THE SEALED NICKEL CADMIUM BATTERY

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Sealed, maintenance-free rechargeable batteries are becoming increasingly readily available to the model maker, handyman, radio enthusiast and electronics engineer. Until recently they have served the public in a somewhat hidden way, as components of 'rechargeable' razors, calculators etc. Nowadays they can be obtained off the shelf, and for most purposes only a small amount of knowledge on simple charging techniques is necessary. Single units are referred to as 'cells', and these can be connected together into 'batteries'.

We shall be considering the sealed nickel-cadmium cells and batteries, which are the 'maids of all work' in the small power source field.

Probably the most important facts are:—

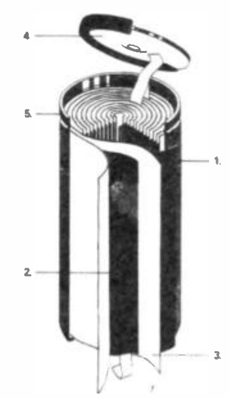
1. The cell discharge voltages are essentially the same as those of 'dry', cells, i.e. zinc/carbon or alkaline manganese;
2. Some nickel-cadmium cells have exactly the same dimensions as the common dry cells and can be interchanged;
3. Their discharge currents can be drawn continuously, and very rapidly as required
4. They can be recharged and discharged a great number of times; 500 or 1,000 times, or many more depending on use;
5. They can be left on continuous charge for years, and thereby maintained in a constant, fully charged state of readiness.

There are, of course, a few 'ifs' and 'buts' relating to the above and we shall consider these below.

There are two basic types of sealed nickel cadmium cell: the 'cylindrical' cells and the 'button' cells. A mixed group is shown in Figure 1, and Figures 2 and 3 illustrate construction differences and similarities. Respectively tables 1 and 2 give details of the available sizes of the two kinds.

Note that the nickel cadmium cells which are interchangeable with dry batteries are to be found amongst the cylindricals, and Table 1 includes references to the non-rechargeable zinc-carbon and alkaline-manganese equivalents. We shall deal with the cylindrical cells first.

Figure 1. Various Ni-Cad batteries



1. **Sintered nickel positive electrode.**
2. **Electrodeposited cadmium negative electrode.**
3. **Separator.**
4. **Top cover with resealing safety vent.**
5. **Nickel plated steel can.**
6. **Electrolyte.**

Figure 2. Construction of a 4.5 Ah cylindrical cell (AN450).

Cylindrical Cells

As an example, consider a nickel cadmium cell of penlight size, the AN 50. It can be left permanently on charge at currents of up to 65mA; it can deliver 10A for 30 seconds; 5A for 3 minutes; or 0.5A for 1 hour. All this can be done in any position, and cycles of charge and discharge can be repeated hundreds or thousands of times. It has the same dimensions as the penlight HP7 and MN1500, and can be used in temperatures as low as -30°C, and as high as +50°C, and attains at least half capacity at the extremes.

How is this versatility achieved? The main secret is in the 'Oxygen Recombination Reaction', which means that the gas produced internally on overcharge is absorbed continuously and re-used inside the sealed cell in accordance with the reaction:—

$$O_2 + 2\,H_2O + 2\,Cd \rightarrow 2\,Cd\,(OH)_2$$

The oxygen is given off at the positive (nickel) electrode and reacts very quickly with the cadmium in the charged negative electrode. To help this reaction in the cell the two electrodes are separated only by a thin porous membrane. Cylindrical cells are spirally wound (as shown in Figure 2), whereas button cells consist of flat plates (as shown in the sectional drawing in Figure 3). The electrode 'plates' are made containing finely divided 'active' materials, nickel hydroxide for the positive and cadmium hydroxide for the negative. These materials are absorbed into a sintered or an electro-deposited metal matrix, and this type of construction gives the very low internal resistances and the correspondingly high short-circuit currents shown in Figure 4.

Note that the cylindrical cells are fitted with a re-sealing one-way safety vent that relieves any excess internal pressure caused by a fault or abuse. It opens at about 200 psi and closes again at about 175 psi. Typical abuse conditions would be overcharging at too high a current or excessive reverse charging.

The electrical capacity of a secondary (i.e. rechargeable) cell is expressed in Ampere hours (Ah) or for small cells in milli-Ampere hours (mAh). It depends on the rate of discharge, and it is common practice to measure it at the 5-hour rate. It will be seen from Table 1 that the cylindricals come in a wide range of capacities, from 110 mAh to 10 Ah.

Cells can be connected together in series to produce batteries. Only cells of the same capacity should be used. Connecting in series increases the voltage but the resulting battery has the same ampere hour capacity as the individual cells. Thus ten 4 Ah cells connected in series will give a battery of 12

Ever Ready Catalogue Code	IEC No.	Size	Cell Voltage	Ampere-Hour Capacity (Ah)	Diameter (mm)	Height (mm)	Weight (g)	16 Hour Charge Rate Milliamperes	Equivalent 'Dry' Batteries (not rechargeable)	
									Zinc Carbon	Alkaline Manganese
NCC18	KR/11/45	AAA	1.2	0.18	10.5	44.5	10.0	18	HP16	MN2400
NCC12	KR/15/18	⅓AA	1.2	0.11	14.1	17.0	8.0	12		
NCC24		½AA	1.2	0.24	14.3	28.1	14.0	24		
AN45	KR/16/29	½A	1.2	0.45	16.7	28.1	19.0	45		
AN50	KR/15/51	AA	1.2	0:50	14.3	50.3	25.0	50	Penlight HP7	MN1500
AN60	KR/17/51	super AA	1.2	0.60	15.6	50.0	30.0	60		
AN140	KR/23/43	RR	1.2	1.40	22.6	42.6	50.0	140		
AN220	KR/27/50	C	1.2	2.20	26.0	49.0	70.0	220	HP11	MN1400
AN260	KR/35/44	½D	1.2	2.60	32.5	43.7	100.0	260		
AN400	KR/35/62	D	1.2	4.00	32.5	61.3	140.0	400	HP2	MN1300
AN450	R/35/62	D	1.2	4.50	33.8	61.0	150.0	450		
AN700	KR/35/92	F	1.2	7.00	33.8	91.0	225.0	700		
AN1000	KR/44/91	super F	1.2	10.00	41.5	91.0	345.0	1000		

Table 1. Some typical cylindrical cells.

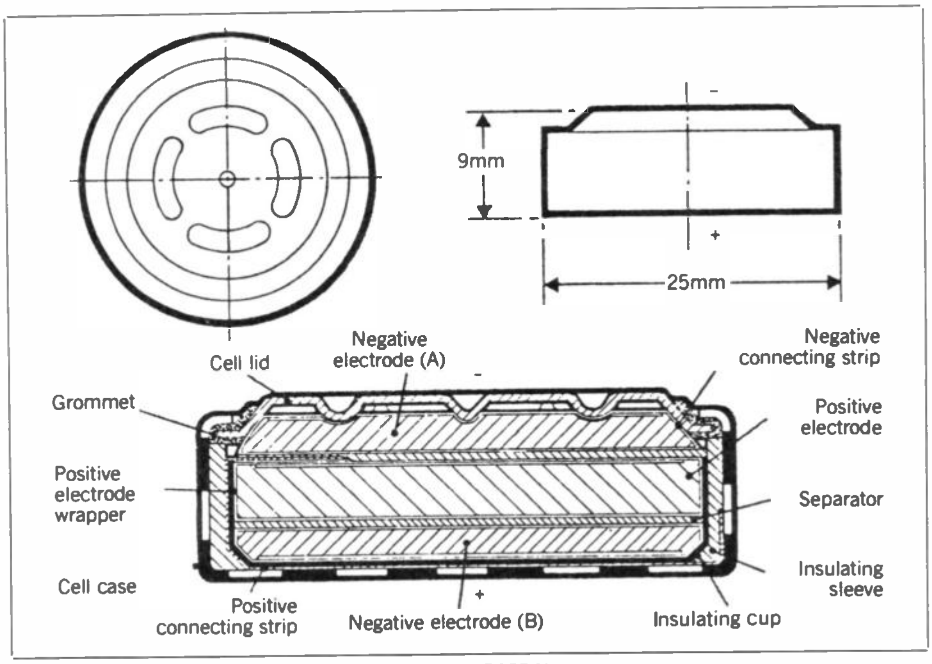
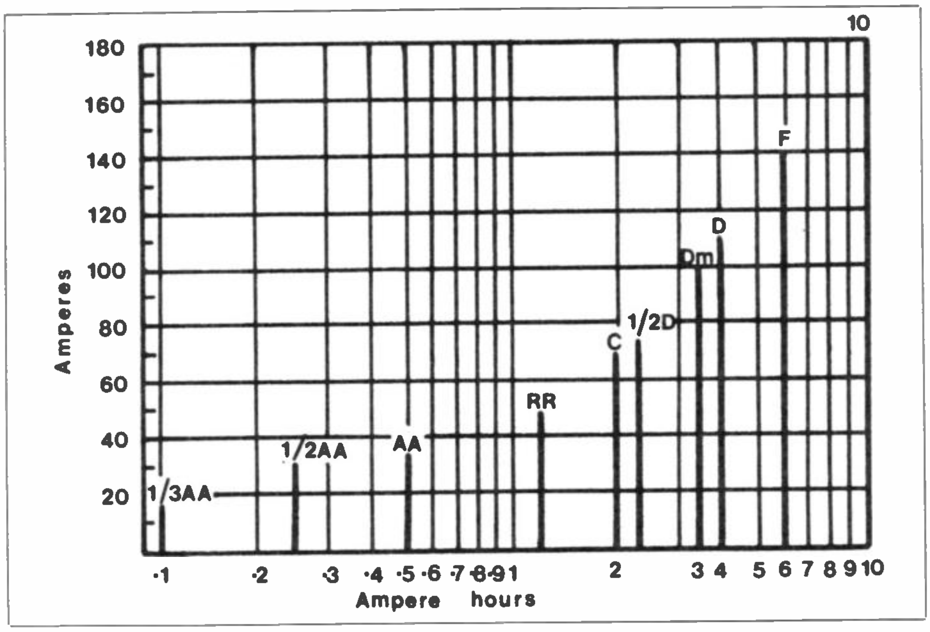


Figure 3. Construction of a 250 mAh button cell (NCB25DA).



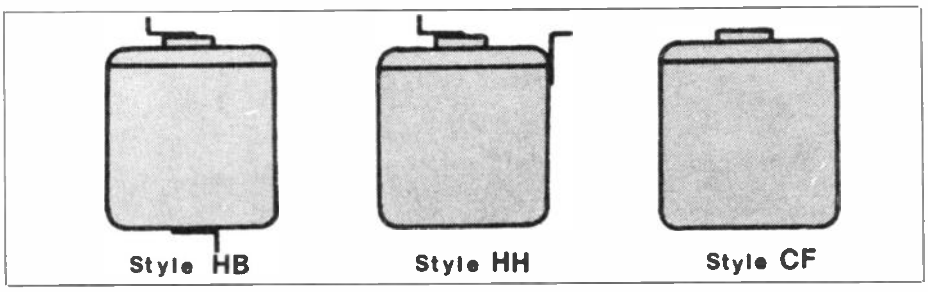


Figure 5 Solder tag styles.

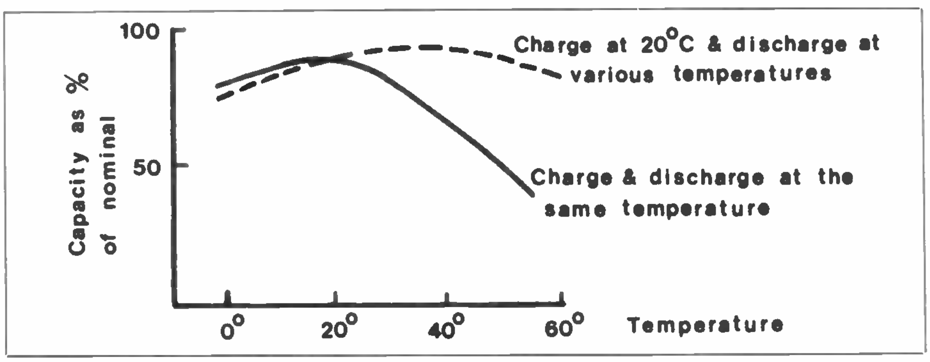


Figure 6. Variation of capacity with temperature.

volts (1.2 x 10) and the capacity is unchanged at 4 Ah.

The charge or discharge currents (or 'rates') of cells and batteries are usually expressed as multiples or sub-multiples of the ONE HOUR or 'C' rate. This standard convention makes for easier comparison between batteries of different sizes.

For instance the C/10 rate will discharge any cell or battery in 10 hours; the C/5 hour rate will discharge it in 5 hours and the 2C rate will discharge in ½ hour. The C/10 rate is 1 A for a 10 Ah battery and 200 mA for a 2 Ah battery.

It is very important to grasp that the charging/discharging cycle has an efficiency coefficient of about 1.5, so that the 'C/10' current would in fact need about 15 hours (10 x 1.5) for a full charge.

It is worth dwelling a little on the cells which have the same dimensions as 'dry' or common non-rechargeable cells. For many purposes e.g. tape recorders, transceivers, torches etc., nickel cadmium cells can take the place of the equivalent battery. They have many advantages. They can give heavier, continuous power if needed, and their voltages are more uniform during discharge. Their rechargeability makes them very economical in use, and many hundreds of recharges can be obtained at a small fraction of a penny each.

Very often nickel cadmium cells are soldered into circuits. This is desirable if high currents are to be taken, or the battery is to be kept on permanent charge in readiness or standby for emergency purposes. Cell manufacturers fit solder tags at no extra cost, and the styles are shown in Figure 5. When ordering cells the designation 'CF', 'HH' or 'HB' should be used. This is easy to remember if associated with the terms 'Contact Free', 'Head-Head', 'Head-Base'. Note that soldering directly on to a cell case could severely damage the cell.

From the point of view of the tolerance of electronic circuits, it is very important to realise that the battery on-charge voltage is higher than the discharge voltage. Thus, a circuit may have to tolerate 1.5 volts per cell on charge at the C/8 rate and a mid-point discharge voltage of 1.25 volts/cell at the C/5 rate.

Sealed (i.e. gas recombining) cells should not be charged in parallel as their very low internal resistances and supressed overcharge voltages can mean that one cell or one row of cells is doing all the work and getting more than its fair share of overcharge current. It is also possible under these parallel conditions for a row of cells to receive very high 'stray' currents from neighbouring rows. Diode protection between rows is sometimes incorporated to reduce this possibility.

Temperature

A battery is by nature a chemical device and therefore it is affected by temperature in a variety of ways. The lower working limit of the nickel-cadmium system is generally taken to be the freezing point of the potassium hydroxide electrolyte at about -30°C. At low temperatures the charging process becomes more efficient, and for continuous charging under these conditions an upper charge voltage limit of 1.55 volts per cell is often imposed. By this, it is meant the circuits are designed so that as this voltage is approached the charging current will decrease and the upper voltage limit is not exceeded. This will greatly reduce the possibility of gassing under these very efficient charge conditions.

The battery capacity is also affected by temperature and Figure 6 demonstrates this. Note the differences between the two

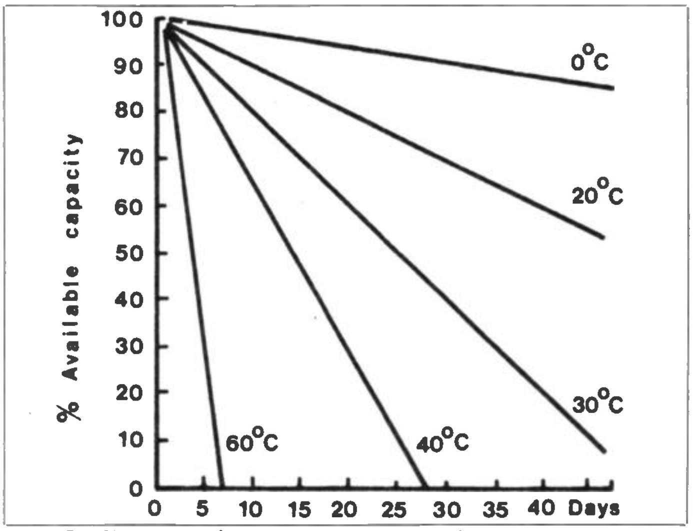


Figure 7. Charge retention versus storage temperature.

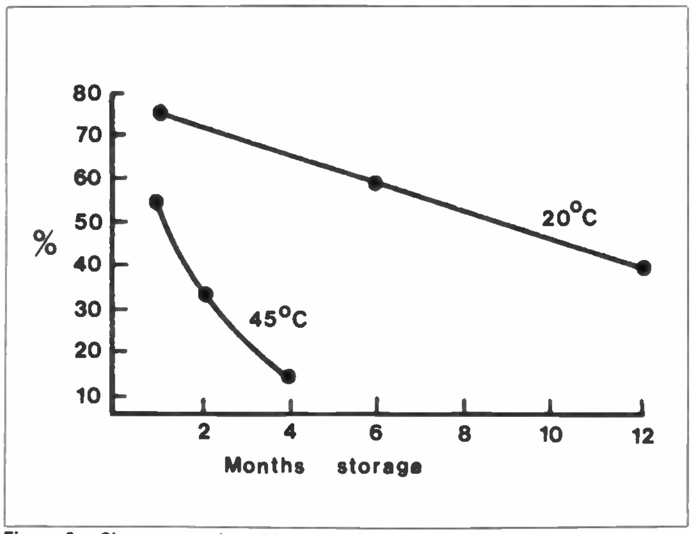


Figure 9. Charge retention of button cells.

curves. Charging is more efficient at low temperatures and less so at high temperatures. These curves highlight this.

Another important aspect of battery temperature is its influence on the retention of charge on standing. Figure 7 demonstrates the marked self-discharge brought about by storing charged cells at elevated temperatures. Compare, however, with the button-cell performance shown on Figure 9.

Special Cylindrical Cells

When batteries have to be kept on continuous charge under conditions of high temperature, such as in emergency lighting where there are electric lamps, transformers, chokes etc. to generate heat, it is now common practice to use specially formulated cylindrical cells to withstand these arduous conditions and to comply with recent specifications. These batteries need to have an expected life of at least four years in use. (Specification BS 5266 and ICEL 1001.)

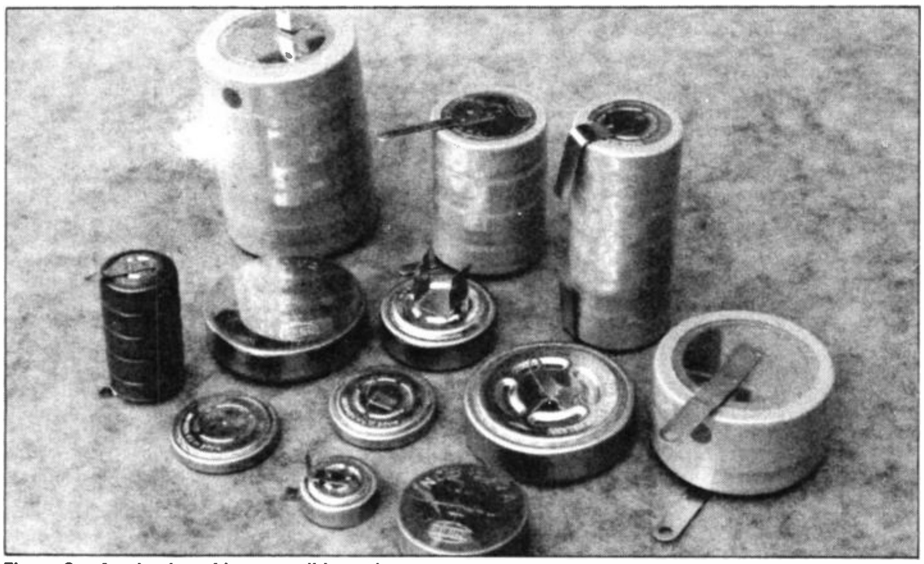


Figure 8. A selection of button cell batteries.

Button Cells

These cells are not fitted with a venting mechanism, and their construction means that they have a higher internal resistance. They are very popular for relatively small current, regular cycling, and infrequent or limited overcharge applications. Their capacities range from 60 mAh to 600 mAh, as shown in Table 2. Although their energy densities are somewhat less than that of cylindricals (70 watt-hours per litre compared with 100 watt-hours per litre), this is often compensated for by the compact way in which they can be stacked to form very convenient battery packs, as illustrated in Figure 8.

A cross-section of a button cell is shown in Figure 3. This is of the 250 mAh size and it will be seen to have three electrodes; one positive sandwiched between two negatives. This is a typical so-called 'D.A.' construction. Other variations are the 'Z.A.' type with only two electrodes and the 'V.A.' with four electrodes. The greater the number of electrodes, the lower the internal resistance for a given Ampere hour capacity (see Table 2).

Button cells are of the 'mass plate' type of construction, in which the electrodes are produced by compressing the active chemical ingredients into metal mesh pockets. The big advantage of these pressed plate cells is that they retain their charge longer when stored (compare figures 7 and 9). This very important property of button cells is often utilised for memory protection in electronic circuits.

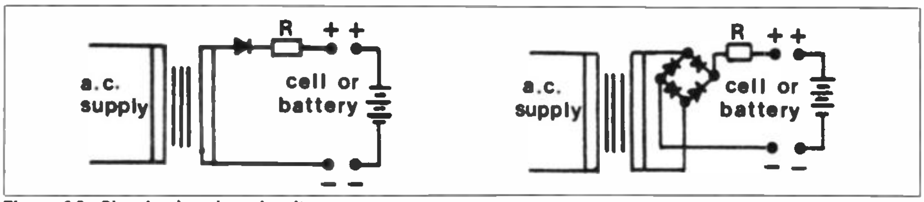


Figure 10. Simple charging circuits.

	Capacity	Voltage	Maximum Diameter	Maximum Thickness	Approx. Weight	C/10 Charge Rate	Internal Resistance
NCB6ZA	60mAh	1.2	16mm	6.1mm	4g	6mA	280m Ω
NCB11ZA	110mAh	1.2	23mm	4.5mm	6g	11mA	140m Ω
NCB15ZA	150mAh	1.2	25mm	5.5mm	9g	15mA	120m Ω
NCB25ZA	250mAh	1.2	25mm	9.0mm	13g	25mA	100m Ω
NCB25DA	250mAh	1.2	25mm	9.0mm	13.5g	25mA	70m Ω
NCB60ZA	600mAh	1.2	35mm	10.0mm	30.0g	60mA	70m Ω
NCB60VA	600mAh	1.2	35mm	10.0mm	30.5g	60mA	30m Ω

Table 2. Some typical button cells.

Continuous charging of button cells is possible at normal temperatures, but it is necessary to limit the charge current to C/100. Thus, for the 250 mAh cell or battery, the maximum 'trickle' current should be 2.5 mA.

As with other cells, solder joints must not be made directly on to the cell cases, as internal plastic insulators could be damaged. Manufacturers supply cells and batteries with solder tags as requested. Certain packs, for memory protection, are often supplied with tags suitable for fixing directly to PC boards.

Charging

For most purposes a 'constant-current' charge system is used for sealed cells. Figure 10 gives a couple of simple circuits suitable for this purpose. For a satisfactory constant current it is recommended that the resistances marked 'R' drop a voltage about equal to that of the battery being charged.

Other types include circuits for charging from vehicle batteries, solar cells and transistorised sources, and there are many techniques employed for controlling such refinements as fast charging, and correcting for extremes of environmental conditions.

Simple, well designed, and convenient chargers are readily available on the retail market, to accept and charge cells and batteries for domestic items such as torches, tape recorders, and toys etc.

PRICE LIST

All prices shown in this price list are valid from 16th August 1982 to 13th November 1982

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 30p handling charge which must be paid on all orders having a total value of under £4.00.

The price list is intended for use with our 1981 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.

Notes:

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
*	Item is mentioned in "Amendments to Catalogue" elsewhere in this newsletter
NV	Indicates that item is zero rated for VAT purposes
■	Price reduced

Prices charged will be those ruling on the day of despatch

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TS08J	Parts T-Shirt LC	DIS
TS09K	Parts T-Shirt S	£3.95
TS10L	Parts T-Shirt M	£3.95
TS11M	Parts T-Shirt L	£2.99
XF30H	Pirate Attack Poster	£1.00*NV*
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XQ23A	Mushkiller FM234T	£16.50
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XQ29G	Trucolour TC10 Grp A	£10.50
XQ30H	Trucolour TC10 Grp B	£9.40
XQ31J	TrucolourTC10 GrpC/D	£9.95
XQ32K	Trucolour TC13 Grp A	£11.85
XQ33L	Trucolour TC13 Grp B	£12.20
XQ34M	TrucolourTC13 GrpC/D	£11.45
XQ35Q	Trucolour TC18 Grp A	£13.95
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XQ40T	Extragain XG8 GroupB	£23.50
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XQ42V	Extragain XG8 Wdbnd	£21.95
XQ43W	ExtragainXG14 GroupA	£35.50
XQ44X	ExtragainXG14 GroupB	£36.35
XQ45Y	ExtragainXG14 GrpC/D	£34.85
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XQ50E	Extragain XG21 Wdbnd	£49.75
XQ51F	Super-Set Top	£8.95
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XQ59P	Mast C	£3.95
XQ60Q	Mast D	£3.75
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XQ63T	Mast M	£5.79
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*BW46A	Masthead UP1300/W	£10.90
*BW47B	Now Same As BW46A	
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*BW50E	Power Unit PU1240	£14.65
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BW51F	Diplexer UF2	£5.55
BW52G	Splitter CS100	£8.95
BW53H	Splitter SB2	DIS
HX88V	Aerial Splitter SB11	£3.20
YQ23A	Splitter CS200	£4.45
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HX87U	Surface Co-Ax Outlet	75p
BW54J	Sfce Dble Co-Ax Otlt	£2.70
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BW57M	TV/FM Outlet	£4.65
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LB11M	FM Tape Aerial	60p
YG20W	Ferrite Rod 810	29p ■
YG21X	Ferrite Rod 814	46p
YG22Y	Ferrite Rod 101	45p
YG23A	Ferrite Rod 102	69p
Page 20		
LB12N	MW/LW Aerial	£2.35
*LB10L	Telescp Aerial 54in	£3.30
XB54J	Aerial Rotator	£59.90
YB00A	Low-Pass RF Filter	£3.95
YB01B	RF Antenna Switch	£6.34
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YG16S	Mag Mount	£8.50
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YG03D	Ni Cad D	£5.99
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RH24B	Book BP31	DIS
RQ22Y	Book NB245	£4.65*NV*
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RL02C	Book NB059	£5.15*NV*
RH04E	Book BP6	85p*NV*
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RH21X	Book BP27	65p*NV*
RH32K	Book BP196	DIS
RH53H	Book BP160	DEC
XX10L	Basic Electronic Set	£11.75*NV*
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RR06G	Book NB209	£6.75*NV*
RH63T	Book NB041	£2.75*NV*
RF10L	Book BP228	£1.50*NV*
RL33L	Book NB188	£6.95*NV*
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RQ24B	Book BP41	£3.25*NV*
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RF11M	Book BP40	DIS
RH35Q	Book BP202	NOV
XW56L	Book FT1037	£14.95*NV*
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RL03D	Book NB061	DIS
RL32K	Book NB185	£11.46*NV*
RL20W	Book NB130	DIS
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BL43W	EC Wire 36 swg.	£1.25
BL44X	EC Wire 38 swg.	£1.25
BL60Q	EC Wire 40 swg.	£1.50
BL61R	EC Wire 42 swg.	£1.49
BL62S	EC Wire 44 swg.	£2.20
BL63T	EC Wire 48 swg.	£4.95
XR39N	Zip Wire	14p
XR60Q	HD Loudspeaker Cable	36p
YG08J	Litz Speaker Leads	£8.99
XR06G	Ribbn Cable 10-Way	60p
XR07H	Ribbn Cable 20-Way	£1.20
XR65V	IDC Cable 12-Way	£2.11

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XR47B	Twn Mains DS Black	28p
XR00A	Twn Mains DS White	18p
XR61R	Twin 6A Mains Orange	49p
XR62S	Twin 6A Mains White	49p
XR01B	Min Mains Black	35p
XR02C	Min Mains White	36p
XR03D	6A Mains Black	56p
XR04E	6A Mains White	56p
XR05F	6A Mains Orange	70p
XR09K	HD Mains Black	99p
XR10L	HD Mains White	80p
XR11M	HD Mains Orange	90p
XR24B	Cotton Mains	94p
BL71N	Stretchflex 1A	£1.05
BL72P	Stretchflex 6A	£4.95
XR48C	4-Core Mains	£1.05

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XR49D	1.0mm TE Cable	43p
XR50E	1.5mm TE Cable	48p
XR51F	2.5mm TE Cable	65p
XR52G	6mm TE Cable	£1.75
XR53H	1mm Trpl &ECC Cbl	69p
XR15R	Min Screened	15p
XR12N	Cable Single Black	19p
XR13P	Cable Single Grey	19p
XR14Q	Cable Single White	19p
XR16S	Single Mic Cable	42p

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XR18U	Low Noise Scnd	42p
XR19V	Low C Cable	55p
XR63T	UR67 RF Cable	£1.95
XR08J	Twin Mic Cable	82p
XR20W	Lapped Pair	21p
XR21X	Cable Twin	29p
XR23A	Cable Quad	28p
XR25C	Multi-Core 4-Way	60p

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XR26D	Multi-Core 6-Way	65p
XR27E	Multi-Core 9-Way	86p
XR28F	Multi-Core 15-Way	£1.25
XR46A	Multi-Core 25-Way	£1.74
XR54J	Multi-Core 36-Way	£2.31
BH30H	Scr Strtchflx Blck	£1.80
BH31J	Scr Strtchflx Blue	£1.80
BH33L	Scr Stchflx Psychdic	DIS
BH34M	Scr Stretchflex Red	£1.80
HQ49D	Twin Stretchflex	£2.40
XR30H	Standard Co-Ax	48p
XR29G	Low Loss Co-Ax	50p
XR31J	Bal Feeder	19p
YR19V	Marker A0	9p
YR20W	Marker A1	9p
YR21X	Marker A2	9p
YR22Y	Marker A3	9p
YR23A	Marker A4	9p
YR24B	Marker A5	9p
YR25C	Marker A6	9p
YR26D	Marker A7	9p
YR27E	Marker A8	9p
YR28F	Marker A9	9p
YR29G	Marker B0	12p
YR30H	Marker B1	10p
YR31J	Marker B2	9p
YR32K	Marker B3	10p
YR33L	Marker B4	11p
YR34M	Marker B5	10p
YR35Q	Marker B6	10p
YR36P	Marker B7	10p
YR37S	Marker B8	12p
YR38R	Marker B9	12p
YR39N	Marker C0	10p
YR40T	Marker C1	10p
YR41U	Marker C2	10p
YR42V	Marker C3	10p
YR43W	Marker C4	10p
YR44X	Marker C5	10p
YR45Y	Marker C6	10p
YR46A	Marker C7	10p
YR47B	Marker C8	10p
YR48C	Marker C9	10p

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BF86T	Heat Shrink CP 16	55p
BF87U	Heat Shrink CP 24	65p
BF88V	Heat Shrink CP 32	30p
BF89W	Heat Shrink CP 48	32p
BF90X	Heat Shrink CP 64	34p
YR17T	Heat Shrink CP95	50p
YR18U	Heat Shrink CP127	£1.10
BL66W	Ht-Resist Sleeve Blk	12p
BL69A	Ht-Resist Sleeve Grn	12p
BL70M	Ht-Resist Sleeve Red	12p
BH00A	Systoflex 1mm Black	6p
BH01B	Systoflex 1mm Blue	6p
BH02C	Systoflex 1mm Green	6p
BH03D	Systoflex 1mm Red	6p
BH04E	Systoflex 1mm White	6p
BH05F	Systoflex 1mm Yellow	6p
BH06G	Systoflex 2mm Black	9p
BH07H	Systoflex 2mm Blue	9p
BH08J	Systoflex 2mm Green	9p
BH09K	Systoflex 2mm Red	9p
BH10L	Systoflex 2mm White	11p
BH11M	Systoflex 2mm Yellow	9p
BH12N	Systoflex 4mm Black	15p
BH13P	Systoflex 4mm Blue	15p
BH14Q	Systoflex 4mm Green	15p
BH15R	Systoflex 4mm Red	15p
BH16S	Systoflex 4mm White	15p
BH17T	Systoflex 4mm Yellow	15p

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BH42V	Systoflex 6mm Black	17p
BH43W	Systoflex 10mm Black	24p
BL65V	Lacing Cord	£1.10
BL57M	Spirawrap 1/8in.	18p
BL58N	Spirawrap 1/4in.	21p
BL59P	Spirawrap 1/2in.	46p
BF91Y	Tie-Wrap 92	2p
BF92A	Tie-Wrap 140	3p
BF93B	Tie-Wrap 186	4p
BF94C	Cable Tie Base	19p
BH26D	Safix 4	12p
BH27E	Safix 8	10p
BH28F	Safix 12	14p

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LR44X	Cable P Clip 3/16in.	3p
LR45Y	Cable P Clip 1/4in.	3p
LR46A	Cable P Clip 5/16in.	3p
LR04E	Cable Clip 3/8in.	3p
BH18U	Hiatt Rd 2.3/4mm	23p
BH19V	Hiatt Rd 3.1/2mm	29p
BH20W	Hiatt Rd 4mm	24p
BH21X	Hiatt Rd 5mm	29p
BH22Y	Hiatt Rd 6mm	25p
BH23A	Hiatt Rd 7mm	32p
BH24B	Hiatt Rd 8mm	29p
BH36P	Hiatt Rd 9mm	37p
BH25C	Hiatt Flat 4mm	20p
BH37S	Hiatt Flat 5mm	25p
BH38R	Hiatt Flat 7mm	27p
BH39N	Hiatt Flat 9mm	32p
BH40T	Hiatt Flat 10mm	34p
BH41U	Hiatt Flat 14mm	40p

CAPACITORS

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WX35Q	Ceramic 1.8	6p
WX36P	Ceramic 2.2	6p
WX37S	Ceramic 2.7	6p
WX38R	Ceramic 3.3	6p
WX39N	Ceramic 3.9	6p
WX40T	Ceramic 4.7	6p
WX41U	Ceramic 5.6	6p
WX42V	Ceramic 6.8	6p
WX43W	Ceramic 8.2	6p
WX44X	Ceramic 10	6p
WX45Y	Ceramic 12	6p
WX46A	Ceramic 15	6p
WX47B	Ceramic 18	6p
WX48C	Ceramic 22	6p
WX49D	Ceramic 27	6p
WX50E	Ceramic 33	6p
WX51F	Ceramic 39	6p
WX52G	Ceramic 47	6p
WX53H	Ceramic 56	6p
WX54J	Ceramic 68	6p
WX55K	Ceramic 82	6p
WX56L	Ceramic 100	6p
WX57M	Ceramic 120	6p
WX58N	Ceramic 150	6p
WX59P	Ceramic 180	6p
WX60Q	Ceramic 220	6p
WX61R	Ceramic 270	6p
WX62S	Ceramic 330	6p
WX63T	Ceramic 390	6p
WX64U	Ceramic 470	6p
WX65V	Ceramic 560	6p
WX66W	Ceramic 680	6p
WX67X	Ceramic 820	6p
WX68Y	Ceramic 1000	6p
WX69A	Ceramic 1200	6p
WX70M	Ceramic 1500	6p
WX71N	Ceramic 1800	6p
WX72P	Ceramic 2200	6p
WX73Q	Ceramic 2700	6p
WX74R	Ceramic 3300	6p
WX75S	Ceramic 3900	6p
WX76H	Ceramic 4700	6p
WX77J	Ceramic 10,000	6p
WX78K	Ceramic 22,000	6p
YY24B	Monocap 0.001uF	19p
YY25C	Monocap 0.0022uF	20p
YY07H	Monocap 0.0047uF	20p
YY08J	Monocap 0.01uF	21p
YY09K	Monocap 0.022uF	25p
YY10L	Monocap 0.047uF	28p
YY11M	Monocap 0.1uF	36p
YR73Q	Minidisc 0.01uF	5p
YR74R	Minidisc 0.047uF	5p
YR75S	Minidisc 0.1uF	7p
YR76H	Minidisc 0.47uF	15p
BX00A	Disc 0.01uF	10p
BX01B	Disc 0.022uF	10p
BX02C	Disc 0.047uF	12p
BX03D	Disc 0.1uF	12p

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BX05F	HV Disc 10	14p
BX06G	HV Disc 47	19p
BX07H	HV Disc 100	22p
BX10L	HV Disc 470	11p
BX12N	HV Disc 1000	11p
BX13P	HV Disc 2200	11p
BX14Q	HV Disc 4700	22p
BX15R	HV Disc 10,000	19p
HY18U	1000V Disc 4700pF	26p
BX16S	Feed Thro Cap	8p
WX00A	Mica 2.2pF	27p
WX01B	Mica 3.3pF	27p
WX02C	Mica 5pF	27p
WX03D	Mica 10pF	27p
WX04E	Mica 18pF	27p
WX05F	Mica 22pF	27p
WX06G	Mica 27pF	28p
WX07H	Mica 33pF	28p
WX08J	Mica 39pF	28p
WX09K	Mica 47pF	28p
WX10L	Mica 56pF	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
WX18U	Mica 270pF	49p
WX19V	Mica 330pF	49p
WX20W	Mica 390pF	49p
WX21X	Mica 470pF	49p
WX22Y	Mica 560pF	49p
WX23A	Mica 680pF	51p
WX24B	Mica 820pF	51p
WX25C	Mica 1000pF	56p
WX26D	Mica 1500pF	65p
WX27E	Mica 1800pF	72p

1981 Catalogue Page No.		VAT inclusive PRICE
WX28F	Mica 2200pF	69p
WX29G	Mica 2700pF	92p
WX30H	Mica 3600pF	99p
WX31J	Mica 4700pF	£1.25
WX32K	Mica 6800pF	DIS
WX33L	Mica 8200pF	£2.09
WX34M	Mica 10,000pF	£1.99
BX24B	Polystyrene 22	13p
BX25C	Polystyrene 33	8p
BX26D	Polystyrene 47	8p
BX27E	Polystyrene 68	8p
BX28F	Polystyrene 100	8p
BX29G	Polystyrene 150	8p
BX30H	Polystyrene 220	8p
BX31J	Polystyrene 330	8p
BX32K	Polystyrene 470	8p
BX33L	Polystyrene 560	8p
BX34M	Polystyrene 680	8p
BX35Q	Polystyrene 1000	8p
BX36P	Polystyrene 1500	8p
BX37S	Polystyrene 2200	8p
BX38R	Polystyrene 3300	8p
BX39N	Polystyrene 4700	8p
BX40T	Polystyrene 5600	10p
BX41U	Polystyrene 6800	10p
BX92A	Polystyrene 10,000	14p
BX93B	Polystyrene 22,000	19p
BX94C	Polystyrene 47,000	25p
BX95D	Polystyrene 100,000	49p

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BX46A	1% Polysty 100	27p
BX47B	1% Polysty 150	27p
BX49D	1% Polysty 220	27p
BX50E	1% Polysty 270	29p
BX51F	1% Polysty 330	29p
BX52G	1% Polysty 390	29p
BX53H	1% Polysty 470	29p
BX54J	1% Polysty 560	29p
BX55K	1% Polysty 750	29p
BX56L	1% Polysty 1000	29p
BX57M	1% Polysty 1200	29p
BX58N	1% Polysty 1500	29p
BX59P	1% Polysty 1800	29p
BX60Q	1% Polysty 2200	29p
BX61R	1% Polysty 2700	29p
BX62S	1% Polysty 3300	29p
BX63T	1% Polysty 3900	29p
BX64U	1% Polysty 4700	37p
BX65V	1% Polysty 5600	37p
BX66W	1% Polysty 6800	37p
BX85G	1% Polysty 8200	37p
BX86T	1% Polysty 10,000	37p
BX87U	1% Polysty 22,000	48p
WW22Y	Carbonate 0.001	9p
WW23A	Carbonate 0.0015	9p
WW24B	Carbonate 0.0022	9p
WW25C	Carbonate 0.0033	9p
WW26D	Carbonate 0.0047	9p
WW27E	Carbonate 0.0068	9p
WW28F	Carbonate 0.0082	9p
WW29G	Carbonate 0.01	9p
WW30H	Carbonate 0.012	9p
WW31J	Carbonate 0.015	9p
WW32K	Carbonate 0.018	9p
WW33L	Carbonate 0.022	10p
WW34M	Carbonate 0.027	11p
WW35Q	Carbonate 0.033	11p
WW36P	Carbonate 0.039	11p
WW37S	Carbonate 0.047	11p
WW38R	Carbonate 0.056	14p
WW39N	Carbonate 0.068	12p
WW40T	Carbonate 0.082	14p
WW41U	Carbonate 0.1	11p
WW42V	Carbonate 0.12	11p
WW43W	Carbonate 0.15	14p
WW44X	Carbonate 0.18	14p
WW45Y	Carbonate 0.22	16p
WW46A	Carbonate 0.27	16p
WW47B	Carbonate 0.33	22p
WW48C	Carbonate 0.39	22p
WW49D	Carbonate 0.47	25p
WW50E	Carbonate 0.56	27p
WW51F	Carbonate 0.68	36p
WW52G	Carbonate 0.82	38p
WW53H	Carbonate 1	42p
BX70M	Polyester 0.01uF	8p
BX71N	Polyester 0.015uF	8p
BX72P	Polyester 0.022uF	8p
BX73Q	Polyester 0.033uF	8p
BX74R	Polyester 0.047uF	9p
BX75S	Polyester 0.068uF	9p
BX76H	Polyester 0.1uF	9p
BX77J	Polyester 0.15uF	15p
BX78K	Polyester 0.22uF	13p
BX79L	Polyester 0.33uF	18p
BX80B	Polyester 0.47uF	21p
BX81C	Polyester 0.68uF	34p
BX82D	Polyester 1uF	38p
BX83E	Polyester 1.5uF	56p
BX84F	Polyester 2.2uF	64p

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WW15R	Mylar 0.001	5p
WW16S	Mylar 0.0022	5p
WW17T	Mylar 0.0047	5p
WW18U	Mylar 0.01	6p
WW19V	Mylar 0.022	6p
WW20W	Mylar 0.047	8p
WW21X	Mylar 0.1	10p
WW83E	Mylar 0.22	16p
FF53H	IS Cap 0.01uF	22p
FF54J	IS Cap 0.022uF	23p
FF55K	IS Cap 0.047uF	23p
FF56L	IS Cap 0.1uF	32p
FF57M	IS Cap 0.22uF	45p
FF58N	IS Cap 0.47uF	78p
†BX22Y	Mx D 0.001uF 1500V	25p
BX42V	Mx D 0.0047uF 1000V	DIS
BX43W	Mix D 0.01 1000V	DIS
BX44X	Mix D 0.022uF 1000V	DIS
BX45Y	Mix D 0.047uF 1000V	DIS
BX67X	Mix D 0.1uF 600V	DIS
BX68Y	Mix D 0.1uF 1000V	DIS
BX69A	Mix D 0.22uF 1000V	DIS
BX90X	Mix D 0.47uF 1000V	DIS
BX91Y	Mix D 1.0uF 600V	DIS
WW54J	Tant 0.1uF 35V	13p
WW55K	Tant 0.15uF 35V	13p
WW56L	Tant 0.22uF 35V	16p
WW57M	Tant 0.33uF 35V	18p
WW58N	Tant 0.47uF 35V	17p
WW59P	Tant 0.68uF 35V	17p
WW60Q	Tant 1.0uF 35V	18p
WW61R	Tant 1.5uF 35V	18p
WW62S	Tant 2.2uF 35V	23p
WW63T	Tant 3.3uF 35V	19p
WW64U	Tant 4.7uF 16V	18p
WW65V	Tant 4.7uF 35V	19p
WW66W	Tant 6.8uF 16V	21p
WW67X	Tant 6.8uF 35V	24p
WW68Y	Tant 10uF 16V	25p
WW69A	Tant 10uF 25V	28p
WW70M	Tant 10uF 35V	36p
WW72P	Tant 22uF 16V	39p
WW73Q	Tant 22uF 25V	65p
WW74R	Tant 33uF 10V	32p
WW75S	Tant 47uF 10V	57p
WW76H	Tant 47uF 16V	75p
WW78K	Tant 100uF 3V	35p
WW79L	Tant 100uF 10V	£1.25
YY29G	Minelect 0.1uF 50V	13p
YY30H	Minelect 0.47uF 50V	13p
YY31J	Minelect 1uF 50V	14p
YY32K	Minelect 2.2uF 50V	15p
YY33L	Minelect 4.7uF 25V	21p
YY34M	Minelect 10uF 16V	13p
YY35Q	Minelect 10uF 25V	16p
YY36P	Minelect 22uF 16V	18p
YY37S	Minelect 47uF 16V	22p

