3.25 (C) |
| WY03D | ABS Box 2002 | £1.36 (D) |
| LH60Q | ABS Box 2004 | £1.68 (D) |
| LH61R | ABS Box 2005 | £1.98 (D) |
| LH62S | ABS Box 2006 | £3.35 (C) |
| LH63T | ABS Console M1005 | £2.64 (C) |
| LH64U | ABS Console M1006 | £4.25 (C) |
| YK24B | Calc-Style Verobox | £4.45 (C) |

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| | | |
|---|---|---|
| LH65V | ABS Console M6005 | £2.96 (C) |
| LH66W | ABS Console M6006 | £3.82 (C) |
| LH67X | ABS Console M6007 | £5.20 (B) |
| LH68Y | ABS Console M8005 | £4.55 (C) |
| LH69A | ABS Console M8007 | £6.85 (B) |
| YR72P | Pcb Guide Adaptor | 6p (H) |
| WY00A | Metal Panel Bx M4003 | £1.62 (D) |
| WY01B | Metal Panel Bx M4004 | £1.98 (D) |
| WY02C | Metal Panel Bx M4005 | £2.88 (C) |
| LH09K | Foot Sw Box | £3.95 (C) |
| YK26D | Pedal Switch Box | £5.95 (B) |
| LF03D | Box PB301 | £1.85 (D) |
| HY25C | Display Box | £1.25 (D) |

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| | | |
|---|---|---|
| HQ47B | Tilt Leg Large | £1.55 (D) |
| LH00A | Verobox 101 | £4.36 (C) |
| LH01B | Verobox 102 | £4.92 (C) |
| LL00A | Verobox 103 | £6.52 (B) |
| LL01B | Verobox 104 | £14.62 (A) |
| †LL02C | Verobox 105 | £6.39 (B) |
| LL03D | Verobox 106 | £3.25 (C) |
| LL04E | Verobox 107 | £3.86 (C) |
| LL05F | Verobox 201 | £7.32 (B) |
| LL06G | Verobox 202 | £8.10 (B) |
| LL07H | Verobox 203 | £10.54 (A) |
| LL08J | Verobox 211 | £4.35 (C) |
| LL09K | Verobox 212 | £4.85 (C) |
| LL10L | Verobox 213 | £5.49 (B) |
| LQ07H | Verobox 214 | £6.39 (B) |
| LQ08J | Verobox 215 | £6.98 (B) |
| LQ09K | Verobox 216 | £7.49 (B) |
| LL11M | Verobox 217 | £7.37 (B) |
| LH24B | Verobox 221 | £3.75 (C) |
| LH25C | Verobox 222 | £4.95 (C) |
| LH26D | Verobox 223 | £5.10 (B) |
| LL12N | Verobox 301 | 86p (E) |
| LL13P | Verobox 302 | 89p (E) |
| LH50E | Verobox 303 | £1.45 (D) |
| LH51F | Verobox 305 | £2.45 (C) |
| LL14Q | Verobox 401 | £1.10 (D) |
| XB88V | Verocase 501 | £13.86 (A) |
| XB89W | Verocase 502 | £29.95 (A) |
| XY15R | Verobox 503 | £13.95 (A) |
| LQ03D | Flip-Top Box 601 Blk | £3.72 (C) |
| LQ05F | Flip-Top Box 602 Blk | £5.25 (B) |
| LH27E | Verobox 701 | £5.96 (B) |
| LH28F | Verobox 702 | £6.10 (B) |
| LH30H | Verobox 705 | £7.25 (B) |

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| | | |
|---|---|---|
| LF08J | Box AB7 | £1.25 (D) |
| LF09K | Box AB8 | £1.25 (D) |
| LF10L | Box AB9 | £1.15 (D) |
| LF11M | Box AB10 | £1.35 (D) |
| LF12N | Box AB11 | £1.25 (D) |
| LF13P | Box AB12 | 90p (E) |
| LF14Q | Box AB13 | £1.65 (D) |
| XB71N | Box AB15 | £3.25 (C) |
| LF15R | Box AB23 | £1.65 (D) |
| LF16S | Box AB24 | £1.75 (D) |
| LH10L | Box AB28 | £1.50 (D) |
| XB69A | Box AB31 | £2.25 (C) |
| XB56L | Chassis AC64 | £2.10 (C) |
| XB68Y | Chassis AC86 | £3.25 (C) |
| LF02C | Case WB1 Vinyl | £1.99 (D) |
| LH37S | Case WB2 Vinyl | £3.06 (C) |
| LH38R | Case WB3 Vinyl | £3.54 (C) |
| LH39N | Case WB4 Vinyl | £4.26 (C) |
| LH40T | Case WB5 Vinyl | £6.20 (B) |
| LH41U | Case WB6 Vinyl | £6.55 (B) |
| LH42V | Case WB7 Vinyl | £7.85 (B) |
| LH43W | Case TP1 Teak | £2.20 (C) |
| LH44X | Case TP2 Teak | £3.24 (C) |
| LH45Y | Case TP3 Teak | £3.55 (C) |
| LH46A | Case TP4 Teak | £4.20 (C) |
| LH47B | Case TP5 Teak | £5.62 (B) |
| LH48C | Case TP6 Teak | £7.22 (B) |
| LH70M | Box DCM5002 | £2.62 (C) |
| LH71N | Box DCM5004 | £3.54 (C) |
| LH72P | Box DCM5007 | £4.64 (C) |
| LH73Q | Box DCM5005 | £4.64 (C) |
| LH74R | Box DCM5006 | £6.36 (B) |
| XQ08J | G Range 2A | £10.95 (A) |
| XQ09K | G Range 3G | £14.40 (A) |
| XQ10L | G Range 4B | £21.95 (A) |

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| | | |
|---|---|---|
| YK41U | Instrument Case NM1 | £10.50 (A) |

| 1983 Catalogue Page No. | | VAT inclusive PRICE |
|---|---|---|
| YK42V | Instrument Case NM2 | £11.95 (A) |
| YK43W | Instrument Case NM3 | £12.90 (A) |
| YK44X | Instrument Case NM4 | £14.50 (A) |
| YK45Y | Instrument Case NM5 | £14.90 (A) |
| YK46A | Instrument Case NM6 | £10.90 (A) |
| YK47B | Instrument Case NM7 | £13.50 (A) |
| XY59P | Console 103 | £10.95 (A) |
| XY60Q | Console 108 | £16.45 (A) |
| XB73Q | Blue Case 227 | £4.55 (C) |
| XY40T | Blue Case 230 | £4.95 (C) |
| XY41U | Blue Case 235 | £5.40 (B) |
| XY42V | Blue Case 209 | £4.65 (C) |
| XY43W | Blue Case 212 | £5.35 (B) |
| XY44X | Blue Case 231 | £5.95 (B) |
| XB67X | Blue Case 236 | £6.45 (B) |
| XY45Y | Blue Case 222 | £5.85 (B) |
| XY46A | Blue Case 226 | £6.85 (B) |
| XB70M | Blue Case 232 | £6.45 (B) |
| XY47B | Blue Case 237 | £7.90 (B) |
| XY48C | Blue Case 233 | £7.70 (B) |
| XY49D | Blue Case 238 | £9.80 (B) |
| †XY52G | Wood-End Case 645 | £12.30 (A) |
| †XY56L | Wood-End Case 1426 | £13.95 (A) |
| XY57M | Wood-End Case 1437 | £19.92 (A) |
| XY58N | Wood-End Case 1449 | £24.20 (A) |

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| | | |
|---|---|---|
| FW19V | Feet Cab | 8p (H) |
| FW38R | Stick-on Feet | 18p (G) |
| FW39N | HD Feet | 10p (G) |
| HH23A | Recess Plate | 8p (H) |
| YR54J | Eurocard Guide | 29p (F) |
| YR55K | Mod Int Card Guide | 23p (G) |
| YR53H | PCB Brackets | 50p (E) |
| FX96E | Castors | £2.75 (C) |
| FX05F | Castor Cup | 49p (F) |
| XY31J | Piano Legs | £24.50 (A) |
| FX06G | Cool Grille | 35p (F) |
| †FX03D | Inst Handle PLastic | 59p (E) |
| BK29G | HD Strap † Recess | £2.95 (C) |
| FW81C | Handle | 64p (E) |
| FX00A | Inst Handle Small | £2.68 (C) |
| FX01B | Inst Handle Large | £3.20 (C) |
| FX02C | Ferrule | 34p (F) |

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| | | |
|---|---|---|
| FW82D | HD Strap Handle | £1.55 (D) |
| LH08J | Recess Handle | 43p (F) |
| LH11M | Heavy Duty Handle | £2.94 (C) |
| YL05F | Flip Handle | £4.95 (C) |
| YX00A | Cab Corners Small | 20p (G) |
| FX04E | Cab Corner Large | 12p (G) |
| FX94C | Corner Two-Side | 29p (F) |
| FX95D | Corner Three-Side | 36p (F) |
| BK25C | Cab Corner/Foot Lge | 62p (E) |
| BK26D | Cab Corner/Foot Sm | 40p (F) |
| HB20W | Flexihinge | 8p (H) |
| YL24B | Small Hinge | £1.55 (D) |
| YL04E | Lift off Hinge | £1.85 (D) |
| YL25C | Lockable Catch | £1.94 (D) |
| YL06G | Butterfly Catch | £4.79 (C) |

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| | | |
|---|---|---|
| XY17T | Laminate Japan Teak | £3.75 (C) |
| XY18U | Laminate Penang W/Nu | £3.75 (C) |
| XY19V | Laminate Alum Small | £1.59 (D) |
| XY20W | Laminate Alum Large | £2.11 (C) |
| RY06G | Acoustic Wadding | 65p (E) |
| RY00A | Black Tygan 45in. | £1.96 (D) |
| RY01B | Black Tygan 22.1/2in | 98p (E) |
| RY02C | Brown Tygan 45in. | £1.96 (D) |
| RY03D | Brown Tygan 22.1/2in | 98p (E) |
| RY04E | Covering Cloth 50in. | £1.06 (D) |
| RY05F | Covering Cloth 25in. | 53p (E) |

## CABLES

### Page 75

| | | |
|---|---|---|
| BL77J | Wire-Wrap Black | £1.85 (G) |
| BL82D | Wire-Wrap Red | £1.85 (G) |
| BL83E | Wire-Wrap White | £1.85 (G) |
| BL85G | Bell Wire Black | 50p (H) |
| BL86T | Bell Wire Blue | 50p (H) |
| BL87U | Bell Wire Brown | 50p (H) |
| BL88V | Bell Wire Green | 50p (H) |
| BL89W | Bell Wire Grey | 62p (H) |
| BL90X | Bell Wire Orange | 62p (H) |
| BL91Y | Bell Wire Pink | 62p (H) |
| BL92A | Bell Wire Red | 62p (H) |
| BL93B | Bell Wire Violet | 62p (H) |
| BL94C | Bell Wire White | 62p (H) |
| BL95D | Bell Wire Yellow | 62p (H) |
| BL46A | L/C Wire Black | £1.25 (H) |
| BL47B | L/C Wire Blue | £1.25 (H) |
| BL48C | L/C Wire Brown | £1.25 (H) |
| BL49D | L/C Wire Green | £1.25 (H) |
| BL50E | L/C Wire Grey | £1.25 (H) |
| BL51F | L/C Wire Orange | £1.25 (H) |
| BL52G | L/C Wire Pink | £1.25 (H) |
| BL53H | L/C Wire Red | £1.25 (H) |
| BL54J | L/C Wire Violet | £1.25 (H) |
| BL55K | L/C Wire White | £1.25 (H) |
| BL56L | L/C Wire Yellow | £1.25 (H) |
| BL00A | Wire 10M Black | 35p (H) |
| BL01B | Wire 10M Blue | 35p (H) |
| BL02C | Wire 10M Brown | 35p (H) |
| BL03D | Wire 10M Green | 35p (H) |
| BL04E | Wire 10M Grey | 35p (H) |
| BL05F | Wire 10M Orange | 35p (H) |
| BL06G | Wire 10M Pink | 35p (H) |
| BL07H | Wire 10M Red | 35p (H) |
| BL08J | Wire 10M Violet | 35p (H) |
| BL09K | Wire 10M White | 35p (H) |
| BL10L | Wire 10M Yellow | 35p (H) |
| XL10L | Wire 11C | £3.75 |
| YR00A | Bicol Green/Red | 34p (H) |
| YR01B | Bicol Green/Yellow | 34p (H) |
| YR04E | Bicol Orange/Black | 34p (H) |
| YR05F | Bicol Orange/Red | 34p (H) |
| YR06G | Bicol Pink/Black | 34p (H) |
| YR07H | Bicol Purple/Red | 34p (H) |
| YR08J | Bicol Red/Black | 34p (H) |
| YR09K | Bicol Red/Blue | 34p (H) |
| YR12N | Bicol White/Black | 34p (H) |
| YR14Q | Bicol Yellow/Black | 34p (H) |
| YR16S | Bicol Yellow/Red | 34p (H) |
| XR32K | Wire 3202 Black | 17p (G) |
| XR33L | Wire 3202 Blue | 17p (G) |
| XR34M | Wire 3202 Brown | 17p (G) |
| XR35Q | Wire 3202 Green | 17p (G) |
| XR36P | Wire 3202 Red | 17p (G) |
| XR37S | Wire 3202 White | 17p (G) |
| XR38R | Wire 3202 Grn/Yllw | 17p (G) |

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| | | |
|---|---|---|
| XR57M | HC Wire Black | 38p (G) |
| XR58N | HC Wire Green | 38p (G) |
| XR59P | HC Wire Red | 38p (G) |
| XR40T | Extra Flex Black | 20p (G) |
| XR41U | Extra Flex Blue | 20p (G) |

**TRADE QUANTITIES**

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. See table at start of price list. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity.

Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.

| 1983 Catalogue Page No. | | VAT inclusive PRICE |
|---|---|---|
| XR43W | Extra Flex Green | 20p (G) |
| XR44X | Extra Flex Red | 20p (G) |
| XR45Y | Extra Flex Yellow | 20p (G) |
| XR68Y | Min Extra Flex Black | 15p (G) |
| XR69A | Min Extra Flex Red | 15p (G) |
| XR22Y | EHT Wire | 32p (G) |
| BL11M | Strappg Wire 16swg | 82p (E) |
| BL12N | Strappg Wire 18swg | 87p (E) |
| BL13P | Strappg Wire 20swg | 95p (E) |
| BL14Q | Strappg Wire 22swg | 94p (E) |
| BL15R | Strappg Wire 24swg | 96p (E) |
| BL16S | EC Wire 14 swg | 70p (E) |
| BL24B | EC Wire 16 swg | 79p (E) |
| BL25C | EC Wire 18 swg | 88p (E) |
| BL26D | EC Wire 20 swg | 89p (E) |
| BL27E | EC Wire 22 swg | 93p (E) |
| BL28F | EC Wire 24 swg | £1.05 (D) |
| BL29G | EC Wire 26 swg | £1.07 (D) |
| BL39N | EC Wire 28 swg | £1.07 (D) |
| BL40T | EC Wire 30 swg | £1.10 (D) |
| BL41U | EC Wire 32 swg | £1.12 (D) |
| BL42V | EC Wire 34 swg | £1.16 (D) |
| BL43W | EC Wire 36 swg | £1.25 (D) |
| BL44X | EC Wire 38 swg | £1.25 (D) |
| BL60Q | EC Wire 40 swg | £1.50 (D) |
| BL61R | EC Wire 42 swg | £1.49 (D) |
| BL62S | EC Wire 44 swg | £2.20 (C) |
| BL63T | EC Wire 48 swg | £4.95 (C) |
| XR39N | Zi Wire | 14p (G) |
| XR60Q | HS Loudspeaker Cable | 36p (G) |
| YG08J | Litz Speaker Leads | £8.99 (B) |
| XR06G | Ribbon Cable 10-Way | 60p |
| XR07H | Ribbon Cable 20-Way | £1.20 |
| XR67X | Ribbon Cable 30 Way | £1.80 (D) |

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| | | |
|---|---|---|
| XR65V | IDC Cable 12-Way | £2.11 |
| RK30H | Flexicable 7-way | 54p (G) |
| RK31J | Flexicable 10-way | 65p (G) |
| XR47B | Twin Mains DS Black | 28p (G) |
| XR00A | Twin Mains DS White | 18p (G) |
| XR61R | Twin 6A Mains Orange | 49p (E) |
| XR62S | Twin 6A Mains White | 49p (E) |
| XR01B | Min Mains Black | 35p (E) |
| XR02C | Min Mains White | 36p (E) |
| XR03D | C6A Mains Black | 56p (E) |
| XR04E | C6A Mains White | 56p (E) |
| XR05F | C6A Mains Orange | 70p (E) |
| XR09K | HD Mains Black | 89p (E) |
| XR10L | HD Mains White | 80p (E) |
| XR11M | HD Mains Orange | 90p (E) |
| XR24B | Cotton Mains | 94p (E) |
| BL71N | Stretchflex 1A | £1.05 (D) |
| BL72P | Stretchflex 6A | £4.95 (C) |

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| | | |
|---|---|---|
| XR48C | 4-Core Mains | £1.05 (E) |
| XR49D | 1.0mm TE Cable | 43p (E) |
| XR50E | 1.5mm TE Cable | 48p (E) |
| XR51F | 2.5mm TE Cable | 65p (E) |
| XR52G | 6mm TE Cable | £1.75 (E) |
| XR53H | 1mm Trpl & ECC Cbl | 74p (E) |
| XR15R | Min Screened | 15p (G) |
| XR12N | Cable Single Black | 19p (G) |
| XR13P | Cable Single Grey | 19p (G) |
| XR14Q | Cable Single White | 19p (G) |

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| | | |
|---|---|---|
| XR16S | Single Mic Cable | 42p (G) |
| XR18U | Low Noise Scnd | 42p (G) |
| XR19V | Low C Cable | 55p (G) |
| XR63T | UR67 RF Cable | £1.95 (D) |
| XR08J | Twin Mic Cable | 82p (E) |
| XR20W | Lapped Pair | 21p (G) |
| XR21X | Cable Twin | 29p (G) |
| XR23A | Cable Quad | 38p (G) |

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| | | |
|---|---|---|
| XR25C | Multi-Core 4-Way | 60p (E) |
| XR26D | Multi-Core 6-Way | 65p (E) |
| XR27E | Multi-Core 9-Way | 86p (E) |
| XR28F | Multi-Core 15-Way | £1.25 (E) |
| XR46A | Multi-Core 25-Way | £1.74 (E) |
| XR54J | Multi-Core 36-Way | £2.31 (E) |
| XR66W | 4-Wire Phone Cable | 21p (G) |
| XR55K | 7-Core Trailer Cable | £1.19 (E) |
| BH30H | Scr Strtchflx Blck | £1.80 (D) |
| BH31J | Scr Strtchflx Blue | £1.65 (D) |
| BH34M | Scr Stretchflex Red | £1.80 (D) |
| HQ49D | Twin Stretchflex | £2.40 (C) |
| XR30H | Standard Co-Ax | 48p (G) |
| XR29G | Low Loss Co-Ax | 50p (G) |

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| | | |
|---|---|---|
| XR31J | Bal Feeder | 19p (G) |
| YR19V | Marker A0 | 12p (G) |
| YR20W | Marker A1 | 12p (G) |
| YR21X | Marker A2 | 12p (G) |
| YR22Y | Marker A3 | 12p (G) |
| YR23A | Marker A4 | 12p (G) |
| YR24B | Marker A5 | 12p (G) |
| YR25C | Marker A6 | 12p (G) |
| YR26D | Marker A7 | 12p (G) |
| YR27E | Marker A8 | 12p (G) |
| YR28F | Marker A9 | 12p (G) |
| YR29G | Marker B0 | 12p (G) |
| YR30H | Marker B1 | 12p (G) |
| YR31J | Marker B2 | 12p (G) |
| YR32K | Marker B3 | 12p (G) |
| YR33L | Marker B4 | 12p (G) |
| YR34M | Marker B5 | 12p (G) |
| YR35Q | Marker B6 | 12p (G) |
| YR36P | Marker B7 | 12p (G) |
| YR37S | Marker B8 | 12p (G) |
| YR38R | Marker B9 | 12p (G) |
| YR39N | Marker C0 | 12p (G) |
| YR40T | Marker C1 | 12p (G) |
| YR41U | Marker C2 | 12p (G) |
| YR42V | Marker C3 | 12p (G) |
| YR43W | Marker C4 | 12p (G) |
| YR44X | Marker C5 | 12p (G) |
| YR45Y | Marker C6 | 12p (G) |
| YR46A | Marker C7 | 12p (G) |
| YR47B | Marker C8 | 12p (G) |
| YR48C | Marker C9 | 12p (G) |
| BF86T | Heat Shrink CP 16 | 55p (E) |
| BF87U | Heat Shrink CP 24 | 65p (E) |
| BF88V | Heat Shrink CP 32 | 30p (F) |
| BF89W | Heat Shrink CP 48 | 32p (F) |
| BF90X | Heat Shrink CP 64 | 34p (F) |
| YR17T | Heat Shrink CP95 | 50p (E) |
| YR18U | Heat Shrink CP127 | £1.10 (E) |
| BL66W | Ht-Resist Sleeve Blk | 12p (G) |
| BL69A | Ht-Resist Sleeve Grn | 12p (G) |
| BL70M | Ht-Resist Sleeve Red | 12p (G) |
| BH00A | Systoflex 1mm Black | 6p (H) |
| BH01B | Systoflex 1mm Blue | 6p (H) |
| BH02C | Systoflex 1mm Green | 6p (H) |
| BH03D | Systoflex 1mm Red | 6p (H) |
| BH04E | Systoflex 1mm White | 6p (H) |

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| BH05F | Systoflex 1mm Yellow | 6p (H) |
| BH06G | Systoflex 2mm Black | 9p (H) |
| BH07H | Systoflex 2mm Blue | 9p (H) |
| BH08J | Systoflex 2mm Green | 9p (H) |
| BH09K | Systoflex 2mm Red | 9p (H) |
| BH10L | Systoflex 2mm White | 11p (H) |
| BH11M | Systoflex 2mm Yellow | 9p (H) |
| BH12N | Systoflex 4mm Black | 15p (H) |
| BH13P | Systoflex 4mm Blue | 15p (H) |
| BH14Q | Systoflex 4mm Green | 15p (H) |
| BH15R | Systoflex 4mm Red | 15p (H) |
| BH16S | Systoflex 4mm White | 15p (H) |
| BH17T | Systoflex 4mm Yellow | 15p (H) |
| BH42V | Systoflex 6mm Black | 17p (H) |
| BH43W | Systoflex 10mm Black | 24p (H) |
| BL65V | Lacing Cord | £1.10 (H) |
| BL57M | Spirawrap 1/8in. | 18p (G) |
| BL58N | Spirawrap 1/4in. | 21p (F) |
| BL59P | Spirawrap 1/2in. | 46p (F) |

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| | | |
|---|---|---|
| BF91Y | Tie-Wrap 92 | 2p (H) |
| BF92A | Tie-Wrap 140 | 3p (H) |
| BF93B | Tie-Wrap 186 | 4p (H) |
| BF94C | Cable Tie Base | 19p (G) |
| RK59P | Re-Usable Cable Tie | 2p (H) |
| BH26D | Safix 4 | 12p (G) |
| BH27E | Safix 8 | 10p (G) |
| BH28F | Safix 12 | 14p (G) |
| LR44X | Cable P Clip 3/16in. | 3p (H) |
| LR45Y | Cable P Clip 1/4in. | 3p (H) |
| LR46A | Cable P Clip 5/16in. | 3p (H) |
| LR04E | Cable P Clip 3/8in. | 3p (H) |
| BH18U | Hiatt Rd 2.3/4mm | 23p (G) |
| BH19V | Hiatt Rd 3.1/2mm | 29p (F) |
| BH20W | Hiatt Rd 4mm | 24p (F) |
| BH21X | Hiatt Rd 5mm | 29p (F) |
| BH22Y | Hiatt Rd 6mm | 25p (F) |
| BH23A | Hiatt Rd 7mm | 32p (F) |
| BH24B | Hiatt Rd 8mm | 29p (F) |
| BH36P | Hiatt Rd 9mm | 37p (F) |
| BH25C | Hiatt Flat 4mm | 20p (G) |
| BH37S | Hiatt Flat 5mm | 25p (F) |
| BH38R | Hiatt Flat 7mm | 29p (F) |
| BH39N | Hiatt Flat 9mm | 32p (F) |
| BH40T | Hiatt Flat 10mm | 34p (F) |
| BH41U | Hiatt Flat 14mm | 40p (F) |

## CAPACITORS

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| | | |
|---|---|---|
| WX35Q | Ceramic 1.8 | 6p (H) |
| WX36P | Ceramic 2.2 | 6p (H) |
| WX37S | Ceramic 2.7 | 6p (H) |
| WX38R | Ceramic 3.3 | 6p (H) |
| WX39N | Ceramic 3.9 | 6p (H) |
| WX40T | Ceramic 4.7 | 6p (H) |
| WX41U | Ceramic 5.6 | 6p (E) |
| WX42V | Ceramic 6.8 | 6p (H) |
| WX43W | Ceramic 8.2 | 6p (H) |
| WX44X | Ceramic 10 | 6p (H) |
| WX45Y | Ceramic 12 | 6p (H) |
| WX46A | Ceramic 15 | 6p (H) |
| WX47B | Ceramic 18 | 6p (H) |
| WX48C | Ceramic 22 | 6p (H) |
| WX49D | Ceramic 27 | 6p (H) |
| WX50E | Ceramic 33 | 6p (H) |
| WX51F | Ceramic 39 | 6p (H) |
| WX52G | Ceramic 47 | 6p (H) |
| WX53H | Ceramic 56 | 6p (H) |
| WX54J | Ceramic 68 | 6p (H) |
| WX55K | Ceramic 82 | 6p (H) |
| WX56L | Ceramic 100 | 6p (H) |
| WX57M | Ceramic 120 | 6p (H) |
| WX58N | Ceramic 150 | 6p (H) |
| WX59P | Ceramic 180 | 6p (H) |
| WX60Q | Ceramic 220 | 6p (H) |
| WX61R | Ceramic 270 | 6p (H) |
| WX62S | Ceramic 330 | 6p (H) |
| WX63T | Ceramic 390 | 6p (H) |
| WX64U | Ceramic 470 | 6p (H) |
| WX65V | Ceramic 560 | 6p (H) |
| WX66W | Ceramic 680 | 6p (H) |
| WX67X | Ceramic 820 | 6p (H) |
| WX68Y | Ceramic 1000 | 6p (H) |
| WX69A | Ceramic 1200 | 6p (H) |
| WX70M | Ceramic 1500 | 7p (H) |
| WX71N | Ceramic 1800 | 6p (H) |
| WX72P | Ceramic 2200 | 6p (H) |
| WX73Q | Ceramic 2700 | 6p (H) |
| WX74R | Ceramic 3300 | 6p (H) |
| WX75S | Ceramic 3900 | 6p (H) |
| WX76H | Ceramic 4700 | 6p (H) |
| WX77J | Ceramic 10,000 | 6p (H) |
| WX78K | Ceramic 22,000 | 6p (H) |
| YY24B | Monocap 0.01uF | 28p (F) |
| YY25C | Monocap 0.0022uF | 28p (F) |
| YY07H | Monocap 0.0047uF | 28p (F) |
| YY08J | Monocap 0.01uF | 28p (F) |
| YY09K | Monocap 0.022uF | 29p (F) |
| YY10L | Monocap 0.047uF | 28p (F) |
| YY11M | Monocap 0.1uF | 43p (F) |
| YR73Q | Minidisc 0.01uF | 5p (H) |
| YR74R | Minidisc 0.047uF | 5p (H) |
| YR75S | Minidisc 0.1uF | 7p (H) |
| YR76H | Minidisc 0.47uF | 15p (G) |
| BX00A | Disc 0.01uF | 10p (G) |
| BX01B | Disc 0.022uF | 10p (G) |
| BX02C | Disc 0.047uF | 12p (G) |
| BX03D | Disc 0.1uF | 12p (G) |

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| | | |
|---|---|---|
| BX05F | HV Disc 10 | 14p (G) |
| BX06G | HV Disc 47 | 19p (G) |
| BX07H | HV Disc 100 | 22p (G) |
| BX10L | HV Disc 470 | 11p (G) |
| BX12N | HV Disc 1000 | 11p (G) |
| BX13P | HV Disc 2200 | 11p (G) |
| BX14Q | HV Disc 4700 | 22p (G) |
| BX15R | HV Disc 10,000 | 19p (G) |
| HY18U | 1000V Disc 4700pF | 26p (F) |
| BX16S | Feed Thro Cap | 8p (H) |
| WX02C | Mica 5pF | 27p |
| WX03D | Mica 10pF | 27p |
| WX05F | Mica 22pF | 27p |
| WX07H | Mica 33pF | 28p |
| WX09K | Mica 47pF | 28p |
| WX11M | Mica 68pF | 28p |
| WX12N | Mica 82pF | 28p |
| WX13P | Mica 100pF | 28p |
| WX14Q | Mica 120pF | 28p |
| WX15R | Mica 150pF | 28p |
| WX16S | Mica 180pF | 28p |
| WX17T | Mica 220pF | 28p |
| WX19V | Mica 330pF | 49p |
| WX21X | Mica 470pF | 49p |
| WX23A | Mica 680pF | 51p |
| WX25C | Mica 1000pF | 56p |
| WX31J | Mica 4700pF | £1.25 |
| BX24B | Polystyrene 22 | 13p (G) |

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| BX25C | Polystyrene 33 | 8p (H) |
| BX26D | Polystyrene 47 | 8p (H) |
| BX27E | Polystyrene 68 | 8p (H) |
| BX28F | Polystyrene 100 | 8p (H) |
| BX29G | Polystyrene 150 | 8p (H) |
| BX30H | Polystyrene 220 | 8p (H) |
| BX31J | Polystyrene 330 | 8p (H) |
| BX32K | Polystyrene 470 | 8p (H) |
| BX33L | Polystyrene 560 | 8p (H) |
| BX34M | Polystyrene 680 | 8p (H) |
| BX35Q | Polystyrene 1000 | 8p (H) |
| BX36P | Polystyrene 1500 | 8p (H) |
| BX37S | Polystyrene 2200 | 8p (H) |
| BX38R | Polystyrene 3300 | 8p (H) |
| BX39N | Polystyrene 4700 | 8p (H) |
| BX40T | Polystyrene 5600 | 10p (G) |
| BX41U | Polystyrene 6800 | 10p (G) |
| BX92A | Polystyrene 10,000 | 14p (G) |
| BX93B | Polystyrene 22,000 | 19p (G) |
| BX94C | Polystyrene 47,000 | 25p (F) |
| BX95D | Polystyrene 100,000 | 49p (F) |

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| | | |
|---|---|---|
| BX46A | 1% Polysty 100 | 27p (F) |
| BX47B | 1% Polysty 150 | 27p (F) |
| BX50E | 1% Polysty 270 | 29p (F) |
| BX51F | 1% Polysty 330 | 29p (F) |
| BX52G | 1% Polysty 390 | 29p (F) |
| BX53H | 1% Polysty 470 | 29p (F) |
| BX54J | 1% Polysty 560 | 29p (F) |
| BX55K | 1% Polysty 750 | 29p (F) |
| BX56L | 1% Polysty 1000 | 29p (F) |
| BX57M | 1% Polysty 1200 | 29p (F) |
| BX58N | 1% Polysty 1500 | 29p (F) |
| BX59P | 1% Polysty 1800 | 29p (F) |
| BX60Q | 1% Polysty 2200 | 29p (F) |
| BX61R | 1% Polysty 2700 | 29p (F) |
| BX62S | 1% Polysty 3300 | 29p (F) |
| BX63T | 1% Polysty 3900 | 29p (F) |
| BX64U | 1% Polysty 4700 | 37p (F) |
| BX65V | 1% Polysty 5600 | 37p (F) |
| BX66W | 1% Polysty 6800 | 37p (F) |
| BX85G | 1% Polysty 8200 | 37p (F) |
| BX86T | 1% Polysty 10,000 | 37p (F) |
| BX87U | 1% Polysty 22,000 | 48p (F) |
| WW22Y | Carbonate 0.001 | 9p (H) |
| WW23A | Carbonate 0.0015 | 9p (H) |
| WW24B | Carbonate 0.0022 | 9p (H) |
| WW25C | Carbonate 0.0033 | 9p (H) |
| WW26D | Carbonate 0.0047 | 9p (H) |
| WW27E | Carbonate 0.0068 | 9p (H) |
| WW28F | Carbonate 0.0082 | 9p (H) |
| WW29G | Carbonate 0.01 | 9p (H) |
| WW30H | Carbonate 0.012 | 9p (H) |
| WW31J | Carbonate 0.015 | 9p (H) |
| WW32K | Carbonate 0.018 | 9p (H) |
| WW33L | Carbonate 0.022 | 10p (G) |
| WW34M | Carbonate 0.027 | 11p (G) |
| WW35Q | Carbonate 0.033 | 11p (G) |
| WW36P | Carbonate 0.039 | 11p (G) |
| WW37S | Carbonate 0.047 | 11p (G) |
| WW38R | Carbonate 0.056 | 14p (G) |
| WW39N | Carbonate 0.068 | 12p (G) |
| WW40T | Carbonate 0.082 | 14p (G) |
| WW41U | Carbonate 0.1 | 11p (G) |
| WW42V | Carbonate 0.12 | 11p (G) |
| WW43W | Carbonate 0.15 | 14p (G) |
| WW44X | Carbonate 0.18 | 14p (G) |
| WW45Y | Carbonate 0.22 | 16p (G) |
| WW46A | Carbonate 0.27 | 16p (G) |
| WW47B | Carbonate 0.33 | 22p (G) |
| WW48C | Carbonate 0.39 | 22p (G) |
| WW49D | Carbonate 0.47 | 25p (F) |
| WW50E | Carbonate 0.56 | 27p (F) |
| WW51F | Carbonate 0.68 | 36p (F) |
| WW52G | Carbonate 0.82 | 38p (F) |
| WW53H | Carbonate 1 | 42p (F) |
| BX70M | Polyester 0.01uF | 8p (H) |
| BX71N | Polyester 0.015uF | 8p (H) |
| BX72P | Polyester 0.022uF | 8p (H) |
| BX73Q | Polyester 0.033uF | 9p (H) |
| BX74R | Polyester 0.047uF | 9p (H) |
| BX75S | Polyester 0.068uF | 9p (H) |
| BX76H | Polyester 0.1uF | 9p (H) |
| BX77J | Polyester 0.15uF | 15p (G) |
| BX78K | Polyester 0.22uF | 13p (G) |
| BX79L | Polyester 0.33uF | 18p (G) |
| BX80B | Polyester 0.47uF | 21p (G) |
| BX81C | Polyester 0.68uF | 34p (F) |
| BX82D | Polyester 1uF | 38p (F) |
| BX83E | Polyester 1.5uF | 56p (E) |
| BX84F | Polyester 2.2uF | 64p (E) |

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| | | |
|---|---|---|
| WW15R | Mylar 0.001 | 5p (H) |
| WW16S | Mylar 0.0022 | 5p (H) |
| WW17T | Mylar 0.0047 | 5p (H) |
| WW18U | Mylar 0.01 | 6p (H) |
| WW19V | Mylar 0.022 | 6p (H) |
| WW20W | Mylar 0.047 | 8p (H) |
| WW21X | Mylar 0.1 | 10p (G) |
| WW83E | Mylar 0.22 | 16p (G) |
| FF53H | IS Cap 0.01uF | 23p (G) |
| FF54J | IS Cap 0.022uF | 25p (F) |
| FF55K | IS Cap 0.047uF | 25p (F) |
| FF56L | IS Cap 0.1uF | 41p (F) |
| FF57M | IS Cap 0.22uF | 45p (F) |
| FF58N | IS Cap 0.47uF | 78p (E) |
| YY29G | Minelect 0.1uF 50V | 13p (G) |
| YY30H | Minelect 0.47uF 50V | 13p (G) |
| YY31J | Minelect 1uF 50V | 14p (G) |
| YY32K | Minelect 2.2uF 50V | 15p (G) |
| YY33L | Minelect 4.7uF 35V | 21p (G) |
| YY34M | Minelect 10uF 16V | 13p (G) |
| YY35Q | Minelect 10uF 40V | 16p (G) |
| YY36P | Minelect 22uF 16V | 18p (G) |
| YY37S | Minelect 47uF 16V | 22p (G) |
| RK50E | Minelect 100uF 6.3V | 22p (G) |
| WW54J | Tant 0.1uF 35V | 13p (G) |
| WW55K | Tant 0.15uF 35V | 13p (G) |
| WW56L | Tant 0.22uF 35V | 16p (G) |
| WW57M | Tant 0.33uF 35V | 18p (G) |
| WW58N | Tant 0.47uF 35V | 17p (G) |
| WW59P | Tant 0.68uF 35V | 17p (G) |
| WW60Q | Tant 1.0uF 35V | 18p (G) |
| WW61R | Tant 1.5uF 35V | 18p (G) |
| WW62S | Tant 2.2uF 35V | 23p (G) |
| WW63T | Tant 3.3uF 35V | 19p (G) |
| WW64U | Tant 4.7uF 16V | 18p (G) |
| WW65V | Tant 4.7uF 35V | 19p (G) |
| WW66W | Tant 6.8uF 16V | 21p (G) |
| WW67X | Tant 6.8uF 35V | 24p (F) |
| WW68Y | Tant 10uF 16V | 25p (F) |
| WW69A | Tant 10uF 25V | 28p (F) |
| WW70M | Tant 10uF 35V | 36p (F) |
| WW72P | Tant 22uF 16V | 39p (F) |
| WW73Q | Tant 22uF 25V | 65p (E) |
| WW74R | Tant 33uF 10V | 32p (F) |
| WW75S | Tant 47uF 10V | 57p (E) |
| WW76H | Tant 47uF 16V | 75p (E) |
| WW78K | Tant 100uF 3V | 35p (F) |
| WW79L | Tant 100uF 10V | £1.25 (D) |

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| | | |
|---|---|---|
| FF00A | PC Elect 0.47uF 100V | 11p (G) |
| FF01B | PC Elect 1uF 100V | 11p (G) |
| FF02C | PC Elect 2.2uF 63V | 10p (G) |
| FF03D | PC Elect 4.7uF 63V | 10p (G) |
| FF04E | PC Elect 10uF 35V | 10p (G) |
| FF05F | PC Elect 10uF 63V | 11p (G) |
| FF06G | PC Elect 22uF 16V | 10p (G) |
| FF07H | PC Elect 22uF 63V | 12p (G) |
| FF08J | PC Elect 47uF 25V | 12p (G) |
| FF09K | PC Elect 47uF 63V | 14p (G) |
| FF10L | PC Elect 100uF 10V | 10p (G) |
| FF11M | PC Elect 100uF 25V | 12p (G) |
| FF12N | PC Elect 100uF 63V | 22p (G) |
| FF13P | PC Elect 220uF 16V | 12p (G) |
| FF14Q | PC Elect 220uF 63V | 33p (F) |
| FF15R | PC Elect 470uF 16V | 20p (G) |
| FF16S | PC Elect 470uF 25V | 25p (F) |
| FF59P | PC Elect 470uF 63V | 56p (E) |
| FF17T | PC Elect 1000uF 16V | 27p (F) |
| FF18U | PC Elect 1000uF 25V | 33p (F) |
| FF60Q | PC Elect 2200uF 16V | 42p (F) |
| FB11M | Axial 0.47uF 250V | 21p (G) |
| FB12N | Axial 1uF 63V | 8p (H) |
| FB13P | Axial 1uF 450V | 25p (F) |
| FB14Q | Axial 1.5uF 63V | 10p (G) |
| FB15R | Axial 2.2uF 63V | 10p (G) |
| FB16S | Axial 2.2uF 450V | 30p (F) |
| FB17T | Axial 3.3uF 63V | 10p (G) |
| FB18U | Axial 4.7uF 63V | 12p (G) |
| FB19V | Axial 4.7uF 450V | 33p (F) |
| FB20W | Axial 6.8uF 40V | 15p (G) |
| FB21X | Axial 6.8uF 63V | 16p (G) |
| FB22Y | Axial 10uF 25V | 9p (H) |
| FB23A | Axial 10uF 63V | 11p (G) |
| FB24B | Axial 10uF 100V | 18p (G) |
| FB25C | Axial 10uF 450V | 45p (F) |
| FB26D | Axial 15uF 16V | 9p (H) |
| FB27E | Axial 15uF 40V | 11p (G) |
| FB28F | Axial 15uF 63V | 16p (G) |
| FB30H | Axial 22uF 25V | 11p (G) |
| FB31J | Axial 22uF 63V | 16p (G) |
| FB32K | AXial 22uF 100V | 24p (F) |
| FB33L | Axial 22uF 450V | 55p (E) |
| FB34M | Axial 33uF 6.3V | 10p (G) |
| FB35Q | Axial 33uF 16V | 11p (G) |
| FB36P | Axial 33uF 40V | 12p (G) |
| FB38R | Axial 47uF 10V | 10p (G) |
| FB39N | Axial 47uF 25V | 13p (G) |
| FB41U | Axial 47uF 63V | 17p (G) |
| FB42V | Axial 47uF 100V | 32p (F) |
| FB43W | Axial 47uF 450V | 85p (E) |
| FB44X | Axial 68uF 6.3V | 15p (G) |
| FB45Y | Axial 68uF 16V | 16p (G) |
| FB48C | Axial 100uF 10V | 11p (G) |
| FB49D | Axial 100uF 25V | 14p (G) |
| FB50E | Axial 100uF 40V | 18p (G) |
| FB51F | Axial 100uF 63V | 22p (G) |
| FB52G | Axial 100uF 100V | 52p (E) |
| FB53H | Axial 100uF 250V | 85p (E) |
| FB54J | Axial 150uF 6.3V | 21p (G) |
| FB56L | Axial 150uF 25V | 15p (G) |
| FB58N | Axial 150uF 63V | 32p (F) |
| FB60Q | Axial 220uF 10V | 12p (G) |
| FB61R | Axial 220uF 16V | 14p (G) |
| FB62S | Axial 220uF 25V | 18p (G) |
| FB63T | Axial 220uF 40V | 27p (F) |
| FB64U | Axial 220uF 63V | 32p (F) |
| FB65V | Axial 220uF 100V | 55p (E) |
| FB67X | Axial 330uF 10V | 14p (G) |
| FB68Y | Axial 330uF 25V | 20p (G) |
| FB69A | Axial 330uF 63V | 44p (F) |
| FB71N | Axial 470uF 10V | 22p (G) |
| FB72P | Axial 470uF 16V | 26p (F) |
| FB73Q | Axial 470uF 25V | 30p (F) |
| FB74R | Axial 470uF 63V | 55p (E) |
| FB75S | Axial 470uF 100V | 89p (E) |
| FB77J | Axial 680uF 16V | 30p (F) |
| FB78K | Axial 680uF 25V | 38p (F) |
| FB79L | Axial 680uF 40V | 68p (E) |
| FB80B | Axial 1000uF 6.3V | 29p (F) |
| FB81C | Axial 1000uF 10V | 25p (F) |
| FB82D | Axial 1000uF 16V | 32p (F) |
| FB83E | Axial 1000uF 25V | 40p (F) |
| FB84F | Axial 1000uF 63V | £1.00 (D) |
| FB85G | Axial 1500uF 6.3V | 32p (F) |
| FB86T | Axial 1500uF 10V | 38p (F) |
| FB87U | Axial 1500uF 16V | 42p (F) |
| FB89W | Axial 2200uF 10V | 40p (F) |
| FB90X | Axial 2200uF 25V | 57p (E) |
| FB91Y | Axial 2200uF 40V | 98p (E) |
| FB92A | Axial 2200uF 63V | £1.54 (D) |
| FB93B | Axial 3300uF 6.3V | 58p (E) |
| FB94C | Axial 3300uF 25V | 94p (E) |
| FB95D | Axial 4700uF 10V | 60p (E) |
| FB96E | Axial 4700uF 25V | £1.25 (D) |
| RK26D | Axial 4700uF 40V | £1.40 (D) |

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|---|---|---|
| FB97F | Reversolytic 1uF | 29p (F) |
| FB01B | Reversolytic 2.2uF | 36p (F) |
| FB02C | Reversolytic 3.3uF | 42p (F) |
| FB03D | Reversolytic 4.7uF | 46p (F) |
| FB06G | Reversolytic 10uF | 58p (E) |
| FB08J | Reversolytic 22uF | 68p (E) |
| FB09K | Reversolytic 33uF | 65p (E) |
| FB10L | Reversolytic 47uF | DIS |
| RK83E | Reversolytic 100u | 69p (E) |
| FF19V | Can 1000uF 100V | £1.86 (D) |
| FF20W | Can 1500uf 63V | £1.95 (D) |
| FF21X | Can 2200uF 40V | £1.86 (D) |
| FF22Y | Can 2200uF 63V | £3.25 (C) |
| FF24B | Can 3300uF 40V | £2.15 (C) |
| †FF25C | Can 3300uF 63V | £3.55 (C) |
| FF26D | Can 4700uF 25V | £1.45 (D) |
| FF27E | Can 4700uF 40V | £4.35 (C) |
| FF28F | Can 4700uF 63V | £3.85 (C) |
| FF29G | Can 4700uF 100V | £5.35 (B) |
| FF30H | Can 6800uf 40V | £4.85 (C) |
| FF31J | Can 10,000uF 25V | £4.95 (C) |
| FF32K | Can 10,000uF 63V | £5.45 (B) |
| FF33L | Clip Can 25 | 15p (G) |
| FF34M | Clip Can 35 | 22p (G) |
| FF35Q | Clip Can 40 | 19p (G) |
| FF36P | Clip Can 50 | 45p (F) |
| FF37S | Horiz Clip 25 | 18p (G) |
| FF38R | Horiz Clip 35 | 18p (G) |
| †WL68Y | Trimmer 5.5pF | 30p (F) |
| WL69A | Trimmer 10pF | 30p (F) |
| WL70M | Trimmer 22pF | 26p (F) |
| WL72P | Trimmer 65pF | 29p (F) |
| WL71N | Trimmer 40pF | 19p (G) |
| WL73Q | Trimmer 500pF | 33p (F) |
| YQ24B | AM Varitune | £1.32 (C) |

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|---|---|---|
| FF39N | Vari O | £4.62 (C) |
| FF40T | DG Vari | £6.95 (B) |
| FF41U | Twin OO | £7.16 (B) |
| FF42V | SW Trim 10pF | £5.23 (B) |
| FF43W | SW Trim 15pF | £5.23 (B) |
| FF44X | SW Trim 25pF | £5.23 (B) |
| FF45Y | SW Trim 50pF | £5.23 (B) |

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|---|---|---|
| FF46A | SW Trim 60pF | £6.15 (B) |
| FF48C | SW Trim 100pF | £6.10 (B) |
| FF49D | SW Trim 150pF | £5.50 (B) |
| FF50E | Dilecon 300pF | £4.45 (C) |
| FF51F | Dilecon 500pF | £4.35 (C) |
| FY77J | FS Crystal 100kHz | £4.55 (C) |
| HX62S | FS Crystal 1MHz | £5.95 (B) |
| FY78K | FS Crystal 10MHz | £2.95 (C) |
| FY79L | MP Crystal 1MHz | £4.45 (C) |
| FY60B | MP Crystal 2MHz | £2.20 (C) |
| FY81C | MP Crystal 2.4576MHz | £3.35 (C) |
| FY82D | MP Crystal 4MHz | £1.80 (D) |
| FY83E | MP Crystal 6.144MHz | £1.25 (D) |
| FY84F | MP Crystal 18.432MHz | £2.65 (C) |
| HX30H | MCR Crys Brown Pairs | £2.96 (C) |
| HX31J | MCR Crystal Red Pair | £2.96 (C) |
| HX32K | MCR Crys Orange Pair | £2.96 (C) |
| HX33L | MCR Crys Yellow Pair | £2.96 (C) |
| HX34M | MCR Crystal Green Pr | £2.96 (C) |
| HX35Q | MCR Crys Blue Pair | £2.96 (C) |
| FY85G | Colour TV Crystal | £1.20 (D) |

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| | | |
|---|---|---|
| FY86T | Crystal 50HzX 2.16 | £3.15 (C) |
| FY87U | Crystal 1HzX 2.22 | £3.15 (C) |
| HX60Q | Crystal Socket 25u | 23p (G) |
| HX61R | Crystal Socket 6u | 45p (F) |
| HX99H | Ceramic Fltr 10.7MHz | 60p (E) |

## CAR ACCESSORIES

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| | | |
|---|---|---|
| HW18U | Car Aerial Pull Up | £1.99 (D) |
| LH99H | Windscreen Aerial | £2.69 (C) |
| XX37S | Car Aerial Booster | £6.95 (B) |
| HW12N | Car Accessory Plug | 45p (F) |
| YB68Y | Car Lighter Ext Lead | £2.25 |
| YW59P | Car Power Lead | £2.70 (C) |
| FQ73Q | Map Light | 69p (E) |
| HW22Y | 12V Inspection Lamp | £1.60 (D) |
| HQ30H | Wiper Control | £9.65 (B) |

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|---|---|---|
| WY09K | Demister | £6.95 (B) |
| FQ78K | Car Ammeter | £2.95 (C) |
| HQ35Q | Charger Ammeter | £1.47 (D) |
| HW16S | Car Flash 4-Lamp | £1.63 (D) |
| HW17T | Car Flash 6-Lamp | £1.55 (D) |
| HW01B | Supp Cap Small Lucar | 59p (E) |
| HW03D | Supp Cap Spade | DIS |
| FQ87U | Supp Cap 3uF | £1.12 (D) |
| FQ88V | Plug-Top Supp Strt | 38p (F) |
| FQ89W | Plug-Top Supp Ang | 50p (E) |
| FQ90X | In-Line Plug Supp | 25p (F) |
| FQ91Y | Suppressor Choke | 84p (E) |
| YL02C | Magnilamp | 95p (E) |
| FY01B | Tyre Pressure Gauge | £1.95 (D) |
| XB44X | Car Speakers Shelf | £6.75 (B) |
| XG26D | Slim Line Car Spkers | £10.95 (A) |

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|---|---|---|
| XY73Q | 10W Shelf Spkrs | £18.25 (A) |
| XQ75S | 10W Car Stereo Spkrs | £13.95 (A) |
| XG27E | 15W Shelf Speakers | £15.95 (A) |
| XG25C | 20W Shelf Speakers | £26.95 (A) |
| AF00A | Booster Amp | £17.99 (A) |
| AF01B | Booster Equaliser | £37.50 (A) |

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|---|---|---|
| YX85G | Speed Sensor | £11.93 (A) |
| YX86T | Flow Sensor | £16.90 (A) |

## COMMUNICATIONS

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|---|---|---|
| AF46A | CB Model GT-868. | £49.95 (A) |
| XG10L | 12V 3A Power Unit. | £16.95 (A) |
| YK29G | Ext CB Speaker. | £7.45 (B) |
| YL42V | Filter Choke | £1.99 (D) |
| YK30H | Noise Filter System | £10.95 (A) |
| YB00A | Low-Pass RF Filter | £3.95 (C) |

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|---|---|---|
| YL43W | TVI Filter | £5.25 (B) |
| YL44X | CB Aerial Converter | £7.25 (B) |
| YQ73Q | CB/Radio Aerial Cplr | £5.49 (B) |
| YB01B | RF Antenna Switch | £6.34 (B) |
| YQ74R | CB Aerial Matcher | £5.25 (B) |
| XG13P | 1.5m CB Aerial | £13.95 (A) |
| YG41U | 27MHz Rubber Duck | £4.75 (C) |
| YG15R | 2m Rubber Duck | £4.75 (C) |

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| | | |
|---|---|---|
| YG16S | Mag Mount | £8.50 (B) |
| HL94C | 30W Dummy Load | £6.75 (B) |
| YK00A | 2m Scanning Receiver | £54.95 (A) |
| WY11M | Compact PA Amp | £22.70 (A) |
| WY12N | 10W PA Amp | £29.95 (A) |

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|---|---|---|
| XY81C | 40W PA Amp | £65.50 (A) |
| XY82D | 60W PA Amp | £106.75 (A) |
| XQ72P | Megaphone | £49.95 (A) |
| XY76H | Pistol Grip Megphone | £49.95 (A) |
| XQ73Q | Car PA 8W | £8.25 (B) |
| XQ74R | Car PA 15W | £12.95 (A) |

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|---|---|---|
| LB72P | Intercom 2-Station | £8.75 (B) |
| RK81C | FM Door Phone Set | £46.50 (A) |
| XY77J | 4-Channel FM Intrcom | £29.95 (A) |
| XG18U | PB Telephone | £21.90 (B) |
| XG19V | Set 4 PB Telephones | £69.99 (A) |
| AF09K | AM Radio | £1.95 (C) |
| AF10L | AM/FM Radio | £4.95 (C) |

## COMPUTERS

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| | | |
|---|---|---|
| AF02C | Atari 800 with 16K | £499.00 |
| AF55K | Atari 800 48K RAM | £590.00 |

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| | | |
|---|---|---|
| AF36P | Atari 400 with 16K | £249.90 |
| AF37S | Atari 400 with 48k | £319.00 |
| AF28F | Atari 410 Cass Rcdr | £50.00 |
| AF06G | Atari 810 Disk Drive | £299.95 |
| AF04E | Atari 822 Therm Prtr | £265.00 |
| HY24B | Printer 822 Paper | £4.95 |

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|---|---|---|
| AF41U | 400 Cent I/F | £59.95 |
| AF42V | 800 Cent I/F | £59.95 |
| AF29G | Atari 850 Interface | £135.00 |
| AF43W | Versawriter | £199.95 (A) |
| AF08J | 16K Memory Module | £55.00 (A) |
| AF44X | 48K RAM Memry Module | £125.35 (A) |
| AF45Y | Atari 400 48K Upgrad | £75.00 (A) |
| AC37S | Game Joysticks | £13.95 |
| AC53H | Single Game Joystick | £7.50 |
| AC30H | Games Paddles | £13.95 |
| AC45Y | Le Stick | £24.95 (B) |

## TRADE QUANTITIES

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. See table at start of price list. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity.

Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.