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FF00A	PC Elect 0.47uF 100V	11p
FF01B	PC Elect 1uF 100V	11p
FF02C	PC Elect 2.2uF 63V	10p
FF03D	PC Elect 4.7uF 63V	10p
FF04E	PC Elect 10uF 35V	10p
FF05F	PC Elect 10uF 63V	11p
FF06G	PC Elect 22uF 16V	10p
FF07H	PC Elect 22uF 63V	12p
FF08J	PC Elect 47uF 25V	12p
FF09K	PC Elect 47uF 63V	14p
FF10L	PC Elect 100uF 10V	10p
FF11M	PC Elect 100uF 25V	12p
FF12N	PC Elect 100uF 63V	22p
FF13P	PC Elect 220uF 16V	12p
FF14Q	PC Elect 220uF 63V	33p
FF15R	PC Elect 470uF 16V	20p
FF16S	PC Elect 470uF 25V	25p
FF59P	PC Elect 470uF 63V	56p
FF17T	PC Elect 1000uF 16V	27p
FF18U	PC Elect 1000uF 25V	33p
FF60Q	PC Elect 2200uF 16V	42p
FB11M	Axial 0.47uF 250V	21p
FB12N	Axial 1uF 63V	8p
FB13P	Axial 1uF 450V	25p
FB14Q	Axial 1.5uF 63V	10p
FB15R	Axial 2.2uF 63V	10p
FB16S	Axial 2.2uF 450V	30p
FB17T	Axial 3.3uF 63V	10p
FB18U	Axial 4.7uF 63V	12p
FB19V	Axial 4.7uF 450V	33p
FB20W	Axial 6.8uF 40V	15p
FB21X	Axial 6.8uF 63V	16p
FB22Y	Axial 10uF 25V	9p
FB23A	Axial 10uF 63V	11p
FB24B	Axial 10uF 100V	18p
FB25C	Axial 10uF 450V	45p
FB26D	Axial 15uF 16V	9p
FB27E	Axial 15uF 40V	11p
FB28F	Axial 15uF 63V	16p
FB29G	Axial 22uF 10V	10p
FB30H	Axial 22uF 25V	11p
FB31J	Axial 22uF 63V	16p
FB32K	Axial 22uF 100V	24p
FB33L	Axial 22uF 450V	55p
FB34M	Axial 33uF 6.3V	10p
FB35Q	Axial 33uF 16V	11p
FB36P	Axial 33uF 40V	12p
FB37S	Axial 47uF 4V	14p
FB38R	Axial 47uF 10V	10p
FB39N	Axial 47uF 25V	13p
FB40T	Axial 47uF 40V	14p
FB41U	Axial 47uF 63V	17p
FB42V	Axial 47uF 100V	32p
FB43W	Axial 47uF 450V	85p
FB44X	Axial 68uF 6.3V	15p
FB45Y	Axial 68uF 16V	16p
FB47B	Axial 100uF 6.3V	DIS
FB48C	Axial 100uF 10V	11p
FB49D	Axial 100uF 25V	14p
FB50E	Axial 100uF 40V	18p
FB51F	Axial 100uF 63V	22p
FB52G	Axial 100uF 100V	52p
FB53H	Axial 100uF 250V	85p
FB54J	Axial 150uF 6.3V	21p
FB55K	Axial 150uF 16V	13p
FB56L	Axial 150uF 25V	15p
FB58N	Axial 150uF 63V	32p
FB59P	Axial 220uF 6.3V	DIS
FB60Q	Axial 220uF 10V	12p
FB61R	Axial 220uF 16V	14p
FB62S	Axial 220uF 25V	18p
FB63T	Axial 220uF 40V	27p
FB64U	Axial 220uF 63V	32p
FB65V	Axial 220uF 100V	55p
FB66W	Axial 330uF 6.3V	DIS
FB67X	Axial 330uF 10V	14p
FB68Y	Axial 330uF 25V	20p
FB69A	Axial 330uF 63V	44p
FB70M	Axial 470uF 6.3V	15p
FB71N	Axial 470uF 10V	22p
FB72P	Axial 470uF 16V	26p
FB73Q	Axial 470uF 25V	30p
FB74R	Axial 470uF 63V	55p
FB75S	Axial 470uF 100V	89p
FB77J	Axial 680uF 16V	30p
FB78K	Axial 680uF 25V	38p
FB79L	Axial 680uF 40V	68p
FB80B	Axial 1000uF 6.3V	29p
FB81C	Axial 1000uF 10V	25p
FB82D	Axial 1000uF 16V	32p
FB83E	Axial 1000uF 25V	40p
FB84F	Axial 1000uF 63V	£1.00
FB85G	Axial 1500uF 6.3V	32p
FB86T	Axial 1500uF 10V	38p
FB87U	Axial 1500uF 16V	42p
FB89W	Axial 2200uF 10V	40p
FB90X	Axial 2200uF 25V	57p
FB91Y	Axial 2200uF 40V	98p
FB92A	Axial 2200uF 63V	£1.54
FB93B	Axial 3300uF 6.3V	58p
FB94C	Axial 3300uF 25V	94p
FB95D	Axial 4700uF 10V	60p
FB96E	Axial 4700uF 25V	£1.25

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FB97F	Reversolytic 1uF	29p
FB00A	Reversolytic 1.5uF	32p
FB01B	Reversolytic 2.2uF	36p
FB02C	Reversolytic 3.3uF	42p
FB03D	Reversolytic 4.7uF	46p
FB04E	Reversolytic 6.8uF	54p
FB06G	Reversolytic 10uF	58p
FB07H	Reversolytic 15uF	66p
FB08J	Reversolytic 22uF	68p
FB09K	Reversolytic 33uF	70p
FF19V	Can 1000uF 100V	£1.86
FF20W	Can 1500uF 63V	£1.95
FF21X	Can 2200uF 40V	£1.86
FF22Y	Can 2200uF 63V	£3.25
FF24B	Can 3300uF 40V	£2.15
FF25C	Can 3300uF 63V	£3.55
FF26D	Can 4700uF 25V	£1.45
FF27E	Can 4700uF 40V	£4.35
FF28F	Can 4700uF 63V	£3.85
FF29G	Can 4700uF 100V	£5.35
FF30H	Can 6800uF 40V	£4.85
FF31J	Can 10,000uF 25V	£4.95
FF32K	Can 10,000uF 63V	£5.45
FF33L	Clip Can 25	15p
FF34M	Clip Can 35	19p
FF35Q	Clip Can 40	19p
FF36P	Clip Can 50	45p
FF37S	Horiz Clip 25	18p
FF38R	Horiz Clip 35	18p
WL68Y	Trimmer 5.5pF	30p
WL69A	Trimmer 10pF	30p
WL70M	Trimmer 22pF	26p
WL72P	Trimmer 65pF	29p
WL71N	Trimmer 40pF	19p
WL73Q	Trimmer 500pF	33p
YQ24B	AM Vantune	£1.32

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FF39N	Vari O	£4.62
FF40T	DG Vari	£6.95
FF41U	Twin OO	£7.16
FF42V	SW Trim 10pF	£4.45
FF43W	SW Trim 15pF	£4.95
FF44X	SW Trim 25pF	£4.80
FF45Y	SW Trim 50pF	£4.45
FF46A	SW Trim 60pF	£5.35
FF47B	SW Trim 75pF	£4.45
FF48C	SW Trim 100pF	£6.10
FF49D	SW Trim 150pF	£5.50
FF50E	Dilecon 300pF	£4.45
FF51F	Dilecon 500pF	£4.35
FY77J	FS Crystal 100kHz	£4.55
HX62S	FS Crystal 1MHz	£5.95
FY78K	FS Crystal 10MHz	£2.95
FY79L	MP Crystal 1MHz	£4.45
FY80B	MP Crystal 2MHz	£2.20
FY81C	MP Crystal 2.4576MHz	£3.35
FY82D	MP Crystal 4MHz	£1.80
FY83E	MP Crystal 6.144MHz	£1.25
FY84F	MP Crystal 18.432MHz	£2.65
HX30H	MCR Crys Brown Pairs	£2.96
HX31J	MCR Crystal Red Pair	£2.96
HX32K	MCR Crys Orange Pair	£2.96
HX33L	MCR Crys Yellow Pair	£2.96
HX34M	MCR Crystal Green Pr	£2.96
HX35Q	MCR Crys Blue Pair	£2.96
FY85G	Colour TV Crystal	£1.20

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FY86T	Crystal 50HzX 2.16	£3.15
FY87U	Crystal 1HzX 2.22	£3.15
HX60Q	Crystal Socket 25u	23p
HX61R	Crystal Socket 6u	45p
HX99H	Ceramic Fltr 10.7MHz	60p

CAR EQUIPMENT

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HW18U	Car Aerial Pull Up	£1.99
YB67X	Car Aerial Roof Top	£5.75
LH99H	Windscreen Aerial	£2.69
XX37S	Car Aerial Booster	£6.95
RW29G	Plugpak R	£1.95
RW30H	Plugpak S	£2.35
HW11M	Cigar Lighter	DIS
YX75S	Accessory Socket	DIS
HW12N	Car Accessory Plug	45p
YB68Y	Car Lighter Ext Lead	£2.25
YW59P	Car Power Lead	£2.70
FQ73Q	Map Light	69p

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HW22Y	12V Inspection Lamp	£1.60
FQ76H	Inspection Lamp L86	DIS
WY10L	Front Fog Lamp	£11.55
LY07H	Fog Lamp	£5.65
LQ13P	Wiper Kit	£21.75
LY08J	Reversing Lamp	£4.55
LQ14Q	Washer Kit	£12.78
WY09K	Demister	£6.95
HQ30H	Wiper Control	£9.65
FQ78K	Car Ammeter	£2.95

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HQ35Q	Charger Ammeter	£1.47
HW16S	Car Flash 4-Lamp	£1.63
HW17T	Car Flash 6-Lamp	£1.55
FQ79L	Caravan Flasher	£7.45
FQ92A	7-Pin Trailer Plug	£2.35
FQ93B	7-Pin Trailer Socket	£2.98
XR55K	7-Core Trailer Cable	£1.15
FQ94C	Trailer Socket Bolts	33p
YB70M	Trailer Lamp Cluster	£4.97
YB71N	Trailer Reflector	£1.45
FQ95D	Sign 50mph	29p
FQ96E	Sign GB	29p
FQ88V	Plug-Top Supp Strt	38p
FQ89W	Plug-Top Supp Ang	50p
FQ90X	In-Line Plug Supp	25p

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HW01B	Supp Cap Small Lucar	59p
HW02C	Supp Cap Large Lucar	DIS
HW03D	Supp Cap Spade	59p
FQ87U	Supp Cap 3uF	£1.12
FQ91Y	Suppressor Choke	84p
FQ77J	Jumper Leads	£4.40
YL02C	Magnilamp	95p
FQ97F	Anti-Glare Strip	85p
FQ98G	Luggage Elastic	45p
FQ99H	Ice Scraper	28p
YB72P	Tow Rope	£4.25
FY00A	Keep Clean Kit	DIS
YB94C	Plug Spanner	DIS
FY01B	Tyre Pressure Gauge	£1.95
*XY74R	Electric Pump	£18.79

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XB44X	Car Speakers Shelf	£6.75
XB42V	Car Speakers Door	£6.45
XY73Q	10W Shelf Spkrs	£18.25
XQ75S	10W Car Stereo Spkrs	£13.95
XQ76H	20W Air Suspen Spkrs	£19.49
LY06G	Car Cassette Carrier	£4.85
AF00A	Booster Amp	£17.99
AF01B	Booster Equaliser	£37.50

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YX86T	Flow Sensor	£16.90
YX85G	Speed Sensor	£11.93

CONNECTORS

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HF25C	Croc Clips	10p
HF23A	Alligator Clip Black	13p
HF24B	Alligator Clip Red	11p
HF26D	Charger Clip	25p
BW69A	Croc Lead Kit	£1.45
HF10L	Push-On Receptacle	33p
HF11M	Push-On Blade	33p
HF12N	Push-On Covers	73p
YX47B	Comcon Block 5-way	36p
YX48C	Comcon Terminal	5p
HF02C	Terminal Post Black	35p
HF03D	Terminal Post Blue	37p
HF04E	Terminal Post Brown	37p
HF05F	Terminal Post Green	38p
HF06G	Terminal Post Grey	38p
HF07H	Terminal Post Red	35p
HF08J	Terminal Post White	38p
HF09K	Terminal Post Yellow	38p
HF13P	Press Terminal Black	28p
HF14Q	Press Terminal Blue	28p
HF15R	Press Terminal Green	28p
HF16S	Press Terminal Red	28p
HF17T	Press Terminal White	30p
HF18U	Press Terminal Yellw	28p
BW72P	Quickterm Lever 2way	49p
YR92A	Quickterm Type B	62p
BW71N	Quckterm Push 4 way	62p

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WL57M	1mm Plug Black	20p
WL58N	1mm Plug Red	20p
WL59P	1mm Socket Black	15p
WL60Q	1mm Socket Red	15p
HF38R	2mm Plug Black	17p
HF39N	2mm Plug Blue	18p
HF40T	2mm Plug Green	17p
HF41U	2mm Plug Red	17p
HF42V	2mm Plug White	17p
HF43W	2mm Plug Yellow	18p
HF44X	2mm Socket Black	15p
HF45Y	2mm Socket Blue	15p
HF46A	2mm Socket Green	15p
HF47B	2mm Socket Red	15p
HF48C	2mm Socket White	15p
HF49D	2mm Socket Yellow	15p
HF50E	Wander Plug Black	17p
HF51F	Wander Plug Blue	17p
HF52G	Wander Plug Green	17p
HF53H	Wander Plug Red	17p
HF54J	Wander Plug White	17p
HF55K	Wander Plug Yellow	12p
HF56L	Wander Socket Black	12p
HF57M	Wander Socket Blue	12p
HF58N	Wander Socket Green	12p
HF59P	Wander Socket Red	12p
HF60Q	Wander Socket White	12p
HF61R	Wander Socket Yellow	12p
HF62S	4mm Plug Black	15p
HF63T	4mm Plug Blue	15p
HF64U	4mm Plug Brown	15p
HF65V	4mm Plug Green	15p
HF66W	4mm Plug Red	15p
HF67X	4mm Plug White	15p
HF68Y	4mm Plug Yellow	15p
HF69A	4mm Socket Black	15p
HF70M	4mm Socket Blue	15p
HF71N	4mm Socket Brown	15p
HF72P	4mm Socket Green	15p
HF73Q	4mm Socket Red	15p
HF74R	4mm Socket White	17p
HF75S	4mm Socket Yellow	19p
HF34M	4mm Patch Cord	£1.98
HQ54J	Screw-Cap Phono Blk	12p
HQ55K	Screw Cap Phono Blue	12p
HQ58N	Screw Cap Phono Red	12p
HQ59P	Screw Cap Phono Whte	12p
HQ60Q	Screw Cap Phono Yell	12p
HH01B	Scr Phono	17p
YW06G	Threaded Phono Skt	15p
HH02C	Phono Socket Single	12p
HH03D	Phono Socket Twin	16p
BW74R	Phono Socket Quad	35p
BW75S	Phono Socket 5-way	45p
BW76H	Phono Socket 6-way	55p

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HH04E	Line Phono	20p
HH05F	Phono Conn	19p
HF76H	2.5 Plug Plas	13p
HF77J	2.5 Plug Scr	22p
HF78K	2.5 Jack Socket	11p
HF79L	2.5 Line Socket	30p
HF80B	Plug Plas 3.5	12p
HF81C	Plug Scr 3.5	22p
HF82D	Jack Socket 3.5	14p
HF83E	Line Socket Plas 3.5	15p
HF84F	Line Socket Scr 3.5	21p
HF85G	Jack Plug Plas	19p
HF86T	Side Jack Plas	24p
HF87U	Jack Plug Scr	39p
YW07H	SR Jack Plug	41p
YL03D	Side Jack Screened	29p
HF88V	Jack Pl Sto Plas	28p
HF89W	Jack Pl Sto Scr	45p
HF90X	Jack Skt Brk	21p
BW78K	Chro Mono Jack Skt	39p
HF91Y	Jack Skt Open	19p
HF92A	Jack Skt Sto	25p

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BW79L	Chro Stereo Jack Skt	35p
HF93B	Stereo Open Skt	35p
BW80B	DPDT Jack Socket	52p
HH19V	Line Jack Plas	24p
HH20W	Scr Line Jack	42p
HH21X	Stereo Line Skt	30p
HH22Y	Scr Stereo Line Skt	58p
HH07H	Co-ax Plug Aly	24p
HH06G	Co-ax Plug Plas	20p
YW08J	Co-ax Plug Imp	15p
HH08J	Co-ax Socket Pan	29p
HH09K	Co-ax Socket Flush	25p
YW09K	Co-ax Line Skt	43p
HH11M	Co-ax Conn	15p
HH13P	Skeleton Car Plug	14p
HH12N	Car Plug Plas	49p
HH14Q	Chassis Car Socket	24p
HH15R	Car Line Socket	DIS
HH16S	FM Aerial Plug	17p
HH17T	BNC Plug	98p
HH18U	BNC Socket	98p
GA84F	Remote Data Ltch PCB	£2.10

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YW00A	BNC Square Socket	85p
YW01B	BNC Line Socket	£1.10
YW02C	BNC Straight Adaptor	£1.37
YW03D	BNC T Adaptor	£2.95
BW81C	Plug PL259	51p
BW82D	UHF Reducer Small	17p
BW83E	UHF Reducer Large	17p
BW84F	UHF Socket Round	49p
BW85G	Socket SO239	53p
BW86T	UHF Elbow Adaptor	£1.32
BW87U	UHF Straight Adaptor	59p
BW88V	UHF T Adaptor	£1.55
YW04E	Adaptor 239	£1.12
YW05F	Adaptor 259	£1.40
YX51F	Audio Conn 2-way	£1.15
YX52G	Audio Conn 3-way	£1.35
YX53H	Audio Conn 4-way	£1.26
YX54J	Audio Conn 5-way	£1.55
YX55K	Audio Conn 6-way	£1.75
BW89W	XLR Line Plug	£1.82

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BW90X	XLR Chassis Socket	£2.95
BW91Y	XLR Line Socket	£2.35
BW92A	XLR Chassis Plug	£1.45
BW94C	Dinlatch 5-pin A Plg	£1.39
BW98G	Dinltch Sckt 5-pin A	69p
HH24B	DIN L/S Plug	10p
HH25C	DIN Plug 3-pin	16p
HH26D	DIN Plug 4-pin	30p
HH27E	DIN Plug 5-pin A	14p
HH28F	DIN Plug 5-pin B	19p
HH29G	DIN Plug 6-pin	39p
HH30H	DIN Plug 7-pin	19p
HH31J	DIN L/S Socket	7p
HH32K	DIN Socket 3-pin	16p
HH33L	DIN Socket 4-pin	16p
HH34M	DIN Socket 5-pin A	14p
HH35Q	DIN Socket 5-pin B	18p
HH36P	DIN Socket 6-pin	21p
HH37S	DIN Socket 7-pin	19p
HH40T	DIN Line Skt 2-pin	15p
HH41U	DIN Line Scket 3-pin	16p
HH42V	DIN Line Scket 4-pin	DIS
HH43W	DIN Line Skt 5-pin A	29p
HH44X	DIN Line Skt 5-pin B	21p
HH45Y	DIN Line Scket 6-pin	20p
HH46A	DIN Line Scket 7-pin	DIS
YX90X	PC DIN Skt 2-pin	25p
YX91Y	PC DIN Skt 5-pin A	25p

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YQ48C	D-Range 25-Way Plug	£2.15
YQ49D	D-Range 25W Socket	£2.35
YQ50E	D-Range 25-Way Cover	£1.92
YQ51F	D-Range Latch	33p
WQ14Q	PCB Connectors 45	7p
WQ15R	PCB Connectors Vert	7p
WQ16S	PCB Connectors Horz	7p
FL83E	Edge Connector 108	52p
FL84F	Edge Connector 116	£1.08
FL85G	Edge Connector 124	£1.29
FL86T	Edge Connector 132	£1.95
FL87U	Edge Connector 140	DIS
FL91Y	Edge Connector FeetG	15p
FL92A	Edge Connector FeetH	14p
FL93B	Edge Connector FeetL	DIS
FL30H	Edge Connector Silvr	£1.99
YR57M	Card Frame Edge Conn	£3.95
YR58N	Edge Conn End Bkt	23p

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HL01B	Octal Ch Plug	75p
HL00A	Octal Ch Skt	50p
HL02C	8-way Plug	95p
HL03D	8-way Socket	99p
HF35Q	Voltage Selector Skt	DIS
†HF37S	Voltage Selector Plg	95p
YX33L	Multicon Plug 2-way	15p
YX34M	Multicon Plug 4-way	20p
YX35Q	Multicon Plug 9-way	29p
YX36P	Multicon Plug 15-way	43p
YX37S	Multicon Plug 24-way	58p
YX38R	Multicon Plug 36-way	78p
YX39N	Multicon Skt 2-way	18p
YX40T	Multicon Skt 4-way	19p
YX41U	Multicon Skt 9-way	27p
YX42V	Multicon Skt 15-way	45p
YX43W	Multicon Skt 24-way	59p
YX44X	Multicon Skt 36-way	68p
YX45Y	Multicon Plug Pin	3p
YX46A	Multicon Skt Pin	3p

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YW10L	Minicon Plug 3-pin	20p
YW11M	Minicon Plug 4-pin	22p
YW12N	Minicon Plug 6-pin	29p
YW13P	Minicon Plug 8-pin	29p
YW14Q	Minicon Plug 12-pin	48p
YW15R	RA Minicon Pl 3-pin	31p
YW16S	RA Minicon Pl 4-pin	38p
YW17T	RA Minicon Pl 6-pin	47p
YW18U	RA Minicon Pl 8-pin	52p
YW19V	RA Minicon Pl 12-pin	74p
YW20W	Minicon Hsg 3-pin	10p
YW21X	Minicon Hsg 4-pin	10p
YW22Y	Minicon Hsg 6-pin	12p
YW23A	Minicon Hsg 8-pin	15p
YW24B	Minicon Hsg 12-pin	17p
YW25C	Minicon Terminal	3p
YW26D	Minicon Skt 3-way	24p
YW27E	Minicon Skt 4-way	30p
YW28F	Minicon Skt 6-way	36p
YW29G	Minicon Skt 8-way	50p
YW30H	Minicon Skt 12-way	65p
YW31J	Polarcon 0.1in	6p

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YW95D	IDC Con 3-way	20p
YW96E	IDC Con 4-way	26p
YW97F	IDC Con 6-way	38p
YW98G	IDC Con 8-way	50p
YW99H	IDC Con 12-way	88p
YX49D	IDC Insertion Tool	£1.98
HL04E	Wafercon Plug 3-pin	12p
HL05F	Wafercon Plug 4-pin	14p
HL06G	Wafercon Plug 6-pin	19p
HL07H	Wafercon Plug 8-pin	19p
HL08J	Wafercon Plug 12-pin	29p

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HL09K	Wafercon Skt 3-way	11p
HL10L	Wafercon Skt 4-way	10p
HL11M	Wafercon Skt 6-way	16p
HL12N	Wafercon Skt 8-way	17p
HL13P	Wafercon Skt 12-way	25p
HL14Q	Wafercon Terminal	3p
YW32K	Polarcon 0.2in	6p
YW40T	Compactboard	£13.50
YY22Y	CB Pin Blue	37p
YY23A	CB Pin Red	37p
YY26D	CT Pin White	£1.26
YY27E	AT Pin Black	£1.33
YR63T	CB Plug Extractor	£7.50
YB08J	Large Patchboard	£111.00
WQ10L	Large Patch Plug	37p
HH39N	Multi-position Plug	67p
HH38R	Universal Plug	85p

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HH60Q	Std Power Plug 2.1	14p
HH61R	Long Pwr Plug 2.1	16p
HH62S	Std Power Plug 2.5	15p
HH63T	Long Pwr Plug 2.5	15p
HH85G	Power Skt 2.1	20p
HH86T	Power Skt 2.5	22p
HH87U	Cassette Skt Nivico	39p
HH88V	Cassette Skt Paros	46p
HL17T	USA Mains Plug	20p
HL18U	Flat Pin M/S	27p
HL19V	Flat Pin Conn	31p
RW56L	Cas Lead Crown	60p
RW57M	Cas Lead Hitachi	60p
RW58N	Cas Lead Nat Pan	60p
RW59P	Cas Lead Nivico	60p
RW60Q	Cas Lead Dtake-Drion	60p
RW61R	Cas Lead Paros	65p
RW62S	Cas Lead Philips	75p
RW63T	Cas Lead Sanyo	60p
RW64U	Cas Lead Sharp	60p

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RW65V	Cas Lead Sony	60p
RW66W	Cas Lead Telefunken	65p
YX62S	Cassette Lead OS219	60p
YX63T	Cassette Lead 955	60p
HL16S	Eurosocket	69p
HL15R	Europlug	48p
HL42V	Euro Facility Outlet	£1.55
HL43W	Euro Facility Plug	75p
BW99H	Euroconn Lead	£1.75
*WY16S	Euroboard 4-way	£7.35
WY17T	Euroboard 6-way	£10.75
HL20W	Mains Plug P429	64p
HL44X	Mains Socket P646	£1.39
HL23A	Mains Socket P430SE	£1.15
HL45Y	Mains Plug P649	£1.15
HL46A	Mains Socket P650	98p
HL47B	Mains Plug SA2403	£1.36
HL48C	Mains Socket SA2404	94p
HL27E	Mains Plug SA2190	49p

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HL28F	Mains Socket SA1862	52p
HL49D	Mains Socket SA2111	£1.75
HL30H	Mains Plug SA2019A	£1.48
HL31J	Mains Socket SA2020	£1.34
HL33L	Mains Plug SA2367	£1.55
HL34M	Mains Socket SA2368	93p
HL36P	Mains Plug P635	£1.05
HL37S	Mains Socket P636	£1.29
HL39N	Mains Plug P551	£2.97
HL40T	Mains Socket P552	98p
HL50E	Sleeve 8037	12p
HL51F	Boot 9455	27p
HL52G	Boot 8878	38p

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

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RW23A	Dinpak K	65p
RW24B	Dinpak L	87p
RW18U	Dinpak E	82p
RW19V	Dinpak F	95p
RW17T	Dinpak D	£1.42
RW20W	Dinpak G	£1.34
RW49D	Dinpak 280	£1.55

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RW37S	Dinpak 205	DIS
RW48C	Plugpak 279	89p
RW50E	Plugpak 282	89p
RW51F	Plugpak 283	£1.85
RW28F	Plugpak Q	65p
RW31J	Plugpak T	£2.25
RW32K	Plugpak V	DIS
RW34M	Plugpak X	£2.48
RW35Q	Plugpak HD Guitar	£4.45

CONSUMER

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AF18U	Canon LC31	£6.95
AF19V	Canon LC52	£11.85
AF20W	Canon FC42	£13.95

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AF21X	Canon LC61T	£16.95
AF22Y	Canon P7-D	DIS
YX88V	P7 Paper Roll	46p
YX89W	P7 Ink Cassette	£2.75

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AF02C	Atari 800 Computer	£499.00

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AF03D	Atari 400 8K Computr	DIS
AF28F	Recorder 410	£50.00
AF04E	Printer 822	£265.00

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AF06G	Disc Drive 810	£299.95
YX87U	Mini Floppy Disc	£2.50
AF29G	Interface 850	£135.00
AF07H	8K Memory Module	NYA
AF08J	16K Memory Module	£55.00
AF05F	Printer 825	£550.00
AF30H	Modem 830	NYA
AC38R	See YG48C	See
AC39N	See YG63T	note
AC40T	See YG66W	below

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WF20W	Mag Headset	£4.85
LH81C	Education Headphone	£5.75
LH82D	Boom Mic Headphone	£12.35
LH83E	Stereophone OH150P	£4.25
WF13P	Stereophone HP110C	£5.40
WF14Q	Stereophone DH207	£7.99
LH84F	Stereophone M110B	£8.60
LH85G	Stereophone HS310	£12.50

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WF19V	Stereophone Elec 100	DIS
LB13P	Headphone Adaptor	£3.95
LB72P	Intercom 2-Station	£8.75
XY78K	FM Intercom Pair	DIS
XY77J	4-Channel FM Intrcom	£29.95

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WY11M	Compact PA Amp	£22.70
WY12N	10W PA Amp	£29.95
XY81C	40W PA Amp	£65.50
XY82D	60W PA Amp	£106.75

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AF09K	AM Radio	£1.95
AF10L	AM/FM Radio	£4.95
AF11M	AM/FM/Air Radio	DIS
AF17T	5-Band Radio	£37.50
AF12N	Teak Clock Radio	£22.50
AF13P	Silver Clock Radio	DIS

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AF14Q	Cassette Clock Radio	£45.90
AF15R	3-Band Radio Recordr	DIS
AF16S	4-Band Recorder	DIS
AF27E	GE1305 Equaliser	£77.50

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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	Fun Wth Numbers Game	£14.95
AC10L	Codebreaker Game	£18.95
AC11M	Hunt & Score Game	£18.95
AC12N	Miniature Golf Game	£14.95
AC13P	Skydiver Game	£14.95
AC14Q	Street Racer Game	£18.95
AC15R	Bowling Game	£18.95

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

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

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AC20W	Circus Game	£24.95
AC17T	Human Cannonball	£14.95
AC23A	Casino Game	£18.95
AC31J	Night Driver Game	£24.95
AC32K	Dodge Em	£18.95
AC33L	Pele Soccer Game	£24.95

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AC34M	Hangman Game	£14.95
AC35Q	Video Checkers	£18.95
AC36P	Maze Craze	£24.95
AC29G	Video Game Keyboard	£13.95
AC30H	Video Game Paddles	£13.95
AC37S	Video Game Joysticks	£13.95

ELECTRICAL

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

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HL65V	Junction Box Small	£1.50
HL66W	Junction Box Lge	99p
HL67X	Junction Box RM	£1.75
HL68Y	Single Skt Unswtched	£1.85
HL69A	Dble Skt Unswitched	£3.75
HL70M	Dble Skt Unswchd Slv	£7.30
HL71N	Single Sw Socket	£2.60
HL72P	Double Sw Socket	£5.20
HL73Q	Trailing Skt Single	£1.75
HL74R	Trailing Dble Skt	£3.45
RW68Y	Dis Board 4-way	£8.75
HL76H	Cooker Switch	£8.45
HL77J	Neon Cooker Switch	DIS
HL78K	Shaver Skt Isolated	£18.75

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HL79L	Shaver Socket	82p
HL80B	Cooker Outlet C	£2.10
HL81C	Cooker Outlet T	£3.45
HL82D	Flex Outlet Unswchd	£3.95
HL83E	Switched Flex Outlet	£4.38
HL84F	Clock Connector S	DIS
HL85G	Clock Connector B	DIS
HL86T	Blanking Plate	85p
HL87U	20A Plateswitch	£3.20
HL88V	20A Water Htr Switch	£4.85
HL89W	Light Swch ST Single	£1.08
HL90X	Light Swch DT Single	£1.49
HL91Y	Light Swch Dual	£2.39
HL92A	Light Switch Triple	£3.25
HL93B	Light Switch Quad	DIS

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FQ10L	250W Rotary Dimmer	£7.30
FQ12N	250W Push Dmr Sngl	£9.95
FQ13P	250W Push Dmr Dble	£19.49
*FQ14Q	250W Touch Dimmer	£15.95
XX35Q	Remote Control Dmmr	£29.45
XX36P	Dmmr Control Box	£15.75
FQ15R	Security Dimmer	£16.95
FQ16S	Auto Security Switch	£15.32
YB09K	Fl Pattress 16mm Sgl	96p
YB10L	Fl Pattress 25mm Sgl	70p
YB11M	Fl Pattress 25mm Dbl	£1.06
YB12N	Fl Pattress 35mm Dbl	£1.34
YB13P	Steel Pattress 47mm	£2.62
YB14Q	Sur Patt 20mm Sngl	78p
YB15R	Sur Patt 29mm Sngl	98p
YB16S	Sur Patt 29mm Dble	£1.65
YB17T	Sur Patt 47mm Dble	£3.68
YB18U	Conversion Pattress	£2.62

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FQ00A	Ceiling Switch 1-way	£2.65
FQ01B	Ceiling Switch 2-way	DIS
FQ02C	Lampholder 702	79p
FQ03D	Lampholder 254 CG	DIS
FQ04E	Lampholder 252 1/2in	65p
LB63T	Bayonet L/Hldr	88p
FQ05F	Ceiling Rose	£1.12
FQ06G	BC Adaptor	DIS
FQ07H	Starter 80W	25p
YB19V	Time Switch	£16.95
RW69A	Power Controller	DIS
YB20W	Room Thermostat	£8.25
XY08J	Extn Lead 5A	£13.80
XY09K	Extn Lead 13A	£17.95

HARDWARE

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BF00A	Bolt 2BA 1/2in	33p
BF01B	Bolt 2BA 1in	85p
BF02C	Bolt 4BA 1/4in	25p
BF03D	Bolt 4BA 1/2in	28p
BF04E	Bolt 4BA 1in	30p
LR52G	Bolt 4BA 1.1/2in	33p
BF05F	Bolt 6BA 1/4in	12p
BF06G	Bolt 6BA 1/2in	14p
BF07H	Bolt 6BA 1in	43p
LR53H	Bolt 6BA 1.1/2in	63p
BF08J	Bolt 8BA 1/4in	28p
BF09K	Bolt 8BA 1/2in	24p
LR54J	C/S Screw 2BA 1/2in	14p
LR55K	C/S Screw 4BA 1/4in	14p
BF10L	C/S Screw 4BA 1/2in	17p
BF11M	C/S Screw 4BA 1in	32p
LR56L	C/S Screw 6BA 1/4in	9p
BF12N	C/S Screw 6BA 1/2in	19p
BF13P	C/S Screw 6BA 1in	35p
LR00A	C/S Screw 8BA 1/2in	29p
BF14Q	Panel Screw	3p
LR75S	C/S Panel Screw	5p
BF16S	Nut 2BA	19p
BF17T	Nut 4BA	19p
BF18U	Nut 6BA	12p
BF19V	Nut 8BA	12p
BF20W	Washer 2BA	12p
BF21X	Washer 4BA	9p
BF22Y	Washer 6BA	9p
BF23A	Washer 8BA	9p
LR76H	Cup Washer	2p
BF24B	Shake 2BA	9p
BF25C	Shake 4BA	9p
BF26D	Shake 6BA	9p
LR01B	Shake 8BA	8p
BF27E	Tag 2BA	12p
BF28F	Tag 4BA	9p
BF29G	Tag 6BA	13p
LR02C	Tag 8BA	11p

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BF30H	Pozi Screw M5 6mm	23p
BF31J	Pozi Screw M5 12mm	33p
BF32K	Pozi Screw M5 25mm	33p
BF33L	Pozi Screw M4 6mm	25p
BF34M	Pozi Screw M4 12mm	32p
BF35Q	Pozi Screw M4 25mm	27p
BF36P	Pozi Screw M3 6mm	13p
LR57M	Pozi Screw M3 9mm	13p
BF37S	Pozi Screw M3 12mm	15p
BF38R	Pozi Screw M3 25mm	27p
LR58N	Pozi Screw M3 40mm	33p
BF39N	Pozi Screw M2.5 6mm	15p
BF40T	Pozi Screw M2.5 12mm	18p
BF41U	Pozi Screw M2 6mm	29p
BF46A	Isobolt M5 12mm	55p
BF48C	Isobolt M4 6mm	26p
BF49D	Isobolt M4 12mm	33p
BF50E	Isobolt M4 25mm	57p
BF51F	Isobolt M3 6mm	20p
BF52G	Isobolt M3 12mm	26p
BF53H	Isobolt M3 25mm	35p
BF54J	Isobolt M2 5 6mm	19p
BF55K	Isobolt M2.5 12mm	24p
BF56L	Isonut M5	20p
BF57M	Isonut M4	20p
BF58N	Isonut M3	15p
BF59P	Isonut M2 5	14p
LR59P	Isonut M2	10p
BF60Q	Isowasher M5	15p
BF61R	Isowasher M4	9p
BF62S	Isowasher M3	9p
BF63T	Isowasher M2 5	9p
LR60Q	Isowasher M2	7p
BF42V	Isoshake M5	12p
BF43W	Isoshake M4	9p
BF44X	Isoshake M3	9p
BF45Y	Isoshake M2.5	9p
LR61R	Isoshake M2	9p

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LR62S	Isotag M5	18p
LR63T	Isotag M4	20p
LR64U	Isotag M3	12p
LR65V	Isotag M2.5	12p
LR66W	Isotag M2	9p
BF68Y	Slf-Tpr No.8 x 3/8in	22p
BF69A	Slf-Tpr No 8 x 1/2in	25p
LR67X	Slf-Tpr No.6 x 3/8in	20p
BF67X	Slf-Tpr No.6 x 1/2in	22p
BF65V	Slf-Tpr No 4 x 3/8in	15p
BF66W	Slf-Tpr No 4 x 1/2in	16p
BF64U	Slf-Tpr No.2 x 3/16"	12p
LR68Y	Slf-Tpr No 2 x 3/8in	14p
BF70M	Nyl 2BA 1/2in	86p
BF71N	Nyl 2BA 1in	95p
BF72P	Nyl 4BA 1/2in	39p
BF73Q	Nyl 4BA 1in	55p
BF74R	Nyl 4BA 1 1/2in	£1.55
BF75S	Nyl 6BA 1/2in	50p
BF76H	Nyl 6BA 1in	60p
BF77J	Nyl 8BA 1/2in	60p
BF78K	Nyl Nut 2BA	55p
BF79L	Nyl Nut 4BA	55p
BF80B	Nyl Nut 6BA	53p
BF81C	Nyl Nut 8BA	55p
BF82D	Nyl Washer 2BA	18p
BF83E	Nyl Washer 4BA	18p
BF84F	Nyl Washer 6BA	18p
BF85G	Nyl Washer 8BA	26p
WH18U	Nyl C/S Scw M3 x12mm	4p
WH19V	Nylon Nut M3	4p
BF15R	Spring Clip	4p
YW94C	Batten Clip	4p
LB99H	Blk Wdscrw No 4 1/2"	15p
BH44X	Plas Fixing	12p
YL23A	Hand Wheel Bolt	35p
FW10L	Spade 2BA	28p
FW11M	Spade 4BA	23p
FW13P	Studding 2BA	32p
FW14Q	Studding 4BA	34p
FW15R	Studding 6BA	30p
FW30H	4BA Spacer 1/8in	38p
FW31J	4BA Spacer 1/4in	48p
FW32K	4BA Spacer 1/2in	52p
FW33L	6BA Spacer 1/8in	35p
FW34M	6BA Spacer 1/4in	38p
FW35Q	6BA Spacer 1/2in	49p
LR69A	8BA Spacer 1/8in	32p
LR70M	8BA Spacer 1/4in	36p
LR71N	Thrded Spcr 4BA	78p
LR72P	Thrded Spcr 6BA	59p

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

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LH12N	Aly Sheet 18 swg	£1.59
LH13P	Aly Sheet 16 swg	£3.85
LW21X	Mixer Trim 4	DIS
LW22Y	Mixer Trim 8	DIS
LW23A	Mixer Trim 12	DIS
LW24B	Mixer Trim 16	DIS
LW17T	Mixer Mtg Tube 4	DIS
LW18U	Mixer Mtg Tube 8	DIS
LW19V	Mixer Mtg Tube 12	DIS
LW20W	Mixer Mtg Tube 16	DIS
WH48C	Mains Warning Label	15p
XX31J	PCB Guides	25p
XH39N	Transfer 1/8in Black	£1.35
XH40T	Transfer 1/8in Red	£1.56
XH41U	Transfer 1/8in White	£1.56
XH42V	Transfer 1/4in Black	£1.56
XH43W	Transfer 1/4in Red	£1.45
XH44X	Transfer 1/4in White	£1.35
XH45Y	Panel Transfer Black	£1.56
XH46A	Panel Transfer Red	£1.56
XH47B	Panel Transfer White	£1.35

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KNOBS

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RW75S	Knob BK12	16p
RW77J	Knob PN20	DIS
RX99H	Knob RN92	28p
RW87U	Knob KB4	22p
RW86T	Knob KB3	45p
RX09K	Knob R78	58p
HB23A	Knob K1	29p
HB24B	Knob K2	39p
HB19V	Knob RK401	95p
HB57M	Knob RK403	£1.55
RW88V	Knob M1	38p
RW89W	Knob M2	30p
RW90X	Knob M3	26p
RX00A	Knob M4	45p
RX10L	Knob R81	45p
RX11M	Knob 82	55p

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RW78K	Knob F10	35p
HB26D	Knob F11	31p
RX01B	Knob NK2	45p
RX02C	Knob PK2	45p
YX01B	Knob K7A	24p
YX02C	Knob K7B	27p
YX03D	Knob K7C	32p
YX04E	Knob K7D	49p
HB28F	Knob R51	52p
HB29G	Knob R52	53p
RX07H	Knob R76	55p
RX08J	Knob R77	64p
HB30H	Knob R53	69p
HB31J	Knob R54	96p
YR64U	Knob K8A	43p
YR65V	Knob K8B	56p
YR66W	Knob K8C	64p
HB34M	Knob K105L	95p
HB35Q	Knob K106L	£1.74
HB32K	Knob K105	59p
HB33L	Knob K106	95p
HB36P	Knob K15	55p
HB37S	Knob K24	DIS
HB38R	Knob K30	72p
HB39N	Knob K44	69p
HB40T	Knob K45	79p
HB41U	Knob K46	£1.15

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RX16S	Collet Knob Black	38p
RX17T	Collet Knob Grey	45p
WL45Y	15mm Collet Cap Blk	5p
WL46A	15mm Collet Cap Blue	5p
WL47B	15mm Collet Cap Grn	5p
WL48C	15mm Collet Cap Grey	5p
WL49D	15mm Collet Cap Red	5p
WL50E	15mm Collet Cap Yllw	5p
WL51F	15mm Collet Pntr Blk	5p
WL52G	15mm Collet Pntr Blu	5p
WL53H	15mm Collet Pntr Grn	5p
WL54J	15mm Collet Pntr Gry	5p
WL55K	15mm Collet Pntr Red	5p
WL56L	15mm Collet Pntr Ylw	5p
RX18U	15mm Collet Nut Cvr	13p
RX19V	15mm Collet Indctr	18p
RX20W	15mm Collet Skirt	21p
RX21X	15mm Collet Stator	19p
*WL43W	Collet Rd Nut 3/8in	16p
*WL44X	Collet Rd Nut 10mm	16p
RX22Y	Slide Knob A	15p
YG09K	Slide Knob B	21p
YG10L	Slide Knob C Black	20p
YG11M	Slide Knob C Chrome	29p
RX24B	Slide Knob F Blk	17p
RX25C	Slide Knob F Blue	17p
RX26D	Slide Knob F Green	17p
RX27E	Slide Knob F Grey	17p
RX28F	Slide Knob F Red	17p
RX29G	Spindle Coupler	59p
RX30H	Ext Spindle	69p
*RX38R	Nylon Rod	14p
RX45Y	Cord Drive Brass	DIS
RX46A	Cord Drive Steel	£1.39

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RX31J	Brass Bush	53p
BL73Q	Drive Cord	7p
RX43W	Cord Drum Small	£1.05
RX94C	Cord Drum Large	£1.05
RX44X	Flywheel	£3.35
RX39N	Vernier Dial Small	£2.35
RX40T	Vernier Dial Medium	£2.95
RX41U	Vernier Dial Large	£3.84
RX42V	Ball Drive	£2.35
HB42V	Mini Ball Drive	£1.95
HB43W	DR Drive Scale	£12.20
HB45Y	Aluminium Dial	£6.60
HB46A	White Pointer	35p
HB47B	Ball Drive Pointer	62p
HB48C	Spring Short	9p
HB49D	Spring Medium	9p
HB50E	Spring Long	9p
RX95D	Pulley 1/2in	14p

MICROPHONES

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LB92A	Phone Coil	95p
LB93B	Crystal Mic Insert	50p
LB68Y	Lapel Mic	£1.28
YW69A	Stick Mic	DIS
YB31J	Cassette Mic Jacks	£1.95
YB32K	Cassette Mic DIN	£2.75
YB33L	Electret Cssette Mic	£2.95
WF35Q	Dynamic Ball Mic	£9.93
LH86T	Long Stem Mic	DIS

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LH87U	Dynamic Stereo Mics	£10.25
WF05F	Communications Mic	£5.75
YW70M	Diff Comm Mic	£8.25
YW77J	Mic Hldr Screw-Fix	28p
YW78K	Mic Hldr Adhesive	49p
YW79L	Mic Hldr Magnetic	52p
XY72P	Base Station Mic	£24.75
LB69A	Tie-Clip Mic	£7.85

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YW71N	UM Tie-Clip Mic	£12.45
YB34M	Low-Cost Elect Mic	DIS
YB35Q	Eletret Mic 8CM31	£10.45
WF34M	Electret Mic Dual-Z	£16.75

Note: For details of software, please ask for leaflet XH52G (Issue 3 now available)

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YB36P Unisound Mic EM82D £19.17
YB37S Unisound Mic EM83D £20.85

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WY06G Super Cardioid Mic £23.55
WY07H Stereo Electret Mic £19.75
*YB38R Unisnd Mic DM1500D £35.45
LB94C Screen S15 £6.58
LB95D Mic Unit U15 £10.75
LB35Q Mic Windshield 45p
YW72P Gsneck Mic Stand 8in £1.99
LH88V Gsneck Mic Stnd 12in £2.95
WF36P Gsneck Mic Stnd 21in £3.45
YW73Q Plastic Gsneck Base 65p
YW74R Metal Gsneck Base £3.25
WF37S Bkt For Gsnk Stand £1.95

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LB96E Table-Top Mic Stand £2.25
YW75S Cast Base Mic Stand £3.85
YW76H Extra Hgt Mic Stand £6.95
XB45Y 5-Foot Mic Stand £13.45
XB46A Boom Arm £12.65

MUSICAL

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LB97F Pre-Amp EQ2S £3.45
YB39N Pre-Amp CS5 £8.43
XB30H Mono Mic Mixer £8.65
XB29G Stereo Mixer £22.88
LB66W Mini-Phaser £19.77
YB30H Fuzz Box £15.25

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

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YB40T Cry Guitar Pick-Up £3.93
YB41U Nylon Mag Pick-Up £7.30
YB42V Steel Mag P.U. £8.45
YL08J Pickup Transl.AJ21 £27.95
YL09K Pickup Transl.AJ51 £19.95
YL10L Pickup Transl.AJ15 DIS
YL07H Pickup Switch £3.24
LB78K Guitar Strings Nylon £1.85
LB60Q Guitar Strings Steel £1.55
LB98G Strap Button 55p

OPTO

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RX86T MES Batten Hldr 21p
RX57M Holder MES Amber £1.45
RX58N Holder MES Blue DIS
RX59P Holder MES Clear £1.45
RX60Q Holder MES Green £1.45
RX61R Holder MES Red £1.45
RX76H Dmd LES Lhldr Blue 35p
RX77J Dmd LES Lhldr Green 35p
RX78K Dmd LES Lhldr Red 35p
RX79L Dmd LES Lhldr White 35p
RX80B Dmd LES Lhldr Yellow 35p
RX67X Flt-Tp LES Lhldr Blu 35p
RX68Y Flt-Tp LES Lhldr Grn 35p
RX69A Flt-Tp LES Lhldr Red 35p
FF66W Fluted Lhldr Amber 30p
FF67X Fluted Lhldr Clear 30p
FF68Y Fluted Lhldr Green 30p
FF69A Fluted Lhldr Red 30p
YY00A LES Cover Amber 6p
YY01B LES Cover Blue 6p
YY02C LES Cover Green 6p
YY03D LES Cover Purple 6p
YY04E LES Cover Red 6p
YY05F LES Cover White 6p
YY06G LES Cover Yellow 6p
*RX82D Pan Neon Amber 55p
RX83E Pan Neon Red DIS
RX81C Square Neon Red 33p
RX98G Square Neon Green 33p
RX70M Wire Neon 14p
WQ13P Wire Bulb 12V 30p
WL74R LES Bulb 6V 17p
WL75S LES Bulb 12V 15p
RX84F Neon Bulb 99p

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WL76H Bulb MES 3.5V 35p
WL77J Bulb MES 6V 0.24W 36p
WL78K Bulb MES 6V 6W 31p
WL79L Bulb MES 6.5V 27p
WL80B BUlb MES 12V 1.2W 28p
WL81C Bulb MES 12V 2.2W 29p
WL82D Bulb MES 24V 36p
LQ10L Portable Lamp £6.95
XY71N Caravan Lamp £9.65
LQ11M 12V Tube £1.38
LL15R 240V Inspection Lamp £5.60
XQ15R Bulkhead £4.35
XR64U Festoon Cable DIS
YW45Y Festoon Lampholder DIS
HB52G Pygmy Bulb Blue 90p
HB53H Pygmy Bulb Green 90p
HB54J Pygmy Bulb Red 90p
HB55K Pygmy Bulb White 70p
HB56L Pygmy Bulb Yellow 90p
XY25C Stay-Put Lamp DIS
YB29G Spot Holder £3.96

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XY00A 3-Bank Lampholder DIS
XB31J BC Clip-On Hdr Sngl £4.99
XB32K BC Clip-On Hdr Twn £6.95
WF25C Spot Lamp Amber £2.85
WF26D Spot Lamp Blue £2.85
WF27E Spot Lamp Clear £2.35
WF28F Spot Lamp Green £2.85
WF29G Spot Lamp Red £2.85
WF30H Spot Lamp Violet £2.85
WF22Y Gooseneck Lamp £5.32
WL32K Mini LED Red 10p
WL33L Mini LED Green 19p
WL34M Mini LED Orange 20p
YY38R Mini LED Yellow 19p
YY39N Mini LED Clip 2p
WL27E LED Red 12p
WL28F LED Green 19p
WL29G LED Orange 33p
WL30H LED Yellow 17p
YY40T LED Clip 2p
QW96E Square LED Red 36p
YH60Q Square LED Green 36p
YH61R Square LED Yellow 40p
YH62S Square LED Clip 7p
YY41U Large LED Red £1.49
YY42V Large LED Clip 21p

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YY45Y Shape LED R1 Red 20p
YY46A Shape LED R1 Green 25p
YY47B Shape LED R1 Orange 37p
YY48C Shape LED R1 Yellow 27p
YY49D Shape LED S2 Red 20p
YY50E Shape LED S2 Green 27p
YY51F Shape LED L3 Red 21p
YY52G Shape LED L3 Green 26p
YY53H Shape LED L3 Yellow 26p
YY54J Shape LED T4 Red 22p
YY55K Shape LED T4 Green 26p
YY56L Shape LED T4 Yellow 26p
YY57M Shape LED A5 Red 23p
YY58N Shape LED A5 Green 27p
YY43W Illuminator Orange NYA
YY44X Illuminator Yellow NYA
YH53H Cliplite Amber 16p
YH54J Cliplite Clear 16p
YH55K Cliplite Green 16p
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WR00A Fuse 20mm 100mA 6p
WR94C Fuse 20mm 150mA 6p
WR01B Fuse 20mm 250mA 6p
WR02C Fuse 20mm 500mA 6p
WR03D Fuse 20mm 1A 8p
WR04E Fuse 20mm 1.5A 8p
WR05F Fuse 20mm 2A 8p
WR06G Fuse 20mm 3A 8p
WR07H Fuse 20mm 5A 7p
WR18U Fuse A/S 500mA 12p
WR19V Fuse A/S 1A 12p
WR20W Fuse A/S 2A 12p
WR95D Fuse 1.1/4 50mA 4p
WR08J Fuse 1.1/4 100mA 6p
WR96E Fuse 1.1/4 150mA 8p
WR09K Fuse 1.1/4 250mA 7p
WR10L Fuse 1.1/4 500mA 6p
WR11M Fuse 1.1/4 1A 8p
WR12N Fuse 1.1/4 1.5A 8p
WR13P Fuse 1.1/4 2A 8p
WR14Q Fuse 1.1/4 3A 8p
WR15R Fuse 1.1/4 5A 8p
WR16S Fuse 1.1/4 10A 9p
WR17T Fuse 1.1/4 15A 12p
HQ31J Plug Fuse 2A 15p
HQ32K Plug Fuse 3A 14p
HQ33L Plug Fuse 5A 15p
HQ34M Plug Fuse 13A 14p
HB51F Fuse Wire 30p
HW04E RF Supp Choke 1A 29p
HW05F RF Supp Choke 2A 29p
HW06G RF Supp Choke 3A 39p

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HW13P Mains Trans Supp 65p
HW07H Delta Cap 97p
YR90X R-C Network £1.39
YW46A Door Contact Reed £1.49
YW50E Window Foil £1.25
YW51F Foil Terms 65p
YW47B Surface BA Reed £1.95
YW48C Door Loop £1.75
YW49D BA Junction Box 59p
YB91Y Pressure Mat £3.55
XY33L Smoke Detectr Type 1 £12.75

RECORD AND TAPE

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XQ00A Autochanger £22.50
XB23A Rim Drive Turntable £29.90
*XB25C Belt Drive Turntable £34.50

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FQ17T Cartridge Slide MP60 £2.68
FQ18U Cartridge Slide 710 DIS
FQ19V Crtridge Slide BDS95 DIS
LB75S Drive Wheel BSR £1.55
FQ20W Spindle Auto BSR £4.40
FQ21X Spindle Manual BSR 56p
YW58N BSR Drive Belt £2.20
FQ22Y Carrier Kit SL75K £4.85
FQ23A Cartrdg Carrier SL95 £3.95
FQ24B Carrier Kit SL95K £5.25
FQ25C Crtrdg Car Zero 100 DIS
FQ26D Crtrdg Car SP25II £7.30
FQ28F Cartrdg Crrier SP25V £4.25
FQ29G Carrier Kit SP25VK £5.95
LB76H Dr Wheel Garrard Lrg £2.55
FQ30H Dr Wheel Garrard Sm £2.85
FQ31J Spindle Man Short 72p
FQ32K Spindle Man Long 79p
FQ33L Spindle Auto Short £4.50
FQ34M Spindle Auto Long DIS
YB43W SP25IV Tone Arm DIS
FQ35Q CB Weight SP25IV £3.95
FQ36P Garrard Drive Belt £2.50
YB44X SP25III Motor DIS
YB45Y SP25IV Motor DIS

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XX34M Headshell £3.50
HR01B Ctrdg BSR X5M £3.65
HR02C Ctrdg BSR X5H £3.65
HR04E Ctrdg BSR SX6M £4.25
HR05F Ctrdg BSR SX6H £4.49
YX76H Drive Belt 46mm 98p
YX77J Drive Belt 57mm 98p
YX78K Drive Belt 66mm 98p
YX79L Drive Belt 76mm 98p
YX80B Drive Belt 90mm 98p
HR06G Ctrdg Acos 104 DIS
HR09K Ctrdg BSR SC12M £3.75
HR10L Ctrdg BSR SC12H £3.65
YX83E Ctridge Phlips GP215 £4.55

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FY75S Ctrdg Rigonda 2SB £4.45

HR11M Ctrdg Sono 9TAHC £5.93
HR12N Ctrdg Sono 3509 £4.95
HR13P Ctrdg Sono 3549 £5.95
HR14Q Ctrdg Sono 3559 £5.25
HR17T Ctrdg Sono V100 £5.98
YX81C Cartridge QLM30 £9.55
YX82D Cartridge QLM36 £21.40
HR15R Ctrdg Goldring G850 £5.70
HR16S Ctrdg Goldring G800 £7.40

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FQ38R Ctrdg Goldring G800H £9.49
FQ39N Ctrdg Goldring G800E £11.95
FQ40T Ctrdg Tenorel T2001D £4.85
FQ41U Cdg Tenorel T2001ED £11.29

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HR25C Stylus GP91SC DD £1.85
HR28F Stylus GP93 DD £1.85
HR65V Stylus GP95 DD £1.85
HR31J Stylus GP104 DD £1.85
HR66W Stylus Acos SM6 £4.95
YX05F Stylus ADCRK8 £5.82
YX06G Stylus ADC RSQ30 £7.07
YX07H Stylus ADC RSQ36 £16.35
YX08J Stylus AT6 £4.95
YX09K Stylus AT70 £4.95
YX10L Stylus ATS11E £5.50
HR68Y Stylus VM8 £5.50
HR39N Stylus BSR TC8 D £1.50
HR71N Stylus BSR ST4 DD £1.85
HR42V Stylus BSR ST10 £1.85
HR45Y Stylus BSR ST15 £1.85
HR47B Stylus BSR ST17 DD £1.85
HR74R Stylus BSR ST21 £1.85
HR75S Stylus Decca Deram £1.50
YX11M Stylus Dual DN201 £5.50
YX12N Stylus Gerrard GA150 £10.50
HR76H Stylus D110E £5.50
HR77J Stylus D110H £2.95
HR48C Stylus D110SR £1.95
HR49D Stylus D120SR £2.45
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HR79L Stylus Hitachi ST103 £6.75
YX13P Stylus Hitachi ST104 £4.95
*YX14Q Stylus JVC DT21S £4.35
FQ54J Stylus Victor DT33 £4.95
*YX15R Stylus JVC DT36 £4.35
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HR83E Stylus NP EPS36 £2.25
HR84F Stylus NP EPS52 £4.95
YX16S Stylus NP EPS53 £5.50
YX17T Stylus Philip AG3306 £1.85
HR87U Sty Philips GP200DD £1.85
HR89W Stylus Philips GP205 £1.25
YX18U Stylus Philips GP213 £1.85
HR90X Styl Philips GP400 £5.10
YX19V Styl Phlps GP400Mk2 £4.95
YX20W Styl Phlps GP401Mk2 £6.75

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HR93B Stylus RIG-2SB DD £1.85
HR51F Stylus BF400 £1.85
HR96E Stylus DM500/7 £4.95
YX22Y Stylus Sanyo ST10J £4.95
HR95D Stylus Sansui £4.95
YX23A Stylus Sansui SN41 £4.95
YX24B Stylus Sanyo ST7D £4.95
HR97F Stylus Sanyo 2611 £4.95
FQ48C Stylus Sony ND128 £2.20
YX25C Stylus Sharp 101 £4.95
HR98G Stylus Sharp 706 £4.95
HR99H Stylus Sharp 717 £4.95
HR60Q Stylus 9TAHC DD £1.85
HR61R Stylus Sonotone V100 £4.95
YX26D Stylus Sonotone V101 £4.95
FQ45Y Stylus 2509 £1.85
FQ43W Stylus 2529 DD £1.85
HR53H Stylus KS40A DD £1.85
HR55K Stylus KS41B DD £1.85
HR57M Stylus KS41C DD £1.85
YX27E Stylus Sony XL15 £4.35
YX28F Stylus Sony ND126 £4.95
FQ49D Stylus Sony ND133 £5.50
FQ50E Stylus Sony ND134 £5.50
FQ51F Styl Tenorel N2001D £2.95
YX29G Styl Tenorel N2001DM £2.95
FQ52G Styl Tenorel N2001ED £6.75
YX30H Stylus Tetrad 51 £2.25
FQ53H Stylus Toshiba N3C £2.20
YX31J Stylus Toshiba N55 £4.95
YX32K Stylus Toshiba N58 £4.95
YX21X Stylus Toshiba N550 £4.95

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YB47B Record Care kt C106 £4.95
*LX03D Musicentre Kit C113 £6.45
LX06G Cleaning Arm C100 £3.25
LH89W Cleaning Arm C108 £4.95
FR44X Roller Pack C93 35p
YW80B Roller Pack C96 48p
YW81C Cleaning Cloth C104 78p
FR48C Dust-Off C101 99p
YW82D Cleaner C92 £4.65
YX93B Stylus Microscope £2.45
YW83E Stylus Brush C103 12p
YW84F Stylus Brush C97 28p
FR46A Stylus Cleaner C95 80p
YB55K Cleaning Kit C116 £2.42

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FR52G Anti-Stat Fluid 69S 49p
LX10L Anti-Stat Mat C119 £1.95
LX04E Anti-Stat Gun £5.25
FQ60Q Spirit Level 44 £3.65
FR49D Stylus Balance PX1 £2.45
YW85G Record Grip C206 £1.28
FR50E Gram Speed Indicator 9p
YW86T Cassette Kit C115 £1.85
YB56L Cassette Kit C107 £4.25
RB04E Cass Head Clnr C118 £1.25
YW87U Cleaning Stick C109 23p
YW88V Tape Cleaning Fluid 58p

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FR54J Cassette Clnr Tape 55p
YW89W Cassette Cln & Demag £2.25
FR62S Straight Demagnetizer £3.35
FQ62S Curved Demagnetiser £3.85
*YW90X Cassette Splicer £4.25
YW91Y Splicing Block £1.85

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RB01B Cassette Fast Winder £2.75
FR59P Test Cassette 53 £4.98
YG25C Cassette Tape C60 61p
YG26D Cassette Tape C90 65p

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RB05F Cassette Tray 52A DIS
RB07H Rota-Rack £2.45
LH91Y Cassettebox £4.65
LH92A Videocassettebox £9.68
FQ63T GF Cassette Head £12.80
FQ64U Mono Cassette Head £4.55
FQ66W Cassette Erase Head £2.75
FQ65V Stereo Cassette Head £5.26
FQ67X Tape Hd Two-Track RP £15.50

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FQ68Y Tpe Hd Two-Trck Eras £9.95
FQ69A Tape hd Four-Trck RP £16.95
FQ70M Tpe Hd Four Trk Eras £8.85
FQ71N 2-Head Bracket £4.65
FQ72P 3-Head Bracket £5.39

RESISTORS

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U Micro Res 3p
M Min Res 2p
S Std Res 3p
C 1W Res 5p

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X Oxide 5p
T 1% Res 9p
XL05F Colour Wheel 25p
W W/W Min Res 19p

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L 7W W/W 24p
H 10W W/W 29p
P 25 W/W Res £1.65
V HV Res 1M-33M 12p
V HV Res 47M 22p
BL64U Constantan 28 swg £3.35
YY12N Resnet 100R 85p
YY13P Resnet 220R 85p
YY14Q Resnet 470R 85p
YY15R Resnet 1k 85p
YY16S Resnet 2k2 85p
YY17T Resnet 4k7 85p
YY18U Resnet 10k 85p
YY19V Resnet 22k 85p
YY20W Resnet 47k 85p
YY21X Resnet 100k 85p
WR52G Hor S-Min Prest 100R 10p
WR53H Hor S-Min Prest 220R 10p
WR54J Hor S-Min Prest 470R 10p
WR55K Hor S-Min Prest 1k 10p
WR56L Hor S-Min Prest 2K2 10p
WR57M Hor S-Min Prest 4k7 10p
WR58N Hor S-Min Prest 10k 10p
WR59P Hor S-Min Prest 22K 10p
WR60Q Hor S-Min Prest 47k 10p
WR61R Hor S-Min 100k 10p
WR62S Hor S-Min Prest 220k 10p
WR63T Hor S-Min Prest 470k 10p
WR64U Hor S-Min Preset 1M 10p
WR65V Vrt S-Min Prest 100R 11p
WR66W Vrt S-Min Prest 220R 11p
WR67X Vrt S-Min Prest 470R 11p
WR68Y Vrt S-Min Prest 1k 11p
WR69A Vrt S-Min Prest 2k2 11p
WR70M Vrt S-Min Prest 4k7 11p
WR71N Vrt S-Min Prest 10k 11p
WR72P Vrt S-Min Prest 22k 11p
WR73Q Vrt S-Min Prest 47k 11p
WR74R Vrt S-Min Prest 100k 11p
WR75S Vrt S-Min Prest 220k 11p
WR76H Vrt S-Min Prest 470k 11p
WR77J Vert S-Min Prest 1M 11p

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WR78K Hor Skeleton 100R 14p
WR79L Hor Skeleton 220R 14p
WR80B Hor Skeleton 470R 26p
WR81C Hor Skeleton 1k 26p
WR82D Hor Skeleton 2k2 26p
WR83E Hor Skeleton 4k7 26p
WR84F Hor Skelton 10k 26p
WR85G Hor Skeleton 22k 26p
WR86T Hor Skeleton 47k 26p
WR87U Hor Skeleton 100k 26p
WR88V Hor Skeleton 220k 26p
WR89W Hor Skeleton 470k 26p
WR90X Hor Skeleton 1M 26p
WR91Y Hor Skeleton 2M2 26p
WR92A Hor Skeleton 4M7 26p
WW00A Vrt Skeleton 100R 24p
WW01B Vrt Skeleton 220R 24p
WW02C Vert Skeleton 470R 24p
WW03D Vrt Skeleton 1k 24p
WW04E Vrt Skeleton 2k2 24p
WW05F Vrt Skeleton 4k7 24p
WW06G Vrt Skeleton 10k 24p
WW07H Vrt Skeleton 22k 24p
WW08J Vrt Skeleton 47k 24p
WW09K Vrt Skeleton 100k 24p
WW10L Vrt Skeleton 220k 24p
WW11M Vrt Skeleton 470k 24p
WW12N Vrt Skeleton 1M 28p
WW13P Vrt Skeleton 2M2 24p
WW14Q Vrt Skeleton 4M7 24p
WR38R Cermet 100R 98p
WR39N Cermet 500R 98p
WR40T Cermet 1k 98p
WR41U Cermet 5k 98p
WR42V Cermet 10k 98p
WR43W Cermet 50k 98p
WR44X Cermet 100k 98p
WR45Y Cermet 1M 98p
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WR47B 15-Turn Cermet 1k £1.20
WR48C 15-Turn Cermet 5k £1.20
WR49D 15-Turn Cermet 10k £1.42
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BW08J Edge Knob Small Grey 8p
BW09K Edge Knob Large Blk 8p
BW10L Edge Knob Large Grey 8p
FW00A Pot Lin 1k 37p

FW01B Pot Lin 4k7 37p
FW02C Pot Lin 10k 37p
FW03D Pot Lin 22k 37p
FW04E Pot Lin 47k 45p
FW05F Pot Lin 100k 45p
FW06G Pot Lin 220k 45p
FW07H Pot Lin 470k 45p
FW08J Pot Lin 1M 45p
FW09K Pot Lin 2M2 45p
FW21X Pot Log 4k7 37p
FW22Y Pot Log 10k 37p
FW23A Pot Log 22k 45p
FW24B Pot Log 47k 45p
FW25C Pot Log 100k 45p
FW26D Pot Log 220k 45p
FW27E Pot Log 470k 45p
FW28F Pot Log 1M 45p
FW29G Pot Log 2M2 45p

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FW41U Sw Pot Lin 4k7 95p
FW42V Sw Pot Lin 10k 95p
FW43W Sw Pot Lin 22k 95p
FW44X Sw Pot Lin 47k 95p
FW45Y Sw Pot Lin 100k 95p
FW46A Sw Pot Lin 220k 95p
FW47B Sw Pot Lin 470k 95p
FW48C Sw Pot Lin 1M 95p
FW49D Sw Pot Lin 2M2 95p
FW62S Sw Pot Log 4k7 95p
FW63T Sw Pot Log 10k 95p
FW64U Sw Pot Log 22k 95p
FW65V Sw Pot Log 47k 95p
FW66W Sw Pot Log 100k 95p
FW67X Sw Pot Log 220k 95p
FW68Y Sw Pot Log 470k 95p
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FW70M Sw Pot Log 2M2 95p
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FX18U W/W Pot 50k £2.79
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FW87U Dual Pot Lin 47k 99p
FW88V Dual Pot Lin 100k 99p
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FW91Y Dual Pot Lin 1M 99p
FW92A Dual Pot Lin 2M2 99p
FX08J Dual Pot Log 4k7 £1.10
FX09K Dual Pot Log 10k £1.10
FX10L Dual Pot Log 22k £1.10
FX11M Dual Pot Log 47k £1.10
FX12N Dual Pot Log 100k £1.10
FX13P Dual Pot Log 220k £1.10
FX14Q Dual Pot Log 470k £1.10
FX15R Dual Pot Log 1M £1.10
FX16S Dual Pot Log 2M2 £1.10
FX40T L/S Control 20R 55p
FX97F L/S Control 50R 55p
FX98G L/S Control 100R 55p
FX99H L/S Control 200R 55p
YG04E Rheostat 50R £4.90
YG05F Rheostat 100R £4.90
YG06G Rheostat 150R £4.90
YG07H Rheostat 200R £4.90

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

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FX22Y Thermistor VA1056S 38p
FX42V Thermistor VA1066S 41p
FX43W Thermistor VA1067S 39p
FX62S Thermistor R53 £5.95
WH23A Thermistor G16 £5.40
WH24B Thermistor G23 £5.35
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HB12N LDR DRP61 DIS
HB09K LDR RPY58A £1.07

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QB02C AC127 38p
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QB05F AC142 33p
QB06G AC176 26p
QB07H AC187 29p
QB08J AC188 37p
QB10L ACY19 77p
QB11M ACY20 75p
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BL30H AD140 £1.55
BL31J AD149 £1.35
BL32K AD161 61p
BL33L AD161/2MP £1.22
BL34M AD162 61p

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HQ51F	AY-1-5050	£1.99
YY98G	AY-3-1270	£8.30
YY89W	AY-3-1350	£5.95
WQ17T	AY-3-8115	DIS
*WQ18U	AY-5-1013A	£5.98
QB24B	AY-5-1224	DIS
QB25C	AY-5-1230	DIS
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QB33L	BC109C	16p
QB34M	BC117	24p
QB35Q	BC119	39p
QB36P	BC139	40p
QB37S	BC140	34p
QB38R	BC141	37p
QB39N	BC142	34p
QB40T	BC143	34p
QB44X	BC154	27p
QB48C	BC160	43p
QB49D	BC161	36p
QB50E	BC168C	11p
QB51F	BC169C	11p
QB52G	BC177	20p
QB53H	BC178	20p
QB54J	BC179	20p
QB55K	BC182L	11p
QB56L	BC183L	11p
QB57M	BC184L	11p
QB58N	BC204	15p
QB59P	BC209C	14p
QB60Q	BC212L	11p
QB61R	BC213L	11p
QB62S	BC214L	10p
QB63T	BC301/5	40p
QB64U	BC301/5/302/5MP	89p
QB65V	BC302/5	36p
QB66W	BC327	15p
QB67X	BC328	15p
QB68Y	BC337	15p
QB69A	BC338	15p
QB70M	BC441	38p
QB71N	BC441/461MP	79p
QB72P	BC461	43p
QQ14Q	BC547	11p
QB73Q	BC548	14p
QQ15R	BC549	12p
QQ16S	BC557	11p
QQ17T	BC558	11p
QQ18U	BC559	11p
QB74R	BC650	29p
QF00A	BCY70	18p
QF01B	BCY71	18p
QF03D	BD131	49p
QF04E	BD131/2MP	£1.19
QF05F	BD132	50p
QF06G	BD135	45p
QF75S	BD136	40p
QF07H	BD139	40p
QF08J	BD140	40p
WH15R	BD711	68p
WH16S	BD712	68p
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QF10L	BF167	38p
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QF26D	BFX88	36p
QF27E	BFY50	30p
QF28F	BFY51	29p
QF29G	BFY52	31p
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QF31J	BRY39	48p
QF32K	BSX20	26p
QF33L	BSX21	29p
QF34M	BSY95A	26p
QF35Q	BT109	£1.49
QF37S	BU205	£1.95
QF38R	BU206	DIS
QF39N	BU208	£2.99
QF41U	BY126	21p
QF42V	BY127	13p
QF43W	BY164	76p
QF44X	BY206	30p
QF45Y	BZX61C4V7	16p
QF46A	BZX61C5V1	16p
QF47B	BZX61C5V6	16p
QF48C	BZX61C6V2	16p
QF49D	BZX61C6V8	16p
QF50E	BZX61C7V5	16p
QF51F	BZX61C8V2	16p
QF52G	BZX61C9V1	16p
QF53H	BZX61C10	16p
QF54J	BZX61C11	16p
QF55K	BZX61C12	16p
QF56L	BZX61C13	16p
QF57M	BZX61C15	16p
QF58N	BZX61C16	16p
QF59P	BZX61C18	16p
QF60Q	BZX61C20	16p
QF61R	BZX61C22	16p
QF62S	BZX61C24	16p
QF63T	BZX61C27	16p
QF64U	BZX61C30	16p
QF65V	BZX61C33	16p
QF66W	BZX61C36	16p
QF67X	BZX61C39	16p
QF68Y	BZX61C43	16p
QF69A	BZX61C47	16p
QF70M	BZX61C51	16p
QF71N	BZX61C56	16p
QF72P	BZX61C62	16p
QF73Q	BZX61C68	16p
QF74R	BZX61C75	16p

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QH00A	BZY88C2V7	9p
QH01B	BZY88C3V0	9p
QH02C	BZY88C3V3	9p
QH03D	BZY88C3V6	9p
QH04E	BZY88C3V9	9p
QH05F	BZY88C4V3	9p
QH06G	BZY88C4V7	9p
QH07H	BZY88C5V1	9p
QH08J	BZY88C5V6	9p
QH09K	BZY88C6V2	9p
QH10L	BZY88C6V8	9p
QH11M	BZY88C7V5	8p
QH12N	BZY88C8V2	9p
QH13P	BZY88C9V1	9p
QH14Q	BZY88C10	9p
QH15R	BZY88C11	9p
QH16S	BZY88C12	9p
QH17T	BZY88C13	9p
QH18U	BZY88C15	9p
QH19V	BZY88C16	9p
QH20W	BZY88C18	9p
QH21X	BZY88C20	9p
QH22Y	BZY88C22	9p
QH23A	BZY88C24	9p
QH24B	BZY88C27	8p
QH25C	BZY88C30	9p
QH26D	CA3046	72p
YH58N	CA3080E	87p
QH27E	CA3089E	£2.70
QH28F	CA3130T	£1.10
QH29G	CA3140T	99p
WQ20W	CA3189E	£1.95
WQ21X	CA3240E	£1.38
YG37S	CL8960	£29.95
QH30H	C106D	42p
WQ22Y	C116D	99p
WQ23A	C126D	£1.63
WQ24B	C206D	95p
WQ25C	C226D	64p
QL14Q	C2460	£1.24
QQ01B	DAC0801LCN	£2.45
YY82D	DF412	£8.40
QQ21X	DV1202W	£8.35
QQ22Y	DV1205W	£10.70
QQ23A	DV1210W	£13.63
QQ24B	DV1220W	£16.88
QQ25C	DV1230W	£21.30
QQ26D	DV1240W	TEMP
WQ26D	ER1400	£9.99
WQ27E	ER3401	DIS
WQ28F	HSCH1001	55p
YH59P	ICL7109	£16.55
YY75S	ICL7660CPA	£3.24
YY93B	ICM7045IPI	£14.20
YY94C	ICM7216DIPI	£17.45
YY95D	ICM7226BIPI	£21.90
YH63T	ICM 7555	£1.25
QH32K	IR122A	DIS
QH33L	IR122D	£3.95
BH45Y	J005	£1.75
BL36P	J02	£1.80
BH46A	J04	£1.95
BH47B	KO1	£3.15
BH48C	K04	£4.25
*YY74R	L200	£2.69
WQ29G	LF347	£2.55
WQ30H	LF351	56p
WQ31J	LF353	99p
YY69A	LF13741	55p
QH35Q	LH0042C	£4.30
QH36P	LM301A	27p
QH37S	LM308	95p
WQ32K	LM334	£1.10
YY73Q	LM335Z	£1.23
QH38R	LM377	£1.77
QH39N	LM379S	£5.29
QH40T	LM380	75p
QH41U	LM381	£1.57
YY84F	LM382	£1.65
*WQ33L	LM383	£1.61
WQ34M	LM384	£1.44
WQ35Q	LM387	£1.25
WQ36P	LM389	£1.49
YY85G	LM1818	£1.95
YY99H	LM1830	£2.65
YY71N	LM1871	£5.60
YY72P	LM1872	£5.90
WQ38R	LM2917	£2.29
WQ37S	LM1820	£1.80
QH42V	LM3900	57p
WQ39N	LM3909	87p
*WQ40T	LM3911	£1.31
WQ41U	LM3914	£2.41
YY96E	LM3915	£2.93
YY97F	LM3916	£3.46
YH64U	LM13600N	£1.39
YY81C	M083	£4.75
WH22Y	M087	£4.95
YY90X	M108	£18.25
YY91Y	M147	£6.51
HQ71N	M251	£12.20
QH64U	M252	DIS
WH21X	M254	£7.49
XL07H	MA1003	DIS
XL14Q	MA1023	DIS
QH43W	MCR102	59p
QH44X	MC1303	DIS
QH45Y	MC1310P	£2.30
QH47B	MC1496	89p
QH48C	MC3302P	80p
QH49D	MC3340P	£1.35

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QH50E	MC3360P	DIS
WQ42V	MCM4027 250ns	£1.88
WQ43W	MC6800P	£5.10
WQ44X	MC6802P	£5.99
WQ45Y	MC6810AP 450ns	£2.42
WQ46A	MC6821P	£1.99
QQ03D	MC6845	£10.55
WQ48C	MC6850P	£2.99
WQ49D	MC6852P	£2.95
WQ50E	MC6875L	£6.32
HQ61R	MEL 12	38p
QH54J	MJE340	75p
WQ51F	MJE350	£1.15
*QH55K	MJE2955+TIP2955	£1.20
*QH56L	MJE3055+TIP3055	81p
QH57M	MJ2501	£3.20
BL38R	MJ2955	£1.10
QH58N	MJ3001	£2.40
YY92A	MK50395	£10.50
YH67X	ML922	£5.25
YH68Y	ML928	£2.40
YH69A	ML929	£2.40
QH59P	MPF102	66p
QH60Q	MPSA14	36p

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QH61R	MPSA65	45p
QH62S	MPS3638	21p
QH63T	MPS3638A	18p
BL23A	MS4A	£2.95
WQ53H	MVAM115	£2.10
WQ54J	NE531	£1.65
WQ55K	NE 544	£2.18
QH66W	NE 555	21p
QH67X	NE 556	62p
WQ56L	NE 565	£1.34
QH68Y	NE 566	£1.60
QH69A	NE 567	£1.30
*YY87U	NE571	£4.77
YY68Y	NE5534A	£2.45
YY67X	NE5539	£7.85
YG38R	NSM4000A	£7.99
QH70M	OA47	12p
QH71N	OA90	9p
QH72P	OA91	8p
QH73Q	OA95	8p
QH74R	OA200	8p
QH75S	OA202	13p
QH77J	OC28	DIS
QH78K	OC35	£1.35
QH82D	OC45	47p
QH83E	OC70	38p
QH84F	OC71	31p
QH85G	OC72	42p
QH87U	OC81	42p
QH89W	OC83	45p
QH91Y	OC170	95p
QH92A	OC171	99p
QH93B	PN3643	30p
WQ57M	PW01	95p
WQ58N	PW06	89p
WQ59P	RO-3-2513	£8.95
QL00A	R2008B	£2.25
QL02C	SAM77	£1.20
QL05F	SC146D	£1.55
WQ60Q	SFF96364	£9.45
QL06G	SG1495D	£3.95
QL07H	SG3402	£3.78
WQ61R	SH120A	£6.65
YH66W	SL490	£3.35
QL08J	ST2	25p
QL09K	S005	47p
QL10L	S04	52p
WQ62S	TAA 550	35p
QL11M	TAG1/100	£1.45
QL12N	TAG1/600	£1.20
BL35Q	TBA 651	£2.25
QL13P	TBA810P	95p
WQ63T	TBA820M	70p
YY79L	TCA350Z	£3.95
WQ64U	TCA4500A	£3.35
*WH20W	TDA1022	£6.75
YY76H	TDA1024	£1.49
YY70M	TDA2005M	£8.25
WQ66W	TDA2006	£1.65
WQ67X	TDA2030	£1.95
*YY86T	TDA3410	£1.90
QL15R	TIP31A	39p
QL16S	TIP32A	39p
WQ71N	TIP33A	78p
WQ72P	TIP34A	99p
QL17T	TIP41A	49p
QL18U	TIP42A	45p
WQ73Q	TIP122	99p
WQ74R	TIP127	75p
QL19V	TIS43	55p
WQ75S	TL170C	55p
WQ76H	TL172C	76p
YY77J	TL430C	85p
YY78K	TL497A	£1.65
YY88V	TMS1121	£9.73
QL20W	uA709C	75p
BL22Y	uA723C TO99	85p
QL21X	uA723C 14-pin DIL	55p
QL22Y	uA741C 8-pin DIL	23p
QL23A	uA741C 14-pin DIL	78p
QL24B	uA747C	75p
QL25C	uA748C	52p
QL26D	uA78L05AWC	45p
WQ77J	uA78L12AWC	45p
QL27E	uA78L15AWC	45p
QL28F	uA78M05UC	79p
QL29G	uA78M12UC	79p
QL30H	uA78M15UC	79p
WQ78K	u78MGU1C	£1.25
QL31J	uA7805UC	78p
QL32K	uA7812UC	78p
QL33L	uA7815UC	78p
WQ79L	uA78GU1C	£1.25
QL34M	uA7805KC	£1.65
QL35Q	uA7815KC	£1.65
WQ80B	uA78H05KC	£5.55
WQ81C	uA78H12KC	£6.49
WQ82D	uA78H15KC	DIS
WQ83E	uA78HGKC	£6.25
WQ84F	uA78P05SC	£8.25
WQ85G	uA79L05AWC	58p
WQ86T	uA79L12AWC	63p
WQ87U	uA79L15AWC	75p
WQ88V	uSA79M05UC	89p
WQ89W	uA79M12UC	89p
WQ90X	uA79M15UC	89p
WQ91Y	uA79MGU1C	£1.20
WQ92A	uA7905UC	£1.38
WQ93B	uA7912UC	95p
†QL36P	uA7915UC	82p
WQ94C	uA79GU1C	£1.25
WQ95D	uA79HGKC	£8.59
QQ27E	VK10KM	83p
QQ28F	VK1010	£1.35
QQ29G	VK1011	£1.35
WQ96E	VN46AF	£1.10
WQ97F	VN66AF	£1.55
WQ98G	VN88AF	£1.37
QQ11M	VQ1000CJ	£4.30
QL37S	W005	28p
QL38R	W01	34p
QL39N	W02	38p
QL40T	W04	39p
QL41U	ZN414	£1.25
QL42V	ZS120	44p
QL43W	ZTX107	18p
QL44X	ZTX108	15p
QL45Y	ZTX109	19p
QL46A	ZTX300	16p
QL47B	ZTX301	20p
QL48C	ZTX302	22p
QL50E	ZTX304	24p
QL54J	ZTX326	98p
QL56L	ZTX330	29p
QL57M	ZTX331	28p
QL60Q	ZTX500	21p
QL62S	ZTX502	19p
QL64U	ZTX504	34p

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QL66W	ZTX530	29p
QL67X	ZTX531	33p
QL68Y	ZTX541	31p
QL69A	ZTX542	33p
QL70M	ZSJ	£2.84
QW00A	Z80-CPU	£7.95
QW01B	Z80-CTC	£4.50
QW03D	Z80-PIO	£4.25
QW04E	Z80-SIO	£19.00
QL71N	1N914	4p
QL72P	1N916	5p
QL73Q	1N4001	5p
QL74R	1N4002	4p
QL75S	1N4003	6p
QL76H	1N4004	6p
QL77J	1N4005	6p
QL78K	1N4006	6p
QL79L	1N4007	7p
QL80B	1N4148	4p
QL81C	1N5400	15p
QL82D	1N5401	12p
QL83E	1N5402	16p
QL84F	1N5404	19p
QL85G	1N5406	20p
QL86T	1N5407	21p
QL87U	1N5408	19p
QL88V	1S921	9p
QH46A	1458C	45p
QW05F	1702 1000ns	£4.10
QR00A	2N697	49p
QR01B	2N706	26p
QR03D	2N708	35p
QR04E	2N1302	DIS
QR05F	2N1303	DIS
QR06G	2N1304	DIS
QR09K	2N1711	39p
QR10L	2N1893	32p
QR11M	2N2219	31p
QR12N	2N2369A	22p
QR13P	2N2484	38p
QR14Q	2N2646	55p
QR15R	2N2647	95p
QR16S	2N2904	31p
QR17T	2N2905	31p
QR18U	2N2906	26p
QR19V	2N2907	26p
QR20W	2N2926Or	12p
QR21X	2N2926Ye	12p
QR22Y	2N2926Gn	12p
QR23A	2N3053	34p
QR24B	2N3054	66p
BL45Y	2N3055	75p
QR25C	2N3525	£1.85
QR26D	2N3702	11p
QR27E	2N3703	10p
QR28F	2N3704	10p
QR29G	2N3705	12p
QR30H	2N3706	14p
QR31J	2N3707	12p
QR32K	2N3708	11p
QR34M	2N3711	11p
QW07H	2N3772	£1.95
QR35Q	2N3773	£2.70
QR36P	2N3819	32p
QR37S	2N3823	65p
QR38R	2N3866	£1.10
QR39N	2N3903	17p
QR40T	2N3904	17p
QR41U	2N3905	15p
QR42V	2N3906	14p
QR43W	2N4058	12p
QR44X	2N4060	12p
QR45Y	2N4061	17p
QR46A	2N4062	12p
QR47B	2N4871	69p
QR49D	2N5458	42p
QR50E	2N5459	36p
QR51F	2N6073	£1.20
QW08J	2N6609	£3.55
QQ30H	2SA872	39p
QQ31J	2SB716	30p
QQ32K	2SC1307	£2.18
QQ33L	2SD756	30p
QQ34M	2SJ48	£2.50
QQ35Q	2SJ49	£3.95
QW09K	2SJ50	£4.54
QQ36P	2SK133	£2.50
QQ37S	2SK134	£4.18
QW10L	2SK135	£4.30
QW11M	2102 450ns	£1.95
QW12N	2114 450ns	£1.30
QW13P	2708 450ns	£4.40
QQ07H	2716 450ns	£3.23
QQ08J	2732 450ns	£5.19
QQ09K	2764 450ns	NYA
QR52G	3N140	£1.12
QR53H	3N141	DIS
QH51F	3403	98p
QX00A	4000BE	24p
QX01B	4001BE	17p
QL03D	4001UBE	17p
QX02C	4002BE	16p
QX03D	4006BE	68p
QX04E	4007UBE	16p
QW14Q	4008BE	52p
QX05F	4011BE	16p
QL04E	4011UBE	24p
QX06G	4012BE	16p
QX07H	4013BE	35p
QW15R	4014BE	89p
QW16S	4015BE	54p
QX08J	4016BE	25p
QX09K	4017BE	42p
QX10L	4018BE	49p
QW17T	4019BE	42p
QX11M	4020BE	55p
QW18U	4021BE	49p
QW19V	4022BE	55p
QX12N	4023BE	23p
QX13P	4024BE	45p
QX14Q	4025BE	22p
QX15R	4026BE	84p
QX16S	4027BE	28p
QX17T	4028BE	58p
QW20W	4029BE	77p
QW21X	4031BE	£1.70
QW22Y	4032BE	75p
QW23A	4033BE	95p
QW24B	4034BE	£2.45
QW25C	4035BE	60p
QW26D	4038BE	85p
QW27E	4040BE	59p
QW28F	4041UBE	83p
QX19V	4042BE	48p
QW29G	4043BE	52p
QW30H	4044BE	52p
QW31J	4045BE	£1.40
QW32K	4046BE	75p

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QX20W	4047BE	75p
QW33L	4048BE	60p
QX21X	4049UBE	28p
QX22Y	4050BE	29p
QW34M	4051BE	78p
QW35Q	4052BE	68p
QW36P	4053BE	78p
QW37S	4054BE	95p
QW38R	4055BE	85p

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QW39N	4056BE	£1.12
QW40T	4060BE	£1.20
QW41U	4063BE	£1.12
QX23A	4066BE	36p
QW42V	4067BE	£3.69
QX24B	4068BE	23p
QX25C	4069UBE	20p
QX26D	4070BE	16p
QW43W	4071BE	16p
QX27E	4072BE	16p
QW44X	4073BE	21p
QW45Y	4075BE	16p
QW46A	4076BE	60p
QW47B	4077BE	16p
QX28F	4078BE	16p
QW48C	4081BE	24p
QW49D	4082BE	16p
QW50E	4085BE	65p
QW51F	4086BE	65p
QW52G	4089BE	£1.40
QW53H	4093BE	29p
QW54J	4094BE	£1.20
QW55K	4095BE	75p
QW56L	4097BE	£3.20
QX29G	4098BE	85p
QW57M	4099BE	79p
QW58N	40100BE	£1.49
QW59P	40101BE	90p
QW60Q	40102BE	£1.50
QW61R	40103BE	85p
QW62S	40104BE	85p
QW63T	40105BE	85p
QW64U	40106BE	75p
QW65V	40107BE	60p
QW66W	40108BE	£4.30
QW67X	40109BE	95p
QW68Y	40110BE	£1.10
QW69A	40160BE	£1.25
QW70M	40161BE	92p
QW71N	40162BE	85p
QW72P	40163BE	£1.60
QW73Q	40174BE	85p
QQ38R	40175BE	£1.25
QW74R	40181BE	£1.99
QW75S	40182BE	85p
QW76H	40192BE	£1.25
QW77J	40193BE	80p
QW78K	40194BE	85p
QW79L	40257BE	£1.10
QX34M	40673	£1.75
QW93B	4116 250ns	£1.30
QQ05F	4118 250ns	£4.45
QQ06G	4164 250ns	£5.99
XX01B	4136	75p
QW80B	4151	89p
XX02C	4195	£1.45
QQ39N	4412VP	£8.00
QX30H	4416BE	£1.92
QQ40T	4459BE	£8.00
QW81C	4502BE	£1.19
QQ41U	4503BE	95p
QW82D	4508BE	£2.10
QW83E	4510BE	68p
QX31J	4511BE	85p
QW84F	4512BE	£1.49
QW85G	4514BE	£1.20
QW86T	4515BE	£1.20
QW87U	4516BE	60p
QX32K	4518BE	63p
QX33L	4520BE	78p
QQ42V	4521BE	£2.00
QQ43W	4522BE	88p
QQ44X	4526BE	95p
QW88V	4527BE	£1.15
QX29G	4528BE see 4098BE	
QQ45Y	4529BE	£1.42
QQ46A	4530BE	97p
QW89W	4532BE	£1.10
QQ47B	4541BE	£1.40
QQ48C	4551BE	£1.59
QW90X	4555BE	50p
QW91Y	4556BE	58p
QQ49D	4568BE	£3.15
QQ50E	4583BE	£1.79
QQ51F	45100BE	£3.25
QX35Q	5W Zener 5V6	£1.27
QX36P	5W Zener 8V2	£1.27
YH31J	5101-L1	£3.48
QQ04E	6402	£5.80
QQ02C	6502	£5.48
QX37S	7400	17p
YF00A	74LS00	17p
QX38R	7401	17p
YF01B	74LS01	17p
QX39N	7402	17p
YF02C	74LS02	21p
QX74R	7403	20p
YF03D	74LS03	17p
QX40T	7404	21p
YF04E	74LS04	20p
QX41U	7405	21p
YF05F	74LS05	20p
QX75S	7406	29p
QX76H	7407	29p
QX42V	7408	21p
YF06G	74LS08	22p
QX77J	7409	22p
YF07H	74LS09	20p
QX43W	7410	17p
YF08J	74LS10	22p
QX44X	7411	24p
YF09K	74LS11	20p
YF10L	74LS12	17p
QX45Y	7413	28p
YF11M	74LS13	31p
QX46A	7414	42p
YF12N	74LS14	44p
YF13P	74LS15	17p
QX78K	7416	31p
QX79L	7417	30p
QX47B	7420	23p
YF14Q	74LS20	21p
QX48C	7421	40p
YF15R	74LS21	20p
YF16S	74LS22	17p
QX80B	7425	28p