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YG44X Conversation French £39.95
YG45Y Conversation German £39.95
YG46A Conversation Spanish £39.95
YG47B Conversation Italian £39.95
YG49D Touch Typing £15.95
YG56L States & Capitals £9.95
YG57M Euro Country & Caps £8.95
BG00A Kids 1 Cassette £9.95 (B)
BG01B Kids 1 Disk £9.95 (B)
BG02C Kids 2 Cassette £9.95 (B)
BG03D Kids 2 Disk £9.95 (B)
YG43W Inv To Prog 1 £21.52 (A)
BQ67X Inv To Prog 2 £22.95 (A)
BQ68Y Inv To Prog 3 £22.95 (A)
BQ57M Basic Animation Cass £11.95 (A)
BQ58N Basic Animation Disk £11.95 (A)
BQ59P PM Graphics Cass £18.95 (A)
BQ60Q PM Graphics Disk £18.95 (A)
BQ51F Display Lists Cass £11.95 (A)
BQ52G Display Lists Disk £11.95 (A)
BQ53H Scrolling Cassette £11.95 (A)
BQ54J Scrolling Disk £11.95 (A)
BQ55K Page Flipping Cass £11.95 (A)
BQ56L Page Flipping Disk £11.95 (A)

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BG04E Sounds & Music Cass £11.95 (A)
BG05F Sounds & Music Disk £11.95 (A)
BG06G Tricky Tutorial Cass £59.95 (A)
BG07H Tricky Tutorial Disk £59.95 (A)
YL39N Visicalc £119.95 (A)
YG42V APC Word Processor £99.95 (A)
BQ99H Text Wizard Disk £69.95 (A)
BQ08J Mini Word Procr Cass £9.95 (B)
BG09K Mini Word Procr Disk £11.95 (A)
YG51F Graph-It £13.95 (A)
YG52G Statistics Cassette £13.95 (A)
BQ65V Financial Manager £49.00 (A)
BQ66W Mortgage & Loan £13.95 (A)
BG11M Bob's Business Cass £9.95 (B)
BG12N Bob's Business Disk £9.95 (B)
BQ14Q Galactic Empire £14.95 (A)
BG75S Galaxy Cassette £12.95 (A)
BG76H Galaxy Disk £14.95 (A)
BG77J Galaxy Log Pad NYA

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BQ21X Rescue Rigel Cass £22.45 (A)
BQ80B Rescue Rigel Disk £22.45 (A)
BQ22Y Datestones Ryn Cass £14.95 (A)
BQ82D Datestones Ryn Disk £14.95 (A)
BQ24B Star Warrior Cass £28.95 (A)
BQ79L Star Warrior Disk £28.95 (A)
BG95D Voyager 1 Cassette £12.95 (A)
BG96E Voyager 1 Disk £15.95 (A)
BQ23A Invasion Orion Cass £18.95 (A)
BQ81C Invasion Orion Disk £18.95 (A)
BG89W Planet Miners Cass £10.95 (A)
BG90X Planet Miners Disk £13.95 (A)
BQ83E Crush Crumble Cass £22.48 (A)
BQ84F Crush Crumble Disk £22.48 (A)
BQ91Y Mission: Asteroid £17.19 (A)
BQ25C Wizard and Princess £21.79 (A)
BQ92A Ulysses Gold Fleece £20.64 (A)

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KB04E Goodcode Cavern Disk £23.95 (A)
BQ94C Zork I Disk £29.95 (A)
BQ95D Zork II Disk £29.95 (A)
BQ78K Ali Baba 40 Thieves £27.95 (A)
BQ85G Temple Apshai Cass £28.95 (A)
BQ86T Temple Apshai Disk £28.95 (A)
BQ87U Upper Reaches Cass £14.95 (A)
BQ88V Upper Reaches Disk £14.95 (A)
BQ89W Curse of Ra Cass £14.95 (A)
BQ90X Curse Of Ra Disk £14.95 (A)
BG73Q Empire Ovr-Mind Cass £17.95 (A)
BG74R Empire Ovr-Mind Disk £20.95 (A)
BG79L Lords Of Karma Cass £12.95 (A)
BG80B Lords Of Karma Disk £15.95 (A)
BQ33L Analog Adventure £16.95 (A)
BQ00A Adventure Land £14.95 (A)

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BQ01B Pirate Adventure £14.95 (A)
BQ02C Mission Impossible £14.95 (A)
BQ03D Voodoo Castle £14.95 (A)
BQ04E The Count £14.95 (A)
BQ05F Strange Odyssey £14.95 (A)
BQ06G Mystery Fun House £14.95 (A)
BQ07H Pyramid of Doom £14.95 (A)
BQ08J Ghost Town £14.95 (A)
BQ09K Savage Island I £14.95 (A)
BQ10L Savage Island II £14.95 (A)
BQ11M Golden Voyage £14.95 (A)
BQ93B Softporn Adventure £20.64 (A)
BQ96E Deadline £34.95 (A)
YG53H Energy Czar £9.95
YG55K Kingdom £9.95
BG65V Space Shuttle Mod 1 £19.95 (A)
BQ98G Shattered Alliance £29.95 (A)

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KB00A Legionnaire Cassette £20.95 (A)
BG63T Battle Shiloh Cass £29.95 (A)
BQ97F Battle Shiloh Disk £29.95 (A)
BG71N Dnieper Line Cass £17.95 (A)
BG72P Dnieper Line Disk £17.95 (A)
BG93B Tanktics Cassette £15.95 (A)
BG94C Tanktics Disk £17.95 (A)
BG83E NA Convoy Raider Cass £10.95 (A)
BG84F NA Convoy Raider Dsk £13.95 (A)
KB01B Tigers in Snow Cass £24.95 (A)
KB02C Tigers in Snow Disk £24.95 (A)
BG81C Midway Campaign Cass £10.95 (A)
BG82D Midway Campaign Disk £13.95 (A)
BG68Y B1 Nuke Bomber Cass £10.95 (A)
BG69A B1 Nuke Bomber Disk £13.95 (A)

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BG87U Nukewar Cassette £10.95 (A)
BG88V Nukewar Disk £13.95 (A)
BG85G Conflict 2500 Cass £10.95 (A)
BG86T Conflict 2500 Disk £13.95 (A)
YG66W Star Raiders £29.95
BG97F Shootout Galaxy Cass £12.95 (A)
BG98G Shootout Galaxy Disk NYA
YG60Q Asteroids £29.95
YG70M Space Invaders £29.95
YG64U Missile Command £29.95
BQ69A Caverns Of Mars £24.50
KB20W Shamus Cassette £25.50 (A)
KB21X Shamus Disk £25.50 (A)
BQ63T K-razy Shoot Out £29.95 (A)

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BG51F K-Razy Kritters £29.95 (A)
BG52G K-Star Patrol £29.95 (A)
BG33L Pathfinder Disk £27.95 (A)
BG22Y Crossfire Cassette £20.64 (A)
BG23A Crossfire Disk £20.64 (A)
BG24B Protector Cassette £22.95 (A)
BG25C Protector Disk £22.95 (A)
KB12N Choplifter Disk £25.50 (A)
BG18U Threshold Disk £27.54 (A)
BG34M Deluxe Invaders Disk £29.95 (A)
BQ62S Galactic Chase Cass £16.95 (A)
BQ61R Galactic Chase Disk £19.95 (A)
BQ35Q Race in Space Cass £14.95 (A)
BG20W Race in Space Disk £16.95 (A)
BG42V Space Chase Cassette £10.95 (A)
BG43W Space Chase Disk £12.95 (A)
KB05F Track Attack(Disk £21.80 (A)
BQ70M Centipede £29.95

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BG50E Angle Worms Cassette £10.95 (A)
BQ16S Lunar Lander Cass £10.95 (A)
BQ49D Lunar Lander Disk £14.95 (A)
BG35Q Rasterblaster £22.95 (A)
BQ36P Shoot Gallery Cass £14.95 (A)
BG19V Shoot Gallery Disk £16.95 (A)
BG15R Shoot Arcade Cass £24.95 (A)
BG16S Shoot Arcade Disk £24.95 (A)
YG67X Super Breakout £24.50
KB06G Apple Panic Disk £21.80 (A)
BG29G Dodge Racer Cassette £19.95 (A)
BG30H Dodge Racer Disk £19.95 (A)
BG31J Matchracer Cassette £23.95 (A)
BG32K Matchracer Disk £23.95 (A)
BG99H Roadracer Cassette £10.95 (A)
BQ77J Mouskattack £22.95 (A)
BG17T Jawbreaker Cassette £20.64 (A)
BQ26D Jawbreaker Disk £20.64 (A)
KB17T Andromeda Disk £19.95 (A)

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KB16S K-razy Antiks NYA
BQ64U Ghost Hunter £24.50 (A)
BQ71N Pac-Man £29.95
KB03D Wizard of Wor Disk £29.95 (A)
YL34M Tank Trap Cassette £8.95 (B)
YL35Q Tank Trap Disk £12.95 (A)
KB13P Nautilus Cassette £25.50 (A)
KB14Q Nautilus Disk £25.50 (A)
BQ37S Thunder Island £10.95 (A)
BG13P Pacific Hiway Cass £24.95 (A)
BG14Q Pacific Hiway Disk £24.95 (A)
KB07H Preppie Cassette NYA
KB08J Preppie Disk £29.95 (A)
BG27E Chicken Cassette £22.95 (A)
BG28F Chicken Disk £22.95 (A)
BG46A Tumble Bugs Disk £24.95 (A)
BG36P Bug Attack Cassette £23.95 (A)
BG37S Bug Attack Disk £23.95 (A)
BG78K Guns Fort Defiance £12.95 (A)

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BG44X Canyon Climber Cass £24.95 (A)
BG45Y Canyon Climber Disk £24.95 (A)
BQ12N Mountain Shoot £10.95 (A)
BG38R Haunted Hill Cass £16.95 (A)
BG39N Haunted Hill Disk £19.95 (A)
BG40T Time Bomb Cassette £10.95 (A)
BG41U Time Bomb Disk £12.95 (A)
BG70M Bomber Attack Cass £10.95 (A)
BG66W Acquire Cassette £12.95 (A)
BG67X Acquire Disk £14.95 (A)
BG91Y Stocks and Bonds Css £12.95 (A)
BG92A Stocks and Bonds Dsk £15.92 (A)
YG58N Scram £17.50
YG61R Basketball £24.50
BQ20W Cypher Bowl £29.50 (A)
BQ13P Sunday Golf £10.95 (A)
†BQ45Y Pool £19.95 (A)

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BG47B Ricochet Cassette £14.95 (A)
BG48C Ricochet Disk £14.95 (A)
YG63T Computer Chess £24.50
YL33L Fast Gammon £16.95 (A)
BQ18U Gomoko Cassette £14.95 (A)
BG55K Gomoku Disk £19.95 (A)
BQ19V Reversi Cassette £14.95 (A)
BG54J Reversi Disk £19.95 (A)
†BQ43W Crib and Dominoes £14.95
BQ17T Poker Solitare Cass £10.95
BG53H Poker Solitaire Disk £14.95
YG62S Blackjack £9.95
YG54J Hangman £9.95
KB09K Wordrace Disk £18.20 (A)
KB10L Wordrace Access Disk £14.50 (A)
†BQ48C Super Cubes and Tilt £14.95
†BQ38R Humpty Dumpty £19.95
†BQ39N Hickory Dickory Dock £19.95

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†BQ41U Euro Scene Puzzle £19.95
BQ72P Video Easel £24.50
BG56L Micro Painter Disk £29.95 (A)
KB22Y Paint Disk £29.95 (A)
KB11M Abuse Disk £14.50 (A)
YG48C Music Composer £35.95
BQ34M Movie Themes £9.95 (B)
YG68Y Assembler Editor £34.50
YL32K Assembler £19.95 (A)
BQ73Q Macro Assembler £59.95
BQ31J BASIC A† DISK £49.95 (A)
BQ32K BASIC A† & Op-Sys A† £99.50 (A)
BQ74R Microsoft BASIC £59.95

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BQ75S Pilot Educator £79.95
YG69A Pilot Consumer £54.00
YL29G QS Forth £49.95 (A)
BG62S Tiny-C £64.95 (A)
BG61R LISP £87.00 (A)
KB15R SAM Disk £43.70 (A)
BG60Q Program Aids Pack £9.95 (B)
YL30H Disassembler Cass £9.95 (B)
YL31J Disassembler Disk £12.95 (A)
BQ27E Atari World £43.95 (A)
BQ29G 3D-Supergraphics Cas £29.95 (A)
BQ28F 3D-Supergraphics Dsk £29.95 (A)
BG64U The Next Step Disk £27.54 (A)
BG10L File-It 2 Disk £34.95 (A)

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BG59P Filemanager 800 £74.95 (A)
BQ76H K-DOS £49.95 (A)
BG58N Disk Manager £22.95 (A)
BG57M Disk Detective £24.95 (A)
BQ30H Op-Sys A† £49.95 (A)
YG59P Telelink £21.50
GG24B Analog Subscription £9.00NV
XH60Q Mapsoft Catalogue £60p (E)

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AF57M Dragon 32 Computer £199.50
BC31J Dragon Cassette Cabl £2.95
BC30H Dragon Joysticks £14.95

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BC41U Quest £7.95
BC43W Graphics Animator £7.95
BC35Q Ghost Attack £24.95
BC42V Madness & Minotaur £7.95
BC33L Meteoroids £19.95
BC32K Berserk £19.95
BC34M Cosmic Invaders £19.95
BC39N Dragon Selection 1 £7.95
BC44X Computavoice £7.95
BC36P Cave Hunter £19.95
BC38R Starship Chameleon £19.95
BC37S Tube Frenzy £19.95
BC40T Dragon Selection 2 £7.95
BC45Y Maze Craze £7.95
AF58N Commodore Max £110.00 (A)

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AF56L Commodore 64 Computr £339.00 (A)

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AF47B VIC20 Colour Computr £169.99 (A)

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AF48C VIC20 Cassette C2N £44.95 (A)
AF49D VIC20 Printer £230.00 (A)
AF50E VIC20 Disk Drive £299.99 (A)
AF51F VIC 3K RAM £29.95 (A)
AF52G VIC 8K RAM £44.95 (A)
AF53H VIC 16K RAM £74.95 (A)
AC54J Super Expander £34.95 (A)
AC55K Programmers Aid £34.95 (A)
AC56L Machine Code Mon £34.95 (A)

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AC57M Intro To Basic Part1 £14.95 (A)
AC58N Intro To Basic Part2 £14.95 (A)
AC59P VIC Avenger £19.95 (A)
AC60Q VIC Star Battle £19.95 (A)
AC61R VIC Super Slot £19.95 (A)
AC86T VIC Adventureland £24.95 (A)
AC84F VIC Pirate Cove £24.95 (A)
AC87U VIC Mission Impossbl £24.95 (A)
AC88V VIC Voodoo Castle £24.95 (A)
AC89W VIC The Count £24.95 (A)
AC77J VIC Sargon II Chess £24.95 (A)
AC80B VIC Cosmiads £7.00 (B)

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AC79L VIC Panic £7.00 (B)
AC78K Another VIC In Wall £7.00 (B)
AC62S VIC Jelly Monsters £19.95 (A)
AC63T VIC Alien £19.95 (A)
AC64U VIC Superlander £19.95 (A)
AC65V VIC Road Race £19.95 (A)
AC67X VIC Blitz £4.99 (C)
AC66W VIC Rat Race £19.95 (A)
AC85G VIC Mole Attack £24.95 (A)
AC81C Vicgammon £7.00 (B)
AC83E VIC Asteroids £7.00 (B)
BC46A VIC Race £4.99 (C)

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BC47B VIC Hoppit £4.99 (C)
BC48C VIC Strategic Advnc £4.99 (C)
AC92A Simplicalc Disk £24.95 (A)
AC93B Simplicalc Cassette £19.95 (A)
AC94C VIC Stock Control £19.95 (A)
AC95D VIC File £24.95 (A)
AC96E VIC Writer Disk £24.95 (A)
AC97F VIC Writer Cassette £19.95 (A)
AC98G English Language £9.99 (B)
AC99H VIC Maths 1 £9.99 (B)
BC00A VIC Maths 2 £9.99 (B)
BC02C VIC Chemistry £9.99 (B)

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BC01B VIC Biology £9.99 (B)
BC03D VIC Physics £9.99 (B)
BC11M Quizmaster £9.99 (B)
BC12N Know Your Own IQ £9.99 (B)
BC13P Junior IQ £9.99 (B)
BC15R VIC Menu Planner £9.99 (B)
BC14Q Know Yr Personality £9.99 (B)
BC16S VIC Money Manager £9.99 (B)
BC17T VIC Highway Code £9.99 (B)
BC21X VIC Mastermind £9.99 (B)
BC22Y MM Data 1 £2.50 (C)
BC23A MM Data 2 £2.50 (C)
BC24B MM Data 3 £2.50 (C)
BC25C MM Data 4 £2.50 (C)
BC26D MM Wine & Food £2.50 (C)
BC27E MM Music £2.50 (C)
BC28F MM Sport & Games £2.50 (C)
BC29G MM Films & TV £2.50 (C)
BC18U Type-A-Tune £4.99 (C)
AC90X Gorf Cartridge £24.95 (A)
AC91Y Omega Race Cartridge £24.95 (A)
BC04E Computer Studies £9.99 (B)
BC05F Geography £9.99 (B)
BC06G History £9.99 (B)
BC07H Arithmetic £9.99 (B)
BC08J Reading £9.99 (B)
BC09K General Knowledge £9.99 (B)
BC10L Spelling £9.99 (B)
BC18U Garden Planner £9.99 (B)
BC19V Interior Designer £9.99 (B)
BC20W BBC "Ask the Family" £9.99 (B)
BC50E VIC Letter Writer £19.95 (A)
BC51F VIC Pinball NYA
BC52G VIC Cosmic Jailbreak NYA

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XG28F MENTA £115.00 (A)
AF38R Epson MX80T Mk III £325.00 (A)
AF40T Epson MX80F/T Mk III £447.35 (A)
YX87U Mini Floppy Disc £2.50 (D)

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AC00A Vid Gme Cnsl £99.95
AC01B Air Sea Battle Game £18.95
AC02C Space War Game £14.95

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AC03D Outlaw Game £14.95
AC04E Video Olympics Game £18.95
AC05F Breakout Game £18.95
AC06G Basketball Game £14.95
AC07H Surround Game £14.94

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AC09K Basic Maths £14.95
AC10L Codebreaker £18.95
AC11M Hunt & Score £18.95
AC12N Miniature Golf £14.95
AC13P Skydiver £14.95
AC14Q Street Racer £18.95
AC15R Bowling £18.95

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AC16S Brain Games £24.95
AC18U Golf £18.95
AC19V Slot Racers £14.95
AC21X Superman £24.95
AC22Y Adventure Game £18.95
AC24B Indy 500 £29.95
AC25C Backgammon £18.95 (A)

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AC26D Space Invaders £24.95
AC27E Programming £18.95
AC28F Chess £18.95

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AC20W Circus Atari Game £24.95 (A)
AC17T Human Cannonball £14.95
AC23A Casino Game £18.95
AC31J Night Driver Game £24.95 (A)
AC32K Dodge Em £18.95 (A)
AC33L Pele Soccer Game £24.95
AC34M Hangman £14.95

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AC35Q Video Checkers £18.95 (A)
AC36P Maze Craze £24.95 (A)
AC41U Othello Game £18.95
AC42V Video Pinball £24.95 (A)

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AC43W Asteroids £29.95 (A)
AC44X Warlords £29.95
AC46A Missile Command £29.95 (A)
AC48C Super Breakout £29.95
AC49D Kaboom! £19.95 (A)
AC50E Laser Blast £19.95 (A)
AC51F Freeway £19.95 (A)

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AC52G Dragster £19.95 (A)
AC68Y Pac Man £29.95
AC69A Haunted House £18.95
AC71N Yar's Revenge £29.95
AC73Q Defender £29.95
AC70M Demons To Diamonds £18.95
AC72P Berzerk £29.95
AC74R Adventure I £24.95
AC75S Adventure II £24.95
AC76H Raiders Of Lost Ark £29.95
AC29G Video Game Keyboard £13.95

## CONNECTORS

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HF25C Croc Clips 10p (G)
HF23A Alligator Clip Black 13p (G)
HF24B Alligator Clip Red 11p (G)
HF26D Charger Clip 25p (F)
BW69A Croc Lead Kit £1.45 (D)
HF10L Push-On Receptacle 33p (F)
HF11M Push-On Blade 33p (F)
HF12N Push-On Covers 73p (E)
YX47B Comcon Block 5-way 38p (F)
YX48C Comcon Terminal 5p (H)
HF02C Terminal Post Black 35p (F)
HF03D Terminal Post Blue 37p (F)
HF04E Terminal Post Brown 37p (F)
HF05F Terminal Post Green 38p (F)
HF06G Terminal Post Grey 38p (F)
HF07H Terminal Post Red 35p (F)
HF08J Terminal Post White 38p (F)
HF09K Terminal Post Yellow 38p (F)
HF13P Press Terminal Black 28p (F)
HF15R Press Terminal Green 28p (F)
HF16S Press Terminal Red 28p (F)
HF17T Press Terminal White 30p (F)
HF18U Press Terminal Yellw 28p (F)
†HF19V Press Terminal Blue 28p (F)
BW72P Quickterm Type A 49p (F)
YR92A Quickterm Type B 62p (E)
BW71N Quickterm Push 62p (E)

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WL57M 1mm Plug Black 20p (G)
WL58N 1mm Plug Red 20p (G)
WL59P 1mm Socket Black 15p (G)
WL60Q 1mm Socket Red 15p (G)
HF38R 2mm Plug Black 17p (G)
HF39N 2mm Plug Blue 18p (G)
HF40T 2mm Plug Green 17p (G)
HF41U 2mm Plug Red 17p (G)
HF42V 2mm Plug White 17p (G)
HF43W 2mm Plug Yellow 18p (G)
HF44X 2mm Socket Black 15p (G)
HF45Y 2mm Socket Blue 15p (G)
HF46A 2mm Socket Green 15p (G)
HF47B 2mm Socket Red 15p (G)
HF48C 2mm Socket White 15p (G)
HF49D 2mm Socket Yellow 15p (G)
HF50E Wander Plug Black 17p (G)
HF51F Wander Plug Blue 17p (G)
HF52G Wander Plug Green 17p (G)
HF53H Wander Plug Red 17p (G)
HF54J Wander Plug White 17p (G)
HF55K Wander Plug Yellow 12p (G)
HF56L Wander Socket Black 12p (G)
HF57M Wander Socket Blue 12p (G)
HF58N Wander Socket Green 12p (G)
HF59P Wander Socket Red 12p (G)
HF60Q Wander Socket White 12p (G)
HF61R Wander Socket Yellow 12p (G)
HF62S 4mm Plug Black 15p (G)
HF63T 4mm Plug Blue 15p (G)
HF64U 4mm Plug Brown 15p (G)
HF65V 4mm Plug Green 15p (G)
HF66W 4mm Plug Red 15p (G)
HF67X 4mm Plug White 15p (G)
HF68Y 4mm Plug Yellow 15p (G)
HF69A 4mm Socket Black 15p (G)
HF70M 4mm Socket Blue 15p (G)
HF71N 4mm Socket Brown 15p (G)
HF72P 4mm Socket Green 15p (G)
HF73Q 4mm Socket Red 15p (G)
HF74R 4mm Socket White 17p (G)
HF75S 4mm Socket Yellow 19p (G)
HF34M 4mm Patch Cord £1.98 (D)

HQ54J Screw-Cap Phono Blk 12p (G)
HQ55K Screw Cap Phono Blue 12p (G)
HQ58N Screw Cap Phono Red 12p (G)
HQ59P Screw Cap Phono Whte 12p (G)
HQ60Q Screw Cap Phono Yell 12p (G)
HH01B Scr Phono 17p (G)
YW06G Threaded Phono Skt 15p (G)
HH02C Phono Socket Single 12p (G)
HH03D Phono Socket Twin 16p (G)
BW74R Phono Socket Quad 35p (F)
†BW75S Phono Socket 5-way 45p (F)
BW76H Phono Socket 6-way 55p (E)

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HH04E Line Phono 20p (G)
HH05F Phono Conn 19p (G)
HF76H 2.5 Plug Plas 13p (G)
HF77J 2.5 Plug Scr 22p (G)
HF78K 2.5 Jack Socket 11p (G)
HF79L 2.5 Line Socket 30p (F)
HF80B Plug Plas 3.5 12p (G)
HF98G Stereo Plas 3.5 Plug 25p (F)
HF81C Plug Scr 3.5 22p (G)
HF82D Jack Socket 3.5 14p (G)
HF83E Line Socket Plas 3.5 15p (G)
RK51F Stereo Plas 3.5 Skt 25p (F)
HF84F Line Socket Scr 3.5 21p (G)
HF85G Jack Plug Plas 19p (G)
HF86T Side Jack Plas 24p (F)
HF87U Jack Plug Scr 39p (F)
YW07H SR Jack Plug 41p (F)
YL03D Side Jack Screened 29p (F)
HF88V Jack Pl Sto Plas 28p (F)
HF89W Jack Pl Sto Scr 45p (F)
HF90X Jack Skt Brk 21p (G)
BW78K Chro Mono Jack Skt 39p (F)

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HF91Y Jack Skt Open 19p (G)
HF92A Jack Skt Sto 25p (F)
BW79L Chro Stereo Jack Skt 35p (F)
HF93B Stereo Open Skt 35p (F)
BW80B DPDT Jack Socket 52p (E)
HH19V Line Jack Plas 24p (F)
HH20W Scr Line Jack 42p (F)
HH21X Stereo Line Skt 30p (F)
HH22Y Scr Stereo Line Skt 58p (E)
RK80B Mono 0.25in Jk Cplr 49p (F)
HH07H Co-ax Plug Aly 24p (F)
†HH06G Co-ax Plug Plas 20p (G)
YW08J Co-ax Plug Imp 15p (G)
HH08J Co-ax Socket Pan 29p (F)
HH09K Co-ax Socket Flush 25p (F)
YW09K Co-ax Line Skt 43p (F)
HH11M Co-ax Conn 15p (G)
HH13P Skeleton Car Plug 14p (G)
HH12N Car Plug Plas 49p (F)
HH14Q Chassis Car Socket 24p (F)

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HH16S FM Aerial Plug 17p (G)
HH17T BNC Plug 98p (E)
HH18U BNC Socket 98p (E)
YW00A BNC Square Socket 85p (E)
QY22Y BNC Earth Tag 20p
YW01B BNC Line Socket £1.10 (D)
YW02C BNC Straight Adaptor £1.37 (D)
YW03D BNC T Adaptor £2.95 (C)
BW81C Plug PL259 51p (E)
BW82D UHF Reducer Small 17p (G)
BW83E UHF Reducer Large 17p (G)
HL95D RA PL259 Plug 85p (E)
HL96E Quick-Connect PL259 99p (E)
BW84F UHF Socket Round 49p (F)
BW85G Socket SO239 53p (E)
BW86T UHF Elbow Adaptor £1.32 (D)
BW87U UHF Straight Adaptor 59p (E)
BW88V UHF T Adaptor £1.55 (D)

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RK00A UHF Female T Adaptor £1.75 (D)
RK01B UHF Adaptor FFLA £1.65 (D)
RK02C UHF Adaptor FMLA £1.75 (D)
YW04E Adaptor 239 £1.12 (D)
YW05F Adaptor 259 £1.40 (D)
YX51F Audio Conn 2-way £1.15 (D)
YX52G Audio Conn 3-way £1.35 (D)
YX53H Audio Conn 4-way £1.26 (D)
YX54J Audio Conn 5-way £1.55 (D)
YX55K Audio Conn 6-way £1.75 (D)
RK52G 10 Way Line Skt £2.85 (C)
RK53H 10 Way Line Plug £2.75 (C)
RK54J 10 Way Chassis Skt £1.95 (D)
BW89W XLR Line Plug £1.82 (D)
BW90X XLR Chassis Socket £2.95 (C)
BW91Y XLR Line Socket £2.35 (C)
BW92A XLR Chassis Plug £1.45 (D)
RK76H Mic Con with S R 55p (E)
RK79L Min Mic SR Connector 55p (E)

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RK77J Mic Jck Plug Adaptor 42p (F)
RK78K Mic Jck Skt Adaptor 65p (E)
BW94C Dinlatch 5-pin A Plg £1.39 (D)
BW98G Dinltch Sckt 5-pin A 69p (E)
HH24B DIN L/S Plug 10p (G)
HH25C DIN Plug 3-pin 16p (G)
HH26D DIN Plug 4-pin 30p (F)
HH27E DIN Plug 5-pin A 14p (G)
HH28F DIN Plug 5-pin B 19p (G)
RK64U DIN Plug 5-pin C 25p (F)
HH29G DIN Plug 6-pin 39p (F)
HH30H DIN Plug 7-pin 19p (G)
HH31J DIN L/S Socket 7p (H)
HH32K DIN Socket 3-pin 16p (G)
HH33L DIN Socket 4-pin 16p (G)
HH34M DIN Socket 5-pin A 14p (G)
HH35Q DIN Socket 5-pin B 18p (G)
HH36P DIN Socket 6-pin 21p (G)
HH37S DIN Socket 7-pin 19p (G)
HH40T DIN Line Skt 2-pin 15p (G)
HH41U DIN Line Sckt 3-pin 16p (G)
HH43W DIN Line Skt 5-pin A 29p (F)
HH44X DIN Line Skt 5-pin B 21p (G)
HH45Y DIN Line Sckt 6-pin 20p (G)
YX90X PC DIN Skt 2-pin 25p (F)
YX91Y PC DIN Skt 5-pin A 25p (F)

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RK60Q D-Range 9 Way Plug 95p (E)
BK58N D-Range 15-Way Plug £1.45 (D)
YQ48C D-Range 25-Way Plug £2.15 (C)
RK61R D-Range 9 Way Skt £1.40 (D)
BK59P D-Range 15-Way Skt £1.85 (D)
YQ49D D-Range 25W Socket £2.35 (C)
RK62S D-Range 9 Way cover 95p (E)
BK60Q D-Range 15 Way cover £1.29 (D)
YQ50E D-Range 25-Way Cover £1.92 (D)
WQ14Q PCB Conns 45 7p (H)

## TRADE QUANTITIES

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. See table at start of price list. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity.
Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.

| 1983 Catalogue Page No. | | VAT inclusive PRICE |
|---|---|---|
| WQ15R | PCB Conns Vertical | 7p (H) |
| WQ16S | PCB Conns Horizontal | 7p (H) |
| RK63T | D Range 9 Way Latch | 28p (F) |
| BK61R | D Range 15 Way Latch | 35p (F) |
| YQ51F | D-Range Latch | 33p (F) |
| RK35Q | PC Edgeconn 2x23-way | £2.39 (C) |

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|---|---|---|
| FL83E | Edge Conn 108 | 52p (E) |
| FL84F | Edge Conn 116 | £1.08 (D) |
| FL85G | Edge Conn 124 | £1.29 (D) |
| FL86T | Edge Conn 132 | £1.95 (D) |
| FL87U | Edge Conn 140 | DIS |
| FL91Y | Edge Conn Feet G | 15p (G) |
| FL92A | Edge Conn Feet H | 14p (G) |
| FL93B | Edge Conn Feet L | DIS |
| FL30H | Edge Conn Silver | £1.99 (D) |
| YR57M | Card Frame Edge Conn | £3.95 (C) |
| YR58N | Edge Conn End Bkt | 26p (F) |
| YX33L | Multicon Plug 2-way | 15p (G) |
| YX34M | Multicon Plug 4-way | 20p (G) |
| YX35Q | Multicon Plug 9-way | 29p (F) |
| YX36P | Multicon Plug 15-way | 43p (F) |
| YX37S | Multicon Plug 24-way | 58p (E) |
| YX38R | Multicon Plug 36-way | 78p (E) |
| YX39N | Multicon Skt 2-way | 18p (G) |
| YX40T | Multicon Skt 4-way | 19p (G) |
| YX41U | Multicon Skt 9-way | 27p (F) |
| YX42V | Multicon Skt 15-way | 51p (E) |
| YX43W | Multicon Skt 24-way | 59p (E) |
| YX44X | Multicon Skt 36-way | 68p (E) |
| YX45Y | Multicon Plug Pin | 3p (H) |
| YX46A | Multicon Skt Pin | 3p (H) |

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| | | |
|---|---|---|
| HL01B | Octal Ch Plug | 75p (E) |
| HL00A | Octal Ch Skt | 50p (E) |
| HL02C | 8-way Plug | 95p (E) |
| HL03D | 8-way Socket | 99p (E) |
| RK65V | Minicon Latch Pl 2w | 13p (G) |
| BX96E | Minicon Latch Pl 3w | 23p (G) |
| YW11M | Minicon Latch Pl 4w | 22p (G) |
| FY93B | Minicon Latch Pl 5w | 26p (F) |
| YW12N | Minicon Latch Pl 6w | 29p (F) |
| YW13P | Minicon Latch Pl 8w | 29p (F) |
| RK66W | Minicon Latch Pl 10w | 70p (E) |
| YW14Q | Minicon Latch Pl 12w | 48p (F) |
| BH61R | Minicon Latch Pl 17w | 78p (E) |
| FY92A | RA Lch Minicn Pl 2w | 26p (F) |
| YW15R | RA Lch Minicn Pl 3w | 31p (F) |
| FY91Y | RA Lch Minicn Pl 4w | 33p (F) |
| RK67X | RA Lch Minicn Pl 5w | 29p (F) |
| FB99H | RA Lch Minicn Pl 6w | 40p (F) |
| YW18U | RA Lch Minicn Pl 8w | 52p (E) |
| RK68Y | RA Lch Minicn Pl 10w | 45p (F) |
| YW19V | RA Lch Minicn Pl 12w | 74p (E) |
| HB59P | Mncn Ltch Hsg 2way | 8p (H) |
| BX97F | Mncn Ltch Hsg 3-way | 11p (G) |
| HB58N | Mncn Ltch Hsg 4way | 10p (G) |
| BH66W | Mncn Ltch Hsng 5-way | 11p (G) |
| BH65V | Mncn Ltch Hsng 6-way | 13p (G) |
| YW23A | Mncn Ltch Hsng 8-way | 15p (G) |
| FY94C | Mncn Ltch Hsng 10way | 18p (G) |
| YW24B | Mncn Ltch Hsng 12way | 17p (G) |
| RK69A | Mncn Ltch Hsng 17way | 25p (F) |
| YW26D | Minicon Skt 3-way | 24p (F) |
| YW27E | Minicon Skt 4-way | 30p (F) |
| YW28F | Minicon Skt 6-way | 36p (F) |
| YW29G | Minicon Skt 8-way | 50p (E) |
| YW30H | Minicon Skt 12-way | 65p (E) |
| YW31J | Polarcon 0.1in | 6p (H) |
| YW25C | Minicon Terminal | 3p (H) |
| YW95D | IDC Con 3-way | 20p (G) |
| YW96E | IDC Con 4-way | 26p (F) |
| YW97F | IDC Con 6-way | 38p (F) |
| YW98G | IDC Con 8-way | 50p (E) |
| YW99H | IDC Con 12-way | 88p (E) |
| YX49D | IDC Insertion Tool | £1.98 (D) |

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| | | |
|---|---|---|
| HL04E | Wafercon Plug 3-pin | 12p (G) |
| HL05F | Wafercon Plug 4-pin | 14p (G) |
| HL06G | Wafercon Plug 6-pin | 19p (G) |
| HL07H | Wafercon Plug 8-pin | 19p (G) |
| HL08J | Wafercon Plug 12-pin | 29p (F) |
| HL09K | Wafercon Skt 3-way | 11p (G) |
| HL10L | Wafercon Skt 4-way | 10p (G) |
| HL11M | Wafercon Skt 6-way | 16p (G) |
| HL12N | Wafercon Skt 8-way | 17p (G) |
| HL13P | Wafercon Skt 12-way | 25p (F) |
| HL14Q | Wafercon Terminal | 3p (H) |
| YW32K | Polarcon 0.2in | 8p (H) |
| RK72P | 3 way PC Terminal | 29p (F) |
| RK73Q | 4 way PC Terminal | 37p (F) |
| RK38R | 8-Way PC Terminal | 55p (E) |
| RK74R | 12 way PC Terminal | 95p (E) |
| YW40T | Compactboard | £13.50 (A) |
| YY22Y | CB Pin Blue | 37p (F) |
| YY23A | CB Pin Red | 37p (F) |
| YY26D | CT Pin White | £1.26 (D) |
| YY27E | AT Pin Black | £1.33 (D) |
| YB08J | Large Patchboard | £111.00 (A) |

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|---|---|---|
| WQ10L | Large Patch Plug | 37p (F) |
| HH39N | Multi-position Plug | 67p (E) |
| HH38R | Universal Plug | 85p (E) |
| HH60Q | Std Power Plug 2.1 | 14p (G) |
| HH61R | Long Pwr Plug 2.1 | 16p (G) |
| HH62S | Std Power Plug 2.5 | 15p (G) |
| HH63T | Long Pwr Plug 2.5 | 15p (G) |
| HH85G | Power Skt 2.1 | 20p (G) |
| HH86T | Power Skt 2.5 | 22p (G) |
| RK37S | PC Mtg Power Socket | 28p (F) |
| HH87U | Cassette Skt Nivico | 39p (F) |
| HH88V | Cassette Skt Paros | 46p (F) |
| HL17T | USA Mains Plug | 20p (G) |
| HL18U | Flat Pin M/S | 27p (F) |
| HL19V | Flat Pin Conn | 31p (F) |

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| | | |
|---|---|---|
| HL16S | Eurosocket | 69p (E) |
| HL15R | Europlug | 48p (F) |
| HL42V | Euro Facility Outlet | 89p (E) |
| HL43W | Euro Facility Plug | £1.99 (D) |
| BW99H | Euroconn Lead | £1.75 (D) |
| RW56L | Cas Lead Crown | 60p (E) |
| RW57M | Cas Lead Hitachi | 60p (E) |
| RW58N | Cas Lead Nat Pan | 60p (E) |
| RW59P | Cas Lead Nivico | 60p (E) |
| RW60Q | Cas Lead Otake-Orion | 60p (E) |
| RW61R | Cas Lead Paros | 65p (E) |
| RW62S | Cas Lead Philips | 75p (E) |
| RW63T | Cas Lead Sanyo | 60p (E) |
| RW64U | Cas Lead Sharp | 60p (E) |
| RW65V | Cas Lead Sony | 60p (E) |
| RW66W | Cas Lead Telefunken | 65p (E) |
| YX62S | Cassette Lead OS219 | 60p (E) |

| 1983 Catalogue Page No. | | VAT inclusive PRICE |
|---|---|---|
| YX63T | Cassette Lead 955 | 60p (E) |
| WY16S | Euroboard 4-way | £7.35 (B) |
| WY17T | Euroboard 6-way | £10.75 (A) |
| HL20W | Mains Plug P429 | 64p (E) |
| HL44X | Mains Socket P646 | £1.39 (D) |

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| | | |
|---|---|---|
| HL23A | Mains Socket P430SE | £1.15 (D) |
| HL45Y | Mains Plug P649 | £1.15 (D) |
| HL46A | Mains Socket P650 | £1.10 (D) |
| HL47B | Mains Plug SA2403 | £1.56 (D) |
| HL48C | Mains Socket SA2404 | 94p (E) |
| HL27E | Mains Plug SA2190 | 49p (F) |
| HL28F | Mains Socket SA1862 | 52p (E) |
| HL49D | Mains Socket SA2111 | £2.24 (C) |
| HL30H | Mains Plug SA2019A | £1.48 (D) |
| HL31J | Mains Socket SA2020 | £1.36 (D) |
| HL33L | Mains Plug SA2367 | £1.55 (D) |
| HL34M | Mains Socket SA2368 | 93p (E) |
| HL36P | Mains Plug P635 | £1.05 (D) |
| HL37S | Mains Socket P636 | £1.29 (D) |
| HL39N | Mains Plug P551 | £2.97 (C) |

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| | | |
|---|---|---|
| HL40T | Mains Socket P552 | 98p (E) |
| HL50E | Sleeve 8037 | 12p (G) |
| RK71N | Video Kopy Kit | £11.95 (A) |
| HL51F | Boot 9455 | 35p (F) |
| HL52G | Boot 8878 | 38p (F) |
| RK84F | Video Lead 1 | 69p (E) |
| RK85G | Video Lead 2 | £1.95 (D) |
| RK70M | Video Lead 3 | £2.45 (C) |
| RK86T | Video Lead 4 | £1.15 (D) |
| RK87U | Video Lead 5 | £2.15 (C) |
| RK88V | Video Lead 6 | £1.65 (D) |

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| | | |
|---|---|---|
| RW04E | Adaptor E | 45p (F) |
| RW01B | Adaptor B | 45p (F) |
| YW38R | Adaptor W | 59p (E) |
| YW39N | Adaptor X | 56p (E) |
| RW07H | Adaptor H | 38p (F) |
| RW03D | Adaptor D | 40p (F) |
| RW11M | Adaptor M | 39p (F) |
| RW06G | Adaptor G | 46p (F) |
| RW08J | Adaptor J | 37p (F) |
| RW00A | Adaptor A | 42p (F) |
| YW34M | Adaptor S | 55p (E) |
| YW35Q | Adaptor T | £1.25 (D) |
| RW05F | Adaptor F | 40p (F) |
| RW09K | Adaptor K | 40p (F) |
| RW02C | Adaptor C | 45p (F) |
| YW37S | Adaptor V | £1.55 (D) |
| RW12N | Adaptor N | 45p (F) |
| YW33L | Adaptor R | £1.28 (D) |
| HL53H | Adaptor P | £1.30 (D) |
| YW36P | Adaptor U | 99p (E) |
| RK55K | Adaptor Y | 42p (F) |
| RK56L | Adaptor Z | 48p (F) |
| RW27E | Dinpak P | 60p (E) |
| RW26D | Dinpak N | £1.20 (D) |
| RW45Y | Dinpak 273 | £1.45 (D) |
| RW44X | Dinpak 262 | 75p (E) |
| RW47B | Dinpak 275 | 95p (E) |
| RW25C | Dinpak M | £1.55 (D) |
| RW46A | Dinpak 274 | £1.50 (D) |
| RW15R | Dinpak B | £1.55 (D) |
| RW14Q | Dinpak A | £1.10 (D) |
| RW43W | Dinpak 254 | £1.10 (D) |
| RW16S | Dinpak C | £1.10 (D) |
| RW22Y | Dinpak J | 69p (E) |

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| | | |
|---|---|---|
| RW23A | Dinpak K | 65p (E) |
| RW24B | Dinpak L | 87p (E) |
| RW18U | Dinpak E | 82p (E) |
| RW19V | Dinpak F | 95p (E) |
| RW17T | Dinpak D | £1.42 (D) |
| RW20W | Dinpak G | £1.34 (D) |
| RW49D | Dinpak 280 | £1.55 (D) |
| RW48C | Plugpak 279 | 89p (E) |
| RW50E | Plugpak 282 | 89p (E) |
| RW51F | Plugpak 283 | £1.85 (D) |
| RW28F | Plugpak Q | 65p (E) |
| RW31J | Plugpak T | £2.25 (C) |
| RW34M | Plugpak X | £2.48 (C) |
| RW35Q | Plugpak HD Guitar | £4.45 (C) |
| RK58N | Plugpak Y | £1.55 (D) |
| RK27E | Plugpak Z | 96p (E) |
| RK57M | Plugpak W | £1.45 (D) |

## ELECTRICAL

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| | | |
|---|---|---|
| HF01B | Terminal Block 5A | 35p (F) |
| HL54J | Terminal Block 15A | 69p (E) |
| HL55K | Terminal Block 30A | £1.10 (D) |
| HL56L | Terminal Block Conn | £1.47 (D) |
| HL57M | 5 Amp Plug Nylon | 59p (E) |
| RW67X | 13 Amp Plug Nylon | 79p (E) |
| HL58N | Rubber 13A Plug | 99p (E) |
| HL59P | 15A Plug Nylon | 99p (E) |
| HL60Q | Kettle Connector | £1.94 (D) |
| HL61R | Flex Connector | £1.40 (D) |
| HL62S | Mains Adaptor 2 way | £2.20 (C) |
| HL63T | Mains Adaptor 3 way | £2.95 (C) |
| HL64U | Shaver Adaptor | £1.15 (D) |

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| | | |
|---|---|---|
| HL65V | Junction Box Small | £1.50 (D) |
| HL66W | Junction Box Lge | 99p (E) |
| HL67X | Junction Box RM | £1.75 (D) |
| HL68Y | Single Skt Unswitched | £1.85 (D) |
| HL69A | Dble Skt Unswitched | £3.75 (C) |
| HL71N | Single Sw Socket | £2.60 (C) |
| HL72P | Double Sw Socket | £5.20 (B) |
| HL73Q | Trailing Skt Single | £1.75 (D) |
| HL74R | Trailing Dble Skt | £3.45 (C) |
| RW68Y | Dis Board 4 way | £8.75 (B) |
| HL76H | Cooker Switch | £8.45 (B) |
| HL78K | Shaver Skt Isolated | £18.75 (A) |
| HL79L | Shaver Socket | 82p (E) |
| HL82D | Flex Outlet Unswchd | £3.95 (C) |

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| | | |
|---|---|---|
| HL83E | Switched Flex Outlet | £4.38 (C) |
| HL86T | Blanking Plate | 85p (E) |
| HL87U | 20A Plateswitch | £3.20 (C) |
| HL88V | 20A Water Htr Switch | £4.85 (C) |
| HL89W | Light Swch ST Single | £1.25 (D) |
| HL90X | Light Swch DT Single | £1.49 (D) |
| HL91Y | Light Swch Dual | £2.39 (C) |
| HL92A | Light Swtch Triple | £3.25 (C) |
| FQ10L | 250W Rotary Dimmer | £7.30 (B) |
| FQ12N | 250W Push Dmr Sngl | £9.95 (B) |
| XX35Q | Remote Control Dimmr | £29.45 (A) |

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| XX36P | Dmmr Control Box | £15.75 (A) |
| FQ15R | Security Dimmer | £16.95 (A) |
| FQ16S | Auto Security Switch | £15.32 (A) |
| YB09K | Fl Pattress 16mm Sgl | 96p (E) |

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| | | |
|---|---|---|
| YB10L | Fl Pattress 25mm Sgl | 70p (E) |
| YB11M | Fl Pattress 25mm Dbl | £1.06 (D) |
| YB12N | Fl Pattress 35mm Dbl | £1.34 (D) |
| YB13P | Steel Pattress 47mm | £2.62 (C) |
| YB14Q | Sur Patt 20mm Sngl | 78p (E) |
| YB15R | Sur Patt 29mm Sngl | 98p (E) |
| YB16S | Sur Patt 29mm Dble | £1.65 (D) |
| YB17T | Sur Patt 47mm Dble | £3.68 (C) |
| YB18U | Conversion Pattress | £2.62 (C) |
| FQ00A | Ceiling Switch 1-way | £2.65 (C) |
| FQ02C | Lampholder 702 | 79p (E) |
| FQ04E | Lampholder 252 1/2in | 65p (E) |
| LB63T | Bayonet L/Hldr | 88p (E) |
| FQ05F | Ceiling Rose | £1.12 (D) |
| FQ07H | Starter 80W | 25p (F) |
| YB19V | Time Switch | £16.95 (A) |
| WY23A | Timetouch | £24.80 (A) |

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| | | |
|---|---|---|
| YB20W | Room Thermostat | £8.25 (B) |
| XY08J | Extn Lead 5A | £13.80 (A) |
| XY09K | Extn Lead 13A | £17.95 (A) |

## HARDWARE

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| | | |
|---|---|---|
| BF00A | Bolt 2BA 1/2in | 33p (F) |
| BF01B | Bolt 2BA 1in | 85p (E) |
| BF02C | Bolt 4BA 1/4in | 25p (F) |
| BF03D | Bolt 4BA 1/2in | 28p (F) |
| BF04E | Bolt 4BA 1in | 30p (F) |
| LR52G | Bolt 4BA 1.1/2in | 33p (F) |
| BF05F | Bolt 6BA 1/4in | 12p (G) |
| BF06G | Bolt 6BA 1/2in | 14p (G) |
| BF07H | Bolt 6BA 1in | 43p (F) |
| LR53H | Bolt 6BA 1.1/2in | 63p (E) |
| BF08J | Bolt 8BA 1/4in | 28p (F) |
| BF09K | Bolt 8BA 1/2in | 24p (F) |
| LR54J | C/S Screw 2BA 1/2in | 14p (G) |
| LR55K | C/S Screw 4BA 1/4in | 14p (G) |
| BF10L | C/S Screw 4BA 1/2in | 17p (G) |
| BF11M | C/S Screw 4BA 1in | 32p (F) |
| LR56L | C/S Screw 6BA 1/4in | 9p (H) |
| BF12N | C/S Screw 6BA 1/2in | 19p (G) |
| BF13P | C/S Screw 6BA 1in | 35p (F) |
| LR00A | C/S Screw 8BA 1/2in | 29p (F) |
| BF14Q | Panel Screw | 3p (H) |
| LR75S | C/S Panel Screw | 5p (H) |
| BF16S | Nut 2BA | 19p (G) |
| BF17T | Nut 4BA | 19p (G) |
| BF18U | Nut 6BA | 12p (G) |
| BF19V | Nut 8BA | 12p (G) |
| BF20W | Washer 2BA | 12p (G) |
| BF21X | Washer 4BA | 9p (H) |
| BF22Y | Washer 6BA | 9p (H) |
| BF23A | Washer 8BA | 9p (H) |
| LR76H | Cup Washer | 2p (H) |
| BF24B | Shake 2BA | 9p (H) |
| BF25C | Shake 4BA | 9p (H) |
| BF26D | Shake 6BA | 9p (H) |
| LR01B | Shake 8BA | 8p (H) |
| BF27E | Tag 2BA | 12p (G) |
| BF28F | Tag 4BA | 9p (H) |
| BF29G | Tag 6BA | 13p (G) |
| LR02C | Tag 8BA | 11p (G) |
| BF30H | Pozi Screw M5 6mm | 23p (G) |
| BF31J | Pozi Screw M5 12mm | 33p (F) |
| BF32K | Pozi Screw M5 25mm | 33p (F) |
| BF33L | Pozi Screw M4 6mm | 25p (F) |
| BF34M | Pozi Screw M4 12mm | 32p (F) |
| BF35Q | Pozi Screw M4 25mm | 27p (F) |
| BF36P | Pozi Screw M3 6mm | 13p (G) |
| LR57M | Pozi Screw M3 9mm | 13p (G) |
| BF37S | Pozi Screw M3 12mm | 15p (G) |
| BF38R | Pozi Screw M3 25mm | 27p (F) |
| LR58N | Pozi Screw M3 40mm | 33p (F) |
| BF39N | Pozi Screw M2.5 6mm | 15p (G) |
| BF40T | Pozi Screw M2.5 12mm | 18p (G) |
| BF41U | Pozi Screw M2 6mm | 29p (F) |
| BF46A | Isobolt M5 12mm | 55p (E) |
| BF48C | Isobolt M4 6mm | 26p (F) |
| BF49D | Isobolt M4 12mm | 33p (F) |
| BF50E | Isobolt M4 25mm | 57p (E) |
| BF51F | Isobolt M3 6mm | 20p (G) |
| HY30H | Isobolt M3 9mm | 12p (G) |
| BF52G | Isobolt M3 12mm | 26p (F) |
| BF53H | Isobolt M3 25mm | 35p (F) |
| BF54J | Isobolt M2.5 6mm | 19p (G) |
| BF55K | Isobolt M2.5 12mm | 24p (F) |
| BF56L | Isonut M5 | 20p (G) |
| BF57M | Isonut M4 | 20p (G) |
| BF58N | Isonut M3 | 15p (G) |
| BF59P | Isonut M2.5 | 14p (G) |
| LR59P | Isonut M2 | 10p (G) |
| BF60Q | Isowasher M5 | 15p (G) |
| BF61R | Isowasher M4 | 9p (H) |
| BF62S | Isowasher M3 | 9p (H) |
| BF63T | Isowasher M2.5 | 9p (H) |
| LR60Q | Isowasher M2 | 7p (H) |
| BF42V | Isoshake M5 | 12p (G) |
| BF43W | Isoshake M4 | 9p (H) |
| BF44X | Isoshake M3 | 9p (H) |
| BF45Y | Isoshake M2.5 | 9p (H) |
| LR61R | Isoshake M2 | 9p (H) |

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| | | |
|---|---|---|
| LR62S | Isotag M5 | 18p (G) |
| LR63T | Isotag M4 | 20p (G) |
| LR64U | Isotag M3 | 12p (G) |
| LR65V | Isotag M2.5 | 12p (G) |
| LR66W | Isotag M2 | 9p (H) |
| BF68Y | Slf-Tpr No.8 x 3/8in | 22p (G) |
| BF69A | Slf-Tpr No.8 x 1/2in | 25p (F) |
| LR67X | Slf-Tpr No.6 x 3/8in | 20p (G) |
| BF67X | Slf-Tpr No.6 x 1/2in | 22p (G) |
| BF65V | Slf-Tpr No.4 x 3/8in | 15p (G) |
| BF66W | Slf-Tpr No.4 x 1/2in | 16p (G) |
| BF64U | Slf-Tpr No.2 x 3/16" | 12p (G) |
| LR68Y | Slf-Tpr No.2 x 3/8in | 14p (G) |
| BF70M | Nyl 2BA 1/2in | 36p (F) |
| BF71N | Nyl 2BA 1in | 55p (E) |
| BF72P | Nyl 4BA 1/2in | 39p (F) |
| BF73Q | Nyl 4BA 1in | 55p (E) |
| BF74R | Nyl 4BA 1.1/2in | £1.55 (D) |
| BF75S | Nyl 6BA 1/2in | 50p (E) |
| BF76H | Nyl 6BA 1in | 60p (E) |
| BF77J | Nyl 8BA 1/2in | 60p (E) |
| BF78K | Nyl Nut 2BA | 55p (E) |
| BF79L | Nyl Nut 4BA | 55p (E) |
| BF80B | Nyl Nut 6BA | 53p (E) |
| BF81C | Nyl Nut 8BA | 55p (E) |
| BF82D | Nyl Washer 2BA | 18p (G) |
| BF83E | Nyl Washer 4BA | 18p (G) |
| BF84F | Nyl Washer 6BA | 18p (G) |

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| BF85G | Nyl Washer 8BA | 32p (F) |
| WH18U | Nyl C/S Scw M3 x12mm | 4p (H) |
| WH19V | Nylon Nut M3 | 4p (H) |
| BF15R | Spring Clip | 4p (H) |
| YW94C | Batten Clip | 4p (H) |
| LB99H | Blk Wdscrw No 4 1/2" | 15p (G) |
| BH44X | Plas Fixing | 12p (G) |
| YL23A | Hand Wheel Bolt | 35p (F) |
| FW10L | Spade 2BA | 28p (F) |
| FW11M | Spade 4BA | 23p (G) |
| FW13P | Studding 2BA | 32p (F) |
| FW14Q | Studding 4BA | 34p (F) |
| FW15R | Studding 6BA | 30p (F) |
| FW30H | 4BA Spacer 1/8in | 38p (F) |
| FW31J | 4BA Spacer 1/4in | 48p (F) |
| FW32K | 4BA Spacer 1/2in | 52p (E) |
| FW33L | 6BA Spacer 1/8in | 35p (F) |
| FW34M | 6BA Spacer 1/4in | 38p (F) |
| FW35Q | 6BA Spacer 1/2in | 49p (F) |
| LR69A | 8BA Spacer 1/8in | 32p (F) |
| LR70M | 8BA Spacer 1/4in | 36p (F) |
| LR71N | Thrded Spcr 4BA | 78p (E) |
| LR72P | Thrded Spcr 6BA | 59p (E) |

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| | | |
|---|---|---|
| FW16S | Standoff Short | 8p (H) |
| FW17T | Standoff Medium | 8p (H) |
| FW18U | Standoff Long | 8p (H) |
| LR03D | Terry Clip 1/2in. | 10p (G) |
| LR73Q | Terry Clip 1.1/2in. | 26p (F) |
| FW59P | Grommet Small | 2p (H) |
| FW60Q | Grommet Large | 2p (H) |
| LR47B | SR Grommet 3P-4 | 6p (H) |
| LR48C | SR Grommet 5M-3 | 7p (H) |
| LR49D | SR Grommet 6W-1 | 10p (G) |
| LR50E | SR Grommet 7K-2 | 26p (F) |
| LR51F | Sealing Grommet | 8p (H) |
| BL74R | Flexigrommet A | 24p (F) |
| BL75S | Flexigrommet B | 29p (F) |
| BL76H | Flexigrommet C | 31p (F) |
| FW36P | Hole Plug 1/4in | 10p (G) |
| FW37S | Hole Plug 3/8in | 12p (G) |
| HB22Y | Quickstick Pads | 9p (H) |
| HB21X | Velcromounts | 15p (G) |
| LQ12N | Sealing Strip | 79p (E) |

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| | | |
|---|---|---|
| LH12N | Aly Sheet 18 swg | £1.59 (D) |
| LH13P | Aly Sheet 16 swg | £3.85 (C) |
| WH48C | Mains Warning Label | 15p (G) |
| XX31J | PCB Guides | 25p (F) |
| YX88V | P7 Paper Roll | 46p (F) |
| YX89W | P7 Ink Cassette | £2.75 (C) |
| XH39N | Transfer 1/8in Black | £1.35 (D) |
| XH40T | Transfer 1/8in Red | £1.56 (D) |
| XH41U | Transfer 1/8in White | £1.56 (D) |
| XH42V | Transfer 1/4in Black | £1.56 (D) |
| XH43W | Transfer 1/4in Red | £1.45 (D) |
| XH44X | Transfer 1/4in White | £1.35 (D) |
| XH45Y | Panel Transfer Black | £1.56 (D) |
| XH46A | Panel Transfer Red | £1.56 (D) |
| XH47B | Panel Transfer White | £1.35 (D) |

## KNOBS

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| | | |
|---|---|---|
| RW75S | Knob BK12 | 16p (G) |
| RX99H | Knob RN92 | 28p (F) |
| RW87U | Knob KB4 | 22p (G) |
| RW86T | Knob KB3 | 45p (F) |
| RX09K | Knob R78 | 58p (E) |
| HB23A | Knob K1 | 29p (F) |
| HB24B | Knob K2 | 39p (F) |
| HB19V | Knob RK401 | 95p (E) |
| HB57M | Knob RK403 | £1.55 (D) |
| RW88V | Knob M1 | 38p (F) |
| RW89W | Knob M2 | 36p (F) |
| RW90X | Knob M3 | 26p (F) |
| RX00A | Knob M4 | 45p (F) |
| RX10L | Knob R81 | 45p (F) |
| RX11M | Knob 82. | 55p (E) |

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| | | |
|---|---|---|
| RW78K | Knob F10 | 35p (F) |
| HB26D | Knob F11 | 31p (F) |
| RX01B | Knob NK2 | 45p (F) |
| RX02C | Knob PK2 | 45p (F) |
| YX01B | Knob K7A | 24p (F) |
| YX02C | Knob K7B | 27p (F) |
| YX03D | Knob K7C | 32p (F) |
| YX04E | Knob K7D | 49p (F) |
| HB28F | Knob R51 | 52p (E) |
| HB29G | Knob R52 | 53p (E) |
| RX07H | Knob R76 | 55p (E) |
| RX08J | Knob R77 | 64p (E) |
| HB30H | Knob R53 | 69p (E) |
| HB31J | Knob R54 | 96p (E) |
| YR64U | Knob K8A | 43p (F) |
| YR65V | Knob K8B | 56p (E) |
| YR66W | Knob K8C | 64p (E) |
| RK89W | Knob K10A | 45p (F) |
| RK90X | Knob K10B | 57p (E) |
| RK91Y | Knob K10C | 75p (E) |
| HB34M | Knob K105L | 95p (E) |
| HB35Q | Knob K106L | £1.74 (D) |
| HB32K | Knob K105 | 59p (E) |
| HB33L | Knob K106 | 95p (E) |
| HB36P | Knob K15 | 55p (E) |
| HB38R | Knob K30 | 78p (E) |

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| | | |
|---|---|---|
| HB39N | Knob K44 | 69p (E) |
| HB40T | Knob K45 | 79p (E) |
| HB41U | Knob K46 | £1.15 (D) |
| RX16S | Collet Knob Black | 41p (F) |
| WL45Y | 15mm Collet Cap Blk | 5p (H) |
| WL46A | 15mm Collet Cap Blue | 5p (H) |
| WL47B | 15mm Collet Cap Grn | 5p (H) |
| WL48C | 15mm Collet Cap Grey | 5p (H) |
| WL49D | 15mm Collet Cap Red | 5p (H) |
| WL50E | 15mm Collet Cap Yllw | 5p (H) |
| WL51F | 15mm Collet Pntr Blk | 5p (H) |
| WL52G | 15mm Collet Pntr Blu | 5p (H) |
| WL53H | 15mm Collet Pntr Grn | 5p (H) |
| WL54J | 15mm Collet Pntr Gry | 5p (H) |
| WL55K | 15mm Collet Pntr Red | 5p (H) |
| WL56L | 15mm Collet Pntr Ylw | 5p (H) |
| RX18U | 15mm Collet Nut Cvr. | 13p (G) |
| RX19V | 15mm Collet Indctr. | 18p (G) |
| RX20W | 15mm Collet Skirt | 21p (G) |
| RX21X | 15mm Collet Stator | 24p (F) |
| WL43W | 3/8in Nut | 16p (G) |
| WL44X | 10mm Nut | 16p (G) |
| YG40T | Low-Cost Collet Knob | 27p (F) |
| QY00A | LC Cap Black | 5p (H) |
| QY01B | LC Cap Blue | 5p (H) |
| QY02C | LC Cap Green | 5p (H) |
| QY03D | LC Cap Grey | 5p (H) |
| QY04E | LC Cap Red | 5p (H) |

| 1983 Catalogue Page No. | | VAT inclusive PRICE |
|---|---|---|
| QY05F | LC Cap White | 5p (H) |
| QY06G | LC Cap Yellow | 5p (H) |
| RX22Y | Slide Knob A | 15p (G) |
| YG09K | Slide Knob B | 21p (G) |
| YG10L | Slide Knob C Black | 20p (G) |
| YG11M | Slide Knob C Chrome | 29p (F) |
| RX24B | Slide Knob F Blk | 17p (G) |
| RX25C | Slide Knob F Blue | 17p (G) |
| RX26D | Slide Knob F Green | 17p (G) |
| RX27E | Slide Knob F Grey | 17p (G) |
| RX28F | Slide Knob F Red | 17p (G) |

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| | | |
|---|---|---|
| RX29G | Spindle Coupler | 59p (E) |
| RX30H | Ext Spindle | 74p (E) |
| RX38R | Nylon Rod | 14p (G) |
| RX46A | Cord Drive Steel | £1.51 (D) |
| RX31J | Brass Bush | 53p (E) |
| BL73Q | Drive Cord | 7p (H) |
| RX43W | Cord Drum Small | £1.05 (D) |
| RX94C | Cord Drum Large | £1.05 (D) |
| RX44X | Flywheel | £3.35 (C) |
| HB45Y | Aluminium Dial | £6.60 (B) |
| RX42V | Ball Drive | £2.35 (C) |
| HB42V | Mini Ball Drive | £1.95 (D) |
| RX39N | Vernier Dial Small | £2.35 (C) |
| RX40T | Vernier Dial Medium | £2.95 (C) |
| RX41U | Vernier Dial Large | £3.84 (C) |
| HB46A | White Pointer | 38p (F) |
| HB47B | Ball Drive Pointer | 62p (E) |
| HB48C | Spring Short | 9p (H) |
| HB49D | Spring Medium | 9p (H) |
| HB50E | Spring Long | 9p (H) |
| RX95D | Pulley 1/2in | 14p (G) |

## MICROPHONES

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| | | |
|---|---|---|
| LB92A | Phone Coil | 95p (E) |
| LB93B | Crystal Mic In Plas | 50p (E) |
| HY33L | Crystal Mic In Metal | 84p (E) |
| LB68Y | Lapel Mic | £1.28 (D) |
| YB31J | Cassette Mic Jacks | £1.95 (D) |
| YB32K | Cassette Mic DIN | £2.75 (C) |
| YB33L | Electret Cssette Mic | £2.95 (C) |
| WF35Q | Dynamic Ball Mic | £9.93 (B) |
| LH87U | Dynamic Stereo Mics | £10.25 (A) |
| WF05F | Communications Mic | £5.75 (B) |

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| | | |
|---|---|---|
| YW70M | Diff Comm Mic | £8.25 (B) |
| RK03D | Power Mic DM313P | £11.75 (A) |
| YW77J | Mic Hldr Screw-Fix | 28p (F) |
| YW78K | Mic Hldr Adhesive | 49p (F) |
| YW79L | Mic Hldr Magnetic | 52p (E) |
| RK04E | Power Mic DM311P | £13.95 (A) |
| XY72P | Base Station Mic | £29.30 (A) |

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| | | |
|---|---|---|
| XG11M | Base Stn Mic DX357 | £33.50 (A) |
| XG12N | Base Stn Mic BSA610A | £33.50 (A) |
| LB69A | Tie-Clip Mic | £6.45 (B) |
| YW71N | UM Tie-Clip Mic | £12.45 (A) |
| YB35Q | Eletret Mic EM507 | £10.45 (A) |

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| | | |
|---|---|---|
| WF34M | Electret Mic Dual-Z | £16.75 (A) |
| YB36P | Unisound Mic EM82D | £19.17 (A) |
| YB37S | Unisound Mic EM83D | £20.85 (A) |
| WY06G | Super Cardioid Mic | £23.55 (A) |
| WY07H | Stereo Electret Mic | £19.75 (A) |
| YB38R | Unisnd Dyn DM-31011 | £35.45 (A) |

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| | | |
|---|---|---|
| LB94C | Screen S15 | £6.58 (B) |
| LB95D | Mic Unit U15 | £10.75 (A) |
| BK01B | FM Mic | £19.50 (A) |
| BK02C | FM Mic Adaptor | £19.50 (A) |
| LB35Q | Mic Windshield | 45p (F) |
| RK92A | Universal Mic Holder | £1.85 (D) |
| RK93B | Tapered Mic Holder | £1.45 (D) |
| YW72P | Gsneck Mic Stand 8in | £1.99 (D) |
| LH88V | Gsneck Mic Stnd 13in | £2.95 (C) |
| WF36P | Gsneck Mic Stnd 19in | £3.45 (C) |
| YW73Q | Plastic Gsneck Base | 65p (E) |
| YW74R | Metal Gsneck Base | £3.25 (C) |
| WF37S | Bkt For Gsnk Stand | £1.95 (D) |
| YW75S | Cast Base Mic Stand | £3.85 (C) |
| YW76H | Extra Hgt Mic Stand | £6.95 (B) |

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| | | |
|---|---|---|
| LB96E | Table-Top Mic Stand | £2.25 (C) |
| XB45Y | 5-Foot Mic Stand | £13.45 (A) |
| XB46A | Boom Arm | £12.65 (A) |

## MUSIC & EFFECTS

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| | | |
|---|---|---|
| LB97F | Pre-Amp EQ2S | £3.45 (C) |
| YB39N | Pre-Amp CS5 | £8.43 (B) |
| XB30H | Mono Mic Mixer | £8.65 (B) |
| YK55K | Stereo Mixer MM2 | £10.75 (A) |
| XB29G | Stereo Mixer | £22.88 (A) |

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| | | |
|---|---|---|
| AF60Q | Graphic Eqlizr GE206 | £59.95 (A) |
| AF27E | GE1305 Equaliser | £77.50 (A) |
| AF59P | Graphic Eq. GE909 | £124.50 (A) |
| LB66W | Mini-Phaser | £19.77 (A) |
| YB30H | Fuzz Box | £15.25 (A) |

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| | | |
|---|---|---|
| XB41U | Fuzz-Wah Pedal | £29.50 (A) |
| XB34M | Vibra Chorus | £57.30 (A) |
| YB88V | Mini Compressor | £21.20 (A) |
| XB33L | Echo Chamber | £67.33 (A) |
| LB67X | Echo Chamber Tape | £4.99 (C) |
| XY80B | BBD Echo Machine | £72.50 (A) |

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| | | |
|---|---|---|
| YB40T | Cry Guitar Pick-Up | £3.93 (C) |
| YB42V | Steel Mag Pick-up | £8.45 (B) |
| YL08J | Pickup Transl.AJ21 | £27.95 (A) |
| YL09K | Pickup Transl.AJ51 | £19.95 (A) |
| YL07H | Pickup Switch | £3.24 (C) |
| LB98G | Strap Button | 55p (E) |
| LB60Q | Guitar Strings Steel | £1.72 |

## OPTO-ELECTRICAL

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| | | |
|---|---|---|
| RX86T | MES Batten Hldr | 21p (G) |
| RX57M | Holder MES Amber | £1.45 (D) |
| RX58N | Holder MES Blue | DIS |
| RX59P | Holder MES Clear | £1.45 (D) |
| RX60Q | Holder MES Green | £1.45 (D) |

## TRADE QUANTITIES

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. See table at start of price list. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity.

Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.

| 1983 Catalogue Page No. | | VAT inclusive PRICE |
|---|---|---|
| RX61R | Holder MES Red | £1.45 (D) |
| RX76H | Dmd LES Lhldr Blue | 35p (F) |
| RX77J | Dmd LES Lhldr Green | 35p (F) |
| RX78K | Dmd LES Lhldr Red | 35p (F) |
| RX79L | Dmd LES Lhldr White | 35p (F) |
| RX80B | Dmd LES Lhldr Yellow | 35p (F) |
| RX67X | Flt-Tp LES Lhldr Blu | 35p (F) |
| RX68Y | Flt-Tp LES Lhldr Grn | 35p (F) |
| RX69A | Flt-Tp LES Lhldr Red | 35p (F) |
| FF66W | Fluted Lhldr Amber | 30p (F) |
| FF67X | Fluted Lhldr Clear | 30p (F) |
| FF68Y | Fluted Lhldr Green | 30p (F) |
| FF69A | Fluted Lhldr Red | 30p (F) |
| YY00A | LES Cover Amber | 6p (H) |
| YY01B | LES Cover Blue | 6p (H) |
| YY02C | LES Cover Green | 6p (H) |
| YY03D | LES Cover Purple | 6p (H) |
| YY04E | LES Cover Red | 6p (H) |
| YY05F | LES Cover White | 6p (H) |
| YY06G | LES Cover Yellow | 6p (H) |
| BK52G | Min Neon Red | 30p (F) |
| BK53H | Min Neon Green | 30p (F) |
| BK54J | Min Neon Amber | 30p (F) |
| RX82D | Pan Neon Amber | 29p (F) |
| RX83E | Pan Neon Red | 29p (F) |
| BK51F | Pan Neon Green | 33p (F) |
| RX81C | Square Neon Red | 33p (F) |
| RX98G | Square Neon Green | 33p (F) |
| BK55K | Chrome Neon Red | 55p (E) |
| BK56L | Chrome Neon Green | 55p (E) |

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|---|---|---|
| RX70M | Wire Neon | 14p (G) |
| WQ13P | Wire Bulb 12V | 30p (F) |
| WL74R | LES Bulb 6V | 17p (G) |
| WL75S | LES Bulb 12V | 15p (G) |
| RX84F | Neon Bulb | 99p (E) |
| WL76H | Bulb MES 3.5V | 35p (F) |
| WL77J | Bulb MES 6V 0.24W | 36p (F) |
| WL78K | Bulb MES 6V 0.6W | 31p (F) |
| WL79L | Bulb MES 6.5V | 27p (F) |
| WL80B | Bulb MES 12V 1.2W | 28p (F) |
| WL81C | Bulb MES 12V 2.2W | 29p (F) |
| WL82D | Bulb MES 24V | 36p (F) |
| LQ10L | Portable Lamp | £6.95 (B) |
| XY71N | Caravan Lamp | £9.65 (B) |
| LQ11M | 12V Tube | £1.38 (D) |
| LL15R | 240V Inspection Lamp | £5.60 (B) |
| HB52G | Pygmy Bulb Blue | 90p (E) |
| HB53H | Pygmy Bulb Green | 90p (E) |
| HB54J | Pygmy Bulb Red | 90p (E) |
| HB55K | Pygmy Bulb White | 70p (E) |
| HB56L | Pygmy Bulb Yellow | 90p (E) |
| WF25C | Spot Lamp Amber | £2.85 (C) |
| WF26D | Spot Lamp Blue | £2.85 (C) |
| WF27E | Spot Lamp Clear | £2.35 (C) |
| WF28F | Spot Lamp Green | £2.85 (C) |
| WF29G | Spot Lamp Red | £2.85 (C) |
| WF30H | Spot Lamp Violet | £2.85 (C) |
| YB29G | Spot Holder | £3.96 (C) |
| XB31J | BC Clip-On Hdr Sngl | £4.99 (C) |
| XB32K | BC Clip-On Hdr Twin | £6.95 (B) |

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| | | |
|---|---|---|
| WF22Y | Gooseneck Lamp | £5.32 (B) |
| YK39N | Alarm Beacon | £18.45 (A) |
| WL32K | Mini LED Red | 10p (G) |
| WL33L | Mini LED Green | 19p (G) |
| WL34M | Mini LED Orange | 27p (F) |
| YY38R | Mini LED Yellow | 19p (G) |
| YY39N | Mini LED Clip | 2p (H) |
| WL27E | LED Red | 12p (G) |
| WL28F | LED Green | 19p (G) |
| WL29G | LED Orange | 33p (F) |
| WL30H | LED Yellow | 17p (G) |
| YY40T | LED Clip | 2p (H) |
| QW96E | Square LED Red | 36p (F) |
| YH60Q | Square LED Green | 36p (F) |
| YH61R | Square LED Yellow | 40p (F) |
| YH62S | Square LED Clip | 7p (H) |
| YY41U | Large LED Red | £1.49 (D) |
| YY42V | Large LED Clip | 21p (G) |
| YY45Y | Shape LED R1 Red | 20p (G) |
| YY46A | Shape LED R1 Green | 25p (F) |
| YY47B | Shape LED R1 Orange | 37p (F) |
| YY48C | Shape LED R1 Yellow | 27p (F) |
| YY49D | Shape LED S2 Red | 20p (G) |
| YY50E | Shape LED S2 Green | 27p (F) |
| YY51F | Shape LED L3 Red | 21p (G) |
| YY52G | Shape LED L3 Green | 26p (F) |
| YY53H | Shape LED L3 Yellow | 26p (F) |
| YY54J | Shape LED T4 Red | 22p (G) |
| YY55K | Shape LED T4 Green | 26p (F) |
| YY56L | Shape LED T4 Yellow | 26p (F) |
| YY57M | Shape LED A5 Red | 23p (G) |
| YY58N | Shape LED A5 Green | 27p (F) |

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| | | |
|---|---|---|
| YH53H | Cliplite Amber | 16p (G) |
| YH54J | Cliplite Clear | 16p (G) |
| YH55K | Cliplite Green | 16p (G) |
| YH56L | Cliplite Red | 16p (G) |
| YH57M | Cliplite Yellow | 16p (G) |
| YY61R | Multicolour LED | TEMP |
| QR54J | Rect Multicolour LED | 75p (E) |
| YY59P | Chrome LED Small | 49p (F) |
| QY46A | Chrome LED Small Gn | 53p (E) |
| YY60Q | Chrome LED Large Red | 54p (E) |
| QY47B | Chrome LED Large Gn | 56p (E) |
| QY48C | Black Bezel LED Red | 38p (F) |
| QY49D | Black Bezel LED Gn | 47p (F) |
| BY65V | Red Bargraph Dslpy | £3.26 (C) |
| YG33L | Green Bargraph Dslpy | £3.22 (C) |
| YG34M | Ornge Bargraph Dspy | £2.95 (C) |
| YG35Q | Yllow Bargraph Dsply | £3.35 (C) |
| FR36P | 7-Seg Red Type 1 | £1.07 (D) |
| FR38R | 7-Seg Red Type 4 | £1.25 (D) |

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| | | |
|---|---|---|
| FR39N | "1/2" Display Type 1 | 99p (E) |
| FR41U | "1/2" Display Type 4 | £1.07 (D) |
| BK03C | Vertisocket Type 1 | £1.15 (D) |
| BK04D | Vertisocket Type 2 | £2.45 (C) |
| BY66W | DD Display Type A | £1.98 (D) |
| BY67X | DD Display Type AF | 50p (E) |
| BY68Y | DD Display Type C | £1.98 (D) |
| XX08J | 4-Dig Dspy Cmn Cath | £2.69 (C) |
| BY70M | 4 Dig Dis Cmn Anode | £1.50 (D) |

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| | | |
|---|---|---|
| HQ36P | Mult Cmn Cath Disply | £3.45 (C) |
| FR32K | Filter Amber | 85p (E) |
| FR33L | Filter Green | £1.20 (D) |
| FR34M | Filter Red | 85p (E) |
| FR35Q | Filter Yellow | 65p (E) |
| FY89W | Lqd Crystal Display | £4.82 (C) |

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|---|---|---|
| WL35Q | Opto-Isolator | 69p (E) |
| YY62S | Dual Opto-Isolator | £1.58 (D) |
| YY63T | Quad Opto-Isolator | £2.96 (C) |
| WQ70M | Darlington Isolator | 74p (E) |
| YY64U | SCR Isolator | £2.12 (C) |
| QQ10L | Triac Isolator | £1.55 (D) |
| YY65V | Infra-Red Source | 38p (F) |
| YY66W | Infra-Red Sensor | 31p (F) |

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| | | |
|---|---|---|
| RK22Y | Solar Panel 6V | £7.95 (B) |
| RK23A | Solar Panel 9V | £8.95 (B) |
| RK24B | Solar Panel 12V | £10.25 (A) |
| YH70M | IR Emitter TIL38 | 49p (F) |
| YH71N | Photodiode TIL100 | 93p (E) |
| BL23A | Solar Cess MS4A | £2.95 (C) |
| QF30H | BPX25 | £4.20 (C) |

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|---|---|---|
| HQ61R | MEL 12 | 38p (F) |
| YQ62S | Xenon Tube | £2.40 (C) |
| YQ63T | Trigger Transfmr | 49p (F) |
| XR56L | 1mm Light Guide | 67p (E) |
| XL11M | Laser Tube | £124.00 (A) |
| HY19V | 5KV Laser PCB | £4.80 (C) |
| HQ63T | Lens | £2.30 (C) |
| HQ64U | Lensholder | 69p (E) |

## ORGAN COMPONENTS

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| | | |
|---|---|---|
| QL02C | SAM77 | £1.20 (D) |

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| | | |
|---|---|---|
| XB10L | DMO2 | £14.82 (A) |
| XB11M | DMO2T | £16.82 (A) |

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| | | |
|---|---|---|
| XL08J | Short Spring Line | £5.53 (B) |
| FB98G | Rubber Coupling | 66p (E) |
| XB84F | Long Spring Line | £11.13 (A) |
| XB85G | MES Driver Module | £6.95 (B) |
| YL17T | Reverb PSU Module | £4.73 (C) |
| XB17T | Mid Kbd 49-Note C-C | £23.40 (A) |
| XB13P | KB Mounting Strip | 39p (F) |

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| | | |
|---|---|---|
| XB14Q | Keyboard 48-Note | £23.94 (A) |
| XB15R | Keyboard 49-Note | £27.50 (A) |
| XB16S | Keyboard 61-Note | £28.95 (A) |
| XY92A | Twin Kbd & Frame | £49.90 (A) |
| XY97F | Kbd Separator | £1.95 (D) |
| BH62S | Spacer Block | 4p (H) |
| BH63T | Keyboard Spacer | 2p (H) |
| XB94C | Contact Block 1WG | 29p (F) |
| XB01B | Contact Block GJ | 45p (F) |
| XB02C | Contact Block GB2 | 78p (E) |
| XB03D | Contact Block GC3 | DIS |
| QY07H | Contact Springs | 8p (H) |
| XB00A | Gold Wire | £1.10 (D) |

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|---|---|---|
| XB04E | Earth Bar | 23p (G) |
| FL66W | Stop Tab Black | 75p (E) |
| FL67X | Stob Tab Blue | 75p (E) |
| FL68Y | Stop Tab Green | 75p (E) |
| FL69A | Stop Tab Grey | 75p (E) |
| FL70M | Stop Tab Ivory | 75p (E) |
| FL71N | Stop Tab Maroon | 75p (E) |
| FL72P | Stop Tab Orange | 75p (E) |
| FL73Q | Stop Tab Red | 75p (E) |
| FL74R | Stop Tab White | 75p (E) |
| FL75S | Stop Tab Yellow | 75p (E) |
| BR05F | S Tab Acc Del Trem | £1.10 (D) |
| BR47B | S Tab Bass Guitar | £1.10 (D) |
| BR67X | S Tab Bourdon 8' | £1.10 (D) |
| BR06G | S Tab Cello 16' | £1.10 (D) |
| BR07H | S Tab Clarinet 8' | £1.10 (D) |
| BR08J | S Tab Clarion 4' | £1.10 (D) |
| BY00A | S Tab Clavichord | £1.10 (D) |
| BY01B | S Tab D/B to Rotor | £1.10 (D) |
| BY02C | S Tab Dly Vbrato Acc | £1.10 (D) |
| BY03D | S Tab Dly Vbrto Solo | £1.10 (D) |
| BR09K | S Tab Diapason 8' | £1.10 (D) |
| BR68Y | S Tab Diapason 16' | £1.10 (D) |
| BR10L | S Tab Drawbars Acc | £1.10 (D) |
| BR11M | S Tab Drawbars Solo | £1.10 (D) |
| BR12N | S Tab Dulciana 8' | £1.10 (D) |
| BR13P | S Tab Flute 1' | £1.10 (D) |
| BR14Q | S Tab Flute 2' | £1.10 (D) |
| BR15R | S Tab Flute 2.2/3' | £1.10 (D) |
| BR16S | S Tab Flute 4' | £1.10 (D) |
| BR17T | S Tab Flute 5.1/3' | £1.10 (D) |
| BR18U | S Tab Flute 8' | £1.10 (D) |
| BR19V | S Tab Flute 16' | £1.10 (D) |
| BR20W | S Tab French Horn 8' | £1.10 (D) |
| BR21X | S Tab Gedeckt 8' | £1.10 (D) |
| BY05F | S Tab Gedeckt 16' | £1.10 (D) |
| BY06G | S Tab Honky Tonk | £1.10 (D) |
| BR22Y | S Tab Horn 8' | £1.10 (D) |
| BY07H | S Tab Mixture 16' | £1.10 (D) |
| BR23A | S Tab Oboe 8' | £1.10 (D) |
| BR24B | S Tab Octave 4' | £1.10 (D) |
| BR25C | S Tab Pedal Sustain | £1.10 (D) |
| BY08J | S Tab Piano | £1.10 (D) |
| BY09K | S Tab Presets Cancel | £1.10 (D) |
| BY10L | S Tab Prsts to Rotor | £1.10 (D) |
| BY11M | S Tab Reed 4' | £1.10 (D) |
| BR26D | S Tab Reverb | £1.10 (D) |
| BY12N | S Tab Rotor Fast | £1.10 (D) |
| BY13P | S Tab Rotor To Main | £1.10 (D) |
| BR27E | S Tab Salicet 4' | £1.10 (D) |
| BR28F | S Tab Salicional 8' | £1.10 (D) |
| BR29G | S Tab Saxophone 16' | £1.10 (D) |
| BR30H | S Tab Solo Del Trem | £1.10 (D) |
| BR31J | S Tab String 4' | £1.10 (D) |
| BR32K | S Tab String 8' | £1.10 (D) |
| BR33L | S Tab Sub Bass 16' | £1.10 (D) |
| BY14Q | S Tab Sustain Acc | £1.10 (D) |
| BY15R | S Tab Sustain Solo | £1.10 (D) |
| BR34M | S Tab Tremulant | £1.10 (D) |
| BR35Q | S Tab Trumpet 8' | £1.10 (D) |
| BR36P | S Tab Tuba 16' | £1.10 (D) |
| BY16S | S Tab Vibrato | £1.10 (D) |
| BR37S | S Tab Vox Angelica 8' | £1.10 (D) |
| BR38R | S Tab Vox Humana 8' | £1.10 (D) |
| BH49D | Tablet Rocker Grey | 96p (E) |
| BH50E | Tablet Rocker Orange | 96p (E) |
| BH51F | Tablet Rocker Red | 96p (E) |
| BY17T | Mar Ky Tab Cello 16' | £3.45 |
| BY18U | Mar Key Tab Clar 8' | £3.45 |
| BY19V | Mar Ky Tab Clrion 4' | £3.45 |
| BY20W | Mar Key Tab Clav | £3.45 |
| BY21X | Mar Ky Tb D/B to Rtr | £3.45 |
| BY22Y | Mr Ky Tb Dly Vbr Acc | £3.45 |
| BY23A | Mr Ky Tb Dly Vbr Slo | £3.45 |
| BY24B | Mar Key Tab Diap 8' | DIS |

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| | | |
|---|---|---|
| BY25C | Mar Key Tab Diap 16' | DIS |
| BY26D | Mar K Tab Dbar Acc | £3.45 |
| BY27E | Mar K Tab Dbar Solo | £3.45 |
| BY28F | Mar Key Tab Dulc 8' | £3.45 |
| BY29G | Mar Key Tab Flute 1' | £3.45 |
| BY30H | Mar Key Tab Flute 2' | £3.45 |
| BY31J | Mr Ky Tb Flte 2 2/3' | DIS |
| BY32K | Mar Key Tab Flute 4' | DIS |
| BY33L | Mr Ky Tb Flte 5 1/3' | DIS |
| BY34M | Mar Key Tab Flute 8' | £3.45 |
| BY35Q | Mar Ky Tab Flute 16' | £3.45 |
| BY36P | Mr Ky Tb Frch Hrn 8' | £3.45 |
| BY37S | Mar Key Tab Gedkt 8' | £3.45 |
| BY38R | Mr Key Tab Gedkt 16 | £3.45 |
| BY39N | Mar Key Tab Hnky Tnk | £3.45 |
| BY40T | Mar Key Tab Horn 8' | £3.45 |
| BY41U | Mar Key Tab Mix 16' | DIS |
| BY42V | Mar Key Tab Oboe 8' | £3.45 |
| BY43W | Mar Key Tab Octve 4' | £3.45 |
| BY44X | Mar Key Tab Pdl Sus | £3.45 |
| BY45Y | Mar Key Tab Piano | £3.45 |
| BY46A | Mr Ky Tb Prsts Cncl | £3.45 |
| BY47B | Mr Ky Tb Prsts To Rr | £3.45 |
| BY48C | Mar Key Tab Reed 4' | £3.45 |
| BY49D | Mar Key Tab Reverb | £3.45 |
| BY50E | Mar Key Tab Rtr Fst | £3.45 |
| BY51F | Mr Ky Tb Rtr To Main | £3.45 |
| BY52G | Mar Key Tab Salict 4' | £3.45 |
| BY53H | Mar Key Tab Salic 8' | £3.45 |
| BY54J | Mar Key Tab Sax 16 | £3.45 |
| BY55K | Mar Key Tab Strng 4' | £3.45 |
| BY56L | Mar key Tab Strng 8' | £3.45 |
| BY57M | Mr Ky Tb Sb-Bss 16' | £3.45 |
| BY58N | Mar Key Tab Sus Acc | £3.45 |
| BY59P | Mar Key Tab Sus Solo | £3.45 |
| BY60Q | Mar Key Tab Trmpt 8' | DIS |
| BY61R | Mar Key Tab Tuba 16' | £3.45 |
| BY62S | Mar Key Tab Vibrato | £3.45 |
| BY63T | Mar K Tab Vox Ang 8' | £3.45 |
| BY64U | Mar K Tab Vox Hum 8' | DIS |
| FL76H | Key Tab | 90p (E) |
| BR46A | ST Strip | £1.35 (D) |
| XX13P | KT Strip | £1.50 (D) |
| BR41U | Drawbar Red | £1.35 (D) |
| BR42V | Drawbar White | £1.35 (D) |
| BR98G | Drawbar Blue | £1.55 (D) |
| BR99H | Drawbar Green | £1.55 (D) |
| XB18U | Contact Pedal Board | £22.30 (A) |

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| | | |
|---|---|---|
| XB19V | Free Stdg Pedalboard | £63.00 (A) |
| XB99H | Pdl Unit Front Panel | £2.95 (C) |
| XB96E | 32-Note Pdlbd | £135.41 (A) |
| YC96E | Carr in UK with XB96 | £14.30 |
| XB21X | Piano Pedal | £12.85 (A) |
| XB20W | Swell Pedal | £8.50 (B) |
| XY89W | Switched Swell Pedal | £11.45 (A) |
| XY98G | Swell Pdl Hsg & Trim | £3.75 (C) |
| XY28F | Remote Foot Control | £11.20 (A) |

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| | | |
|---|---|---|
| XY99H | Roll Top | £19.50 (A) |
| XG00A | Roll Top Guides (pr) | £2.50 (C) |
| XG01B | Music Stand | £4.75 (C) |
| XB95D | Organ Stool | £29.50 (A) |

## PANEL METERS

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| | | |
|---|---|---|
| RW74R | Level Meter | £4.35 (C) |
| LB80B | Sig Strength Meter | £1.95 (D) |
| LB79L | Tuning Meter | £1.95 (D) |
| RW73Q | VU Meter V41 | £2.20 (C) |
| YQ47B | Dual VU Meter | £3.90 (C) |
| RK21X | Quick Ft Mtr 50-0-50 | £2.95 (C) |
| RK05F | Qck Ft Mtr 100-0-100 | £2.95 (C) |
| RK06G | Quick Fit Meter 50uA | £2.95 (C) |
| RK07H | Quick Fit Mtr 100uA | £2.95 (C) |
| RK08J | Quick Fit Mtr 500uA | £2.95 (C) |
| RK09K | Quick Fit Meter 1mA | £2.95 (C) |
| RK10L | Quick-Fit Meter 5mA | £2.95 (C) |
| RK11M | Quick-Fit Meter 10mA | £2.95 (C) |
| RK12N | Quick-Ft Meter 50mA | £2.95 (C) |
| RK13P | Quick-Ft Meter 100mA | £2.95 (C) |
| RK14Q | Quick-Fit Meter 500mA | £2.95 (C) |
| RK15R | Quick-Fit Meter 1A | £2.95 (C) |
| RK16S | Quick-Fit Meter 5A | £2.95 (C) |
| RK17T | Quick-Fit Meter 25V | £2.95 (C) |
| RK18U | Quick-Fit Meter 50V | £2.95 (C) |
| RK19V | Quick-Fit Meter VU | £2.95 (C) |
| RK20W | Punch 27.5mm | £6.58 (B) |

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| | | |
|---|---|---|
| RW98G | 2inPn Mt 100-0-100uA | £6.65 (B) |
| RW99H | 2inPn Mt 500-0-500uA | £6.65 (B) |
| RW91Y | 2in Pan Meter 50uA | £6.45 (B) |
| RW92A | 2in. Pan Meter 100uA | £6.45 (B) |
| RW93B | 2in. Pan Meter 500uA | £6.45 (B) |
| RW94C | 2in. Pan Meter 1mA | £6.45 (B) |
| RW95D | 2in Pan Meter 5mA | £6.45 (B) |
| RW96E | 2in. Pan Meter 10mA | £6.45 (B) |
| †RX32K | 2in. Pan Meter 50mA | £6.65 (B) |
| RX33L | 2in. Pan Meter 100mA | £6.20 (B) |
| RX34M | 2in Pan Meter 500mA | £6.45 (B) |
| RX35Q | 2in. Pan Meter 1A | £6.20 (B) |
| RX36P | 2in. Pan Meter 50V | £6.65 (B) |
| RX37S | 2in. Pan Meter 300V | £5.90 (B) |
| †RX52G | 2in. Pan Meter 'S' | £6.65 (B) |
| RX53H | 2in. Pan Meter 'VU' | £6.65 (B) |
| RX54J | Large Panel Meter | £7.59 (B) |
| RX92A | Meter MI 15V | £6.95 (B) |
| RX88V | Meter MI 300V | £7.96 (B) |
| RX89W | Meter MI 1A | £7.38 (B) |
| RX90X | Meter MI 5A | £6.95 (B) |
| RX91Y | Meter MI 15A | £7.65 (B) |
| RX93B | Meter MI 25A | £7.95 (B) |

## PCB EQUIPMENT

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| | | |
|---|---|---|
| FL02C | SRBP 0.1in Type 3 | £1.39 (D) |
| FL06G | Vero 14354 | 25p (F) |
| FL07H | Vero 10345 | £1.06 (D) |
| FL08J | Vero 13466 | 89p (E) |
| FL09K | Vero 10347 | £1.54 (D) |
| FL10L | Vero 10348 | £1.05 (D) |
| FL53H | Vero 10401 | £3.65 (C) |
| FL17T | Verostrip | £1.39 (D) |
| FL19V | DIP Board | £4.35 (C) |
| HQ48C | Vero V-Q Board | £1.95 (D) |
| FL25C | Tool 2022 | £1.45 (D) |
| FL26D | Tool 2150 | £1.95 (D) |
| FL27E | Tool 2151 | £1.95 (D) |
| FL20W | Pin 2140 | 82p (E) |
| FL21X | Pin 2141 | 55p (E) |
| FL23A | Pin 2144 | 55p (E) |
| FL24B | Pin 2145 | 69p (E) |

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| | | |
|---|---|---|
| FL80B | Pin 0266 Pk of 10 | 25p (F) |
| FL81C | Pin 1657 Pk of 10 | 38p (F) |
| RK94C | Verowire Kit | £6.95 (B) |
| HY16S | Verowire Pen | £4.95 (C) |
| HY17T | Verowire Spool | 99p (E) |
| FY33L | Verowire Comb | 8p (H) |
| FL82D | Track Pin | 85p (E) |
| FL28F | 4-Way Tag | 12p (G) |
| FL29G | Mounting Strip | 32p (F) |
| FL11M | Tag Board | 94p (E) |
| YL11M | Vero Plugblock | £4.38 (C) |
| HQ84F | Verobloc Bracket | 63p (E) |
| BK62S | Engineer Design Sht | 48p (F) |
| BK63T | Verobloc Kit | £4.82 (C) |

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| | | |
|---|---|---|
| YR83E | Eurobreadboard | £6.75 (B) |
| YR84F | Prof Plugblock | £6.95 (B) |
| XX42V | MP Urobreadboard | £21.75 (A) |
| YR85G | Bus-Strip Plugblock | £2.95 (C) |
| YR86T | Plugblck Contct Strp | 28p (F) |
| YR87U | Plugblock PCB | £1.85 (D) |
| XB43W | Serio Etch System | £6.99 (B) |

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| | | |
|---|---|---|
| XY10L | UV Exposure Box | £41.32 (A) |
| BW19V | Photo-Etch PCB | £2.94 (C) |
| XX12N | Etch Crystals | £1.25 (D) |
| BW20W | Phot Etch Drftg Pk | £1.95 (D) |
| WF10L | Etcher Fluid | £2.52 (C) |
| HX02C | PCB Pen | £1.35 (D) |
| HX03D | Resist Remover | 88p (E) |
| HX00A | PCB SRBP Smll Single | 48p (F) |
| WF38R | PCB SRBP Med Single | 96p (E) |
| WF39N | PCB SRBP Lrg Single | £1.25 (D) |
| HX01B | PCB F Glass Sm Sngl | 85p (E) |
| WF40T | PCB F Glass Med Sngl | £1.75 (D) |
| WF41U | PCB F Glass Lrg Sngl | £2.75 (C) |
| WF42V | PCB F Glass Med Dble | £1.39 (D) |

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| | | |
|---|---|---|
| HX04E | Polish Block | £1.40 (D) |
| XB90X | Fixircuit | £9.52 (B) |
| XG20W | CM100 PCB Kit | £69.95 (A) |
| RK40T | Film FPF012 | £9.95 (B) |
| RK41U | Etching Kit CM100E | £4.95 (C) |
| RK42V | PCB006 Pack | £7.95 (B) |
| XG21X | Chemicals Kit CM100C | £16.95 (A) |
| BW21X | Track Tape 31 | 98p (E) |
| BW22Y | Track Tape 40 | 91p (E) |
| BW23A | Track Tape 50 | 98p (E) |
| BW24B | Track Tape 62 | £1.32 (D) |
| BW25C | Track Tape 80 | £1.39 (D) |
| BW26D | Track Tape 100 | £1.32 (D) |
| BW27E | Track Tape 125 | £1.96 (D) |
| BW28F | Track Tape 150 | £1.92 (D) |
| BW29G | Track Tape 200 | £1.96 (D) |
| BW30H | Pad 075 | £1.55 (D) |
| BW31J | Pad 100 | £1.55 (D) |
| BW32K | Pad 125 | £1.64 (D) |
| BW33L | Pad 150 | £1.12 (D) |
| BW34M | Pad 200 | £1.64 (D) |
| BW35Q | Pad 300 | £1.50 (D) |
| BW36P | Pad 400 | £2.55 (C) |
| BW37S | Pad 500 | £3.95 (C) |
| BW38R | Pad 600 | £5.64 (B) |

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| | | |
|---|---|---|
| BW40T | IC Pads 200 | £4.65 (C) |
| BW41U | Drafting Template | 88p (E) |
| HX45Y | Transfer Sheet 1 | 42p (F) |
| HX46A | Transfer Sheet 2 | 42p (F) |
| HX47B | Transfer Sheet 3 | 42p (F) |
| HX48C | Transfer Sheet 4 | 42p (F) |
| HX49D | Transfer Sheet 5 | 42p (F) |
| HX63T | Transfer Sheet 6 | 42p (F) |
| HX64U | Transfer Sheet 7 | 42p (F) |
| HX65V | Transfer Sheet 8 | 42p (F) |
| HX66W | Transfer Sheet 9 | 42p (F) |
| HX67X | Transfer Sheet 10 | 42p (F) |
| HX68Y | Transfer Sheet 11 | 42p (F) |
| HX83E | Transfer Sheet 12 | 42p (F) |
| HX84F | Transfer Sheet 13 | 42p (F) |
| HX44X | Transfer Kit | £3.75 (C) |

## PROJECTS MODULES

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| | | |
|---|---|---|
| BH64U | Minicon Pl 17way | 46p (F) |
| BH67X | Rt-Angle Mncn Pl 15W | 65p (E) |
| BX98G | Jumper Cable 17-way | £3.65 (C) |
| YK06G | Pedalboard Cableform | £2.98 (C) |
| HY31J | Steel Washer 4BA | 11p (G) |
| XY94C | Matinee Front Panel | £17.95 (A) |
| XY95D | Matinee Mtlwk Kit | £9.50 (B) |
| XY96E | End Cheek Set | £6.75 (B) |
| YK04E | Matinee PSU Bkt | £1.60 (D) |
| YK05F | Pot Mntg Brkt | 79p (E) |
| FH86T | Reset Spring | 3p (H) |
| HB60Q | Latchbrkt 5 way | 27p (F) |
| HY26D | Latch Brkt 16 way | 72p (E) |
| HY27E | Reset Bar 15way | 35p (F) |
| HY28F | Latchbrkt 9way | 39p (F) |
| HY29G | Reset Bar 6way | 16p (G) |
| QY15R | 2716/M2 | £10.50 (A) |
| GA18U | Matinee PSU PCB | £2.10 (C) |
| XY86T | Matinee Main PCB | £50.00 (A) |
| XY88V | Matinee Contact pcb | £7.30 (B) |
| XY91Y | Matinee Organ Kit | £299.95 (A) |
| BD06G | Carriage with XY91Y | £15.00 |
| XY93B | Matinee Cabinet Kit | £99.50 (A) |
| BD07H | Carriage with XY93B | £20.00 |
| XG05F | Matinee Module Kit | £399.95 (A) |
| BD13P | Carr in UK With XG05 | £15.00 |
| XX43W | Matinee Dem Cassette | £1.99 (D) |
| XH55K | Matinee Book | £2.50NV (C) |

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| | | |
|---|---|---|
| BR45Y | AS314 | 33p (F) |
| BR88V | Mk/Space Adptr Kit | £3.95 (C) |
| YL20W | Mstr Tuning Module | £19.87 (A) |
| BB00A | Divider Board 'A' | £4.35 (C) |
| BB01B | Divider Board 'B' | £3.28 (C) |
| BB02C | Tone Board 'A' | £4.45 (C) |
| BB03D | Tone Board 'B' | £1.98 (D) |
| BB07H | Control Board 'A' | £4.25 (C) |
| BB08J | Control Board 'B' | £2.98 (C) |
| BB09K | Sawtooth Board 'A' | £4.35 (C) |
| BB10L | Sawtooth Board 'B' | £5.49 (B) |
| BB77J | Divider MO & Frq Gen | £4.95 (C) |
| BB78K | Pedal PCB 'B' | £3.87 (C) |
| BB79L | 32-Note Pedal Voice | £3.95 (C) |
| BB80B | Pedal Diode PCB | £1.65 (D) |
| HQ72P | Auto Ogn Gen/Clk PCB | £3.95 (C) |
| HQ73Q | Auto Ogn Crd Cdr PCB | £3.95 (C) |
| HQ74R | Auto Ogn Auto St PCB | £6.32 (B) |
| HQ75S | Auto Ogn PA/PSU PCB | £4.35 (C) |
| YL00A | Organ Mixer PCB | £3.25 (C) |
| YL18U | 2G05 PSU PCB | £1.35 (D) |
| YL21X | 32 Note Pdl PSU PCB | £2.95 (C) |
| XX38R | Downbeat Indictr PCB | £2.20 (C) |
| BB11M | Gate Board | 44p (F) |
| BB04E | Tone Board 'C' | £4.90 (C) |
| BB05F | Tone Board 'D' | £4.82 (C) |
| BB06G | Tone Board 'E' | £4.96 (C) |
| BB12N | Pedal PCB 'A' | £2.20 (C) |
| BB15R | Mother Board 'A' | £10.30 (A) |
| BB13P | A/B Switch Board | £1.68 (D) |
| BB14Q | MES Amp Board 'A' | 72p (E) |
| XH00A | MES51 | 15pNV |
| XH02C | MES52 | 15pNV |
| XH04E | MES53 | 35pNV |
| XH31J | MES54 | 30pNV |
| XH33L | MES55 | 30pNV |

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| | | |
|---|---|---|
| XF11M | Stereo Synth Book | £2.00NV (C) |
| BB41U | Synth Mixer PCB | £3.95 (C) |
| BB44X | Synth VCA PCB | £1.48 (D) |
| BY87U | Synth Preset Mtg Bd | 68p (E) |
| BY88V | Synth 1979 Kybd Cont | £6.64 (B) |
| BY89W | Synth Binary Encoder | £8.24 (B) |
| BB40T | Synth PSU Mk.II PCB | £4.99 (C) |
| BY90X | Synth Smpl & Nse PCB | £4.20 (C) |
| BB43W | Synth Trns Gen 1 PCB | £3.20 (C) |
| BB45Y | Synth Trns Gen 2 PCB | £3.36 (C) |
| BY81C | Synth Trns Rept PCB | £1.24 (D) |
| BY82D | Synth Rvrb & Phs PCB | £3.20 (C) |
| BY83E | Synth VC Pn & AncPCB | £8.36 (B) |
| BB38R | Synth Oscillator PCB | £4.39 (C) |
| BB48C | Synth Ext I/P's PCB | £1.54 (D) |
| BB65V | 3600 VCF PCB | £2.20 (C) |
| BB64U | 4600 Hinge | 63p (E) |
| BB63T | Synth Ext I/P's Bkt | 64p (E) |
| BB49D | Synth Oscltr Mtg Bkt | 67p (E) |
| BB52G | Synth Mixer Chassis | £2.10 (C) |
| BB51F | Synth Pwr Sply Htsnk | £1.30 (D) |
| BB56L | Synth Mixer Mtg Bkt | 16p (G) |
| BB61R | Synth VCF Mtg Bkt | 64p (E) |
| BB58N | Synth Trns 1/Env Bkt | 85p (E) |
| BB59P | Synth Trns 2 Mtg Bkt | £1.20 (D) |
| BB60Q | Synth VCA Mtg Bkt | 52p (E) |
| BF95D | Joylever PCB | 99p (E) |
| XQ01B | 5600 Front Panel | £13.50 (A) |
| BD01B | Carr in UK with XQ01 | £9.00 |
| BY84F | 5600 Rear Panel | £4.55 (C) |
| XQ02C | 5600 Cabinet | £55.23 (A) |
| BD02C | Carr in UK with XQ02 | £9.00 |
| XB79L | Teak 5600 Cabinet | £55.70 (A) |
| YC79L | Carr in UK with XB79 | £7.00 |
| LW53H | 5600S Synth Kit | £599.95 (A) |
| BD08J | Carr in UK with LW53 | £20.00 |

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| | | |
|---|---|---|
| BY86T | 3800 Interface PCB | £2.29 (C) |
| BB47B | Synth Dtpt Stge PCB | £6.34 (B) |
| XQ03D | 3800 Front Panel | £9.73 (B) |
| BB67X | 3600 VCF Mtg Bkt | 59p (E) |
| BF96E | 3800 Sp Ext I/P Bkt | 55p (E) |
| BF98G | 3800 VCA Bkt | 55p (E) |
| BF99H | 3800 Intface Mtg Bkt | 55p (E) |
| BY85G | 3800 Rear Panel | £4.56 (C) |
| XQ04E | 3800 Cabinet | £49.60 (A) |
| BD03D | Carr in UK with XQ04 | £9.00 |
| LW54J | 3800 Synth Kit | £336.75 (A) |
| BD09K | Carr in UK with LW54 | £20.00 |
| YQ46A | Synth Demo Tape | £4.50 (A) |
| XF41U | Synth Guide Book | £2.00NV (C) |
| XF42V | 5600S Patch Chart | 7pNV (H) |
| XF43W | 3800 Patch Chart | 7pNV (H) |

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| | | |
|---|---|---|
| QY17T | 2716/M3 | £14.95 (A) |
| RK32K | Sequencer Key Print | 65p (E) |
| GA65V | Sequencer PSU PCB | £1.35 (D) |
| YQ56L | Sequencer Main PCB | £4.99 (C) |
| YQ57M | Seq Display PCB | £1.65 (D) |
| YQ58N | Seq Keyboard PCB | £2.35 (C) |
| YQ59P | Seq Interface PCB | £2.10 (C) |
| LW66W | Sequencer Kit | £125.00 (A) |
| XH59P | Sequencer Leaflet | 40pNV (F) |

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| | | |
|---|---|---|
| XG08J | Spectrum Front Panel | £14.95 (A) |
| XX46A | Spectrm Joystk Panel | £2.25 (C) |
| XY90X | Spectrum Bus Bar Set | £2.20 (C) |
| GA03D | Spectrum PSU PCB | £2.30 (C) |
| GA09K | 24-Way Contact PCB | £2.80 (C) |
| GA10L | 25-Way Contact PCB | £2.87 (C) |
| GA36P | Spectrum VCO PCB | £4.75 (C) |
| GA53H | Spectrum LFO PCB | £2.50 (C) |
| GA55K | Spectrum Cntrllr PCB | £1.82 (D) |
| GA57M | Spectrum VCF PCB | £2.64 (C) |
| GA59P | Spectrum Shaper PCB | £2.95 (C) |
| LW60Q | Spectrum Synth Kit | £167.50 (A) |
| XH56L | Spectrum Synth Book | £1.00NV (D) |
| XH18U | MES22 | 25pNV |
| BY78K | Piano PSU/Voice PCB | £4.45 (C) |
| BY79L | Piano Top Oct PCB | £4.95 (C) |
| BY80B | Piano Two-Oct PCB | £5.80 (B) |
| XQ06G | Piano Cabinet Black | £49.95 (A) |

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| | | |
|---|---|---|
| XH20W | MES25 | 25pNV |
| BB16S | Orgn/Gtar Bass PCB | £10.50 (A) |
| GA32K | Hexadrum Pcb | £2.60 (C) |
| LW85G | Hexadrum Kit | £18.95 (A) |
| GA05F | Syntom PCB | £1.18 (D) |
| BH60Q | Syntom Front Panel | £1.10 (D) |
| LW86T | Syntom Kit | £10.90 (A) |

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| | | |
|---|---|---|
| GA35Q | Synwave PCB | £1.10 (D) |
| BX99H | Synwave Front Panel | £1.46 (D) |
| LW87U | Synwave Kit | £10.25 (A) |
| GA54J | Synclock PCB | £1.65 (D) |
| XX44X | Synclock Front Panel | £1.50 (D) |
| LW55K | Synclock Kit | £19.75 (A) |
| LW88V | Volume Pedal Kit | £21.45 (A) |

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| | | |
|---|---|---|
| GA52G | Auto Swell PCB | £1.35 (D) |
| LW89W | Auto Swell Kit | £10.90 (A) |
| GA24B | Guitar Tuner PCB | £1.65 (D) |
| YL26D | Guitar Tuner Frt Pan | £1.10 (D) |
| LW90X | Guitar Tuner Kit | £10.75 (A) |
| GA48C | Harmony Gen PCB | £2.25 (C) |
| LW91Y | Harmony Gen Kit | £15.45 (A) |

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| | | |
|---|---|---|
| GA00A | D.I.Box PCB | £1.10 (D) |
| GA41U | Combo Amp PCB | £5.75 (B) |
| XG03D | Combo Amp Frnt Panel | £3.35 (C) |
| LW92A | Combo-Amp Kit | £89.90 (A) |

## TRADE QUANTITIES

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. See table at start of price list. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity.

Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.

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|---|---|---|
| **Page 221** | | |
| RK25C | Stereo Amp Heatsink | £1.25 (D) |
| XG16S | Stereo Amp Woodwork | £6.25 (B) |
| XG15R | Stereo Amp Chassis | £5.95 (B) |
| GA71N | Stereo Amp PCB | £4.60 (C) |
| GA78K | Stereo Amp Sw PCB | 55p (E) |
| LW71N | 25W Stereo Amp Kit | £49.95 (A) |
| RK36P | Switch Panel | £1.20 (D) |
| GA97F | Stereo Amp IR Decodr | £2.75 (C) |
| GA99H | Sto Amp IR Contrller | £1.40 (D) |
| LW77J | Amp Remote Cntrl Kit | £26.95 (A) |
| **Page 222** | | |
| XH48C | MES33 | 40pNV (F) |
| FL94C | HiFi Amp Sel Mthr PC | £4.20 (C) |
| FL95D | HiFi Amp Sel PCB | £3.47 (C) |
| FL96E | HiFi Amp Eql Mthr PC | £2.95 (C) |
| FL97F | HiFi Amp Eql PCB | £1.97 (D) |
| FL98G | HiFi Amp Pk Det PCB | £1.97 (D) |
| FL99H | HiFi Amp PSU PCB | £2.15 (C) |
| XX32K | H/Phones Skt Brckt | 59p (E) |
| XY21X | HiFi Amp Chassis | £22.10 (A) |
| XY22Y | HiFi Amp Screen | £1.85 (D) |
| XY23A | HiFi Amp Frt Panel | £10.99 (B) |
| XY24B | HiFi Amp Cover Black | £6.95 (B) |
| **Page 223** | | |
| LR13P | HQ Mixer PCB No 2 | £1.96 (D) |
| LR14Q | HQ Mixer PCB No 3 | £1.55 (D) |
| LR15R | HQ Mixer PCB No.4 | £1.39 (D) |
| LR34M | HQ Mixer PCB No 24 | £1.98 (D) |
| **Page 224** | | |
| LR16S | HQ Mixer PCB No.5 | £1.10 (D) |
| LR35Q | HQ Mixer PCB No.25 | £1.60 (D) |
| LR21X | HQ Mixer PCB No.6 | 99p (E) |
| LR22Y | HQ Mixer PCB No 7 | £1.75 (D) |
| LR23A | HQ Mixer PCB No.8 | £1.60 (D) |
| **Page 225** | | |
| LR24B | HQ Mixer PCB No.9 | £1.78 (D) |
| LR42V | HQ Mixer PCB No. 29 | £2.95 (C) |
| LR25C | HQ Mixer PCB No 10 | £1.85 (D) |
| LR26D | HQ Mixer PCB No.14 | £1.87 (D) |
| **Page 226** | | |
| GA68Y | Quadramix PCB | £1.15 (D) |
| YQ18U | Tone Con PCB | £1.55 (D) |
| YQ06G | Stereophoner PCB | £1.10 (D) |
| YQ19V | LM380 Amp PCB | £1.25 (D) |
| YQ20W | 20W Amp PCB | £1.50 (D) |
| **Page 227** | | |
| HQ68Y | 50W Hi-Fi PCB | £2.96 (C) |
| **Page 228** | | |
| LW35Q | 50W Amp Kit | £14.95 (A) |
| GA29G | MOSFET Amp Mtg Bkt | £1.15 (D) |
| GA28F | 75W MOSFET Amp PCB | £1.80 (D) |
| LW51F | 75W MOSFET Amp Kit | £11.49 (A) |
| **Page 229** | | |
| LW32K | 150W Power Amp Kit | £17.95 (A) |
| **Page 230** | | |
| GA08J | Woofer PCB | £2.00 (C) |
| LW40T | Tuner Metalwork Kit | £42.88 (A) |
| **Page 231** | | |
| LW41U | Tuner PSU Module | £23.95 (A) |
| LW42V | Tuner Switching Mod | £18.95 (A) |
| LW45Y | TV Sound Tuner | £39.55 (A) |
| LW44X | Tuner Head FD811U14 | £23.79 (A) |
| YQ00A | IF Tuner Mono Module | £9.50 (B) |
| YQ10L | 12/30V PSU Module | £6.70 (B) |
| **Page 232** | | |
| LW43W | Tuner IF Module | £18.98 (A) |
| LW48C | Stereo Tuner Kit | £161.00 (A) |
| LW46A | AM Tuner | £17.95 (A) |
| XF22Y | Tuner Schedule | FREE |
| **Page 233** | | |
| XH21X | MES37 | 25pNV (F) |
| XX03D | 10-Channel G.E. PCB | £1.95 (D) |
| XB74R | 10-Chl Eqlsr Mtwrk | £10.45 (A) |
| XB75S | 10-Chl Eqlsr Wwrk | £8.50 (B) |
| GA30H | Compander PCB | £3.20 (C) |
| GA31J | Compander PSU PCB | £1.60 (D) |
| GA43W | Noise Gate Pcb | £1.30 (D) |
| **Page 234** | | |
| XY32K | Cassette Mechanism | £14.95 (A) |
| XY34M | Stereo Tape Module | £19.73 (A) |
| XH51F | MES30 | 20pNV |
| YQ30H | Tape Switch Board | 42p |
| YQ33L | Tape Switch Bracket | 51p |
| YQ31J | Tape PSU PCB | 39p |
| XY35Q | Cassette Parts Kit | £12.98 (A) |
| XY36P | Cassette Recrder Kit | £39.95 (A) |
| **Page 235** | | |
| XF04E | MES41 | 40pNV |
| XB76H | Disco Front Panel | £11.50 (A) |
| XY26D | Heatsink Mtg Plate | £3.95 (C) |
| XY27E | Heatsink Cover | £6.45 (B) |
| BB18U | Heatsink DR2 | 74p (E) |
| XB77J | Disco Cabinet | £48.44 (A) |
| YC77J | Carr in UK with XB77 | £8.00 |
| BB81C | Disco Pre-Amp Tn PCB | £4.45 (C) |
| BB19V | Disco PSU PCB | £1.95 (D) |
| BB20W | 150W Amp Board | £2.35 (C) |
| BB26D | Motor Switch PCB | £1.15 (D) |
| BB27E | Light Mod Bd | £5.30 (B) |
| BB22Y | FET-Ceramic PU Bd | £1.69 (D) |
| BB24B | Disco Fader Bd | £2.20 (C) |
| BB25C | VUM & HP Amp Bd | £2.35 (C) |
| XH23A | MES42 | 25pNV |
| XB37S | Sound To Light Case | £11.50 (A) |
| **Page 236** | | |
| GA42V | Partylite Pcb | £2.25 (C) |
| LW93B | Partylite Kit | £8.45 (B) |
| YQ21X | Snd/Light Conv PCB | £2.10 (C) |
| GA25C | Power Control pcb | £1.15 (D) |
| GA58N | The Bomb PCB | £1.55 (D) |
| **Page 237** | | |
| GA04E | Stopwatch PCB | £2.95 (C) |
| LW65V | Stopwatch Kit | £34.95 (A) |

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|---|---|---|
| FY94C | Mncn Ltch Hsng 10way | 18p (G) |
| HQ85G | Minicon Plug 10-Way | 47p (F) |
| GA64U | Timer Front Panel | £3.85 (C) |
| GA61R | Timer Main PCB | £2.80 (C) |
| GA62S | Timer Switch Board | £3.85 (C) |
| GA63T | Timer Relay PCB | £1.10 (D) |
| LW94C | Universal Timer Kit | £39.95 (A) |
| **Page 238** | | |
| QY25C | 2716/M4 | £10.50 (A) |
| GB04E | E L C Board | £2.95 (C) |
| GB05F | Connect PCB | £3.80 (C) |
| GB06G | T/E Motherboard | £12.75 (A) |
| GB07H | T/E PSU PCB | £4.50 (C) |
| LW80B | Digi-Tel ELC Kit | £24.95 (A) |
| LW81C | Digi-Tel Connect Kit | £9.95 (B) |
| LW82D | Digi-Tel Main Kit | £67.50 (A) |
| **Page 239** | | |
| XG06G | Burglar Alarm Box | £12.50 (A) |
| XG07H | Ext Horn Box | £14.50 (A) |
| GA44X | Burglar Alrm PSU PCB | £2.40 (C) |
| GA45Y | Burglr Alrm Main PCB | £6.75 (B) |
| GA46A | Break Contact PCB | £1.95 (D) |
| GA47B | Ext Horn PCB | £1.60 (D) |
| LW57M | Burglar Alarm Kit | £44.95 (A) |
| LW59P | Break Contact Kit | £2.99 (C) |
| LW58N | Ext Horn Kit | £29.95 (A) |
| GA81C | Channel/PSU PCB | £1.85 (D) |
| GA82D | Extra Channel PCB | £1.35 (D) |
| LW73Q | RTX3 Doppler Kit | £39.95 (A) |
| LW74R | Radar Ch/PSU Module | £13.95 (A) |
| LW75S | Radar Extr Ch Module | £4.50 (C) |
| **Page 240** | | |
| GB00A | Ultrasonic Xvr PCB | £1.60 (D) |
| GB01B | Ultrasonic IF PCB | £1.60 (D) |
| LW83E | Usonic Xceiver Kit | £12.25 (A) |
| LW84F | Usonic Interface Kit | £2.50 (C) |
| XF44X | Magnum Booklet | 50pNV (E) |
| YQ44X | Magnum 1 PCB | £2.95 (C) |
| YQ45Y | Magnum 2 PCB | £2.95 (C) |
| YQ72P | Magnum Mode Chng PCB | £1.65 (D) |
| GA79L | Multi-circuit Board | £1.25 (D) |
| **Page 241** | | |
| LW50E | Electronics For All | £19.95 (A) |
| XG09K | Train Control Case | £12.50 (A) |
| XX47B | Train Cntrl Front Pnl | £3.75 (C) |
| GA72P | Train Common PCB | £2.90 (C) |
| GA73Q | Train Control PCB | £2.20 (C) |
| GA74R | Train Receiver 1 PCB | £1.35 (D) |
| GA75S | Train Receiver 2 PCB | £1.35 (D) |
| LW61R | Train Common/PSU Kit | £27.50 (A) |
| LW62S | Train Control Kit | £6.45 (B) |
| LW63T | Train Rcvr1 ML926Kit | £5.95 (B) |
| LW64U | Train Rcvr2 ML926Kit | £5.95 (B) |
| LW68Y | Train Rcvr1 ML927Kit | £5.95 (B) |
| LW69A | Train Rcvr2 ML927Kit | £5.95 (B) |
| **Page 242** | | |
| GA84F | Remote Data Ltch PCB | £2.10 (C) |
| GA85G | Data Encoder PCB | £2.49 (C) |
| GA86T | Data Decoder PCB | £2.45 (C) |
| GA87U | IR Tx PCB | £1.25 (D) |
| GA88V | IR Rx PCB | £1.25 (D) |
| GA89W | 27MHz Tx PCB | 98p (E) |
| XH26D | MES71 | 30pNV |
| BB82D | Keyboard PCB | £7.72 (B) |
| BB83E | VDU Logic PCB | £10.96 (A) |
| BB98G | VDU PSU PCB | £2.98 (C) |
| XY12N | VDU Front Panel | £7.90 (B) |
| XX05F | UHF Mod No 2 | £4.99 (C) |
| **Page 243** | | |
| XH58N | Keytop Print ZX81 | 25p (F) |
| XG17T | ZX81 Keyboard Case | £4.95 (C) |
| GA83E | ZX81 Ext Kyboard PCB | £2.95 (C) |
| LW72P | ZX81 Keyboard Kit | £19.95 (D) |
| XG22Y | ZX81 Keyboard | £29.95 (A) |
| GA90X | I/O Port PCB | £2.25 (C) |
| LW76H | ZX81 I/O Port Kit | £9.25 (B) |
| GB08J | ZX81 Extendiboard | £3.95 (C) |
| **Page 244** | | |
| XF03D | MES26 | £1.20NV |
| BB28F | RC Coder PCB | £1.95 (D) |
| BB29G | RC Xmitter PCB | £1.99 (D) |
| BB30H | RC Receiver PCB | £1.45 (D) |
| BB31J | RC Interface PCB | £1.55 (D) |
| BB32K | RC Decoder PCB | £1.35 (D) |
| BB33L | RC Relay Drive PCB | 99p (E) |
| BB34M | RC Servo Drive PCB | 82p (E) |
| BB35Q | RC Servo Amp PCB | 92p (E) |
| BB36P | RC Tone Gen PCB | 85p (E) |
| BB37S | RC Tone Decoder PCB | 85p (E) |
| YQ03D | McM Encoder PCB | £1.10 (D) |
| YQ04E | McM Receiver PCB | £1.18 (D) |
| YQ05F | McM Rcvr Dcdr PCB | £1.05 (D) |
| YQ07H | McM Transmitter PCB | £1.95 (D) |
| YQ08J | McM Elect Ig/Cnv PCB | £1.60 (D) |
| XH27E | MES16 | 15pNV |
| XX40T | Ignition PCB | £1.30 (D) |
| XX41U | Ign Mtg Plate | £1.28 (D) |
| GA22Y | Strobe Main pcb | £2.20 (C) |
| GA23A | Strobe HT pcb | £1.20 (D) |
| YQ09K | McM Flasher PCB | £1.10 (D) |
| **Page 245** | | |
| GA26D | Dig Tacho Main PCB | £1.75 (D) |
| GA27E | Dig Tacho Dsply PCB | £1.25 (D) |
| GA19V | Batt Mon PCB | £1.20 (D) |
| GA98G | Car Burglar Alrm PCB | £1.10 (D) |
| LW78K | Car Burglar Alarm Kit | £6.95 (B) |
| GA40T | Car Aerial Bster Pcb | £1.35 (D) |
| **Page 246** | | |
| GA76H | MPG Meter Main PCB | £2.45 (C) |
| GA77J | MPG Meter Disply PCB | £1.75 (D) |
| LW67X | MPG Meter Kit | £44.95 (A) |
| RK39N | Freq Cnt Front Panel | £1.99 (D) |
| GB02C | Frequency Counter PCB | £4.95 (C) |
| GB03D | Freq Ctr Display PCB | £1.85 (D) |
| LW79L | Frequency Counter Kit | £85.00 (A) |
| BB72P | Sine/Square Gen PCB | £3.12 (C) |
| BB73Q | Audio Osc Prt Panel | £1.74 (D) |
| XH24B | MES15 | 15pNV |
| **Page 247** | | |
| XF11M | Stereo Synth Book | £2.00NV (C) |
| XF13P | MES12B | FREE |
| XF37S | MES12C | FREE |
| XH24B | MES15 | 15pNV |
| XF14Q | MES15B | FREE |

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| XH27E | MES16 | 15pNV |
| XF15R | MES16B | FREE |
| XH18U | MES22 | 25pNV |
| XF18U | MES22B | FREE |
| XH06G | MES24 | FREE |
| XH20W | MES25 | 25pNV |
| XF20W | MES25B | FREE |
| XF03D | MES26 | £1.20NV |
| XH13P | MES27 | FREE |
| XH51F | MES30 | 20pNV |
| XH48C | MES33 | 40pNV (F) |
| XF21X | 40W Amp Schedule | FREE |
| XF22Y | Tuner Schedule | FREE |
| XF25C | MES35B | FREE |
| XH21X | MES37 | 25pNV (F) |
| XF06G | MES37B | FREE |
| XF04E | MES41 | 40pNV |
| XF05F | Disco Schedule | FREE |
| XH23A | MES42 | 25pNV |
| XF23A | MES42B | FREE |
| XH00A | MES51 | 15pNV |
| XH01B | MES51B | FREE |
| XH02C | MES52 | 15pNV |
| XH03D | MES52B | FREE |
| XH04E | MES53 | 35pNV |
| XH05F | MES53B | FREE |
| XH31J | MES54 | 30pNV |
| XH32K | MES54B | FREE |
| XH33L | MES55 | 30pNV |
| XH34M | MES55B | FREE |
| XH26D | MES71 | 30pNV |
| XF26D | MES71B | FREE |
| GA11M | Continuity Testr PCB | £1.32 (D) |
| XF46A | E&MM April 1981 | £1.00NV |
| XF47B | E&MM May 1981 | £1.00NV |
| XF48C | E&MM June 1981 | £1.00NV |
| XF49D | E&MM July 1981 | £1.00NV |
| XF50E | E&MM August 1981 | £1.00NV |
| **Page 248** | | |
| XF52G | E&MM October 1981 | £1.00NV |
| XF53H | E&MM November 1981 | £1.00NV |
| XF54J | E&MM December 1981 | £1.10NV |
| XF55K | E&MM January 1982 | £1.10NV |
| XF56L | E&MM February 1982 | £1.10NV |
| XF57M | E&MM March 1982 | £1.10NV |
| XF58N | E&MM April 1982 | £1.10NV |
| XF59P | E&MM May 1982 | £1.10NV |
| XF60Q | E&MM June '82 | £1.10NV |
| XF61R | E&MM July 1982 | £1.10NV |
| XF62S | E&MM August 1982 | £1.10NV |
| **Page 249** | | |
| XF63T | E&MM September 1982 | £1.10NV |
| XF64U | E&MM October 1982 | £1.10NV* |
| XH61R | E&MM Projects Vol 1 | £1.00NV (D) |
| XA00A | Maplin Mag Subscrptn | £2.40NV |
| XA01B | Projects Book One | 60pNV (E) |
| XA02C | Projects Book Two | 60pNV (E) |
| XA03D | Projects Book Three | 60pNV (E) |
| XA04E | Projects Book Four | 60pNV (E) |

## PROTECTION

| | | |
|---|---|---|
| **Page 250** | | |
| RX96E | Safuseholder 20 | 45p (F) |
| RX97F | Safuseholder 1.1/4in | £1.96 (D) |
| RX49D | Chassis F/H 20mm | 11p (G) |
| RX50E | Chassis F/H 1.1/4 in | 17p (G) |
| WH49D | Fuse Clip | 3p (H) |
| RX51F | F/H Car | 10p (G) |
| WR93R | Fuse 20mm 50mA | 6p (H) |
| WR00A | Fuse 20mm 100mA | 6p (H) |
| WR94C | Fuse 20mm 150mA | 6p (H) |
| WR01B | Fuse 20mm 250mA | 6p (H) |
| WR02C | Fuse 20mm 500mA | 6p (H) |
| WR03D | Fuse 20mm 1A | 8p (H) |
| WR04E | Fuse 20mm 1.5A | 8p (H) |
| WR05F | Fuse 20mm 2A | 8p (H) |
| WR06G | Fuse 20mm 3A | 8p (H) |
| WR07H | Fuse 20mm 5A | 7p (H) |
| WR18U | Fuse A/S 500mA | 12p (G) |
| WR19V | Fuse A/S 1A | 12p (G) |
| WR20W | Fuse A/S 2A | 12p (G) |
| WR95D | Fuse 1.1/4 50mA | 4p (H) |
| WR08J | Fuse 1.1/4 100mA | 6p (H) |
| WR96E | Fuse 1.1/4 150mA | 8p (H) |
| WR09K | Fuse 1.1/4 250mA | 7p (H) |
| WR10L | Fuse 1.1/4 500mA | 6p (H) |
| WR11M | Fuse 1.1/4 1A | 8p (H) |
| WR12N | Fuse 1.1/4 1.5A | 8p (H) |
| WR13P | Fuse 1.1/4 2A | 8p (H) |
| WR14Q | Fuse 1.1/4 3A | 8p (H) |
| WR15R | Fuse 1.1/4 5A | 9p (H) |
| WR16S | Fuse 1.1/4 10A | 9p (H) |
| WR17T | Fuse 1.1/4 15A | 12p (G) |
| HQ31J | Plug Fuse 2A | 15p (G) |
| HQ32K | Plug Fuse 3A | 14p (G) |
| HQ33L | Plug Fuse 5A | 15p (G) |
| HQ34M | Plug Fuse 13A | 14p (G) |
| BK21X | Thermal Breaker 1A | £2.35 (C) |
| BK22Y | Thermal Breaker 3A | £1.35 (D) |
| BK23A | Thermal Breaker 5A | £1.35 (D) |
| BK24B | Thermal Breaker 12A | £1.35 (D) |
| BK20W | Thermal Breaker 15A | £1.35 (D) |
| **Page 251** | | |
| HB51F | Fuse Wire | 30p (F) |
| HW04E | RF Supp Choke 1A | 29p (F) |
| HW05F | RF Supp Choke 2A | 29p (F) |
| HW06G | RF Supp Choke 3A | 39p (F) |
| YR90X | R-C Network | £1.39 (D) |
| HW13P | Mains Trans Supp | 65p (E) |
| HW07H | Delta Cap | 97p (E) |
| YW46A | Door Contact Reed | £1.49 (D) |
| YW50E | Window Foil | £1.25 (D) |
| YW51F | Foil Terms | 65p (E) |
| YW49D | BA Junction Box | 59p (E) |
| YW47B | Surface BA Reed | £1.95 (D) |
| YW48C | Door Loop | £1.75 (D) |
| YB91Y | Pressure Mat | £3.55 (C) |

## RECORD & VIDEO

| | | |
|---|---|---|
| **Page 252** | | |
| XQ00A | Autochanger | £22.50 (A) |
| XB23A | Rim Drive Turntable | £29.90 (A) |
| XB25C | Belt Drive Turntable | £34.50 (A) |
| **Page 253** | | |
| FQ17T | Cartridge Slide MP60 | £2.68 (C) |
| FQ18U | Cartridge Slide 710 | DIS |
| FQ19V | Crtridge Slide BDS95 | DIS |
| LB75S | Drive Wheel BSR | £1.55 (D) |
| YW58N | BSR Drive Belt | £2.20 (C) |
| LB76H | Dr Wheel Garrard Lrg | £2.55 (C) |
| FQ30H | Dr Wheel Garrard Sm | £2.85 (C) |
| †FQ31J | Spindle Man Short | 72p (E) |