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QX81C	7426	22p
YF17T	74LS26	22p
QX49D	7427	29p
YF18U	74LS27	29p
YF19V	74LS28	44p
QX50E	7430	17p
YF20W	74LS30	17p
QX51F	7432	36p
YF21X	74LS32	21p
YF22Y	74LS33	40p
YF23A	74LS37	21p
QX82D	7438	26p
YF24B	74LS38	22p
QX53H	7440	24p
YF25C	74LS40	40p
QX54J	7442	48p
YF26D	74LS42	36p
QX55K	7447A	55p
QQ52G	74LS47	65p
QQ53H	74LS48	68p
QX83E	7451	22p
YF27E	74LS51	17p
QX84F	7454	22p
YF28F	74LS54	30p
YF29G	74LS55	40p
QX56L	7470	36p
QX57M	7472	35p
QX58N	7473	32p
YF30H	74LS73	28p
QX59P	7474	32p
YY83E	74ALS74	£3.35
YF31J	74LS74	26p
QX60Q	7475	45p
YF32K	74LS75	31p
QX61R	7476	32p
YF33L	74LS76	28p
YF34M	74LS78	68p
QX62S	7481	£1.75
QX85G	7483	50p
QX63T	7485	77p
YF35Q	74LS85	70p
QX64U	7486	28p
YF36P	74LS86	36p
QX65V	7489	£3.10
QX66W	7490	32p
YF38R	74LS90	36p
QX86T	7491	£1.20
QX67X	7492	32p
YF39N	74LS92	36p
QX68Y	7493	35p
YF40T	74LS93	36p
QX69A	7494	39p
QX70M	7495	48p
YF41U	74LS95	89p
QX87U	7496	50p
YF42V	74LS96	£1.69
QX71N	74107	26p
YF43W	74LS107	41p
QX88V	74109	53p
YF44X	74LS109	34p
YF45Y	74LS112	34p
YF46A	74LS113	40p
YF47B	74LS114	39p
QX72P	74118	£2.30
QX73Q	74121	33p
WH00A	74122	48p
QQ54J	74LS122	62p
WH01B	74123	42p
YF48C	74LS123	62p
WH02C	74LS124	DIS
YF49D	74LS125	33p
YF50E	74LS126	33p
WH03D	74132	55p
YF51F	74LS132	45p
YF52G	74LS136	32p
QQ55K	74LS137	£2.20
YF53H	74LS138	38p
YF54J	74LS139	44p
WH05E	74141	78p
WH06G	74145	67p
YF55K	74LS145	£1.65
QX89W	74150	80p
WH07H	74151	65p
YF56L	74LS151	43p
YF57M	74LS153	49p
WH08J	74154	78p
YF58N	74LS154	98p
YF59P	74LS155	37p
YF60Q	74LS156	57p
YF61R	74LS157	35p
YF62S	74LS158	46p
WH09K	74160	67p
YF63T	74LS160	49p
YF64U	74LS161	49p
YF65V	74LS162	53p
YF66W	74LS163	49p
WH10L	74164	66p
YF67X	74LS164	55p
YF68Y	74LS165	£1.40
YF69A	74LS166	£1.95
YF70M	74LS168	£1.20
YF71N	74LS169	99p
YF72P	74LS170	£2.99
YF73Q	74LS173	65p
WH11M	74174	81p
YF74R	74LS174	62p
YF75S	74LS175	58p
YF76H	74LS181	£2.95
YF77J	74LS189	£4.95
YF78K	74LS190	58p
YF79L	74LS191	68p
WH12N	74192	70p
YF80B	74LS192	62p
QX90X	74193	66p
YF81C	74LS193	65p
WH13P	74194	55p
YF82D	74LS194	85p
YF83E	74LS195	45p
WH14Q	74196	65p
YF84F	74LS196	61p
YF85G	74LS197	88p
YF86T	74LS221	63p
YF87U	74LS240	99p
YF88V	74LS241	99p
YF89W	74LS242	99p
YF90X	74LS243	89p
QQ56L	74LS244	87p
YF91Y	74LS245	£1.95
YF92A	74LS251	53p
YF93B	74LS253	53p
YF94C	74LS256	£1.36
YF95D	74LS257	52p
YF96E	74LS258	55p
YF97F	74LS259	89p
YF98G	74LS261	£2.25
YF99H	74LS266	32p
YH00A	74LS273	£1.50
YH01B	74LS279	44p
YH02C	74LS283	69p

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YH03D	74LS290	£1.30
YH04E	74LS293	96p
YH05F	74LS295	£2.35
YH06G	74LS298	£1.75
YH07H	74LS299	£4.25
YH08J	74LS323	£6.75
YH09K	74LS363	£2.36
YH10L	74LS364	NYA
YH11M	74LS365	39p
YH12N	74LS366	45p
YH13P	74LS367	62p
YH14Q	74LS368	43p
YH15R	74LS373	£1.15
YH16S	74LS374	£1.30
YH17T	74LS375	£1.30
YH18U	74LS377	£2.90
YH19V	74LS378	£1.40
YH20W	74LS379	£2.40
YH21X	74LS390	£1.45
YH22Y	74LS393	£1.40
YH23A	74LS395	£1.35
YH24B	74LS398	£1.99
YH25C	74LS399	£2.50
QQ57M	74LS442	£3.50
QQ58N	74LS443	£6.85
YH26D	74LS490	£2.40
YH27E	74LS568	NYA
YH28F	74LS569	NYA
QQ59P	74LS600	NYA
QQ60Q	74LS606	£23.60
QQ61R	74LS608	NYA
QQ62S	74LS610	NYA
YH29G	74LS670	£1.46
QQ63T	74LS684	£4.75
YH30H	74C917	£8.85
YH32K	76477	£3.45
YH33L	76489	£4.75
YH34M	8T28	£3.30
YH35Q	8T95	£2.55
YH36P	8T97=74LS367	82p
YH37S	8T98	£2.35
YH38R	8038 CCPD	£4.69
YH39N	8069 DCQ	£2.35
YH40T	8080A	£4.95
YH41U	8085A	£5.99
YH43W	8211 CPA	£3.25
YH44X	8212	£1.95
YH45Y	8216	£1.95
YH46A	8224	£2.68
YH47B	8228	£4.94
YH48C	8250	£9.95
YH49D	8251	£4.60
YH50E	8255A	£4.40
YH51F	8279	£9.95
YH52G	82S126M1	£3.49

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QH36P	LM301A	27p
QH37S	LM308	95p

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WQ54J	NE531	£1.65
YY68Y	NE5534A	£2.45
QL20W	uA709C	75p
QL22Y	uA741C 8-pin DIL	23p
QL23A	uA741C 14-pin DIL	78p
QL24B	uA747C	75p
QL25C	uA748C	52p
QH46A	1458C	45p
QH51F	3403	98p
XX01B	4136	75p
QH28F	CA3130T	£1.10
QH29G	CA3140T	99p
WQ21X	CA3240E	£1.38

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QH35Q	LH0042C	£4.30
WQ30H	LF351	56p
WQ31J	LF353	99p
WQ29G	LF347	£2.55
YY69A	LF13741	55p
YH58N	CA3080E	87p
YH64U	LM13600N	£1.39
QH48C	MC3302P	80p

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QH50E	MC3360P	DIS
WQ63T	TBA820M	70p
QH38R	LM377	£1.77

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WQ36P	LM389	£1.49
QH39N	LM379S	£5.29
QH40T	LM380	75p

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*WQ33L	LM383	£1.61
BY73Q	8W Amp PCB	62p
LW36P	8W Amp Kit	£4.45
WQ34M	LM384	£1.44
QL13P	TBA810P	95p
BR02C	5W Amp PCB	£1.45
YY70M	TDA2005M	£8.25

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WQ67X	TDA2030	£1.95
YQ43W	15W Amp Kit	£6.45
YQ35Q	15W Amp PCB	£1.25
YQ36P	15W Amp Bracket	65p
YQ38R	30/2 PSU PCB	£1.40
YQ37S	15W Amp Module	£6.49

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WQ66W	TDA2006	£1.65
QH44X	MC1303	DIS
QH41U	LM381	£1.57
BR04E	LM381 PCB	£2.15

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YY84F	LM382	£1.65
*YY87U	NE571	£4.77
*YY86T	TDA3410	£1.90
WQ35Q	LM387	£1.25

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QH49D	MC3340P	£1.35
YY85G	LM1818	£1.95
QB21X	AY-1-0212	£8.20
YY81C	M083	£4.75
WH22Y	M087	£4.95

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HQ51F	AY-1-5050	£1.99
HQ53H	Piano IC Kit	£38.44
HQ52G	AY-1-1320	£4.99
HQ71N	M251	£12.20
QH64U	M252	DIS
WH21X	M254	£7.49
YY90X	M108	£18.25

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YY91Y	M147	£6.51
YY89W	AY-3-1350	£5.95
*WH20W	TDA1022	£6.75
YH33L	76489	£4.75

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YY79L	TCA350Z	£3.95
YH32K	76477	£3.45
YQ42V	Sound Effects PCB	£1.10

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WQ61R	SH120A	£6.65
QH27E	CA3089E	£2.70
WQ20W	CA3189E	£1.95

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WQ37S	LM1820	£1.80
BL35Q	TBA 651	£2.25
WQ64U	TCA4500A	£3.35
QH45Y	MC1310P	£2.30
BR03D	Decoder PCB	£1.72

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WQ17T	AY-3-8115	DIS
QL41U	ZN414	£1.25

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QH47B	MC1496	89p
QL06G	SG1495D	£3.95
QL07H	SG3402	£3.78
QH26D	CA3046	72p

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YH66W	SL490	£3.35
YH67X	ML922	£5.25

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YH68Y	ML928	£2.40
YH69A	ML929	£2.40
YY71N	LM1871	£5.60
YQ69A	LM1871 Xmitter PCB	98p

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YY72P	LM1872	£5.90
YQ70M	LM1872 Receiver PCB	95p
WQ55K	NE 544	£2.18
YQ71N	Servo Driver PCB	85p
WQ76H	TLI72C	76p

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WQ75S	TL170C	55p
YG37S	CL8960	£29.95
YY99H	LM1830	£2.65
YY73Q	LM335Z	£1.23
*WQ40T	LM3911	£1.31

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YY98G	AY-3-1270	£8.30
WQ41U	LM3914	£2.41
YY96E	LM3915	£2.93
YY97F	LM3916	£3.46
YQ66W	LM3914 PCB	85p

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YH30H	74C917	£8.85
YY82D	DF412	£8.40
QB24B	AY-5-1224	DIS
BB53H	4-Dig Clock PCB 'A'	DIS

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FY90X	Crystal 6.5536MHz	£2.98
YY93B	ICM7045IPI	£14.20
QB25C	AY-5-1230	DIS

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YY88V	TMS1121	£9.73
YY92A	MK50395	£10.50
QB26D	AY-5-4007D	£6.90

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YY94C	ICM7216DIPI	£17.45
YY95D	ICM7226BIPI	£21.90
YH63T	ICM 7555	£1.25

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QH66W	NE 555	21p
QH67X	NE 556	62p
QH68Y	NE 566	£1.60
WQ56L	NE 565	£1.34

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QH69A	NE 567	£1.30
WQ39N	LM3909	87p
YY76H	TDA1024	£1.49
YH43W	8211 CPA	£3.25
WQ32K	LM334	£1.10
YH39N	8069 DCQ	£2.35
WQ62S	TAA 950	35p

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YY78K	TL497A	£1.65
YY77J	TL430C	85p
YY75S	ICL7660CPA	£3.24
XX02C	4195	£1.45
XX04E	15V Supply PCB	75p
BL22Y	uA723C TO99	85p
QL21X	uA723C 14-pin DIL	55p

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YQ39N	0.1A Reg PSU PCB	£1.05
YQ40T	0.5/1A Reg V PS PCB	85p
YQ41U	0.5/1A Reg -V PS PCB	85p
YQ54J	0.5/1A Vareg Pos PCB	85p
YQ55K	0.5/1A Vareg Neg PCB	85p
*YY74R	L200	£2.69

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QQ02C	6502	£5.48
WQ43W	MC6800P	£5.10
WQ44X	MC6802P	£5.99
WQ46A	MC6821P	£1.99
WQ48C	MC6850P	£2.99
WQ49D	MC6852P	£2.95
WQ50E	MC6875L	£6.32
QW00A	Z80-CPU	£7.95
QW03D	Z80-PIO	£4.25
QW04E	Z80-SIO	£19.00
QW01B	Z80-CTC	£4.50

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YH40T	8080A	£4.95
YH41U	8085A	£5.99
YH46A	8224	£2.68
YH47B	8228	£4.94
YH50E	8255A	£4.40
YH49D	8251	£4.60
YH48C	8250	£9.95
YH51F	8279	£9.95
YH44X	8212	£1.95
YH45Y	8216	£1.95
YH34M	8T28	£3.30
YH35Q	8T95	£2.55
YH36P	8T97=74LS367	82p
YH37S	8T98	£2.35
WQ19V	AY-5-2376	£9.95

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*WQ18U	AY-5-1013A	£5.98
QQ04E	6402	£5.80
WQ60Q	SFF96364	£9.45
QQ03D	MC6845	£10.55
YH31J	5101-L1	£3.48
QW11M	2102 450ns	£1.95
WQ45Y	MC6810AP 450ns	£2.42
QW12N	2114 450ns	£1.30
QQ05F	4118 250ns	£4.45
WQ42V	MCM4027 250ns	£1.88

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QW93B	4116 250ns	£1.30
QQ06G	4164 250ns	£5.99
QW05F	1702 1000ns	£4.10
QW13P	2708 450ns	£4.40
QQ07H	2716 450ns	£3.23

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QQ08J	2732 450ns	£5.19
QQ09K	2764 450ns	NYA
XY84F	Softy 2 System	£169.00
XY85G	Softy PSU	DIS
XY83E	EPROM Eraser	£42.95

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WQ26D	ER1400	£9.99
WQ27E	ER3401	DIS
YH52G	82S126M1	£3.49
WQ59P	RO-3-2513	£8.95
YH38R	8038 CCPD	£4.69

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YQ65V	8038 PCB	85p
QW80B	4151	89p
QQ01B	DAC0801LCN	£2.45
QQ00A	ADC0804LCN	£4.45
YH59P	ICL7109	£16.55
WQ38R	LM2917	£2.29

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YQ67X	LM2917 PCB	85p
QW94C	7106	£7.90
QW95D	7107	£7.95
BY76H	7106/7 PCB	£1.45
WR29G	Transkt 3-Lead TO18	16p
WR30H	Transkt 4-Lead TO18	35p
WR31J	Transkt 3-Lead TO5	19p
WR32K	IC Skt 8-Lead	55p
WR33L	IC Skt 10-Lead	67p

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WR24B	Kit TO3	8p
WR25C	Kit TO66	9p
WR27E	Kit SO55	9p
WR26D	Kit TO126	5p
WR23A	Kit (P) Plas	6p
BL17T	DIL Socket 8-pin	9p
BL18U	DIL Socket 14-Pin	11p
BL19V	DIL Socket 16-pin	12p
HQ76H	DIL Socket 18-pin	16p
HQ77J	DIL Socket 20-pin	17p
HQ78K	DIL Socket 22-pin	20p
BL20W	DIL Socket 24-pin	19p
BL21X	DIL Socket 28-pin	24p
HQ38R	DIL Socket 40-pin	31p
YX50E	ZIF Socket 24-Way	£3.40
XX14Q	Soldercons	90p
YG27E	Header 14-pin	54p
YG28F	Header 16-pin	63p
YG29G	Header 24-pin	£1.10
FR25C	Insertion Tool	80p

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FL56L	Transistor Cover	10p
HQ79L	Heatsink 92F	14p
HQ80B	Heatsink 18F	19p
FL78K	Heatsink Clip-On	16p
WR34M	TO5 Chassis Heatsink	89p
FL59P	Vaned Heatsink TO3	46p
FL58N	Vaned Htsnk Plas Pwr	34p
FL57M	Vaned Heatsink IC	72p
HQ70M	Heatsink 2E	£2.55
FL41U	Heatsink 4Y	£1.96
HQ69A	50W Hi-Fi Heatsink	£1.95

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HQ81C	8W Hi-Fi Heatsink	£1.17
FL42V	Flat Heatsink	£3.25
FL54J	Heatsink 10DN	£2.15
FL55K	Heatsink 10DNDR	£2.60
FL77J	Heatsink 6W-1	£5.50
YB26D	Heatsink 60DN	£13.95
FL79L	Thermpath	£3.60
*HQ00A	Small Thermpath	99p
WY08J	Standard Fan	£15.50

SPEAKERS

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HY12N	Ultrasonic Transducr	£6.20
FL39N	Buzzer 6V	88p
FL40T	Buzzer 12V	88p
FL38R	AC Bell	£1.90
FL37S	Bell Xformer	£4.95
FQ08J	Bell Push	£1.10
FQ09K	Nameplate Bell Push	55p
YB25C	Baby Siren	£9.25
LH96E	Plastic Siren	£5.50
LH97F	Star War Siren	£5.95

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LH98G	Hawaii Five-O Siren	£24.95
XQ71N	Re-entrant Horn Sndr	£26.50
XQ72P	Megaphone	£49.95
XY76H	Pistol Grip Megphone	£49.95
XQ73Q	Car PA 8W	£8.25
XQ74R	Car PA 15W	£12.95

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YW52G	2in Piezo Tweeter	£2.49
WF54J	Direct Rad Piezo	£3.95
WF09K	Piezo Horn Flush	£5.96
WF55K	Piezo Horn Recessed	£5.99
WF56L	Wide Angle Piezo	£7.90
LB23A	Mag Earpiece 2.5mm	25p
LB24B	Mag Earpiece 3.5mm	25p
LB25C	Crystal Earpiece	55p
YW57M	Stethoscope	75p
WB04E	L/S Lo-Z 388	85p
WB05F	L/S Lo-Z 458	89p
WB08J	L/S Lo-Z 508	89p
WB09K	L/S Lo-Z 568	89p
WB13P	L/S Lo-Z 668	89p
WF57M	Hi-Z L/S 64R	99p
YW53H	L/S Lo-Z 768	99p
WF58N	3 inch Tweeter	£1.45

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YW54J	15W Cone Tweeter	£2.85
WF24B	Multi-Cell Tweeter	£5.95
WF33L	Free Stand Tweeter	£5.95
WF43W	Dome Tweeter	£5.45
WF44X	Rectangular Tweeter	£5.45
*WF02C	Crossover 2-Way	£4.20
WF03D	Crossover 3-Way	£5.20

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WF45Y	Escutcheon Crssvr	DIS
WF46A	Controlled Crossover	£10.69
WF47B	Low-Cost 4in Spkr	£4.25
WB27E	Rd Spkr CM420	DIS
YW55K	Plastic Car Grille	90p
YW56L	Metal Car Grille	DIS
WF48C	Hvy Duty Car Spkr	£6.45
WF50E	Elliptcal Spkr CM641	£3.35
WF18U	Elliptcal Spkr CM742	£4.45
WF23A	Elliptcal Spkr CM852	£5.20
WY13P	Elliptcal Spkr LT853	£6.45

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WF00A	Rd Speaker LT530	£6.95
WF52G	Rd Speaker LT610	£5.75
WF08J	Rd Speaker CM820	£5.95
WF11M	Rd Speaker LT830	£7.30
WF12N	Rd Speaker LT840	£11.45
WF53H	20W Squawker	£3.25
WY15R	40W Squawker	£5.25
XQ77J	Fane 50 4R	£19.95
XB26D	Fane 50 8R	£21.45
XQ78K	Disco 80 4R	£29.45
XB27E	Disco 80 8R	£29.45
XQ79L	Forte 1250TC 8R	£21.75
XQ80B	Forte 1250TC 16R	£21.75
XQ81C	Forte C1285TC 8R	£28.45
XQ82D	Forte C1285TC 16R	£28.45

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XQ83E	C15 Bass 8R	£57.80
XQ84F	C15 Bass 16R	£57.80
XB28F	Power L/S Cabinet	£49.00
XQ05F	15 inch Power Cab	DIS
AF33L	Mini Speaker System	£45.50
AF34M	5W Spkr in Cab	£9.95
AF35Q	15W Spkr Pair	£33.50

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AF31J	20W Spkr Pair	£63.00
AF32K	PA Spkr in Cab	£21.99
XY79L	Ceiling Speaker	£11.75
YL15R	Bracket Minor 5	£6.50
YL16S	Bracket Bek 100	£13.90
WY14Q	Spkr Selector	DIS

SWITCHES

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FH97F	SPST Ultra Min Tggle	66p
FH98G	SPDT Ultra Min Tggle	69p
FH99H	DPDT Ultra Min Tggle	75p
FH00A	Sub-Min Toggle A	70p
FF70M	Sub-Min Toggle J	80p
FH01B	Sub-Min Toggle B	89p
FH02C	Sub-Min Toggle C	89p
FH03D	Sub-Min Toggle D	£1.06
FH04E	Sub-Min Toggle E	99p
FF71N	Sub-Min Toggle K	£2.35
FH05F	Sub-Min Toggle F	£1.29
FH06G	Sub-Min Toggle G	£1.10
FH07H	Sub-Min Toggle H	£1.25
FF72P	Sub-Min Toggle L	£2.15
FH08J	4-Pole SM Toggle	£2.35
FH39N	Toggle Sw	60p
YL01B	Toggle Switch Cover	47p
FH10L	Std Toggle SPST	50p
FH11M	Std Toggle SPDT	57p
FH12N	Std Toggle DPDT	77p
FH16S	H/D Toggle Type 1	DIS
FH17T	H/D Toggle Type 4	£4.25
FH18U	H/D Toggle Type 7	£1.95
FH19V	H/D Toggle Type 8	£4.40
FH20W	H/D Toggle Type 9	£4.30

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FH13P	Duck Bill Toggle	55p
FH14Q	Long-Arm Tgl Locking	90p
FH15R	Long-Arm Tgl Flasher	99p
YX56L	Chrome Bar Toggle	85p
YX64U	Min Rocker SPST	69p
YX65V	Min Rocker DPDT	£1.15
FH21X	Hekla Switch Black	DIS
FH22Y	Hekla Switch Blue	DIS
FH23A	Hekla Switch Green	DIS
FH24B	Hekla Swtch Luminous	DIS
FH25C	Hekla Switch Red	DIS
FH26D	Hekla Switch White	DIS
FH27E	Hekla Switch Yellow	DIS
FH30H	SPST Rocker	39p
FH31J	SPDT Rocker	49p
YR68Y	Rocker Neon	63p
YR69A	Rocker Sw DP	69p
FH34M	DPDT Rocker	98p
*YR70M	Dual Rocker Neon	£1.10
XX26D	DIL Switch SPST Dual	£1.20
XX27E	DIL Switch SPST Octl	£1.50
XX28F	DIL Switch SPDT Sgl	95p
XX29G	DIL Switch SPDT Quad	£2.95

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FF73Q	Rotary SW12B	70p
FF74R	Rotary SW6B	70p
FF75S	Rotary SW4B	70p
FF76H	Rotary SW3B	70p
FH42V	Rotary SW12	70p
FH43W	Rotary SW6	70p
FH44X	Rotary SW4	70p
FH45Y	Rotary SW3	70p
FF83E	Thumbwheel Decimal	£4.95
FF84F	Thumbwheel BCD	£4.55
FF86T	Thumbwheel Mtg Kit	£1.35
YR77J	Push Wheel BCD	£5.45
YR78K	Push Wheel Spacer	48p
YR79L	Push Whl End Cheeks	99p
FH40T	Key Switch	£3.60
FH57M	Rotary Mains	75p
FH95D	Roller Microswitch	£1.15

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FH46A	Maka Shaft	£1.10
FH47B	Maka Wafer 1p 12w	£1.06
FH48C	Maka Wafer 2p 6w	£1.06
FF81C	Maka Wafer 2p 9w	£1.25
FH50E	Maka Wafer 4p 3w	£1.10
FH51F	Maka Wafer 6p 2w	£1.17
FH52G	Maka Wafer 1p 12w MB	75p
FH53H	Maka Wafer 2p 6w MB	£1.05
FF82D	Maka Wafer 2p 9w MB	29p
FH54J	Maka Mains	63p
FH55K	Maka Screen	5p
FF87U	Click Switch	30p
FF88V	Click Cap Black	18p
FF89W	Click Cap Blue	18p
FF90X	Click Cap Green	18p
FF91Y	Click Cap Grey	18p
FF92A	Click Cap Ivory	18p
FF93B	Click Cap Red	18p
FF94C	Click Cap White	18p
FF95D	Click Cap Yellow	18p
FF61R	Keyboard Switch	23p
FF62S	Keytop 1 Position	18p
FF63T	Keytop 2 Position	29p
FF64U	Keytop 3 Position	56p
FF65V	ASCII Transparency	£1.35
YR71N	Switch Contact Sheet	£1.49

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FF77J	SP Slide	12p
FH35Q	Sub-Min Slide	15p
FF79L	Long Chrome Slide	22p
FH36P	Std Slide Switch	15p
FH38R	4-Pole Slide	69p
YR67X	HQ Push Switch	39p
FH59P	Push Switch	17p
FH60Q	Break Push	23p
FH91Y	Motor-Start Press	43p
FF96E	Square Push Black	77p
FF97F	Square Push Green	77p
FF98G	Square Push Red	77p
FF99H	Square Push Yellow	77p
YW41U	Square Psh Lck Black	75p
YW42V	Square Psh Lck Green	DIS
YW43W	Square Psh Lck Red	75p
YW44X	Square Psh Lck Yllow	75p
FH41U	Pushlock SPCD	£1.20
FH66W	Pushlock DPCD	£1.45
FH94C	Pressil Switch	28p

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FH92A	Press Toe Sw Type 1	£1.20
FH93B	Press Toe Sw Type 2	£1.95
*LB64U	Foot Switch 2.5mm Jk	£4.25
FH37S	Mains Push	£1.10
LB91Y	Flasher Unit 2-Way	£5.75
LQ00A	Beginners Morse Key	£1.90
LQ01B	Professl Morse Key	£5.40
HY00A	Touch Pads Rect	22p
HY01B	Touch Pads Tri	27p
YR88V	Solenoid 12V	£4.75
YR89W	Solenoid 240V AC	£4.85

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FH67X	Latchswitch 2-pole	46p
FH68Y	Latchswitch 4-pole	59p
FH69A	Latchswitch 6-pole	99p
FH70M	Latchswitch 8-pole	£1.45
FH71N	Latchswitch 10-pole	£1.25
BW11M	Latchsoft 2-pole	60p
BW12N	Latchsoft 4-pole	£1.20
FH72P	Latchdummy	32p
FH74R	Mains Latchswitch	£1.59
FH75S	Latchbracket Single	13p
FH76H	Latchbracket 2-way	38p
FH78K	Latchbracket 4-way	45p
FH80B	Latchbracket 6-way	55p
FH82D	Latchbracket 8-way	59p
FH84F	Latchbracket 10-way	69p

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FL31J	Rd Latchbutton Black	14p
FL32K	Rd Latchbutton Green	14p
FL33L	Rd Latchbutton Grey	14p
FL34M	Rd Latchbutton Red	14p
FL35Q	Rd Latchbutton White	14p
FL36P	Rd Latchbutton Chrm	22p
BW13P	Sm Latchbutton Black	11p
BW14Q	Sm Latchbutton Chrm	33p
FH61R	Rct Latchbutton Blk	14p
FH62S	Rct Latchbutton Grey	14p
FH63T	Rct Latchbutton Red	14p
FH64U	Rct Latchbutton Whte	14p
FH87U	Magiclight Button Bl	23p
FH88V	Magiclight Buttn Grn	DIS
FH89W	Magiclight Button Dr	42p
FH90X	Magiclight Button Yl	49p
BW15R	Latchbush Blue	39p
BW16S	Latchbush Green	45p
BW17T	Latchbush Orange	45p
BW18U	Latchbush Yellow	39p

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YX94C	Ultra-Min Relay SPDT	96p
YX95D	Ultra-Min Relay DPDT	£1.49
YX96E	3A Min Relay	98p
YX97F	10A Mains Relay	£1.65
YX98G	5A Mains Relay	£3.20

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YX99H	12V 30A Relay	£2.15
FX23A	Open Relay 6V	£3.25
FX24B	Open Relay 12V	£3.88
FX26D	2p Sub-Min Relay 6V	£3.45
FX27E	2p Sub-Min Relay 12V	£3.45
FX28F	2p Sub-Min Relay 24V	DIS
FX30H	4p Sub-Min Relay 12V	£3.99

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HY20W	Relay Flat 12V	£2.43
FX48C	Power Relay 12V	£3.95
FX49D	Power Relay 230V AC	£4.25
YB89W	Car Relay Single	DIS
FX50E	Reed Relay 6 to 9V	£1.98
FX51F	Reed Relay 9 to 12V	£2.15
FX73Q	Reed Relay 12 to 18V	£2.15
FX74R	Reed Relay 18 to 30V	£2 95

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FX88V	Dil Reed Relay 1p 5V	£1.95
FX89W	Dil Reed Relay 1p12V	£2.15
FX90X	Dil Reed Relay 2p 5V	£3.99
FX91Y	Dil Reed Relay 2p12V	£3.85
FX92A	Dil Rd Relay 1pC/05V	DIS
FX93B	Dil Rd Rly 1p C/O12V	£8.39
FX68Y	Reed SW Standard	89p
FX69A	Reed SW Compact	£1.75
FX70M	Reed SW Miniature	69p
FX71N	Magnet Small	38p
FX72P	Magnet Large	88p
HB13P	Sw Former Stan One	DIS
HB17T	Sw Former Min One	DIS
HB15R	Sw Former Comp One	75p

TEST GEAR

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HF19V	Test Prod Black	45p
HF20W	Test Prod Red	45p
YX57M	Min Probe Black	42p
YX58N	Min Probe Blue	38p
YX59P	Min Probe Green	42p
YX60Q	Min Probe Red	42p
YX61R	Min Probe Yellow	42p
HF21X	Probe Clips	98p
HF30H	Pistol Probe Black	99p
HF31J	Pistol Probe Red	99p
HF22Y	Lo-Cost Test Probe	74p
HF32K	Moulded Test Probe	79p
HF33L	4mm Test Probe	89p
YR94C	AVO-type Test Lead	£4.45
YR93B	Test Lead Kit	£2.75
FY73Q	Logic Probe	£9.50

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FY88V	Continuity Probe	99p
FL61R	Signal Injector	£5.99
BW05F	Scope Probe BNC	£15.63
BR89W	Scope Probe 4mm	£16.25
FY74R	IC Test Clip	£2.35
YB21X	Safebloc	£7.50
YR95D	Lo-Cost Scope Probe	£3.75

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XB82D	Calscope Super 6	DIS
	Carr in UK with XB82	DIS
*XB83E	Scopex 14D-10	£286.00
	Carr in UK with XB83	£9.45

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XY05F	500MHz Freqncy Cntr	£115.95
LH05F	Transistor Testr HFE	£15.20
YB82D	LCR Bridge	£25.30
YB81C	Seesure Sig Gen	£26.75
YW93B	Low Cost Multimeter	£4.85
FL60Q	Pocket Multimeter	£7.50

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YB83E	Small Multimeter	£15.95
YW68Y	Multimeter Type 320	£16.25
LH93B	Taut-Band Multimeter	£23.95
YB87U	100K Multitester	£44.00

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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
LH94C	DMM 200	£47.50
LH95D	DMM 100	£88.61

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YL12N	HV Probe	£8.91
YL13P	Shunt 25A	£8.91
YL14Q	Shunt 100A	£8.91
XY75S	Ham Multimeter	£31.95
WY18U	SWR Meter 310	£10.75

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WY19V	SWR Meter 110	£14.75
WY20W	Transtest UH74	£19.75
WY21X	SWR Meter 178	£24.95
YB04E	Grid Dip Meter	£45.00

TOOLS

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LH15R	Hobby Box	£3.45
FR22Y	Storage Drawer	95p
BR48C	Hex Trimmer	24p
BR51F	Trim Tool	45p
BR49D	Preset Trimmer	72p
BR50E	Trim TT5	60p
FY07H	Min Screwdriver Set	85p
BR58N	Jewllers Scrwdvr Set	£2.30
BR79L	Intrchgbl Scdrvr Set	£1.69
YW60Q	Min Tool Set	£2.10
FY08J	Utility Set	£4.49

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YX74R	Min Screwdriver	10p
BR52G	Small Screwdriver	34p
BR53H	Large Screwdriver	36p
YG24B	Driver S2	DIS
FY10L	Driver S3	26p
FY12N	Driver S5	89p
FY13P	Driver S6	63p
FY15R	Pozidriver P1	£1.49
FY17T	Pozidriver P2	99p
BR71N	Mains Tester	60p
LH75S	Spiraldriver	£4.25
YW92A	Ratchet Socket Set	£5.99
WY04E	Cushiongrip Drvr Set	£5.25
FY19V	Low Cost Min Cutters	£4.25
BR75S	Ins Min Cutters	£6.93

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BR70M	Box-Joint Min Cutter	DIS
FY20W	Box-JT End Cutter	£5.60
FY21X	Low-Cost Cutters	£2.25
FY76H	Large Low Cost Cutts	£3.75
BR74R	Side Cutters	£5.95
FY22Y	Box Jt Side Cutters	£7.60
BR72P	Side Cutters S55	£4.50
FY23A	High Leverage Cutter	DIS
YW67X	Tweezers	19p
FY24B	Low Cost Min Pliers	£3.90
BR78K	Ins Min Snipe	£5.45
BR69A	Box Joint Min Pliers	£8.60
BR77J	Bright Pliers	£4.99
FY25C	Low-Cost Pliers	£1.95
FY26D	Box Combined Pliers	£3.99

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FY27E	Low-Cost Long Pliers	£3.99
BR92A	Combination Pliers	£5.50
BR73Q	Long Snipe Pliers	£7.49
BR90X	Box Radio Pliers	£6.37
FY28F	Low-Cost Elec Pliers	£2.85
FY29G	Low-Cost HD Pliers	£2.45
BR91Y	Electricians Pliers	£4.90
FY30H	Pincers	£3.37
*FY31J	Crimp Tool	£2.15
BR76H	End Action Strippers	£5.99
BR93B	Wire Strippers 3A	£2.35
BR94C	Wire Strippers 8B	£1.49
BR95D	Wire Strippers 9	£3.96
BR96E	Stripmaster	£16.25
BR97F	Blade L5361	£6.20
XX11M	Blade L4421	£6.25

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FY32K	Hand Wrap Tool	£6.48
HY16S	Verowire Pen	£4.95
HY17T	Verowire Spool	99p
FY33L	Verowire Comb	8p
FY34M	Allen Keys AF	£1.64
FY35Q	Allen Keys Metric	£1.35
YR82D	Min Spanner Set	£2.10
FY36P	Min Spanner 24	£1.15
FY37S	Min Spanner 68	£1.15
FY38R	Ring Spanner 02	£1.99
FY39N	Ring Spanner 46	£1.69
YW61R	Box Spanner Set	£2.15
YW62S	PSD6 Spanner Set	DIS
FY45Y	Crescent Wrench 160	£3.35
FY46A	Crescent Wrench 210	£4.20

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FY40T	Box Spanner 2BA	£1.25
FY41U	Box Spanner 4BA	£1.25
FY42V	Box Spanner 6BA	£1.25
FY43W	Box Spanner 8BA	£1.25
FY44X	Quick Grips	DIS
FY47B	Adjustable Wrench	£3.20
*YW63T	Needle File Set	£5.60
FY49D	Needle File Flat Wrd	£1.75
FY50E	Needle File Hand	£1.75
FY51F	Needle File Halfrnd	£1.63
FY52G	Needle File Round	£2.27
BR63T	Junior Hacksaw	99p
BR64U	6in Hacksaw Blades	98p
FY54J	Wire Brush	45p
FY55K	Wet & Dry Fine	20p
FY56L	Wet & Dry Med	19p
FY57M	Wet & Dry Course	25p
HX04E	Polish Block	£1.40
FY02C	Utility Knife	£1.60
FY03D	Retractable Knife	£1.99
FY04E	Knife Blades	99p
YW64U	Snap-Off Blade Knife	99p

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FY05F	Scalpel Handle	£1.75
FY06G	Scalpel Bld Type II	46p
BR59P	Punch 3/8in	£4.38
BR60Q	Punch 7/16in	£4.29
BR61R	Punch 1/2in	£4.64
BR62S	Punch 9/16in	£4.49
BR80B	Punch 5/8in	£4.64
BR81C	Punch 3/4in	£4.83
BR83E	Punch 1in	£5.20
BW00A	Punch 1 1/2in	£6.49
FY53H	Mini Vice	£3.85
LH79L	Reliant Kit	£21.95
BW03D	Reliant Drill	£7.60
BW02C	Titan Drill	£11.25
YW65V	Mini Mains Drill	£14.25
XB12N	Drill Stand	£14.95
BR84F	Reliant Collar	75p
BW04E	Drill Power Supply	£13.99

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BR65V	Twist Burr 0.8mm	43p
BR66W	Twist Burr 1.4mm	43p
BR85G	HS Twist Drill 0.8mm	75p
BR86T	HS Twist Drill 1mm	75p
BR87U	HS Twist Drill 1.4mm	75p
YY28F	Long-Life Drill 1mm	£1.20
LH77J	20-Piece Tool Kit	£8.25
LH78K	40-Piece Tool Kit	£14.95
LH76H	Wishbone Sharpener	£6.85
YW66W	Pin Drill	£4.95
HQ02C	HS Drill 1/16in	19p
HQ03D	HS Drill 5/64in	23p
HQ04E	HS Drill 3/32in	26p
HQ05F	HS Drill 7/64in	28p
HQ06G	HS Drill 1/8in	29p
HQ07H	HS Drill 9/64in	35p
HQ08J	HS Drill 5/32in	41p
HQ09K	HS Drill 11/64in	45p
HQ10L	HS Drill 3/16in	50p
HQ11M	HS Drill 13/64in	56p
HQ12N	HS Drill 7/32in	60p
HQ13P	HS Drill 15/64in	68p
HQ14Q	HS Drill 1/4in	75p
HQ15R	HS Drill 17/64in	89p
HQ16S	HS Drill 9/32in	96p
HQ17T	HS Drill 19/64in	£1.05
HQ18U	HS Drill 5/16in	£1.15
HQ19V	HS Drill 21/64in	£1.22
HQ20W	HS Drill 11/32in	£1.32
HQ21X	HS Drill 23/64in	£1.48
HQ22Y	HS Drill 3/8in	£1.49
HQ23A	HS Drill 25/64in	£1.55
HQ24B	HS Drill 13/32in	DIS
HQ25C	HS Drill 27/64in	£1.95
HQ26D	HS Drill 7/16in	£2.17
HQ27E	HS Drill 29/64in	DIS
HQ28F	HS Drill 15/32in	£2.45
HQ29G	HS Drill 1/2in	£2.75
FY58N	Round Tape Rule	DIS
FY59P	Retractable Rule	£2.75
FY60Q	Feeler Gauge Imp	95p
FY61R	Feeler Gauge Metric	97p

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FY62S	Iron CX	£6.59
FY63T	Element CX	£2.94
FR30H	Bit 6/1106	89p
FY64U	Bit 1100	84p
FY65V	Bit 1101	92p
FR31J	Bit 7/1101	£1.19
FY66W	Bit 1102	93p
FY67X	Bit 1103	92p
FR01B	Element Type CN	£2.65
FR02C	Handle Type CN	85p
FR03D	Bit 102	84p
FR04E	Bit 104	88p
FR05F	Bit 106	84p
FR06G	Bit 820	89p
FR07H	Bit 821	84p
FR08J	Bit 822	84p
FR12N	Iron X25	£5.95
FR13P	12V Iron MLX12	£7.48
FR14Q	Element X25	£2.92
FR15R	Element MLX12	£2.49
FR16S	Bit No. 50	89p
FR17T	Bit No. 51	92p
FR18U	Bit No. 52	89p
FR20W	Stand ST3	£2.95
FR11M	Sponge	11p
FY68Y	Kit SK3	£8.92

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FY69A	Kit SK4	£8.99
WY05F	Rechargeable Iron	£26.95
YX67X	B50 Bit Round	£2.95
YX68Y	B50 Bit Angled	£3.62
YX69A	B50 Bit Flattened	£3.65
YX70M	B50 Lamp	85p
YX71N	B50 Holder	62p
YX72P	B50 Sponge	29p
FR10L	Heat Sink Tweezers	19p
FR23A	Solder Sucker	£4.50
FR24B	Sucker Tiplet	£1.55
FR26D	Desolder Tool	£7.25
HY13P	Desldr Nozzle Type 2	89p
FR63T	Desldr Washer Type 2	24p
FR27E	Desolder Washer	DIS
FR28F	Desolder Nozzle	£1.55
FR29G	Solda-Mop	90p
FR21X	Solder D622	75p
FY70M	1/2kg Reel Solder	£10.50
FY71N	Alum Solder 1m Pk	43p

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FY72P	Conductive Paint	£5.35
LH04E	Freeze-It	£1.94
LH03D	Switch Cleaner	£1.94
YB77J	Servisol	£1.66
LH02C	Aero-Klene	£1.55
YB73Q	Aero-Duster	£1.75
YB74R	Silicone Grease	£1.98
YB75S	Plastic Seal	£1.55
YB76H	Foam Cleanser	£2.35
YB78K	Excel Polish	£1.78
YB79L	Anti-Static Spray	£1.72
YB80B	Fire Extinguisher	£4.85
FL43W	Evostik Impact	99p

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FL46A	Cyanoacrylate	£1.55
LQ02C	Potting Compound	£3.55
FL44X	Araldite Rapid	£2.25
FL45Y	Double Bubble Sachet	28p
FL47B	PVC Tape Black	35p
FL48C	PVC Tape Blue	35p
FL49D	PVC Tape Brown	35p
FL50E	PVC Tape Green	35p
FL51F	PVC Tape Red	35p
FL52G	PVC Tape White	35p
YR99H	PVC Tape Yellow	35p

WOUND PARTS

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LB40T	9.5 Coil Former	60p
LB17T	Former 351	24p
LB18U	Former 450	16p
LB19V	Former 722/1	13p
LB20W	Former 722/2	13p
LB21X	Former 722/8	13p
LB22Y	Former 722/4	13p
LB41U	Dust Core Type 4	10p
LB42V	Dust Core Type 6	11p
LB43W	Dust Core Type 8	17p
LB44X	Former Base	12p
LB36P	Screening Can 10	10p
LB37S	Screening Can 13	DIS
LB39N	Screening Can 15	14p
LB38R	Screening Can 14	DIS
LB62S	A/P Beads	35p
HX05F	Small Pot Core	£1.30
HX06G	Core Type 2	£1.45

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HX07H	Bobbin Type 2	75p
HX08J	Clips Type 2	5p
HX09K	Type 3 Core	£1.85
HX10L	Type 3 Bobbin	42p
HX11M	Type 3 Clips	6p
HX12N	Large Pot Core	99p
HX13P	Bobbin Type 4	10p
HX14Q	Mtg System Type 4	£1.10
HW23A	GE Coil L15	£1.95
HX58N	GE Coil L9	£2 20
HX57M	GE Coil L8	£2 20
HW24B	GE Coil L14	£1.95
HX56L	GE Coil L7	£2 20
HX55K	GE Coil L6	£2.20
HX54J	GE Coil L5	£2.25
HW25C	GE Coil L12	£1.99
HW26D	GE Coil L11	£1.99

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HX24B	Choke 0.5H	£1.15
HX25C	Choke 1H	£1.15
HX26D	Choke 2H	£1.15
HX27E	Choke 4H	£1.15
LR07H	Filter Pot Core	£2.15
XX30H	Equaliser Pot Core	£1.99
HW27E	Choke 10H	£1.96
HW28F	Choke 5uH HC	48p
HX15R	Choke 1.5mH	58p
HX16S	Choke 2.5mH	59p
HX17T	Choke 5mH	66p
HX18U	Choke 7.5mH	66p
HX19V	Choke 10mH	29p
HX22Y	Choke RFC5	£2.36
HX23A	Choke RFC9A	£2.65
WH25C	Choke 0.22uH	48p
WH27E	Choke 0.47uH	53p
WH29G	Choke 1.0uH	45p
WH30H	Choke 1.5uH	45p
WH31J	Choke 2.2uH	45p
WH32K	Choke 3.3uH	45p
WH33L	Choke 4.7uH	49p
WH34M	Choke 6.8uH	55p
WH35Q	Choke 10.0uH	45p
WH36P	Choke 15.0uH	61p
WH37S	Choke 22.0uH	48p
WH38R	Choke 33.0uH	48p
WH39N	Choke 47.0uH	48p
WH41U	Choke 100uH	54p
WH45Y	Choke 470uH	55p
WH47B	Choke 1mH	75p
HX29G	Crystl Set Coil PCC1	£1.95

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HX42V	Toko YRCS 11098	51p
YG30H	Toko YRCS12374	52p
HX43W	Toko YHCS 11100	52p
YG31J	Toko CSK3464	47p
YG32K	Toko YMCS17104	47p
HX97F	Toko ACS 34342	64p
HX98G	Toko ACS 34343	46p
YG39N	Toko KAC8448	48p
YG36P	Toko KAC8449	46p
LB00A	IFT 13	£1.48
LB01B	IFT 14	£1.75
LB03D	IFT 16	£1.72
LB04E	IFT 17	£1.75
LB02C	IFT 15	£1.81
LB05F	IFT 18 465kHz	£2.19
LB06G	IFT 18 1.6MHz	£1.98
HX28F	Toc 1	£1.99
HX69A	Trans Coil 1T Blue	£2.57
HX70M	Trans Coil 1T Red	£2.17
HX71N	Trans Coil 1T White	£2.95
HX72P	Trans Coil 1T Yellow	£2.42
HX73Q	Trans Coil 2T Blue	£2.17
HX74R	Trans Coil 2T Red	£2.20
HX75S	Trans Coil 2T White	£1.48
HX76H	Trans Coil 2T Yellow	£2.22
HX77J	Trans Coil 3T Blue	£2.17
HX78K	Trans Coil 3T Red	£2.17
HX79L	Trans Coil 3T White	£2.17
HX80B	Trans Coil 3T Yellow	£2.20
HX89W	Trans Coil 4T Blue	£2.17
HX90X	Trnas Coil 4T Red	£2.17
HX91Y	Trans Coil 4T White	£2.45
HX92A	Trans Coil 4T Yellow	£2.20
HX93B	Trans Coil 5T Blue	£1.82
HX94C	Trans Coil 5T Red	£2.17
HX95D	Trans Coil 5T White	£2.11
HX96E	Trans Coil 5T Yellow	£2.16

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HX82D	Min Tr LT44	55p
LB14Q	Min Tr LT700	55p
YR91Y	Min Tr LT800	33p
WB00A	Sub-Min Tr 6V	£1.30
WB01B	Sub-Min Tr 9V	£1.30
WB02C	Sub-Min Tr 12V	£1.40
WB06G	Min Tr 6V	£3.30
WB11M	Min Tr 9V	£4.25
WB10L	Min Tr 12V	£3.35
WB15R	Min Tr 15V	£3.35
LY03D	Tr 10VA 15V	£4.95
WB16S	Min Tr 20V	£3.35
WB20W	Min Tr 24V	£3.35
WB21X	Min Tr 36V	DIS
WB25C	Tr 12V 1A	£6.55
WB26D	Tr 12V 2A	£7.95
WB03D	Tr 9V 1.1/2A	£6.25
WB12N	Tr 20V 1A	£8.25
WB17T	Tr 28V 1.1/2A	£9.95
XB38R	TR 32032/6.1/2A	£23.25
HX59P	Trnsformer Mtg Plate	66p

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WB07H	Tr 34V 1A	£7.85
WB22Y	Tr 34V HP	£8.15
LW34M	15/22V Power Tran	£14.84
LW33L	Tr 240V Isotran	£4.95
HX81C	Pulse Transformer	£3.82
WB28F	Clock Transformer	DIS
YX66W	Line Transformer	£3.35
LB70M	Mic Xformer MX5	DIS
LB71N	Mic Xformer MX6	DIS
LR05F	Mic Xfrm Typ2 20-30R	DIS
LR06G	Mc Xfm Typ2 200-600R	£19.45
YX84F	Z Changer	£7.85

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YG12N	Min Motor	£2.45
YG13P	Small Motor	£1.25
YG14Q	Servo Mechanism	£3.60

NEW ITEMS PRICE LIST

The following is a list of all items introduced prior to this price list, but since publication of our 1981/82 catalogue and includes all special items for projects that appeared in the March 1981 to August 1982 issues of Electronics & Music Maker.