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|---|---|---|
| †FQ32K | Spindle Man Long | 79p (E) |
| †FQ33L | Spindle Auto Short | £4.50 (C) |
| FQ35Q | CB Weight SP25IV | £3.95 (C) |
| FQ36P | Garrard Drive Belt | £2.50 (C) |
| XX34M | Headshell | £3.50 (C) |
| YX76H | Drive Belt 46mm | 98p (E) |
| YX77J | Drive Belt 57mm | 98p (E) |
| YX78K | Drive Belt 66mm | 98p (E) |
| RK99H | Drive Belt 71mm | £1.00 (D) |
| YX79L | Drive Belt 76mm | 98p (E) |
| YX80B | Drive Belt 90mm | 98p (E) |
| HR01B | Ctrdg BSR X5M | £3.65 (C) |
| HR02C | Ctrdg BSR X5H | £3.65 (C) |
| **Page 254** | | |
| HR04E | Ctrdg BSR SX6M | £4.25 (C) |
| HR05F | Ctrdg BSR SX6H | £4.49 (C) |
| HR09K | Ctrdg BSR SC12M | £3.75 (C) |
| HR10L | Ctrdg BSR SC12H | £3.65 (C) |
| YX83E | Crtidge Philips GP215 | £4.55 (C) |
| FY75S | Ctrdg Rigonda 2SB | £4.45 (C) |
| HR12N | Ctrdg Sono 3509 | £4.95 (C) |
| HR13P | Ctrdg Sono 3549 | £5.95 (B) |
| HR14Q | Ctrdg Sono 3559 | £5.25 (B) |
| HR17T | Ctrdg Sono V100 | £5.98 (B) |
| YX82D | Cartridge QLM36 | £21.40 (A) |
| **Page 255** | | |
| HR15R | Ctrdg Goldring G850 | £5.70 (B) |
| HR16S | Ctrdg Goldring G800 | £7.45 (B) |
| FQ38R | Ctrdg Goldring G800H | £9.49 (B) |
| FQ39N | Ctrdg Goldring G800E | £11.95 (A) |
| FQ40T | Ctrdg Tenorel T2001D | £4.85 (C) |
| FQ41U | Cdg Tenorel T2001ED | £11.29 (A) |
| RK98G | Tenorel TMC10 Cart | £39.95 (A) |
| BK64U | TMC10 Replacement | £19.95 (A) |
| **Page 256** | | |
| HR25C | Stylus GP91SC DD | £1.85 (D) |
| BK05F | Stylus Sanyo ST26 | £5.50 (B) |
| BK07H | Stylus ATN3400 | £4.95 (C) |
| HR31J | Stylus GP104 DD | £1.85 (D) |
| HR66W | Stylus Acos SM6 | £4.95 (C) |
| BK08J | Stylus ATN71 | £5.50 (B) |
| YX06G | Stylus ADC RSQ30 | £7.07 (B) |
| BK09K | Stylus ATN3710 | £4.95 (C) |
| BK10L | Stylus Toshiba-N501 | £5.50 (B) |
| YX09K | Stylus AT70 | £4.95 (C) |
| BK19V | Stylus D5107AL | £4.95 (C) |
| HR68Y | Stylus VM8 | £5.50 (B) |
| HR39N | Stylus BSR TC8 D | £1.50 (D) |
| HR71N | Stylus BSR ST4 DD | £1.85 (D) |
| HR42V | Stylus BSR ST10 | £1.85 (D) |
| HR45Y | Stylus BSR ST15 | £1.85 (D) |
| HR47B | Stylus BSR ST17 DD | £1.85 (D) |
| HR48C | Stylus BSR ST21 | £1.85 (D) |
| BK11M | Stylus Hitachi E100 | £5.50 (B) |
| BK12N | Stylus JVC DT31 | £5.50 (B) |
| YX12N | Stylus Garrard GA150 | £10.50 (A) |
| HR76H | Stylus D110E | £5.50 (B) |
| HR77J | Stylus D110H | £2.95 (C) |
| HR48C | Stylus D110SR | £1.95 (D) |
| HR49D | Stylus D120SR | £2.45 (C) |
| HR78K | Stylus Hitachi ST101 | £4.95 (C) |
| HR79L | Stylus Hitachi ST103 | £6.75 (B) |
| YX13P | Stylus Hitachi ST104 | £4.95 (C) |
| †YX14Q | Stylus JVC DT21S | £4.35 (C) |
| FQ54J | Stylus JVC DT33 | £4.95 (C) |
| BK14Q | Stylus Trio STY111 | £4.95 (C) |
| HR81C | Stylus LV6597D | £1.50 (D) |
| HR83E | Stylus NP EPS36 | £2.25 (C) |
| HR84F | Stylus NP EPS52 | £4.95 (C) |
| YX16S | Stylus NP EPS53 | £5.50 (B) |
| YX17T | Stylus Philip AG3306 | £1.85 (D) |
| HR87U | Sty Philips GP200DD | £1.85 (D) |
| HR89W | Stylus Philips GP205 | £1.25 (D) |
| YX18U | Stylus Philips GP213 | £1.85 (D) |
| HR90X | Styl Philips GP400 | £5.10 (B) |
| YX19V | Styl Philps GP400Mk2 | £4.95 (C) |
| YX20W | Styl Philips GP401Mk2 | £6.75 (B) |
| BK15R | Stylus EPC207 | £6.75 (B) |
| HR51F | Stylus BF40D | £1.85 (D) |
| HR96E | Stylus DM500/7 | £4.95 (C) |
| YX22Y | Stylus Sanyo ST10J | £4.95 (C) |
| HR95D | Stylus Sansui SN28 | £4.95 (C) |
| YX23A | Stylus Sansui SN41 | £4.95 (C) |
| YX24B | Stylus Sanyo ST7D | £4.95 (C) |
| HR97F | Stylus Sanyo 2611 | £4.95 (C) |
| FQ48C | Stylus Sony ND128 | £2.20 (C) |
| YX25C | Stylus Sharp STY101 | £4.95 (C) |
| HR98G | Stylus Sharp 706 | £4.95 (C) |
| HR99H | Stylus Sharp 717 | £4.95 (C) |
| BK16S | Stylus PN12 | £5.50 (B) |
| HR61R | Stylus Sonotone V100 | £4.95 (C) |
| YX26D | Stylus Sonotone V101 | £4.95 (C) |
| FQ45Y | Stylus 2509 | £1.85 (D) |
| †HR60Q | Stylus 9TAHC DD | £1.85 (D) |
| HR53H | Stylus KS40A DD | £1.85 (D) |
| BK17T | Stylus Sony ND114 | £5.50 (B) |
| BK18U | Stylus ND200 | £6.75 (B) |
| YX27E | Stylus Sony XL15 | £4.35 (C) |
| YX28F | Stylus Sony ND126 | £4.95 (C) |
| FQ49D | Stylus Sony ND133 | £5.50 (B) |
| FQ50E | Stylus Sony ND134 | £5.50 (B) |
| FQ51F | Stylus N2001D | £2.95 (C) |
| FQ52G | Stylus N2001ED | £6.75 (B) |
| YX30H | Stylus Tetrad 51 | £2.25 (C) |
| FQ53H | Stylus Toshiba N3C | £2.20 (C) |
| YX31J | Stylus Toshiba N55 | £4.95 (C) |
| YX32K | Stylus Toshiba N58 | £4.95 (C) |
| YX21X | Stylus Toshiba N55D | £4.95 (C) |
| **Page 258** | | |
| YB47B | Record Care kt C106 | £4.95 (C) |
| LX06G | Cleaning Arm C100 | £3.25 (C) |
| YW81C | Cleaning Cloth C104 | 78p (E) |
| FR48C | Dust-Off C101 | 99p (E) |
| YW82D | Cleaner C92 | £4.65 (C) |
| YX93B | Stylus Microscope | £2.45 (C) |
| YW83E | Stylus Brush C103 | 12p (G) |
| FR46A | Stylus Cleaner C95 | 80p (E) |
| YB55K | Cleaning Kit C116 | £2.42 (C) |
| FR52G | Anti-Stat Fluid 69S | 49p (F) |
| LX10L | Anti-Stat Mat C119 | £1.95 (D) |
| LX04E | Anti-Stat Gun | £5.25 (B) |
| FR49D | Stylus Balance PX1 | £2.45 (C) |
| FR50E | Gram Speed Indicator | 9p (H) |
| **Page 259** | | |
| YW86T | Cassette Kit C115 | £1.85 (D) |
| RK95D | Tape Head Care Kit | £2.75 (C) |
| YB56L | Cassette Kit C107 | £4.25 (C) |
| BK28F | Deluxe Head Cleaner | £3.25 (C) |
| RB04E | Cass Head Clnr C118 | £1.25 (D) |
| YW87U | Cleaning Stick C109 | 23p (G) |
| YW88V | Tape Cleaning Fluid | 58p (E) |
| FR54J | Cassette Clnr Tape | 55p (E) |
| YW89W | Cassette Cln & Demag | £2.25 (C) |
| FR62S | Straight Demagnetzer | £3.64 (C) |

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|---|---|---|
| FQ62S | Curved Demagnetiser | £3.85 (C) |
| BK27E | Elec Head Demag | £8.95 (B) |
| YW91Y | Splicing Block | £1.85 (D) |
| **Page 260** | | |
| YW90X | Cassette Splicer | £4.25 (C) |
| LX17T | Splicing Tape | 65p (E) |
| RB03D | Cassette Case | 23p (G) |
| FR60Q | Index Cards | £1.40 (D) |
| RB01B | Cassette Fast Winder | £2.75 (C) |
| FR59P | Test Cassette 53 | £4.98 (C) |
| YG25C | Cassette Tape C60 | 61p (E) |
| YG26D | Cassette Tape C90 | 65p (E) |
| RB07H | Rola-Rack | £2.45 (C) |
| LH91Y | Cassettebox | £4.65 (C) |
| LH92A | Videocassettebox | £9.68 (B) |
| RK96E | VHS Head Cleaner | £9.75 (B) |
| RK97F | Betamax Head Cleaner | £10.95 (A) |
| **Page 261** | | |
| FQ63T | GF Cassette Head | £12.80 (A) |
| FQ64U | Mono Cassette Head | £4.55 (C) |
| FQ66W | Cassette Erase Head | £2.75 (C) |
| FQ65V | Stereo Cassette Head | £5.26 (B) |
| FQ69A | Tape hd Four-Trck RP | £16.95 (A) |
| FQ70M | Tpe Hd Four Trk Eras | £8.85 (B) |
| FQ71N | 2-Head Bracket | £4.65 (C) |
| FQ72P | 3-Head Bracket | £5.39 (B) |

## RESISTORS

| | | |
|---|---|---|
| **Page 262** | | |
| U | Micro Res | 3p (H) |
| B | Econ Res 1R to 8R2 | 2p (H) |
| B | Econ Res 1M2 to 10M | 2p (H) |
| M | M1R to 8R2 (1%) | 12p (H) |
| M | M10R to 1M (1%) | 2p (H) |
| M | M1M2 to M10M (1%) | 12p (H) |
| **Page 263** | | |
| S | Std Res | 3p (H) |
| C | 1W Res | 5p (H) |
| XL05F | Colour Wheel | 25p (F) |
| X | See M | |
| T | See M | |
| W | W/W Min | 29p (F) |
| **Page 264** | | |
| L | 7W W/W | 29p (F) |
| H | 10W W/W | 35p (F) |
| P | 25 W/W Res | £1.65 (D) |
| V | HV Res 1M-33M | 12p (G) |
| V | HV Res 47M | 25p (F) |
| BL64U | Constantan 28 swg | £3.25 (C) |
| YY12N | Resnet 100R | 85p (E) |
| YY13P | Resnet 220R | 85p (E) |
| YY14Q | Resnet 470R | 85p (E) |
| YY15R | Resnet 1k | 85p (E) |
| YY16S | Resnet 2k2 | 93p (E) |
| YY17T | Resnet 4k7 | 85p (E) |
| YY18U | Resnet 10k | 85p (E) |
| YY19V | Resnet 22k | 85p (E) |
| YY20W | Resnet 47k | 85p (E) |
| YY21X | Resnet 100k | 85p (E) |
| WR52G | Hor S-Min Prest 100R | 10p (G) |
| WR53H | Hor S-Min Prest 220R | 10p (G) |
| WR54J | Hor S-Min Prest 470R | 10p (G) |
| WR55K | Hor S-Min Prest 1k | 10p (G) |
| WR56L | Hor S-Min Prest 2K2 | 10p (G) |
| WR57M | Hor S-Min Prest 4k7 | 10p (G) |
| WR58N | Hor S-Min Prest 10k | 10p (G) |
| WR59P | Hor S-Min Prest 22K | 10p (G) |
| WR60Q | Hor S-Min Prest 47k | 10p (G) |
| WR61R | Hor S-Min 100k | 10p (G) |
| WR62S | Hor S-Min Prest 220k | 10p (G) |
| WR63T | Hor S-Min Prest 470k | 10p (G) |
| WR64U | Hor S-Min Preset 1M | 10p (G) |
| WR65V | Vrt S-Min Prest 100R | 11p (G) |
| WR66W | Vrt S-Min Prest 220R | 11p (G) |
| WR67X | Vrt S-Min Prest 470R | 11p (G) |
| WR68Y | Vrt S-Min Prest 1k | 11p (G) |
| WR69A | Vrt S-Min Prest 2k2 | 11p (G) |
| WR70M | Vrt S-Min Prest 4k7 | 11p (G) |
| WR71N | Vrt S-Min Prest 10k | 11p (G) |
| WR72P | Vrt S-Min Prest 22k | 11p (G) |
| WR73Q | Vrt S-Min Prest 47k | 11p (G) |
| WR74R | Vrt S-Min Prest 100k | 11p (G) |
| WR75S | Vrt S-Min Prest 220k | 11p (G) |
| WR76H | Vrt S-Min Prest 470k | 11p (G) |
| WR77J | Vert S-Min Prest 1M | 11p (G) |
| **Page 265** | | |
| WR78K | Hor Skeleton 100R | 14p (G) |
| WR79L | Hor Skeleton 220R | 14p (G) |
| WR80B | Hor Skeleton 470R | 28p (F) |
| WR81C | Hor Skeleton 1k | 26p (F) |
| WR82D | Hor Skeleton 2k2 | 26p (F) |
| WR83E | Hor Skeleton 4k7 | 26p (F) |
| WR84F | Hor Skelton 10k | 26p (F) |
| WR85G | Hor Skeleton 22k | 26p (F) |
| WR86T | Hor Skeleton 47k | 26p (F) |
| WR87U | Hor Skeleton 100k | 27p (F) |
| WR88V | Hor Skeleton 220k | 26p (F) |
| WR89W | Hor Skeleton 470k | 26p (F) |
| WR90X | Hor Skeleton 1M | 26p (F) |
| WR91Y | Hor Skeleton 2M2 | 26p (F) |
| WR92A | Hor Skeleton 4M7 | 26p (F) |
| WW00A | Vrt Skeleton 100R | 26p (F) |
| WW01B | Vrt Skeleton 220R | 26p (F) |
| WW02C | Vert Skeleton 470R | 26p (F) |
| WW03D | Vrt Skeleton 1k | 26p (F) |
| WW04E | Vrt Skeleton 2k2 | 26p (F) |
| WW05F | Vrt Skeleton 4k7 | 26p (F) |
| WW06G | Vrt Skeleton 10k | 26p (F) |
| WW07H | Vrt Skeleton 22k | 29p (F) |
| WW08J | Vrt Skeleton 47k | 26p (F) |
| WW09K | Vrt Skeleton 100k | 26p (F) |
| WW10L | Vrt Skeleton 220k | 26p (F) |
| WW11M | Vrt Skeleton 470k | 24p (F) |
| WW12N | Vrt Skeleton 1M | 28p (F) |
| WW13P | Vrt Skeleton 2M2 | 28p (F) |
| WW14Q | Vrt Skeleton 4M7 | 24p (F) |
| WR38R | Cermet 100R | 98p (E) |
| WR39N | Cermet 500R | 98p (E) |
| WR40T | Cermet 1k | 98p (E) |
| WR41U | Cermet 5k | 98p (E) |
| WR42V | Cermet 10k | 98p (E) |
| WR43W | Cermet 50k | 98p (E) |
| WR44X | Cermet 100k | 98p (E) |
| WR45Y | Cermet 1M | 98p (E) |
| WR46A | 15-Turn Cermet 500R | £1.20 (D) |
| WR47B | 15-Turn Cermet 1k | £1.20 (D) |
| WR48C | 15-Turn Cermet 5k | £1.20 (D) |
| WR49D | 15-Turn Cermet 10k | £1.42 (D) |
| WR50E | 15-Turn Cermet 50k | £1.20 (D) |
| WR51F | 15-Turn Cermet 100k | £1.42 (D) |
| BW06G | Edge Control Pot | 65p (E) |
| BW07H | Edge Knob Small Blk | 8p (H) |

## TRADE QUANTITIES

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. See table at start of price list. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity.

Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.

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|---|---|---|
| BW08J | Edge Knob Small Grey | 8p (H) |
| BW09K | Edge Knob Large Blk | 8p (H) |
| BW10L | Edge Knob Large Grey | 8p (H) |
| FW00A | Pot Lin 1k | 45p (F) |
| FW01B | Pot Lin 4k7 | 45p (F) |
| FW02C | Pot Lin 10k | 45p (F) |
| FW03D | Pot Lin 22k | 45p (F) |
| FW04E | Pot Lin 47k | 45p (F) |
| FW05F | Pot Lin 100k | 45p (F) |
| FW06G | Pot Lin 220k | 45p (F) |
| FW07H | Pot Lin 470k | 45p (F) |
| FW08J | Pot Lin 1M | 45p (F) |
| FW09K | Pot Lin 2M2 | 45p (F) |
| FW21X | Pot Log 4k7 | 45p (F) |
| FW22Y | Pot Log 10k | 45p (F) |
| FW23A | Pot Log 22k | 45p (F) |
| FW24B | Pot Log 47k | 45p (F) |
| FW25C | Pot Log 100k | 45p (F) |
| FW26D | Pot Log 220k | 45p (F) |
| FW27E | Pot Log 470k | 45p (F) |
| FW28F | Pot Log 1M | 45p (F) |
| FW29G | Pot Log 2M2 | 45p (F) |

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|---|---|---|
| FW41U | Sw Pot Lin 4k7 | £1.12 (D) |
| FW42V | Sw Pot Lin 10k | £1.12 (D) |
| FW43W | Sw Pot Lin 22k | £1.12 (D) |
| FW44X | Sw Pot Lin 47k | £1.12 (D) |
| FW45Y | Sw Pot Lin 100k | £1.12 (D) |
| FW46A | Sw Pot Lin 220k | £1.12 (D) |
| FW47B | Sw Pot Lin 470k | £1.12 (D) |
| FW48C | Sw Pot Lin 1M | £1.12 (D) |
| FW49D | Sw Pot Lin 2M2 | £1.12 (D) |
| FW62S | Sw Pot Log 4k7 | £1.12 (D) |
| FW63T | Sw Pot Log 10k | £1.12 (D) |
| FW64U | Sw Pot Log 22k | £1.12 (D) |
| FW65V | Sw Pot Log 47k | £1.12 (D) |
| FW66W | Sw Pot Log 100k | £1.12 (D) |
| FW67X | Sw Pot Log 220k | £1.12 (D) |
| FW68Y | Sw Pot Log 470k | £1.12 (D) |
| FW69A | Sw Pot Log 1M | £1.12 (D) |
| FW70M | Sw Pot Log 2M2 | £1.12 (D) |
| FW50E | W/W Pot 10R | £2.15 (C) |
| FW51F | W/W Pot 25R | £1.99 (D) |
| FW52G | W/W Pot 50R | £1.99 (D) |
| FW71N | W/W Pot 100R | £2.55 (C) |
| FW72P | W/W Pot 250R | £1.98 (D) |
| FW73Q | W/W Pot 500R | £1.85 (D) |
| FW93B | W/W Pot 1k | £1.85 (D) |
| FW96E | W/W Pot 2K5 | 59p (E) |
| FW94C | W/W Pot 5k | 99p (E) |
| FW95D | W/W Pot 10k | £2.29 (C) |
| FX18U | W/W Pot 50k | £2.79 (C) |
| FW84F | Dual Pot Lin 4k7 | £1.24 (D) |
| FW85G | Dual Pot Lin 10k | £1.24 (D) |
| FW86T | Dual Pot Lin 22k | £1.24 (D) |
| FW87U | Dual Pot Lin 47k | £1.24 (D) |
| FW88V | Dual Pot Lin 100k | £1.24 (D) |
| FW89W | Dual Pot Lin 220k | £1.24 (D) |
| FW90X | Dual Pot Lin 470k | £1.24 (D) |
| FW91Y | Dual Pot Lin 1M | £1.24 (D) |
| FW92A | Dual Pot Lin 2M2 | £1.24 (D) |
| FX08J | Dual Pot Log 4k7 | £1.24 (D) |
| FX09K | Dual Pot Log 10k | £1.24 (D) |
| FX10L | Dual Pot Log 22k | £1.24 (D) |
| FX11M | Dual Pot Log 47k | £1.24 (D) |
| FX12N | Dual Pot Log 100k | £1.24 (D) |
| FX13P | Dual Pot Log 220k | £1.24 (D) |
| FX14Q | Dual Pot Log 470k | £1.24 (D) |
| FX15R | Dual Pot Log 1M | £1.24 (D) |
| FX16S | Dual Pot Log 2M2 | £1.24 (D) |
| FX40T | L/S Control 20R | 55p (E) |
| FX97F | L/S Control 50R | 55p (E) |
| FX98G | L/S Control 100R | 55p (E) |
| FX99H | L/S Control 200R | 55p (E) |
| YG04E | Rheostat 50R | £4.90 (C) |
| YG05F | Rheostat 100R | £4.90 (C) |
| YG06G | Rheostat 150R | £4.90 (C) |
| YG07H | Rheostat 200R | £4.90 (C) |

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|---|---|---|
| FX32K | Slide Pot Lin 5k | 79p (E) |
| FX33L | Slide Pot Lin 10k | 79p (E) |
| FX34M | Slide Pot Lin 25k | 79p (E) |
| FX35Q | Slide Pot Lin 50k | 79p (E) |
| FX36P | Slide Pot Lin 100k | 79p (E) |
| FX37S | Slide Pot Lin 250k | 79p (E) |
| FX38R | Slide Pot Lin 500k | 79p (E) |
| FX53H | Slide Pot Log 5k | 79p (E) |
| FX54J | Slide Pot Log 10k | 79p (E) |
| FX55K | Slide Pot Log 25k | 79p (E) |
| FX56L | Slide Pot Log 50k | 79p (E) |
| FX57M | Slide Pot Log 100k | 79p (E) |
| FX58N | Slide Pot Log 250k | 79p (E) |
| FX59P | Slide Pot Log 500k | 79p (E) |
| FX76H | Dual Slide Lin 5k | £1.25 (D) |
| FX77J | Dual Slide Lin 10k | £1.25 (D) |
| FX80B | Dual Slide Lin 100k | £1.25 (D) |
| HB02C | Dual Slide Log 10k | £1.25 (D) |
| HB04E | Dual Slide Log 50k | £1.25 (D) |
| HB05F | Dual Slide Log 100k | £1.25 (D) |
| HB07H | Dual Slide Log 500k | £1.25 (D) |
| FX07H | Slide Bezel | 49p (F) |
| XB09K | Joystick Pot | £6.38 (B) |
| HQ50E | 2-Axis Joystick | £3.25 (C) |
| XB06G | Joystick Mtg Plate | £1.66 (D) |

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|---|---|---|
| FX87U | Thermistor KR152CW | 98p (E) |
| FX21X | Thermistor VA1055S | 51p (E) |
| FX22Y | Thermistor VA1056S | 38p (F) |
| FX42V | Thermistor VA1066S | 41p (F) |
| FX43W | Thermistor VA1067S | 39p (F) |
| FX62S | Thermistor R53 | £5.95 (B) |
| WH23A | Thermistor G16 | £5.40 (B) |
| WH24B | Thermistor G23 | £5.35 (B) |
| HB10L | LDR ORP12 | £1.35 (D) |
| HB11M | LDR ORP60 | £1.72 (D) |
| HB09K | LDR RPY58A | £1.18 (D) |

**SEMICONDUCTORS**

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|---|---|---|
| QB00A | AA119 | 11p (G) |
| QB01B | AC126 | 36p (F) |
| QB02C | AC127 | 38p (F) |
| QB03D | AC128 | 42p (F) |
| QB04E | AC141 | 39p (F) |
| QB05F | AC142 | 33p (F) |
| QB06G | AC176 | 26p (F) |
| QB07H | AC187 | 29p (F) |
| QB08J | AC188 | 37p (F) |
| QB10L | ACY19 | 77p (E) |
| QB11M | ACY20 | 75p (E) |
| BL30H | AD140 | £1.55 (D) |
| BL31J | AD149 | £1.35 (D) |
| BL32K | AD161 | 61p (E) |
| BL33L | AD161/2MP | £1.22 (D) |
| BL34M | AD162 | 61p (E) |
| QQ00A | ADC0804LCN | £4.45 (C) |
| QB19V | AF139 | 65p (E) |
| QB20W | AF239 | 88p (E) |
| BR45Y | AS314 | 33p (F) |
| QB21X | AY-1-0212 | £8.20 (B) |
| HQ52G | AY-1-1320 | £4.99 (C) |
| HQ51F | AY-1-5050 | £1.99 (D) |
| YY98G | AY-3-1270 | £8.30 (B) |
| YY89W | AY-3-1350 | £5.95 (B) |
| WQ18U | AY-3-1015D | £5.98 (B) |
| WQ19V | AY-5-2376 | £9.95 (B) |
| QB27E | BA102B | 29p (F) |
| QQ12N | BA243 | 10p (G) |
| QQ13P | BAR28 | 15p (G) |
| QB28F | BAX13 | 7p (H) |
| QB29G | BAX16 | 7p (H) |
| QB31J | BC107B | 14p (G) |
| QB32K | BC108C | 14p (G) |
| QB33L | BC109C | 16p (G) |
| QB34M | BC117 | 24p (F) |
| QB35Q | BC119 | 39p (F) |
| QB36P | BC139 | 40p (F) |
| QB37S | BC140 | 34p (F) |
| QB38R | BC141 | 37p (F) |
| QB39N | BC142 | 34p (F) |
| QB40T | BC143 | 34p (F) |
| QB44X | BC154 | 27p (F) |
| QB48C | BC160 | 43p (F) |
| QB49D | BC161 | 36p (F) |
| QB50E | BC168C | 11p (G) |
| QB51F | BC169C | 11p (G) |
| QB52G | BC177 | 20p (G) |
| QB53H | BC178 | 20p (G) |
| QB54J | BC179 | 20p (G) |
| QB55K | BC182L | 11p (G) |
| QB56L | BC183L | 11p (G) |
| QB57M | BC184L | 11p (G) |
| QB58N | BC204 | 15p (G) |
| QB59P | BC209C | 14p (G) |
| QB60Q | BC212L | 11p (G) |
| QB61R | BC213L | 11p (G) |
| QB62S | BC214L | 10p (G) |
| QB63T | BC301/5 | 40p (F) |
| QB64U | BC301/5/302/5MP | 89p (E) |
| QB65V | BC302/5 | 36p (F) |
| QB66W | BC327 | 15p (G) |
| QB67X | BC328 | 15p (G) |
| QB68Y | BC337 | 15p (G) |
| QB69A | BC338 | 15p (G) |
| QB70M | BC441 | 38p (F) |
| QB71N | BC441/461MP | 79p (E) |
| QB72P | BC461 | 43p (F) |
| QQ14Q | BC547 | 11p (G) |
| QB73Q | BC548 | 14p (G) |
| QQ15R | BC549 | 12p (G) |
| QQ16S | BC557 | 11p (G) |
| QQ17T | BC558 | 11p (G) |
| QQ18U | BC559 | 11p (G) |
| QB74R | BC650 | 29p (F) |
| QF00A | BCY70 | 18p (G) |
| QF01B | BCY71 | 18p (G) |
| QF03D | BD131 | 49p (F) |
| QF04E | BD131/2MP | £1.19 (D) |
| QF05F | BD132 | 50p (E) |
| QF06G | BD135 | 45p (F) |
| QF75S | BD136 | 24p (F) |
| QF07H | BD139 | 40p (F) |
| QF08J | BD140 | 40p (F) |
| WH15R | BD711 | 68p (E) |
| WH16S | BD712 | 68p (E) |
| QF09K | BF115 | 38p (F) |
| QF10L | BF167 | 38p (F) |
| QF11M | BF180 | 38p (F) |
| QF15R | BF200 | 32p (F) |
| QF16S | BF244 | 30p (F) |
| QF17T | BF258 | 33p (F) |
| QF18U | BF259 | 39p (F) |
| QF19V | BF337 | 40p (F) |
| QQ19V | BF494 | 25p (F) |
| QQ20W | BF495 | 25p (F) |
| QF20W | BFW10 | £1.43 (D) |
| QF21X | BFX29 | 33p (F) |
| QF22Y | BFX30 | 35p (F) |
| QF23A | BFX84 | 34p (F) |
| QF24B | BFX85 | 31p (F) |
| QF25C | BFX87 | 32p (F) |
| QF26D | BFX88 | 36p (F) |
| QF27E | BFY50 | 30p (F) |
| QF28F | BFY51 | 29p (F) |
| QF29G | BFY52 | 31p (F) |
| QF31J | BRY39 | 48p (F) |
| QF32K | BSX20 | 26p (F) |
| QF33L | BSX21 | 29p (F) |
| QF35Q | BT109 | £1.49 (D) |
| QF37S | BU205 | £1.95 (D) |
| QF39N | BU208 | £2.99 (C) |
| QF41U | BY126 | 21p (G) |
| QF42V | BY127 | 13p (G) |
| QF43W | BY164 | 76p (E) |
| QF44X | BY206 | 30p (F) |
| QF45Y | BZX61C4V7 | 16p (G) |
| QF46A | BZX61C5V1 | 16p (G) |
| QF47B | BZX61C5V6 | 16p (G) |
| QF48C | BZX61C6V2 | 16p (G) |
| QF49D | BZX61C6V8 | 16p (G) |
| QF50E | BZX61C7V5 | 16p (G) |
| QF51F | BZX61C8V2 | 16p (G) |
| QF52G | BZX61C9V1 | 16p (G) |
| QF53H | BZX61C10 | 16p (G) |
| QF54J | BZX61C11 | 16p (G) |
| QF55K | BZX61C12 | 16p (G) |
| QF56L | BZX61C13 | 16p (G) |
| QF57M | BZX61C15 | 16p (G) |
| QF58N | BZX61C16 | 16p (G) |
| QF59P | BZX61C18 | 16p (G) |
| QF60Q | BZX61C20 | 16p (G) |
| QF61R | BZX61C22 | 16p (G) |
| QF62S | BZX61C24 | 16p (G) |
| QF63T | BZX61C27 | 16p (G) |
| QF64U | BZX61C30 | 16p (G) |
| QF65V | BZX61C33 | 16p (G) |
| QF66W | BZX61C36 | 16p (G) |
| QF67X | BZX61C39 | 16p (G) |
| QF68Y | BZX61C43 | 16p (G) |
| QF69A | BZX61C47 | 16p (G) |
| QF70M | BZX61C51 | 16p (G) |
| QF71N | BZX61C56 | 16p (G) |
| QF72P | BZX61C62 | 16p (G) |
| QF73Q | BZX61C68 | 16p (G) |
| QF74R | BZX61C75 | 16p (G) |
| QH00A | BZY88C2V7 | 9p (H) |
| QH01B | BZY88C3V0 | 9p (H) |
| QH02C | BZY88C3V3 | 9p (H) |
| QH03D | BZY88C3V6 | 9p (H) |
| QH04E | BZY88C3V9 | 9p (H) |
| QH05F | BZY88C4V3 | 9p (H) |
| QH06G | BZY88C4V7 | 9p (H) |
| QH07H | BZY88C5V1 | 9p (H) |
| QH08J | BZY88C5V6 | 9p (H) |
| QH09K | BZY88C6V2 | 9p (H) |
| QH10L | BZY88C6V8 | 9p (H) |
| QH11M | BZY88C7V5 | 9p (H) |
| QH12N | BZY88C8V2 | 9p (H) |
| QH13P | BZY88C9V1 | 9p (H) |
| QH14Q | BZY88C10 | 9p (H) |
| QH15R | BZY88C11 | 9p (H) |
| QH16S | BZY88C12 | 9p (H) |
| QH17T | BZY88C13 | 9p (H) |
| QH18U | BZY88C15 | 9p (H) |
| QH19V | BZY88C16 | 9p (H) |
| QH20W | BZY88C18 | 9p (H) |
| QH21X | BZY88C20 | 9p (H) |
| QH22Y | BZY88C22 | 9p (H) |
| QH23A | BZY88C24 | 9p (H) |
| QH24B | BZY88C27 | 8p (H) |
| QH25C | BZY88C30 | 9p (H) |
| QH26D | CA3046 | 72p (E) |
| YH58N | CA3080E | 87p (E) |
| QH27E | CA3089E | £2.70 (C) |
| QH28F | CA3130T | £1.10 (D) |
| QH29G | CA3140T | 99p (E) |
| WQ20W | CA3189E | £1.95 (D) |
| WQ21X | CA3240E | £1.38 (D) |
| YG37S | CL8960 | £31.26 (A) |
| QH30H | C106D | 42p (F) |
| WQ22Y | C116D | 99p (E) |
| WQ23A | C126D | £1.63 (D) |
| WQ24B | C206D | 95p (E) |
| WQ25C | C226D | 64p (E) |
| QL14Q | C246D | £1.24 (D) |
| QQ01B | DAC0801LCN | £2.45 (C) |
| QQ21X | DV1202W | £8.35 (B) |
| QQ22Y | DV1205W | TEMP |
| QQ23A | DV1210W | £13.63 (A) |
| QQ24B | DV1220W | £16.88 (A) |
| QQ25C | DV1230W | £21.30 (A) |
| QQ26D | DV1240W | TEMP |
| WQ28F | HSCH1001 | 55p (E) |
| YH59P | ICL7109 | £19.33 (A) |
| YY75S | ICL7660CPA | £3.24 (C) |
| YY93B | ICM7045IPI | £14.20 (A) |
| YY94C | ICM7216DIPI | £17.45 (A) |
| YY95D | ICM7226BIPI | £21.90 (A) |
| YH63T | ICM 7555 | £1.25 (D) |
| QH33L | 1R122D | £3.95 (C) |
| BH45Y | J005 | £1.75 (D) |
| BL36P | J02 | £1.80 (D) |
| BH46A | J04 | £1.95 (D) |
| BH47B | K01 | £3.15 (C) |
| BH48C | K04 | £4.25 (C) |
| YY74R | L200 | £2.69 (C) |
| WQ29G | LF347 | £2.55 (C) |
| WQ30H | LF351 | 56p (E) |
| WQ31J | LF353 | 99p (E) |
| QY26D | LF400CN | NYA |
| QY27E | LF411CN | 82p (E) |
| QY28F | LF412CN | £1.38 (D) |
| QY29G | LF441CN | 72p (E) |
| QY30H | LF442CN | £1.38 (D) |
| QY31J | LF444CN | £1.96 (D) |
| YY69A | LF13741 | 55p (E) |
| QH35Q | LH0042C | £4.30 (C) |
| QH36P | LM301A | 27p (F) |
| QH37S | LM308 | 95p (E) |
| QY09K | LM311N | 62p (E) |
| WQ32K | LM334 | £1.10 (D) |
| YY72P | LM335Z | £1.42 (D) |
| QH38R | LM377 | £2.25 (C) |
| QH39N | LM379S | £5.52 (B) |
| QH40T | LM380 | 75p (E) |
| QH41U | LM381 | £1.57 (D) |
| YY84F | LM382 | £1.65 (D) |
| WQ33L | LM383 | £1.61 (D) |
| WQ34M | LM384 | £1.44 (D) |
| WQ35Q | LM387 | £1.25 (D) |
| WQ36P | LM389 | £1.49 (D) |
| QY19V | LM1035 | £4.50 (C) |
| QY33L | LM1037N | £2.21 (C) |
| QY34M | LM1038N | £2.24 (C) |
| YY85G | LM1818 | £1.95 (D) |
| YY99H | LM1830 | £2.65 (C) |
| QY36P | LM1851N | £1.46 (D) |
| YY71N | LM1871 | £5.60 (B) |
| YY72P | LM1872 | £5.90 (B) |
| WQ38R | LM2917 | £2.45 (C) |
| WQ37S | LM1820 | £1.80 (D) |
| QH42V | LM3900 | 57p (E) |
| WQ39N | LM3909 | 87p (E) |
| WQ40T | LM3911 | £1.31 (D) |
| WQ41U | LM3914 | £3.51 (C) |
| YY96E | LM3915 | £2.93 (C) |
| YY97F | LM3916 | £3.46 (C) |
| YH64U | LM13600N | £1.39 (D) |
| YY81C | M083 | £4.75 (C) |
| WH22Y | M087 | £4.95 (C) |
| YY90X | M108 | £18.25 (A) |
| YY91Y | M147 | £6.51 (B) |
| HQ71N | M251 | £12.20 (A) |
| WH21X | M254 | £7.49 (B) |
| QH43W | MCR102 | 59p (E) |

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| QH45Y | MC1310P | £2.30 (C) |
| QH47B | MC1496 | 89p (E) |
| QH48C | MC3302P | 80p (E) |
| QH49D | MC3340P | £1.35 (D) |
| WQ42V | MCM4027 250ns | £1.88 (D) |
| WQ43W | MC6800P | £5.10 (B) |
| WQ44X | MC6802P | £4.72 (C) |
| WQ45Y | MC6810AP 450ns | £1.86 (D) |
| WQ46A | MC6821P | £1.99 (D) |
| QQ03D | MC6845 | £10.55 (A) |
| WQ48C | MC6850P | £2.99 (C) |
| WQ49D | MC6852P | £2.95 (C) |
| WQ50E | MC6875L | £6.32 (B) |
| QY23A | MC10116P | 85p (E) |
| YY35Q | MF10CN | £4.96 (C) |
| QH54J | MJE340 | 75p (E) |
| WQ51F | MJE350 | £1.15 (D) |
| QH55K | MJE2955=TIP2955 | £1.20 (D) |
| QH56L | MJE3055=TIP3055 | 81p (E) |
| QH57M | MJ2501 | £3.20 (C) |
| BL38R | MJ2955 | £1.10 (D) |
| QH58N | MJ3001 | £2.40 (C) |
| YY92A | MK50395 | £10.50 (A) |
| YH67X | ML922 | £5.25 (B) |
| QR57M | ML926 | £2.45 (C) |
| QR58N | ML927 | £2.45 (C) |
| YH68Y | ML928 | £2.40 (C) |
| YH69A | ML929 | £2.40 (C) |
| QH59P | MPF102 | 66p (E) |
| QH60Q | MPSA14 | 36p (F) |
| QH61R | MPSA65 | 45p (F) |
| QH62S | MPS3638 | 21p (G) |
| QH63T | MPS3638A | 18p (G) |
| WQ53H | MVAM115 | £2.10 (C) |
| WQ54J | NE531 | £1.65 (D) |
| WQ55K | NE 544 | £2.18 (C) |
| QH66W | NE 555 | 21p (G) |
| QH67X | NE 556 | 62p (E) |
| WQ56L | NE 565 | £1.64 (D) |
| QH68Y | NE 566 | £1.60 (D) |
| QH69A | NE 567 | £1.30 (D) |
| QY10L | NE570 | £4.28 (C) |
| YY87U | NE571 | £3.36 (C) |
| YY68Y | NE5534A | £2.45 (C) |
| YY67X | NE5539 | £7.85 (B) |
| QH70M | OA47 | 12p (G) |
| QH71N | OA90 | 9p (H) |
| QH72P | OA91 | 8p (H) |
| QH73Q | OA95 | 8p (H) |
| QH74R | OA200 | 8p (H) |
| QH75S | OA202 | 13p (G) |
| QH82D | OC45 | 47p (F) |
| QH84F | OC71 | 31p (F) |
| QH85G | OC72 | 42p (F) |
| QH87U | OC81 | 42p (F) |
| QH89W | OC83 | 45p (F) |
| QH91Y | OC170 | 95p (E) |
| QH92A | OC171 | 99p (E) |
| QY37S | Satronics PC1R | £3.62 (C) |
| QY38R | Satronics PC12R | £6.94 (B) |
| QH93B | PN3643 | 30p (F) |
| WQ57M | PW01 | 95p (E) |
| WQ58N | PW06 | 89p (E) |
| WQ59P | RO-3-2513 | £8.95 (B) |
| QL00A | R2008B | £2.25 (C) |
| QL02C | SAM77 | £1.20 (D) |
| QL05F | SC146D | £1.62 (D) |
| WQ60Q | SFF96364 | £9.45 (B) |
| QL06G | SG1495D | £3.95 (C) |
| QL07H | SG3402 | £3.98 (C) |
| WQ61R | SH120A | £6.65 (B) |
| YH66W | SL490 | £3.35 (C) |
| QY18U | SP8680B | £12.40 (A) |
| QL08J | ST2 | 25p (F) |
| QL09K | S005 | 47p (F) |
| QL10L | S04 | 52p (E) |
| WQ62S | TAA 550 | 35p (F) |
| QL11M | TAG1/100 | £1.45 (D) |
| QL12N | TAG1/600 | £1.20 (D) |
| BL35Q | TBA 651 | £2.25 (C) |
| QL13P | TBA810P | 95p (E) |
| WQ63T | TBA820M | 70p (E) |
| YY79L | TCA350Z | £3.95 (C) |
| WQ64U | TCA4500A | £3.35 (C) |
| WH20W | TDA1022 | £6.75 (B) |
| YY76H | TDA1024 | £1.49 (D) |
| QY32K | TDA 1102SP | £3.24 (C) |
| YY70M | TDA2005M | £8.25 (B) |
| WQ66W | TDA2006 | £1.65 (D) |
| WQ67X | TDA2030 | £1.95 (D) |
| YY86T | TDA3410 | £1.90 (D) |
| QL15R | TIP31A | 39p (F) |
| QL16S | TIP32A | 39p (F) |
| WQ71N | TIP33A | 68p (E) |
| WQ72P | TIP34A | 99p (E) |
| QL17T | TIP41A | 49p (F) |
| QL18U | TIP42A | 45p (F) |
| WQ73Q | TIP122 | 99p (E) |
| WQ74R | TIP127 | 75p (E) |
| QL19V | TIS43 | 55p (E) |
| WQ75S | TL170C | 55p (E) |
| WQ76H | TL172C | 76p (E) |
| YY77J | TL430C | 99p (E) |
| YY78K | TL497A | £1.65 (D) |
| YY88V | TMS1121 | £9.73 (B) |
| QY14Q | UAA170L | £2.50 (C) |
| QL20W | uA709C | 75p (E) |
| BL22Y | uA723C TO99 | 85p (E) |
| QL21X | uA723C 14-pin DIL | 55p (E) |
| QL22Y | uA741C 8-pin DIL | 23p (G) |
| QL23A | uA741C 14-pin DIL | 78p (E) |
| QL24B | uA747C | 75p (E) |
| QL25C | uA748C | 52p (E) |
| QL26D | uA78L05AWC | 45p (F) |
| WQ77J | uA78L12AWC | 45p (F) |
| QL27E | uA78L15AWC | 45p (F) |
| QL28F | uA78M05UC | 79p (E) |
| QL29G | uA78M12UC | 79p (E) |
| QL30H | uA78M15UC | 79p (E) |
| WQ78K | u78MGU1C | £1.25 (D) |
| QL31J | uA7805UC | 78p (E) |
| QL32K | uA7812UC | 78p (E) |
| QL33L | uA7815UC | 78p (E) |
| WQ79L | uA78GU1C | £1.25 (D) |
| QL34M | uA7805KC | £1.65 (D) |
| QL35Q | uA7815KC | £1.65 (D) |
| WQ80B | uA78H05KC | £5.55 (B) |
| WQ81C | uA78H12KC | £6.49 (B) |
| WQ83E | uA78HGKC | £6.25 (B) |
| WQ84F | uA78P05SC | £8.25 (B) |
| WQ85G | uA79L05AWC | 62p (E) |
| WQ86T | uA79L12AWC | 68p (E) |
| WQ87U | uA79L15AWC | 75p (E) |
| WQ88V | uA79M05UC | 89p (E) |
| WQ89W | uA79M12UC | 64p (E) |
| WQ90X | uA79M15UC | 89p (E) |
| WQ91Y | uA79MGU1C | £1.20 (D) |
| WQ92A | uA7905UC | £1.38 (D) |
| WQ93B | uA7912UC | 95p (E) |
| QL36P | uA7915UC | 82p (E) |
| WQ94C | uA79GU1C | £1.25 (D) |
| WQ95D | uA79HGKC | £8.59 (B) |
| QQ27E | VK10KM | 83p (E) |
| QQ28F | VK1010 | £1.48 (D) |
| QQ29G | VK1011 | £1.35 (D) |
| WQ96E | VN46AF | £1.10 (D) |
| WQ97F | VN66AF | £1.55 (D) |
| WQ98G | VN88AF | £1.37 (D) |
| QQ11M | VQ1000CJ | £4.30 (C) |
| QL37S | W005 | 28p (F) |
| QL38R | W01 | 34p (F) |
| QL39N | W02 | 38p (F) |
| QL40T | W04 | 39p (F) |
| QL41U | ZN414 | £1.25 (D) |
| QL42V | ZS120 | 44p (F) |
| QL43W | ZTX107 | 22p (G) |
| QL44X | ZTX108 | 15p (G) |
| QL45Y | ZTX109 | 19p (G) |
| QL46A | ZTX300 | 16p (G) |
| QL47B | ZTX301 | 20p (G) |
| QL48C | ZTX302 | 22p (G) |
| QL50E | ZTX304 | 24p (F) |
| QL54J | ZTX326 | 98p (E) |
| QL56L | ZTX330 | 29p (F) |
| QL57M | ZTX331 | 28p (F) |
| QL60Q | ZTX500 | 21p (G) |
| QL62S | ZTX502 | 19p (G) |
| QL64U | ZTX504 | 34p (F) |
| QL66W | ZTX530 | 29p (F) |
| QL67X | ZTX531 | 33p (F) |
| QL68Y | ZTX541 | 31p (F) |
| QL69A | ZTX542 | 33p (F) |
| QL70M | Z5J | £2.84 (C) |
| QW00A | Z80-CPU | £7.95 (B) |
| QW01B | Z80-CTC | £4.50 (C) |
| QW03D | Z80-PIO | £4.25 (C) |
| QL71N | 1N914 | 4p (H) |
| QL72P | 1N916 | 5p (H) |
| QL73Q | 1N4001 | 5p (H) |
| QL74R | 1N4002 | 4p (H) |
| QL75S | 1N4003 | 6p (H) |
| QL76H | 1N4004 | 6p (H) |
| QL77J | 1N4005 | 6p (H) |
| QL78K | 1N4006 | 6p (H) |
| QL79L | 1N4007 | 7p (H) |
| QL80B | 1N4148 | 4p (H) |
| QL81C | 1N5400 | 15p (G) |
| QL82D | 1N5401 | 12p (G) |
| QL83E | 1N5402 | 16p (G) |
| QL84F | 1N5404 | 19p (G) |
| QL85G | 1N5406 | 20p (G) |
| QL86T | 1N5407 | 21p (G) |
| QL87U | 1N5408 | 19p (G) |
| QL88V | 1S921 | 9p (H) |
| QH46A | 1458C | 45p (F) |
| QR00A | 2N697 | 49p (F) |
| QR01B | 2N706 | 26p (F) |
| QR03D | 2N708 | 35p (F) |
| QR09K | 2N1711 | 39p (F) |
| QR10L | 2N1893 | 32p (F) |
| QR11M | 2N2219 | 31p (F) |
| QR12N | 2N2369A | 22p (G) |
| QR13P | 2N2484 | 38p (F) |
| QR14Q | 2N2646 | 55p (E) |
| QR15R | 2N2647 | 95p (E) |
| QR16S | 2N2904 | 31p (F) |
| QR17T | 2N2905 | 31p (F) |
| QR18U | 2N2906 | 26p (F) |
| QR19V | 2N2907 | 26p (F) |
| QR20W | 2N2926Or | 12p (G) |
| QR21X | 2N2926Ye | 12p (G) |
| QR22Y | 2N2926Gn | 12p (G) |
| QR23A | 2N3053 | 34p (F) |
| QR24B | 2N3054 | 66p (E) |
| BL45Y | 2N3055 | 75p (E) |
| QR25C | 2N3525 | £1.85 (D) |
| QR26D | 2N3702 | 11p (G) |
| QR27E | 2N3703 | 11p (G) |
| QR28F | 2N3704 | 10p (G) |
| QR29G | 2N3705 | 12p (G) |
| QR30H | 2N3706 | 14p (G) |
| QR31J | 2N3707 | 12p (G) |
| QR32K | 2N3708 | 11p (G) |
| QR34M | 2N3711 | 11p (G) |
| QW07H | 2N3772 | £1.95 (D) |
| QR35Q | 2N3773 | £2.70 (C) |
| QR36P | 2N3819 | 32p (F) |
| QR37S | 2N3823 | 65p (E) |
| QR38R | 2N3866 | £1.10 (D) |
| QR39N | 2N3903 | 17p (G) |
| QR40T | 2N3904 | 17p (G) |
| QR41U | 2N3905 | 15p (G) |
| QR42V | 2N3906 | 14p (G) |
| QR43W | 2N4058 | 12p (G) |
| QR44X | 2N4060 | 12p (G) |
| QR45Y | 2N4061 | 17p (G) |
| QR46A | 2N4062 | 12p (G) |
| QR47B | 2N4871 | 69p (E) |
| QR49D | 2N5458 | 42p (F) |
| QR50E | 2N5459 | 36p (F) |
| QR51F | 2N6073 | £1.20 (D) |
| QW08J | 2N6609 | £3.55 (C) |
| QR56L | 2SA715 | 45p (F) |
| QQ30H | 2SA872 | 39p (F) |
| QY12N | 2SA1085E | 34p (F) |
| QQ31J | 2SB716 | 30p (F) |
| QR59P | 2SC1162 | 45p (F) |
| QQ32K | 2SC1307 | £2.18 (C) |
| QY11M | 2SC2547E | 38p (F) |
| QQ33L | 2SD756 | 30p (F) |
| QQ34M | 2SJ48 | £3.82 (C) |
| QQ35Q | 2SJ49 | £3.95 (C) |
| QW09K | 2SJ50 | £4.54 (C) |
| QQ36P | 2SK133 | £3.60 (C) |
| QQ37S | 2SK134 | £4.18 (C) |
| QW10L | 2SK135 | £4.30 (C) |
| QW11M | 2102 450ns | £1.95 (D) |
| QW12N | 2114 450ns | £1.30 (D) |
| QW13P | 2708 450ns | £4.40 (C) |
| QQ07H | 2716 450ns | £3.96 (C) |
| QQ08J | 2732 450ns | £5.19 (B) |
| QQ09K | 2764 450ns | £11.90 (A) |
| QR52G | 3N140 | £1.12 (D) |
| QR53H | 3N141 | DIS |
| QH51F | 3403 | 98p (E) |
| QX00A | 4000BE | 24p (F) |
| QX01B | 4001BE | 17p (G) |
| QL03D | 4001UBE | 17p (G) |
| QX02C | 4002BE | 16p (G) |
| QX03D | 4006BE | 68p (E) |
| QX04E | 4007UBE | 16p (G) |
| QW14Q | 4008BE | 52p (E) |
| QX05F | 4011BE | 16p (G) |
| QL04E | 4011UBE | 24p (F) |
| QX06G | 4012BE | 16p (G) |
| QX07H | 4013BE | 35p (F) |
| QW15R | 4014BE | 89p (E) |
| QW16S | 4015BE | 54p (E) |
| QX08J | 4016BE | 25p (F) |
| QX09K | 4017BE | 42p (F) |
| QX10L | 4018BE | 49p (F) |
| QW17T | 4019BE | 42p (F) |
| QX11M | 4020BE | 55p (E) |
| QW18U | 4021BE | 49p (F) |
| QW19V | 4022BE | 55p (E) |
| QX12N | 4023BE | 23p (G) |
| QX13P | 4024BE | 45p (F) |
| QX14Q | 4025BE | 22p (G) |
| QX15R | 4026BE | 84p (E) |
| QX16S | 4027BE | 28p (F) |

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| QW40T | 4060BE | £1.20 (D) |
| QW41U | 4063BE | £1.12 (D) |
| QX23A | 4066BE | 36p (F) |
| QW42V | 4067BE | £3.69 (C) |
| QX24B | 4068BE | 23p (G) |
| QX25C | 4069UBE | 24p (F) |
| QX26D | 4070BE | 16p (G) |
| QW43W | 4071BE | 16p (G) |
| QX27E | 4072BE | 16p (G) |
| QW44X | 4073BE | 21p (G) |
| QW45Y | 4075BE | 16p (G) |
| QW46A | 4076BE | 68p (E) |
| QW47B | 4077BE | 16p (G) |
| QX28F | 4078BE | 16p (G) |
| QW48C | 4081BE | 24p (F) |
| QW49D | 4082BE | 16p (G) |
| QW50E | 4085BE | 65p (E) |
| QW51F | 4086BE | 65p (E) |
| QW52G | 4089BE | £1.40 (D) |
| QW53H | 4093BE | 29p (F) |
| QW54J | 4094BE | £1.20 (D) |
| QW55K | 4095BE | 75p (E) |
| QW56L | 4097BE | £3.20 (C) |
| QX29G | 4098BE | 85p (E) |
| QW57M | 4099BE | 79p (E) |
| QW58N | 40100BE | £1.96 (D) |
| QW59P | 40101BE | 90p (E) |
| QW60Q | 40102BE | £1.50 (D) |
| QW61R | 40103BE | 85p (E) |
| QW62S | 40104BE | 85p (E) |
| QW63T | 40105BE | 85p (E) |
| QW64U | 40106BE | 75p (E) |
| QW65V | 40107BE | 60p (E) |
| QW66W | 40108BE | £4.30 (C) |
| QW67X | 40109BE | 95p (E) |
| QW68Y | 40110BE | £1.10 (D) |
| QW69A | 40160BE | £1.25 (D) |
| QW70M | 40161BE | 92p (E) |
| QW71N | 40162BE | 85p (E) |
| QW72P | 40163BE | £1.60 (D) |
| QW73Q | 40174BE | 85p (E) |

## TRADE QUANTITIES

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. See table at start of price list. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity.

Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.

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|---|---|---|
| QQ38R | 40175BE | £1 25 (D) |
| QW74R | 40181BE | £1.99 (D) |
| QW75S | 40182BE | 85p (E) |
| QW76H | 40192BE | £1 25 (D) |
| QW77J | 40193BE | 80p (E) |
| QW78K | 40194BE | 85p (E) |
| QW79L | 40257BE | £1 10 (D) |
| QX34M | 40673 | £1 75 (D) |
| QW93B | 4116 250ns | £1.45 (D) |
| QQ05F | 4118 250ns | £4.45 (C) |
| XX01B | 4136 | 75p (E) |
| QW80B | 4151 | 89p (E) |
| QQ06G | 4164 250ns | £5 99 (B) |
| XX02C | 4195 | £1 45 (D) |
| QX30H | 4416BE | £1.92 (D) |
| QW81C | 4502BE | £1.19 (D) |
| QQ41U | 4503BE | 95p (E) |
| QW82D | 4508BE | £2.10 (C) |
| QW83E | 4510BE | 68p (E) |
| QX31J | 4511BE | 68p (E) |
| QW84F | 4512BE | £1.49 (D) |
| QW85G | 4514BE | £1.20 (D) |
| QW86T | 4515BE | £1.20 (D) |
| QW87U | 4516BE | 49p (F) |
| QX32K | 4518BE | 85p (E) |
| QX33L | 4520BE | 78p (E) |
| QQ42V | 4521BE | £2.58 (C) |
| QQ43W | 4522BE | 88p (E) |
| QQ44X | 4526BE | 95p (E) |
| QW88V | 4527BE | £1.15 (D) |
| QQ45Y | 4529BE | £1.42 (D) |
| QW89W | 4532BE | £1.10 (D) |
| QW90X | 4555BE | 50p (E) |
| QW91Y | 4556BE | 58p (E) |
| QQ49D | 4568BE | £3.15 (C) |
| QQ51F | 45100BE | £3 25 (C) |
| QX35Q | 5W Zener 5V6 | £1.27 (D) |
| QX36P | 5W Zener 8V2 | £1.27 (D) |
| YH31J | 5101-L1 | £3.48 (C) |
| QR55K | 634SS2 | £4.95 (C) |
| QQ04E | 6402 | £5.80 (B) |
| QQ02C | 6502 | £5.48 (B) |
| QW94C | 7106 | £7.90 (B) |
| QW95D | 7107 | £7.95 (B) |
| QX37S | 7400 | 17p (G) |
| YF00A | 74LS00 | 17p (G) |
| QX38R | 7401 | 17p (G) |
| YF01B | 74LS01 | 17p (G) |
| QX39N | 7402 | 17p (G) |
| YF02C | 74LS02 | 21p (G) |
| QX74R | 7403 | 20p (G) |
| YF03D | 74LS03 | 17p (G) |
| QY24B | 74S03 | 68p (E) |
| QX40T | 7404 | 21p (G) |
| YF04E | 74LS04 | 20p (G) |
| QX41U | 7405 | 21p (G) |
| YF05F | 74LS05 | 20p (G) |
| QX75S | 7406 | 29p (F) |
| QX76H | 7407 | 29p (F) |
| QX42V | 7408 | 21p (G) |
| YF06G | 74LS08 | 22p (G) |
| QX77J | 7409 | 22p (G) |
| YF07H | 74LS09 | 22p (G) |
| QX43W | 7410 | 17p (G) |
| YF08J | 74LS10 | 22p (G) |
| QX44X | 7411 | 24p (F) |
| YF09K | 74LS11 | 20p (G) |
| YF10L | 74LS12 | 17p (G) |
| QX45Y | 7413 | 28p (F) |
| YF11M | 74LS13 | 31p (F) |
| QX46A | 7414 | 42p (F) |
| YF12N | 74LS14 | 44p (F) |
| YF13P | 74LS15 | 17p (G) |
| QX78K | 7416 | 31p (F) |
| QX79L | 7417 | 30p (F) |
| QX47B | 7420 | 23p (G) |
| YF14Q | 74LS20 | 21p (G) |
| QX48C | 7421 | 40p (F) |
| YF15R | 74LS21 | 20p (G) |
| YF16S | 74LS22 | 17p (G) |
| QX80B | 7425 | 28p (F) |
| QX81C | 7426 | 22p (G) |
| YF17T | 74LS26 | 22p (G) |
| QX49D | 7427 | 29p (F) |
| YF18U | 74LS27 | 29p (F) |
| YF19V | 74LS28 | 44p (F) |
| QX50E | 7430 | 17p (G) |
| YF20W | 74LS30 | 17p (G) |
| QX51F | 7432 | 36p (F) |
| YF21X | 74LS32 | 21p (G) |
| YF22Y | 74LS33 | 40p (F) |
| YF23A | 74LS37 | 21p (G) |
| QX82D | 7438 | 26p (F) |
| YF24B | 74LS38 | 22p (G) |
| QX53H | 7440 | 24p (F) |
| YF25C | 74LS40 | 40p (F) |
| QX54J | 7442 | 48p (F) |
| YF26D | 74LS42 | 42p (F) |
| QX55K | 7447A | 55p (E) |
| QQ52G | 74LS47 | 65p (E) |
| QQ53H | 74LS48 | 68p (E) |
| QX83E | 7451 | 22p (G) |
| YF27E | 74LS51 | 17p (G) |
| YF28F | 74LS54 | 30p (F) |
| QX56L | 7470 | 36p (F) |
| QX57M | 7472 | 35p (F) |
| QX58N | 7473 | 32p (F) |
| YF30H | 74LS73 | 28p (F) |
| QX59P | 7474 | 32p (F) |
| YY83E | 74ALS74 | 90p (E) |
| YF31J | 74LS74 | 26p (F) |
| QX60Q | 7475 | 45p (F) |
| YF32K | 74LS75 | 31p (F) |
| QX61R | 7476 | 32p (F) |
| YF33L | 74LS76 | 28p (F) |
| QX62S | 7481 | £1.75 (D) |
| QX85G | 7483 | 50p (E) |
| QX63T | 7485 | 77p (E) |
| YF35Q | 74LS85 | 70p (E) |
| QX64U | 7486 | 28p (F) |
| YF36P | 74LS86 | 36p (F) |
| QX65V | 7489 | £3.10 (C) |
| QX66W | 7490 | 32p (F) |
| YF38R | 74LS90 | 36p (F) |
| QX86T | 7491 | £1.20 (D) |
| QX67X | 7492 | 32p (F) |
| YF39N | 74LS92 | 36p (F) |
| QX68Y | 7493 | 35p (F) |
| YF40T | 74LS93 | 36p (F) |
| QX69A | 7494 | 39p (F) |
| QX70M | 7495 | 48p (F) |
| YF41U | 74LS95 | 89p (E) |
| QX87U | 7496 | 56p (E) |
| QX71N | 74107 | 26p (F) |
| YF43W | 74LS107 | 41p (F) |
| QX88V | 74109 | 53p (E) |
| YF44X | 74LS109 | 34p (F) |
| YF45Y | 74LS112 | 64p (E) |
| YF46A | 74LS113 | 40p (F) |
| QX72P | 74118 | £2.30 (C) |
| QX73Q | 74121 | 33p (F) |
| WH00A | 74122 | 68p (E) |
| QQ54J | 74LS122 | 62p (E) |

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|---|---|---|
| WH01B | 74123 | 42p (F) |
| YF48C | 74LS123 | 62p (E) |
| YF49D | 74LS125 | 33p (F) |
| YF50E | 74LS126 | 33p (F) |
| WH03D | 74132 | 55p (E) |
| YF51F | 74LS132 | 45p (F) |
| YF52G | 74LS136 | 32p (F) |
| YF53H | 74LS138 | 38p (F) |
| YF54J | 74LS139 | 44p (F) |
| WH05E | 74141 | 78p (E) |
| WH06G | 74145 | 67p (E) |
| YF55K | 74LS145 | £1 65 (D) |
| QX89W | 74150 | 80p (E) |
| WH07H | 74151 | 65p (E) |
| YF56L | 74LS151 | 43p (F) |
| YF57M | 74LS153 | 49p (F) |
| WH08J | 74154 | 78p (E) |
| YF58N | 74LS154 | 98p (E) |
| YF59P | 74LS155 | 37p (F) |
| YF60Q | 74LS156 | 57p (E) |
| YF61R | 74LS157 | 35p (F) |
| YF62S | 74LS158 | 49½p (E) |
| WH09K | 74160 | 67p (E) |
| YF63T | 74LS160 | 49p (F) |
| YF64U | 74LS161 | 49p (F) |
| YF65V | 74LS162 | 53p (E) |
| YF66W | 74LS163 | 49p (F) |
| WH10L | 74164 | 66p (E) |
| YF67X | 74LS164 | 55p (E) |
| YF68Y | 74LS165 | £1.40 (D) |
| YF69A | 74LS166 | £1.95 (D) |
| YF70M | 74LS168 | £1.20 (D) |
| YF71N | 74LS169 | 99p (E) |
| YF72P | 74LS170 | £2.99 (C) |
| YF73Q | 74LS173 | 65p (E) |
| WH11M | 74174 | 81p (E) |
| YF74R | 74LS174 | 62p (E) |
| YF75S | 74LS175 | 58p (E) |
| YF76H | 74LS181 | £2.95 (C) |
| YF78K | 74LS190 | 58p (E) |
| YF79L | 74LS191 | 68p (E) |
| WH12N | 74192 | 70p (E) |
| YF80B | 74LS192 | 56p (E) |
| QX90X | 74193 | 66p (E) |
| YF81C | 74LS193 | 65p (E) |
| WH13P | 74194 | 55p (E) |
| YF82D | 74LS194 | 85p (E) |
| YF83E | 74LS195 | 45p (F) |
| WH14Q | 74196 | 48p (F) |
| YF84F | 74LS196 | 61p (E) |
| YF85G | 74LS197 | 88p (E) |
| YF86T | 74LS221 | 63p (E) |
| YF87U | 74LS240 | 99p (E) |
| YF88V | 74LS241 | 99p (E) |
| YF89W | 74LS242 | 99p (E) |
| YF90X | 74LS243 | 89p (E) |
| QQ56L | 74LS244 | 87p (E) |
| YF91Y | 74LS245 | £2.57 (C) |
| YF92A | 74LS251 | 53p (E) |
| YF93B | 74LS253 | 53p (E) |
| YF95D | 74LS257 | 52p (E) |
| YF96E | 74LS258 | 55p (E) |
| YF97F | 74LS259 | 89p (E) |
| YF98G | 74LS261 | £2.25 (C) |
| YF99H | 74LS266 | 32p (F) |
| YH00A | 74LS273 | £1.32 (D) |
| YH01B | 74LS279 | 44p (F) |
| YH02C | 74LS283 | 69p (E) |
| YH03D | 74LS290 | £1.30 (D) |
| QY39N | 74LS292 | £11.20 (A) |
| YH04E | 74LS293 | 96p (E) |
| QY40T | 74LS297 | £11.20 (A) |
| YH06G | 74LS298 | £1.75 (D) |
| YH07H | 74LS299 | £4.25 (C) |
| YH08J | 74LS323 | £6.75 (B) |
| YH09K | 74LS363 | £2.36 (C) |
| YH11M | 74LS365 | 39p (F) |
| YH12N | 74LS366 | 45p (F) |
| YH13P | 74LS367 | 62p (E) |
| YH14Q | 74LS368 | 43p (F) |
| YH15R | 74LS373 | £1.15 (D) |
| YH16S | 74LS374 | £1.30 (D) |
| YH18U | 74LS377 | £1.82 (D) |
| YH19V | 74LS378 | £1.40 (D) |
| YH20W | 74LS379 | £2.40 (C) |
| YH21X | 74LS390 | £1.45 (D) |
| YH22Y | 74LS393 | £1.40 (D) |
| YH23A | 74LS395 | £1.35 (D) |
| YH24B | 74LS398 | £1.99 (D) |
| YH25C | 74LS399 | £2.50 (C) |
| QQ59P | 74LS600 | NYA |
| QY41U | 74LS601 | £11.72 (A) |
| QY42V | 74LS604 | £4.56 (C) |
| QQ61R | 74LS608 | NYA |
| QQ62S | 74LS610 | NYA |
| WH02C | 74LS629=74LS124 | £1.49 (D) |
| YH29G | 74LS670 | £3.96 (C) |
| QQ63T | 74LS684 | £4.75 (C) |
| YH30H | 74C917 | £8.85 (B) |
| QY08J | 74C925 | £5.95 (B) |
| YH32K | 76477 | £5.20 (B) |
| YH33L | 76489 | £5.64 (B) |
| YH34M | 8T28 | £3.30 (C) |
| YH35Q | 8T95 | £2.55 (C) |
| YH38R | 8038 CCPD | £4.69 (C) |
| YH39N | 8069 DCQ | £2.35 (C) |
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| QH36P | LM301A | 27p (F) |
| QH37S | LM308 | 95p (E) |
| WQ54J | NE531 | £1.65 (D) |
| YY68Y | NE5534A | £2.45 (C) |
| YY67X | NE5539 | £7.85 (B) |
| QL20W | uA709C | 75p (E) |
| QL22Y | uA741C 8-pin DIL | 23p (G) |
| QL24B | uA747C | 75p (E) |
| QL25C | uA748C | 52p (E) |
| QH46A | 1458C | 45p (F) |
| QH51F | 3403 | 98p (E) |
| XX01B | 4136 | 75p (E) |
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| QH28F | CA3130T | £1.10 (D) |
| QH29G | CA3140T | 99p (E) |
| WQ21X | CA3240E | £1.38 (D) |
| QH35Q | LH0042C | £4.30 (C) |
| WQ30H | LF351 | 56p (E) |
| WQ31J | LF353 | 99p (E) |
| WQ29G | LF347 | £2.55 (C) |
| QY26D | LF400CN | NYA |
| QY27E | LF411CN | 82p (E) |
| QY28F | LF412CN | £1.38 (D) |
| QY29G | LF441CN | 72p (E) |
| QY30H | LF442CN | £1.38 (D) |
| QY31J | LF444CN | £1.96 (D) |
| YY69A | LF13741 | 55p (E) |
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| YH58N | CA3080E | 87p (E) |
| YH64U | LM13600N | £1.39 (D) |
| QY09K | LM311N | 62p (E) |