AERIALS, AMATEUR RADIO AND CB

AF46A CB FM Transceiver GT-868 **Price £49.95**
HL94C 30W Dummy Load **Price £6.75**
XG10L 12V 3A Power Unit **Price £16.95**
XG13P 1.5m CB Aerial **Price £13.95**
YG41U 27MHz Rubber Deck **Price £4.75**
YK00A 2m Scanning Receiver **Price £54.95**
YK29G Ext CB Speaker **Price £7.45**
YK30H Noise Filter System **Price £10.95**
YL42V Filter Choke **Price £1.99**
YL43W TVI Filter **Price £5.25**
YL44X CB Aerial Converter **Price £7.25**
YQ73Q CB/Radio Aerial Coupler **Price £5.49**
YQ74R CB Aerial Matcher **Price £5.25**

BATTERIES

HW31J Nicad PP3 **Price £5.95**
HW32K PP3 Nicad Charger **Price £6.95**
HY32K Large Battery Holder **Price £1.85**
YK31J Universal Ni-Cad Charger **Price £8.95**

BOOKS, MAGAZINES AND LEAFLETS

GG24B Analog Subscription **Price £9.00NV**
WG01B Practical Electronics Handbook by Ian Sinclair **Price £4.70NV**
WG02C Newnes Book of Video by K. G. Jackson **Price £6.90NV**
WG03D Introduction To Pascal by Rodnay Zaks **Price £10.75NV**
WG04E A Basic Approach to BASIC by Henry Mullish DIS
WG05F Atari BASIC by Albrecht **Price £7.95NV**
WG06G Consumers Guide To Personal Computing & Microcomputers by Freiberger **Price £8.25NV**
WG07H Beat The Odds by Hans Sagan **Price £8.60NV**
WG08J BASIC With Business Applications by Lott **Price £9.89NV**
WG09K Introduction to Computer Music by Bateman **Price £15.60NV**
WG10L Basic Electricity by C. Ryan **Price £6.65NV**
WG11M Electronics by H. Kybett **Price £6.65NV**
WG12N BASIC by Albrecht **Price £8.30NV**
WG13P BASIC for Home Computers by Albrecht **Price £6.75NV**
WG14Q TRS80 BASIC by Albrecht **Price £7.70NV**
WG15R Using CP/M by Fernandez **Price £6.65NV**
WG16S Flowcharting by N. Stern **Price £6.85NV**
WG17T The S-100 Bus Handbook by D. Bursky **Price £13.25NV**
WG18U Telephone Accessories You Can Build by J. H. Gilder **Price £6.45NV**
WG19V 60 Challenging Problems with BASIC Solutions by D. Spencer **Price £5.75NV**
WG20W The Best Book On CB by E. Herbert **Price £5.40NV**
WG21X Z80 & 8080 Assembly Language Programming by K. Spracklen **Price £6.75NV**
WG22Y Intel Memory Book **Price £19.35NV**
WG23A Intel 8080/8085 Book **Price £16.95NV**
WG24B 8086 Primer by S. Morse **Price £10.49NV**
WG25C Writing Interactive Compilers & Interpreters by P Brown **Price £13.45NV**
WG26D Foundations of Programming with Pascal by L. Moore **Price £6.24NV**
WG27E What To Do After You Hit Return by The People's Computer Company **Price £13.45NV**
WG28F VMOS Projects by R. A. Penfold **Price £2.15NV**
WG29G Digital IC Projects by F. G. Rayer **Price £2.15NV**
WG30H International Transistor Equivalents Guide by Adrian Michaels **Price £3.25NV**
WG31J Fifty BASIC Exercises by J. P. Lamoitier **Price £10.45NV**
WG32K The Pascal Handbook by Jacques Tiberghien **Price £12.15NV**
WG33L Learning BASIC With Your Sinclair ZX80 by Robin Norman **Price £4.75NV**
WG34M Oscilloscopes: How To Use Them: How They Work by Ian Hickman **Price £4.20NV**
WG35Q More Telephone Accessories You Can Build by Jules H. Gilder **Price £5.46NV**
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WG37S Problem Solving Principles For Programmers by William E. Lewis **Price £8.85NV**
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WG41U Apple II Users Guide by Lon Poole **Price £13.95NV**
WG42V An Introduction To BASIC Programming Techniques by S. Daly **Price £2.15NV**
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WG55K Atari Basic Learning By Using by Thomas E. Rowley **Price £5.24NV**
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WG69A Public Address Handbook by Vivian Capel **Price £8.75NV**
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WG86T Popular Electronic Circuits Book 2 by R. A. Penfold **Price £2.25NV**
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WG88V The 6809 Companion by M. James **Price £1.95NV**
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WG90X The Giant Book of Computer Software by 73 Magazine **Price £10.50NV**
WG91Y Secrets of 123 Old-Time Science Tricks and Experiments by Edi Lanners **Price £5.45NV**
WG92A How To Design and Build Your Own Custom Robot by David L. Heiserman **Price £9.75NV**
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WG95D Microcomputers In Amateur Radio by Joe Kasser **Price £7.45NV**
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WG98G The BASIC Conversions Handbook by Brain Bank **Price £6.95NV**
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WA13P The Interface Circuits Data Book **Price £9.54NV**
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WA19V Linear Integrated Circuit Pocket Guide **Price £4.50NV**
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XA04E Maplin Magazine Vol. 1 No. 4 **Price 60pNV**
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XF59P E&MM May 1982 Issue **Price £1.10NV**
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XF61R E&MM July 1982 Issue **Price £1.10NV**
XF62S E&MM August 1982 Issue **Price £1.10NV**
XH52G Atari Software Leaflet (Issue 2) **Free**
XH53H Matinee Component Identification Leaflet **Price 40pNV**
XH54J Atari Hardware Leaflet **Free**
XH55K Matinee Organ Book **Price £2.50NV**
XH56L Spectrum Synthesiser Book **Price £1.00NV**
XH59P Sequencer Leaflet **Price 40pNV**

BOXES

HY25C Display Box **Price £1.25**
YK24B Calculator Style Verobox **Price £4.45**

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RK30H Flexicable 7-way **Price 54p**
RK31J Flexicable 10-way **Price 65p**
XR66W 4-Wire Phone Cable per metre **Price 15p**

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RK26D Axial 4700uF 40V **Price £1.40**

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BH65V Minicon Latch Housing 6-Way **Price 13p**
BH66W Minicon Latch Housing 5-Way **Price 11p**
BH67X Right-Angle Minicon Plug 15-Way **Price 65p**
BX96E Minicon Latch Plug 3-Way **Price 23p**
BX97F Minicon Latch Housing 3-Way **Price 11p**
BX98G Jumper Cable 17-Way **Price £3.65**
FB99H Right-Angle Latch Minicon Plug 6-Way **Price 40p**
FY91Y Right-Angle Latch Minicon Plug 4-Way **Price 33p**
FY92A Right-Angle Latch Minicon Plug 2-Way **Price 26p**
FY93B Minicon Latch Plug 5-Way **Price 26p**
FY94C Minicon Housing 10-Way **Price 18p**
HB58N Minicon Latch Housing 4 Way **Price 10p**
HB59P Minicon Latch Housing 2-Way **Price 8p**
HF98G Stereo Plastic 3.5mm Plug **Price 25p**
HL95D RA PL259 Plug **Price 85p**
HL96E Quick Connect PL259 Plug **Price 99p**
HQ85G Minicon Plug 10-Way **Price 47p**
RK00A UHF Female T Adaptor **Price £1.75**
RK01B UHF Adaptor FFLA **Price £1.65**
RK02C UHF Adaptor FMLA **Price £1.75**
RK27E Adaptor L **Price 60p**
RK28F RA Flexiconnector 5-way DIS
RK29G RA Flexiconnector 8-way DIS
YK06G Pedalboard Cableform **Price £2.98**

CONSUMER GOODS

AC41U Othello Video Game Cartridge **Price £18.95**
AC42V Video Pinball Cartridge **Price £24.95**
AC43W Asteroids Video Game Cartridge **Price £29.95**
AC44X War Lords Game Cartridge **Price £29.95**
AC45Y Le Stick **Price £24.95**
AC46A Missile Command Video Game Cartridge **Price £29.95**
AC47B Flag Capture Video Game Cartridge DIS
AC48C Super Breakout Game Cartridge **Price £29.95**
AC49D Kaboom! Game Cartridge **Price £19.95**
AC50E Laser Blast Game Cartridge **Price £19.95**
AC51F Freeway Game Cartridge **Price £19.95**
AC52G Dragster Game Cartridge **Price £19.95**
AC53H Single Game Joystick **Price £7.50**
AC54J Super Expander Cartridge **Price £34.95**
AC55K Programmers Aid Cartridge **Price £34.95**
AC56L Machine Code Monitor Cartridge **Price £34.95**
AC57M Introduction To BASIC Part 1 **Price £14.95**
AC58N Introduction To BASIC Part 2 **Price £14.95**
AC59P VIC Avenger Game **Price £19.95**
AC60Q VIC Star Battle Game **Price £19.95**
AC61R VIC Super Slot Game **Price £19.95**
AC62S VIC Jelly Monsters Game **Price £19.95**
AC63T VIC Alien Game **Price £19.95**
AC64U VIC Super Lander Game **Price £19.95**
AC65V VIC Road Race Game **Price £19.95**
AC66W VIC Rat Race Game **Price £19.95**
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AC68Y Pac-Man **Price £29.95**
AC69A Haunted House **Price £18.95**
AC70M From Demons To Diamonds **Price £18.95**
AC71N Yar's Revenge **Price £29.95**
AC72P Berzerk **Price £29.95**
AC73Q Defender **Price £29.95**
AC74R Adventure I **Price £24.95**
AC75S Adventure II **Price £24.95**
AC76H Raiders Of The Lost Ark **Price £29.95**
AF36P Atari 400 with 16K RAM **Price £249.90**
AF37S Atari 400 with 48K RAM **Price £319.00**
AF38R Epson MX80T Mk II **Price £325.00**
AF39N Epson MX80F/T Mk II **Price £375.00**

Note: AF39N is available while stocks last. AF38R is while stocks last, then Mk III will be supplied at £399.95.

NEW ITEMS PRICE LIST *(continued from page 36)*

AF40T Epson MX80F/T Mk III Price £447.35
AF41U Centronics Interface for Atari 400 Price £59.95
AF42V Centronics Interface for Atari 800 Price £59.95
AF43W Versawriter for Atari 400/800 Price £169.00
AF44X 48K RAM Module Price £125.35
AF45Y 48K Upgrade for Atari 400 Price £75.00
AF47B VIC20 Colour Computer Price £199.99
AF48C VIC20 Cassette C2N Price £44.95
AF49D VIC20 Printer Price £230.00
AF50E VIC20 Disk Drive Price £396.00
AF51F VIC 3K RAM Price £29.95
AF52G VIC 8K RAM Price £44.95
AF53H VIC 16K RAM Price £74.95
AF54J VIC Memory Expansion Board DIS
HY24B 2-Roll Pack of Paper for Printer 822 Price £4.95

Software For Atari 400 and 800: See back cover. (Full details are on XH52G and XH54J both free.) Also see Computer News.

ELECTRICAL
WY23A Timetouch Electronic Time Switch Price £24.80

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HY30H Isobolt M3 x 9mm (pk of 10) Price 12p
HY31J Steel Washer 4BA (pk of 10) Price 11p

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QY05F LC Cap White Price 5p
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RK03D Power Mic DM313P Price £11.75
RK04E Power Mic DM311P Price £13.95
XG11M Base Station Mic DX357 Price £33.50
XG12N Base Station Mic BSA610A Price £33.50

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RK23A Solar Panel 9V Price £8.95
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BR98G Drawbar Blue Price £1.55
BR99H Drawbar Green £1.55
FB98G Rubber Coupling Price 66p
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XY97F Keyboard Separator Price £1.95*
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RK08J Quick-fit Meter 500uA Price £2.95
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RK11M Quick-fit Meter 10mA Price £2.95
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RK13P Quick-fit Meter 100mA Price £2.95
RK14Q Quick-fit Meter 500mA Price £2.95
RK15R Quick-fit Meter 1A Price £2.95
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RK17T Quick-fit Meter 25V Price £2.95
RK18U Quick-fit Meter 50V Price £2.95
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XX42V MP Urobreadboard Price £21.75

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BX99H Synwave Front Panel Price £1.10
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GA05F Syntom PCB Price £1.18
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GA26D Digital Tacho Main PCB Price £1.75
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GA63T Timer Relay PCB Price £1.10
GA64U Timer Front Panel Price £3.85
GA65V Sequencer PSU PCB Price £1.35
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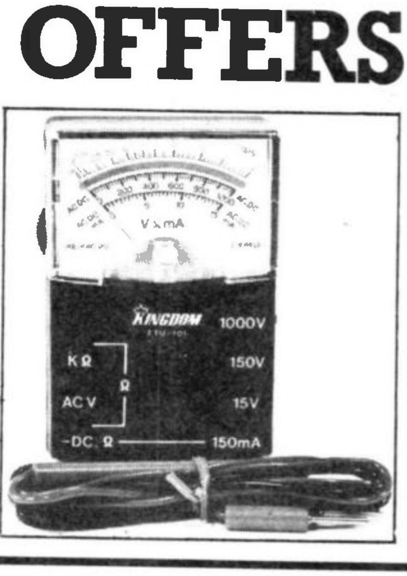

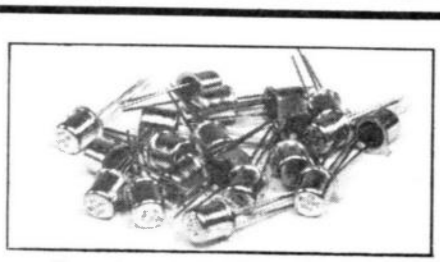

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NEW BOOKS

Electronics Simplified — Crystal Set Construction
by F. A. Wilson
This book is designed especially for those who wish to participate in the intricacies of electronics more through practical construction than by theoretical study. The original crystal set is no longer with us, but it has a modern counterpart and the circuits are still the basis of radio receivers so the reader discovers much about modern radio. Construction of several crystal sets is shown in detail.
1982. 80 pages. 178 x 110mm. Illustrated.
Order As WA34M (Book BP92) Price £1.75*NV*

Mini-Matrix Board Projects
by R. A. Penfold
A selection of twenty useful and interesting circuits any of which can be built on a small Veroboard type 14354 (FL06G). Projects include a MW radio, guitar headphone amp, transistor checker, microphone amp, aerial booster, kitchen timer, baby alarm, touch switch, automatic signal, magnetic lock and 10 more.
1982. 112 pages. 178 x 110mm. Illustrated.
Order As WA35Q (Book BP99). Price £1.95*NV*

Multi-Circuit Board Projects
by R. A. Penfold
The book contains 21 electronic projects, any of which may be constructed on the same specially designed pcb. Ready-made pcb's are available from Maplin (GA79L — £1.25). Also the same components have been used in each design where possible so that components and pcb may be used over and over again.
1982. 128 pages. 178 x 110mm. Illustrated.
Order As WA36P (Book BP103) Price £1.95*NV*

Aerial Projects
by R. A. Penfold
The book contains various practical aerial designs including active, loop and ferrite aerials which give good performances yet are relatively simple and inexpensive to build. Complex theory and mathematics of aerial design have been avoided. Constructional details are given for a number of aerial accessories including a preselector, attenuator, filters and tuning unit.
1982. 96 pages. 178 x 110mm. Illustrated.
Order As WA37S (Book BP105) Price £1.95*NV*

Understanding Automotive Electronics
by W. B. Ribbens & N. P. Mansour (Texas Instruments Data Library)
Many automotive functions are now being controlled electronically. Engine performance with good fuel economy and low exhaust emissions, cruise control, digital panel, displays - even speech synthesis products - are just a few of the practical applications of automotive electronics. This book explains in detail many of the applications of electronics in cars.
1982. 288 pages. 210 x 134mm. Illustrated.
Order As WA44X (Understanding Car Electronics) Price £4.95*NV*

The Art of Programming The 1K ZX81
by M. James & S. M. Gee
The book shows you how to use the features of the ZX81 in programs that fit into the 1K machine. The book covers random number generation graphics, moving graphics, PEEK and POKE, the ZX81 timer, and strings and words. There are several ready-to-run programs and plenty of hints and tips to help you get even more out of your 1K ZX81.
1982. 96 pages. 178 x 110mm. Illustrated.
Order As WA38R (Book BP109) Price £1.95*NV*

Advanced 6502 Interfacing
by John M. Holland
For anyone interested in robotics and computer control, here is a collection of design techniques and actual circuits that can be used or adapted to virtually any situation. Thoroughly covered are input and output port design, serial communications, timing and timers, A/D and D/A conversion, data acquisition and closed-loop control. Though offering advanced solutions to some rather complex and perplexing problems, it is written in an easy-to-understand manner, with clear explanations of circuit applications and operation for those looking for new ideas.
1982. 192 pages. 216 x 134mm. Illustrated.
Order As WA41U (Advanced 6502 Interfacing) Price £11.45*NV*

Beyond Games: Systems Software For Your 6502 Personal Computer
by Ken Skier
Use your 6502-based personal computer for more than games! This book, for Apple, Atari, Ohio Scientific and PET, presents a guided tour to your computer. It moves through a fast, but surprisingly complete course in assembly language programming. Having mastered these fundamentals, the reader is introduced to many useful subroutines and programming tools, such as screen utilities, print utilities, a machine language monitor, a hexadecimal dump tool, a disassembler and a simple screen-based text editor.
1981. 438 pages. 232 x 186mm. Illustrated.
Order As WA45Y (Beyond Games) Price £13.00*NV*

30-Hour BASIC (ZX81 Edition)
by Clive Prigmore, Richard Freeman and Robert Horvath
This book has been specially prepared for BBC TV's 'The Computer Program' for use with the ZX81. The book is a simple self-instructional course on the language of microcomputers, but it teaches you good programming techniques. You'll learn how to keep, order and sort files, records and directories; how to print letters and addresses; how to invent your own computer games; how to handle numbers and so on.
1982. 228 pages. 210 x 148mm. Illustrated in 2 colours.
Order As WA42V (30-Hour Basic) Price £6.50*NV*

Practical Programs (for the BBC Computer & Acorn Atom)
by David Johnson-Davies
The programs in this book illustrate many of the features of the BBC computer and its close relative, the Acorn Atom. They include games, language manipulation, mathematics and sophisticated graphics. Users of the book are encouraged to understand how the programs work so each program is explained in great detail. The programs are listed in both BBC Computer and Acorn Atom formats.
1982. 120 pages. 210 x 148mm. Illustrated.
Order As WA43W (Book JW414) Price £6.95*NV*

Games For The Atari
by S. Roberts
The book contains a BASIC listing for eight games and a machine code listing for one large game, Gunfight. The book also provides hints and tips for programming your own games. Screen movements are covered along with overlap detection, programming the joystick, sound features and ANTIC. The GTIA, display list interrupts and character set redefinition are also described.
1982. 128 pages. 208 x 136mm. Illustrated.
Order As WA47B (Games For The Atari) Price £4.45 *NV*

Atari Sound and Graphics
by Herb Moore, Judy Lower and Bob Albrecht
A crystal clear guide to the vast creative possibilities of artistic programming to owners of the Atari 400 or 800, the most visually advanced personal computers on the market. With this self-teaching guide you'll learn how to compose and play melodies, draw cartoons, create sound effects and games and progress to more sophisticated artistic programming.
1982. 240 pages. 252 x 170mm. Illustrated.
Order As WA39N (Book JW593) Price £8.25*NV*

Your Atari Computer
by Lon Poole with Martin McNiff & Steven Cook
Here's an invaluable all-in-one guide for Atari 400/800 computer users. The authors provide complete operating instructions and troubleshooting tips on hardware, peripherals and compatible software. Two chapters are devoted solely to the superb Atari graphics capabilities. For beginners there is a tutorial in Atari BASIC plus instructions for use of colour graphics and sound. The book has a comprehensive reference of BASIC statements and functions.
1982. 464 pages. 234 x 164mm. Illustrated.
Order As WA40T (Your Atari Computer) Price £13.45*NV*

Atari Computer Operating System User's Manual and Hardware Manual.
This comprehensive loose-leaf book, covers the operating system of the Atari 400 and 800 in great depth. It also describes the hardware and hardware registers at a highly technical level. There are memory maps and complete circuit diagrams of the computer.
1981. 356 pages. 282 x 196mm. Illustrated.
Order As WA46A (Opsys Users Manual) Price £16.95*NV*

De Re Atari

This book is essential for the serious programmer using the Atari 400 or 800, and unlocks the full amazing possibilities of these incredible machines. De Re (Day Ray) is Latin for 'All About' and this book is precisely that: All About Atari.
The book describes Atari's second microprocessor, ANTIC which controls the TV display and whose program is a Display List, and details are given of how you can alter or build your own Display List and thus directly create pictures on your TV set instantaneously. The colour registers and character sets are discussed, there is a whole section on Player Missile Graphics that permits real high-speed arcade-type graphics on your TV set and the powerful potential of Display List Interrupts is covered in detail.
The amazing scrolling capabilities of the Atari are described. Program techniques are described that allow the TV set to appear to be a window showing a small portion of a picture or map for example. By just using a joystick the window can be made to move horizontally, vertically and diagonally over the map smoothly, without steps or flickers.
The Atari has four separate sound generators each having a frequency register determining the note, and a control register regulating the volume and the noise content. Several options are shown allowing you to insert high-pass filters, choose clock bases, set alternate modes of operation and modify polynomial counters all in your programs.
In addition the book covers the Operating System, the Disk Operating System and the BASIC interpreter, showing how the tokenising scheme operates. This book opens the door to the amazing power of the Atari computers.
Order As WG56L (De Re Atari) Price £16.95NV

MAPLIN NEWS

MAPLIN OPEN A NEW SHOP AT BIRMINGHAM

We are very pleased to announce to our tens of thousands of customers in the Midlands, the opening of our new shop to bring Maplin's personal service to you. The shop which opens on Tuesday 24th August 1982 will be open from 9 a.m. to 5.30 p.m. on Tuesdays to Saturdays. Like all our shops it will be closed on Mondays.

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(Please note that all mail orders will still be dealt with by our Rayleigh warehouse. Customers in the Midlands must NOT send mail-orders to the Birmingham shop.)

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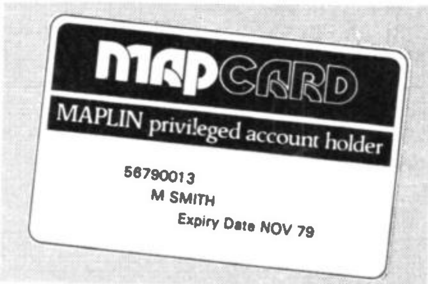

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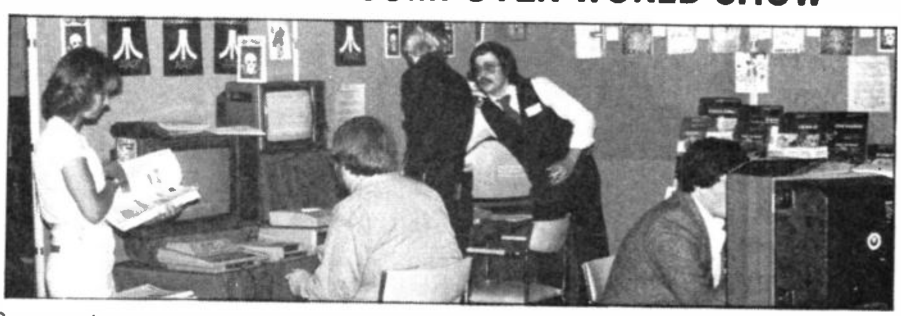
THE 5th PERSONAL COMPUTER WORLD SHOW



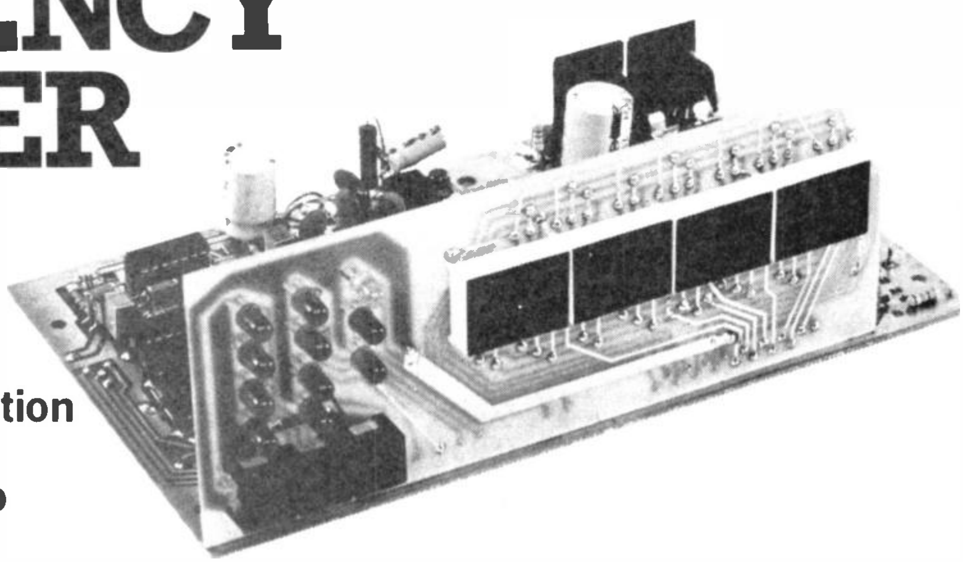
Come and see all our superb software and Atari hardware at the 5th Personal Computer World Show to be held at the new Barbican Centre in the City of London. The show will be more than double the size of last year's show. The show will be held on two floors, one for professional and business microcomputing and one devoted to home and hobbyist applications and that's where you'll find us. So here's your chance to visit the marvellous new Barbican centre and see all the latest things that are happening in microcomputers at the same time.

In particular we extend a warm welcome to everyone to visit our stand to see some of the spectacular new software titles we have on offer.

The show is open on Thursday, Friday, Saturday and Sunday, the 9th to the 12th of September 1982 and we look forward to meeting you there.

THE 8-DIGIT FREQUENCY COUNTER

by Chris Barlow



- ★ **Ranges from 100Hz to 500MHz**
- ★ **Mains or 12V DC operation**
- ★ **Clear 8-digit display**
- ★ **Easy to build - only two interconnecting wires**

This frequency counter offers a superior specification for the first time in kit form. The design is based on the Intersil ICM7216D, and includes electronically switched ranges for greater reliability and ease of construction. Provision has been made for possible future extensions, so this kit can be considered truly flexible.

The integrated circuits used are of an extremely advanced and sophisticated design, including CMOS, ECL, and Schottky TTL. The display uses multiplexed large red 7-segment LEDs for easy viewing. The functions and ranges are selected by computer-style key switches, and displayed on rows of different coloured LEDs. The input is a single BNC socket, and is switched automatically to the correct input amplifier. The counter will run off either an internal or an external reference oscillator, of either 1MHz or 10MHz (programmable). The power supplies are fuse protected on both DC and AC inputs.

The Frequency Counter

IC1 (ICM7216D) has multiplexed inputs for function and range select. It also has its own internal reference

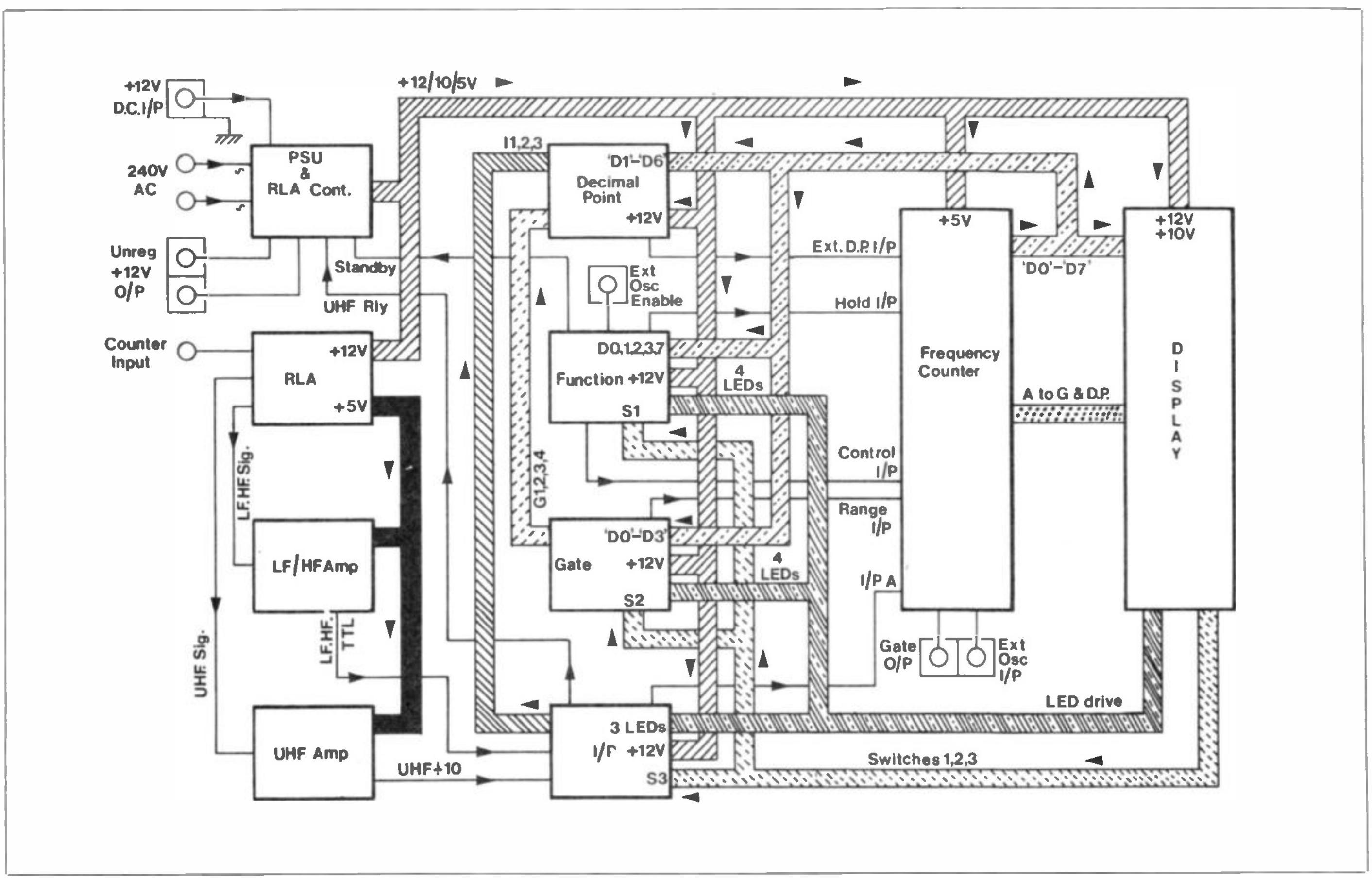


Figure 1. Block schematic of counter.

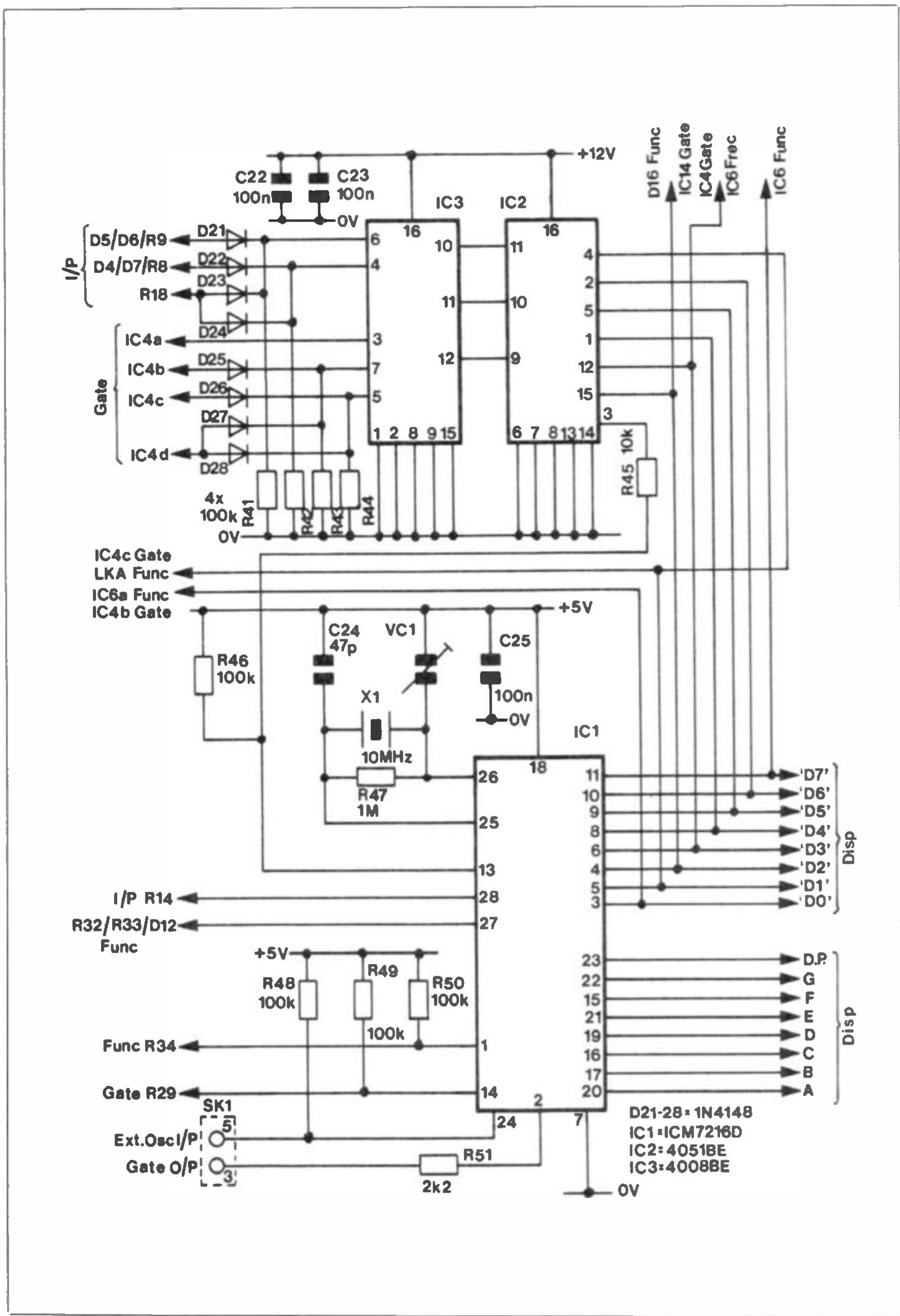
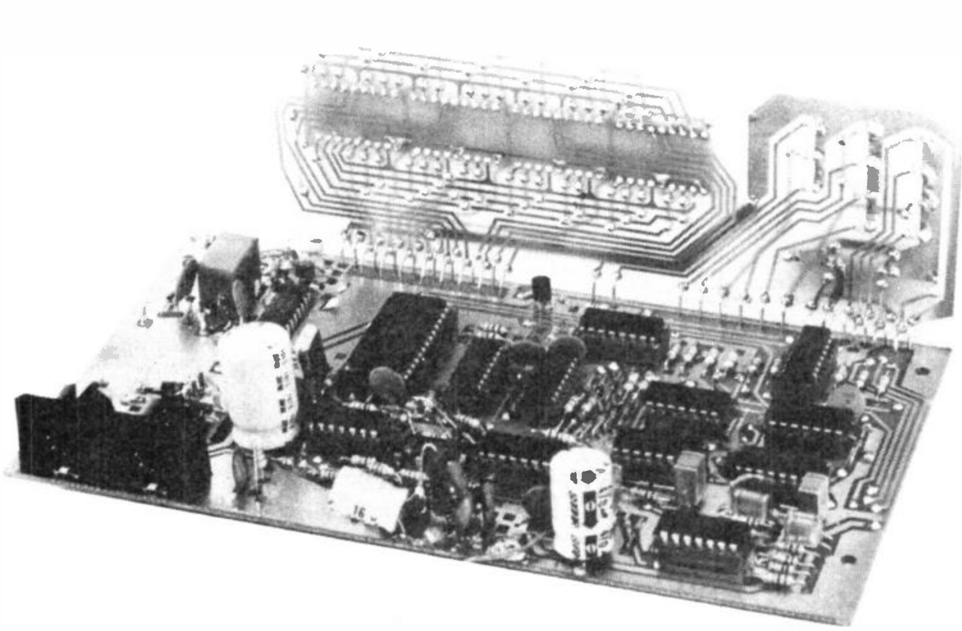


Figure 2. Frequency counter and decimal point logic counter.



oscillator, as well as provision for an external oscillator input (pin 24). Its internal oscillator is controlled by either a 10 MHz or a 1 MHz crystal. A 10 MHz crystal is supplied with the kit. Please note that if you wish to use the 1 MHz option, LKA on the PCB must be fitted. The crystal frequency is set by VC1. The setting of VC1 will determine the accuracy of the displayed frequency, and care should be taken in making this adjustment. IC1 provides the digit and segment drive for the 8-digit 7-segment displays. The digit drive multiplex signal is also used in the function and gate time selects circuits, to control the function and range inputs of IC1. Pin 2 of IC1 provides a gated signal output, which is fed to pin 3 of SK1, for possible future expansion to the system.

The Decimal Point

ICs 2 and 3 (CMOS 4051 and 4008) control the position of the decimal point. This is calculated by looking at the input range and gate time settings. The decimal point occurs at the transitional point between MHz and 100s kHz, except for the 10s gate time on L.F. range, where the decimal point occurs between Hz and tenths of Hz.

The Gate Time Function

This uses the CMOS 4093 (IC11) and 4017 (IC5) to select the gate times. The 4017 controls the CMOS bilateral switch CMOS 4016 (IC4). This selects the appropriate multiplex data line, which controls the range input (pin 14 of IC1). ICs 9 and 10 are the LED drivers for the four LEDs used in the display.

The Function Circuit

This is almost identical in operation to the Gate Time Circuit, but the multiplex data selected is fed to the control pin of IC1 (pin 1). In addition, the function circuit feeds signals to the input select, gate time select, and +10V control circuits. This disables the input select and gate time select in every mode except COUNT, also the +10V control is shut down in the DISPLAY OFF mode. A hold signal is generated in the function circuit which is fed to pin 27 of IC1, so that the frequency displayed can be stored for as long as is required. The display LEDs are driven by IC10 (CMOS 4049).

The Input Range Select Circuit

This functions similarly to the previous two, but features the control of Schottky TTL gates, which select either direct frequency, divide by ten, or divide by a hundred ranges. This is necessary because the maximum frequency that IC1 can handle is 10 MHz, therefore, for HF and UHF, division of the input signal is necessary. IC13 is the divide by ten chip used for HF and UHF ranges. In the UHF mode the prescaler IC14 divides by ten, which is then fed into IC13, making a total division of one hundred. IC9 drives the display LEDs.

The UHF Input Amplifier/Prescaler

The UHF input stage uses a ZTX326 (TR3) broad band, high frequency amplifier in the common base mode. The UHF signal is fed to TR3 via the input relay circuit. It is then fed to the input pins (15 and 16) of IC14. The IC divides the signal by a factor of ten, and the signal is then fed to the input select circuit.

The LF/HF Amplifier

The input to the amplifier is a FET source follower, TR5, to provide a high input impedance. This feeds the signal into pin 5 of IC16, a three stage broadband amplifier. The output on pin 15 is a 1V peak-to-peak signal, which is fed to the base of TR4. This then converts the signal into a TTL switching level, which is fed to pin 1 of IC15. This provides a clean switching waveform to drive the input select circuit. The output is on pin 8.

Power Supply and Relay Control

This consists of a standard transformer/bridge rectifier network, which provides an unregulated 12V supply for the CMOS circuits. REG 1 is a +5V, ½A regulator, and has a 1N4148 diode in its common return to increase the output voltage to +5.6V. This gives a brighter display and more reliable TTL switching. The 10V controlled output feeds the display LEDs on GATE TIME and INPUT ranges. The 10V is shut down in the DISPLAY BLANK mode, by IC11 controlling TR1. The relay RLA is controlled by TR2/IC9, and is active when UHF is selected. The relay controls the voltage and signal feed to either the LF/HF amplifier, or the UHF input amplifier/prescaler.

The Input Protection Circuit

This provides DC isolation to 500V, and AC protection up to a 5V peak-to-peak signal. This is achieved with limiting diodes and DC isolation capacitors on the input.

Construction

This project has been designed to fit into the aluminium instrument case XY45Y. Holes have to be drilled for the transformer, regulator, mains input socket, and fuse, as they are all mounted on the back of the box. Holes also have to be drilled to allow access to the PCB mounted power connector and auxiliary socket. The front of the case requires holes drilling for the BNC input socket, the three key switches, the

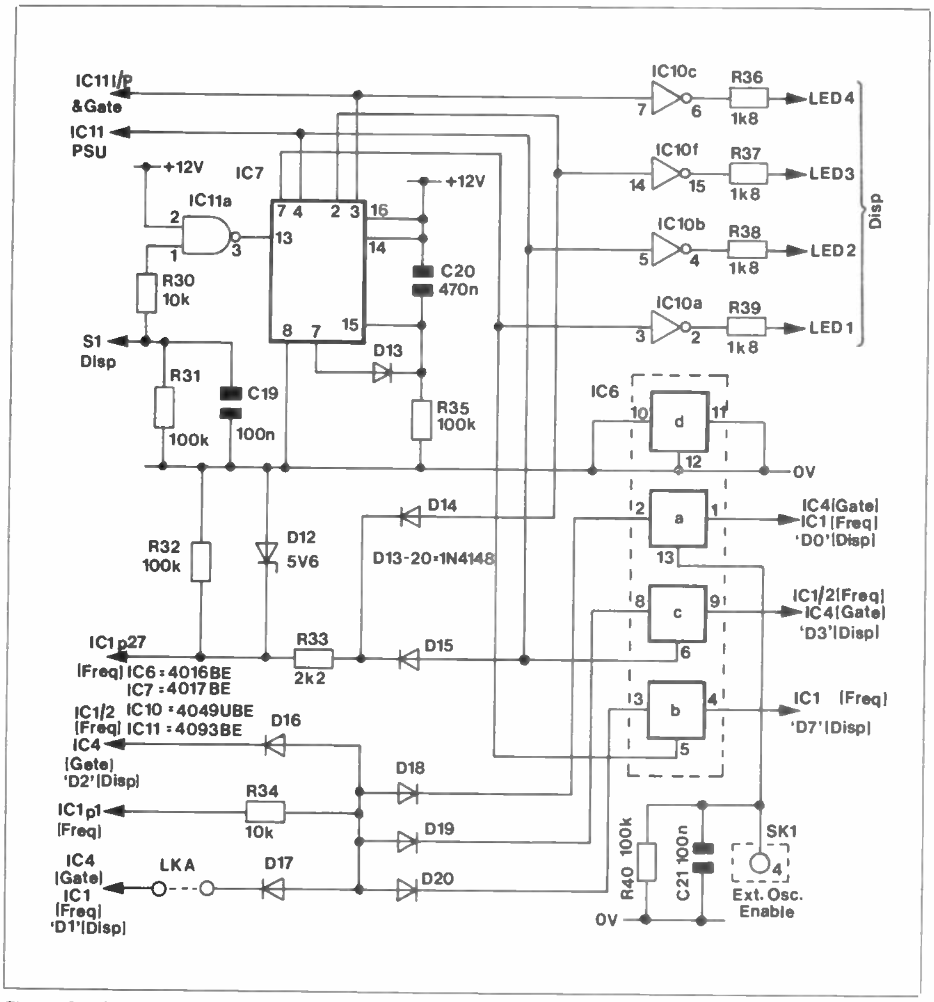


Figure 3. Function select circuit.

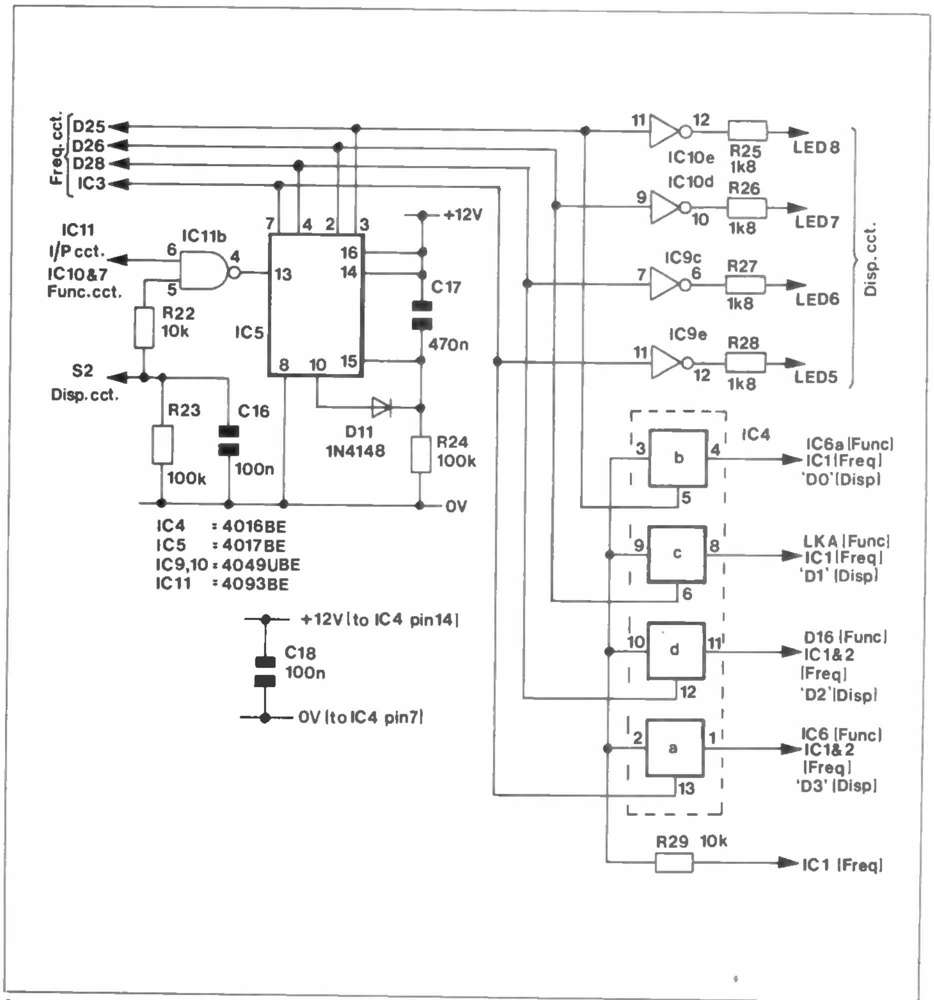


Figure 4. Gate time circuit.

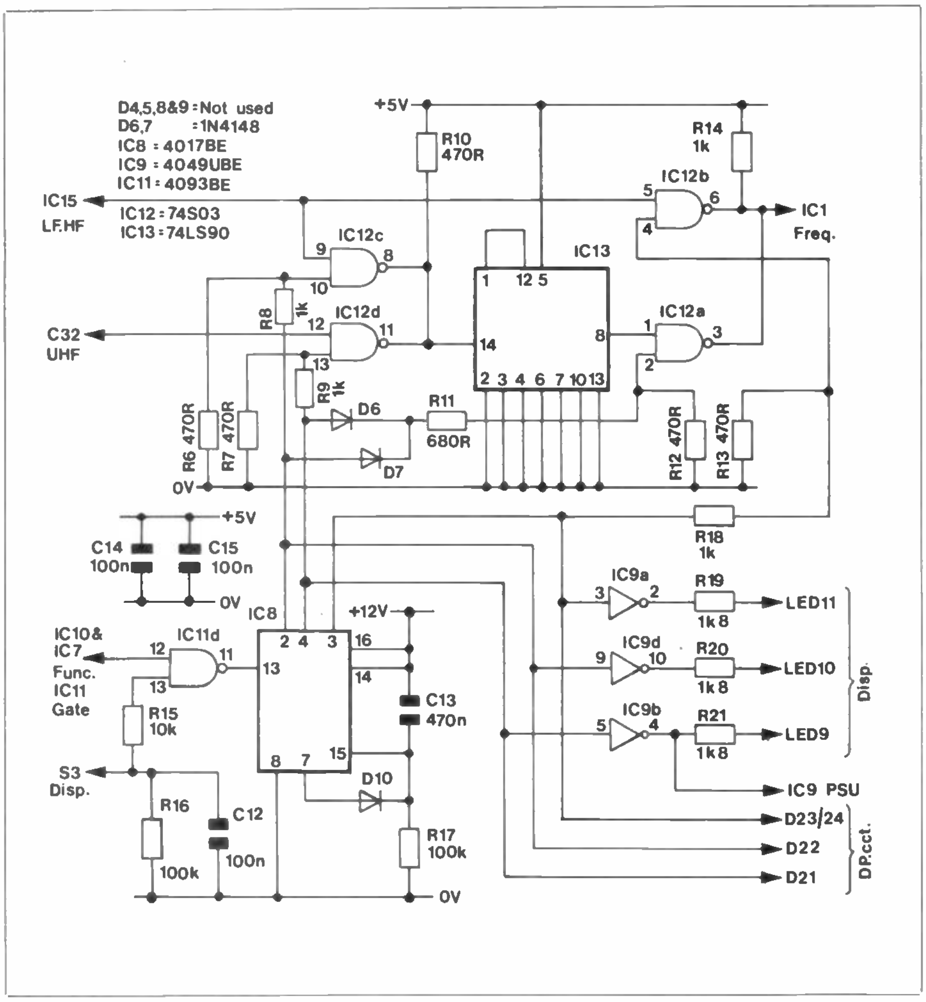


Figure 5. Input select circuit.

three rows of LEDs, and a rectangular window needs cutting for the display. The holes are already provided on the bottom of the box to fit the main PCB on ⅛" 6BA spacers. The CMOS ICs are all provided with sockets, and care should be taken when handling these devices.

The Main PCB

First, fit all track pins, making sure that they are all soldered on both sides. Then insert and solder the Vero pins into their correct positions, and fit all resistors and diodes, including BR1, checking for correct polarity on all the diodes.

Fit the two PCB mounting connectors and the fuse clips. Fit all capacitors, including VC1. Make sure that all the electrolytics and tantalums are correctly polarised. Fit the relay RLA and all IC sockets. These are *only* provided for CMOS ICs. Sockets should *not* be fitted to the ECL and TTL devices, as these can operate at frequencies that make the use of sockets undesirable. Fit the transistors, including the input FET, and solder the regulator into a position enabling it to be bolted to the back panel when the PCB is fitted into the case. Fit the crystal, taking care not to overheat this component. Clean the underside of the PCB, and check soldering for possible dry joints etc.

The Display PCB

Fit all track pins. Fit all 7-segment displays, ensuring correct orientation with markings towards the bottom of the board. Fit all display LEDs, and then the three push switches as shown in Figure 10. Check your soldering!

Fitting the Display PCB to the Main Board

The display PCB must be mounted at an angle of 90 degrees to the main board, and the bottom edge must run parallel to the front edge of the main PCB. Solder the inter-PCB connecting links to the main board.

All CMOS chips with the exception of IC1 should now be fitted. Normal CMOS precautions should be observed. Fit the BNC socket and glue the red filter to the front panel (as shown in Figure 11). The main PCB should now be tested (see the setting up procedure). After testing, mount the PCB with spacers (Figure 11), and bolt the regulator (using the mica washer), the mains transformer, the fuseholder, and the mains input socket to the back panel (Figure 12), and wire up as shown. Fit the capacitors to the back of the BNC socket as shown in Figure 11.

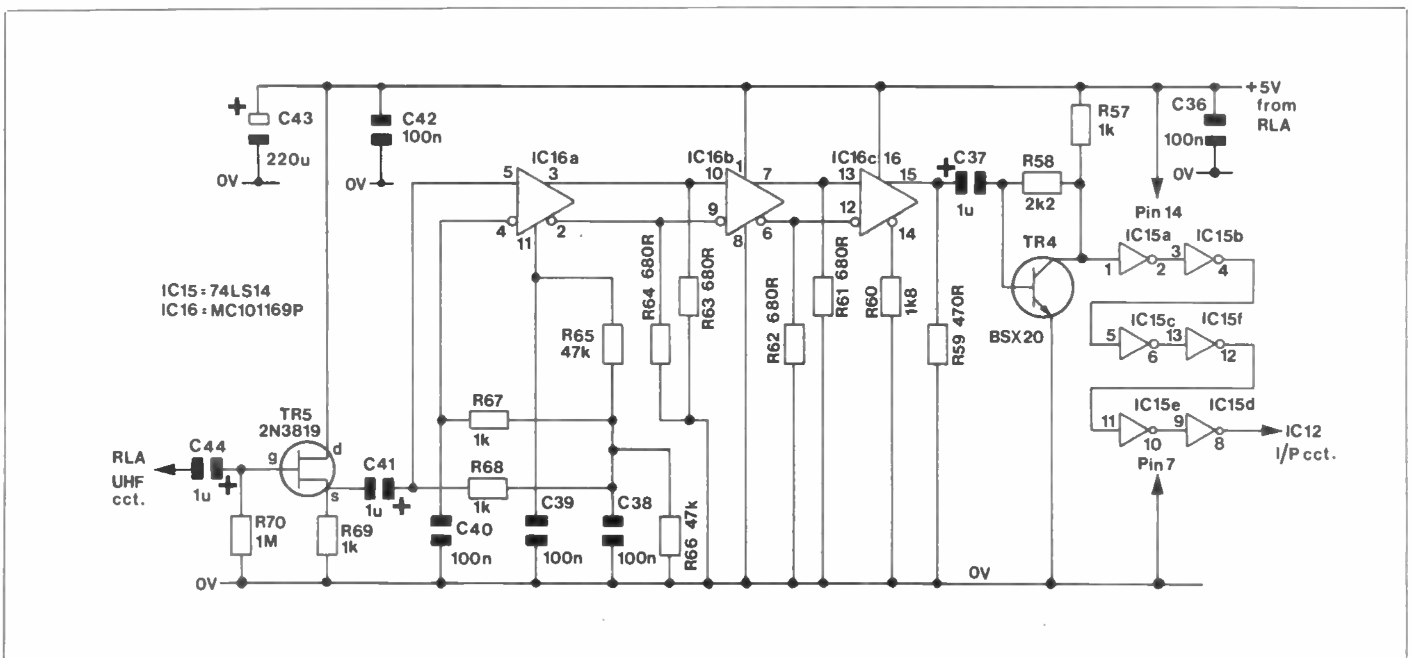


Figure 6. LF/HF input circuit.

Setting Up

Before fitting into the case, the voltage regulator and CMOS control logic can be tested. A 12V DC supply is needed. This can be a battery, C.B. power supply, or similar. Fit a meter capable of reading 1A fsd across the PCB fuseclips, with the negative lead on the side of the fuseclip which connects to the anode of D3. Fit a temporary heatsink (e.g. a croc clip) to the metal tab of the regulator. Connect the 12V supply via the PCB mounted power input socket. A current of no more than 200mA should be observed. If there is more than 200ma, disconnect immediately and check the construction. If there is zero current, you may have incorrect polarity on the power supply. If all is correct the bottom LED in each row should be lit, but none of the 7-segment displays. Press each switch in turn, and check that the LEDs illuminate in sequence. The function should be kept in COUNT mode whilst checking the ranges. When the function is in any mode other than COUNT, the other two switches should have no effect. In 'DISPLAY OFF' mode, the range LEDs will extinguish. Remove the meter and replace the fuse FS2. The regulator output should now be measured, using a voltmeter connected with the negative lead to 0V, and the positive lead to test point 1. A reading of approximately 5.5V should be obtained. Ensure that there is no DC present on pins 1, 13, and 14 of IC1 holder, and that when the function is on HOLD, there should not be more than 6V on pin 27. Remove the power and carefully insert IC1. Re-apply the power and a display should be visible, as

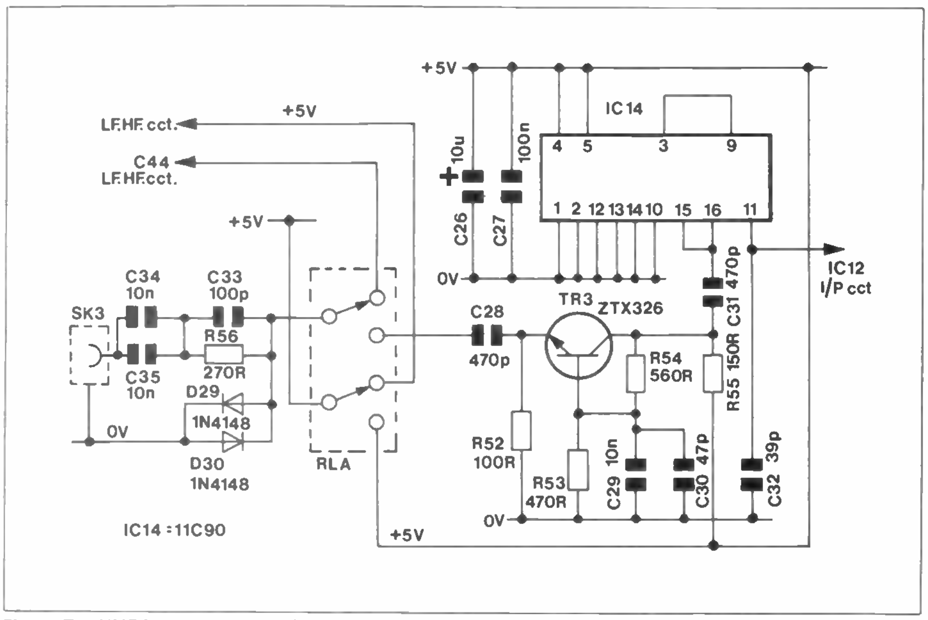
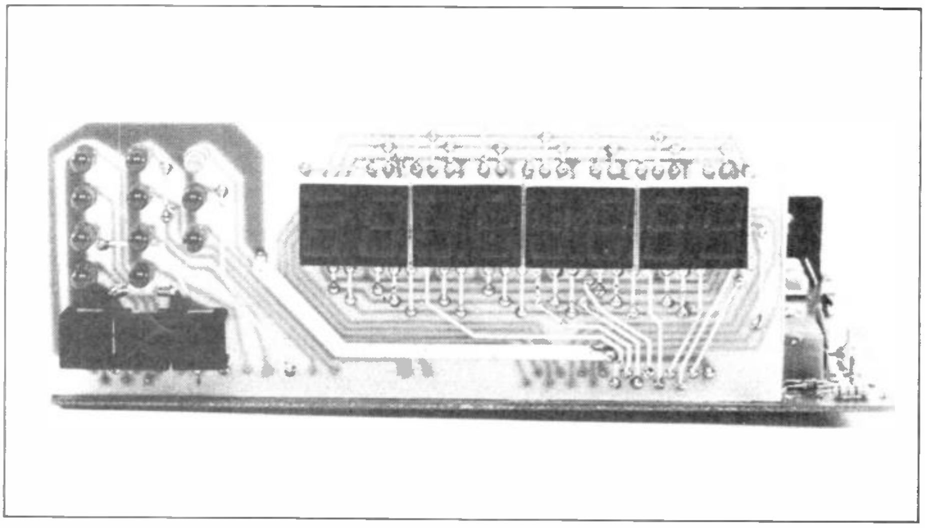


Figure 7. UHF input and relay circuit.



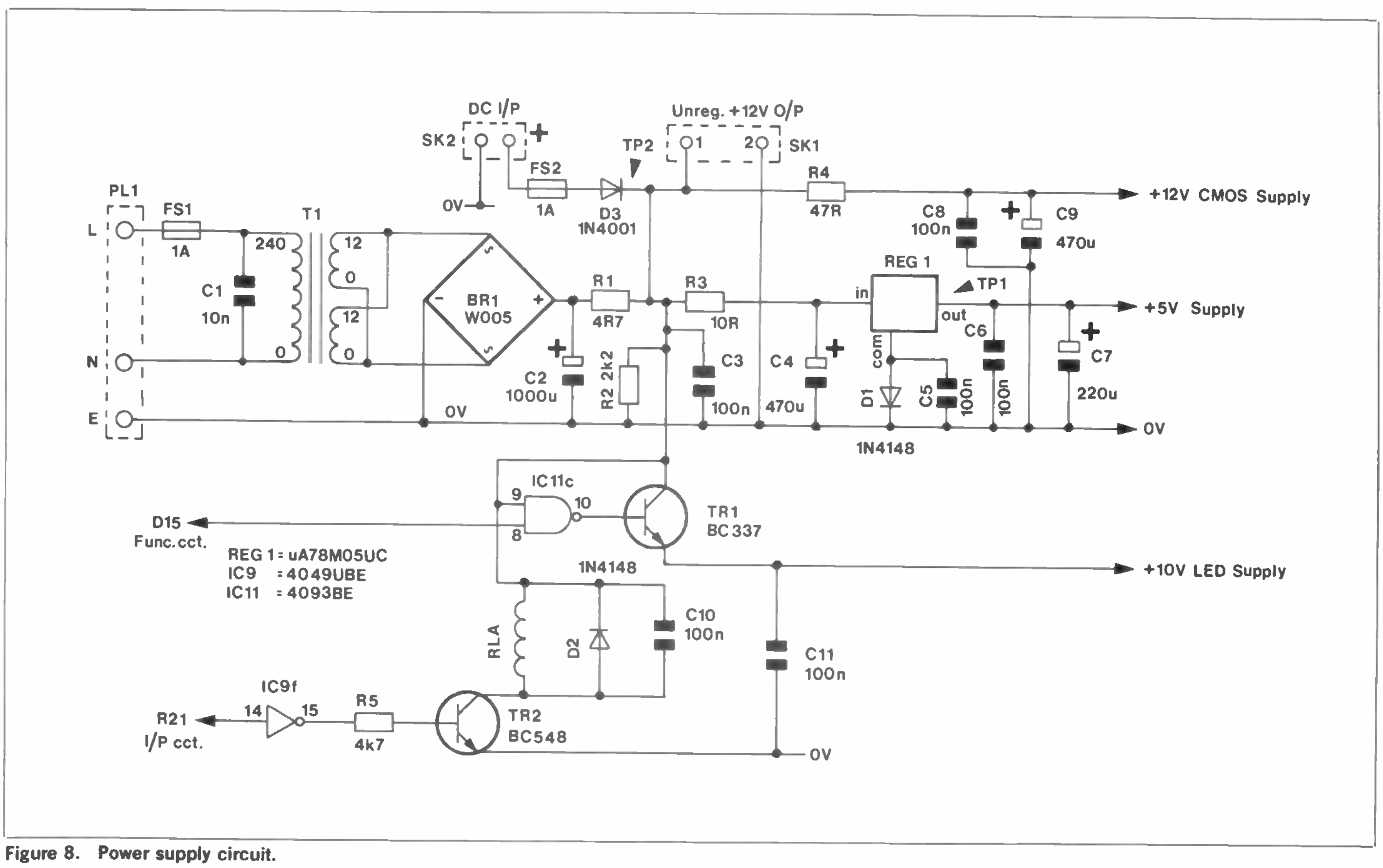


Figure 8. Power supply circuit.

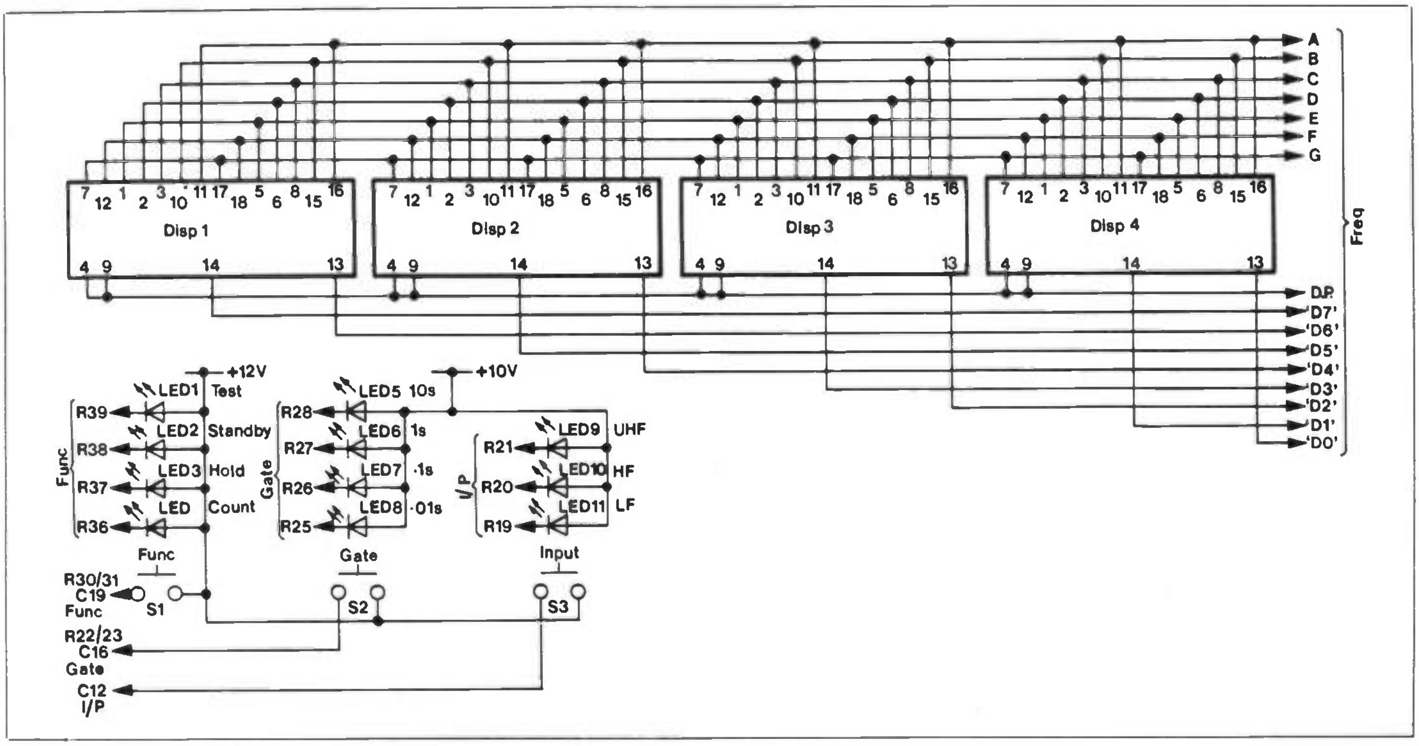


Figure 9. Display circuit.

MAIN PARTS LIST

Resistors: All ⅓W 5% Carbon unless specified.

R1	4R7(½W)		(S4R7)
R2,33,51,58	2k2	(4 off)	(M2K2)
R3	10R (3W wirewound)		(W10R)
R4	47R(½W)		(S47R)
R5	4k7		(M4K7)
R6,7,10,12,13,53,59	470R	(7 off)	(M470R)
R15,22,29,30,34,45	10k	(7 off)	(M10K)
R8,9,14,18,57,67,68,69	1k	(8 off)	(M1K)
R16,17,23,24,31,32,35,40-44,46,48-50	100k	(16 off)	(M100K)
R19-21,25-28,36-39,60	1k8	(12 off)	(M1K8)
R47,70	1M	(2 off)	(M1M)
R52	100R		(M100R)
R54	560R		(M560R)
R55	150R		(M150R)
R56	270R(½W)		(S270R)
R11,61-64	680R	(5 off)	(M680R)
R65,66	47k	(2 off)	(M47K)
Capacitors			
C1	10nF suppression Cap.		(FF53H)
C2	1000uF 25V P.C. Electrolytic		(FF18U)
C3,5,6,8,10,11,14,15,18,21-23,25,27,36,38-40,42	100nF disc ceramic	(19 off)	(BX03D)
C4,9	470uF 25V P.C. Electrolytic	(2 off)	(FF16S)
C7,43	220uF 16V P.C. Electrolytic	(2 off)	(FF13P)
C12,16,19	100nF Polycarbonate	(3 off)	(WW41U)
C13,17,20	470nF Polycarbonate	(3 off)	(WW49D)
C24	47pF Silver Mica		(WX09K)
C26	10uF 16V Tantalum		(WW68Y)
C28,31	470pF Ceramic	(2 off)	(WX64U)
C29	10nF Disc Ceramic		(BX00A)
C30	47pF Ceramic		(WX52G)
C32	39pF Ceramic		(WX51F)
C33	100pF Ceramic		(WX56L)
C34,35	10nF 500V H.V. disc	(2 off)	(BX15R)
C37,41,44	1uF 35V Tantalum	(3 off)	(WW60Q)
VC1	Trimmer 65pF		(WL72P)
Semiconductors			
D1,2,6,7,10,11,13-30 inc.	1N4148	(18 off)	(QL80B)
D3	1N4001		(QL73Q)
D12	BZY88C5V6		(QH08J)
TR1	BC337		(QB68Y)
TR2	BC548		(QB73Q)
TR3	ZTX326		(QL54J)
TR4	BSX20		(QF32K)
TR5	2N3819		(QR36P)
REG.1.	uA78M05uC		(QL28F)
IC1	ICM7216D		(YY94C)
IC2	4051BE		(QW34M)
IC3	4008BE		(QW14Q)
IC4,6	4016BE	(2 off)	(QX08J)
IC5,7,8	4017BE	(3 off)	(QX09K)
IC9,10	4049UBE	(2 off)	(QX21X)
IC11	4093BE		(QW53H)
IC12	74S03		(QY24B)
IC13	74LS90		(YF38R)
IC14	11C90		(QY18U)
IC15	74LS14		(YF12N)
IC16	MC101169P		(QY23A)
BR1	W005		(QL37S)
Miscellaneous			
X1	10MHz crystal		(FY78K)
RLA	Ultra-min Relay DPDT		(YX95D)
SK1	P.C. Mtg. Power Skt.		(RK37S)
SK2	P.C. Din SKT 5-Pin 'A'		(YX91Y)
FS2	20mm Fuse 1A		(WR03D)
	Fuse clip	(2 off)	(WH49D)
	28 Pin Dil Skt		(BL21X)
	14 Pin Dil Skt	(3 off)	(BL18U)
	16 Pin Dil Skt	(7 off)	(BL19V)
	Veropin 2141	(1 Pkt)	(FL21X)
	Track Pin	(2 Pkt)	(FL82D)
	P.C.B.		(GB02C)
	Screw 6BAx½"	(1 Pkt)	(BF06G)
	6BA Nut	(1 Pkt)	(BF18U)
	6BA Washer	(1 Pkt)	(BF22Y)
	6BA Spacer x ⅛"	(1 Pkt)	(FW33L)
	Kit (P) Plas		(WR23A)

DISPLAY PARTS LIST

Disp. 1-4	'DD' Display Type C	(4 off)	(BY68Y)
S1,2,3	Click Key Black	(3 off)	(HY34M)
LED 1-4, 10	Red LED	(5 off)	(WL27E)
LED 5-8, 11	Green LED	(5 off)	(WL28F)
LED 9	Yellow LED		(WL30 H)
	Track Pin	(2 Pkt)	(FL82D)
	P.C.B.		(GB03D)

ADDITIONAL ITEMS LIST

T1	Transformer 12V 500mA	(YK28F)
FS1	20mm Fuse 1A	(WR03D)
	Chassis Fuseholder	(RX96E)
PL1	Euro Conn. Lead set	(BW99H)
SK3	BNC Skt	(HH18U)
	Case	(XY45Y)
	Filter Red	(FR34M)
	BNC Earth Tag	(QY22Y)
	Freq. C. Front Panel	(RK39N)
	Long Power Plug	(HH61R)
	BA Mains Plug	(RW67X)
	Mains Fuse 3A	(HQ32K)

A complete kit of parts is available for this project including an attractive printed and punched adhesive aluminium front panel.

Order As LW79L (Frequency Counter Kit) Price £85.00

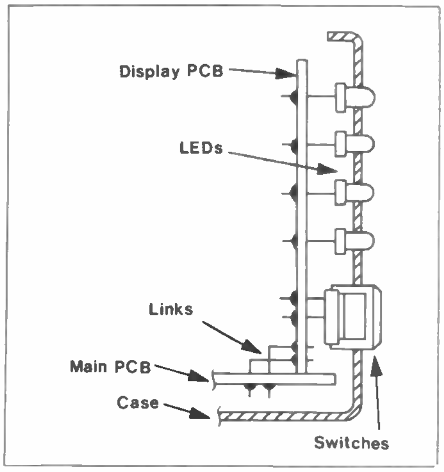


Figure 10. Mounting of switches and LEDs.

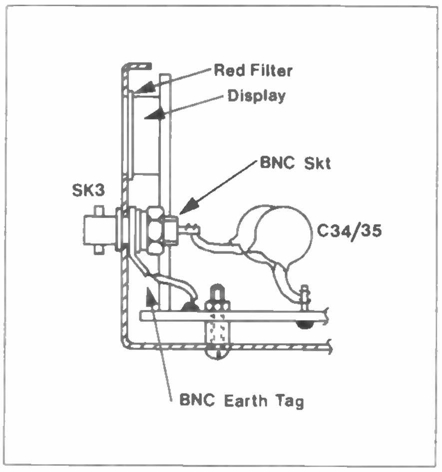


Figure 11. Suggested assembly.

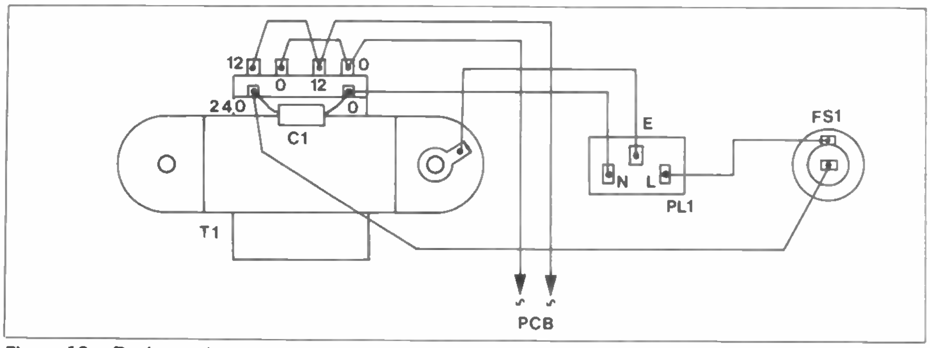


Figure 12. Back panel assembly.

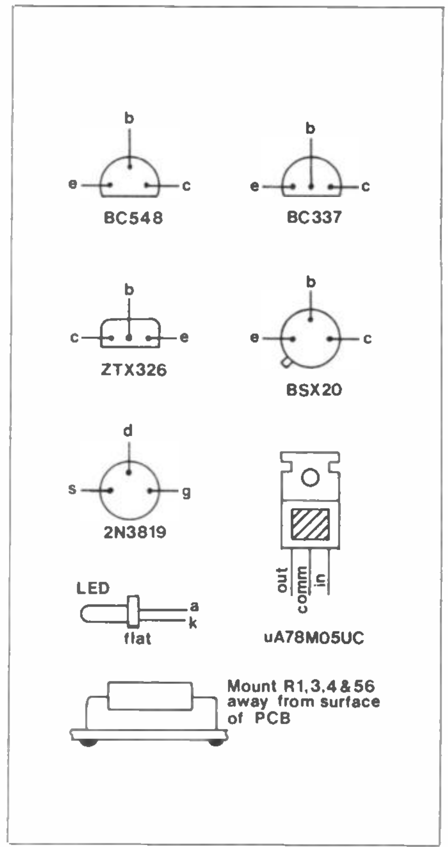


Figure 14. Pin designations.

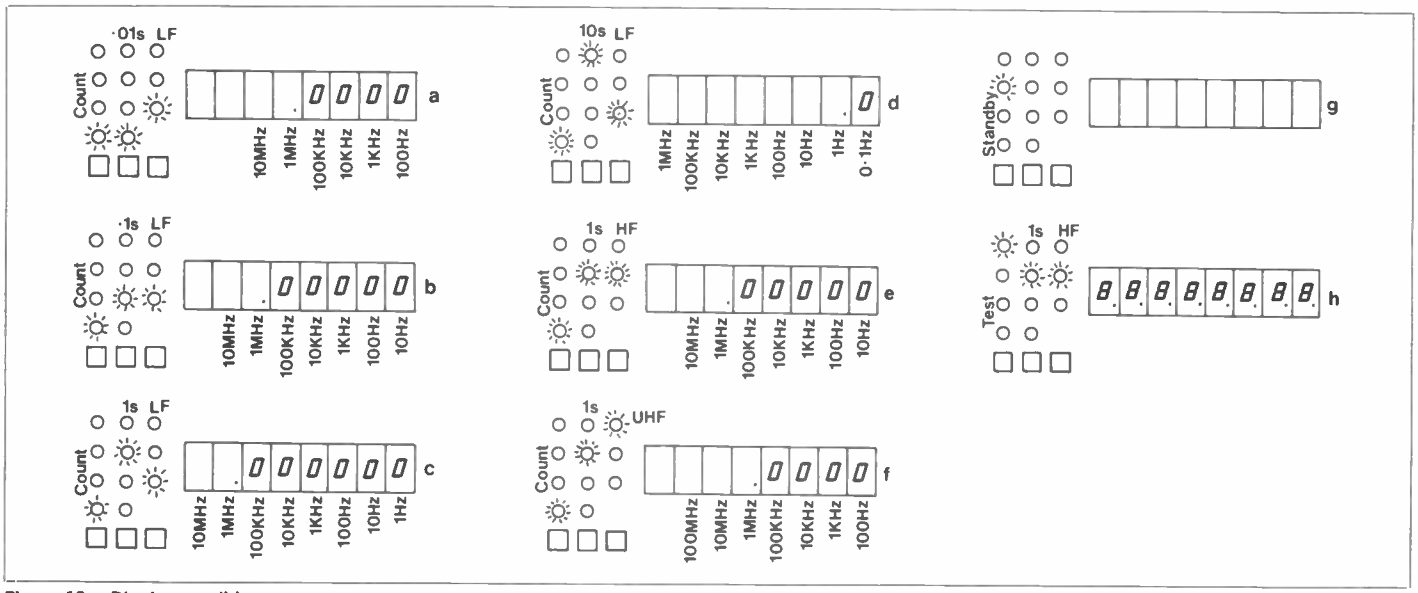


Figure 13. Display conditions.

shown in Figure 13a. Switch through the ranges, and check that the display varies as in Figures 13b to 13h. At this stage the counter is fully working, and frequency measurement is possible.

When the function is in the TEST position, no more than 320mA should be drawn from the DC supply. The counter should now be assembled as described in Construction Details, and the AC feed wires should be connected to the PCB.

Plug in the mains, and check that all functions are correct as before. A DC voltage measurement should be taken between 0V and TP2. Not more than +15V, and not less than +11V should be present. The trimming capacitor VC1 should be adjusted for correct reading using an input of known frequency.■

The Electronics Hobbies Fair

An exciting new electronics show is being launched in November this year. The Electronics Hobbies Fair will be at the new Alexandra Pavilion from the 18th to the 21st of November 1982.

The Alexandra Pavilion is a brand new exhibition hall that offers the best possible modern facilities. There are three cafes and two bars and the superb natural lighting and air conditioning make strolling around the exhibition a pleasure. And you can bring the whole family — there's even a baby changing room!

Getting There

Getting to the exhibition will be really easy too. The organisers have laid on a shuttle bus service that will run regularly from Alexandra Palace British Rail station to the Pavilion. The BR station is right alongside Alexandra Palace Underground station (by the way this station used to be called Wood Green — and probably still is on most maps). If you come by car there is lots of FREE car parking space in Alexandra Palace park and a free shuttle bus service will run from the car park through the grounds to the Pavilion.

The fair is being sponsored by 'Practical Electronics', 'Practical Wireless' and 'Everyday Electronics' who are arranging lots of special extras. There will be special discounts for those travelling by British Rail and full details will be given in all three magazines in their October or November issues. In addition there will be lots of special exhibits and demonstrations as well as some fascinating items that you will be able to operate. Unfortunately we can't be more specific at this time, but we can assure you that there will be lots of things to do.

Prices and Times

Entrance to the exhibition will be £2 for adults and £1 for children, OAP's and parties. However, vouchers will be printed in the monthly magazines 'PE', 'PW' and 'EE' in the near future that will allow you 50p off the entrance fee. The exhibition will be open from 10 a.m. to 6 p.m. on Thursday, Friday and Saturday and from 10 a.m. to 5 p.m. on Sunday.

The exhibition will cover electronics, computing, amateur radio, CB, practical hi-fi and radio control modelling. So there will be a part of the show dedicated to your particular interest.

The MAPLIN Stand

Maplin's own big stand at the exhibition will be split into three sections. The first section will be a display of the amazing Atari computers. We will have a whole bank of computers and TV sets, each set running a different piece of software and you will be able to play with them yourself or just stand back and watch. We will also be demonstrating the VIC20 computers.

The second section will be an active display of the best of our projects. Our ZX81 keyboard will be connected up so that you can try it out, and you will also be able to play with our new telephone exchange, the frequency counter, the stereo amp with its remote control unit, and the Matinee organ. You will also be able to see lots of our other projects including the digital model train controller, the burglar alarm and all the peripherals so far described for it, the universal timer, the stopwatch, the combo-amp, the modem, the super-fast ni-cad charger, the inverter, the 5600S and 3800 synthesisers, the Spectrum synthesiser and the touch-sensitive piano.

The final section of the stand will be dedicated the new Maplin catalogue. This fantastic new catalogue for 1983 contains nearly 400 pages of useful information. By post, the catalogue will be £1.50 and from all branches of W.H. Smith it will cost £1.25. But for the Electronics Hobbies Fair only, the price will be just £1. Renowned as the very best electronics catalogue in the country, £1 for nearly 400 pages is outstanding value for money.

So whether your main interest is electronics, amateur radio, radio control, practical hi-fi or CB this is the only show in the year for you. The Electronics Hobbies Fair is going to be a great day out for you and the whole family. Don't miss it!

NEW ITEMS USED IN PROJECTS IN THIS MAGAZINE

GA79L	Multi-Circuits PCB	Price £1.25
GA90X	I/O Port PCB	Price £2.25
GA97F	Stereo amp IR Decoder PCB	Price £2.75
GA98G	Car Burglar Alarm PCB	Price £1.10
GA99H	Stereo Amp IR Controller PCB	Price £1.40
GB00A	Ultrasonic Transceiver PCB	Price £1.60
GB01B	Ultrasonic Interface PCB	Price £1.60
GB02C	Frequency Counter PCB	Price £4.95
GB03D	Freq Counter Display PCB	Price £1.85
GB04E	E.L.C. Board	Price £2.95
GB05F	Connect PCB	Price £3.80
GB06G	T/E Motherboard	Price £12.75
GB07H	T/E PSU Board	Price £4.50
GB08J	ZX81 Extendiboard	Price £3.95
LW76H	I/O Port Kit	Price £9.25
LW77J	Amp Remote Control Kit	Price £26.95
LW78K	Car Burglar Alarm Kit	Price £6.95
LW79L	Frequency Counter Kit	Price £85.00
LW80B	Digi-Tel ELC Kit	Price £24.95
LW81C	Digi-Tel Connect Kit	Price £9.95
LW82D	Digi-Tel Main Kit	Price £67.50
LW83E	Ultrasonic Xceiver Kit	Price £12.25
LW84F	Ultrasonic Interface Kit	Price £2.50
QY18U	11C90	Price £15.75
QY19V	LM1035	Price £4.50
QY22Y	BNC Earth Tag	Price 20p
QY23A	MC10116P	Price 85p
QY24B	74S03	Price £1.45
QY25C	2716/M4	Price £10.50
RK35Q	P.C. Edgecon 2 x 23 way	Price £2.25
RK36P	Switch Panel	Price £1.20
RK37S	P.C. Mtg Power Socket	Price 15p
RK38R	8-Way P.C. Terminal	Price 55p
RK39N	Frequency Counter Front Panel	Price £1.99
XG18U	PB Telephone	Price £21.90
XG19V	Set of 4 PB Telephones	Price £69.99
YK33L	Toroidal Transformer 24/100V	Price £15.75

MAPLIN'S TOP TWENTY BOOKS

1. (-) De Re Atari (WG56L) (See note).
2. (2) Z80 IC's Data Sheets (RQ54J) (Cat. P35).
3. (-) How To Identify Unmarked IC's by K. H. Recorr (WG87U) (See note).
4. (1) Atari Basic — Learning By Using by T. E. Rowley (WG55K) (See note).
5. (5) Power Supply Projects by R. A. Penfold (XW52G) (Cat. P29).
6. (19) Newnes Radio And Electronics Engineers' Pocket Book (RL06G) (Cat. P24).
7. (-) The 6809 Companion by M. James (WG88V) (See note).
8. (8) Programming The 6502 by Rodnay Zaks (XW80B) (Cat. P35).
9. (12) IC555 Projects by E. A. Parr (LY04E) (Cat. P27).
10. (6) Electronic Synthesiser Projects by M. K. Berry (XW68Y) (Cat. P33).
11. (3) Towers' International Transistor Selector Update 2 by T. D. Towers (RR39N) (Cat. P25).
12. (7) Remote Control Projects by Owen Bishop (XW39N) (Cat. P29).
13. (-) Cost Effective Projects Around The Home by John Watson (XW30H) (Cat. P28).
14. (-) Projects For The Car And Garage by Graham Bishop (XW31J) (Cat. P23).
15. (-) The TTL Data Book (WA14Q) (See note).
16. (-) Practical Repair And Renovation Of Colour TV's by Chas. E. Miller (RH27E) (Cat. P32).
17. (-) How To Use Op-Amps by E. A. Parr (WA29G) (See note).
18. (-) Popular Electronic Circuits Book 2 by R. A. Penfold (WG86T) (See note).
19. (10) How To Make Walkie-Talkies by F. G. Rayer (RF18U) (Cat. P30).
20. (14) CB Projects by R. A. Penfold (WG73Q) (See note).

Note. For prices see page 36 of this magazine. Full details of books WG55K and WG73Q were published in issue 1 of this magazine, details of books WA14Q, WA29G, WG86T, WG87U and WG88V were published in issue 3 and WG56L is described in this issue.

These are our top twenty best-selling books based on mail-order and shop sales during May, June and July 1982. Our own publications and magazines are not included. We stock over 375 different books relating to electronics or computing and the full range is shown on pages 23 to 37 of our 1981/2 catalogue plus page 37 in this magazine and the new books described in this magazine.

STARTING POINT

by R. Penfold

Introducing the fundamentals of electronics for the constructor.

Inductance

An inductor is one of the most simple types of electronic component, and even a short piece of wire acts as an inductor having a very low value. However, most practical inductors are in the form of a coil of wire wound on a special core that gives a high value for the length of wire used. In theory an inductor is assumed to have zero resistance, but practical inductors do, of course, have significant resistances. It is for this reason that special cores which enable a minimal length of wire to be used for a given inductance are an asset, since the shorter the length of wire used, the lower the resistance of the component. Even so, high value R.F. inductors (or "chokes" as they are often called) are usually wound using a considerable length of thin wire, and consequently have a resistance of a few tens or even hundreds of ohms.

Although an inductor allows a D.C. signal to pass readily, the situation is very different if an inductor is fed with an A.C. signal. As we saw in an earlier "Starting Point" article, a magnetic field is generated around a piece of wire if it is fed with an electric current, and an electric current is generated in a wire if it is placed in a magnetic field of varying strength. These two effects are used in a transformer to couple an A.C. signal from one winding to another.

With a simple inductor fed with an A.C. signal it is not the effect of the generated magnetic field on another inductor that is of importance, it is the effect of this magnetic field on the inductor which receives the signal that is of interest. One might reasonably expect the magnetic field produced to either generate a signal within the inductor that aids the input signal, or opposes it, and in practice the polarity of the magnetic field is such that it opposes the input signal.

If a voltage source is applied to an inductor the current flow gradually increases, and (for a theoretically perfect inductor) is only limited ultimately by maximum current that the signal source can provide. Inductance is specified in "henrys", and a change in current flow of one amp per second is produced when one volt is applied to a one henry inductance. As one henry is an extremely high inductance value most practical inductors, have their value specified in millihenrys (mH) or microhenrys (uH). A millihenry is one thousandth of a henry, and a microhenry is one millionth of a henry.

Like a capacitor an inductor has reactance, and it is this property that is exploited in electronic circuits, and it is unusual for an inductor to be used in a timing circuit as capacitors are usually much more convenient in such applications. It is important to realise that capacitive inductance and inductive reactance are very different. The reactance of a capacitor falls as the input frequency is increased, whereas the reactance of an inductor increases as the frequency of the applied signal is raised. As a capacitor has a very high resistance and an inductor has an extremely low resistance, these two types of component are complementary to each other rather than true alternatives, and are definitely not direct substitutes for one another.