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| QH48C | MC3302P | 80p (E) |
| **Page 298** | | |
| WQ36P | LM389 | £1 49 (D) |
| QH38R | LM377 | £2 25 (C) |
| **Page 299** | | |
| QH40T | LM380 | 75p (E) |
| WQ34M | LM384 | £1 44 (D) |
| QL13P | TBA810P | 95p (E) |
| BR02C | 5W Amp PCB | £1.45 (D) |
| **Page 300** | | |
| WQ33L | LM383 | £1 61 (D) |
| BY73Q | 8W Amp PCB | 62p (E) |
| LW36P | 8W Amp Kit | £4 45 (C) |
| YY70M | TDA2005M | £8 25 (B) |
| WQ66W | TDA2006 | £1.65 (D) |
| **Page 301** | | |
| WQ67X | TDA2030 | £1.95 (D) |
| YQ43W | 15W Amp Kit | £6.45 (B) |
| YQ35Q | 15W Amp PCB | £1.25 (D) |
| YQ36P | 15W Amp Bracket | 65p (E) |
| YQ38R | 30/2 PSU PCB | £1.40 (D) |
| YQ37S | 15W Amp Module | £6.49 (B) |
| **Page 302** | | |
| QY32K | TDA 1102SP | £3.24 (C) |
| QH41U | LM381 | £1.57 (D) |
| BR04E | LM381 PCB | £2.15 (C) |
| **Page 303** | | |
| YY84F | LM382 | £1.65 (D) |
| QY10L | NE570 | £4.28 (C) |
| YY87U | NE571 | £3.36 (C) |
| YY86T | TDA3410 | £1.90 (D) |
| WQ35Q | LM387 | £1.25 (D) |
| **Page 304** | | |
| QY19V | LM1035 | £4.50 (C) |
| QY33L | LM1037N | £2.21 (C) |
| QY34M | LM1038N | £2.24 (C) |
| **Page 305** | | |
| QH49D | MC3340P | £1.35 (D) |
| YY85G | LM1818 | £1.95 (D) |
| QY35Q | MF10CN | £4.96 (C) |
| YY81C | M083 | £4.75 (C) |
| WH22Y | M087 | £4.95 (C) |
| **Page 306** | | |
| QB21X | AY-1-0212 | £8.20 (B) |
| HQ53H | Piano IC Kit | £38.44 (A) |
| HQ52G | AY-1-1320 | £4.99 (C) |
| HQ51F | AY-1-5050 | £1.99 (D) |
| HQ71N | M251 | £12.20 (A) |
| WH21X | M254 | £7.49 (B) |
| YY90X | M108 | £18.25 (A) |
| **Page 307** | | |
| YY91Y | M147 | £6.51 (B) |
| YY89W | AY-3-1350 | £5.95 (B) |
| WH20W | TDA1022 | £6.75 (B) |
| YH33L | 76489 | £5.64 (B) |
| **Page 308** | | |
| YY79L | TCA350Z | £3.95 (C) |
| YH32K | 76477 | £5.20 (B) |
| YQ42V | Sound Effects PCB | £1.10 (D) |
| **Page 310** | | |
| WQ61R | SH120A | £6.65 (B) |
| QH27E | CA3089E | £2.70 (C) |
| WQ20W | CA3189E | £1.95 (D) |
| **Page 311** | | |
| WQ37S | LM1820 | £1.80 (D) |
| BL35Q | TBA 651 | £2.25 (C) |
| WQ64U | TCA4500A | £3.35 (C) |
| QH45Y | MC1310P | £2.30 (C) |
| BR03D | Decoder PCB | £1.84 (D) |
| **Page 312** | | |
| QL41U | ZN414 | £1.25 (D) |
| QY23A | MC10116P | 85p (E) |
| **Page 313** | | |
| QH47B | MC1496 | 89p (E) |
| QL06G | SG1495D | £3.95 (C) |
| QL07H | SG3402 | £3.98 (C) |
| QH26D | CA3046 | 72p (E) |
| QQ11M | VQ1000CJ | £4.30 (C) |
| YH66W | SL490 | £3.35 (C) |
| **Page 314** | | |
| YH67X | ML922 | £5.25 (B) |
| QR57M | ML926 | £2.45 (C) |
| QR58N | ML927 | £2.45 (C) |
| **Page 315** | | |
| YH68Y | ML928 | £2.40 (C) |
| YH69A | ML929 | £2.40 (C) |
| YG37S | CL8960 | £31.26 (A) |
| YY71N | LM1871 | £5.60 (B) |
| YQ69A | LM1871 Xmitter PCB | 98p (E) |
| BX11M | HV Disc 680 | 9p (H) |
| **Page 316** | | |
| YY72P | LM1872 | £5.90 (B) |
| YQ70M | LM1872 Receiver PCB | 95p (E) |
| WQ55K | NE 544 | £2.18 (C) |
| YQ71N | Servo Driver PCB | 85p (E) |
| WQ76H | TL172C | 76p (E) |
| **Page 317** | | |
| WQ75S | TL170C | 55p (E) |
| QR55K | 634S2 | £4.95 (C) |
| YY99H | LM1830 | £2.65 (C) |
| YY73Q | LM3352 | £1.42 (D) |
| WQ40T | LM3911 | £1.31 (D) |
| **Page 318** | | |
| YY98G | AY-3-1270 | £8.30 (B) |
| WQ41U | LM3914 | £3.51 (C) |
| YY96E | LM3915 | £2.93 (C) |
| YY97F | LM3916 | £3.46 (C) |
| YQ66W | LM3914 PCB | 85p (E) |

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| **Page 319** | | |
| QY14Q | UAA170L | £2 50 (C) |
| YH30H | 74C917 | £8 85 (B) |
| FY90X | Crystal 6 5536MHz | £2 98 (C) |
| YY93B | ICM7045IPI | £14.20 (A) |
| **Page 320** | | |
| YY88V | TMS1121 | £9.73 (B) |
| QY08J | 74C925 | £5 95 (B) |
| YY92A | MK50395 | £10.50 (A) |
| **Page 321** | | |
| YY94C | ICM7216DIPI | £17.45 (A) |
| QY18U | SP8680B | £12.40 (A) |
| YY95D | ICM7226BIPI | £21.90 (A) |
| QH67X | NE 556 | 62p (E) |
| QH66W | NE 555 | 21p (G) |
| **Page 322** | | |
| YH63T | ICM 7555 | £1.25 (D) |
| QH68Y | NE 566 | £1.60 (D) |
| WQ56L | NE 565 | £1.64 (D) |
| **Page 323** | | |
| QH69A | NE 567 | £1.30 (D) |
| WQ39N | LM3909 | 87p (E) |
| YY76H | TDA1024 | £1 49 (D) |
| QY36P | LM1851N | £1.46 (D) |
| YH43W | 8211 CPA | £3.25 (C) |
| YH39N | 8069 DCQ | £2.35 (C) |
| **Page 324** | | |
| WQ32K | LM334 | £1.10 (D) |
| YY78K | TL497A | £1.65 (D) |
| YY77J | TL430C | 99p (E) |
| WQ62S | TAA 550 | 35p (F) |
| YY75S | ICL7660CPA | £3.24 (C) |
| XX02C | 4195 | £1 45 (D) |
| **Page 325** | | |
| XX04E | 15V Supply PCB | 75p (E) |
| YY74R | L200 | £2.69 (C) |
| BL22Y | uA723C TO99 | 85p (E) |
| QL21X | uA723C 14-pin DIL | 55p (E) |
| **Page 326** | | |
| YQ39N | 0.1A Reg PSU PCB | £1.24 (D) |
| YQ40T | 0.5/1A Reg +V PS PCB | 85p (E) |
| YQ41U | 0.5/1A Reg -V PS PCB | 85p (E) |
| YQ54J | 0 5/1A Vareg Pos PCB | 85p (E) |
| YQ55K | 0.5/1A Vareg Neg PCB | 85p (E) |
| **Page 327** | | |
| QY37S | Satronics PC1R | £3.62 (C) |
| QY38R | Satronics PC12R | £6.94 (B) |
| **Page 328** | | |
| QQ02C | 6502 | £5.48 (B) |
| WQ43W | MC6800P | £5.10 (B) |
| WQ44X | MC6802P | £4 72 (C) |
| WQ46A | MC6821P | £1.99 (D) |
| WQ48C | MC6850P | £2.99 (C) |
| WQ49D | MC6852P | £2.95 (C) |
| WQ50E | MC6875L | £6.32 (B) |
| QW00A | Z80-CPU | £7.95 (B) |
| QW03D | Z80-PIO | £4.25 (C) |
| QW01B | Z80-CTC | £4.50 (C) |
| YH40T | 8080A | £4.95 (C) |
| YH41U | 8085A | £5.99 (B) |
| **Page 329** | | |
| YH46A | 8224 | £2.68 (C) |
| YH47B | 8228 | £4.94 (C) |
| YH50E | 8255A | £4.40 (C) |
| YH49D | 8251 | £4.60 (C) |
| YH48C | 8250 | £9.95 (B) |
| YH51F | 8279 | £7.32 (B) |
| YH44X | 8212 | £1.95 (D) |
| YH45Y | 8216 | £1.95 (D) |
| YH34M | 8T28 | £3.30 (C) |
| YH35Q | 8T95 | £2.55 (C) |
| WQ19V | AY-5-2376 | £9.95 (B) |
| WQ18U | AY-3-1015D | £5.98 (B) |
| QQ04E | 6402 | £5.80 (B) |
| **Page 330** | | |
| WQ60Q | SFF96364 | £9.45 (B) |
| QQ03D | MC6845 | £10.55 (A) |
| YH31J | 5101-L1 | £3.48 (C) |
| QW11M | 2102 450ns | £1.95 (D) |
| WQ45Y | MC6810AP 450ns | £1.86 (D) |
| QW12N | 2114 450ns | £1.30 (D) |
| QQ05F | 4118 250ns | £4.45 (C) |
| WQ42V | MCM4027 250ns | £1.88 (D) |
| QW93B | 4116 250ns | £1.45 (D) |
| **Page 331** | | |
| QQ06G | 4164 250ns | £5.99 (B) |
| QW13P | 2708 450ns | £4.40 (C) |
| QQ07H | 2716 450ns | £3.96 (C) |
| QQ08J | 2732 450ns | £5.19 (B) |
| QQ09K | 2764 450ns | £11.90 (A) |
| **Page 332** | | |
| XY84F | Softy 2 System | £169.00 (A) |
| XY83E | EPROM Eraser | £42.95 (A) |
| YH52G | 82S126M1 | £3.49 (C) |
| WQ59P | RO-3-2513 | £8.95 (B) |
| YH38R | 8038 CCPD | £4.69 (C) |
| **Page 333** | | |
| YQ65V | 8038 PCB | 85p (E) |
| QW80B | 4151 | 89p (E) |
| QQ01B | DAC0801LCN | £2.45 (C) |
| **Page 334** | | |
| QQ00A | ADC0804LCN | £4.45 (C) |
| YH59P | ICL7109 | £19.33 (A) |
| WQ38R | LM2917 | £2.45 (C) |
| YQ67X | LM2917 PCB | 85p (E) |
| QW94C | 7106 | £7.90 (B) |
| QW95D | 7107 | £7.95 (B) |
| **Page 335** | | |
| BY76H | 7106/7 PCB | £1.45 (D) |
| WR29G | Transkt 3-Lead TO18 | 16p (G) |
| WR30H | Transkt 4-Lead TO18 | 35p (F) |
| WR31J | Transkt 3-Lead TO5 | 19p (G) |
| WR32K | IC Skt 8-Lead | 55p (E) |
| WR33L | IC Skt 10-Lead | 67p (E) |

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|---|---|---|
| QY44X | Insulator TO3 | 18p (G) |
| QY45Y | Insulator P | 14p (G) |
| WR24B | Kit TO3 | 8p (H) |
| WR25C | Kit TO66 | 9p (H) |
| WR27E | Kit SO55 | 9p (H) |
| WR26D | Kit TO126 | 5p (H) |
| WR23A | Kit (P) Plas | 6p (H) |
| XX14Q | Soldercons | 90p (E) |
| **Page 336** | | |
| BL17T | DIL Socket 8-pin | 9p ) |
| BL18U | DIL Socket 14-Pin | 11p (G) |
| BL19V | DIL Socket 16-pin | 12p (G) |
| HQ76H | DIL Socket 18-pin | 16p (G) |
| HQ77J | DIL Socket 20-pin | 17p (G) |
| HQ78K | DIL Socket 22-pin | 20p (G) |
| BL20W | DIL Socket 24-pin | 19p (G) |
| BL21X | DIL Socket 28-pin | 24p (F) |
| HQ38R | DIL Socket 40 pin | 31p (F) |
| FR25C | Insertion Tool | 80p (E) |
| YG27E | Header 14-pin | 54p (E) |
| YG28F | Header 16-pin | 63p (E) |
| YG29G | Header 24-pin | £1.10 (D) |
| YX50E | ZIF Socket 24-Way | £3.40 (C) |
| FL56L | Transistor Cover | 10p (G) |
| HQ79L | Heatsink 92F | 14p (G) |
| HQ80B | Heatsink 18F | 24p (F) |
| FL78K | Heatsink Clip-On | 16p (G) |
| WR34M | TO5 Chassis Heatsink | 89p (E) |
| **Page 337** | | |
| FL59P | Vaned Heatsink TO3 | 46p (F) |
| FL58N | Vaned Htsnk Plas Pwr | 34p (F) |
| FL57M | Vaned Heatsink IC | 72p (E) |
| HQ70M | Heatsink 2E | £2 55 (C) |
| FL41U | Heatsink 4Y | £1 96 (D) |
| HQ69A | 50W Hi-Fi Heatsink | £1 95 (D) |
| HQ81C | 8W Hi-Fi Heatsink | £1 17 (D) |
| FL42V | Flat Heatsink | £3 25 (C) |
| FL54J | Heatsink 10DN | £2 15 (C) |
| FL55K | Heatsink 10DNDR | £2 60 (C) |
| FL77J | Heatsink 6W-1 | £5.50 (B) |
| **Page 338** | | |
| YB26D | Heatsink 60DN | £13.95 (A) |
| FL79L | Thermpath | £3.60 (C) |
| HQ00A | Silicone Grease Tube | 99p (E) |
| WY08J | Standard Fan | £15.50 (A) |

## SPEAKERS

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|---|---|---|
| **Page 339** | | |
| HY12N | Ultrasonic Transducr | £6.20 (B) |
| QY13P | Piezo Transducer27mm | 30p (F) |
| QY16S | Rubber Disc 27mm | 5p (H) |
| FL39N | Buzzer 6V | 88p (E) |
| FL40T | Buzzer 12V | 88p (E) |
| FL38R | AC Bell | £1.90 (D) |
| FL37S | Bell Xformer | £4.95 (C) |
| FQ08J | Bell Push | £1.10 (D) |
| FQ09K | Nameplate Bell Push | 55p (E) |
| **Page 340** | | |
| YB25C | Baby Siren | £9.25 (B) |
| LH96E | Plastic Siren | £5.50 (B) |
| LH98G | Hawaii Five-O Siren | £24.95 (A) |
| XG14Q | Electronic Siren | £19.95 (A) |
| XQ71N | Re-entrant Horn Sndr | £26.50 (A) |
| YW52G | 2in Piezo Tweeter | £2.49 (C) |
| **Page 341** | | |
| WF54J | Direct Radiant Piezo | £3.95 (C) |
| WF09K | Piezo Horn Flush | £5.96 (B) |
| WF55K | Piezo Horn Recessed | £5.99 (B) |
| WF56L | Wide Angle Piezo | £7.90 (B) |
| LB23A | Mag Earpiece 2.5mm | 25p (F) |
| LB24B | Mag Earpiece 3.5mm | 25p (F) |
| LB25C | Crystal Earpiece | 55p (E) |
| YW57M | Stethoscope | 75p (E) |
| WF20W | Mag Headset | £4.85 (C) |
| LH81C | Education Headphone | £5.75 (B) |
| LH82D | Boom Mic Headphone | £12.35 (A) |
| LH83E | Stereophone OH150P | £4.25 (C) |
| **Page 342** | | |
| WF13P | Stereophone HP110C | £5.40 (B) |
| WF14Q | Stereophone DH207 | £7.99 (B) |
| LH84F | Stereopho ie M110B | £8.60 (B) |
| LH85G | Stereophone SH590 | £12.50 (A) |
| YK56L | Persnl Stereo Phones | £4.95 (C) |
| LB13P | Headphone Adaptor | £3.95 (C) |
| WB04E | L/S Lo-Z 388 | 85p (E) |
| WB05F | L/S Lo-Z 458 | 89p (E) |
| WB08J | L/S Lo-Z 508 | 89p (E) |
| WB09K | L/S Lo-Z 568 | 89p (E) |
| WB13P | L/S Lo-Z 668 | 89p (E) |
| WF57M | Hi-Z L/S 64R | 99p (E) |
| YW53H | L/S Lo-Z 768 | 99p (E) |
| WF58N | 3 inch Tweeter | £1.45 (D) |
| YW54J | 15W Cone Tweeter | £2.85 (C) |
| **Page 343** | | |
| WF24B | Multi-Cell Tweeter | £5.95 (B) |
| WF33L | Free Stand Tweeter | £5.95 (B) |
| WF43W | Dome Tweeter | £5.45 (B) |
| WF44X | Rectangular Tweeter | £5.45 (B) |
| WF02C | Crossover 2-Way | £4.20 (C) |
| WF03D | Crossover 3-Way | £5.20 (B) |
| WF46A | Controlled Crossover | £10.69 (A) |
| WF47B | Low-Cost 4in Spkr | £4.25 (C) |
| BK30H | Spkr Fixing Clamp | 25p |
| YW55K | Plastic Car Grille | 90p (E) |
| **Page 344** | | |
| WF48C | Hvy Duty Car Spkr | £6.45 (B) |
| WF50E | Elliptcal Spkr CM641 | £3.35 (C) |
| WF18U | Elliptcal Spkr CM742 | £4.45 (C) |
| WF23A | Elliptcal Spkr CM852 | £5.20 (B) |
| WY13P | Elliptcal Spkr LT853 | £6.45 (B) |
| WF00A | Rd Speaker LT530 | £6.95 (B) |
| WF52G | Rd Speaker LT610 | £5.75 (B) |
| WF08J | Rd Speaker CM820 | £5.95 (B) |
| WF11M | Rd Speaker LT830 | £7.30 (B) |
| WF12N | Rd Speaker LT840 | £11.45 (A) |
| WF53H | 20W Squawker | £3.25 (C) |
| WY15R | 40W Squawker | £5.25 (B) |
| XG02C | Loudspeaker 12in 35W | £19.75 (A) |
| XQ77J | Fane 50 4R | £19.95 (A) |
| XB26D | Fane 50 8R | £21.45 (A) |
| **Page 345** | | |
| XQ78K | Disco 80 4R | £29.45 (A) |
| XB27E | Disco 80 8R | £29.45 (A) |
| XQ79L | Forte 1250TC 8R | £21.75 (A) |
| XQ80B | Forte 1250TC 16R | £21.75 (A) |
| XQ81C | Forte C1285TC 8R | £28.45 (A) |

**TRADE QUANTITIES**

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. See table at start of price list. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity.

Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc. refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tag

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| | | |
|---|---|---|
| XQ82D | Forte C1285TC 16R | £28.45 (A) |
| XQ83E | C15 Bass 8R | £57.80 (A) |
| XQ84F | C15 Bass 16R | £57.80 (A) |
| XB28F | Power L/S Cabinet | £49.00 (A) |

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| | | |
|---|---|---|
| AF33L | Mini Speaker System | £45.50 (A) |
| AF34M | 5W Spkr in Cab | £9.95 (B) |
| AF35Q | 15W Spkr Pair | £33.50 (A) |
| AF31J | 20W Spkr Pair | £63.00 (A) |
| AF32K | PA Spkr in Cab | £21.99 (A) |
| XY79L | Ceiling Speaker | £11.75 (A) |
| YL15R | Bracket Minor 5 | £6.50 (B) |
| YL16S | Bracket Bek 100 | £13.90 (A) |
| YK54J | Wallclamps Duo 220 | £15.95 (A) |

## SWITCHES RELAYS

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| | | |
|---|---|---|
| FH97F | SPST Ultra Min Tggle | 66p (E) |
| FH98G | SPDT Ultra Min Tggle | 69p (E) |
| FH99H | DPDT Ultra Min Tggle | 75p (E) |
| FH00A | Sub-Min Toggle A | 70p (E) |
| FF70M | Sub-Min Toggle J | 80p (E) |
| FH01B | Sub-Min Toggle B | 89p (E) |
| FH03D | Sub-Min Toggle D | £1.06 (D) |
| FH04E | Sub-Min Toggle E | 99p (E) |
| FF71N | Sub-Min Toggle K | £2.35 (C) |
| FH05F | Sub-Min Toggle F | £1.29 (D) |
| FH07H | Sub-Min Toggle H | £1.25 (D) |
| FF72P | Sub-Min Toggle L | £2.15 (C) |
| FH08J | 4-Pole SM Toggle | £2.35 (C) |
| FH39N | Toggle Sw | 60p (E) |
| YL01B | Toggle Switch Cover | 47p (F) |
| FH10L | Std Toggle SPST | 50p (E) |
| FH11M | Std Toggle SPDT | 57p (E) |
| FH12N | Std Toggle DPDT | 77p (E) |
| BK32K | 10A SPST Toggle | 95p (E) |
| BK33L | 10A SPDT Toggle | £1.15 (D) |
| FH17T | H/D Toggle Type 4 | £4.25 (C) |
| FH18U | H/D Toggle Type 7 | £1.95 (D) |
| FH19V | H/D Toggle Type 8 | £4.40 (C) |
| FH20W | H/D Toggle Type 9 | £4.30 (C) |

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| | | |
|---|---|---|
| FH13P | Duck Bill Toggle | 55p (E) |
| YX56L | Chrome Bar Toggle | 85p (E) |
| YX64U | Min Rocker SPST | 69p (E) |
| YX65V | Min Rocker DPDT | £1.15 (D) |
| FH30H | SPST Rocker | 39p (F) |
| FH31J | SPDT Rocker | 49p (F) |
| YR68Y | Rocker Neon | 63p (E) |
| YR69A | Rocker Sw DP | 69p (E) |
| FH34M | DPDT Rocker | 98p (E) |
| YR70M | Dual Rocker Neon | £1.10 (D) |
| BH58N | Co-ax Switch SO239 | £6.99 (B) |
| BH59P | Co-ax Switch PL259 | £6.99 (B) |
| XX26D | DIL Switch SPST Dual | £1.20 (D) |
| XX27E | DIL Switch SPST Octl | £1.50 (D) |
| XX28F | DIL Switch SPDT Sgl | 95p (E) |
| XX29G | DIL Switch SPDT Quad | £2.95 (C) |
| FF73Q | Rotary SW12B | 74p (E) |
| FF74R | Rotary SW6B | 70p (E) |
| FF75S | Rotary SW4B | 79p (E) |
| FF76H | Rotary SW3B | 70p (E) |
| FH42V | Rotary SW12 | 70p (E) |
| FH43W | Rotary SW6 | 70p (E) |
| FH44X | Rotary SW4 | 75p (E) |
| FH45Y | Rotary SW3 | 75p (E) |
| XX45Y | Switchpot 1p 12w | 85p (E) |

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| | | |
|---|---|---|
| FF83E | Thumbwheel Decimal | £4.95 (C) |
| FF84F | Thumbwheel BCD | £4.55 (C) |
| BK49D | End Cheeks | 35p (F) |
| BK50E | Dial Stops | 35p (F) |
| YR77J | Push Wheel BCD | £5.45 (B) |
| YR79L | Push Whl End Cheeks | 99p (E) |
| FH40T | Key Switch | £3.60 (C) |
| FH57M | Rotary Mains | 75p (E) |
| FH95D | Roller Microswitch | £1.15 (D) |
| FH46A | Maka Shaft | £1.10 (D) |

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| | | |
|---|---|---|
| FH47B | Maka Wafer 1p 12w | £1.06 (D) |
| FH48C | Maka Wafer 2p 6w | £1.06 (D) |
| FF81C | Maka Wafer 2p 3w | £1.25 (D) |
| FH50E | Maka Wafer 4p 3w | £1.10 (D) |
| FH51F | Maka Wafer 6p 2w | £1.17 (D) |
| FH52G | Maka Wafer 1p 12w MB | 75p (E) |
| FH53H | Maka Wafer 2p 6w MB | £1.05 (D) |
| FF82D | Maka Wafer 2p 9w MB | 29p (F) |
| FH55K | Maka Screen | 5p (H) |
| FF87U | Click Switch | 30p (F) |
| FF88V | Click Cap Black | 18p (G) |
| FF89W | Click Cap Blue | 18p (G) |
| FF90X | Click Cap Green | 18p (G) |
| FF91Y | Click Cap Grey | 18p (G) |
| FF92A | Click Cap Ivory | 18p (G) |
| FF93B | Click Cap Red | 18p (G) |
| FF94C | Click Cap White | 18p (G) |
| FF95D | Click Cap Yellow | 18p (G) |
| HY34M | Click Key Black | 24p (F) |
| FF61R | Keyboard Switch | 23p (G) |
| FF62S | Keytop 1 Position | 18p (G) |
| FF63T | Keytop 2 Position | 29p (F) |
| FF64U | Keytop 3 Position | 56p (E) |
| FF65V | ASCII Transparency | £1.35 (D) |
| YR71N | Switch Contact Sheet | £1.49 (D) |

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| | | |
|---|---|---|
| FF77J | SP Slide | 12p (G) |
| FH35Q | Sub-Min Slide | 15p (G) |
| FF79L | Long Chrome Slide | 22p (G) |
| FH36P | Std Slide Switch | 15p (G) |
| FH38R | 4-Pole Slide | 69p (E) |
| FH59P | Push Switch | 17p (G) |
| YR67X | HQ Push Switch | 39p (F) |
| FH60Q | Break Push | 23p (G) |
| FH91Y | Motor-Start Press | 43p (F) |
| RK82D | Lge Red Push Button | 69p (E) |
| FF96E | Square Push Black | 77p (E) |
| FF97F | Square Push Green | 77p (E) |
| FF98G | Square Push Red | 77p (E) |
| FF99H | Square Push Yellow | 77p (E) |
| YW41U | Square Psh Lck Black | 75p (E) |
| YW43W | Square Psh Lck Red | 75p (E) |
| YW44X | Square Psh Lck Yllow | 75p (E) |

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| | | |
|---|---|---|
| FH41U | Pushlock SPCO | £1.20 (D) |
| FH66W | Pushlock DPCO | £1.45 (D) |
| FH94C | Pressil Switch | 28p (F) |
| FH92A | Press Toe Sw Type 1 | £1.20 (D) |
| BK31J | Press Toe SPST 2 | £1.39 (D) |
| FH93B | Press Toe Sw Type 2 | £1.95 (D) |
| LB64U | Foot Switch | £4.25 (C) |
| FH37S | Mains Push | £1.10 (D) |
| LB91Y | Flasher Unit 2-Way | £5.75 (B) |
| LQ00A | Beginners Morse Key | £1.90 (D) |
| LQ01B | Professl Morse Key | £5.40 (B) |
| HY00A | Touch Pads Rect | 22p (G) |
| HY01B | Touch Pads Tri | 27p (F) |
| YR88V | Solenoid 12V | £4.75 (C) |
| YR89W | Solenoid 240V AC | £4.85 (C) |

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| | | |
|---|---|---|
| FH67X | Latchswitch 2-pole | 46p (F) |
| FH68Y | Latchswitch 4-pole | 59p (E) |
| FH69A | Latchswitch 6 pole | 99p (E) |
| FH70M | Latchswitch 8-pole | £1.45 (D) |
| FH71N | Latchswitch 10-pole | £1.25 (D) |
| BW11M | Latchsoft 2-pole | 60p (E) |
| BW12N | Latchsoft 4-pole | £1.20 (D) |
| FH72P | Latchdummy | 32p (F) |
| FH74R | Mains Latchswitch | £1.59 (D) |
| FH75S | Latchbracket Single | 13p (G) |
| FH76H | Latchbracket 2-way | 38p (F) |
| FH78K | Latchbracket 4-way | 45p (F) |
| FH80B | Latchbracket 6-way | 64p (E) |
| FH82D | Latchbracket 8-way | 64p (E) |
| FH84F | Latchbracket 10 way | 69p (E) |

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| | | |
|---|---|---|
| FL31J | Rd Latchbutton Black | 14p (G) |
| FL32K | Rd Latchbutton Green | 14p (G) |
| FL33L | Rd Latchbutton Grey | 14p (G) |
| FL34M | Rd Latchbutton Red | 14p (G) |
| FL36P | Rd Latchbutton Chrm | 22p (G) |
| BW13P | Sm Latchbutton Black | 11p (G) |
| BW14Q | Sm Latchbutton Chrm | 33p (F) |
| FH61R | Rct Latchbutton Blk | 14p (G) |
| FH62S | Rct Latchbutton Grey | 14p (G) |
| FH63T | Rct Latchbutton Red | 14p (G) |
| FH64U | Rct Latchbutton Whte | 14p (G) |
| FH87U | Magiclight Bttn Blk | 23p (G) |
| FH89W | Magiclight Bttn Orng | 42p (F) |
| FH90X | Magiclight Bttn Yllw | 49p (F) |
| BW15R | Latchbush Blue | 39p (F) |
| BW16S | Latchbush Green | 45p (F) |
| BW17T | Latchbush Orange | 45p (F) |
| BW18U | Latchbush Yellow | 39p (F) |

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| | | |
|---|---|---|
| BK47B | Micro-Min Relay | 60p (E) |
| YX94C | Ultra-Min Relay SPDT | 96p (E) |
| YX95D | Ultra-Min Relay DPDT | £1.49 (D) |
| BK48C | Ultra Min Ry 6V DPDT | 95p (E) |
| YX96E | 3A Min Relay | 99p (E) |
| YX97F | 10A Mains Relay | £1.65 (D) |

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| | | |
|---|---|---|
| YX98G | 5A Mains Relay | £3.20 (C) |
| YX99H | 12V 30A Relay | £2.15 (C) |
| FX23A | Open Relay 6V | £3.25 (C) |
| FX24B | Open Relay 12V | £3.88 (C) |
| FX26D | 2p Sub-Min Relay 6V | £3.45 (C) |
| FX27E | 2p Sub-Min Relay 12V | £3.45 (C) |
| FX30H | 4p Sub-Min Relay 12V | £3.99 (C) |

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| | | |
|---|---|---|
| FX48C | Power Relay 12V | £3.95 (C) |
| FX49D | Power Relay 230V AC | £4.25 (C) |
| HY20W | Relay Flat 12V | £2.43 (C) |
| FX50E | Reed Relay 6 to 9V | £1.98 (D) |
| FX51F | Reed Relay 9 to 12V | £2.15 (C) |
| FX88V | Dil Reed Relay 1p 5V | £1.95 (D) |
| FX89W | Dil Reed Relay 1p12V | £2.15 (C) |
| FX90X | Dil Reed Relay 2p 5V | £3.99 (C) |
| FX91Y | Dil Reed Relay 2p12V | £3.85 (C) |
| FX93B | Dil Rd Rly 1p C/O12V | £7.60 (B) |

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| | | |
|---|---|---|
| FX68Y | Reed SW Standard | 89p (E) |
| FX69A | Reed SW Compact | £1.75 (D) |
| FX70M | Reed SW Miniature | 69p (E) |
| FX71N | Magnet Small | 38p (F) |
| FX72P | Magnet Large | 88p (E) |

## TEST GEAR

### Page 359

| | | |
|---|---|---|
| HF19V | Test Prod Black | 45p (F) |
| HF20W | Test Prod Red | 45p (F) |
| HF21X | Probe Clips | 98p (E) |
| YX57M | Min Probe Black | 42p (F) |
| YX58N | Min Probe Blue | 38p (F) |
| YX59P | Min Probe Green | 42p (F) |
| YX60Q | Min Probe Red | 42p (F) |
| YX61R | Min Probe Yellow | 42p (F) |
| HF30H | Pistol Probe Black | 99p (E) |
| HF31J | Pistol Probe Red | 99p (E) |
| HF22Y | Lo-Cost Test Probe | 74p (E) |
| HF32K | Moulded Test Probe | 79p (E) |
| HF33L | 4mm T | 89p (E) |
| YR93B | Test Lead Kit | £2.75 (C) |
| FY73Q | Logic Probe | £9.50 (B) |
| FY88V | Continuity Probe | 99p (E) |

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| | | |
|---|---|---|
| FL61R | Signal Injector | £5.99 (B) |
| FY74R | IC Test Clip | £2.35 (C) |
| YB21X | Safebloc | £7.50 (B) |
| BW05F | Scope Probe BNC | £15.63 (A) |
| YR95D | Lo-Cost Scope Probe | £3.75 (C) |
| XB82D | Single Beam Scope | £167.90 (A) |
| | Carr in UK with XB82 | £8.45 |

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| | | |
|---|---|---|
| XB83E | Dual Beam Scope | £286.00 (A) |
| | Carr in UK with XB83 | £9.45 (B) |
| YK38R | Low-Cost Counter | £49.90 (A) |
| LH05F | Transistor Testr HFE | £15.20 (A) |
| YB82D | LCR Bridge | £25.30 (A) |

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| | | |
|---|---|---|
| YB81C | Seesure Sig Gen | £26.75 (A) |
| YK40T | Seesure CMOS Tester | £34.95 (A) |
| YW93B | Low Cost Multimeter | £4.85 (C) |
| FL60Q | Pocket Multimeter | £7.50 (B) |
| YB83E | Small Multimeter | £15.95 (A) |

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| | | |
|---|---|---|
| YK35Q | Multimeter 2050 | £11.95 (A) |
| YK37S | Range Dblr Multimetr | £19.95 (A) |
| YW68Y | Multimeter Type 320 | £16.25 (A) |
| LH93B | Taut-Band Multimeter | £23.95 (A) |
| YB87U | 100K Multitester | £44.00 (A) |

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| | | |
|---|---|---|
| YB84F | Microtest 80 | £19.09 |
| YB85G | Supertester 680G | £28.96 |
| YB86T | Supertester 680R | £37.80 |

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| | | |
|---|---|---|
| LH80B | Clamp Meter | £26.90 (A) |
| YK36P | Low Cost DMM | £29.95 (A) |
| YK32K | Multimeter DD601 | £39.95 (A) |

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| | | |
|---|---|---|
| YK34M | Auto Range Meter | £54.50 (A) |
| LH95D | DMM 100 | £88.61 (A) |
| YK01B | RF Frequency Meter | £69.95 (A) |
| YB04E | Grid Dip Meter | £45.00 (A) |

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| | | |
|---|---|---|
| XY75S | Ham Multimeter | £31.95 (A) |
| WY18U | SWR Meter 310 | £10.75 (A) |
| WY19V | SWR Meter 110 | £14.75 (A) |
| WY21X | SWR Meter 178 | £24.95 (A) |

## TOOLS

### Page 368

| | | |
|---|---|---|
| LH15R | Hobby Box | £3.45 (C) |
| FR22Y | Storage Drawer | 98p (E) |
| BR48C | Hex Trimmer | 24p (F) |
| BR51F | Trim Tool | 45p (F) |
| BR49D | Preset Trimmer | 72p (E) |
| BR50E | Trim TT5 | 60p (E) |
| BK34M | Trim Tool Set | £1.25 (D) |
| FY07H | Min Screwdriver Set | 85p (E) |
| BR58N | Jewllers Scrwdvr Set | £2.30 (C) |
| BK44X | 11 Pce S/Driver Set | £6.45 (B) |

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| | | |
|---|---|---|
| BR79L | Intrchgbl Scdrvr Set | £1.69 (D) |
| YW60Q | Min Tool Set | £2.10 (C) |
| FY08J | Utility Set | £4.49 (C) |
| YX74R | Min Screwdriver | 10p (G) |
| BR52G | Small Screwdriver | 34p (F) |
| BR53H | Large Screwdriver | 36p |
| FY10L | Driver S3 | 26p (F) |
| FY12N | Driver S5 | 89p (E) |
| FY13P | Driver S6 | 63p (E) |
| BK35Q | Driver S7 | £1.25 (D) |
| BK36P | Driver S8 | £2.25 (C) |
| FY15R | Pozidriver P1 | £1.49 (D) |
| FY17T | Pozidriver P2 | 99p (E) |
| BK37S | Pozidriver 3 | £1.15 (D) |
| BK38R | Pozidriver 4 | £2.25 (C) |
| BR71N | Mains Tester | 60p (E) |

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| | | |
|---|---|---|
| LH75S | Spiraldriver | £4.25 (C) |
| YW92A | Ratchet Socket Set | £5.99 (B) |
| WY04E | Cushiongrip Drvr Set | £5.84 (B) |
| FY19V | Low Cost Min Cutters | £4.25 (C) |
| BR75S | Ins Min Cutters | £6.93 (B) |
| BK42V | Slant Edge Cutters | £6.75 (B) |
| FY20W | Box-JT End Cutter | £6.95 (B) |
| FY21X | Low-Cost Cutters | £2.25 (C) |
| FY76H | Large Low Cost Cutts | £3.75 (C) |
| BR74R | Side Cutters | £5.95 (B) |
| FY22Y | Box JT Side Cutters | £7.60 (B) |
| BR72P | Side Cutters S55 | £4.50 (C) |
| YW67X | Tweezers | 19p (G) |

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| | | |
|---|---|---|
| BK43W | Pearl Catcher | £1.75 (D) |
| FY24B | Low Cost Min Pliers | £3.90 (C) |
| BR78K | Ins Min Snipe | £5.72 (B) |
| BK41U | Hooked Pliers | £6.75 (B) |
| BR77J | Bright Pliers | £4.99 (C) |
| FY25C | Low-Cost Pliers | £1.95 (D) |
| FY26D | Box Combined Pliers | £3.99 (C) |
| BR73Q | Long Snipe Pliers | £7.49 (B) |
| BR90X | Box Radio Pliers | £6.52 (B) |
| FY27E | Low-Cost Long Pliers | £3.99 (C) |
| BR92A | Combination Pliers | £5.50 (B) |
| FY28F | Low-Cost Elec Pliers | £2.85 (C) |
| FY29G | Low-Cost HD Pliers | £2.45 (C) |

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| | | |
|---|---|---|
| BR91Y | Electricians Pliers | £4.90 (C) |
| FY30H | Pincers | £3.42 (C) |
| FY31J | Crimp Tool | £2.15 (C) |
| BR76H | End Action Strippers | £5.99 (B) |
| BR93B | Wire Strippers 3A | £2.35 (C) |
| BR94C | Wire Strippers 8B | £1.49 (D) |
| BR95D | Wire Strippers 9 | £3.96 (C) |
| BR96E | Stripmaster | £16.25 (A) |
| XX11M | Blade L4421 | £6.25 (B) |
| BR97F | Blade L5361 | £6.20 (B) |
| FY32K | Hand Wrap Tool | £6.48 (B) |
| YK52G | Helping Hands | £5.95 (B) |
| YK53H | Helping Hands † Mag | £7.95 (B) |
| FY34M | Allen Keys AF | £1.64 (D) |
| FY35Q | Allen Keys Metric | £1.46 (D) |

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| | | |
|---|---|---|
| YR82D | Min Spanner Set | £2.10 (C) |
| YW61R | Box Spanner Set | £2.15 (C) |
| FY36P | Min Spanner 24 | £1.15 (D) |
| FY37S | Min Spanner 68 | £1.15 (D) |
| FY38R | Ring Spanner 02 | £1.99 (D) |
| FY39N | Ring Spanner 46 | £1.69 (D) |
| FY45Y | Crescent Wrench 160 | £3.35 (C) |
| FY46A | Crescent Wrench 210 | £4.20 (C) |
| FY40T | Box Spanner 2BA | £1.25 (D) |
| FY41U | Box Spanner 4BA | £1.25 (D) |
| FY42V | Box Spanner 6BA | £1.25 (D) |
| FY43W | Box Spanner 8BA | £1.25 (D) |
| FY47B | Adjustable Wrench | £3.20 (C) |
| YW63T | Needle File Set | £6.94 (B) |
| FY49D | Needle File Flat Wrd | £1.75 (D) |
| FY50E | Needle File Hand | £1.75 (D) |
| FY51F | Needle File Halfrnd | £1.96 (D) |
| FY52G | Needle File Round | £2.27 (C) |
| BR63T | Junior Hacksaw | 99p (E) |
| BR64U | 6in Hacksaw Blades | 98p (E) |
| FY54J | Wire Brush | 45p (F) |
| FY55K | Wet & Dry Fine | 20p (G) |
| FY56L | Wet & Dry Med | 19p (G) |
| FY57M | Wet & Dry Course | 25p (F) |

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| | | |
|---|---|---|
| FY02C | Utility Knife | £1.60 (D) |
| FY03D | Retractable Knife | £1.99 (D) |
| FY04E | Knife Blades | 99p (E) |
| YW64U | Snap-Off Blade Knife | 99p (E) |
| FY05F | Scalpel Handle | £1.75 (D) |
| FY06G | Scalpel Bld Type II | 46p (F) |
| BR59P | Punch 3/8in | £4.38 (C) |
| BR60Q | Punch 7/16in | £4.29 (C) |
| BR61R | Punch 1/2in | £4.64 (C) |
| BR62S | Punch 9/16in | £4.86 (C) |
| BR80B | Punch 5/8in | £4.64 (C) |
| BR81C | Punch 3/4in | £4.83 (C) |
| BR83E | Punch 1in | £5.20 (B) |
| BW00A | Punch 1 1/2in | £6.49 (B) |
| YK27E | Chassis Punch Set | £13.45 (A) |

| | | |
|---|---|---|
| FY53H | Mini Vice | £3.85 (C) |
| LH79L | Reliant Kit | £21.95 (A) |
| BW03D | Reliant Drill | £7.60 (B) |
| BW02C | Titan Drill | £11.25 (A) |

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| | | |
|---|---|---|
| YW65V | Mini Mains Drill | £14.25 (A) |
| XB12N | Drill Stand | £14.95 (A) |
| BR84F | Reliant Collar | 75p (E) |
| BW04E | Drill Power Supply | £13.99 (A) |
| BR65V | Twist Burr 0.8mm | 43p (F) |
| BR66W | Twist Burr 1.4mm | 43p (F) |
| BR85G | HS Twist Drill 0.8mm | 75p (E) |
| BR86T | HS Twist Drill 1mm | 75p (E) |
| BR87U | HS Twist Drill 1.4mm | 75p (E) |
| YY28F | Long-Life Drill 1mm | £1.20 (D) |
| LH77J | 20-Piece Tool Kit | £8.25 (B) |
| LH78K | 40-Piece Tool Kit | £14.95 (A) |
| LH76H | Wishbone Sharpener | £6.85 (B) |
| YW66W | Pin Drill | £4.95 (C) |
| HQ02C | HS Drill 1/16in | 19p (G) |
| HQ03D | HS Drill 5/64in | 23p (G) |
| HQ04E | HS Drill 3/32in | 29p (F) |
| HQ05F | HS Drill 7/64in | 32p (F) |
| HQ06G | HS Drill 1/8in | 36p (F) |
| HQ07H | HS Drill 9/64in | 39p (F) |
| HQ08J | HS Drill 5/32in | 43p (F) |
| HQ09K | HS Drill 11/64in | 49p (F) |
| HQ10L | HS Drill 3/16in | 53p (E) |
| HQ11M | HS Drill 13/64in | 56p (E) |
| HQ12N | HS Drill 7/32in | 65p (E) |
| HQ13P | HS Drill 15/64in | 72p (E) |
| HQ14Q | HS Drill 1/4in | 75p (E) |
| HQ15R | HS Drill 17/64in | 95p (E) |
| HQ16S | HS Drill 9/32in | 98p (E) |
| HQ17T | HS Drill 19/64in | £1.12 (D) |
| HQ18U | HS Drill 5/16in | £1.19 (D) |
| HQ19V | HS Drill 21/64in | £1.26 (D) |
| HQ20W | HS Drill 11/32in | £1.36 (D) |
| HQ21X | HS Drill 23/64in | £1.54 (D) |
| HQ22Y | HS Drill 3/8in | £1.54 (D) |
| HQ23A | HS Drill 25/64in | £1.75 (D) |
| HQ24B | HS Drill 13/32in | DIS |
| HQ25C | HS Drill 27/64in | £2.18 (C) |
| HQ26D | HS Drill 7/16in | £2.32 (C) |
| HQ27E | HS Drill 29/64in | DIS |
| HQ28F | HS Drill 15/32in | DIS |
| HQ29G | HS Drill 1/2in | £2.99 (C) |

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| | | |
|---|---|---|
| FY59P | Retractable Rule | £2.75 (C) |
| FY60Q | Feeler Gauge Imp | 95p (E) |
| FY61R | Feeler Gauge Metric | 97p (E) |
| FY62S | Iron CX | £6.59 (B) |
| FY63T | Element CX | £2.94 (C) |
| FR30H | Bit 6/1106 | 89p (E) |
| FY64U | Bit 1100 | 84p (E) |
| FY65V | Bit 1101 | 92p (E) |
| FR31J | Bit 7/1101 | £1.19 (D) |
| FY66W | Bit 1102 | 93p (E) |
| FY67X | Bit 1103 | 92p (E) |
| FR01B | Element Type CN | £2.65 (C) |
| FR02C | Handle Type CN | 85p (E) |
| FR03D | Bit 102 | 84p (E) |
| FR04E | Bit 104 | 88p (E) |
| FR05F | Bit 106 | 84p (E) |
| FR06G | Bit 820 | 89p (E) |
| FR07H | Bit 821 | 84p (E) |
| FR08J | Bit 822 | 84p (E) |
| FR12N | Iron X25 | £6.32 (B) |
| FR13P | 12V Iron MLX12 | £7.48 (B) |
| FR14Q | Element X25 | £2.92 (C) |
| FR15R | Element MLX12 | £2.49 (C) |
| FR16S | Bit No. 50 | 89p (E) |
| FR17T | Bit No. 51 | 92p (E) |
| FR18U | Bit No. 52 | 89p (E) |

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| | | |
|---|---|---|
| FR20W | Stand ST4 | £2.19 (C) |
| FR11M | Sponge ST3 | 11p (G) |
| RK33L | Sponge ST4 | 32p (F) |
| FY68Y | Kit SK3 | £8.92 (B) |
| FY69A | Kit SK4 | £8.99 (B) |
| WY05F | Rechargeable Iron | £26.95 (A) |
| YX68Y | B50 Bit Angled | £3.62 (C) |
| YX69A | B50 Bit Flattened | £3.65 (C) |
| YX70M | B50 Lamp | 85p (E) |
| YX71N | B50 Holder | 62p (E) |
| YX72P | B50 Sponge | 29p (F) |
| FR10L | Heat Sink Tweezers | 19p (G) |
| FR23A | Solder Sucker | £4.50 (C) |
| FR24B | Sucker Tiplet | £1.55 (D) |
| FR26D | Desolder Tool | £7.25 (B) |
| BK39N | Desolder nozzle 3 | 85p (E) |
| BK40T | Replacement O rings | 55p (E) |
| FR63T | Desldr Washer Type 2 | 24p (F) |
| HY13P | Desldr Nozzle Type 2 | 89p (E) |
| FR28F | Desolder Nozzle | £1.55 (D) |
| FR29G | Solda-Mop | 90p (E) |

### Page 378

| | | |
|---|---|---|
| FR21X | Solder D622 | 75p (E) |
| FY70M | 1/2kg Reel Solder | £10.50 (A) |
| FY71N | Aluminium Solder | 43p (F) |
| FY72P | Conductive Paint | £5.35 (B) |
| LH04E | Freeze-it | £1.94 (D) |
| LH03D | Switch Cleaner | £1.94 (D) |
| YB77J | Servisol | £1.66 (D) |
| LH02C | Aero-Klene | £1.55 (D) |
| YB73Q | Aero-Duster | £1.75 (D) |
| YB74R | Silicone Grease | £1.98 (D) |
| YB75S | Plastic Seal | £1.55 (D) |
| YB76H | Foam Cleanser | £2.35 (C) |
| YB78K | Excel Polish | £1.78 (D) |
| YB79L | Anti-Static Spray | £1.72 (D) |

### Page 379

| | | |
|---|---|---|
| YB80B | Fire Extinguisher | £4.85 (C) |
| FL43W | Evostik Impact | 99p (E) |
| FL46A | Cyanoacrylate | £1.55 (D) |
| LQ02C | Potting Compound | £3.55 (C) |
| FL44X | Araldite Rapid | £2.25 (C) |
| FL45Y | Double Bubble Sachet | 28p (F) |
| FL47B | PVC Tape Black | 35p (F) |
| FL48C | PVC Tape Blue | 35p (F) |
| FL49D | PVC Tape Brown | 35p (F) |
| FL50E | PVC Tape Green | 35p (F) |
| FL51F | PVC Tape Red | 35p (F) |
| FL52G | PVC Tape White | 35p (F) |
| YR99H | PVC Tape Yellow | 35p (F) |

## WOUND COMPONENTS

### Page 380

| | | |
|---|---|---|
| LB40T | 9.5 Coil Former | 60p (E) |
| LB17T | Former 351 | 24p (F) |
| LB18U | Former 450 | 16p (G) |
| LB19V | Former 722/1 | 13p (G) |
| LB20W | Former 722/2 | 13p (G) |
| LB21X | Former 722/8 | 13p (G) |
| LB22Y | Former 722/4 | 13p (G) |
| LB41U | Dust Core Type 4 | 10p (G) |
| LB42V | Dust Core Type 6 | 11p (G) |
| LB43W | Dust Core Type 8 | 17p (G) |
| LB44X | Former Base | 12p (G) |
| LB36P | Screening Can 10 | 10p (G) |
| LB39N | Screening Can 15 | 14p |
| LB62S | A/P Beads | 35p (F) |
| HX05F | Small Pot Core | £1.30 (D) |
| HX06G | Core Type 2 | £1.55 (D) |

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| | | |
|---|---|---|
| HX07H | Bobbin Type 2 | 96p (E) |
| HX08J | Clips Type 2 | 5p (H) |
| HX09K | Type 3 Core | £1.85 (D) |
| HX10L | Type 3 Bobbin | 65p (E) |
| HX11M | Type 3 Clips | 6p (H) |
| HX12N | Large Pot Core | 99p (E) |
| HX13P | Bobbin Type 4 | 10p (G) |
| HX14Q | Mtg System Type 4 | £1.10 (D) |
| HW23A | GE Coil L15 | £1.95 (D) |
| HX58N | GE Coil L9 | £2.20 (C) |
| HX57M | GE Coil L8 | £2.20 (C) |
| HW24B | GE Coil L14 | £1.95 (D) |
| HX56L | GE Coil L7 | £2.20 (C) |
| HX55K | GE Coil L6 | £2.20 (C) |
| HX54J | GE Coil L5 | £2.25 (C) |
| HW25C | GE Coil L12 | £1.99 (D) |
| HW26D | GE Coil L11 | £1.99 (D) |

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| | | |
|---|---|---|
| HX24B | Choke 0.5H | £1.15 (D) |
| HX25C | Choke 1H | £1.15 (D) |
| HX26D | Choke 2H | £1.15 (D) |
| HX27E | Choke 4H | £1.15 (D) |
| LR07H | Filter Pot Core | £2.15 (C) |
| XX30H | Equaliser Pot Core | £1.99 (D) |
| HW27E | Choke 10H | £1.96 (D) |
| HX22Y | Choke RFC5 | £2.36 (C) |
| HX23A | Choke RFC9A | £2.65 (C) |
| HW28F | Choke 5uH HC | 48p (F) |
| HX15R | Choke 1.5mH | 58p (E) |
| HX16S | Choke 2.5mH | 59p (E) |
| HX17T | Choke 5mH | 66p (E) |
| HX19V | Choke 10mH | 29p (F) |
| WH25C | Choke 0.22uH | 52p (E) |
| WH27E | Choke 0.47uH | 53p (E) |
| WH29G | Choke 1.0uH | 45p (F) |
| WH30H | Choke 1.5uH | 74p (E) |
| WH31J | Choke 2.2uH | 45p (F) |
| WH32K | Choke 3.3uH | 45p (F) |
| WH33L | Choke 4.7uH | 49p (F) |
| WH34M | Choke 6.8uH | 55p (E) |
| WH35Q | Choke 10.0uH | 45p (F) |
| WH36P | Choke 15.0uH | 61p (E) |
| WH37S | Choke 22.0uH | 48p (F) |
| WH38R | Choke 33.0uH | 48p (F) |
| WH39N | Choke 47.0uH | 48p (F) |
| WH41U | Choke 100uH | 54p (E) |
| WH45Y | Choke 470uH | 55p (E) |
| WH47B | Choke 1mH | 75p (E) |

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| | | |
|---|---|---|
| HX42V | Toko YRCS 11098 | 51p (E) |
| YG30H | Toko YRCS12374 | 52p (E) |
| HX43W | Toko YHCS 11100 | 52p (E) |
| YG31J | Toko CSK3464 | 53p (E) |
| YG32K | Toko YMCS17104 | 51p (E) |
| HX97F | Toko ACS 34342 | 64p (E) |
| HX98G | Toko ACS 34343 | 46p (F) |
| YG39N | Toko KAC8448 | 48p (F) |
| YG36P | Toko KAC8449 | 46p (F) |
| LB00A | IFT 13 | £1.62 (D) |
| LB01B | IFT 14 | £1.75 (D) |
| LB03D | IFT 16 | £1.72 (D) |
| LB02C | IFT 15 | £1.81 (D) |
| LB05F | IFT 18 465kHz | £2.19 (C) |
| LB06G | IFT 18 1.6MHz | £1.98 (D) |
| HX28F | Toc 1 | £1.99 (D) |
| HX82D | Min Tr LT44 | 55p (E) |
| LB14Q | Min Tr LT700 | 55p (E) |
| YR91Y | Min Tr LT800 | 33p (F) |
| LR06G | Mc Xfm Typ2 200-600R | £19.45 (A) |
| YX84F | Z Changer | £7.85 (B) |

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| | | |
|---|---|---|
| HX81C | Pulse Transformer | £3.82 (C) |
| YX66W | Line Transformer | £3.35 (C) |
| BK57M | 600 Ohm Isotran | £5.45 (B) |
| WB00A | Sub-Min Tr 6V | £1.30 (D) |
| WB01B | Sub-Min Tr 9V | £1.30 (D) |
| WB02C | Sub-Min Tr 12V | £1.40 (D) |
| WB06G | Min Tr 6V | £3.46 (C) |
| WB11M | Min Tr 9V | £4.25 (C) |
| WB10L | Min Tr 12V | £3.35 (C) |
| YK28F | Tr 12V 0.5A | £4.36 (C) |
| LY03D | Tr 10VA 15V | £4.95 (C) |
| WB22Y | Tr 34V HP | £8.15 (B) |
| WB16S | Min Tr 20V | £3.35 (C) |
| WB20W | Min Tr 24V | £3.35 (C) |
| WB07H | Tr 34V 1A | £7.85 B |

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| | | |
|---|---|---|
| WB25C | Tr 12V 1A | £6.55 (B) |
| WB26D | Tr 12V 2A | £7.95 (B) |
| YK02C | Tr 32-0-32 2A | £13.45 (A) |
| YK07H | Tr 32-0-32 4A | £22.25 (A) |
| YK08J | Toroidal 30VA 6V | £7.08 |
| YK09K | Toroidal 30VA 9V | £8.59 |
| YK10L | Toroidal 30VA 12V | £7.08 |
| YK11M | Toroidal 30VA 15V | £7.08 |
| YK12N | Toroidal 30VA 18V | £7.08 |
| YK13P | Toroidal 50VA 6V | £8.05 |
| YK14Q | Toroidal 50VA 9V | £8.05 |
| YK15R | Toroidal 50VA 12V | £8.05 |
| YK16S | Toroidal 50VA 15V | £8.05 |
| YK17T | Toroidal 80VA 18V | £8.91 |
| YK18U | Toroidal 80VA 22V | £8.91 |
| YK19V | Toroidal 80VA 30V | £8.91 |
| YK20W | Toroidal 120VA 30V | £9.86 |
| YK21X | Toroidal 160VA 35V | £11.02 |
| YK22Y | Toroidal 300VA 35V | £14.00 |
| YK23A | Toroidal 500VA 35V | £18.26 |
| WB03D | Tr 9V 1 1/2A | £6.25 (B) |
| WB12N | Tr 20V 1A | £8.25 (B) |
| WB17T | Tr 28V 1.1/2A | £9.95 (B) |
| XB38R | TR 32032/6 1/2A | £23.25 (A) |
| HX59P | Trnsformer Mtg Plate | 66p (E) |
| LW34M | 15/22V Power Tran | £14.84 (A) |
| LW33L | Tr 240V Isotran | £4.95 (C) |

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| | | |
|---|---|---|
| YK03D | Matinee Transformer | £13.75 (A) |
| YG12N | Min Motor | £2.45 (C) |
| YG13P | Small Motor | £1.25 (D) |
| YG14Q | Servo Mechanism | £3.60 (C) |

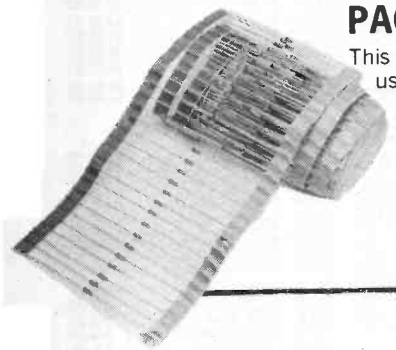
## TRADE QUANTITIES

The letter in brackets after the price indicates the minimum quantity of that item you can buy and qualify for a trade price. See table at start of price list. If you buy less than the quantity shown then the price is that shown. If you want to buy the quantity shown or more of that item, then please contact us for a trade price. If no trade quantity is shown, then the price shown is the best price we can offer regardless of the quantity.

Trade quantities shown for wires or cables of any type is in metres, not reels or parts of metres. Trade quantities for nuts, bolts, washers, Hiatts etc refers to the number of packs, i.e. to qualify for a trade price on Tag 2BA for example (trade quantity 500), you will need to order 500 packs which is equal to 5000 tags.

# SPECIAL OFFERS

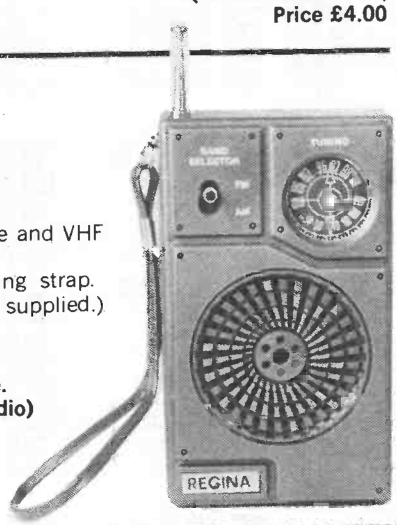
## *FOUR FABULOUS SPECIAL OFFERS FOR CHRISTMAS*



### PACK OF 200 1N4148

This is the most popular of all the diodes, used in thousands of different circuits and ideal for fast logic applications. This is an incredible offer at half our usual price.

**Usual price £8 for 200. Save £4**
**Order As SP95D (Pk of 200 1N4148)**
**Price £4.00**




### AM/FM RADIO

A good quality medium wave and VHF pocket radio with telescopic aerial, earphone and carrying strap. (Needs four HP7 cells, not supplied.)

**Incredible Price only £3.95**
**Saving £1 on our usual price.**
**Order As SP97F (AM/FM Radio)**
**Price £3.95**

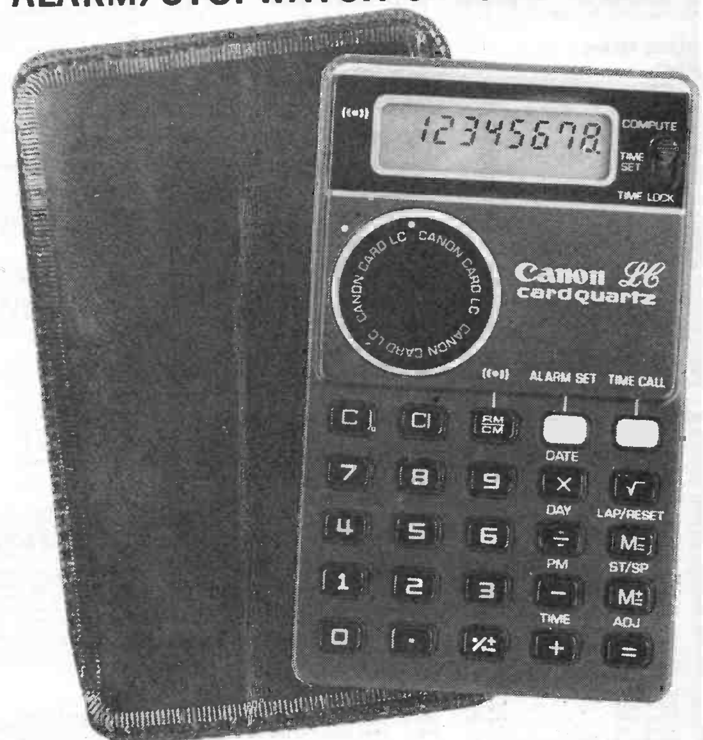
### ELECTRONICS FOR ALL KIT


Now's the time to pick up this fantastic bargain. Our enormously popular 'Electronics For All' kit is available to you at a huge discount. We'd like to clear up our remaining stocks prior to making some more for next Christmas. So hurry — this offer is strictly while stocks last. With this kit, you and your children can get started in this fascinating hobby. You will build projects using the latest micro-chips and you will learn to use the actual components (it's not all in little plastic boxes like most other kits). But you can still use the components over and over again. It is completely safe for children as there is no soldering and there are no dangerous voltages.

Even if you've never touched a transistor before, the superb book contained in the kit will show you exactly how to build the projects. You will build a two-waveband radio, a two-octave organ and lots more interesting projects. Even a nine-year-old, following the simple instructions, should be able to get every project working first time. The kit is superbly packaged in a full colour box.

**Order now and save £15 off our previous price!**
**Order As SP96E (Electronics For All) Price £14.95**

### CANON ULTRA-SLIM TIME/DATE/ALARM/STOPWATCH CALCULATOR



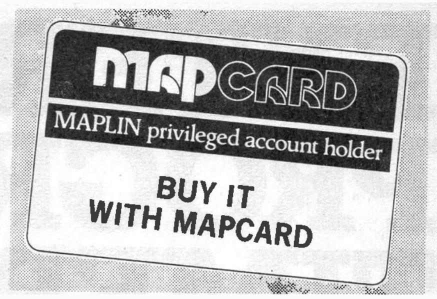

**A special end-of-catalogue offer that is strictly while stocks last!**
An ultra-slim 8-digit calculator with memory that also incorporates a quartz-crystal and functions: as a clock with hours, minutes, day and date displayed; as an alarm clock which beeps discreetly when a preset time is reached and as a stopwatch with hours, minutes, seconds and tenths of seconds displayed. It will fit easily into an inside pocket or handbag as it less than ⅛in. thick. The device has a liquid crystal display and battery life will be about one year. The day, date, time display is normally operating continuously and after use as a calculator, if not returned to clock mode manually, it will return automatically after 10 to 20 minutes.

**Specification**

| | |
|---|---|
| Timepiece | |
| Quartz crystal frequency: | 30, 720Hz |
| Accuracy: | Better than ±30 seconds per month (at 25°C) |
| Display: | Date, day of week, hours, minutes, flashing seconds indicator, AM/PM. |
| Alarm: | Electronic beep signal. Display shows when alarm is set. |
| Stopwatch | |
| Measuring unit: | $^1/_{10}$ second |
| Measuring range: | To 9 hours, 59 minutes, 59.9 seconds |
| Types of measurement: | Standard; Lap time displayed while count continues; Stop count and restart; Two sets of times with simultaneous start. |
| Calculator and General | |
| Display: | 8-digit liquid crystal with minus, overflow and memory signs. |
| Types of calculation: | Addition, subtraction, multiplication, division, percentages, square roots, chain multiplication and division, constants, powers, add-on and discount calculations, reciprocals, sum and difference of products and quotients, calculations requiring memory. |
| Power source: | One lithium battery (LF1/2V) (3V DC 0.6mW) |
| Battery life: | 1 year (with intermittent calculator use) |
| Size: | 94 x 56 x 2.9mm |
| Weight: | 36gms (including battery) |

Supplied complete with batteries, wallet and instruction booklet.
**Save £2 on our previous price!**
**Order As SP98G (Canon LC61T) Price £13.95**

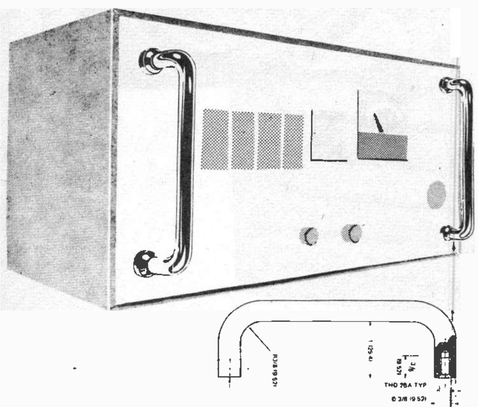
# MAPLIN NEWS




## THE ONE'S THAT GOT AWAY

We regret that the following items were inadvertently omitted from the 1983 Maplin catalogue. They appeared in the 1981/2 edition, and will be reinstated in 1984. Prices can be found in our current price list under the relevant section heading. We apologise for any inconvenience that this causes.

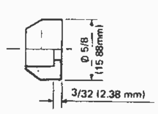
### INSTRUMENT CASE HANDLE



Mild steel handles fine chromed (on nickel on copper). Two sizes available: Fixing hole centres 3¾in. (95.2mm, SMALL) or 6in (152.4mm LARGE).

**Order As FX00A (inst Handle Small)**
**FX01B (Inst Handle Large)**

### FERRULE




A chrome plated brass ferrule is also available to suit INST. HANDLE.

**Order As FX02C (Ferrule)**

### CIGARETTE LIGHTER EXTENSION LEAD

An extension lead with plug at one end to fit the cigarette lighter socket in a car and socket at other end to accept cigarette lighter plug. Approx. 1.7m of lead.

**Order As YB68Y (Car Lighter Ext. Lead)**

### GUITAR STRINGS

A set of replacement steel guitar strings for electric and acoustic guitars, round wound. Pack contains an extra 1st and 2nd string (total 8 strings).

**Order As LB60Q (Guitar Strings Steel)**

## INTEREST FREE CREDIT EXTENDED (APR = 0%)

Following the incredible success of our Interest Free Credit scheme in its first months of operation, we are pleased to announce its indefinite extension.

So if you have an order containing over £120 of computer hardware, then buy it on credit — interest free. Here's how it works.

### In our shops

1. Phone the branch of your choice and give them your order (must include at least £120 worth of computer hardware). We will also have to ask you some personal financial questions in order to fill up our credit application form.
2. We will phone you back within 48 hours to let you know whether your application has been approved.
3. Any time after this, you may visit the shop to collect the goods. You must bring with you some form of identification (e.g. driving licence, credit card) and sign the form that we filled in on your behalf. A deposit of 10% will be required.
4. A further 10% will be payable every month for a further 9 months equalling the total cash price for the goods.

### By mail-order

1. Send your order to us (which must include at least £120 worth of computer hardware) and mark clearly on it "Interest Free Credit Terms". Enclose 10% of the value of the goods with your order.
2. We will send you by return of post, a credit application form.
3. Complete the form and post it in the stamped addressed envelope supplied.
4. When approved we immediately despatch your goods to you.
5. One month after goods despatched the first 10% payment becomes due, and thereafter a further 10% is due monthly for a further 8 months, equalling the total cash price for the goods.

### Example

A VIC20 computer could be yours for just £16.99 down and £17 per month for nine months.

Interest free credit terms are only available in the U.K., not in Northern Ireland, Isle of Man and Channel Islands.

## OUR COMPUTER WOULD LIKE TO TALK TO YOU

We hope to launch a brand new service in early 1983, allowing you, through your Modem, to talk directly to the Maplin computer. You will be able to access our stock file to check stock levels, then place your order, using any of the credit cards that we accept to pay for it. A few seconds later your order will be printed out, then collected and posted to you.

However, until we can make this available, you will still be able to call our computer on 0702 552941, and a message on our computer will tell you if your Modem is working correctly. If our computer is not operational, you will hear only a ringing tone. This part of the service will be ready for use in late November.

## CORRIGENDA

**ISSUE 1**

Page 4. On Combo PCB overlay D6 above R67 should read D4.

Page 6. Fig. 8, Dimns. given for 'B' holes on Front View are incorrect, mount PCB in 'A' holes and drill through fixing holes for correct positions.

**ISSUE 3**

Page 3. Fig. 2, SK2 Pin numbers are incorrect, from left to right they should read 1, 2, 4, 6, 8, 7, 5, 3. Note the PCB is correct.

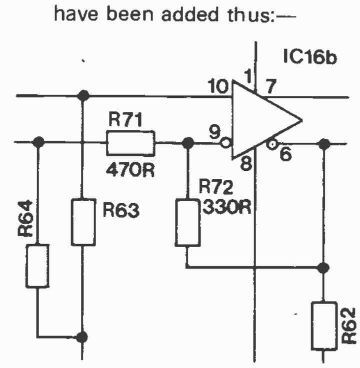
**ISSUE 4**

Page 5. Digi-tel Motherboard cct. There are 4 Diodes shown below R1 to 11 without cct references, their designations are D31 to 34, working from top to bottom; Pin 15 on Skts 1-4 goes to IC's 7, 8, 9 & 10 Pin 2 not 15 as shown; Veropin 48 should be connected to collector of TR2 not to IC4 Pin 10; Veropin 55 has been omitted and joins to IC19 Pin 11.

Page 41. Frequency Counter: Fig. 2, R47 value is 10M.

Page 42. Fig. 3, on IC7 Pin 10 goes to D13.

Page 43. Fig. 6, R65 value is 1k; R71 & R72 have been added thus:—



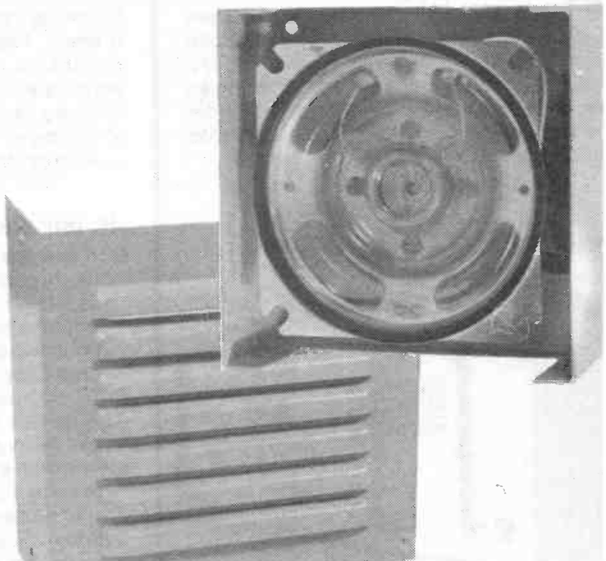

Page 44. Fig. 7, for better performance IC14 has been changed to SP8680, but please note that the circuit and PCB require no modifications, the order code (QY18U) is also unchanged. Some early kits may still contain the 11C90, however.

Page 45. Main Parts List: Add R71 to 470R (Qty 8), Add R65 to 1k (Qty 9), Delete R47 from 1M (Qty 1), Delete R65 from 47k (Qty 1), Add R47 value 10M, Add R72 value 330R; Diode 1N4148 Qty should be 24.

Page 57. ZX81 I/O Port: Fig. 1, IC1 Pin 9 goes to A10.

# EXTERNAL HORN PROGRAMMABLE TIMER

*by Dave Goodman*



- ★ **Three timing settings from 2 minutes to 2½ hours**
- ★ **Switch over from sounder to flashing beacon when time is up**
- ★ **Directly replaces the previous external horn PCB**
- ★ **Two wire control with tampering detection**

New recommendations concerning the use of burglar alarm sounders have recently been introduced, and apply only to sirens or bells fitted outside protected premises, not to those used internally, unless they are likely to be audible outside. The ruling comes under the noise pollution title, and requires that alarm sound indicators cease to function after a seventeen minute running period from switch-on. Presumably the alarm would, or should, have been raised within this time, and the appropriate authorities notified, making further ear-blasting and nerve-shattering decibels unnecessary. So that it is not forgotten that the alarm system has been activated a flashing lamp or beacon can be switched on which will flash away until reset. Perhaps eye pollution will become a problem in the future!

## Specification

A timer project has been designed for use with the Home Security System (see March issue) which will directly replace the previous External Horn PCB. Any type of siren, bell, or sounder requiring 12V at no more than 1A DC can be used, and in addition a lamp or beacon rated at 12V and less than 1A DC can be switched on after a preset time-out period has elapsed. One of three timing periods (see table 1) ranging from 2 minutes to 2½ hours can be programmed by removing or adding two wire links as required.

A 12V battery supply is needed to power this system, and batteries, siren, and PCB will all fit into an external horn cabinet. Unfortunately, this PCB is larger than the previous one, and the mounting holes in the cabinet lid will not align with it, so a further two 6BA holes are required. The lamp may be fitted to the cabinet, or wherever it will be readily visible.

## Circuit Description

R1 terminates a two wire loop connection from the mother board in the main alarm. Removal of R1 from the circuit, either by shorting or open

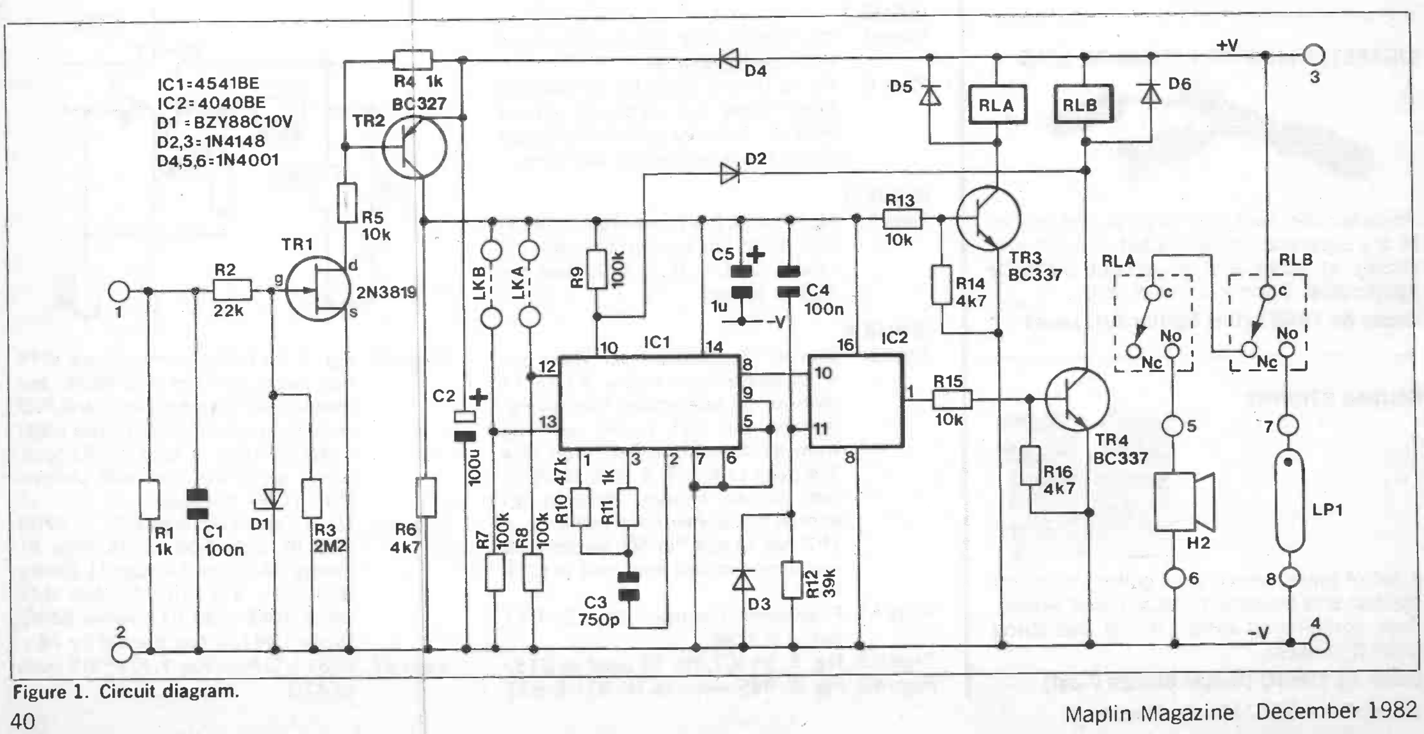



Figure 1. Circuit diagram.

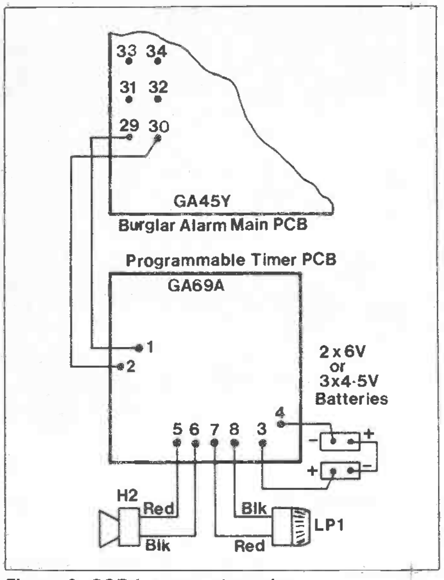
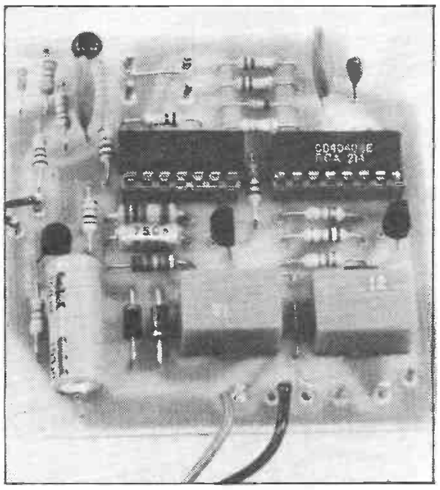
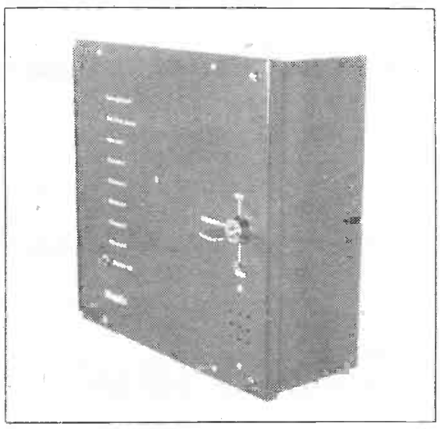



Figure 2. PCB layout and overlay.





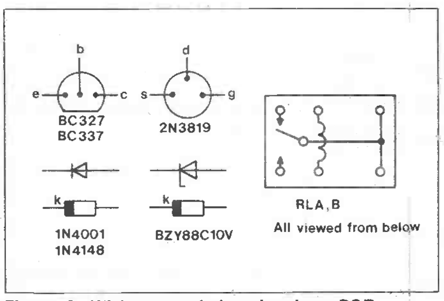


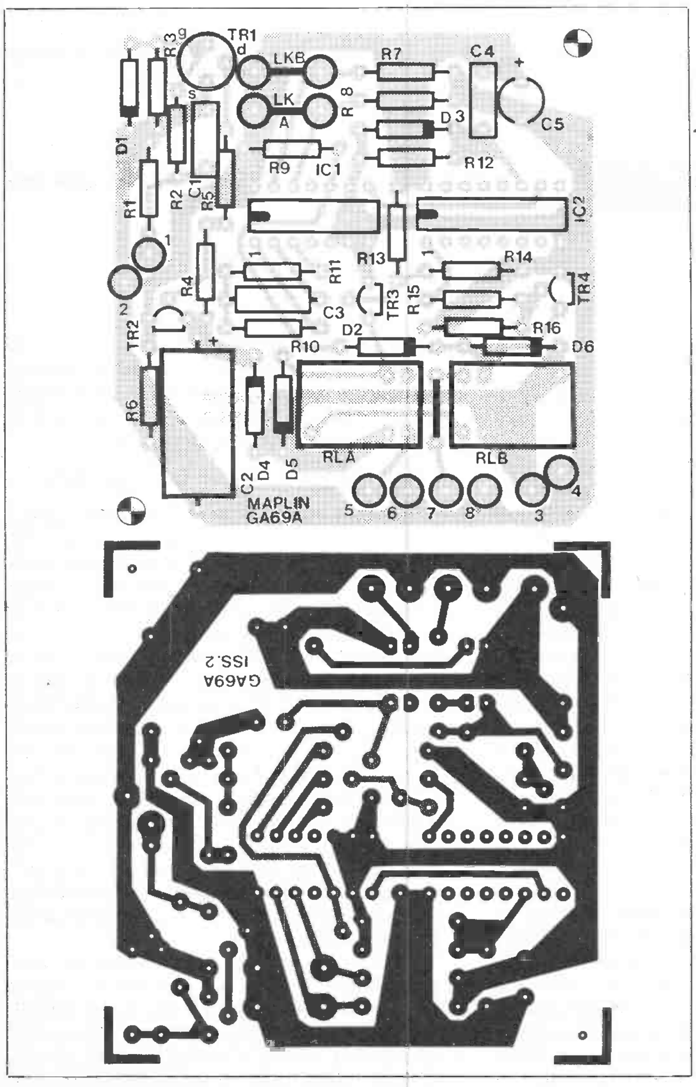

Figure 3. Wiring to main burglar alarm PCB.

circuiting the loop, will trigger the main alarm (described in the March issue). TR1 is an N-type J-FET device, and requires a negative potential between gate and source to prevent drain current flow. With Pin 1 or 2 disconnected, R3 holds TR1 gate to ground, allowing drain current to flow.

C1, R2 and D1 help prevent RF and voltage spikes, that may be introduced along the length of connecting cable used, false triggering the timer. Now, with TR1 conducting, the voltage drop across R4 and R5 is sufficient to allow TR2 to conduct, and connect the battery positive rail, via D4, to the supply rail. R13 monitors the positive supply rail, and TR3 immediately conducts, switching RLA, and allowing the siren connected between pins 5 and 6 to operate for a period of time (generated by IC1 and 2.

IC1 is a programmable timer, with an internal clock and four dividing stages. Clock frequency is set by R10, R11 and C3 to 16.5kHz, which is divided down by one of three stages set by links from the positive rail to pins 12 and 13 (Table 1). The Q output at pin 8 requires further dividing, and is applied to a 12 stage ripple counter, IC2. C4 and R12 apply a reset pulse to IC2, ensuring that all twelve dividing stages will

Continued on page 43




## PROGRAMMABLE TIMER PARTS LIST

Resistors - All 0.4W 1% metal film unless specified.

| | | | |
|---|---|---|---|
| R1, 4, 11 | 1k | 3 off | (M1K) |
| R2 | 22k | | (M22K) |
| R3 | 2M2 | | (M2M2) |
| R5, 13, 15 | 10k | 3 off | (M10K) |
| R6, 14, 16 | 4k7 | 3 off | (M4K7) |
| R7, 8, 9 | 100k | 3 off | (M100K) |
| R10 | 47k | | (M47K) |
| R12 | 39k | | (M39K) |
| **Capacitors** | | | |
| C1, 4 | 100nF Disc Ceramic | 2 off | (BX03D) |
| C2 | 100uF 25V axial electrolytic | | (FB49D) |
| C3 | 750pF 1% polystyrene | | (BX55K) |
| C5 | 1uF 35V Tantalum | | (WW60Q) |
| **Semiconductors** | | | |
| D1 | BZY88C10V | | (QH14Q) |
| D2, 3 | 1N4148 | 2 off | (QL80B) |
| D4, 5, 6 | 1N4001 | 3 off | (QL73Q) |
| TR1 | 2N3819 | | (QR36P) |
| TR2 | BC327 | | (QB66W) |
| TR3, 4 | BC337 | 2 off | (QB68Y) |
| IC1 | 4541BE | | (QQ47B) |
| IC2 | 4040BE | | (QW27E) |
| **Miscellaneous** | | | |
| RLA, B | Ultra-min relay SPDT | 2 off | (YX94C) |
| | Veropin 2141 | 1 Pkt | (FL21X) |
| | 14 pin DIL skt | | (BL18U) |
| | 16 pin DIL skt | | (BL19V) |
| | Programmable timer P.C.B. | | (GA69A) |
| LP1 | 12V 50mA Beacon | | (YK39N) |

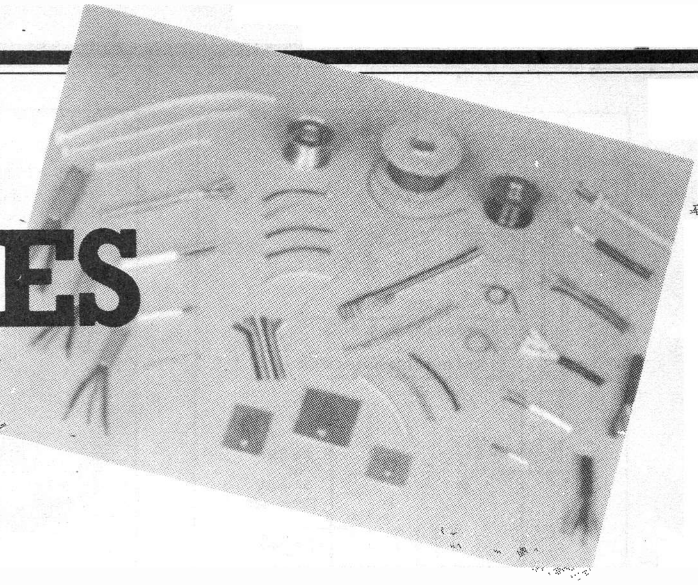
Printed below are the parts needed for the External Horn Case. (If required).

| | | | |
|---|---|---|---|
| H2 | Electronic siren | | (XG14Q) |
| B1, 2 | 6V lantern battery | 2 off | |
| | Case | | (XG07H) |
| | Grommet Small | | (FW59P) |
| | No. 6 self-tapping screws × ½" | 10 off | (BF67X) |
| | Bolt 6BA×½" (for P.C.B.) | 2 off | (BF06G) |
| | Washer 6BA | 4 off | (BF22Y) |
| | Nut 6BA | 4 off | (BF18U) |
| | Spacer 6BA×¼" | 2 off | (FW34M) |
| | Bolt 6BA×¼" (for Siren) | 2 off | (BF05F) |
| | Wire to suit | | |

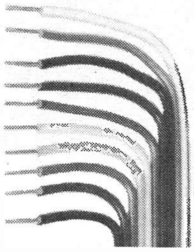
A kit of parts is available for this project. It does not include the Beacon which must be ordered separately if required, not does it include any of the parts listed below.

**Order As LW98G (Programmable Timer Kit) Price £6.95**

# WIRES AND WHEREFORES

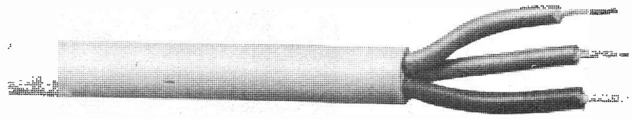


*by Christopher Roper*

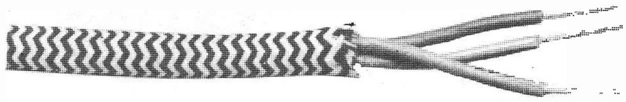


Ribbon cable with end fanned-out (XR06G).

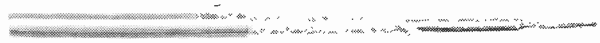
**Multi-strand single core wire 7/02 (BL00A).**



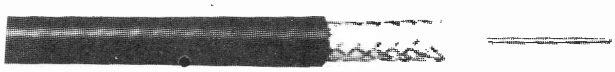
**Heavy-duty mains cable 3-core (XR10L).**



**Cotton-covered rubber mains cable 3-core (XR24B).**



**Single-core audio screened cable (XR15R).**



**High-frequency co-axial cable (XR19V).**

On first sight, a casual glance through the local electronic retailers catalogue usually reveals a bewildering assortment of wires and cables which are available to the amateur enthusiast. With such a wide choice, difficulty may be experienced in choosing the right wire for the job in hand, but armed with a few facts it is relatively simple to decide on the appropriate cable. Having said this it should be borne in mind that the average length of wire is itself something of a technological feat; as I hope this article will show.

Cables and wires usually fall into one of several groups, dictated by their usage; e.g. power cables, signal cables etc, although there is often some overlapping between groups. Consider cables in general. Looking through the appropriate catalogue pages usually reveals several descriptive facts and figures relating to number of strands per core, current ratings, voltage ratings and, in the case of screened cables and some multicore cables, a figure for capacitance is usually given. The figure quoted for the number of strands is given in two parts, e.g. 7/0.2 or 16/0.2. The first number gives the number of strands within the core and the second number gives the diameter of each strand in millimeters. Therefore a wire which is listed as being 7/0.2, has seven strands each of which has a diameter of 0.2mm.

The maximum voltage rating is the maximum potential that can be applied across the conductor's insulation without it breaking down due to electrical stress. For obvious reasons this rating should not be exceeded. The current rating is the maximum current that the conductor should be allowed to carry, but although this should never be exceeded it is often necessary to derate this value under certain conditions. The factors which determine the current capacity of a conductor, apart from its cross sectional area and the type of insulation surrounding it, are its proximity to other current carrying conductors, the ambient air temperature and the type of equipment that it is built into.

The amount of heat generated by current flowing in the conductor, should not be allowed to exceed the temperature rating of the insulation and as the number of individually insulated conductors which are loomed together, is increased, the heat dissipation is decreased. Further restriction of the cables, such as within an enclosed chassis, will further lower the heat dissipation.

When dealing with the above situations it is often necessary to have some form of guide as to the amount by which the current capacity of the cables should be derated. For example, a loom consisting of thirty or more individual conductors may need to have the current rating of each conductor derated by as much as 50%. These considerations can become important when dealing with projects such as hi fi amplifiers and the like, which draw appreciable amounts of current.

## Screened Cables

Current flowing in a wire can cause other problems, apart from those already mentioned. Consider for example, screened cables. These are usually used when outside interference sources can be troublesome. The cable screen is usually connected to zero volts or ground and helps to minimise interference induced signals, as well as helping to contain the transmitted signal. Capacitive effects within screened cables dictate to some extent their usage. The inner insulation of the cable acts as the dielectric of a capacitor, with the screen and the inner conductor acting as the capacitor plates. The capacitive effects which are produced can result in a finite time delay being imposed on the transmitted signal. In general terms a cable with a lower capacitance is more suitable for audio and radio frequencies; bearing in mind that the measure of capacitance in both cases is in pico farads i.e. 100-300pf/m.

Capacitive effects can also cause problems between two individually insulated conductors, which are in close proximity, when one or both are carrying alternating currents; under certain circumstances it is possible for signals being carried in one lead to become superimposed on those being carried in the other lead. The use of screened cables in this situation will help to minimise the effect, although this is not always the answer, especially when dealing with power supply leads. In this case it is best to avoid running power supply cables and signal leads within the same loom.

## High Frequency Cables

Certain conductors are designed specifically to carry very high frequencies. On first sight it might seem that a conductor with virtually zero resistance will carry high frequency signals as efficiently as it will carry low frequency signals, but this is not the case. The effective resistance of a conductor increases with frequency, and at high frequencies its resistance may be many times greater than its low frequency resistance. As the signal frequency increases, the signal current tends to flow more within the surface layers of the conductor and less within its central core, giving rise to the phenomenon known as 'skin effect'. The explanation for skin effect is fairly straightforward, when one considers the effect on a conductor which is within its own associated magnetic field.

A current flowing in a conductor produces lines of magnetic flux which actually exist within the conductor itself and there is a greater concentration of flux lines nearer the centre of the conductor than at the surface layers. From this it follows that in a multi strand conductor, the individual conductor nearest the centre of the bundle has induced within it a greater back e.m.f. (electromotive force) than one nearer the outside. This greater induced e.m.f. results in a greater inductive reactance which is effectively an increase in its resistance. At low frequencies this inductive reactance is negligible, but at much higher frequencies it can become troublesome.

The most commonly used cable for high frequency work, i.e. VHF and UHF is Co-ax. This is similar to the screened cables usually with a centre stranded section of copper wires in a polythene insulation covered with a braided screen. However, the spacing between the core and screen is accurately defined which produces capacitances usually around 50-60 pF/m, i.e. much less than screened cables and also maintains a more consistent impedance level.

A less common method of overcoming high frequency problems is to plate the conductor with silver. The silver has a lower resistance than the copper, which offsets the increase in the relative resistance of the conductor as the signal frequency increases. As the frequency rises, more and more of the current will flow in the silver so that the resistance remains fairly constant over a wide range of frequencies.

For specific purposes where a large number of conductors are required all carrying high frequency signals. Litz wire (Litzendraht) can be used. This type of cable has individually insulated strands which are wound around its neighbours in such a way that each occupies the centre of the bundle in succession. This type of wire comprises 3, 9 or 27 strands which are all plaited together in this manner.

## Which Wire?

The majority of cables and wires that are available, are based on perhaps half a dozen different designs. At the bottom of the table are the relatively simple single cored, multi-strand conductors such as 10/0.1mm and 7/0.2mm, which, for their respective sizes, have useful current carrying capacities. They are ideal for most projects and as general hook-up wire.

### Ribbon Cable

A logical development of this type of wire is ribbon cable. Ribbon cable is usually comprised of ten or twenty individually insulated and colour coded conductors which are bound together lengthways so as to form a ribbon of cable. It may be split into any number of ways and any single conductor may be branched off at any point. It is useful where space is limited as it lies flat against any chassis. Some types of ribbon cable are designed so as to be fitted with multipin plugs which fit neatly into standard IC sockets. This is useful for compact interconnections between circuit boards.

A further development of ribbon cable is interboard jumper cable. This is similar to ribbon cable but is designed specifically for interconnecting circuit boards.

For low to medium power applications, 16/0.2mm is a good general sized wire with a current carrying capacity of about 3 amps. This, alongside with 7/0.2mm is a useful choice for the amateur workbench. For myself, these two wire sizes form the bulk of my stock and although the amount on the wire rack is dependant on the types of projects being built, it is useful to have several metres of each colour.

### Screened

There are many types of screened cable, ranging from single cored to multi-cored, and from single screened to multi-screened. As mentioned before capacitive problems with these types of cables, tends to make the appropriate choice more difficult. As a general guide for the spares box, a few metres each of single core, twin cored and four core should be useful; but this will obviously depend again on the individual requirements.

### Mains Cables

The choice of cable suitable for making external mains connections to equipment is one that requires special attention. Whilst overloading the internal wiring of equipment may lead to the rapid demise of its component parts in a puff of smoke, overloading a mains cable can have consequencies which cannot be overstressed. The wires and cables already mentioned should never be connected to the mains directly; with the possible exception of 16/0.2mm in certain cases, and then only within the equipment itself. To comply with British Standards mains cables must have two separate insulation layers.

Apart from acting as an insulator, it must be capable of withstanding a certain amount of general abuse, and in many cases, the equipment that the cable is fitted to, has a bearing on the type of insulation that is used. For most applications PVC or rubber insulated mains cable of suitable current rating, is probably sufficient, but where there is a possibility of accidental contact with hot appliances, e.g. irons, toasters, fires, etc., it is advisable to use one of the cotton covered heat resistant type.

# EXTERNAL HORN PROGRAMMABLE TIMER

**Continued from page 41**

function, and a positive-going output at pin 1 operates TR4 and relay RLB.

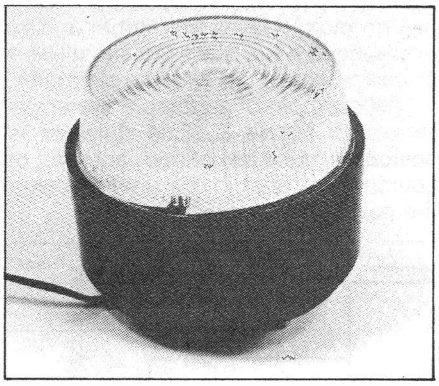
The timing sequence must now be inhibited in this mode, otherwise RLB will switch off and on after each timeout period, and D4 stops this by preventing IC1 pin 8 from changing state. RLB contacts, changing over, will remove the battery supply from the siren and reconnect it to pin 7, hence the beacon will flash until the control loop is restored, either by resetting the main burglar alarm, or by the batteries running down.

| Time Period | Link |
|---|---|
| 2 mins | Link B |
| 2hrs 30mins | Links A & B |
| 17 mins | No Links |

**Table 1: Program Table**

## Assembly

Refer to figure 2 and the parts list for building this project. You may commence construction by bending and inserting resistors R1 to 16 and diodes D1 to 6. Note that D1 is a zener diode, and different from the others. Fit capacitors C1 to 5, you will see that C2 and C5 are polarised, and must be fitted the correct way round. Finally, fit transistors TR1 to 4, and relays RLA and B, both IC holders, and all the Vero pins. Solder all the components into place, clean, and inspect the track for shorts and dry joints. When you are completely satisfied with your handiwork, proceed with testing before putting into use.



## Testing

Preliminary checks can be made with a meter set to resistance range. Measure between pins 3 and 4 (supply rails), there should not be a shortcircuit here. Measure between one of the supply rail pins of LKA or LKB and pin 4, again there should not be a short circuit. Wire the PCB to the burglar alarm as shown in figure 3, and connect to a suitable 12V battery supply. Two 6V lantern type or three 4.5V batteries are recommended for use with the project, because quite high currents can be drawn by bells or sirens.

The beacon listed in the parts list gives a very bright flash once a second, but only draws 50mA, so battery life is extended. It is not necessary to make connection to a siren or lamp at this stage, as both RLA and B give an audible click when operated. Remove the wire from pin 1 and you should hear RLA click on. If you have placed a link in LKB you will have to wait two minutes before RLB clicks on. The next step is to connect both siren and lamp to repeat the tests after remaking the connection to pin 1. Ensure correct polarity of the four connecting wires, red is positive and black negative (figure 3). The system is now ready for use.

## Usage

Fit the timer PCB into your external horn cabinet. If you already have an external horn PCB it must now be discarded as this new system completely replaces the old unit. Two new holes are needed, but the existing spacers, nuts, and bolts can be used for mounting. If you do not possess our external horn cabinet, see parts list for details. Connect the batteries and siren, you will need a length of two-wire cable for connection to the lamp if fitted externally. Connect up to the Burglar Alarm and the system is complete.

# DIGITAL CENTRAL HEATING CONTROLLER

★ **Works with either gas or oil-fired central heating**
★ **Designed to work reliably and without adjustment over long periods of time**
★ **Eliminates wasteful standing losses within the boiler**
★ **Saves you money**

*by Chris Bearman*

Ever rising fuel costs are tending to make most of us seek ways in which to reduce our energy consumption, particularly in the home. Many firms offer us their wares with the promise of lower fuel bills in the future, usually these take the form of some type of insulation, be it draught exclusion, wall and loft insulation or double glazing. One area which has it's fair share of economy suggestions is the central heating system. At present there are thermostatic radiator valves, and zone control valves to name but two.

The digital central heating controller was designed with two basic views in mind. First, to help to make the system more economical, and second, to make the controls more convenient to operate. The controller was designed around a basic gas fired central heating system, but it could work just as well with an oil fired boiler. The controller directly activates two motor valves, a pump and a boiler. The 'primary' water route through the boiler should be pumped to allow the controller to operate correctly. Some types of heating system use what is called a 'gravity primary' which does not require a pump to heat the water in the hot water cylinder. This type of system probably has no motor valves in it either and so would need a few alterations to allow it to work successfully with the controller.

An example of a suitable system is shown in Figure 1. This diagram is obviously much simplified, and can of course be altered in many ways to suit the particular application.

## Circuit description

It can be seen from the circuits (Figures 2, 3 and 4) that there are two sets of control buttons. One set is mounted on the control box (usually near to the pump and motor valves) and the other set is at a convenient remote location. In a two storey house the water cylinder is found upstairs, so the controller would be near to this, the remote control set is probably best mounted in the kitchen.

The remote switches S1-4 activate the LEDs in the opto-coupler D14, hence giving isolation to the logic inputs. Either the outputs of the couplers, or the operation of switches S5-9, act on the inputs of the latches in IC1. These inputs may also be acted on by the operation of the timer circuitry, IC2

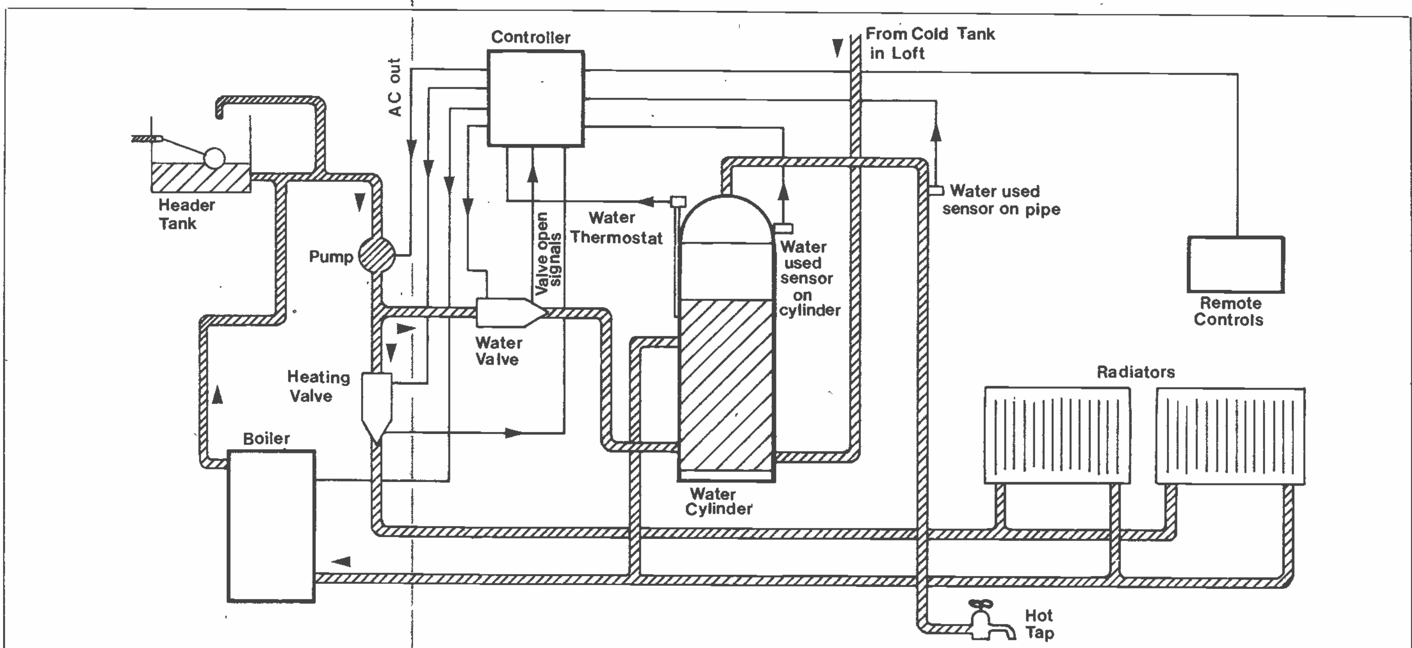



**Figure 1. Outline of a typical heating system.**

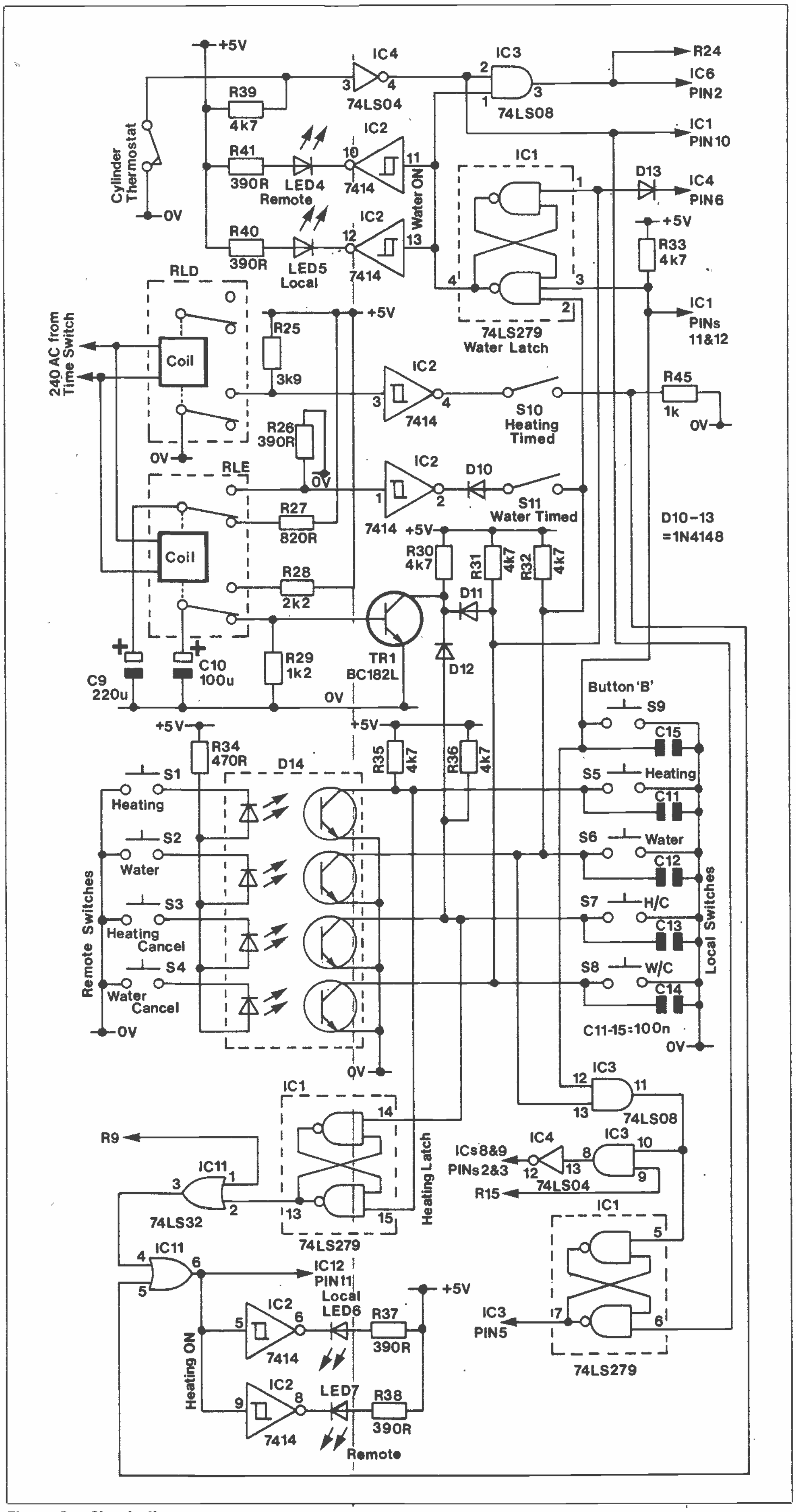
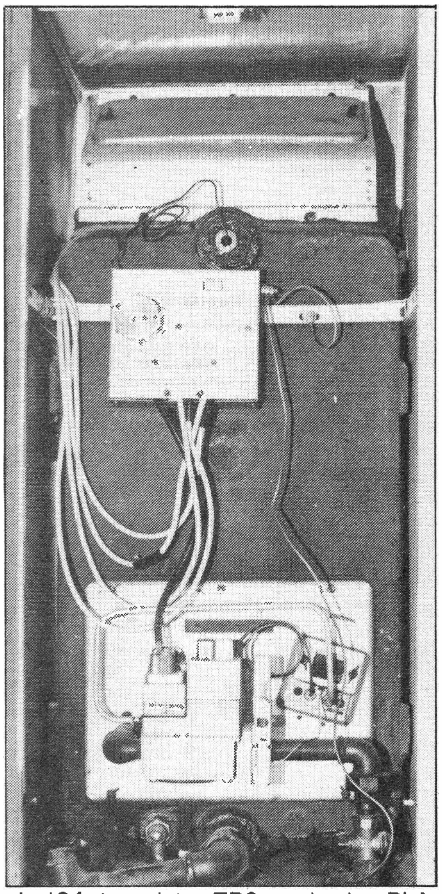



**Figure 2. Circuit diagram.**

and TR1. A standard inexpensive plug-in type timer may be used to operate the A.C. Relays RLD and E, hence allowing timed operation of the water, the heating or both. Switches S10 and S11 enable the circuitry to the latches.

When Pin 2 of water latch IC1 is taken low, the two 'water on' indicators are activated, one on the control box and the other on the remote panel. If the cylinder thermostat shows the water temperature to be below the set level, the output of IC3 will go high, enabling TR4 and so operating the water valve via RLC. Once open, the inbuilt switch in the valve will take pin 11 of IC4 low, enabling input 3 of IC6. Pin 6 of IC6 then activates both the pump and the boiler



via IC4, transistor TR2, and relay RLA.

It can be seen that two thermistor sensors are attached to inputs 12 and 13 of Op Amp IC7. One of these is attached to the hot water pipe leaving the water cylinder, and the other is attached to the cylinder itself. These form the 'Water Used' circuitry. The preset RV1 is adjusted so that when the hot water pipe has cooled down, (in relation to the cylinder) i.e. no hot water has been run off for some time, the output on pin 14 will go high. This disables the reset lines of the counters IC8 and IC9. When the water in the cylinder is up to temperature IC4 pin 4 will go low thus forcing pin 7 of latch IC1 to go high. Clock pulses from the slow clock IC10 will now reach the input of the counter IC8. When no hot water is used for some time, the output of IC7 pin 14 will go high, thus allowing the counters to time out. After a period of about half an hour or so, assuming that the 'water' button is not depressed again, and that no hot water is used, pin 11 of IC9 will go high thus clearing down the water latch IC1; at this point the 'water' indicator will go out.

Heating may be turned on by pressing either of the two 'H' buttons. It may also be set to come on 'timed'. The buttons act upon input Pin 15 of the heating latch IC1 and cause output 13 to go high. This output is taken to Pin 2 of the 'OR' gate IC11. The other input of the 'OR' is from the frost-stat circuitry, IC7.

Both the frost-stat and the room thermostat share the same thermistor, sited to control the temperature of the heating in the house. The output of the thermistor is taken to pins 2 and 6 of the 3403 (IC7). One of the Op-amps is

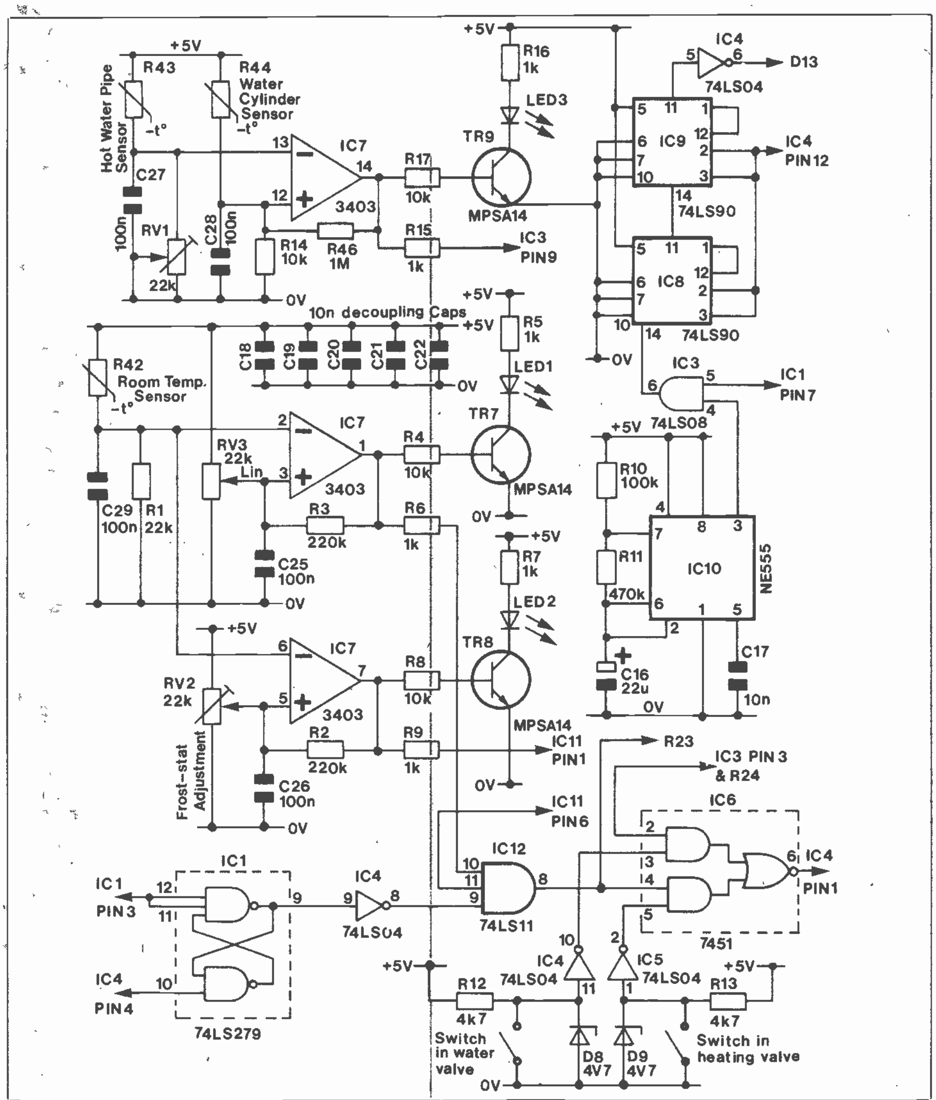



Figure 3. Circuit diagram.

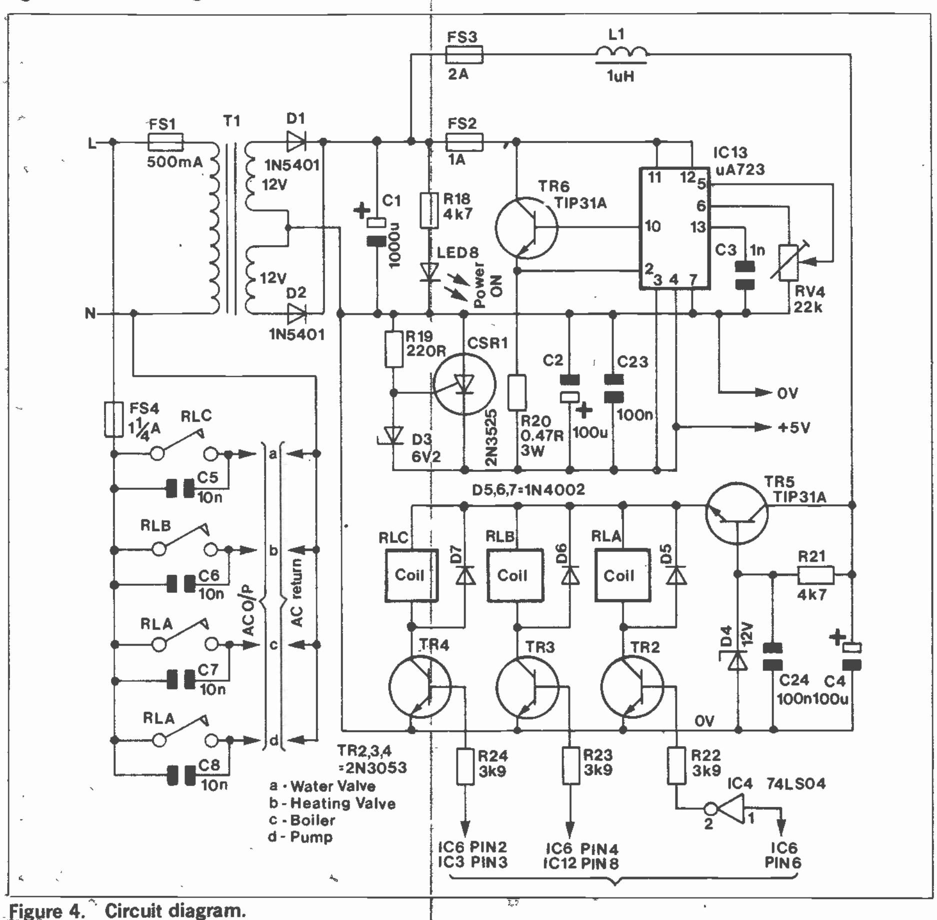



Figure 4. Circuit diagram.

adjusted by an external knob on the control-box (RV3) for the desired room temperature. The other is adjusted by a pre-set (RV2) to the desired lower-level temperature which will activate the heating. It will be noticed that the heating does not have to be on for this to operate, hence the premises may be left unoccupied with no fear of frozen pipes during a cold spell.

The output of the 'heating timed' circuitry is taken to Pin 5 of the next 'OR' gate (IC11) and so to the 74LS11 (IC12), on Pin 11. If the other inputs 10 and 9 are high, the output on Pin 8 will activate the heating motor valve via TR3 and relay RLB. Input 10 of the 74LS11 is taken from Pin 1 IC7 which is acting as the room thermostat. The other input, Pin 9, is fed from the output of latch IC1.

The 'B' button is found only on the control box and is used to give a priority to water heating when the central heating is also being used, for instance when a bath is needed. Switch S9 (B) causes the water latch to operate via Pin 3 of IC1. Pins 11 and 12 of IC1 are also taken low, thus causing the output IC4 pin 8 to go low. This has the effect of shutting down the heating on a temporary basis (as it does when the room-stat is up to temperature). It is restored eventually when the cylinder thermostat reaches the desired temperature, so taking Pin 10 of the latch low and re-activating the heating.

It will be noticed that the system design eliminates 'standing losses' with the boiler, which occur in the majority of central heating systems. This is when the boiler 'short cycles' by itself on it's own thermostat even when no heat is required by the radiators or the hot water.

## System power

The electronics are supplied with the necessary +5 volts from a 723 voltage regulator, IC13, and a series pass transistor TR6. A separate feed is taken off the bridge rectifier to a simple regulator TR5, D4, to give around 12 volts for the operation of the relays. This supply is isolated to a degree by means of the choke L1 and the capacitor C4. The +5 volts is protected from over-voltages by an ordinary cro-bar circuit, D3 and CSR1. Three fuses are used to give protection to the low voltage supplies, these are FS1, FS2 and FS3.

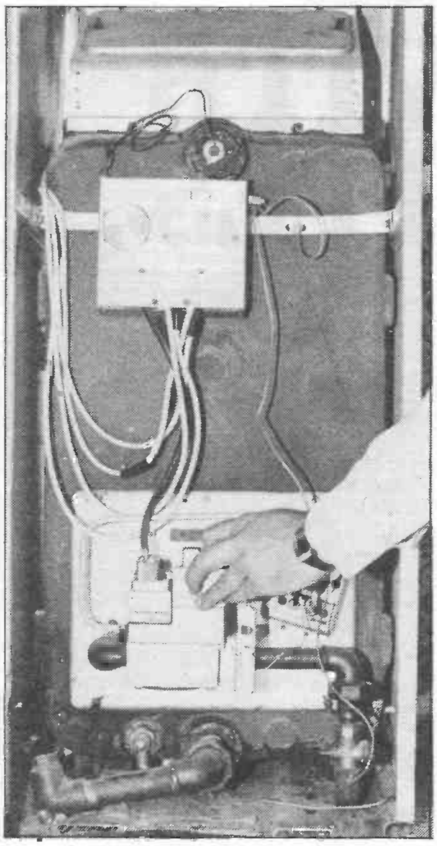
It is preferable to run a separate lead from the mains plug to the relay contacts which supply the voltages to the external devices, this is to reduce the likelihood of mains-originated interference problems. If mains interference poses a serious problem (this all depends on the other devices using the ring main supplying the controller) then the best solution will probably be found in a small mains filter.

When constructing the controller, the logic must be assembled away from the mains transformer and the relays. Transistors TR5 and TR6 must be mounted on adequate heatsinking; TR2, TR3 and TR4, each need only be fitted with a small cooling fin. The cable from the remote controls should not be run alongside of any mains cabling to reduce the possibility of any noise being induced onto the supply rails.

## Setting up

It will be noticed that at various places in the circuitry, indicators have been fitted. These are invaluable for setting up the unit, and are of future use when adjustments to the settings are required.

Before first powering up the unit, the +5V adjustment should be set to it's midway position, along with all of the other pre-sets. Now apply power to the unit and adjust RV4 to give +5 Volts. To calibrate the room thermostat, an ordinary thermometer is required. Set the thermometer up close to where the room thermistor (R42) is mounted, and after allowing ten minutes or so for it to stabilise, note the reading on it. Now turn the room thermostat (RV3) adjustment fully counter-clockwise and note that the room-stat indicator LED 1 is on. (It matters not whether any of the buttons have been pressed). The control should be now rotated clockwise till the indicator goes out. This point on the scale should be marked with the temperature on the thermometer. It will be necessary to turn the heating on (H button) after the thermostat control has been turned up to check for the correct operation of the heating valve, the pump, and the boiler. When the room temperature has risen by a few degrees, it will be possible to add another value onto the thermostat scale using the same method as be-



fore. It should be possible to add further points to the scale by dividing the distance between the two points by the number of degrees rise in the room temperature.

An immersion heater type thermostat may be used to sense the temperature in the water cylinder. It should be firmly attached in an upright position to the top of the hot water cylinder (inside of the insulating jacket) and set to the temperature required by means of the adjusting control at the top. To adjust the 'water used' pre-set RV1, it will be first necessary to bring the water in the cylinder up to temperature by depressing the 'W' button. Check for correct operation of the motor valve, the circuitry and indicators, and when up to temperature note the position of the pre-set RV1 which causes the time out enable indicator LED 3 to extinguish. Run out half a sinkful of hot water and note the new setting of the pre-set. The final position will be somewhere between the two of these marks. Initially set the pre-set two thirds of the way back to the first mark and observe that if no further hot water is used, the indicator comes on after a period of five to fifteen minutes. The longer it takes for the indicator to come on after the last water was used, the longer before the start of the timeout.

The frost-stat is the most difficult to adjust in that the temperature of the thermistor has to be reduced to around five degrees C. The setting may be obtained by adjusting it two thirds of the way down the scale and waiting for the colder weather. Two settings at the lower end of the scale should enable a similar calibration to be carried out as was done with the room-stat.

*Note that a lot of the components have been very conservatively rated, this being felt necessary to ensure that the unit will run cool and reliably as it is likely to be left switched on for very long periods of time.