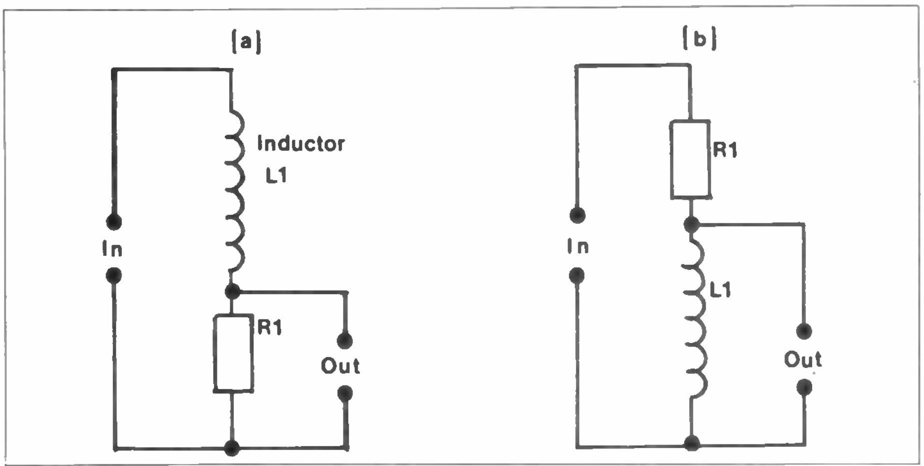


Figure 1(a). A single section L - R low pass filter, (b) a single section high pass L - R filter.

Reactance rising with increased frequency is caused by the limiting effect the inductance has on changes in current flow. With a very low input frequency the current flow would rise and fall very slowly anyway, but with a high input frequency even quite a modest inductance value will severely limit changes in current flow and provide a difficult path for the signal to negotiate. The greater the inductance of a component, the more it opposes changes in current flow, and the higher its reactance at any given frequency.

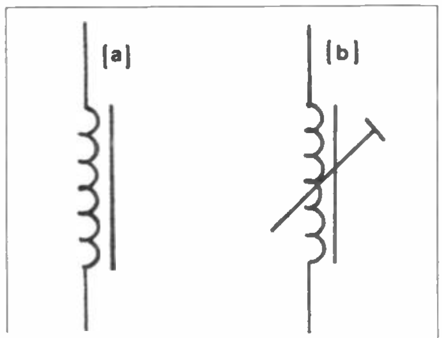


Figure 2(a). The circuit symbol for an iron or ferrite cored inductor, (b) the circuit symbol for a variable inductance with an adjustable iron or ferrite core.

Filters

Simple filters using capacitors were discussed in an earlier "Starting Point" article, and inductors can be used in similar filters. Figure 1(a) shows the circuit of a simple L - R low pass filter, and Figure 1(b) gives the circuit of a simple high pass L - R filter. These diagrams also show the circuit symbol for an air cored inductor. Figure 2 shows the circuit symbols for iron cored and adjustable inductors.

Operation of these two filters is quite straight forward, and if we consider the low pass type first, at low frequencies L1 will have a reactance which is low in comparison to the resistance of R1. The losses through L1 due to a potential divider action are consequently very low. At higher frequencies the reactance of L1 is higher, and at some point losses through L1 start to rise to significant proportions. A doubling of frequency causes a doubling in the reactance of an inductor, and this gives a single stage L - R filter an ultimate attenuation rate of 6dB per octave (i.e. a doubling of input frequency causes the output signal to be reduced by 50%). This is the same roll-off rate as that obtained using a simple C - R filter.

The high pass filter operates in the same basic way, except that it is at high frequencies where the reactance of L1 is high that low losses are produced, and at low frequencies where L1 has a low reactance that large losses are produced through R1.

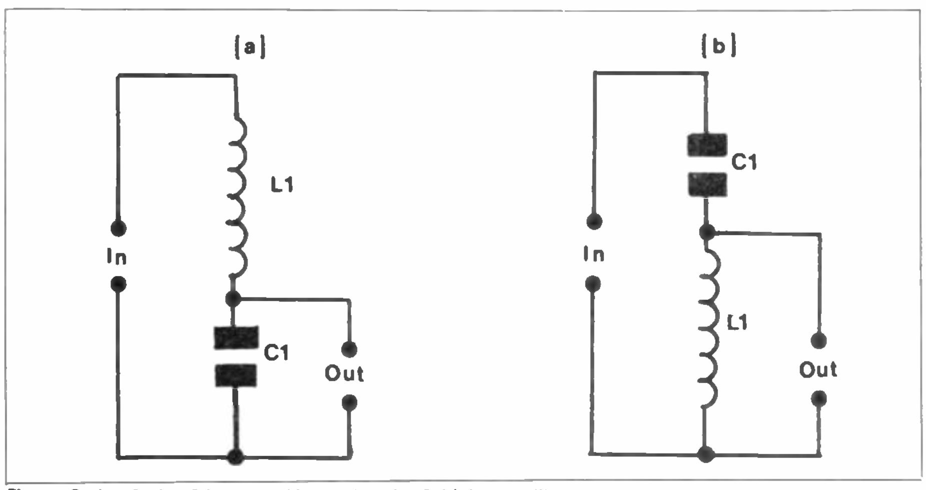


Figure 3(a). An L - C low pass filter, (b) an L - C high pass filter.

Like the low pass filter, the high pass one has a 6dB per octave attenuation rate.

It is possible to use both capacitors and inductors in filters to give an increased roll off rate, and Figure 3(a) shows the circuit of a simple L - C low pass filter which uses one capacitor and a single inductor. The equivalent high pass filter circuit is provided in Figure 3(b).

With these filters there is not just the attenuation provided by the doubling in the reactance of the inductor with a doubling of the input frequency, but also an attendant halving in the reactance of the capacitor. This gives a roll-off rate of 12dB per octave, with a doubling or halving of frequency (as appropriate for the type of filter) giving a 75% reduction in the amplitude of the output signal.

L - C filters are much used in cross-over networks in loudspeaker systems, and it is quite common for high pass and low pass filters to be connected in series to give a simple bandpass filter which directs middle audio frequencies to the appropriate drive unit. It is also quite common for L - C filters to be employed in transmitters and receivers to prevent R.F. signals breaking through to parts of the circuit where they could cause instability. Another application for L - C filters is at the output of transmitters where a low pass type can reduce harmonics which could otherwise cause radio and T.V. interference. However, in most other applications C - R filters are used.

The reactance of an inductor can be calculated using the following formula:-

$$XL = 2\pi FL$$

Parallel Tuned Circuit

A parallel tuned circuit simply consists of a capacitor and an inductor connected in parallel, as shown in Figure 4. At most frequencies this arrangement has a fairly low reactance with the capacitor providing

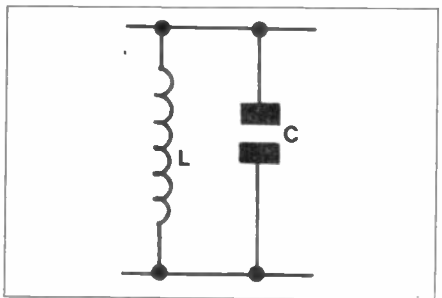


Figure 4. A parallel tuned circuit.

an easy signal path at high frequencies and the inductor providing a low reactance path at low frequencies. At a certain frequency though, the reactance of a parallel tuned circuits peaks at a very high level, and in theory there is actually infinite reactance at this "resonant frequency" as it is known. The resonant frequency is the one at which the inductor and capacitor have the same reactance value.

If we assume that the capacitor is given a charge, when the signal source is removed the capacitor will discharge into the inductor so that a new magnetic field builds up. When the capacitor has discharged, the magnetic field collapses and produces a voltage in the inductor. This voltage is of opposite polarity to the original input signal, and it charges up the capacitor. The capacitor then discharges into the inductor again, and this process continues indefinitely with an A.C. signal at the resonant frequency being produced across the tuned circuit.

In practice the oscillations do in fact rapidly die away due to losses caused by factors such as resistance in the wire used in the winding of the inductor, and leakage through the capacitor. In theory any signal fed into the tuned circuit remains in the tuned circuit so that no output is obtained if the circuit is inserted in a signal path, and the tuned circuit has infinite reactance. A practical tuned circuit will obviously not achieve this, but may still have a reactance of a few hundred kilohms or more.

Parallel tuned circuits are often used as bandpass filters, especially in radio equipment where only small and inexpensive inductors are required. The operating frequency of a filter of this type is easily varied by using a variable capacitor in the tuned circuit, or by adjusting the core of a variable inductance (the latter being known as permeability tuning). A filter of this type is thus ideal for use in the tuning circuits of radio receivers.

The basic method of using a parallel tuned circuit as a bandpass filter is shown in Figure 5. The input signal is provided by a

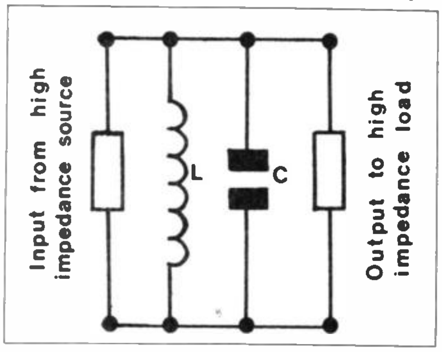


Figure 5. A parallel tuned circuit used as a band-pass filter.

fairly high impedance source, so that at most frequencies the low impedance of the filter seriously loads the source and gives little output. At and near the resonant frequency of the tuned circuit there is no significant loading of the signal source due to the very high reactance of the tuned circuit, and the signal can pass through to the output. A high impedance load must be present at the output since this is in parallel with the tuned circuit, and a low impedance here would effectively eliminate the high impedance of the tuned circuit at resonance and give very poor results. It is possible to use a filter of this type with a low impedance source and load if the tuned circuit is used as part of a transformer, and one method of doing this is illustrated in Figure 6. Another method is to

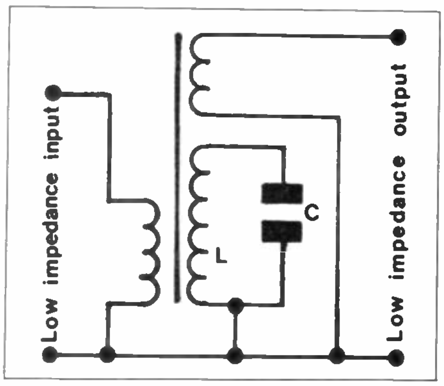


Figure 6. A low impedance bandpass filter using a tuned circuit.

use the tuned circuit as a single wound transformer with the input and output signals connected to tappings on the inductor.

Series Tuned Circuit

There is an alternative type of tuned circuit known as the "series tuned circuit", and as one might expect, this simply consists of an inductor and a capacitor wired in series instead of in parallel (see Figure 7). This provides a low impedance at most frequencies, like a parallel type, but at

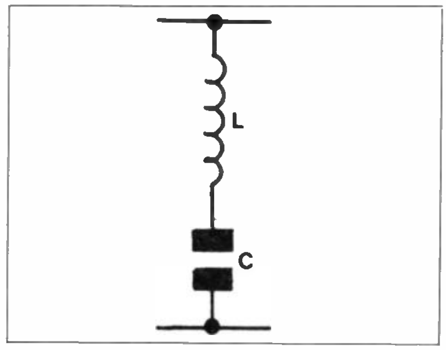


Figure 7. A series tuned circuit.

resonance it theoretically has zero impedance rather than an infinite impedance.

This type of tuned circuit is not as useful in practical applications as the parallel type, and it is not often encountered in electronic circuits.

The formula for calculating resonant frequency is the same for both the parallel and series types, and is as follows:-

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

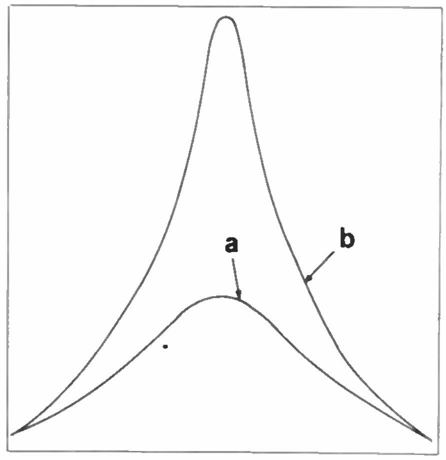


Figure 8. A low Q tuned circuit (a) gives a flatter response than a high Q type (b).

Q Factor

Although no practical tuned circuits quite achieve theoretical perfection, some are closer to this than others. The efficiency of a tuned circuit is known as its "Q", and the higher the Q value the more efficient the tuned circuit. The Q value is very important when a tuned circuit is used as a bandpass filter since it has a very large effect on the frequency response obtained.

A low Q tends to give a very "flat" response of the type shown in "a" of Figure 8. A high Q gives a very "sharp" response of the type shown in "b" of Figure 8. In order to obtain a reasonably high Q it is necessary for the inductor to be wound on a special core (usually made from a ferrite material) which gives a high inductance value for a winding of a given size, and sometimes special wire such as "Litz" wire is used in the winding. Litz wire is basically just a number of thin enamelled copper wires held together by a cotton covering. Radio frequency signals tend to flow down the outer part of wires and not along the centre of the wire, and this is known as the "skin effect". Litz wire gives a greater surface area and therefore a lower resistance than single strand wire of a comparable thickness, and thus gives higher Q in R.F. tuned circuits (but is of no benefit at low frequencies).

In some applications it is not possible to produce normal tuned circuits of sufficiently high Q, and it is then necessary to use alternatives such as crystal or mechanical filters which have similar electrical characteristics to ordinary L - C tuned filters, but are in other respects very different.

THE ULTRASONIC INTRUDER DETECTOR

by Dave Goodman

- ★ **Range up to 20 feet (400 sq. ft. area)**
- ★ **Adjustable sensitivity**
- ★ **Direct connection to the Maplin Home Security System via our ultrasonic interface plug-in module**
- ★ **Single PCB construction with no setting up required**
- ★ **Up to three may be used on any Maplin Home Security System**

The new ultrasonic intruder detector is a worthwhile addition to your Maplin Home Security System. It will function over a much wider area than conventional switch contacts, it is highly portable, can be used almost anywhere, and can offer total security of a fairly large room.

The ultrasonic detector works on the Doppler Effect Principle (see issue 3, page 7), which in this case means transmission of a 40kHz carrier signal, and reception of the fundamental carrier along with additional frequency shifted signals. These extra signals can vary in frequency by up to 200Hz either side of the fundamental, and are quite small in amplitude. Several stages of

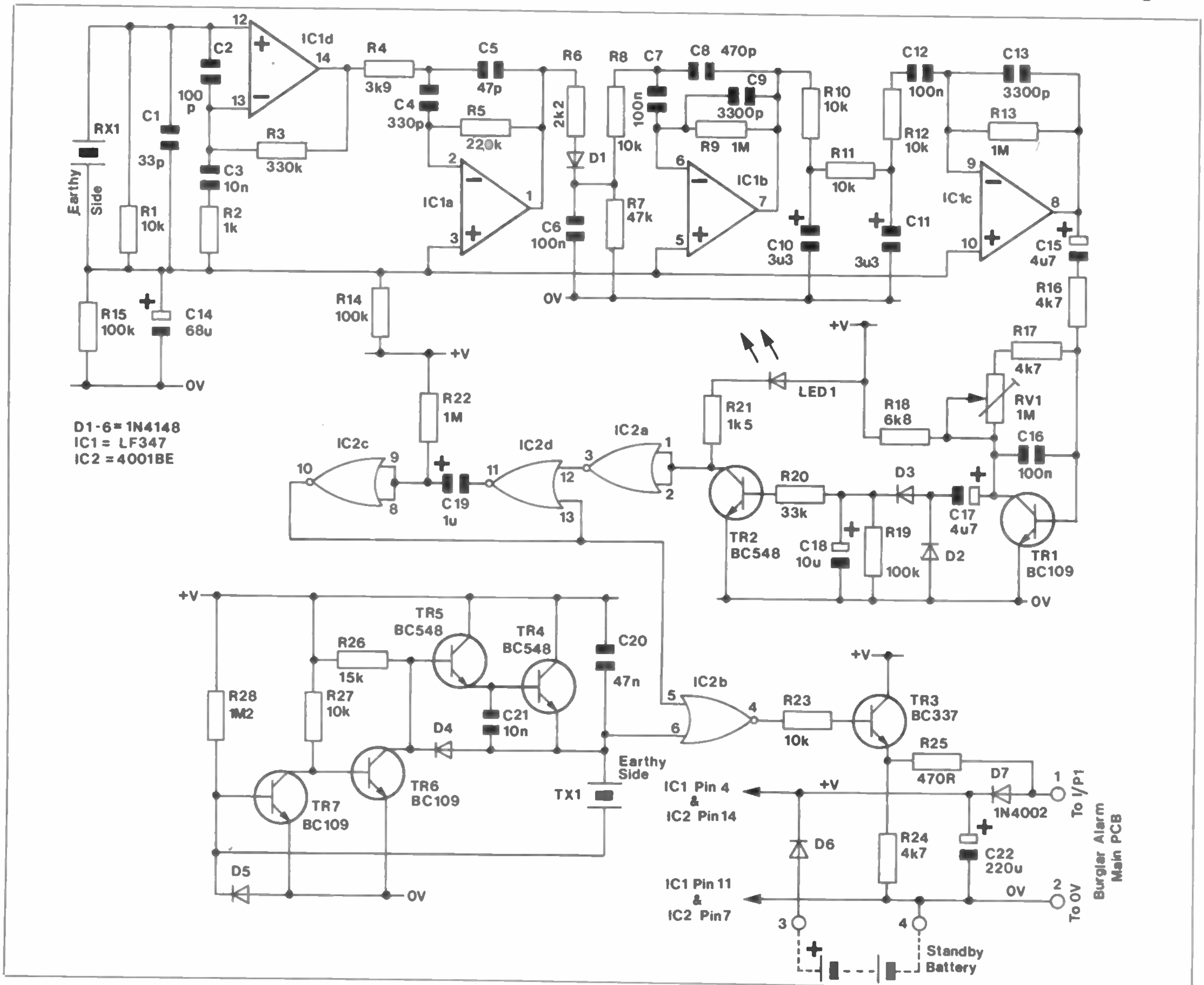


Figure 1. Circuit diagram of the Ultrasonic Transceiver.

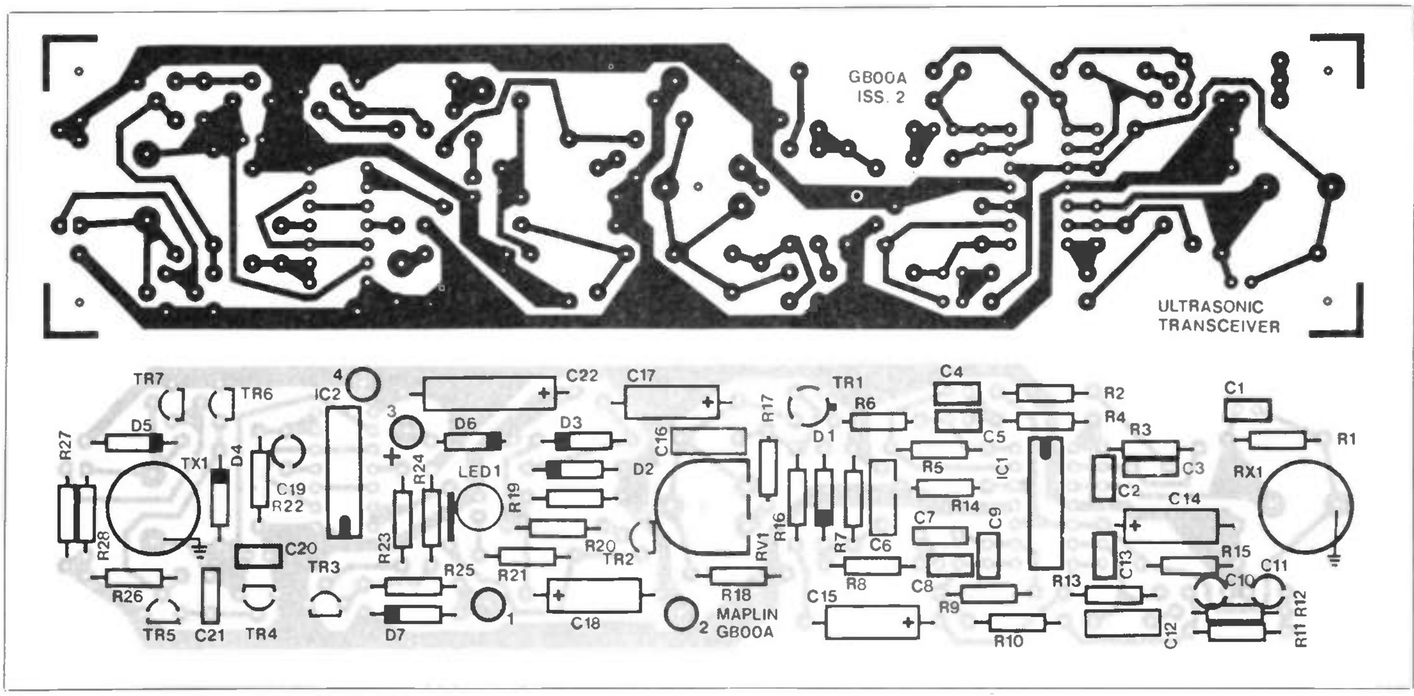
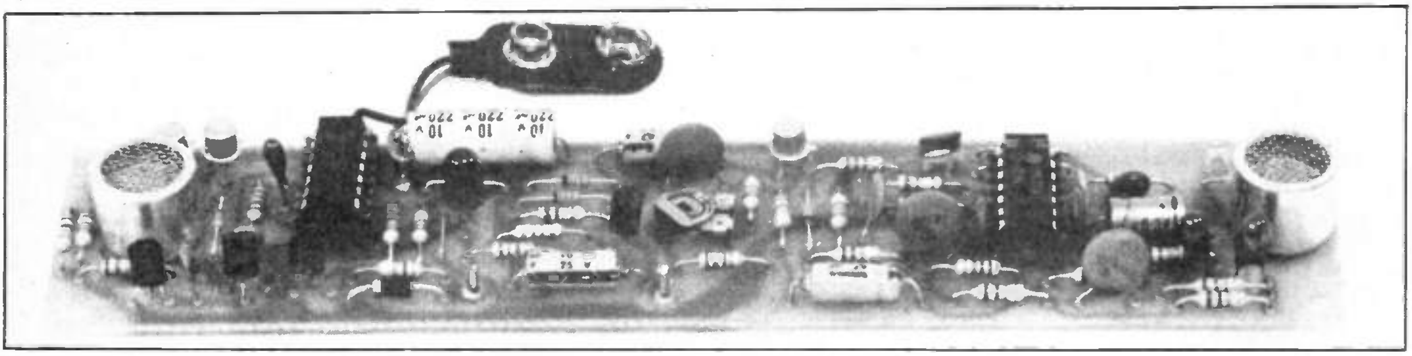


Figure 2. Component layout of the Ultrasonic Transceiver.



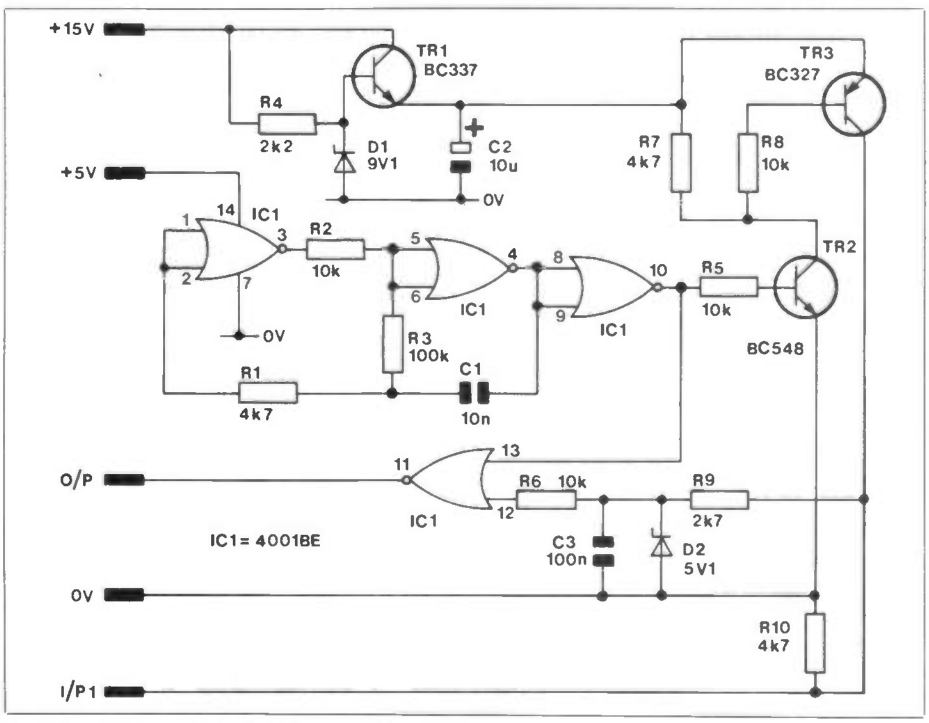


Figure 3. Circuit diagram of the Ultrasonic Interface.

filtering are required to remove the carrier, spurious r.f., and mains interference. The remaining signals are amplified, and, if they are sufficiently large, the alarm will be triggered. The level of triggering is dependent on the sensitivity setting. In this design the transmitter and receiver are both mounted on the same PCB, along with their associated circuitry, and signals are 'bounced' around the room.

The Transmitter

As an improvement over conventional systems, in which the oscillator may require many tedious hours of alignment, we have designed a system in which the transducer determines the oscillator frequency, i.e. the circuit needs NO setting up at all.

The circuit TR4,5,6 and 7, allows the transducer to oscillate at its self-resonating point. C20 at switch-on discharges through the transducer, causing it to resonate. The produced signal is amplified by TR6 and 7, and a constant current circuit comprising TR4, 5 and D4, allows the necessary feedback for sustained oscillation. From this it can be seen that the normal operating frequency becomes dependent on the transducer.

The Receiver

Ultrasonic signals transmitted in an enclosed area will reflect and bounce off hard surfaces, and be absorbed by soft surfaces. A percentage of these signals (called nodes and anti-nodes) are reflected back at the receiver transducer. The transmitter and receiver being matched pairs means that the receiver has a greater affinity for signals transmitted by its partner than for those produced by anything else. Because we are dealing with audio signals, it is possible for low frequency signals of sufficient amplitude (e.g. the rumble of a lorry going past) to trigger the intruder system, so filtering is required. Tests have shown that beat frequencies of between 5Hz and 100Hz can be produced by objects moving through the ultrasonic field. C1 and C2 remove unwanted r.f. signals present at the input of ICld. This stage has a gain of 300, and high rejection of signals above the ultrasonic band. IC1a amplifies the received ultrasonic signals only, and has a first order response. D1 allows only the positive portion of the signal through, and the carrier part of the signal is removed by C6/R7, leaving only the lower frequency content of the signal. IC1b amplifies all low frequency (l.f.) signals, also filtering any possible remaining high frequency (h.f.) content. R10/11/12 and C10/11 form a low pass filter, which only allows signals below 50Hz to pass through to the final amplifying stage of IC1c. We should now be looking (on pin 8) at what is a stable threshold voltage of about +3v, modulated by l.f. signals of 5-50 Hz, and up to 5v in amplitude.

The stage comprising TR1, RV1, and R16/17 determines the overall sensitivity of the receiver, with a range from unity to x100. Amplified signal peaks are coupled to the diode pump D2/3, C18, R19, so that when the voltage across C18 develops more than 0.7v, sufficient current is produced to bias TR2 into conduction. LED1 illuminates. This has been included to give the user a means of visibly testing the circuit range and coverage (see setting-up procedure).

IC2a inverts and buffers the output from TR2. IC2c and IC2d form a monostable triggered by IC2a. IC2b is a control gate switching the 40kHz carrier from the transmitter oscillator to TR3.

With the working system in a stable condition the 40kHz carrier is coupled via R25 to the incoming supply rail. If the system is triggered the carrier is removed. Note that the supply rails connect to the burglar alarm via a plug-in module (the u/s interface PCB, GB01B).

A standby battery (PP3-9V) is shown connected, positive terminal to pin 3, and negative terminal to pin 4. Charging or 'topping up' facilities have not been added to this part of the circuit, so periodical checks on battery conditions are advisable. Note that the battery will not be required when using the transceiver in conjunction with a u/s interface PCB and our Home Security System, although it will be necessary to increase the NiCad battery pack from 7.8v to 9v. This can be accomplished with a total of eight NiCads (1.2v nominal) and two 6v battery holders (HF29G).

Ultrasonic Interface PCB

This simple circuit identifies the carrier signals transmitted by the ultrasonics module. These signals appear between each 2ms current pulse (used for powering the transceiver), and allows monitoring of the two wire supply connection.

IC1a and b form a 500Hz CMOS oscillator, and switch the buffer transistor TR2 at this rate. The regulator D1, TR1, applies 8.6V d.c. to TR3, which is pulsed on and off by TR2, producing an 8.6V, 500Hz signal across R10. This signal is rectified by D7 and C22 (figure 1) in the transceiver, producing 8.2V on the positive rail.

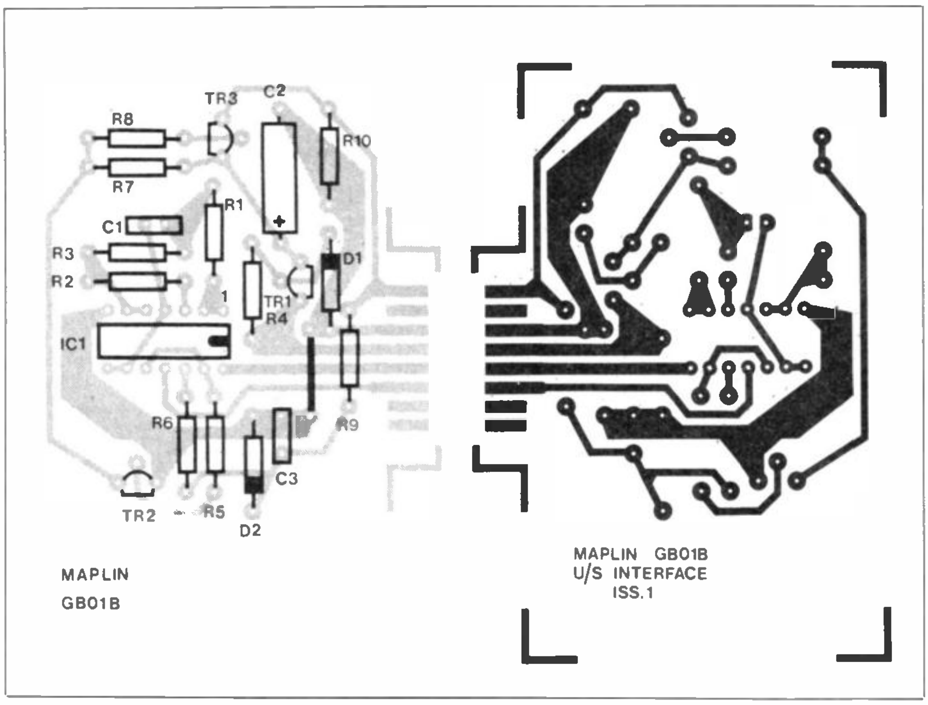
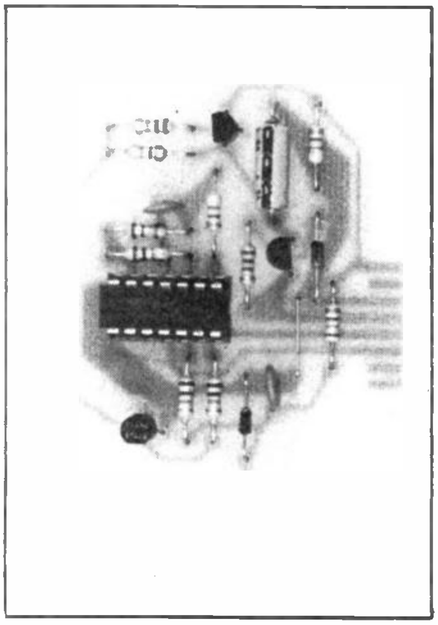


Figure 4. Component layout of the Ultrasonic Interface.



IC1d has a 500Hz clock pulse on pin 13, and an in-phase signal of 500Hz on pin 12. The two signals cancel at the output, pin 11, producing an inverted trigger signal, which fires the burglar alarm. However, under normal conditions a carrier signal will be present across R10, appearing between each 2ms pulse. R6, R9, D2, and C3 filter and limit this composite signal, and ICld output remains low. Either disconnection of the supply, or triggering the transceiver will remove the 2ms 'carrier' from across R10, sending ICld output high (+5V), and setting off the alarm.

Constructional Details for Ultrasonic Intruder Detector

Refer to the parts list and figure (2). Mount D1 to D7 ensuring correct orientation. Mount resistors R1 to R28, and capacitors C1 to C22. Check that the electrolytics C14, C15, C17, C18 and C22, also tantalums C10, C11 and C19 are mounted with correct polarisation. Electrolytics are marked at the negative end but tantalums at the positive. Fit the I.C. sockets, and all transistors. TR1, TR6, and TR7 have their emitters marked with a pip on the case, and should line up with the legend marked on the PCB. If a metal case is used, it is important that the transducers do not touch the chassis. The transducers each have one pin connected directly to their case, and this pin should be connected to the hole marked ⏚ (figure 2).

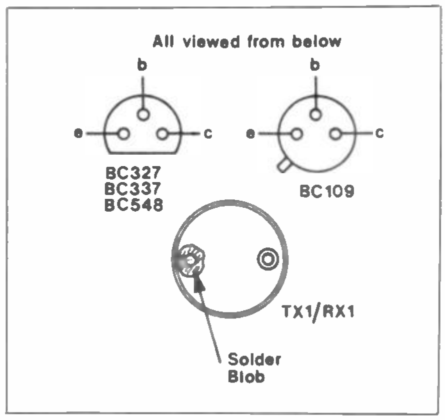


Figure 5. Pin Designations.

Assembly of Ultrasonic Trigger

Observe the usual precautions when mounting components. Use an I.C. holder, for IC1, and double-check all solder joints. Plug the module into any channel on the main PCB of the Home Security System (issue 2, figure 5), and apply power. If you have a voltmeter, check across pins 0V and I/P 1 on the main PCB. This should read approx. 5.0V dc. Also the selected channel should trigger, and the monitoring LED will light.

Setting Up

Set RV1 anti-clockwise. Connect a 9V battery across pin 3 (positive) and pin 4 (negative). LED 1 should come on for a few seconds and then extinguish. Allow 30 seconds settling time, and then wave your hand about six inches away from the transducers. Response to movement should be indicated by LED 1 illuminating, and it should remain so for a few seconds. If there is no response, turn RV1 to approximately ¼ travel to increase sensitivity, and repeat check. If the LED now stays on, move away to a point where the LED is still visible, and keep completely still. After a few seconds the LED should go out. If the circuit still does not work, try disconnecting the battery, and repeating the above checks. If all is satisfactory remove the battery and connect the transceiver to the Maplin Home Security System main PCB.

Use either bell wire, or our 4-wire phone cable (XR66W) to connect the transceiver to the main PCB (burglar alarm). Pin 2 will connect to 0V and Pin 1 will connect to I/P 1.

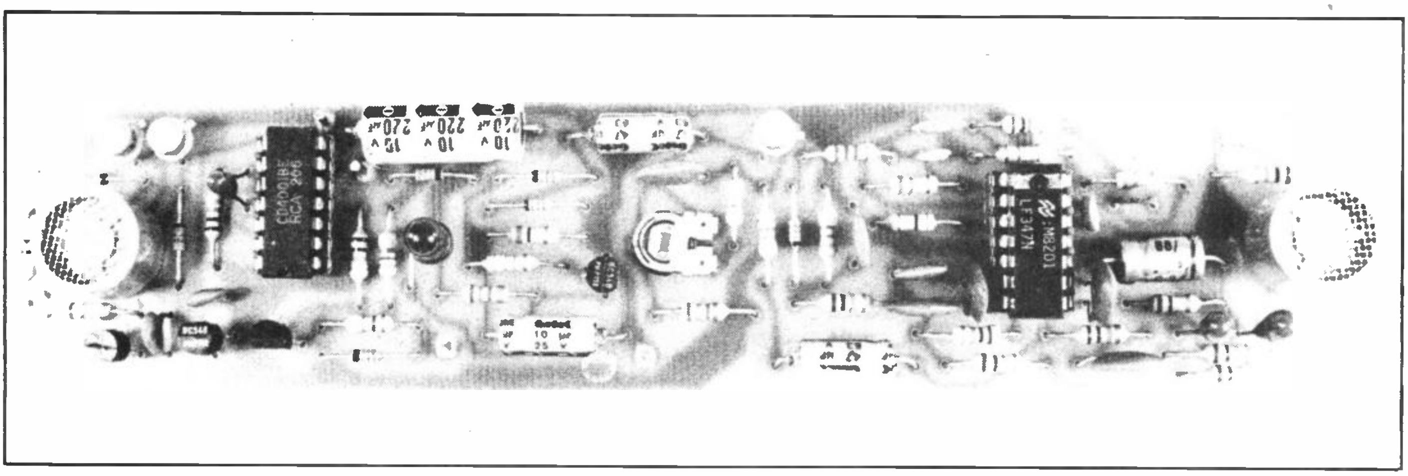
Whatever channel is used for this project, ensure that a u/s interface module is plugged in to this position only.

At switch-on the burglar alarm channel LED will flash. Allow about a minute for the transceiver to stabilise. Turn the sensitivity control RV1 clockwise, to suit conditions, and set the key switch for 'ARM'. Don't forget to switch in the selected channel (switches 3 to 8).

If stand-by batteries are to be used, remove the mains supply, then reconnect. Check that the system does not trigger. If all is well, experiment with RV1 settings for optimum results before putting into service.

Using Ultrasonics

The module is best placed in a corner of the room to be protected, preferably just below ceiling level, and inclined at an angle of 30 to 45 degrees downwards. Keep as far away as possible from windows, radiators, central heating thermostats, and telephones and bells. Remember that anything that moves (e.g. curtains, telephone bells) can set off the alarm, dependent on sensitivity. RV1 must now be adjusted for required sensitivity. Obviously, the more sensitive the system, the greater the possibility of false triggerings occurring. If areas greater than 400 square feet need covering, then two or more devices may be used. Note that each transceiver will draw 24mA, and up to three may be used on one system, dependent on what else is connected to the system.



ULTRASONIC TRANSCEIVER PARTS LIST

Resistors: All ⅓W 5% carbon

R1,8,10-12 inc,23,27	10k	(7 off)	(M10K)
R2	1k		(M1K)
R3	330K		(M330K)
R4	3k9		(M3K9)
R5	220k		(M220K)
R6	2k2		(M2K2)
R7	47k		(M47K)
R9,13,22	1M	(3 off)	(M1M)
R14,15,19	100k	(3 off)	(M100K)
R16,17,24	4k7	(3 off)	(M4K7)
R18	6k8		(M6K8)
R20	33k		(M33K)
R21	1k5		(M1K5)
R25	470R		(M470R)
R26	15k		(M15K)
R28	1M2		(M1M2)
RV1	1M hor sub-min preset		(WR64U)
Capacitors			
C1	33pF ceramic		(WX50E)
C2	100pF ceramic		(WX56L)
C3,21	10nF disc ceramic	(2 off)	(BX00A)
C4	330pF ceramic		(WX62S)
C5	47pF ceramic		(WX52G)
C6,7,12,16	100nf disc ceramic	(4 off)	(BX03D)
C8	470pF ceramic		(WX64U)
C9,13	3300pF ceramic	(2 off)	(WX74R)
C10,11	3u3F 35V tantalum	(2 off)	(WW63T)
C14	68uF 6V3 axial electrolytic		(FB44X)
C15,17	4u7F 63V axial electrolytic	(2 off)	(FB18U)
C18	10uF 25V axial electrolytic		(FB22Y)
C19	1uF 35V tantalum		(WW60Q)
C20	47nf minidisc		(YR74R)
C22	220uF 10V axial electrolytic		(FB60Q)
Semiconductors			
D1-6 inc.	1N4148	(6 off)	(QL80B)
D7	1N4002		(QL74R)
LED 1	LED RED		(WL27E)
TR1,6,7	BC109c	(3 off)	(QB33L)
TR2,4,5	BC548	(3 off)	(QB73Q)
TR3	BC337		(QB68Y)
IC1	LF347		(WQ29G)
IC2	4001BE		(QX01B)
Miscellaneous			
TX1/RX1	Ultrasonic transducers (pair)		(HY12N)
	Veropin 2141		(FL21X)
	14 pin DIL Skt	(2 off)	(BL18U)
	Ultrasonic Transceiver PCB		(GB00A)

A complete kit of all the above parts is available.
Order As LW83E (Ultrasonic Xceiver Kit) Price £12.25

U/SONIC INTERFACE PARTS LIST

Resistors: All ⅓W 5% carbon

R1,7,10	4k7	(3 off)	(M4K7)
R2,5,6,8	10k	(4 off)	(M10K)
R3	100k		(M100K)
R4	2k2		(M2K2)
R9	2k7		(M2K7)
Capacitors			
C1	10nF mini disc		(YR73Q)
C2	10uF 25V axial electrolytic		(FB22Y)
C3	100nF mini disc		(YR75S)
Semiconductors			
D1	BZY88 C9V1		(QH13P)
D2	BZY88 C5V1		(QH07H)
TR1	BC337		(QB68Y)
TR2	BC548		(QB73Q)
TR3	BC327		(QB66W)
IC1	4001BE		(QX01B)
Miscellaneous			
	14 pin DIL Skt		(BL18U)
	U/S Interface PCB		(GB01B)

A complete kit of all the above parts is available.
Order As LW84F (Ultrasonic Interface Kit) Price £2.50

BASICALLY BASIC

Graham Hall, B.Sc. Part 13

This month we continue to describe the string functions available in BASIC. Table 1 provides a summary of the common string functions and explains their use.

LEFT$ Function

The LEFT$ function creates a substring from a main string specified as an argument to the function. The general format of the LEFT$ function is:
LEFT$ (X$, n)
where X$ is the main string and n specifies the length of the substring. The argument n can be an integer or an expression. If the expression evaluates to a non-integer value BASIC truncates the result to an integer. The substring is formed from the first character (left-most character) of the main string to the boundary specified by n. If n is greater than the number of characters in the main string the entire string is returned. If n is zero or less than zero, a blank (null or empty) string is returned.

The following program demonstrates the use of the LEFT$ function:

```
10 LET X$ = "MAPLIN ELECTRONIC SUPPLIES LTD"
20 LET A$ = LEFT$ (X$,6)
30 PRINT A$
40 LET B$ = LEFT$ (X$,0)
50 PRINT B$
60 PRINT LEFT$ (X$,33)
70 END
RUN

MAPLIN

MAPLIN ELECTRONIC SUPPLIES LTD
```

RIGHT$ Function

The RIGHT$ function is similar to LEFT$ function in that it creates a substring from a main string. The substring is formed from a boundary specified as an argument to the function, to the last (right-most) character in the main string. The general format of the RIGHT$ function is:
RIGHT$ (X$,n)
where X$ is the main string and n is the position of the first character in the substring. The argument n can be an integer or an expression. If the expression evaluates to a non-integer value BASIC truncates the result to an integer. If n is greater than the number of characters in the main string a null string is returned.

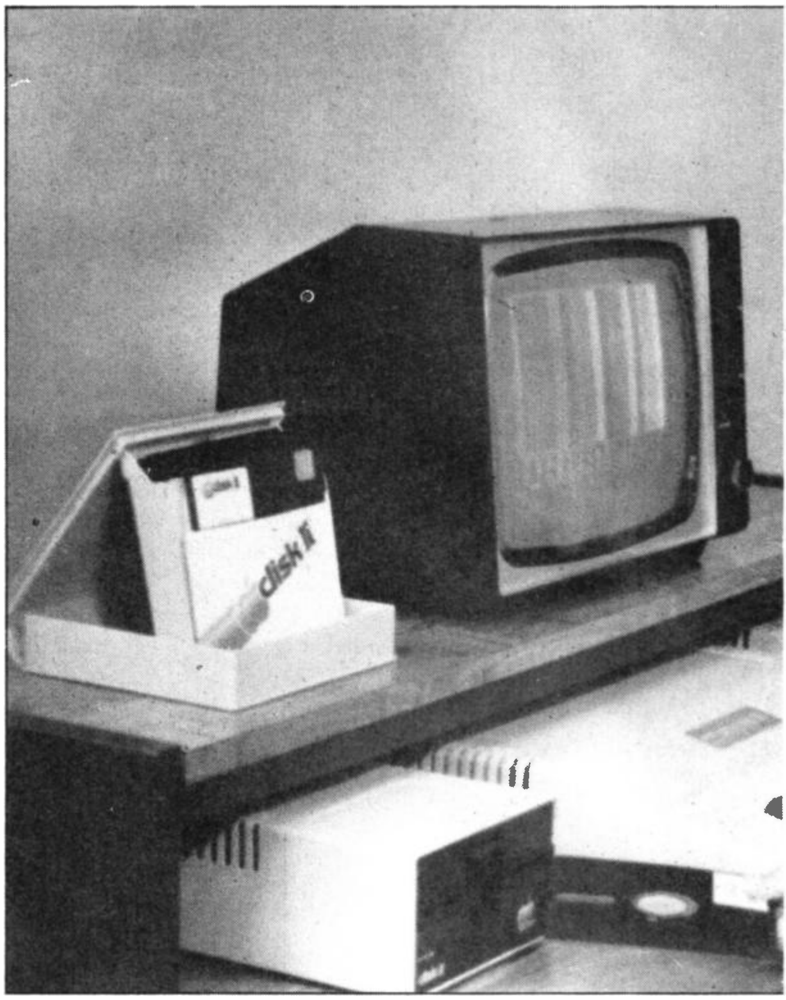
The following program demonstrates the use of the RIGHT$ function:

```
10 LET X$ = "MAPLIN ELECTRONIC SUPPLIES LTD"
20 LET A$ = RIGHT$ (X$,8)
30 PRINT A$
40 PRINT RIGHT$ (X$,31)
50 PRINT RIGHT$ (X$,1)
60 END
RUN

ELECTRONIC SUPPLIES LTD

MAPLIN ELECTRONIC SUPPLIES LTD
```

The substring returned by the RIGHT$ function on line 40 is a null string because the position of the first character in the substring (specified as an argument to the function) is greater than the number of characters in the main string.