## CENTRAL HEATING CONTROLLER PARTS LIST

Resistors: All 0.4W 1% metal film unless specified

| | | | |
|---|---|---|---|
| R1 | 22k | | (M22K) |
| R2,3 | 220k | 2 off | (M220K) |
| R4,8,14,17 | 10k | 4 off | (M10K) |
| R5,6,7,9,15,16,45 | 1k | 7 off | (M1K) |
| R10 | 100k | | (M100K) |
| R11 | 470k | | (M470K) |
| R12,13,18,21,30, 31,32,33,35,36, 39 | 4k7 | 11 off | (M4K7) |
| R19 | 220R | | (M220R) |
| R20 | 0.47R (3W wirewound) | | (W0.47) |
| R22,23,24,25 | 3k9 | 4 off | (M3K9) |
| R26,37,38,40,41 | 390R | 5 off | (M390R) |
| R27 | 820R | | (M820R) |
| R28 | 2k2 | | (M2K2) |
| R29 | 1k2 | | (M1K2) |
| R34 | 470R | | (M470R) |
| R42,43,44 | VA1055S Thermistor | 3 off | (FX21X) |
| R46 | 1M | | (M1M) |
| RV1,2,4 | 22k Hor-sub min preset | 3 off | (WR59P) |
| RV3 | 22k lin pot | | (FW03D) |

Capacitors

| | | | |
|---|---|---|---|
| C1 | 1000uF 63V axial electrolytic | | (FB84F) |
| C2,10 | 100uF 25V axial electrolytic | 2 off | (FB49D) |
| C3 | 1nF polycarbonate | | (WW22Y) |
| C4 | 100uF 63V axial electrolytic | | (FB51F) |
| C5,6,7,8 | 10nF suppression cap. | 4 off | (FF53H) |
| C9 | 220uF 16V axial electrolytic | | (FB61R) |
| C11,12,13,14,15, 23,24,25,26,27, 28,29 | 100nF disc ceramic | 12 off | (BX03D) |
| C16 | 22uF 25V axial electrolytic | | (FB30H) |
| C17,18,19,20,21, 22 | 10nF disc ceramic | 6 off | (BX00A) |

Semi-conductors

| | | | |
|---|---|---|---|
| D1,2 | 1N5401 | 2 off | (QL82D) |
| D3 | BXY88C6V2 | | (QH09K) |
| D4 | BXY88C12V | | (QH16S) |
| D5,6,7 | 1N4002 | 3 off | (QL74R) |
| D8,9 | BXY88C4V7 | 2 off | (QH06G) |
| D10,11,12,13 | 1N4148 | 4 off | (QL80B) |
| D14 | Quad Opto-Isolator | | (YY63T) |
| CSR1 | 2N3525 | | (QR25C) |
| TR1 | BC182L | | (QB55K) |
| TR2,3,4 | 2N3053 | 3 off | (QR23A) |
| TR5,6 | TIP31A | 2 off | (QL15R) |
| TR7,8,9 | MPSA14 | 3 off | (QH60Q) |
| L1 | 1uH choke | | (WH29G) |
| IC1 | 74LS279 | | (YH01B) |
| IC2 | 7414 | | (QX46A) |
| IC3 | 74LS08 | | (YF06G) |
| IC4,5 | 74LS04 | 2 off | (YF04E) |
| IC6 | 7451 | | (QX83E) |
| IC7 | 3403 | | (QH51F) |
| IC8,9 | 74LS90 | 2 off | (YF38R) |
| IC10 | NE555V | | (QH66W) |
| IC11 | 74LS32 | | (YF21X) |
| IC12 | 74LS11 | | (YF09K) |
| IC13 | uA723 (14 pin) | | (QL21X) |

Miscellaneous

| | | | |
|---|---|---|---|
| T1 | 12V toroidal | | (YK10L) |
| FS1 | Fuse 500mA anti-surge | | (WR18V) |
| FS2 | Fuse 1A | | (WR03D) |
| FS3 | Fuse 2A | | (WR05F) |
| FS4 | Fuse 1.25A anti-surge | | |
| LED 1-8 inc | LED red | 8 off | (WL27E) |
| RLA,B,C | 5A mains relay | 3 off | (YX98G) |
| RLD,E | 2-pole changeover relay (coil 240V AC) | 2 off | (FX49D) |
| S1-9 inc. | SP make push button switch | 9 off | |
| S10,11 | SP make min toggle/slide switch | 2 off | |

# SAY IT WITH SATELLITES

*by Mike Wharton*

## Part 2

The first part of this series took a broad view of the historical development of the communications satellite. This is an area of rapid change, with new satellites continually being put into orbit, and some old ones coming back down to Earth! Since the beginning of this year, 9 Russian Cosmos and 1 Ekran satellite have been launched from Plesetsk and Baikonur. These include military navigation and surveillance satellites and one direct-broadcast satellite put into a geostationary orbit. The Americans have not been idle either, with an RCA Satcom 4 and a Western Union Westar 4 being launched into a geostationary position from Cape Canaveral. Of the ones that come down, virtually all burn up in the Earth's atmosphere on re-entry, so there is little danger of being hit by falling satellite debris. Such a fate for the satellite is not inevitable, but depends on the altitude and shape of the orbit. If the altitude is much below 500km., then the drag due to the outermost parts of the atmosphere gradually takes effect and the orbit decays, becoming lower and slower, until the satellite finally burns up in the denser parts of the atmosphere. Some satellites have small rocket motors which are used to carry out manoeuvres in space, either to alter the angle of the orbit or adjust the altitude. Usually, any data produced by satellites is beamed back to Earth by radio, but some of the Russian surveillance satellites are able to dump photographic material in re-entry canisters just before they burn up. This method is used by their low flying 'photosats', which often streak across the target area at altitudes as low as 160km. Such orbits decay very quickly and these satellites have to be replaced about every fortnight.

Those satellites placed in a geostationary orbit, 36,000km. out in space, may last for many years before they finally fail; such failures are usually due to faults developing in the satellite because of the extremely harsh conditions of outer space. The satellites are subjected to the full intensity of the sun's rays on one side and the bitter cold of space on the shaded side. In order to even out the temperatures and keep the internal electronics within reasonable limits, the satellite is given a slow spin to spread out the heating effect. Also, reflective metal foil is used to deflect some of the sun's heat, or electrical heaters used to maintain the stability of particularly sensitive parts of the craft. Part of the telemetry from the satellite monitors the various components and the craft may be manoeuvred to ensure a proper temperature balance. Despite these precautions, some satellites still fail due to impact by micro-meteorites. These are small pieces of inter-stellar debris, some no larger than a pin-head, which travel through space at colossal speeds and can punch a hole through the satellite. Especially, vulnerable are the solar arrays, which offer a large target area; if critical parts of these are damaged then the satellite is deprived of

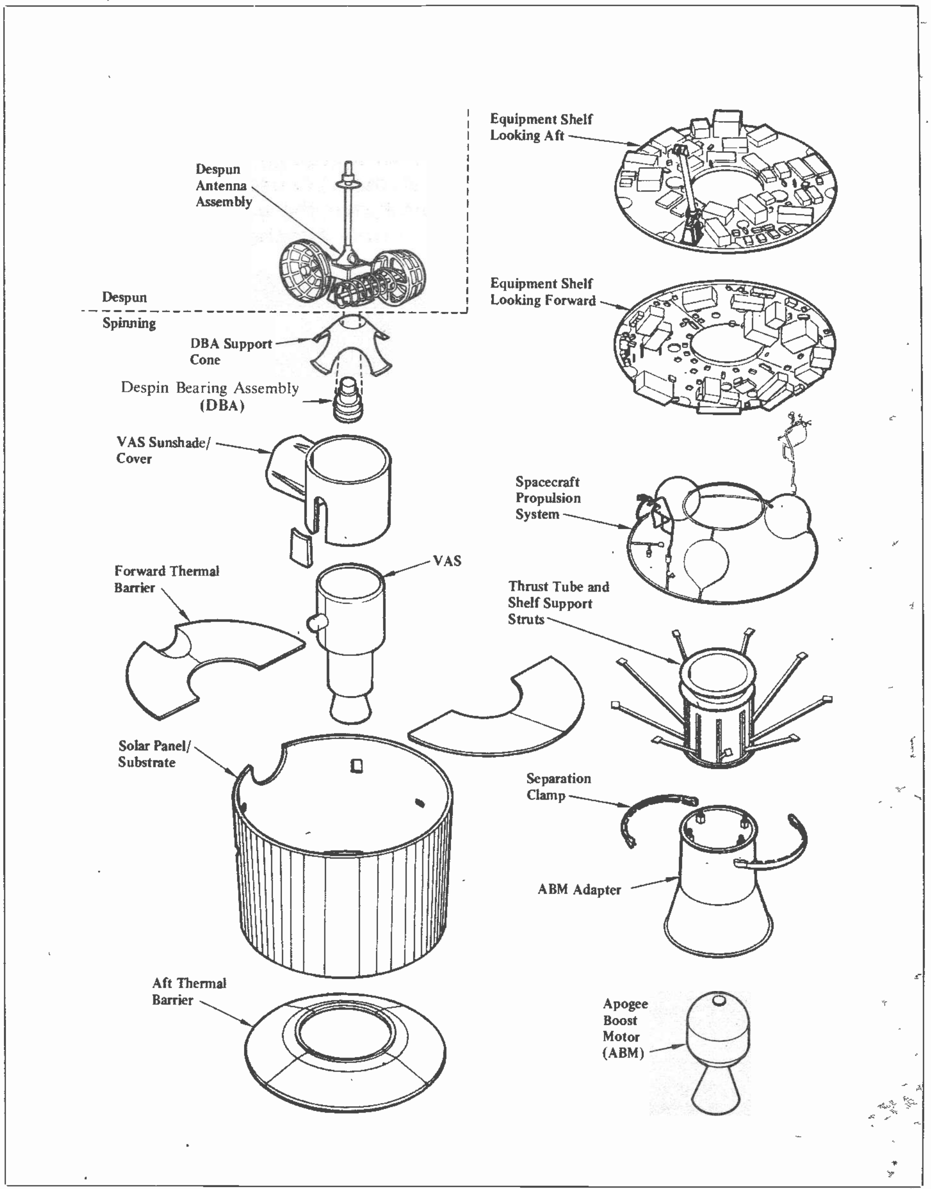



**Figure 1. GOES modular assembly.**

electrical power, and can then only operate until its internal batteries run down.

## GOES weather satellites

The internal construction of a satellite will naturally depend on the job it is intended to do; they range in complexity from that of Echo 1, simply a large balloon launched by NASA for bouncing off radio signals, to those like GOES (Geostationary Operational Environmental Satellite). This satellite is operated by the American National Oceanic and Atmospheric Administration (NOAA). Figure 1 shows the various parts of this particular satellite, which is used mainly for investigations into the physics of the Earth's atmosphere. The most important parts of such a satellite are the imaging sensors, of which GOES carries two, the Visible and Infra-red Spin Scan Radiometer, (VISSR), and the Visible and Infra-red Spin Scan Radiometer Atmospheric Sounder, (VAS), which is a more sophisticated version of the VISSR. The VAS telescope and operation are shown in Figure 2. Imaging is achieved by scanning a focussed spot over the Earth. Light from the surface enters the telescope at right angles to its optical axis via the flat scan mirror, which is provided with an angular positioned stepping mechanism. The scanned pattern, after processing, resembles a conventional TV picture. East-west scan lines are achieved by rotation of the spinning satellite and the lines are moved by the stepped

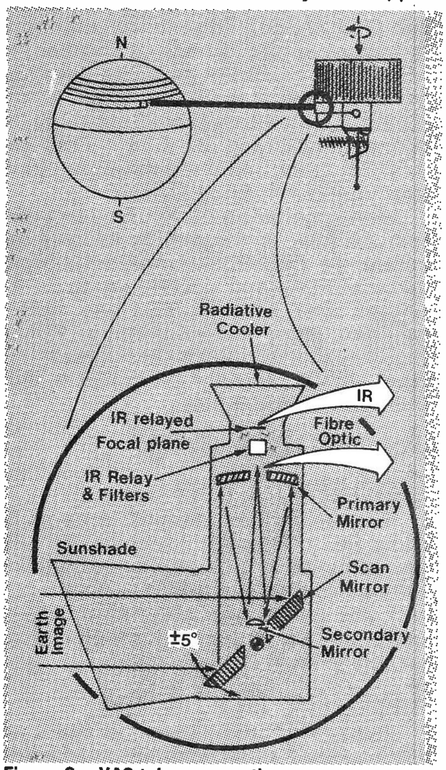
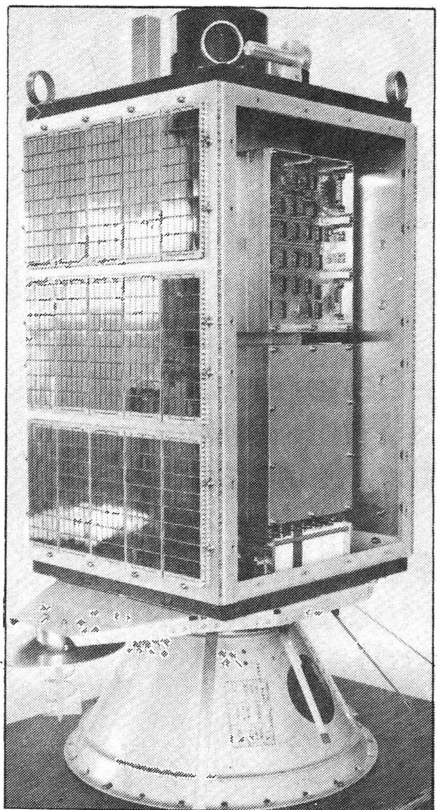



**Figure 2. VAS telescope optics.**

mirror to scan north-south. The data from these sensors can be used for detecting the amount of water vapour in the atmosphere and producing temperature profiles, as well as visible-light and infra-red pictures. All of this information is used by meteorologists to help predict weather patterns and gain some insight into the mechanisms which drive the atmospheric weather machine. One way in which these images are transmitted is as WEFAX, or weather facsimile. By suitably decoding such transmissions it is possible to feed them into a facsimile copier and obtain pictures of the visible field of view. This is by no means a straight-forward task, but there are ways of obtaining a 'satellites-eye-view' of the world which are easier using an Amateur satellite.



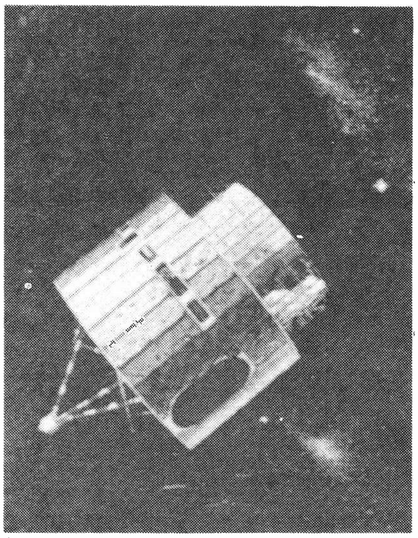
**UOSAT/OSCAR 9**

## TV of the future

The direct-broadcast satellites are rather different in their mode cf operation, being used primarily to re-transmit signals beamed at them from ground stations. They contain a number of devices called transponders, which receive the incoming up-link signal, amplify it, and then re-transmit it back towards Earth, usually on a different frequency. By the use of specially designed transmitting antennae the down-link signal may be directed to a particular area within the satellite's field of view, called the 'footprint'. Although nowhere near as powerful as ground-based broadcast stations, which often have transmitter powers measured in hundreds of kilo-watts, their unique vantage point in space is more than sufficient compensation. The usual problems associated with terrestrial radio communication, such as limited range, obstruction by high ground or buildings, reflections which cause ghosting in TV pictures or interference between the ground wave and the sky wave which introduces multi-path distortion, simply do not exist with satellite reception. Thus it is not necessary to have high-powered transmitters with omni-directional antennae, and there are no areas of weak signal due to hills and valleys. The only disadvantage is that special high frequency receiving dish antennae and tuners are needed, and these are quite expensive at the moment, although with improvements in this area of semi-conductor technology and equipment design they may be expected to become much cheaper. Also, by using a sufficiently high down-link frequency, and 12 GHz is likely for L-sat, the proposed European D-B satellite, a receiving dish of less than a metre diameter may be used. It is likely that an interim solution will be to set up neighbourhood schemes, where one large dish and frequency converter could be used to satisfy a number of normal, domestic TV receivers.

## Amateur satellites

For those interested in becoming involved in satellite communications, possibly the easiest and most rewarding way is through Amateur satellites. Many readers will be aware of the existence of Radio Amateurs, whose activities provide a world-wide service and who operate on nationally and internationally agreed frequency bands. As a group they have been responsible for many advances in the understanding of radio, such as the nature of the propagation of radio waves. One of their latest ventures has been to become involved in producing a number of satellites for Amateur use, and the whole activity from design through to launch has been co-ordinated by AMSAT. This is a group comprised of Radio Amateurs who are interested in satellites and their use in the field of amateur radio communication. Although the organisation originated in America, there is a very well established branch in this country, called AMSAT-UK. The satellites they operate, known as OSCARs, are used to facilitate radio communication between all parts of the world. Although not as complex as commercial satellites, for an amateur group to have put a number of such satellites up aloft is no mean feat. The usual mode of operation is as a transponder, mentioned earlier. Here, though, the frequencies are in the more manageable HF and VHF bands. The up-link is on 145 MHz and the down-link on 29 MHz, and to make the best use of the limited power available transmissions are on SSB (Single Side Band). The Russians, never ones to be left out, launched several of their own amateur satellites at the end of last year.



**GOES weather satellite**

Known simply as R-S satellites, they operate in a similar manner to the OSCARs.

The next article in this series will examine in more detail the operation of the AMSAT OSCARs, particularly OSCAR 9 or UOSAT, which has been produced as the result of a joint venture with the University of Surrey and a number of British companies. Also, methods of predicting the appearance of these satellites from orbital data will be explained and the design of a suitable receiver for OSCAR 9/UOSAT transmissions given.

**Appendix**

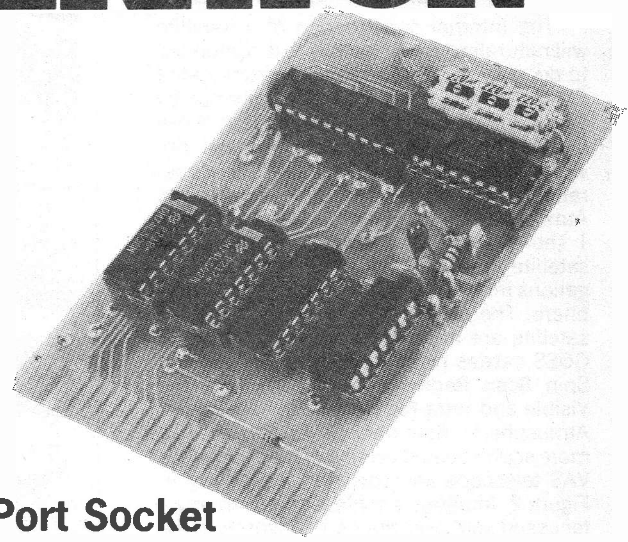
Anyone interested in obtaining more information on AMSAT-UK should write, enclosing a stamped addressed envelope, to:

AMSAT-UK, 94, Herongate Road, Wanstead Park, London, E12 5EQ.

Information on Amateur Radio may be obtained from: The Radio Society of Great Britain, 35, Doughty Street, London, WC1N 2AE.

# SOUND GENERATOR for the ZX 81

*by Dave Goodman*



- ★ **3 Programmable Tone Generators**
- ★ **Noise Generator with 3 Pitch Levels**
- ★ **Separate Attenuators for Noise and Tone Generators**
- ★ **Entry from PEEK and POKE in BASIC**
- ★ **Connects Directly into the Expansion Port Socket (or into the motherboard)**
- ★ **Single Address Access**

This sound generator is a worthy addition to our ZX81 hardware projects. Almost infinite possibilities for sound and noise effects that can be added to your own programs for greater realism.

## Circuit Description

ICs 1, 2, and 3 are connected to the computer address lines A1 to A15. This means that all addresses up to 65534 may be presented, so a decoder is required to examine all lines, but only to respond to a particular address. The address code used here is 16370, which lies between the 16360 and 16380 used in our I/O port project. AØ is not used, so a further address of 16371 exists.

A negative going address decode pulse appears at the output of IC2, and is used to latch data into IC4 and enable IC6. To avoid corruption of data into IC6 the output of IC4 must be latched to the data code before IC6 is enabled.

Buffers IC5a and b delay the enable pulse just enough to allow IC4 to latch before enabling IC6. IC6 pin 4 READY line controls the duration of the WRITE ENABLE (pin 5) and CHIP ENABLE pulse for correct circuit operation, via IC5c. R1 and C1 smoothe the +5V supply, to keep noise spikes down to a minimum, and audio output is taken from IC6 pin 7, via low pass filter R3 and C2, to the output pins 1 and 2. IC5d buffers the 3.22MHz clock, and prevents lengthy track runs from crashing the ZX81.

Most important is D1. You may be aware that because of incomplete address decoding, the ZX81 ROM is repeated between address 8193 and 16383, which is an unused area between ROM and system variables. These addresses can be POKEd providing that the ROM is deselected at that time, and D1 conducts when A13 is high, freeing this area for use.

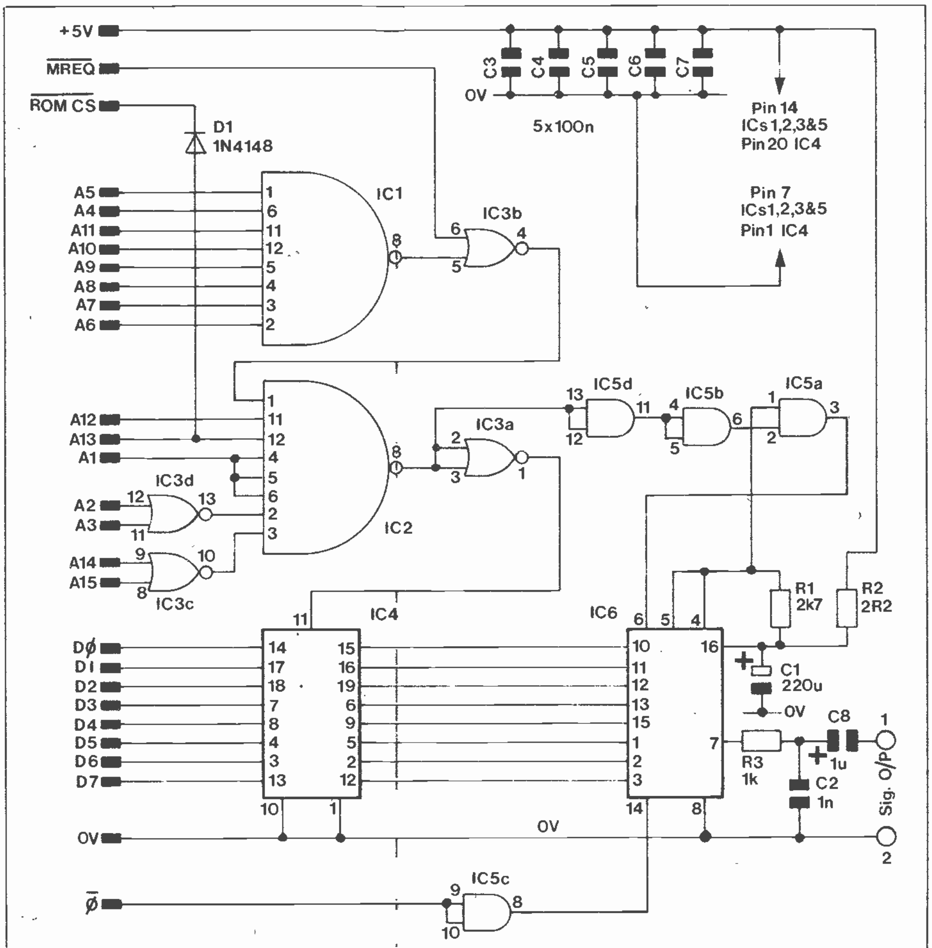


**Figure 1: Circuit diagram**

## Assembly and Construction

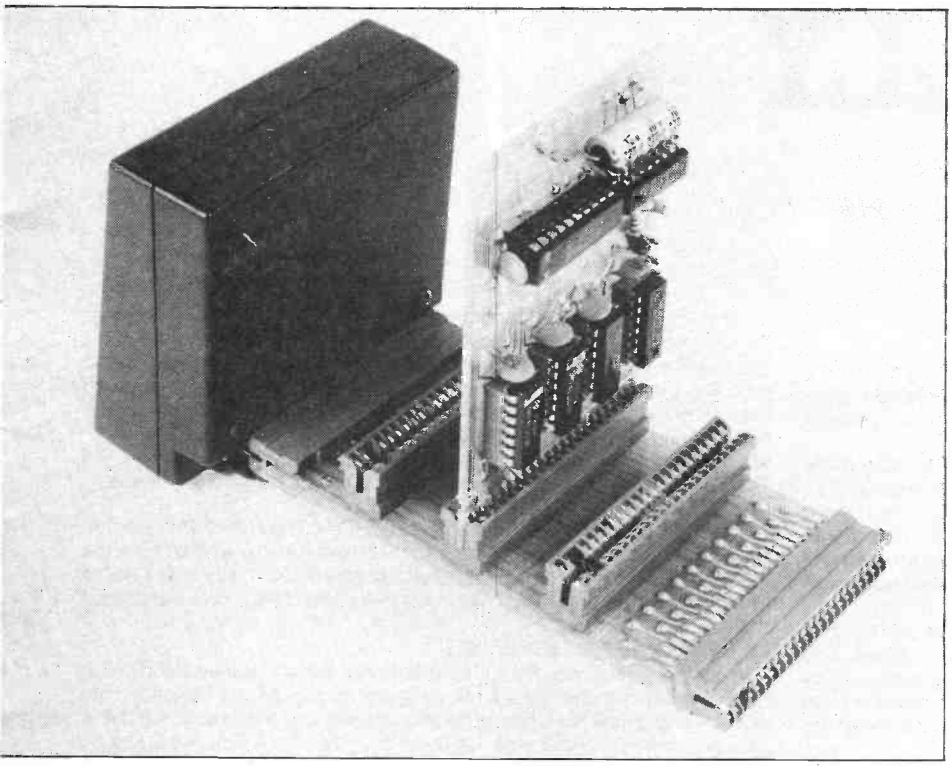
Insert all track pins and both vero pins. Fit all six DIL sockets, R1, 2, and 3 and C2. Fit disc ceramics C3 to C7 and C1 and C8 noting the polarity markings. Insert all ICs the correct way round, then clean the PCB and make the final inspection for short circuits and dry joints.

## Testing and Use

If you do not possess a mother board you will require a 2 x 23 way socket to solder onto the PCB edge connector, otherwise plug into your motherboard. The signal is insufficient to drive a loudspeaker direct, as it is only 300mV in amplitude, so you will need an external amplifier and speaker connected to pins 1 (signal) and 2 (screen). Switch on the ZX81 and a cacophony of noise should be heard. Run the following test program:—

```
10 REM TEST PROGRAM
15 LET A = 16370
20 INPUT B
25 POKE A, B
30 GOTO 10
```

Press RUN then NEWLINE and input the following codes followed by NEWLINE after each code: 159 191 223 255 (you should hear the tones disappearing one by one until all the signals are off) 144 128 64. A low frequency tone of approximately 98Hz (G2)



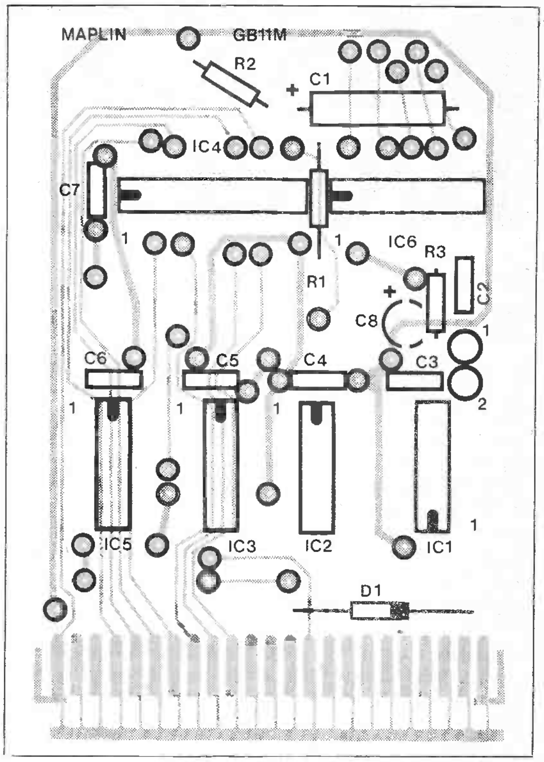



**Figure 2: Overlay and artwork**

| TONE GENERATOR | ACCESS CODE | FREQUENCY RANGE | ATTENUATION CODE |
|---|---|---|---|
| 1 | 128 | 64(G2) to 1(G8) | 144 to 159 (OFF) |
| 2 | 160 | 64(G2) to 1(G8) | 176 to 191 (OFF) |
| 3 | 192 | 64(G2) to 1(G8) | 208 to 223 (OFF) |
| White Noise | 228 | High pitch | 240 to 255 (OFF) |
| White Noise | 229 | Med. pitch | 240 to 255 (OFF) |
| White Noise | 230 | Low pitch | 240 to 255 (OFF) |
| Pulse (spike) | 224 | 480Hz | 240 to 255 (OFF) |
| Pulse (spike) | 225 | 240Hz | 240 to 255 (OFF) |
| Pulse (spike) | 226 | 120Hz | 240 to 255 (OFF) |

should be heard. Any number between 1 and 64 may now be entered and the appropriate tone should be audible. Refer to the following listing for access codes and settings.

To input data into tone generator 1 only, first enter the required volume level from the attenuation codes. The first code given is maximum volume, e.g. Tone generator 1 = 144 and attenuation levels are in 15 x 2dB steps down to 159, which is fully off. Next enter the tone generator access code, which in this example is 128, followed by the required frequency. The frequency range covers 98Hz (G2) up to 6.3kHz (G8) in 64 steps, code 1 being the highest frequency and code 64 being the lowest, so enter 64. The entered codes are now 144, 128, 64, which is tone generator 1 producing an output of 98Hz at full volume. As a Tone Generator access code was entered after the attenuator, the frequency can be changed as desired, but if an attenuator code is now entered, 144 to 159 in this example, the frequency can only be altered by entering the access code, 128, again, and then a frequency code.

Keep in mind that when a register is accessed it will remain 'on line' awaiting further update input codes. Access to Tone Generators 2 and 3 is in the same manner, except that the codes are different. If you enter 144, 128; and 64 to set up a tone in Generator 1, then enter 176, 160 and 32. Two tones will now be heard, with Generator 2 an octave above Generator 1. Entering a frequency code will now only alter Generator 2.

## ZX81 SOUND GENERATOR PARTS LIST

**Resistors: All 0.4W 1% Metal Film**

| | | | |
|---|---|---|---|
| R1 | 2k7 | | (M2K7) |
| R2 | 2R2 | | (M2R2) |
| R3 | 1k | | (M1K) |

**Capacitors**

| | | | |
|---|---|---|---|
| C1 | 220uF 10V axial electrolytic | | (FB60Q) |
| C2 | 1nF ceramic | | (WX68Y) |
| C3-7 inc | 100nF minidisc | | (YR75S) |
| C8 | 1uF35V tantalum | 5 off | (WW60Q) |

**Semiconductors**

| | | | |
|---|---|---|---|
| D1 | 1N4148 | | (QL80B) |
| IC1,2 | 74LS30 | | (YF20W) |
| IC3 | 74LS02 | 2 off | (YF02C) |
| IC4 | 74LS373 | | (YH15R) |
| IC5 | 74LS08 | | (YF06G) |
| IC6 | 76489AN | | (YH33L |

**Miscellaneous**

| | | |
|---|---|---|
| 14 pin dil skt | 4 off | (BL18U) |
| 16 pin dil skt | | (BL19V) |
| 20 pin dil skt | | (HQ77J) |
| Veropin 2141 | | (FL21X) |
| Track pin | 1 pkt | (FL82D) |
| ZX81 Sound Gen. PCB | | (GB11M) |

A complete kit of parts is available for this project. Order As LW96E (Sound Gen. Kit). Price £10.95.

For constructors who may wish to use the Sound Generator in addition to other external hardware, a mother board is available, called the ZX81 Extend board (GB08J) and will accept the Sinclair 16k RAM pack and up to 3 plug-in modules. In addition to the PCB you will require 4 PC Edge Connectors (RK35Q)

Pulse and noise effects require attenuation codes and an access code only. Once the attenuation level has been set noise and pulse codes are entered and are immediately audible.

Tone Generator 3 can be used to control either noise or pulse registers and code 231 followed by 192 allows control of white noise pitch by entering 1 to 64. Similarly, code 227 followed by 192 allows control of a 480Hz pulse tone by entering 1 to 64, and the lowest frequency possible is 6Hz.

Obviously, the best way to understand the system is to use it, therefore a few simple programs are given for assistance, shown at the end of this article. When writing music programs remember that G2 to G8 spans 73 notes and control only covers 64 notes, therefore higher frequency notes tend to become sharper in relation to the lower octaves.

Run these programs in SLOW mode:—

```
10 REM ZMD878DMZ
   MD878DM182.*.2
   8ZMD878DMSMI
   EDFJMZMD878DM
15 LET A = 16370
20 LET B = 16514
25 FOR J = 1 TO 48
30 FOR I = 1 TO 15
35 NEXT I
40 POKE A, (PEEK B)
45 LET B = B+1
50 NEXT J
55 GOTO 10
```

Press break to stop sequence.

```
10 REM GUN SHOT
15 LET A = 16370
20 POKE A, 159
25 POKE A, 191
30 POKE A, 223
35 POKE A, 240
40 POKE A, 23
45 FOR J = 240 TO 255
50 POKE A, J
55 NEXT J
60 INPUT E$
65 GOTO 10
```

After RUN press NEWLINE to fire.

```
 10 REM PHOTON BLAST
 15 LET A = 16370
 20 POKE A, 159
 25 POKE A, 191
 30 POKE A, 223
 35 POKE A, 148
 40 POKE A, 240
 45 POKE A, 231
 50 POKE A, 192
 55 FOR J = TO 30 STEP 2
 60 POKE A, J
 65 POKE A, 128
 70 POKE A, J
 75 POKE A, 192
 80 NEXT J
 85 POKE A, 159
 90 POKE A, 228
 95 POKE A, 247
100 INPUT C$
110 GOTO 10
```

Press NEWLINE to fire. To remove background hiss, delete line 90 and change line 95 to POKE A, 255.

# BASICALLY BASIC

*Graham Hall, B.Sc.*

**Part 14**

## Files

BASIC has three methods of supplying data to a program:

1. The INPUT statement — the user interacts with the computer while the program is running. Each time the program is run new data is requested and is input from the terminal.
2. The READ, DATA and RESTORE statements — the READ statement directs the program to read from a list of values built into a data block by a DATA statement. In terms of program execution time, it is much more efficient to use READ and DATA statements than INPUT statements because the user does not have to interact with the program when it is run. The RESTORE statement enables the same data to be used more than once during the execution of the program.
3. The file statements — data can be accessed from or written to a uniquely named file which is separate from the main program. The computer system stores a file on peripheral devices such as disks or magnetic tapes. As the file is stored under its own name separate from the program which created it, different programs can use the file name to make that file's data available.

The use of the INPUT, READ, DATA and RESTORE statements has already been described. Now the BASIC statements used to create a file, place data into it, and make it available to a program are described. Since files are externally stored and program independent, their configuration and characteristics such as size and data access depend on the computer system and peripheral device that you use. For these reasons the description to follow will be general and serves only as an introductory explanation. For a specific and more complete description refer to your systems user guide.

Most personal computer systems use 'sequential files'. These files are usually terminal — format files in which the contents consist of a collection of ASCII characters stored in lines of various lengths exactly as they would appear on the terminal. A sequential file is one in which the data assigned to the file is arranged one item after another from the beginning of the file. To retrieve an item from the file all items preceding it must be retrieved first. Some systems also allow virtual array files and record files to be created but these will not be described here.

All versions of BASIC have statements to:

i) create a new file and to assign it a unique name,
ii) place data into a file (writing to a file),
iii) access data from a file (reading a file),
iv) close a file which has previously been opened by a program.

These will now be described.

## Creating and Opening a File

The OPEN statement enables a new file, or an existing file, to be opened and associated with a file number which establishes a communication channel between the program and the file. Some versions of BASIC only allow one file at once to be used by a program so it is not required to associate a file number since this will be a system default.

Usually the OPEN statement performs several functions which include naming the file, designating the operations to be performed and opening a communication channel. An example of this would be:

```
10 OPEN "string" {FOR INPUT  } AS FILE # expression
                 {FOR OUTPUT }
```

The OPEN "string" component of this statement either references a file which already exists, in which case the file name enclosed within quotation marks is used to locate the file or names a new file. The file name is a string of alpha-numeric characters enclosed within quotation marks. Usually it must be less than a certain maximum number of characters depending on the system being used. It could also be a string variable.

The FOR INPUT or FOR OUTPUT component of the open statement is optional — one or neither of these portions can be used. When the FOR INPUT option is used BASIC opens the file specified as the file name and allows the data it contains to be used by the program. An error message is returned and displayed on the terminal if BASIC tries to open a file which does not exist. The FOR OUTPUT option creates a new file and allows the program to write data to it. If neither is specified BASIC searches for a file with the name specified in "string". If the file is found it is opened; otherwise a new file assigned to that name is created.

The AS FILE # expression portion of the OPEN statement associates the file and the program with a common communication channel. This enables the file, which is stored on a peripheral device, to be associated with the current program which is in the computer's main memory area. The location associated with the file name is called a channel number and is specified in the expression part of the AS FILE # portion. This location can then be accessed by the program.

The following examples show how the OPEN statement is used:

20 OPEN "SUBJECT" FOR INPUT AS FILE # 1

This statement opens the file named SUBJECT. The FOR INPUT portion shows that the file already exists and that the data is to be read from the file. The AS FILE # portion establishes communication channel 1 as the link between the program in main memory and the file on a peripheral device.

20 OPEN "INFORM" AS FILE # 3

This statement causes BASIC to search for the file named INFORM. If the file exists it is opened and the program can access its data; if the file is not found a new file is created and assigned to the file name INFORM. The program can then write data to this file. The file is accessed by channel number 3.

10 OPEN "RESULTS" FOR OUTPUT AS FILE # 2

This statement creates a new file which is assigned to the file name RESULTS. The FOR OUTPUT portion of the statement notifies BASIC that this is a new file to which data can be written. The AS FILE # 2 portion of the OPEN statement establishes communication channel 2 as the link between the program in main memory and the file on a peripheral device.

Some versions of BASIC have different OPEN statements to open a file for reading and to open a file for writing. For example, to open a file to accept data the statement could be WOPEN (write open) but to open a file to retrieve data the statement could be ROPEN (read open). This depends on the system you are using and will be explained in the user's guide for your system.

## Closing a File

All files opened by a program should be closed before the program terminates execution. Unless they are closed the file may become 'corrupt', that is some of the contents may be spuriously altered or destroyed. The CLOSE statement is used to close a file and dissociate it from a communication channel. After a file has been closed it cannot be accessed until it has been re-opened.

The general format of the CLOSE statement is:

line number CLOSE ([ ] expression list)

where expression list may be one file number or a list of opened file numbers separated by commas. The part of the CLOSE statement shown within square brackets is usually optional. If no expressions are specified all files opened by the program are closed.

The following examples illustrate the use of the CLOSE statement:

```
10 CLOSE # 1:REM CLOSE FILE ASSOCIATED WITH CHANNEL 1
20 X=3
30 CLOSE 2,X,3+2:REM CLOSE FILES 2,3&5
40 CLOSE:REM CLOSE ALL FILES
```

## Writing to a File

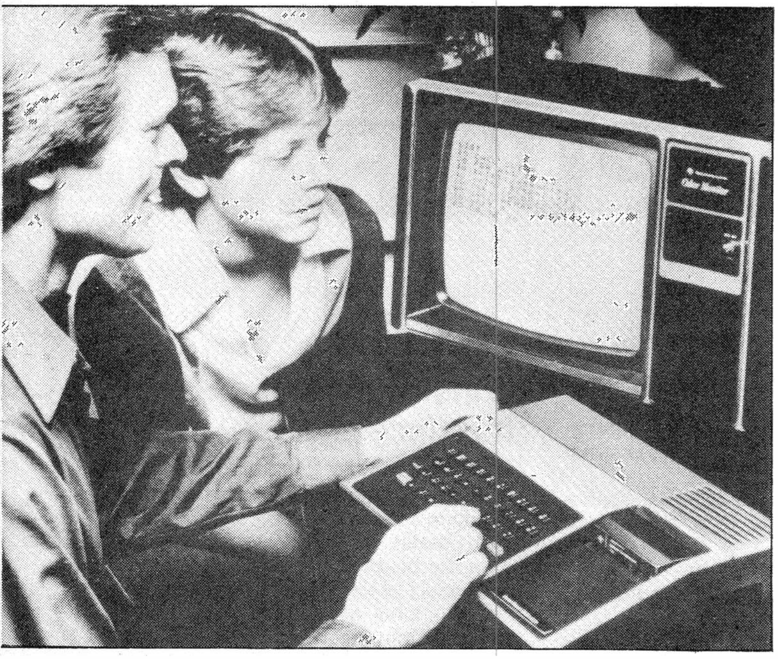
To write data to the terminal the BASIC PRINT statement is used. The PRINT statement can also be used to write data to a file. The general format is:

PRINT (#) channel number, list

where channel number can be the communication channel number associated with a file that has been opened with the OPEN statement or zero. If zero is specified the output is to the terminal. The # character preceding the channel number is usually optional. List can be any numeric or string expression or a numeric or string variable. Each item in the list must be separated with a comma or a semicolon. Also the first item in the list must be separated from the channel number by a comma.

The following short program opens a file called EXAMPLE for output and then writes the string "FIRST LINE OF FILE EXAMPLE" to the file when the program is executed.

```
10 OPEN "EXAMPLE" FOR OUTPUT AS FILE # 1
20 PRINT # 1, "FIRST LINE OF FILE EXAMPLE"
30 CLOSE # 1
40 END
```



The same result would be achieved by assigning the string to a string variable and then printing the string variable, i.e. line 2Ø could be substituted with the lines:

```
15 LET M$ = "FIRST LINE OF FILE EXAMPLE"
2Ø PRINT # 1, M$
```

The next section shows how this data can be retrieved from the file.

## Reading from a File

To input data to a program from the terminal the BASIC INPUT statement is used. The INPUT statement can also be used to retrieve data from a file to use as input to the program. The general format is:

INPUT (#) channel number, list

where channel can be the communication channel number associated with a file previously opened using the OPEN statement, or zero. If zero is specified the input is from the terminal as for the program INPUT statement.

List can be a single string or numeric variable or a list of variables separated by commas. Also the first item in the list must be separated from the channel number by a comma. The '#' character preceding the channel number is usually optional.

The INPUT # statement line that retrieves data from a file must duplicate the format of the PRINT # statement that wrote the data. Also the type of variable used to store the retrieved data must correspond to the type of data item being retrieved. When the INPUT # statement is to request more than one data item, the data must have been written to the file separated by a string constant comma. This is because the INPUT # statement reads data in the file in the same manner as a program INPUT statement (where the data following a DATA statement is separated by commas). For example, the statement which writes the integers 1 and 2 and the string "THREE" to the file assigned to channel number 1 is:

```
1Ø PRINT # 1, 1, ",", 2, ",", "THREE"
```

The program line retrieving this data would be:

```
2Ø INPUT # 1, A, B, Z$
```

When this statement is executed the first data item retrieved from the file is assigned to the variable A, the next to variable B and finally the string is assigned to the string variable Z$. These variables can then be used in other BASIC statements to perform any desired operation on the data within the program.

The following programs demonstrate how data can be written to and retrieved from a file using BASIC file statements.

```
1Ø REM FILE EUROTEMPS TO BE WRITTEN TO
2Ø OPEN "EUROTEMPS" FOR OUTPUT AS FILE # 1
3Ø READ P$, C, F
4Ø IF P$ = "" THEN GOTO 13Ø
5Ø PRINT # 1, P$; ","; C; ","; F
6Ø GOTO 3Ø
7Ø DATA "LONDON", 18.7, 65.7
8Ø DATA "AMSTERDAM", 21.Ø, 69.8
9Ø DATA "EDINBURGH", 17.8, 64.Ø
1ØØ DATA "PARIS", 22.8, 73.Ø
11Ø DATA "MUNICH", 22.8, 73.Ø
12Ø DATA "", Ø, Ø
13Ø PRINT # 1, P$; ","; C; ","; F
14Ø CLOSE # 1
15Ø END

RUN
```

The program consists of the following lines:

Line 1Ø — The REM statement serves only as a comment. The characters after REM are ignored.

Line 2Ø — The OPEN FOR OUTPUT statement creates a new file and assigns it the name "EUROTEMPS". The AS FILE # 1 portion establishes communication channel number 1 as the link between the program in main memory and the file on a peripheral device.

Lines 3Ø, 7Ø to 12Ø — The READ statement on line 5Ø is associated with the DATA statements on lines 7Ø to 12Ø. When it is executed the READ statement assigns data from the DATA statements to the variables P$, C and F. Each data line is a string followed by two numeric constants.

Lines 4Ø, 12Ø — The end of the data is signalled by a null string followed by two zeros. The IF THEN statement tests the string assigned to P$ to see if it is null. If the condition is true the program control is directed to the CLOSE statement on line 14Ø which closes the file. Some versions of BASIC have file statements which test whether the end of the file has been reached. If this facility was available on your system it would not be necessary to set up a dummy data item to signify the end of file.

Line 5Ø — The PRINT # statement writes the variables P$, C and F to the file associated with channel 1. The data is written to the file separated by string constant commas. This is to enable the data to be retrieved using the INPUT # statement.

Line 6Ø — The GOTO statement repeats lines 3Ø, 4Ø and 5Ø to write all the data contained in the DATA statements to the file.

Line 13Ø — The PRINT # statement writes the null string and zeros to the file.

Line 14Ø — The CLOSE statement closes the file EUROTEMPS and disassociates it from communication channel 1.

Line 15Ø — The END statement signifies program completion.

To write the data to the file EUROTEMPS the program must be executed by typing RUN. After program execution is complete the data contained in the file EUROTEMPS can be made available to any BASIC program.

A program to retrieve the data contained in the file EUROTEMPS is:

```
1Ø REM DATA TO BE RETRIEVED FROM FILE EUROTEMPS AND
   DISPLAYED ON THE TERMINAL
2Ø OPEN "EUROTEMPS" FOR INPUT AS FILE # 1
3Ø INPUT # 1, C$, C, F
4Ø IF C$ = "" THEN GOTO 7Ø
5Ø PRINT C$, C, F
6Ø GOTO 3Ø
7Ø CLOSE # 1
8Ø END

RUN

LONDON       18.7    65.7
AMSTERDAM    21.Ø    69.8
EDINBURGH    17.8    64.Ø
PARIS        22.8    73.Ø
MUNICH       22.8    73.Ø
```

The program consists of the following lines:

Line 1Ø — The REM statement serves only as a comment.

Line 2Ø — The OPEN statement causes BASIC to locate the file EUROTEMPS on the peripheral storge device. The FOR INPUT portion of the statement shows that the file already exists and that the data it contains is to be retrieved. AS FILE # 1 associates the file with communication channel number 1.

Line 3Ø — The INPUT # statement reads the data items from the file and stores them in variables. This duplicates the format of the PRINT # statement on line 5Ø of the program that created the file. That is, the variables match in type and number, and a comma separates the data items in the file. If this was not the case, BASIC would display an error message when the program is executed.

Line 4Ø — The IF THEN statement tests for the end of the file. The last data line written to the file consisted of a null string followed by two zeros. When a null string is retrieved from the file the condition is satisfied and the program is directed to the CLOSE statement on line 7Ø.

Line 5Ø — The PRINT statement outputs the contents of the file as stored in the variables C$, C and F to the terminal. The variables are separated by commas so each argument is output to its own field. The output from the program is shown after the RUN command.

Line 6Ø — The GOTO statement repeats lines 3Ø, 4Ø and 5Ø until all of the data are read.

Line 7Ø — The CLOSE statement closes the file EUROTEMPS and disassociates it from communication channel number 1.

Line 8Ø — The END statement signifies program completion.

BASIC programs are also stored in files. The BASIC commands to store and retrieve programs in files from a peripheral device (the SAVE and LOAD, or OLD commands) have been described previously. There are also BASIC commands to delete files which are no longer required.

# INTERFACING MICROCOMPUTERS

## *Using Parallel Input/Output Ports*

*by Roy Waters BSc., MSc., C.Eng., FIEE.*

## The Function of Parallel Interface Adapters

### Introduction

This article deals with how to interface projects to a microcomputer and to program the complete system.

There are two modes of transmission of data between computers and peripherals (external equipment), *serial* and *parallel*. Inside the computer all data transfers are in parallel mode, that is each bit of each data word is assigned a separate line. Serial data transfer, where only one wire is used and the data bits are transferred one after the other is used principally along telephone lines and in other situations where relatively long distances are involved.

For our present purpose we shall consider *parallel* data transfers; the more usual and convenient way of connecting equipment to computer. However, it is still necessary to interpose special circuitry between external equipment and the computer data bus (i.e. the data lines, usually eight in a small computer). See Figure 1.

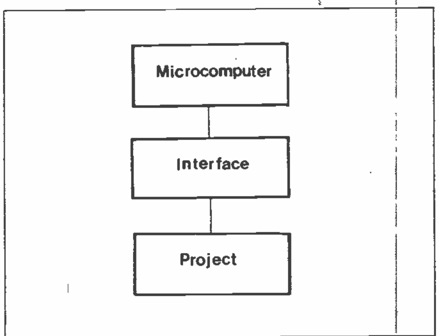



**Figure 1. An Interface is necessary between computer and project.**

### The Need for an Interface Adapter

Data messages from a computer data bus only last for the order of 1us, also data messages to a computer are only allowed to last for about 1us on the data bus otherwise the system would probably crash.

The functions of the interface device are therefore:

a. to capture the data from the computer in a register and retransmit it to the external circuitry "at leisure"
b. to hold data from the external source ready for the computer to "snatch it" very quickly
c. to perform these operations only when instructed to do so by the computer program.

See Figure 2.

### Interface systems

The interface system, Figure 3, will comprise connections to the computer address and data buses and a few control lines. It will provide two 8-bit sets of input/output lines to connect to external equipment.

Most of the work is done by a single IC package. Such packages (or "chips") are appropriately called Peripheral Interface Adapters (PIA), Parallel Input Output (PIO) or Versatile Interface Adapters (VIA), the latter includes timers and serial I/O facilities also which we shall not need to deal with at present.

A few additional logic gates are required to enable the user to choose an address which will not conflict with other operations on his particular computer.

Most current micro computers use micro processors and support devices in the 6800, 6500 or Z-80 families. All of these families have interface packages, but generally speaking they are interchangeable i.e. they will work with other micro processors, but pin-outs and programming will vary.

The following are a selection of such interface adapters. The numbers suggest the families from which they derive: 6820, 6821, Z-80 PIO, 6520, 6522 and 8154. The INS 8154 is related to the 8060 SC/MP but is frequently used with other micro processor systems.

These devices are all similar in principle of operation and use. The 6821 will be considered in particular as it is comparatively easy to understand and use.

## Construction of an Interface System

### Connections to the Computer

Some microcomputers already have an interface adapter fitted (or a socket for one) with parallel Input/Output ports available from the board edge. If your computer has this facility you may like to skip the following constructional details and concentrate on the programming in the next section. However, that which follows will assist greatly in the understanding of interface adapters even if your computer has a different one from the type specifically dealt with here.

If your computer does *not* have an interface facility which is readily accessible, read on. You will learn how to construct your own interface system so that your computer may be connected and used with your own projects. Note, however, that your computer must provide the following:

1. Access to the Address Bus, the Data Bus and certain control lines (i.e. all these lines must be brought out to the board edge or to a socket to facilitate connection.)
2. A wiring or board layout diagram or clear markings on the board identifying clearly the connections.
3. A memory map.

If you are proposing to purchase a microcomputer make certain that the one you choose *either* has these facilities *or* already has an Interface Adapter (or socket for one) on board. At this stage you may not think of connecting your own circuits to the computer, proposing to use it only for programming, games, calculations or business accounts. However, if you dabble in electronics at all you will soon want to involve your computer, when you realise its potential in this context. Connecting your own circuitry is really quite simple and there is no fear of damaging the computer if appropriate instructions are followed.

### Address Decoding

Interface Adapters are accessed via the

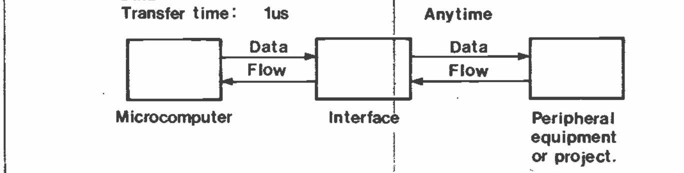



**Figure 2. The data transfer rate is modified by the interface.**

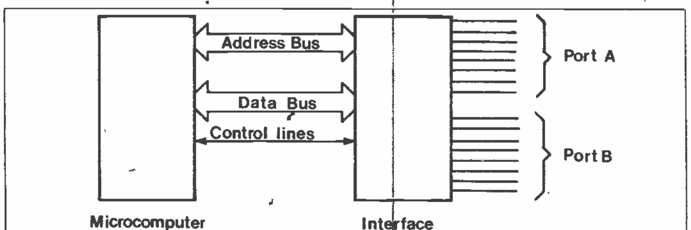



**Figure 3. The interface provides *two* 8-bit data lines for input or output of data.**

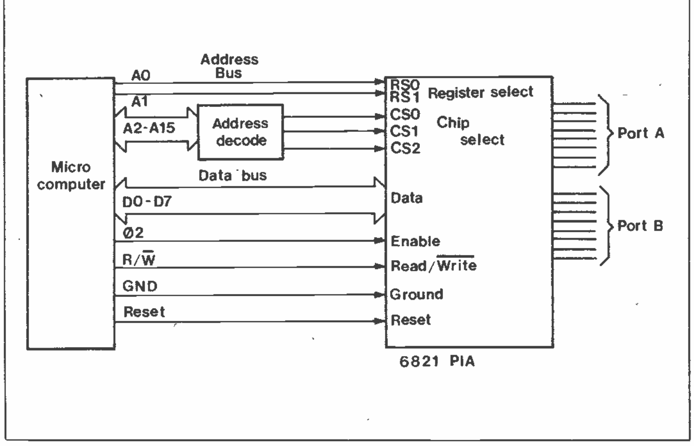



**Figure 4. Essential connections between microcomputer and interface adapter.**

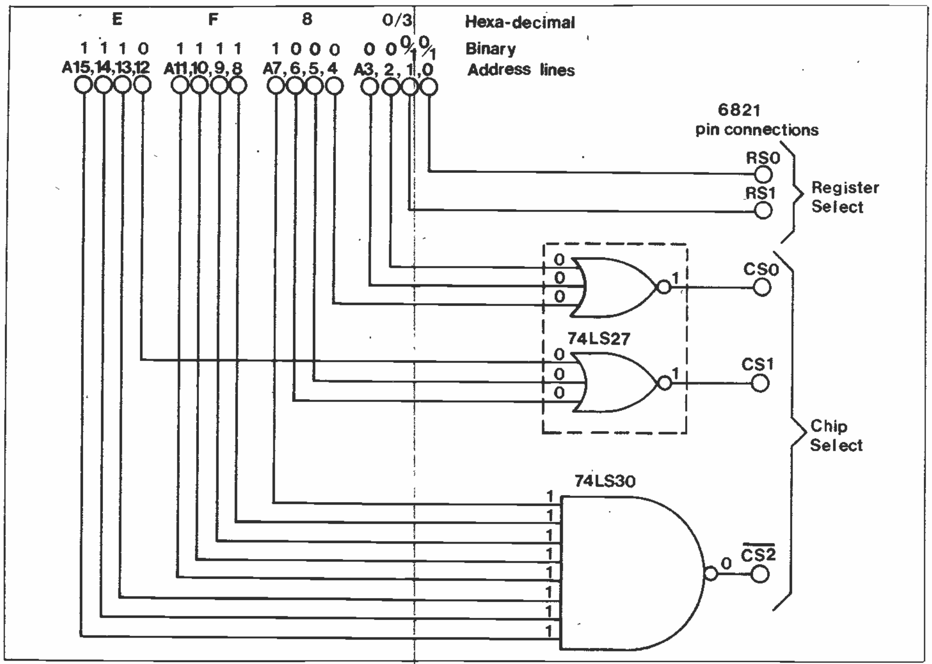



Figure 5. Address decoding.

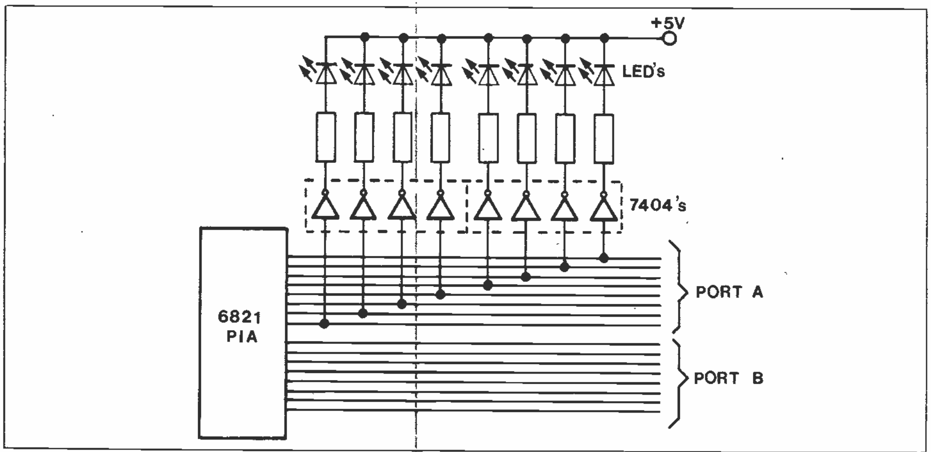



Figure 6. Optional output display.

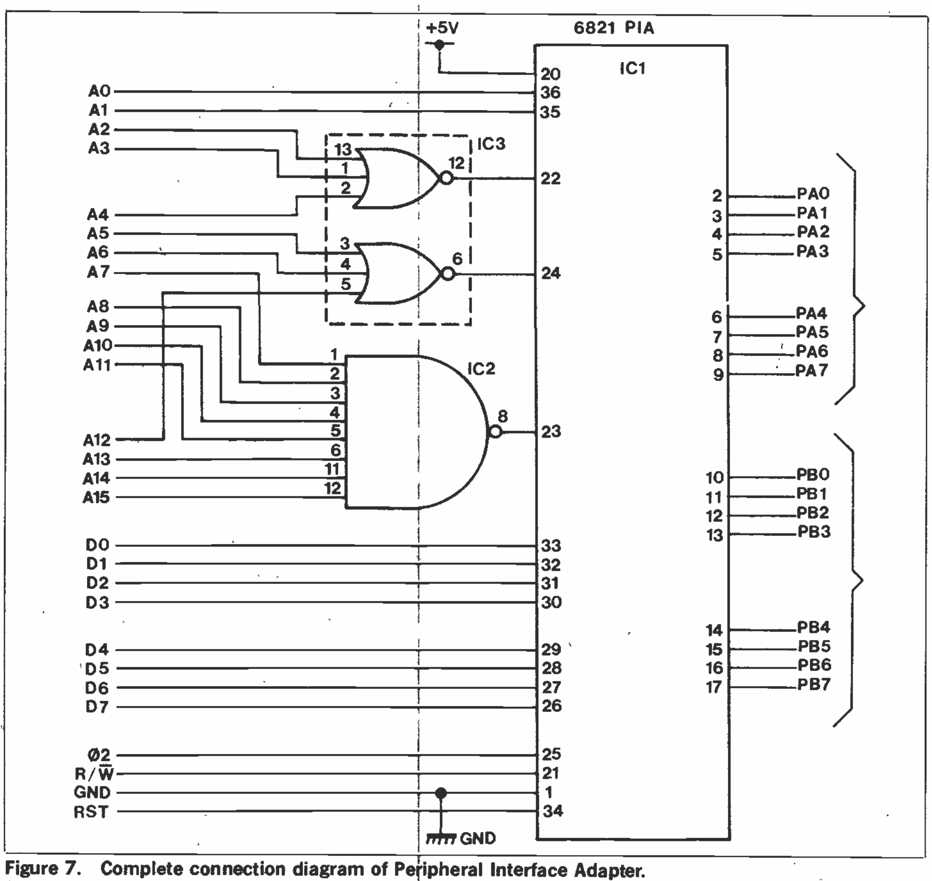



Figure 7. Complete connection diagram of Peripheral Interface Adapter.

Address Bus like RAM or ROM memory and are allocated one or more specific addresses. The address bus lines are therefore connected either directly to the Interface Adapter or through an address decoder.

As indicated in Figure 4 all connections are made directly from the microcomputer to the 6821 PIA except for the address lines. Most of the address lines are decoded externally, using TTL logic gates. These should be from the LS range to minimise bus loading.

One possible arrangement is indicated in Figure 5. To minimise the number of address decoder IC chips to two, utilising all three Chip Select pins on the PIA, a good choice is:
1-74LS30 8-input NAND
1-74LS27 Triple 3-input NOR.

Using the NAND gate and two of the 3-input NOR gates provides for 14 address line inputs, eight of which must be High and six Low to enable the 6821 PIA.

The combination shown in Figure 5 gives the PIA addresses as EF80, EF81, EF82 and EF83 (four addresses are necessary to program this PIA, as we shall see later).

With these suggested TTL IC's, any address combination may be used which results in eight address lines being High (1) and six Low (0). A few examples are indicated in Table 1. From this Table note the following:

1. In each example the two least significant digits are XX, because they are always connected, not to the decoder gates, but directly to the PIA pins RS0 and RS1. The next two address lines, A2 and A3 are always designated 0, so that when programming the PIA the least significant four bits will always be 0000, 0001, 0010, 0011 in binary, that is 0, 1, 2, 3 in hexadecimal.
2. The total of 1's is always 8.
3. The total of 0's is always 6.

| | | | | |
|---|---|---|---|---|
| Hexadecimal: | E | F | 8 | 0/3 |
| Binary: | 1110 | 1111 | 0100 | 00XX |
| or | E | F | 4 | 0/3 |
| | 1110 | 1111 | 0010 | 00XX |
| or | C | C | F | 0/3 |
| | 1100 | 1100 | 1111 | 00XX |
| or | C | E | E | 0/3 |
| | 1100 | 1110 | 1110 | 00XX |

Table 1. Some alternative address combinations.

## Memory Map

Which address decode combination should be used? Before sticking a pin in to decide this, you must study carefully the memory map of your computer. This will almost certainly be designated in hexadecimal and will indicate the "areas" of address memory already allocated for specific functions, e.g. RAM user memory, operating system in ROM, display, etc. You must choose an address within an empty area. As almost all microprocessors used in small microcomputers have 16 address lines giving 65,536 discrete addresses there should be plenty of available addresses from which to choose.

In addition to the Address and Data bus line connections and a common Ground it will be noted that R/W and Ø2 connections are made to the PIA. The R/W Read, not Write signal indicates to the PIA whether the computer wishes to read from or write to the PIA. Ø2, the Phase Two clock signal is the timing strobe to ensure that data transfers only take place after the correct address signals have been set up and docoded.

## The Input/Output Ports

Each individual bit pin of the two 8-bit Ports can be programmed as either an input or an output by the computer program.

These I/O Ports are all TTL compatible, that is to say they may be connected directly to drive TTL logic gates or be driven by TTL devices. For our present purpose it is sufficient to generalise and say that each Port pin may either be fed from a standard TTL gate or feed one standard TTL gate input (not necessarily 'LS' series TTL).

Since it is comparatively easy to drive any electrical circuitry from TTL and to feed any signals into TTL it follows that the computer can drive or be driven from any electrical circuitry, via the PIA.

More will be said about connections to the Ports in following articles on projects using them. However, for the present purpose of developing and testing the system and learning how to program it, it is very useful to be able to read the state of each Port line. This may be done by connecting LED's as indicated in Figure 6. The input of any standard TTL device may be connected to a Port pin and the output will sink enough current to illuminate a LED adequately using a resistor of between 270 and 330R. If TTL Hex. Inverters are used, a LED will be ON when a logic 1 (High) signal is present on the corresponding Port pin.

For test purposes, when checking Ports as inputs the pins may be connected to Ground or +5V for logic 0 or 1 respectively.

## Power Supply

A +5V stabilised supply must be fed to the 6821 PIA and the two decoder TTL gate chips. The total current requirement will be about 110mA. There may well be enough reserve in your computer power supply. However, if indicator LED's also have to be supplied from this source a further 12mA per LED must be taken into account. In this case you are advised to connect 100nF capacitors directly across the 6821 and TTL decoder supply pins, and really it is advisable to do this anyway.

A separate stabilised power supply unit may be used and may well supply any project that is interfaced to the computer as well. There is no problem here, but remember to common the Ground of this supply to that of the computer, but do NOT connect the two +5V lines.

## Circuit Diagram

The circuit shown in Figure 7 assumes the PIA address to be EF80/EF83. Remember the Address line connections may be changed to obtain different addresses.

# Board Layout I
# 6821 PIA Only

The board, Figure 8, accommodates the circuit of Figure 7 providing two 8-bit parallel output ports.

A reset button has been included as there might be difficulty locating the computer reset connection. It will be found more convenient not to common the computer and interface RESET lines, since either may then be reset without the other. For testing and many circuit operations it may be found unnecessary to use the manual reset on the interface. The software routine of initialising the ports virtually does this. However, it may be useful as a safety stop button, particularly if the interface is driving motors or servo-systems.

The Veroboard layout has been designed for ease and minimum construction work, and will only take an hour or two to put together. It is suggested that IC sockets be

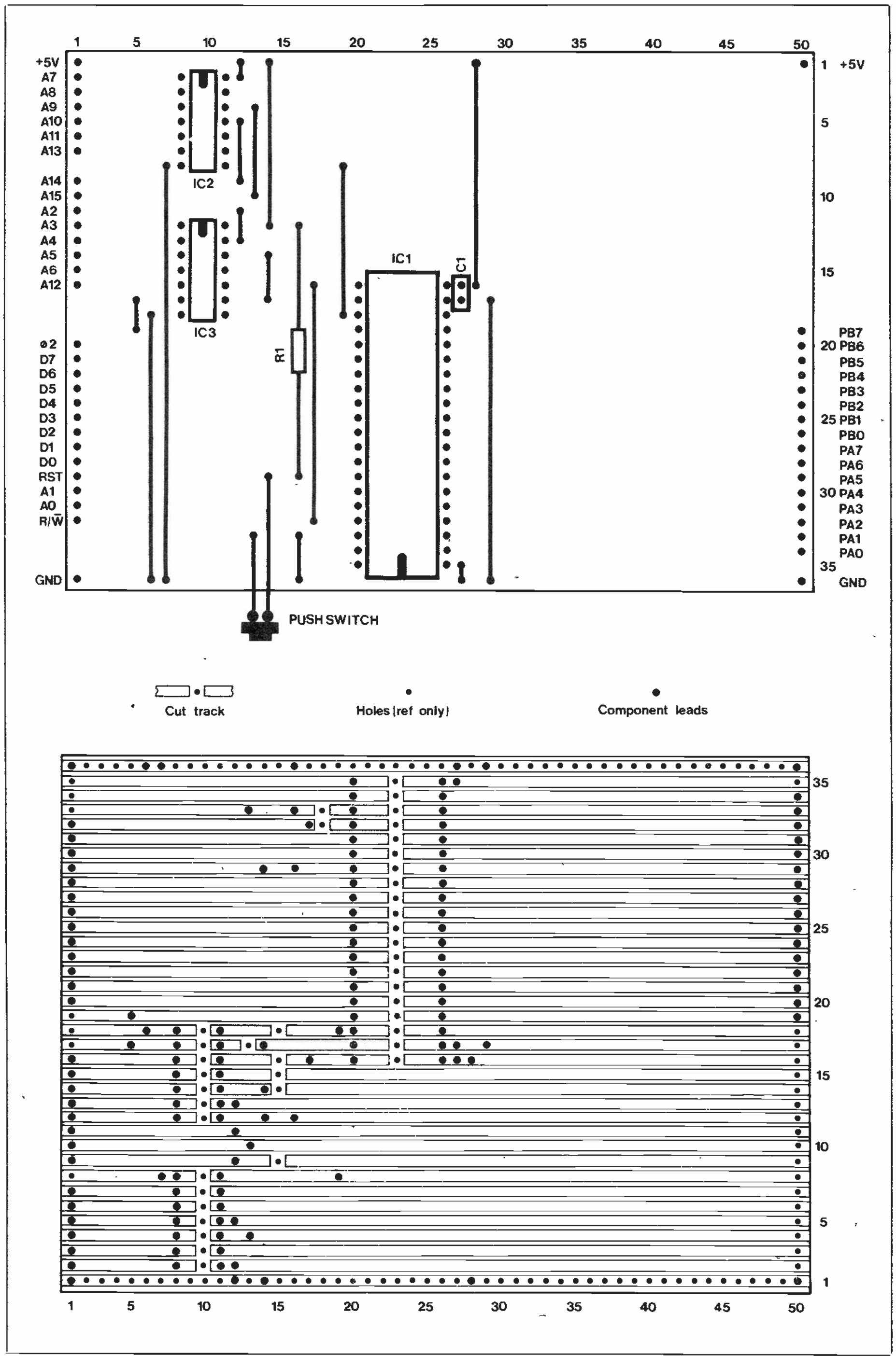



**Figure 8. Veroboard layout for 6821 only.**

used. These do not object to excessive soldering heat and should you have a fault on an IC it is easily replaced. Certainly use a socket for the PIA package which is relatively expensive and also remember to take the usual static precautions (earth yourself whilst handling).

IMPORTANT NOTE. Observe that the 6821 is mounted "upside-down", i.e. with the identifying mark and pin 1 near the Ground line. The other IC's are mounted with the identifying mark towards the top of the board, i.e. nearer to the 5V rail of the board. The reason for this is so that the 6821 inputs are now on the left and the outputs on the right. The address decoders are mounted so that address lines connect conveniently from the left also.

For ease of construction all vertical connections may be made with uninsulated tinned copper 24 swg wire.

The components have been kept to the left of the board so that, if the larger Veroboard is used (see parts list) there is room to add other circuits to the right, for example LED indicators.

Connections to the Veroboard. The quickest and most convenient connections are made using 0.1in. pitch edge connectors plugged into the board edge. 1/0.6 single strand wire can usually be plugged straight into sockets on a computer board for test purposes. Ribbon cable to a plug which will marry to the computer connector is advisable as a long term arrangement.

# Board Layout II
# 6821 PIA and LED Indicators

LED's can be temporarily connected to the Ports via 7404's as buffers with the aid of a socket breadboard.

As a more permanent feature, it is very useful if a lot of development work is to be done, to connect the LED's on to the PIA interface board as shown in Figure 6.

The advantages are:

1. A visual indication of the state of the Ports.
2. Additional Buffered Outputs (B00 through B07) capable of sinking 6mA per

output with the LED's or 16mA if the LED's are disconnected (48mA if 7416's are used).

3. A visual indication of the input signals to the Port, assuming the input circuit can sink the 1.6mA required by the 7404's.

For board and LED economy only eight LED's are shown. By making the vertical connections to the Port lines via Veropins with insulated hook-up wire, it is an easy soldering job to swap between Port A and Port B as the need arises.

**PARTS LIST**
**Interface only**

| | | | |
|---|---|---|---|
| R1 | 4k7 | | M4K7 |
| C1 | 100n | | YR75S |
| IC1 | 6821 | | WQ46A |
| IC2 | 74LS30 | | YF20W |
| IC3 | 74LS27 | | YF18U |
| DIL socket | 40 pin | | HQ38R |
| DIL socket | 14 pin | 2 off | BL18U |
| Vero 10347 | | | FL09K |

or a smaller board if no extra circuits are to be used on board: FL10L (Vero 10348)

**Additional items for the indicators**

| | | | |
|---|---|---|---|
| R2 thru R9 | 300R | 8 off | S300R |
| D1 thru D8 | | 8 off | WL32K |
| IC4,5 7404 | | 2 off | QX40T |
| 2141 | | | FL21X |

# Programming Interface Adapters

## Simplified Functional Diagram

The simplest use of all Interface Adapters for parallel port input/output operations consists of programming the computer to place data on the port lines or read data from the port lines. Most of these devices have additional facilities which are useful but more complex to use. In the interests of simplicity we shall omit these facilities at present.

The simplified functional diagram, Figure 10 is relevant to all parallel I/O adapters as far as their simplest mode of operation is concerned.

The least significant 2, 3 or 4 address lines go straight to the adapter, allowing 4, 8 or 16 discrete addresses to be allocated to programming and using the adapter. Higher order address lines go via the external address decoder to the Chip Select pins. It will have been noted from Figure 4 that the 6821 has only two address pins, allowing four addresses only. These addresses and the data sent to them are decoded by the PIA and fed to four Registers on the right of Figure 10.

Each 8-bit Data Direction Register, DDRA and DDRB (for Ports A and B) determines whether each corresponding bit in the 8-bit Data Registers DRA and DRB shall be an input or an output.

0 defines as an input
1 defines as an output

**Example:** If DDRA is loaded with 15 (decimal), that is OF (hex) or 0000 1111 (binary) then —

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DDRA: | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| DRA: | PA7 | PA6 | PA5 | PA4 | PA3 | PA2 | PA1 | PA0 |

←— inputs —→ ←— outputs —→

The process of defining the Data Direction is referred to as initialisation of the adapter.

The process of initialisation and writing data to a port is precisely the same as writing data to a specified memory location. Similarly reading data from a port is the same as reading data from a specified memory location.

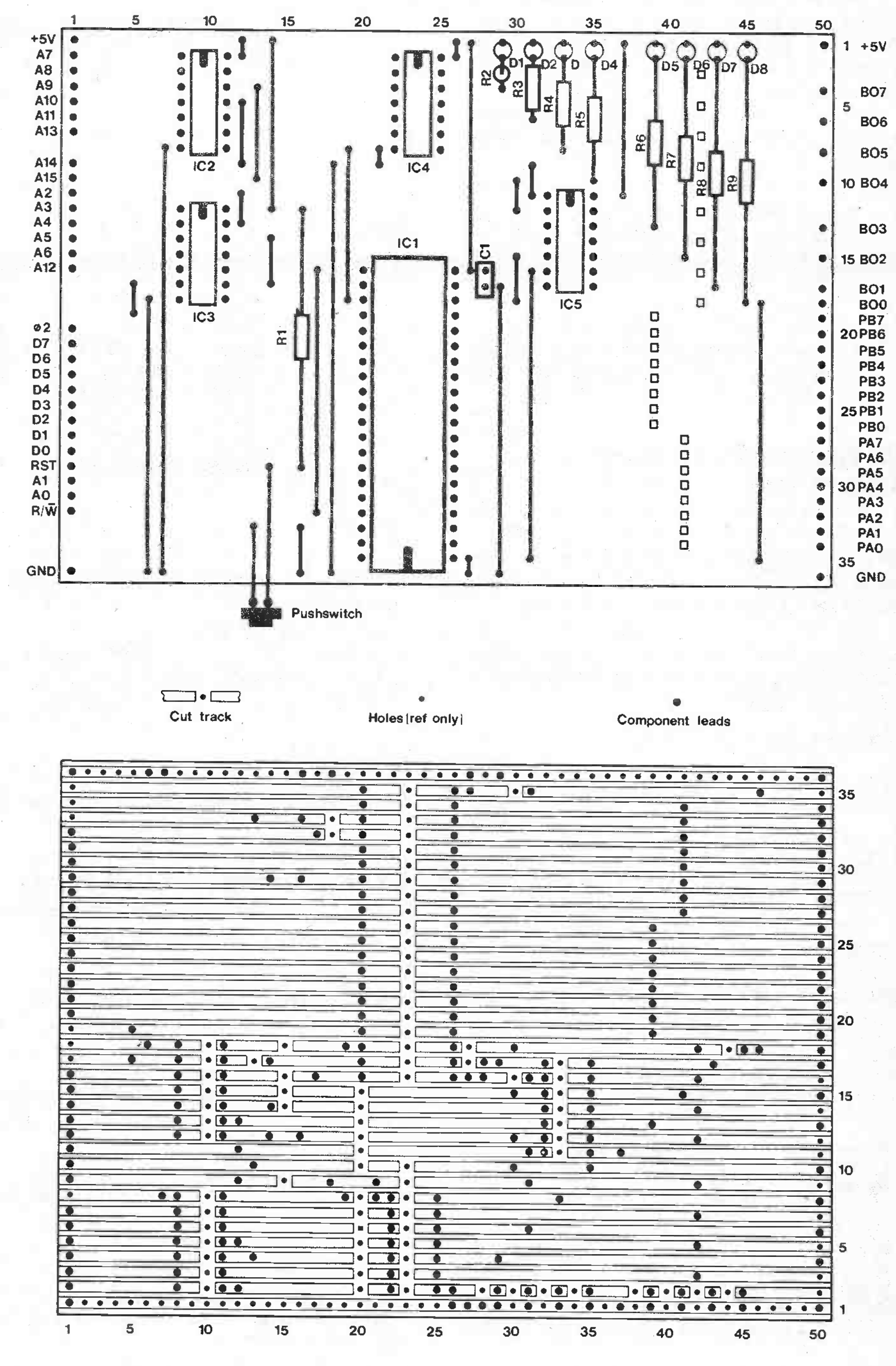



**Figure 9. Veroboard layout for 6821 with LED indicators.**

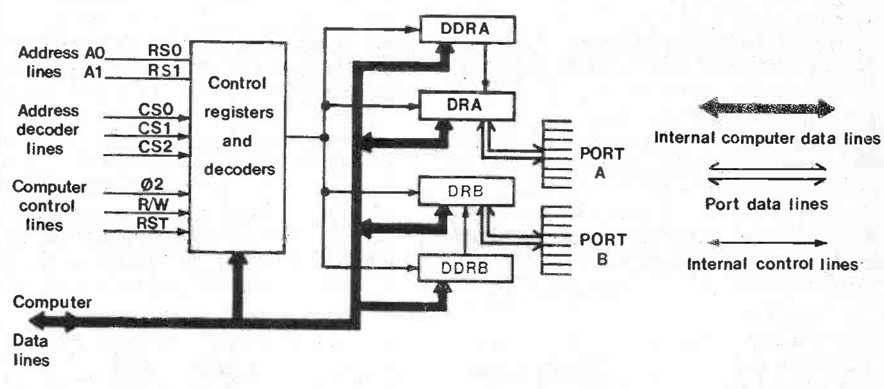



**Figure 10. Simplified functional diagram of the Peripheral Interface Adapter.**


**References**

"Microcomputer Components" — Motorola Inc 1979.
"Superboard II Users Manual" — Ohio Scientific Inc.
R6500 Hardware Manual
R6500 Software Manual — Rockwell International.
Microcomputer Components — Motorola.

The computer may be programmed to perform these functions in machine code, Assembly Language or in a High Level Language (usually BASIC in the case of microcomputers).

It is, of course, much easier to program in BASIC. However, the BASIC interpreter MUST:

Either have the POKE and PEEK instructions to enable specified address locations to be accessed (some microprocessors use symbols instead of the words Poke and Peek but the effect is the same).

Or have BASIC statements enabling the user to write subroutines in machine code in order to access specified addresses.

## To Program Port A as all Output lines

The following assumes that the address decoder has been connected for addresses EF80/EF83. If some other address has been wired this must be used, but note the least significant character will be the same.

For Port A to be all outputs the following locations must be addressed and loaded with data as follows, and in the sequence shown in Table 2.

**Example** Suppose in the table that nn=A6 (Hex)
This is 1010 0110 (binary).
Then a High (nominal 5V) signal would appear on pins PA7, PA5, PA2 and PA1.
A Low signal would appear on pins PA6, PA4, PA3, PA0.

Once the first three lines in the above programming sequence have been run to initialise the Port, the operation of loading Port A with data:

| Location | Data |
|---|---|
| EF80 | nn |

may be repeated for different values of nn, giving different output patterns.

## Programming the PIA in 6502 Machine Code

If your computer uses a 6502 microprocessor, you are using PIA addresses EF80/EF83 and you can use Page 4 (04) of memory for your programs, then the program shown in Table 3, will load the output binary pattern 1101 0011 (D3 in hex) on to the Port A pins.

## Programming in BASIC

Using BASIC all Hexadecimal numbers must be converted to decimal numbers first, unless your version of BASIC allows direct usage of Hexadecimal numbers (some do).

The following BASIC program will load the output binary pattern 1101 0011 (D3 hex.) on to the Port A pins.

EF80 (hex.)=61312 (decimal)
D3 (hex.)=211 (decimal)
FF (hex.)=255 (decimal)

(Note that some BASIC interpreters use symbols instead of the words POKE and PEEK, in which case the following program will need to be modified.)

```
                    Remarks
30 A=61312
40 B=A+1
50 POKE B,Ø         EF81=0
60 POKE A,255       EF80=FF
70 POKE B,255       EF81=FF
80 POKE A,211       EF80=D3
90 END
```

A good check that all port lines are working correctly is to connect LED's to all lines and write a BASIC program to count and output data to the Port from 0 to 255.

| Location (Hex) | Contents (Hex) | Remarks |
|---|---|---|
| EF81 | 0 | Next instruction to DDRA |
| EF80 | FF | DDRA loaded 1111 1111 1111 1111 |
| EF81 | FF | Next instruction to DRA |
| EF80 | nn | Loads the binary pattern equivalent to nn on to Port A pins. |

Table 2

| Location | Contents | Mnemonic | Data | Comments |
|---|---|---|---|---|
| 0400 | A9,0 | LDA | IMM 0 | |
| 0402 | 8D,81,EF | STA | Abs | EF81=0 |
| 0405 | A9,FF | LDA | Imm FF | |
| 0407 | 8D,80,EF | STA | Abs | EF80=FF |
| 040A | 8D,81,EF | STA | Abs | EF81=FF |
| 040D | A9,D3 | LDA | Imm D3 | |
| 040F | 8D,80,EF | STA | Abs | EF80=D3 |

Table 3

This can follow the above program thus:

```
 8Ø INPUT T
 9Ø FOR X=Ø TO 255
1ØØ POKE A,X          Write X to Port A
11Ø FOR Y=1 to T
12Ø NEXT Y            Time Delay,
                      function of T
13Ø NEXT X
14Ø END
```

Try out the program with T=200. Alter the value of T to obtain a count speed slow enough to observe each count.

## To Program Port A as all Inputs

To do this the Data Direction Register A (DDRA) must be loaded with all zeros.

| Location (Hex) | Contents (Hex) | Remarks |
|---|---|---|
| EF81 | 0 | Next instruction to DDRA |
| EF80 | 0 | DDRA loaded with 0000 0000 0000 0000 |
| EF81 | FF | Next instruction to DRA |
| EF80 | — | Read from this location |

The following BASIC program will read the binary pattern of signals connected to Port A and print out the decimal equivalent. (With some versions of BASIC the program can be modified to print-out in hexadecimal, making it easier to check the binary equivalent.)

```
                    Remarks
2Ø A=61312
3Ø B=A+1
4Ø POKE B, Ø        EF81=0
5Ø POKE A, Ø        EF80=0
6Ø POKE B,255       EF81=FF
7Ø M=PEEK (A)       Read EF80
8Ø PRINT M
9Ø END
```

Before running this program connect the Port A output pins as follows:—
PA0,1,2,4 to 5V.
PA3,5,6,7 to Ground
giving a binary pattern of 0001 0111 (17 (hex.) 23 (decimal))
After RUN the printout should be 23.
Check with other input patterns.
In the above program replace the last line with 9Ø GOTO 7Ø
then as you change the connections the new output will appear on the screen.

## Summary of Programming Instructions for the 6821 PIA

In Table 4 XXX represents the first three hexadecimal characters of the PIA address. If this has been wired as EF80/3 then XXX=EF8.

## Mix of Inputs and Outputs

To find the correct data to load into the Data Direction Register proceed as follows:

1. Decide which Port lines are to be inputs and which outputs.
2. Tabulate thus:—

| | | | | |
|---|---|---|---|---|
| Port bit: | 7 | 6 | 5 | 4 |
| Input or Output: | in | out | in | in |
| Corresponding DDR: | 0 | 1 | 0 | 0 |
| Hex. Equivalent: | 4 | | | |
| Port bit: | 3 | 2 | 1 | 0 |
| Input or Output: | out | out | in | in |
| Corresponding DDR: | 1 | 1 | 0 | 0 |
| Hex. Equivalent: (for example) | C | | | |

**Note** For INPUT load 0
For OUTPUT load 1

Therefore, in this example instead of loading FF or 0, 4C must be loaded at the appropriate instruction.

| | | Address | Data | Remarks | |
|---|---|---|---|---|---|
| **Port A.** | | XXX1 | 0 | Next instruction to DDRA | Initialise Port A. |
| | Either | XXX0 | FF | All lines outputs | |
| | or | XXX0 | 0 | All lines inputs | |
| | | XXX1 | FF | Next instruction to DRA | |
| | Either | XXX0 | nn | Write data nn to Port A | |
| | or | XXX0 | — | Read data from Port A | |
| **Port B.** | | XXX3 | 0 | Next instruction to DDRB | Initialise Port B. |
| | Either | XXX2 | FF | All lines outputs | |
| | or | XXX2 | 0 | All lines inputs | |
| | | XXX3 | FF | Next instruction to DRB | |
| | Either | XXX2 | nn | Write data nn to Port B | |
| | or | XXX2 | — | Read data from Port B | |

Table 4

To initialise Port B for the above input/output pattern load the following:—

XXX3 0 Next instruction DDRB
XXX2 4C Defines inputs/outputs
XXX3 FF Next instruction DRB
XXX2 To access Port B

It is advisable to use Port B for mixing inputs and outputs. This Port has Tri-state buffers, so connections to the lines designated as outputs will not affect input readings. However, it is not very likely that lines designated as outputs will acquire a voltage of any significance from external sources so if it is necessary for BOTH Port A and Port B to have a mix of I/O there should be no trouble.

## BASIC Program to Read/Write Port B

Suppose the following is required:—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Port B Bit: | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Designation: | Inputs | | | | Outputs | | | |
| DDRB: | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Port to output: | | | | | 0 | 0 | 1 | 1 |

DDRB=OF(hex.)=15(decimal)
EF82(hex.)=61314
DRB=03(hex.)=3(decimal)

```
 20 A=61314       EF82
 30 B=A+1
 40 POKE B,0      Next instruction to DDRB
 50 POKE A,15     Define I/O bits
 60 POKE B,255    Next instruction to DRB
 70 POKE A,3      Load 0011 in outputs
                  (3 decimal)
 80 D=PEEK (A)    Read Port B
 90 PRINT D
100 END
RUN
```

If the Port B input lines have input signals as follows:—

| PB7 | PB6 | PB5 | PB4 |
|---|---|---|---|
| 0 | 1 | 0 | 1 |

then the printout would be 83 (decimal) i.e. 53 (hex.)

The PEEK statement reads all 8 bits of the Port. In this case it reads the value 3 (decimal) previously POKEd to the 4 output bits, plus 80 (decimal) present on the input lines.

In general the PEEK statement will read the signals on the Input lines *plus* the latest value to be POKEd to the output lines. This is because once a signal has been POKEd to the outputs it is held on the output lines of those bits of the Data Register programmed as Outputs until it is updated.

A number POKEd to a Port containing bits programmed as inputs will not affect these input lines.

At first reading the programming of I/O Ports may appear a little complicated. The easiest way to learn to program a PIA is to build the system, connect LEDs and signals to the Port lines and try it out.

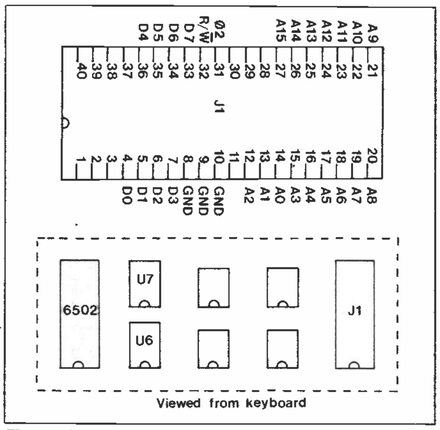



**Figure 11. Superboard II J1 socket designations and location of sockets.**

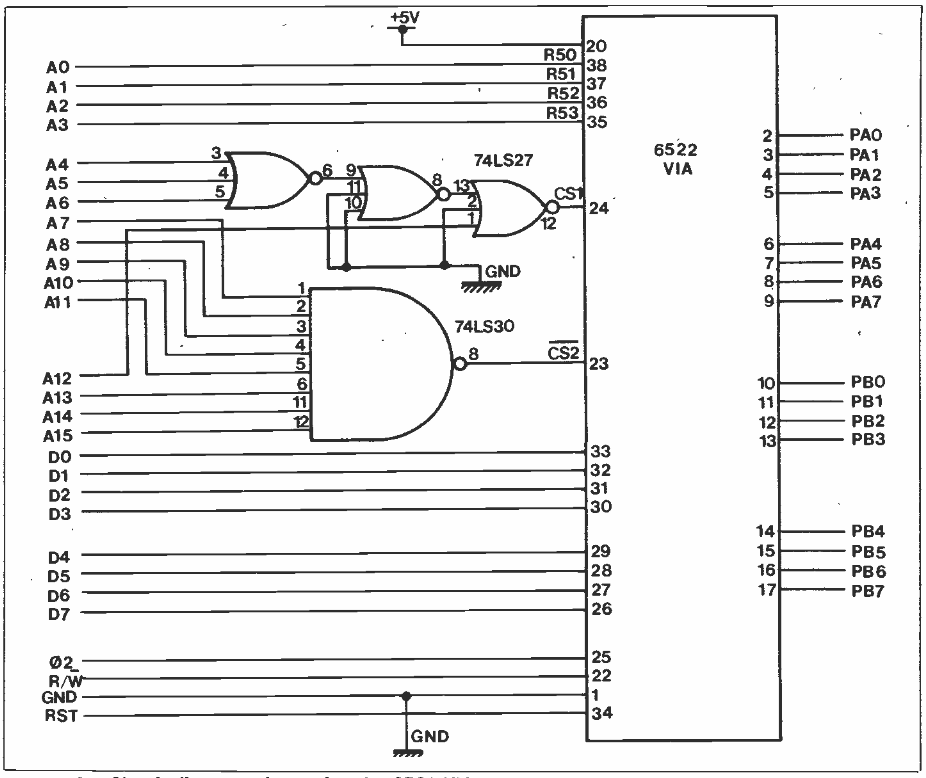



**Figure 13. Circuit diagram when using the 6522 VIA.**

# Appendix A

## For owners of Superboard II or UK101 microcomputers

These microcomputers are readily connected to the interface system described above. However, some owners of Superboard II may feel they have insufficient information to proceed with confidence.

All the necessary bus outputs are connected to the 40-pin socket, designated J1 at the bottom right hand side of the board. The pin connections are shown in the diagram, Figure 11. Note that all DIL sockets and IC's on the Superboard II are "upside-down" when viewed from the keyboard and pin 1 is in the bottom right-hand corner of the socket.

Temporary connections to J1 may be made by pushing 1/0.6 solid-core wire into the sockets, but you are recommended to use a 40-pin DIL "Header socket" and use multicore ribbon cable to connect the interface system as a more permanent feature.

If 8T28 data direction buffers are NOT fitted in positions U7 and U8 (16-pin sockets, lower centre of board) there is no connection between the computer Data Bus and the designated sockets on J1.

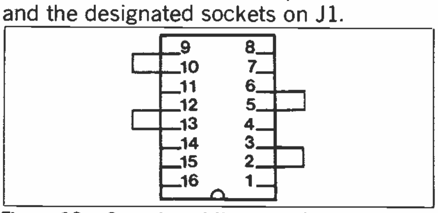


**Figure 12. Superboard II connections for sockets U6 and U7.**

You are advised NOT to use 8T28 buffers as the Superboard connections may not hold these in the Tri-state (high impedance), but in the Read Mode when quiescent. In this mode any signals applied to the external data bus connections may cause a system crash. Instead it is necessary to use jumpers to connect relevant input and output pin sockets of the U7 and U8 DIL sockets, as indicated in Figure 12. These connections may be made with 1/0.6 solid-core wire (again note that the socket connections are "upside-down"). The connections for U7 and U8 are identical.

# Appendix B

## Use of other Interface Adapters

Owners of microcomputers using interface adapters other than the 6821 should find programming details in their computer manuals. Alternatively data sheets should provide the programming information necessary, although sometimes a little difficult for the newcomer to understand.

## 6522 Versatile Interface Adapter

Information on this device is included here as a number of microcomputers use it. Some constructors may prefer to pay a little extra for an adapter having two timers and a serial interface as well as the parallel ports.

## Circuit Diagram

It will be noted that the circuit diagram, Fig. 13, is almost identical to that of Fig. 7. The 6522 pinouts are slightly different and address lines A2 and A3 are connected directly to the VIA. In the software programming that follows these lines will be zero always, however by connecting them to the address bus the Timers and the Serial I/O may also be used.

## Programming the 6522 for Parallel I/O

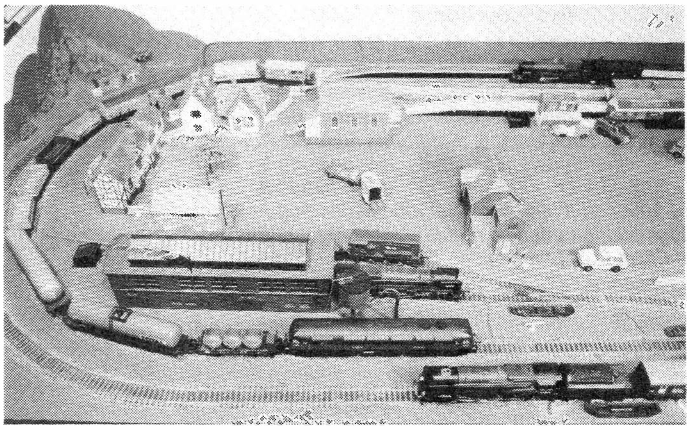
The three most significant hex. address characters depend upon the address decoder connections and will vary from one system to another.

All sixteen variants of the least significant hex. character are used for programming the adapter i.e.: XXXO thru' XXXF. For Parallel I/O only XXXO thru' XXX3 are used.

| | | Address | Data | Remarks |
|---|---|---|---|---|
| **Port A** | | XXX3 | pp | Initialise DDRA |
| | Either | XXX1 | nn | Write data to Port A |
| | or | XXX1 | — | Read Data from Port A |
| **Port B** | | XXX2 | pp | Initialise DDRB |
| | Either | XXXO | nn | Write data to Port B |
| | or | XXXO | — | Read data from Port B |

The data pp initialises bits as outputs or inputs
1 for output
0 for input
in the same way as for the 6821.

# MODEL TRAIN PROJECTS



- ★ **Train Head and Tail Lamp Control**
- ★ **Automatic Loop Control**
- ★ **Track Circuiting**

*by Robert Kirsch*

This article describes several circuits that may be added to a layout using the digital control system described in issues 2 and 3 of Electronics (order numbers XA02C and XA03D). These circuits have been in use on the authors 00 gauge outdoor layout for some time, and have been found to improve the realism and enjoyment of the railway greatly.

## Train Head and Tail Lamp Control

This circuit enables the head and tail lamps to be operated automatically from the receiver unit fitted in the locomotive and controlled by the direction of travel.

This unit may be fitted to dual ended locomotives to enable the headlamps to light only in the directioin of travel, or to a complete train that is to operate in both directions, for example an H.S.T. set, providing white lights at the front and red lights at the rear whichever way the train is moving.

The circuit is fed from the output of the decoder in the receiver module described in issue 2 figure 5.

When a receiver is selected by the control unit and the speed control advanced, pulses appear at one of the two outputs of the decoder, the number of pulses being dependent on the speed setting. These pulses are fed via R1 and D1 (figure 1) to C1, causing it to charge rapidly. It is prevented from discharging when the input goes low by D1 being reverse biassed.

The voltage developed across C1 is used to turn TR1 on, via R2, and in so doing causes current to flow through the lamp in the collector circuit. R3 reduces the voltage to enable a 12V lamp to be used. The lamp and the LED are effectively in series across the supply, so that when TR1 is on the LED is extinguished, and when it is off the LED will light via the resistance of the bulb filament. The lamp will not light because the LED only draws about 10mA as R4 is in series with it.

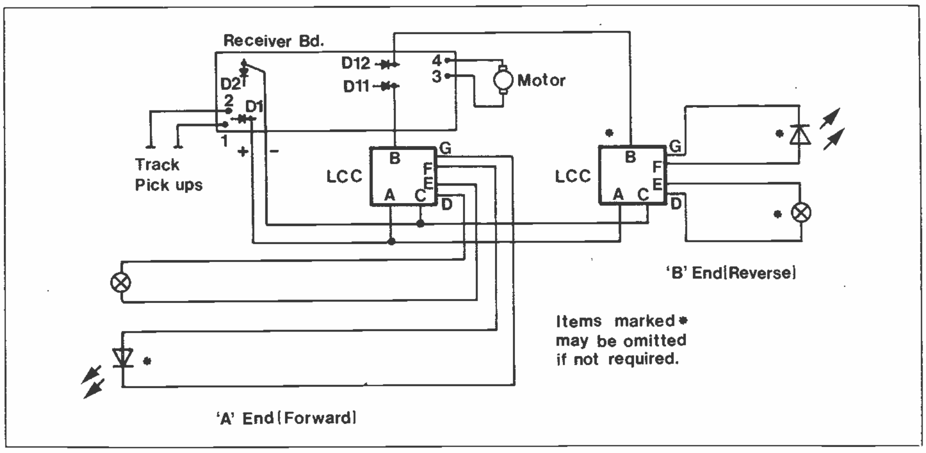


Figure 2. Typical locomotive installation

## Installation

Examples of installation for various applications are shown in figures 2 and 3. It will be seen that to control headlamps at both ends of a locomotive two control circuits will be needed. In the case of a complete train it is necessary to electrically couple all vehicles together. This is useful as it enables several track pick-ups to be made along the length of the train, also making carriage lighting possible.

Three wires are required to enable headlamp control. A bridge rectifier and control circuit are required at the non-driving end of the train, the pulse

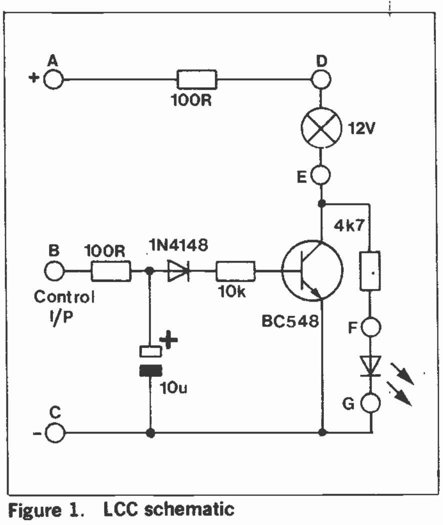


Figure 1. LCC schematic

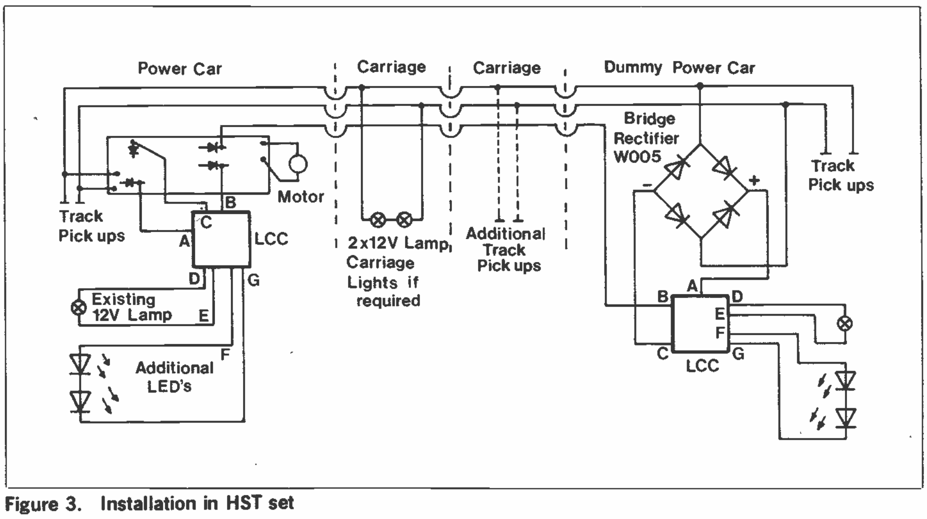


Figure 3. Installation in HST set

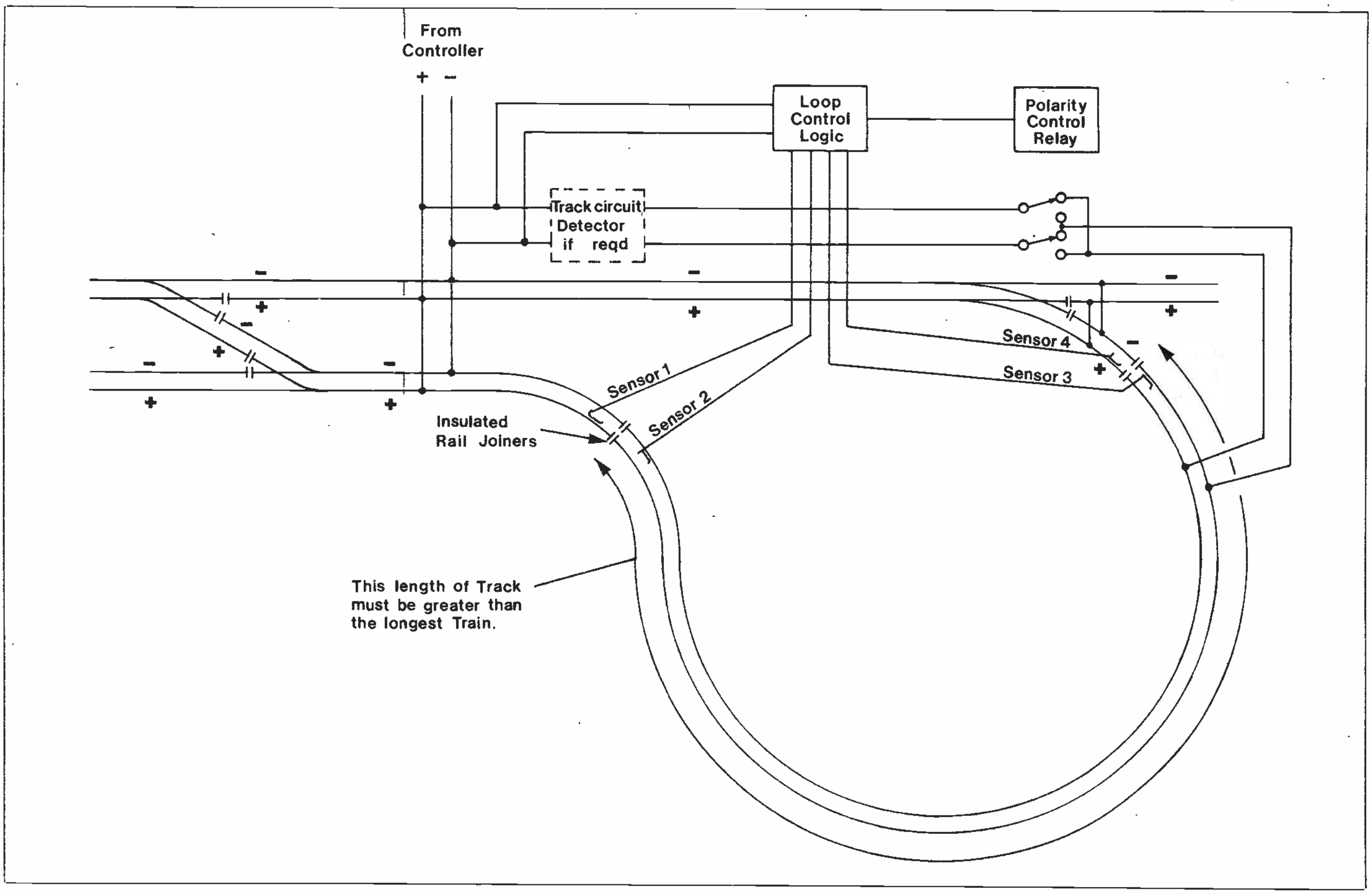
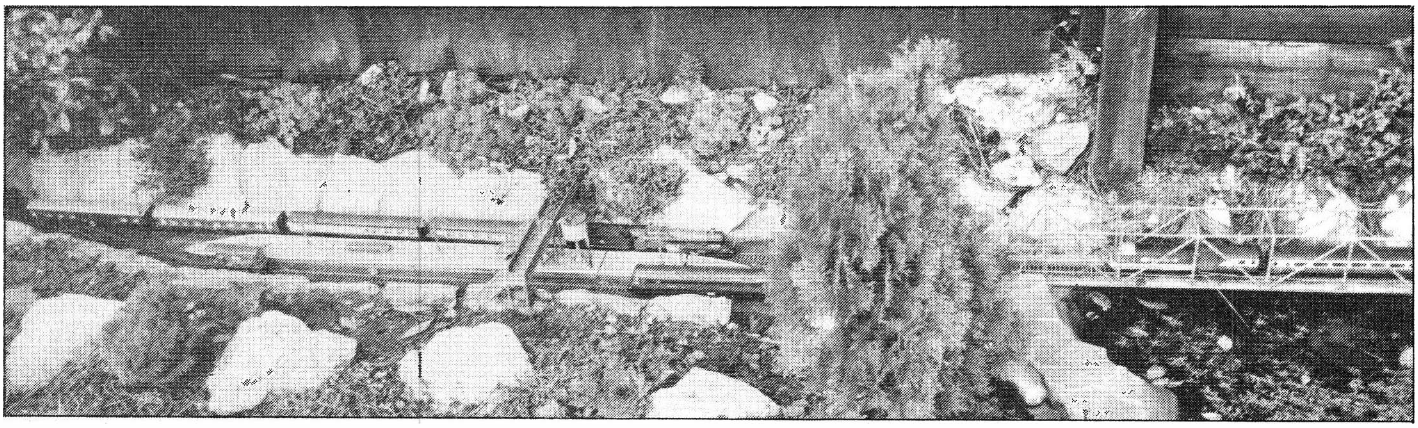



**Figure 4: Loop control schematic.**



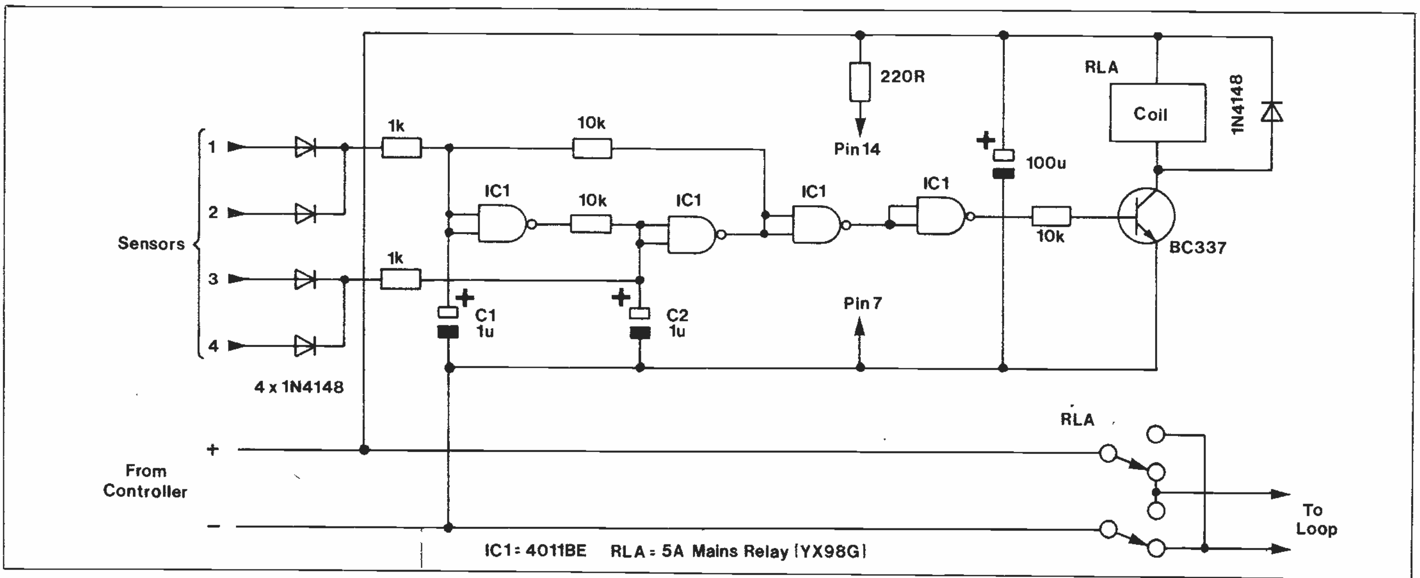
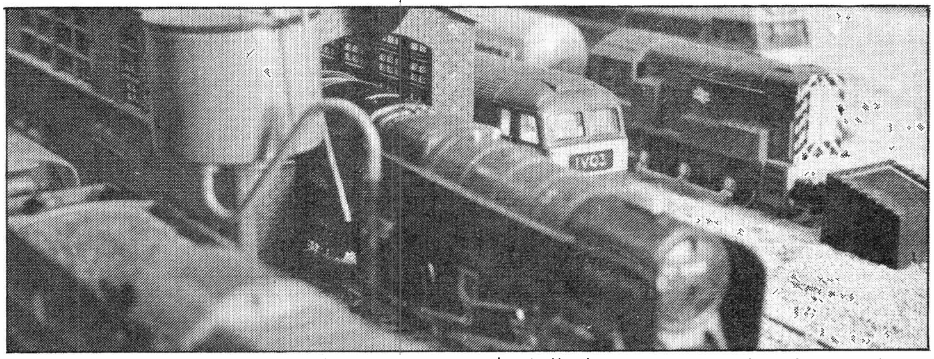



**Figure 5: Loop control circuit.**



signals being fed on the third wire. A very flexible type of wire should be used between carriages, and the wire used in telephone cords has been found suitable for 00 gauge applications. Enough slack must be left to allow for negotiation of sharp curves. A single lamp may be used for the headlamps, and flexible light guide (XR56L) can be used to transfer the light to the front of the vehicle. The ends of the light guide may be shaped into a lens by holding it near a heat source and allowing the plastic to melt and form a small dome. Two LEDs may be used if required by connecting them in series, although it may be necessary to try several LEDs before installation, to ensure that they are both of the same brightness.

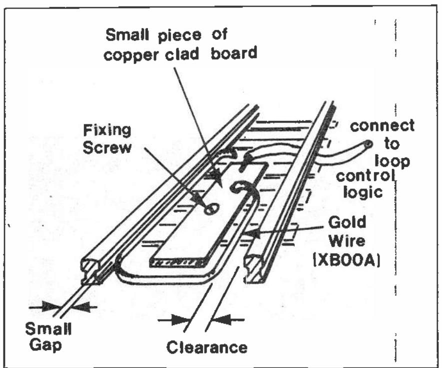



**Figure 6: Track sensor detail.**

# Automatic Loop Control

Loops on model railway systems present a problem due to the confliction of track polarity when entering or leaving the loop. The system described here automatically detects when a train is entering or leaving the loop and sets the polarity accordingly. The receivers used in locomotives are fed from a bridge rectifier, and are therefore not affected by the change in polarity of the track, thus there is no pause during switching.

Figure 4 shows a typical loop arrangement with the four sensors, two placed at each end of the loop. These sensors are simply made from gold plated wire and arranged so that the wheel flanges of the train make contact between one running rail and the sensor wire. This arrangement has been found very reliable in practice, and may be used in other applications where accurate train position detection is required.

Figure 5 shows the circuit of the automatic loop control and it can be seen that a positive input from any of the track sensors will cause the bistable, formed by gates 1 and 2 of the IC, to change to one state or the other, depending on the sensor activated. The inputs from the sensors are decoupled by C1 and C2, to prevent false operation due to inevitable voltage spikes found on model railway systems.

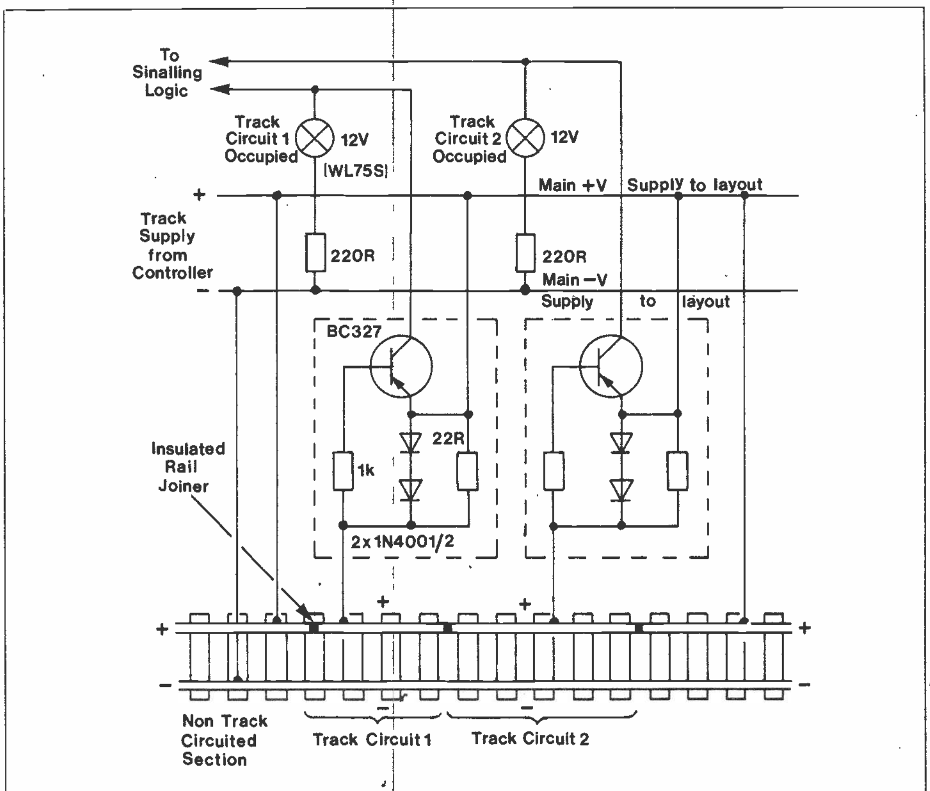



**Figure 7: Track circuiting.**

# Installation

The system should be installed referring to figure 4 as a guide, but do not worry at this stage about the polarity of the connections to the loop section. When the sensors are in position check their operation by shorting them to the appropriate running rail with a screwdriver blade, to ensure that sensors 1 and 2 cause the relay to operate and 3 and 4 cause it to release.

The polarity can now be tested by driving a train into the loop, if the protection circuit on the controller trips as soon as the train enters the isolated section the connections to the loop must be reversed, and a further test carried out to ensure that all is now correct. It will be noted that the distance between the two inner sensors must be greater than the longest train that is likely to use the loop, to prevent both sets of sensors being activated at the same time.

# Track Circuiting

The circuit shown in figure 7 provides a means of detecting when a train is in a particular section of the track. This information may be used to provide an indication on a track layout diagram, as well as being interfaced with signalling equipment.

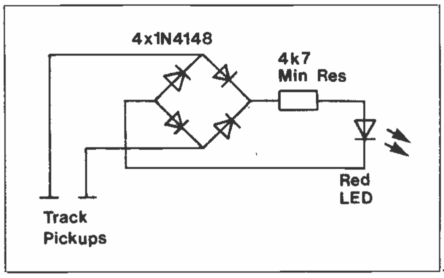



**Figure 8: Tail lamp circuit.**

The individual sections of track which need to be equipped must be isolated at both ends on the positive rail only, and fed by the common supply from the controller via the detector circuit. A single wire feeds from each detector and is connected via a 12V bulb to the negative supply (EARTH). The lamp lights when current is drawn from the track due to TR1 (figure 7) being turned on by the volt drop across D1 and D2. The two diodes only allow a reduction of about 1.4V, and do not affect the operation of the system. It should be noted that only vehicles that draw current through their wheels will be detected by the track circuiting so it is necessary to provide track pickups at both ends of the train. This may be accomplished by connecting a resistor of about 470 ohms between both wheels on an axle of the last vehicle, or a tail lamp may be provided using the circuit shown in figure 8.

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**HOHNER SYMPHONIE** D84 Organ. Immaculate. 4 speakers inc. Leslie 40 watts output. 12 rhythms, + bass, strings etc. RP 1725 £14.50, St. Lawrence, Tillingham 794.
**TRANSCENDANT 2000** synthesiser. Built and working, £95, or exchange for ZX81 + 16K. Phone: Nottingham (0602) 878220 evenings.
**MAPLIN 5600s** synthesiser for sale. Complete component schedule. Requires only some inter-board wiring to complete very high standard of construction. Any good offer considered. Tel: Harpenden 61695 or Staverton 434.
**MAPLIN MES53** organ, roll top cabinet. Working but needs minor repairs, rhythm panels available. Space needed. £450 o.n.o. Buyer collects. Contact: J. Burksfield, 29 Kendall Road, Colchester, Essex.
**PERFECT CONDITION** 5 DM02T generators with edge connectors, offered for £50. Redundant, as using change system. Tel: Stroud, Glos. 78116.
**POWERTRAN POLYSYNTH** (4 voices) and Maplin 5600S. Both complete and calibrated. Any reasonable offers accepted. Also various Maplin Projects to clear. i.e. equaliser, drumsette, etc. Northampton (0604) 27644.
**YAMAHA B35** organ, two 44 note keyboards, 13 pedals, voices, presets. Auto chords and rhythms. Books and matching bench. 3 years old. £525. Tel: Chester 300713.
**YAMAHA CS-5** synthesiser for sale. Excellent condition £195. Tel: Wilmslow (0625) 526517.
**MAPLIN BASIC** organ (single 49 note keyboard). Complete but not working. For sale as I'm too thick to do the fault finding! £60. Phone: Walsall 28911. Ask for Mark Neal.

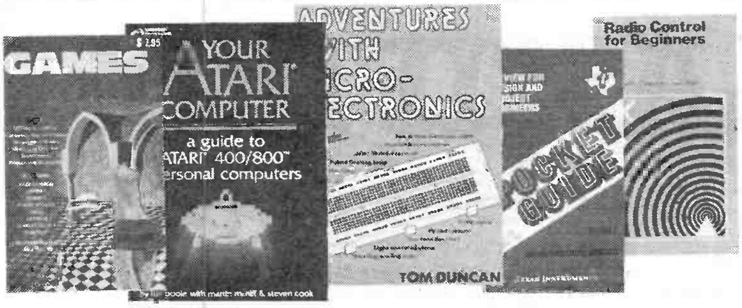
## COMPUTERS FOR SALE

**ACORN ATOM.** 12K RAM. 12K ROM. All leads, manual + PSU included. £190. Dave, 2 Western Villas, Church Rd., Kennington, Ashford, Kent. Tel: (0233) 23077.
**ATARI 800** 16K plus Basic programme recorder. 2 joysticks. Missile Command, Star Raiders, Jaw Breaker, Darts, Jigsaws, Galaxians. Fully boxed and in mint condition. Bargain — £450. Tel: 01-764 1504 (evenings).
**AVENGERS CARTRIDGE** for VIC-20 computer. As new, in box. £15 or nearest offer. Write to Miss Lorna Findlay, The Manse, St. Monans, Fife, Scotland.
**VIC-20** plus cassette, 3K Super Expander, Vic revealed, programmers guide, Intro to Basic 1 + £40 software, mags etc. 4 months old. £230 o.n.o. (Bristol) 621385.
**ZX81 + 16K** RAM + tape recorder and TV. Lots of software. £70 o.n.o. Tel: 0634 721062 (evenings only).
**HOBBY CHANGE** brings sale. Acorn Atom 15K RAM, 12K ROM, VIA, colour. Lots hardware/software. Seikosha GP 80 printer. 40 unopened 5¼ disks. 14in British colour TV (ideal monitor). Enclose s.a.e.
**ZX81 VID SWITCH.** Inverse video module. Sharp white characters on a completely black screen. Switchable between modes. Kit £2.95. Built £4.95. RAM pack stabiliser (Sinclair) and heatsink kit. Cures white outs and top line slant and display jitter. £3.75. All prices inclusive. B. A. Reader, 45 Alfred Street, Kings Heath, Birmingham B14 7HG.
**TWO MICROCOMPUTERS** one 16K ZX81 with Maplin Keyboard. One 8K UK101. Both with software. Offers phone: (06615) 3258. After 6 p.m.
**ZX81 PACMAN.** A superb, fast moving 5K machine code game featuring:— 1 to 4 ghosts, powerpills, sidedoor, fruit cassette only £4.00 or s.a.e. for details. A. Laird, 9 Franklin Road, Saltcoats, Ayrshire.
**NEW 16K ZX81** micro with full size cased Kayde keyboard. If bought new would cost £170. Nearest offer to £110 accepted. Tel: 021-770 1947
**TRS80 16K** L2 with VDU, PSU, cassette recorder, manuals. Various books, games, 24 cassettes and much more. Bargain £380. Tel: Bagshot 71902.
**PSI COMP 80** Computer, 36K RAM, full ASCII keyboard, own PSU and VDU. Well made steel case. Cost over £400. Offers around £200 o.n.o. Tel: Derby (0332) 810543.
**EIGHT 2114** 200nS. Two 74LS138. Thirty D.I.L. sockets. ZX81 edge connector. 75ml pcb. Photo resist lacquer. All unused. £9.50 for lot. Also details for making expandable memory for ZX81 from above components. Tel: Chris, (0254) 771303.
**ZX81 INVERSE** video m/c routine controlled by Basic. Requires 8K ROM + 16K RAM. Send 90p + s.a.e. K. E. Rayner; 25 Mill View, Gazeley, Newmarket, Suffolk CB8 8RN.

## NEW ITEMS USED IN PROJECTS IN THIS MAGAZINE

| | | | | | |
|---|---|---|---|---|---|
| GA16S | Panic Button PCB | **Price £1.25** | LW96E | Sound Generator Kit | **Price £10.95** |
| GA69A | Programmable Timer PCB | **Price £1.49** | LW97F | Panic Button Kit | **Price £4.50** |
| GB09K | Modem Main PCB | **Price £4.99** | LW98G | Programmable Timer Kit | **Price £6.95** |
| GB10L | Modem PSU PCB | **Price £1.75** | LW99H | Modem Kit | **Price £39.95** |
| GB11M | Sound Generator PCB | **Price £2.25** | QQ39N | 4412VP | **Price £8.00** |
| GB12N | Inverter PCB | **Price £1.99** | QY43W | XR2211CP | **Price £4.45** |
| LW95D | Inverter Kit | **Price £49.95** | XG29G | Inverter Transformer | **Price £22.50** |

# MAPLIN'S TOP TWENTY BOOKS




1. (1) De Re Atari (WG56L) (cat. P62).
2. (-) Atari Computer Operating System User's Manual and Hardware Manual. (WA46A) (cat. P62).
3. (-) Games for the Atari by S. Roberts (WA47B) (cat. P62).
4. (11) Towers' International Transistor Selector Update 2 by T. D. Towers (RR39N) (cat. P32).
5. (-) Digital Integrated Circuit Pocket Guide (WA18U) (cat. P34).
6. (10) Electronic Synthesiser Projects by M. K. Berry (XW68Y) (cat. P50).
7. (8) Programming the 6502 by Rodnay Zaks (XW80B) (cat. P54).
8. (5) Power Supply Projects by R. A. Penfold (XW52G) (cat. P38).
9. (13) Cost Effective Projects Around the Home by John Watson (XW30H) (cat. P41).
10. (6) Newnes Radio and Electronics Engineers Pocket Book (RL06G) (cat. P30).
11. (-) Linear Integrated Circuit Pocket Book (WA19V) (cat. P32).
12. (14) Projects for the Car and Garage by G Bishop (XW31J) (cat. P30).
13. (9) IC555 Projects by E. A. Parr (LY04E) (cat. P39).
14. (-) Adventures With Micro-Electronics by Tom Duncan (XW63T) (cat. P30).
15. (-) The Art of Programming the 1K ZX81 by M. James and S. M. Gee (WA56L) (cat. P64).
16. (3) How To Identify Unmarked ICs by K. H. Recorr (WG87U) (cat. P34).
17. (-) Atari Sound and Graphics by Herb Moore, Judy Lower and Bob Albrecht (WA39N) (cat. P62).
18. (12) Remote Control Projects by Owen Bishop (XW39N) (cat. P43).
19. (-) Electronic Music Projects by R. A. Penfold (XW40T) (cat. P50).
20. (-) Radio Control for Beginners by F. G. Rayer (XW66W) (cat. P43).

These are our top twenty best-selling books based on mail-order and shop sales during August, September, and October 1982. Our own publications and magazines are not included. We stock over 450 different books relating to electronics or computing, and the full range is shown on pages 29 to 65 of our 1983 catalogue. For prices see page 29 of this magazine.

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Personal computers
Home computing
Small business systems

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Maplin are pleased to announce that they will be displaying three major makes of home computer at the new Northern Computer Fair. The Fair is at Belle Vue, Manchester, from the 25th to the 27th of November, and the doors will be open from 10 a.m. to 6 p.m. every day. The Fair is all about personal computers, home computing, and small business systems, and there should be plenty for everyone to see and do.

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You will also be able to buy the 1983 Maplin Catalogue, with 392 pages packed full of information. Free literature on computer hardware and software will be placed about our stand, so please do not leave us empty-handed. Our technical staff will also be at hand to answer any queries you may have concerning computers and electronics in general.

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