MID$ Function

The MID$ (middle) function creates a substring from a specified main string within boundaries specified to the function as arguments. The general format of the MID$ function is:
MID$ (X$,n1,n2)
where X$ is the main string, n1 is the starting position of the substring and n2 is the number of characters in the substring. The arguments n1 and n2 can be integers or expressions the results of which are



truncated to an integer value if necessary. If n2 is zero a null string is returned. If n1 or n2 is less than zero, an error message is given.

The following program demonstrates the use of the MID$ function:

```
10 LET X$ = "MAPLIN ELECTRONIC SUPPLIES LTD"
20 LET A$ = MID$ (X$,8,10)
30 PRINT A$
40 PRINT MID$ (X$,19,20)
50 END
RUN

ELECTRONIC
SUPPLIES LTD
```

In line 40 of the program the argument to the MID$ function specifies a substring beginning at the nineteenth character of the main string. The number specified for the length of the substring exceeds the number of remaining characters in the main string, hence the entire string from the nineteenth character is printed.

LEN Function

The LEN (length) function returns the character count of a string given as an argument. The general format of the LEN function is:
LEN (string)
where string can be a string constant or a string variable. Tabs and spaces within a string are counted as significant characters. The following program demonstrates the use of the LEN function:

```
10 LET X$="MAPLIN SUPPLIES"
20 PRINT "LENGTH OF STRING=":LEN(X$)
30 FOR I=1 TO LEN(X$)
40 PRINT LEFT$(X$,I)
50 NEXT I
60 END
RUN
```

```
LENGTH OF STRING=15
M
MA
MAP
MAPL
MAPLI
MAPLIN
MAPLIN
MAPLIN S
MAPLIN SU
MAPLIN SUP
MAPLIN SUPP
MAPLIN SUPPL
MAPLIN SUPPLI
MAPLIN SUPPLIE
MAPLIN SUPPLIES
```

Line 10 assigns the string 'MAPLIN SUPPLIES' to the string variable X$. Line 20 prints the message within double quotes followed by the length of the string assigned to X$, returned by the LEN function. The space between the word 'MAPLIN' and the word 'SUPPLIES' is counted as a significant character so the length of the string is fifteen. The FOR statement, lines 30, 40 and 50, initialises the variable 'I' to one and sets the limit of the loop to the value returned by the LEN function. Its corresponding NEXT statement is on line 50. Each time the loop is executed a substring is created and printed. The LEFT$ function on line 40 is given the loop variable 'I' as the argument which determines the length of the substring.

Each time the loop is executed 'I' is incremented by one, subsequently the substring printed is increased by one character. The output from the program is shown following the RUN command. Line 60 — the END statement signifies the finish of the program.

Function	Application
ASC(X$)	Converts the first character in the string, X$, to its equivalent ASCII value.
CHR$(X)	Converts the ASCII code number, X, to its equivalent character.
LEFT$(X$,n)	Creates a substring from the string X$ in a range from the left-most character to the nth character.
LEN(X$)	Returns the number of characters in the string X$.
MID(X$,n1,n2)	Creates a substring from the string X$, that begins at position n1 and is n2 characters long.
RIGHT(X$,n)	Creates a substring from the string X$ in a range from n to the right-most character.
STR$(X)	Converts the contents of numeric variable X to the ASCII character string equivalent.
VAL(X$)	Converts a specified string of numeric characters to a numeric value.

Table 1. BASIC string functions.

STR$ Function

The STR$ function is used to convert a numeric variable to a string of ASCII characters. The string is the character equivalent of the numeric content of the variable. The general format of the STR$ function is:
STR$ (variable).

The following program demonstrates the use of the STR$ function:

```
10 LET A=365
20 LET X$=STR$(A)
30 PRINT X$
40 PRINT MID$(X$,2,1)
50 END
RUN

365
6
```

The integer 365 is assigned to the numeric variable 'A'. Line 20 uses the STR$ function to convert the contents of 'A' to its equivalent ASCII string, which is then assigned to the string variable X$. Line 30 prints X$. To demonstrate that an ASCII string has been created, line 40 uses the MID$ function to extract the middle character from the string X$. This is printed on the terminal.

VAL Function

The VAL (value) function converts a string of numeric characters to a numeric value. This is the opposite of the STR$ function. The general format of the VAL function is:
VAL (string)
where the argument is a character string or string variable. If the argument string contains a non-numeric character an error message will be output.

The following program demonstrates the use of the VAL function:

```
10 LET X$="1234"
20 LET A=VAL(X$)
30 PRINT A
40 END
RUN

1234
```

String Concatenation

Some versions of BASIC include a concatenation symbol (+) which can be used to combine string variables or string constants to generate a new string. For example the command PRINT "HEL" + "LO" will output the string HELLO on the terminal. Consider the following program:

```
10 LET A$="MAPLIN "
20 LET B$="ELECTRONIC "
30 LET C$="SUPPLIES"
40 LET D$=A$+B$+C$
50 PRINT D$
60 END
RUN

MAPLIN ELECTRONIC SUPPLIES
```

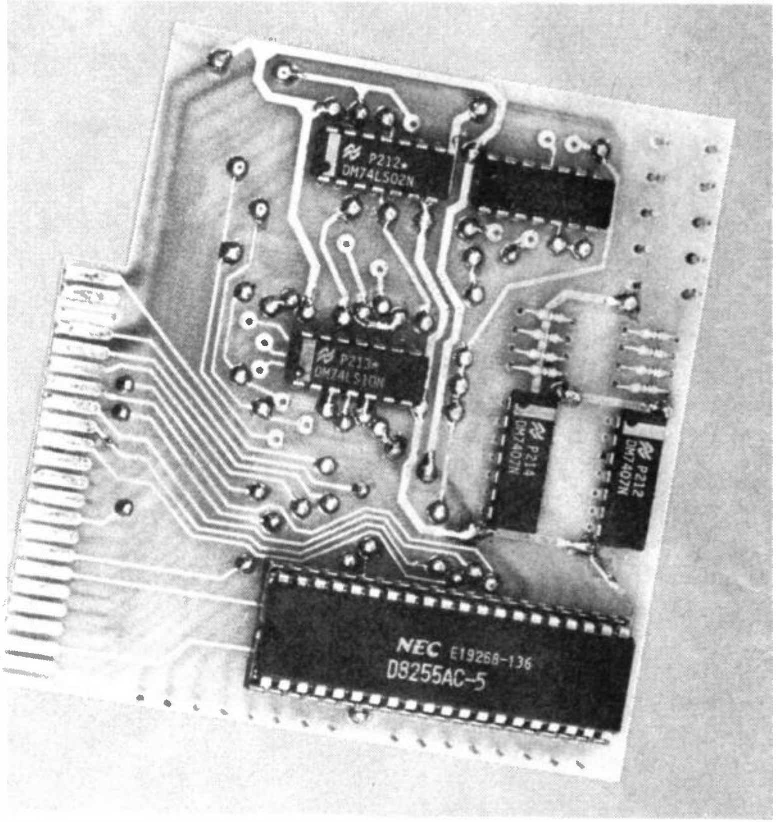
The concatenation symbol is used on line 40 to concatenate the strings assigned to the string variables A$, B$ and C$. The new string is assigned to the string variable D$ and printed by the statement on line 50. If the concatenation symbol is used illegally, such as on the left side of an assignment statement, an error message will be output to the terminal. For example, 10 LET W$ + 2$ = Y$ is illegal and returns an error message. ■

In response to the many enquiries we have received about this extremely popular article, we will shortly be making the complete series available in book form at low cost. Watch this space for further details!

ZX81 INPUT~OUTPUT PORT

by A. Daykin

- ★ **Two 'bi-directional' ports for a total of 16 input or 16 output lines**
- ★ **One buffered output port which can interface directly to CMOS**
- ★ **Able to be used with the MAPLIN digital train controller**
- ★ **On board address selection allows for expansion to 6 ports with two PCBs**



This project for the Sinclair ZX81 will give you access to the outside world with your '81'.

The I/O port, shown in figure 1, gives many possible modes of operation. For the purposes of this article examples are given for only the simplest, although the 8255 used here has a total of three programmable operations.

MODE 'O' provides 3x8bit ports, two of which can be programmed to function either as inputs or outputs, and one (port B), as a buffered output only, which can directly drive the MAPLIN DIGITAL TRAIN CONTROLLER (issue three) or, indeed, many other forms of hardware with a minimum of interfacing.

Circuit Description

Figure 1 shows a complete circuit diagram of the board, and Figure 5 shows the alternative address decoder circuitry. The MP8255 (IC4) has two address lines, pins 8 and 9, which are connected directly to the ZX81 address lines A1 and AØ. The remainder of the address decoding is performed by ICs 1,2, and 3, which enables the MP8255 with a logic Ø at pin 6 (CS).

Data lines DØ to D7 are connected directly to IC4, along with write and read lines WR and RD. The RESET line, P35, has been tied directly to 0v. Should an external reset be required, the track will have to be broken here, and an external reset pin fitted to P35. Two possible address groups are provided on the PCB, which can be selected at the construction stage, by inserting appropriate pins through the PCB. Addresses used are 16360 to 16363, which are designated by a square symbol on the legend, and 16380 to 16383, which are designated by a circle on the legend. All other track pins have a broken circle for designation. If two PCBs are used, they should be constructed for two different address groups.

IC5 and 6 are 7407 buffers, with open collector outputs capable of sinking up to 40mA at a maximum of 30v.

Construction

Commence by inserting all track pins into the holes marked with a broken circle. Decide which address group you require, and insert all track pins into their appropriate holes (see circuit description). Fit R1 to R8, and D1 (note polarity). Insert all 26 Vero pins and push home. Solder all pins and components, remembering that the track pins will need soldering to both sides of the PCB. Fit the 40 pin IC socket and ICs 1, 2, 3, 5, and 6. Solder these components in place and, finally, insert IC4 in the socket. Cut off any protruding leads and clean flux off the PCB with a stiff brush and thinners. Check all components and joints before connecting to your computer. If you are using a mother board the PCB will plug straight in, but if you are using the port direct into the ZX81 a 23-way socket (RK35Q) will be required. Place this socket over the edge connector, aligning pin 3 with the slot cut in the PCB, and solder all 44 pins to both sides of the board.

Testing And Using The Ports

With the power off, plug the port PCB into your ZX81. Switch on and ensure that the command cursor appears. If not, or if the screen fills with lines, switch off and re-check your assembly.

A few lines of BASIC program are now required for use. The highest address (16363 or 16383), used for the

Control Word	D7	D6	D5	D4	D3	D2	D1	DØ	Port A	Port C Upper	Port C Lower	Port B
128	1	0	0	0	0	0	0	0	Output	Output	Output	Output
129	1	0	0	0	0	0	0	1	Output	Output	Input	Output
136	1	0	0	0	1	0	0	0	Output	Input	Output	Output
137	1	0	0	0	1	0	0	1	Output	Input	Input	Output
144	1	0	0	1	0	0	0	0	Input	Output	Output	Output
145	1	0	0	1	0	0	0	1	Input	Output	Input	Output
152	1	0	0	1	1	0	0	0	Input	Input	Output	Output
153	1	0	0	1	1	0	0	1	Input	Input	Input	Output

Table 1. List of Control Words.

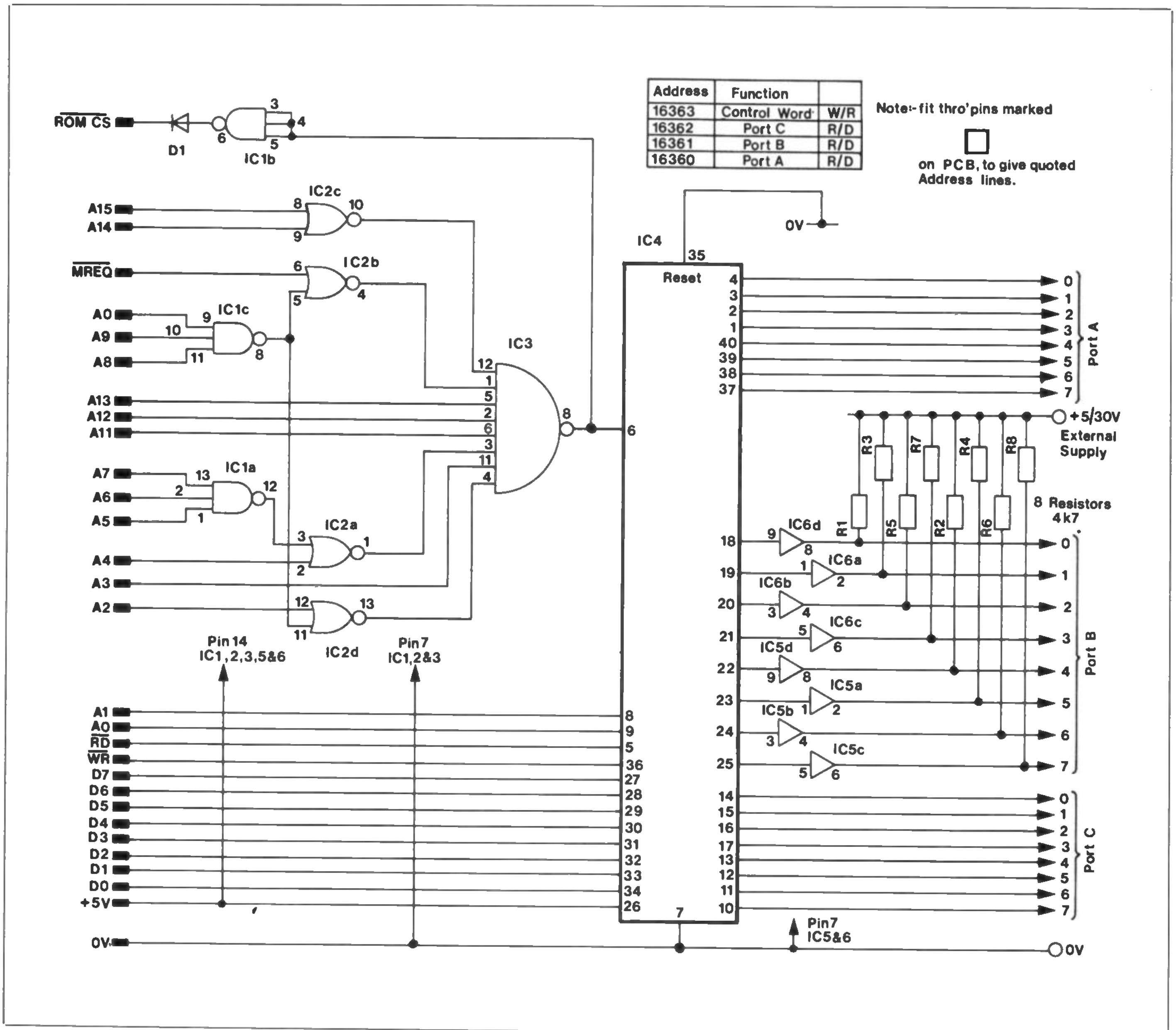


Figure 1. Circuit diagram of I/O Port.

CONTROL WORD, will set MODE and program which ports are to be input and output (see table 1).

PORT A can be used as either input or output, but all the DATA lines will be in the same mode.

PORT B on our PCB can only be used as an output, because of the buffers.

PORT C can be either input or output, and may also be split into two parts, upper and lower halves, which can be changed independently.

Table 1 gives a complete list of the CONTROL WORDS available, along with DATA BUS state and a definition of PORT USE.

Reliable operation with PORT C in split mode can be difficult when using BASIC, and it is advisable to use only the control words 128, 137, 144, and 153. Port A is located at address 16360 or 16380, and if used as an output POKEing to this address will output data on the port pins. PEEKing at the same address will read data in from the same pins. Port B is located at address 16361 or 16381, and can only be POKEd here.

I/O PORT PARTS LIST

Resistors — all ⅓W 5% carbon unless specified			
R1-8	4k7	8 off	(U4K7)
Semiconductors			
D1	1N4148		(QL80B)
IC1	74LS10		(YF08J)
IC2	74LS02		(YF02C)
IC3	74LS30		(YF20W)
IC4	8255A PIA		(YH50E)
IC5,6	7407	2 off	(QX76H)
Miscellaneous			
	40-pin DIL socket		(HQ38R)
	Veropin 2145	1 pkt	(FL24B)
	Track pin	2 pkt	(FL82D)
	PCB		(GA90X)
Test Components			
	2k2 resistors	4 off	(M2K2)
	220R resistor		(M220R)
	LED red	8 off	(WL27E)
or	Red bargraph display		(BY65V)

A complete kit is available for this project. It does NOT include the Test Components.

Order As LW76H (I/O Port Kit) Price £9.25

Port C is located at address 16362 or 16382, and can be POKEd or PEEKed as for port A. Printed here are two demo programs which will quickly check out your board. For demo 1 a number of discrete LEDs or a bar-graph display can be connected to 0v via a 220 ohm resistor, and then to the outputs of port B (see figure 4). Remember to connect the positive supply pin (next to port B pin 0) to a +5v/30v supply.

For the demo 2 program the LEDs can be left connected, and will give a display similar to that of the previous program. Input coding can be set up by wiring port A and C pins to either 0v or +5v, as required, but for test purposes connect the 0v and +5v via 2k2 resistors (figure 5) in case the MP8255 is set in the output mode. This should be done before running the program.

For constructors who may wish to use the I/O port with external hardware, a mother board is available for the ZX81 (GB08J) and will accept the Sinclair 16k RAM pack and up to three plug-in modules. You will need four PC edge connectors 2 x 23 way (RK35Q) and the pcb. See page 47 for prices.

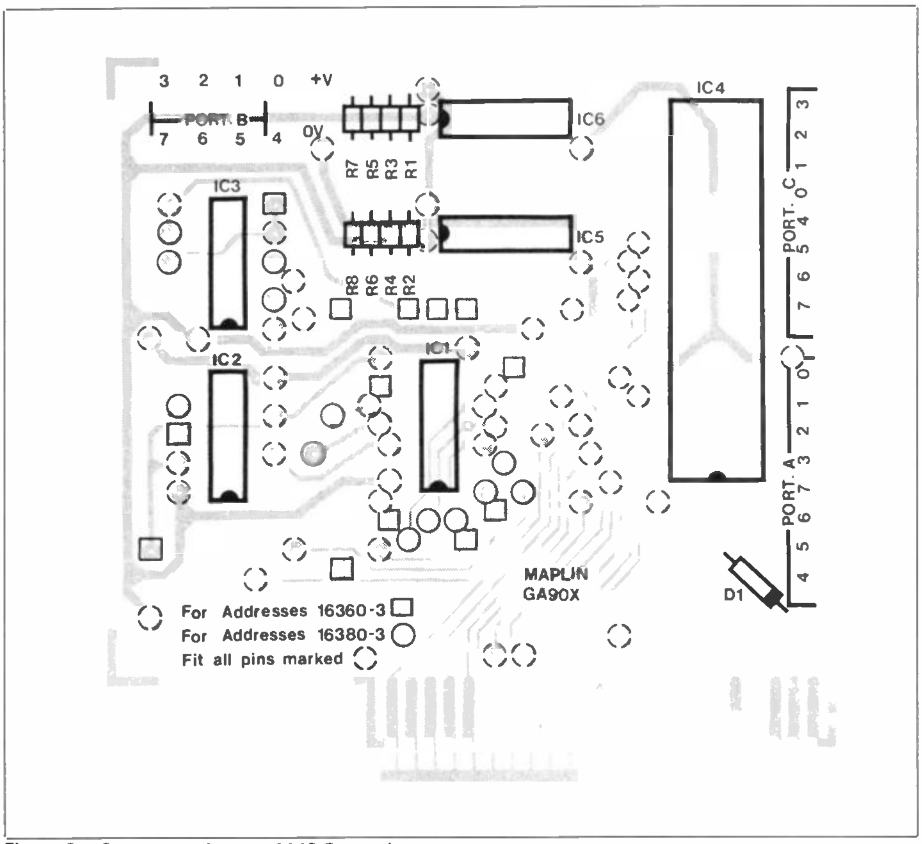


Figure 2. Component layout of I/O Port pcb.

DEMO 1

```
  1 REM  A. DAYKIN.
  5 REM  PORT DEMO NO. 1
 10 POKE 16363,128
 20 LET A=0
 25 SCROLL
 30 PRINT A
 40 FOR L=1 TO 50
 50 POKE 16361,A
 60 NEXT L
 70 LET A=A+1
 80 SCROLL
 90 IF A>=16 THEN GOTO 20
100 GOTO 30
```

DEMO 2

```
  1 REM  A. DAYKIN.
  5 REM  PORT DEMO NO. 2
 10 POKE 16363,153
 20 LET A=0
 25 SCROLL
 30 PRINT "PORT B OUTPUT IS  ";A
 35 SCROLL
 40 FOR L=1 TO 50
 50 POKE 16361,A
 60 NEXT L
 70 LET A=A+1
 80 IF A<16 THEN GOTO 25
 90 SCROLL
100 PRINT "PORTS A AND C WILL BE"
105 SCROLL
110 PRINT "TESTED AS INPUTS"
120 LET B=PEEK 16360
125 SCROLL
130 PRINT "PORT A READS  ";B
140 SCROLL
150 LET C=PEEK 16362
160 SCROLL
170 PRINT "PORT C READS  ";C
180 STOP
```

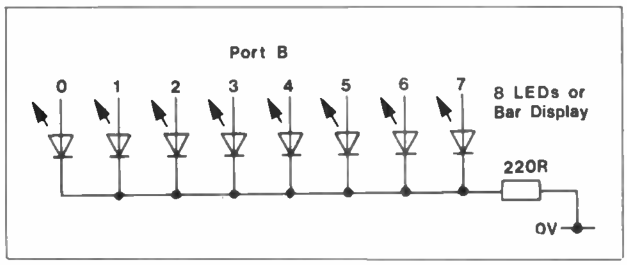


Figure 3. Test LED's.

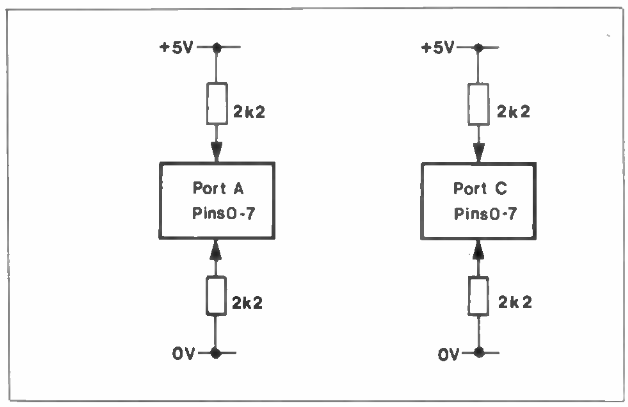
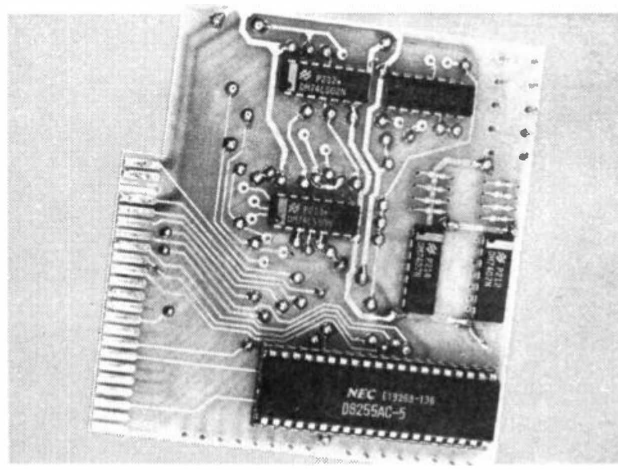


Figure 4. Test resistor connections.



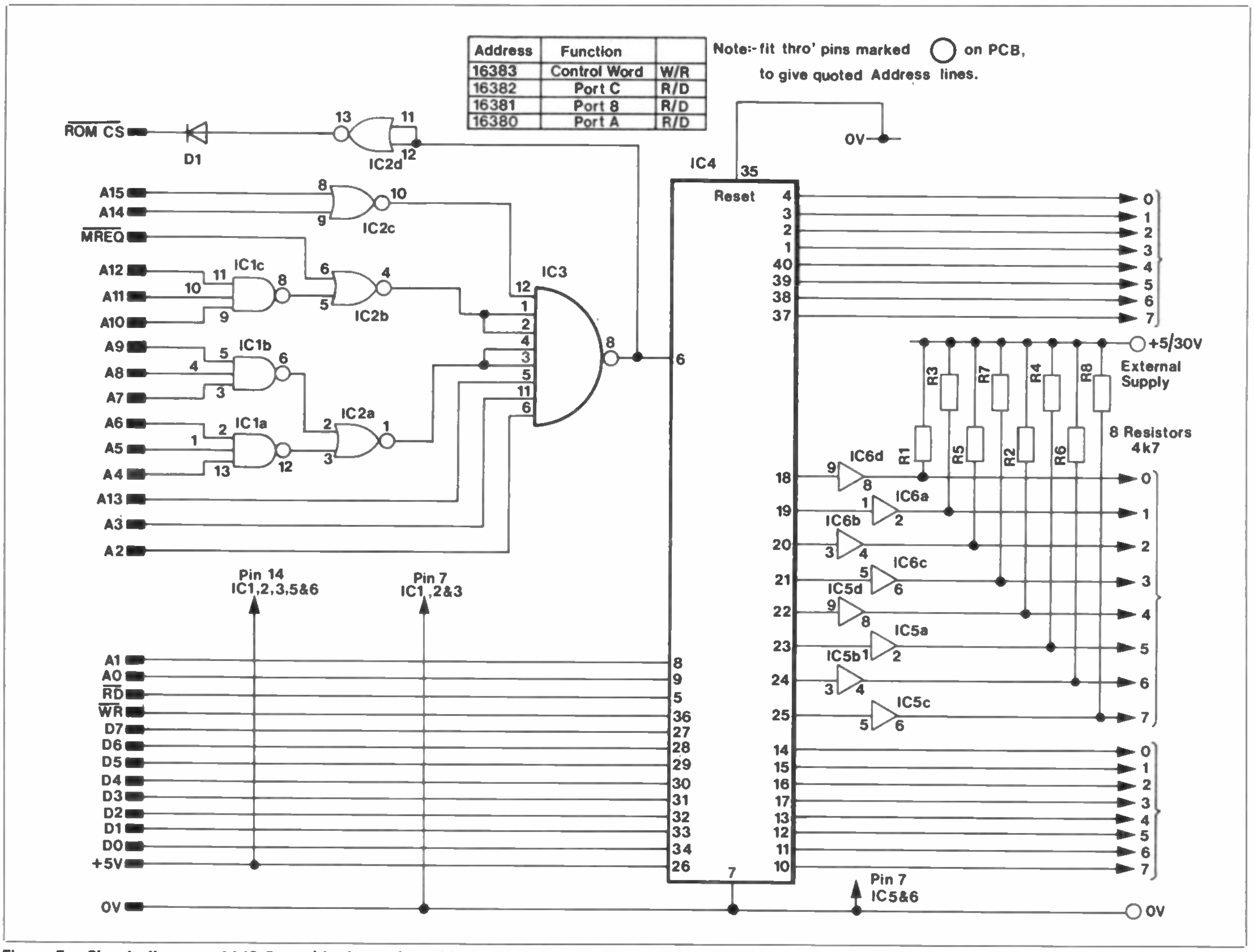


Figure 5. Circuit diagram of I/O Port with alternative address decoding.

MAPLIN TRAIN CONTROLLER PROGRAM FOR ZX81

by Dave Goodman

This program has been designed for use with the ZX81 1k or 16k RAM and our I/O port interface PCB.

Port address used is "16361", and the POKE command in line 3 simulates a track supply fail, bringing on the LED and stopping all trains.

Table 1 shows the decimal value (which, of course, appears as a binary number between 0 and 255) on the data lines.

	A	B	C	D
F	0-9	32-41	64-71	96-105
R	16-25	48-57	80-89	112-121

Table 1. Direction and speed.

```
1 POKE 16363,128
2 LET E "16361"
3 POKE E, 128
4 CLS
5 PRINT "Emergency STOP E"
6 PRINT "Controller A-D?, X To change"
7 GOSUB 1ØØ
8 IF C$<"A" OR C$>"D" THEN GOTO 7
9 LET D$=C$
10 PRINT "Direction F/R?"
11 GOSUB 1ØØ
12 IF C$="F" OR C$="R" THEN GOTO 14
13 GOTO 11
14 LET E$=C$
15 IF E$="F" THEN LET H=Ø
16 IF E$="R" THEN LET H=16
17 PRINT "Speed Ø-9?"
18 GOSUB 1ØØ
19 IF C$<"Ø" OR C$>"9" THEN GOTO 18
20 IF D$="A" THEN POKE E, VAL C$+H
21 IF D$="B" THEN POKE E, VAL C$+H+32
22 IF D$="C" THEN POKE E, VAL C$+H+64
23 IF D$="D" THEN POKE E, VAL C$+H+96
24 GOTO 4
100 IF INKEY$<>"" THEN GOTO 1ØØ
101 IF INKEY$ ="" THEN GOTO 1Ø1
102 LET C$= INKEYS
103 IF C$="E" THEN GOTO 3
104 IF C$="X" THEN GOTO 4
105 RETURN
```

So, if controller "A" is required to move a train in a forward direction at a 'snails pace' speed of 1, then the decimal code set up will be 1.

Similarly, to select controller "D" with reverse direction and speed at maximum (9), the required decimal code will be 121.

Type in the program, followed by RUN and NEW LINE. Two statements are printed. The first, EMERGENCY STOP E, allows key E, when pressed, to stop all trains running at any time, and the second, CONTROLLER A-D?, X TO CHANGE, allows you to select the required train control unit A, B, C, or D. Pressing key X allows you to re-select a control unit.

Select a control unit (A-D) and note that a third statement is added, DIRECTION F/R?. Now that you have selected a controller the direction of travel is needed. Press key F for forward, key R for reverse.

Finally a fourth statement is added, SPEED 0-9?. Now that control and direction are set, train speed must be chosen. Note that speeds minimum (0, stopped) to maximum (9) are set by keys Ø to 9 in either forward or reverse. Press a number, and the code corresponding to all variables will set the train running. The screen will then return to the first two statements, waiting for A-D, F-R, and 0-9 to be input again. Remember that E (panic), and X (train controller) can be pressed at any stage, and that NEWLINE is not required during the program. Under normal conditions the program should be found to be crashproof, and entry to the program is made by pressing the BREAK key (D/1Ø1) and NEWLINE.

Connections from the I/O port PCB to the train control remote latchboard are as follows:—

I/O port B pins	Remote data latch PCB pins
0	28 - B5
1	27 - B6
2	30 - B4
3	31 - B0
4	32 - B1
5	33 - B2
6	34 - B3
7	26 - B7
0V	28 - B5

The +5V supply for the I/O port buffers IC5 and 6 can be taken from the ZX81 +5V supply.

COMPUTER NEWS

K-DOS

A better disk operating system for your Atari computer.

Have you been programming with an ATARI disk based system for some time? Are you irritated by the need to load the second stage of DOS II even to look at the directory of a diskette? Are you frustrated by seeing the screen fill with a menu that you already know? If so, read on.

K-DOS is an exciting new disk-operating system for the ATARI 400/800, which can transform your ATARI from a machine which treats you and the novice as equals into a professional-style system.

K-DOS, from K-Byte, is supplied with a concise manual, which has all the functions laid out in an easily understood format. Booting up the supplied disk will load K-DOS in the usual manner. A successful boot is indicated by the K-Byte identification header. The BASIC cartridge, if present, is then initialised, and control is transferred to it, with the appropriate READY sign. The usual format AUTO RUN.SYS file is supported, and would have been loaded and executed by this stage. Assuming that BASIC is present, one may simply type the usual DOS command to enter DOS control. The immediate confirmation of this is the echoing of DOS two lines down in lower case characters. The two obvious advantages at this stage are:—

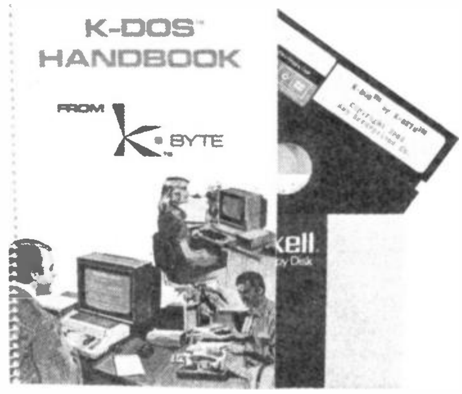
1. There is no delay in entering DOS, as it is present in its entirety.

2. The screen is not blanked, then filled with a redundant menu; the screen simply scrolls when the cursor reaches the bottom line.

A directory is obtained by typing 'DIRECT' or its abbreviation 'D', then hitting the return. This results in the listing as normally produced by ATARI's own DOS. Returning to BASIC is just a matter of typing 'BACK' or its abbreviation 'B', whereon BASIC is entered as usual, but with the difference that the screen is not cleared — a very useful point for those of us with memories like sieves, and who, like myself, are continually forgetting filenames!

Just as it is possible to return to BASIC by hitting (SYSTEM RESET), so is it also possible to go to K-DOS by holding down the (START) key and simultaneously pressing (SYSTEM RESET). This is a nice fast method of entering K-DOS, and is very cleverly done; great if you do not require the contents of the screen to be retained.

K-DOS not only supports all the usual functions of DOS II, i.e. copy file, rename file, delete file, lock and unlock, write DOS file (WBOOT), format disk etc., but also provides



COMMAND SUMMARY

Disk Maintenance	INIT n
	FORMAT n
	WBOOT {n}
	*DISKdup {scr{{,}dest}{/A}{/W}{/F}{/P}}
File Control	Direct {filespec}{,output}
	Copy input {,output}
	DELete filespec {/N}
	LOCk filespec
	UNlock filespec
	REName file,filename
	APpend {sourcefile,} destfile
	*TRansfer filename {/SIRG}{,filename}{/SIRG}
Program Control	Back
	WARM
	COLD
	Xit
	UNLOAD
	LOMem
	DC {character}
Machine Monitor	Run file {/M}{/N}{/P}
	Load file {/M}{/N}{/P}
	Save file {/A} beg end {{init} start}
	Go {hhhh}
	Proceed {hhhh}
	Examine { ◄first ► {, ◄last ► }}
	Alter {adr}{ ◄} hex....or "ascii
	REgister {r ◄h}
Device Control	RESET
	Text
	CLose
	ERror nn
DUP Special	*UDC
	Ident
	KILL
	REVIVE

______ Indicates the minimum abbreviation.

* Indicates a UDC command that normally resides in a disk file.

a whole host of additional ones, which are listed here.

As you can see, commands consist of logical English words. Most of these will have an abbreviation, usually of one or two characters (the minimum abbreviation is shown underlined). Many of the commands shown will have option switches, which may alter the way in which the command is executed. One example of this is the LOAD command. This loads a binary file into memory from disk, and the three option switches are:—

/M which causes the printing to the screen of the area of memory into which the file is loading, as well as the INIT. and RUN addresses.

/N will prevent the file from being run, and

/P will allow the file to overlay an area of DOS, an event which would normally produce an error trap.

Speaking of errors, another of the K-DOS features is the production of proper English error messages, e.g. ERROR 138, DEVICE TIMEOUT, or ERROR 1, ILLEGAL COMMAND. The text for these error reports can be changed easily by using one of the utility files on the supplied disk (CHERROR.SYS), allowing the creation of highly amusing and lively error statements!

One of the nice facilities for large business systems is the ability to define a command to run a particular machine code program. The 'UDC' (User Defined Command) program supplied permits the assignment of one or more character names, which when typed call up and run the designated file — pretty neat, eh?

Another interesting function of K-DOS is its disk duplicate utility. Whereas the DOS II DUPDISK command does not actually duplicate an entire disk, merely its file structure. DUPDISK with K-DOS has an option switch, /A for ALL, which causes the duplication of every single sector of a disk — a true disk duplicate.

A similarly well-written file utility is also supplied, and this is called TRANSFER. This is a file transfer utility primarily for copying files from one device to another, and files from one disk to another using the same drive. A special feature is that it will load from cassette to disk, a file or program written with short inter-record gaps e.g. autoboot cassette programs, as well as reading and writing those with long IRGs.

These are just a few of the functions that K-DOS offers, but as can be seen from the list they represent only a small part of what is available. All of these commands can actually be used from BASIC without actually going 'into' DOS. Simply type a comma before the command, and hey presto!, it is executed from BASIC (e.g., D will produce a directory listing whilst still under BASIC cartridge control).

K-DOS, it seems, represents a major step forward for the serious ATARI programmer, in that:—

1. It provides a very powerful set of monitor and disk commands and 2. It is fast and logical to use, thus giving the user big machine features on a personal computer.

It is highly recommended by myself, indeed, I have not used ATARI's own DOS for at least three months!

NEW SOFTWARE FOR THE VIC20

AC77J	(Sargon II Chess Cartridge)	**Price £24.95**
AC78K	(Another VIC In The Wall Cassette)	**Price £7.00**
AC79L	(VIC Panic Cassette)	**Price £7.00**
AC80B	(Cosmiads Cassette)	**Price £7.00**
AC81C	(Backgammon Cassette) requires at least 3k expansion	**Price £7.00**
AC82D	(VIC-Men Cassette)	**Price £7.00**
AC83E	(VIC Asteroids Cassette)	**Price £7.00**

THE ATARI 400/800

ARE THE BEST HOME COMPUTERS AVAILABLE and here's why! *by Ron Levy*

The majority of microcomputer purchasers are buying for the first time. When they look at what is available, they find a vast bewildering range of machines to choose from. Each manufacturer claims his is the ultimate personal computer system and most are better than all the others. But these advertisements rarely give any thought to the requirements of the home user or to the practicalities of using a system at home.

The three main purposes of a home computer are education, personal software development and entertainment. The educational aspect requires that the machine be well-designed in terms of ease of use, with good documentation and tutorials with the appropriate software back-up to make learning enjoyable. For personal software development, the machine needs to be fully expandable to a complete system with disk drive, printer and cassette recorder etc. without masses of interfacing circuitry, wiring looms or the need for extra chips to be added.

The entertainment aspect is usually of equal importance (certainly when impressing friends or getting the rest of the family interested) and can be the most difficult to fulfill in terms of the complexity of the hardware and software involved.

To achieve these ends a home computer must be designed as a system rather than just a prooessor with the other parts left to be designed later. The Atari was the first personal computer to be designed specifically for home use. It was conceived as a complete system. Many people purchase low-priced personal computers only to find that to make it do anything worthwhile involves great expense for memory or hardware expansion. Memory for the Atari is relatively inexpensive and hardware expansion does not require expensive interface units. Everything just plugs directly one into another.

Graphics

But the one outstanding virtue of the Atari computers, both in terms of personal software development, education and entertainment is its graphics capabilities. These are quite simply unrivalled on any machine costing under £3,000.

The ZX Spectrum and The BBC micro uses Ferranti's Uncommitted Logic Arrays (ULA) to extend the power of the main processor (6502). These are quite powerful chips, but they do not approach the power of a real microprocessor. The reasor they are used is because they are many many times cheaper to design than a complete microprocessor, but clearly if it was a viable proposition a microprocessor would be far more powerful.

Atari are owned by the giant Warner Bros. Corporation who spared no expense in the design of the Atari computers. They designed a microprocessor (and called it 'ANTIC'), specifically to control the TV display, and the Atari therefore has two microprocessors and, as we said, the most brilliant graphics as a result.

But Atari didn't stop there. On top of that there is still another chip that has a hand in the control of the TV display. This chip, called a GTIA, provides a function known as Player Missile Graphics, and it's this concept that makes those amazing arcade games so clever.

With the GTIA, the programmer is able to create an object on the screen in any desired shape and simply designate the shape, a player and missile number. This object does not, however, exist as part of the screen memory known to ANTIC, but is in fact an entirely separate entity having its own separate area of memory which can then be manipulated and superimposed on the display by the GTIA.

These player/missiles can then be assigned a priority relative to the background or other objects so that they move behind or in front of different objects without further intervention. The colours, positions and even the shapes of these player/missiles can also be changed and on the display, the changes appear instantaneously while the 6502 and ANTIC get on with their jobs uninterrupted.

It is these major advantages of the Atari computers, that put Atari graphics leagues ahead of any other computer under £3,000. The Atari makes graphics control easy, colourful and above all permits objects to move with incredible speed and smoothness around the screen, or complex objects to be repositioned instantaneously.

The story does not end there, however, for the Atari has yet another specially designed extremely powerful IC called POKEY. This amazing chip deals with serial input/output, keyboard scan, audio generation, random number generation and analogue to digital conversion.

The Atari has four separate sound generators and on each one the pitch and volume are controllable. Any may be used to produce noises, squawks, bangs, rattles, hisses etc. No other personal computer in the Atari's price range has such a versatile sound generator system.

A look at the front of the machines shows the four joystick ports. As well as being joystick ports, these present one of the easiest methods of interfacing to a computer because they are bi-directional (i.e. they can be used as inputs or outputs) and can be addressed simply as memory locations. Each socket also has two analogue to digital converter inputs (giving a total of eight) that could be used by those wishing to experiment with add-on hardware for robot control for example.

On the side of the machine is the serial input/output port (SIO) to which the periphals, disk drive, printer, etc. can be connected. And again, this has been designed with the home user primarily in mind, for from this one neat little socket, peripherals may be connected, each extra one just plugging into the one before, obviating the need for interface boxes or dozens of cables.

Each device has its own command data frame so that even though they are all connected together there are no problems with the software talking to the particular device required.

One of the major criticisms levelled against the Atari computers by manufacturers and owners of other machines is that the Atari 400/800s are "just games machines". It is a comment given exclusively by people who haven't the faintest idea what they're talking about.

Atari Cassette System

Those who know the Atari will find the comment devoid of any serious consideration, for how many other machines can control up to four disk drives, a printer, a professional multi-channel RS232/Centronics (i.e. non-Atari) interface and communications box and a cassette recorder, simultaneously without further interfacing or hardware and without any hardware or software conflicts or problems of any sort?

Another unique feature of the Atari computer is the way it handles its cassette recorder. The Atari cassette recorder is in fact a two-track device. One track is the data signal as with all other computers, but the other track is used for storing a soundtrack. This brilliant, yet simple idea puts the Atari's educational capabilities in a class of its own!

In Atari's own software, it is used to great effect in the 'Learn Programming' and language learning cassettes. With a single POKE statement, it is possible to transfer the audio track to the TV speaker, thus making controlled commentary a possibility with learning programs on the Atari. I wonder how many people realise that the first "Bonjour" you hear in Atari's TV advertisement is actually spoken by the computer!

Another key feature of the Atari cassette system is that it is possible to increase or slow down the tape drive speed through several times its normal speed without affecting data loading. Data will still load correctly because at the start of every 128-byte block of data there are two additional bytes that are used by the operating system in a very smart piece of software that calculates the baud rate of the tape being loaded. The result is that manufacturing tolerances in the speed and construction of the tape unit and the tapes, have no detrimental effect upon reliability of operation.

The physical construction of the Atari 400 and 800 is very attractive and modern. A heavy-duty plastic moulding is used for the external cabinet and will withstand a good deal of rough treatment unlike the majority of micros currently available. A look inside the machine reveals the fact that the entire CPU and its RAM cards are encased in a die-cast aluminium alloy moulding. Consequently there is very little radiation or interference from the computers and conversely Atari computers do not suffer from system crashes caused by external interference.

The quality and quantity of software for the Atari also far exceeds that of any other personal computer for two very good reasons. Firstly, since the machine is so comprehensive in its graphics facilities, it attracts the best programmers and secondly because the Atari makes it easy to protect software very well against unauthorised copying, producers of software are able to invest time and money developing good programs knowing they will get a fair return from it.

There is already masses of software available for the Atari, from the latest arcade games to complex languages like LISP and FORTH. Over 30 software houses in America are busily writing software for the Atari and others are adapting Apple software. The Atari's are currently America's best-selling computer — the Americans at least have found out how good it really is!

Sinclair's Advertising

Finally, let's take a look at Sinclair's six-page advertising brochure which has been inserted in most of the computer magazines in recent months. In the leaflet, there is a table comparing the ZX Spectrum with the BBC micro, VIC20, Atari 400, TI99/4A and TRS80 Colour computers.

Taking the chart line by line, the first point to note is that the Atari 400 is now a little cheaper than shown, but is still about twice the price of the Spectrum both for the 16k and 48k versions. Nevertheless, we still believe that if you can afford it, the Atari gives you more for your money. When you're fed up with the relatively low quality and quantity of Spectrum software and fed up with the much lesser capabilities of the Spectrum, you'll still be finding new, exciting things to do on the Atari.

The line showing standard RAM available using hi-res graphics is a cunning way of making a bad point look good. The reason the Spectrum has more RAM left than the BBC or Atari is that its highest resolution is less than the BBC or Atari so naturally it has more RAM left.

The highest resolution on the Spectrum, Atari and BBC is as follows respectively: 256 x 192, 320 x 198, and 640 x 256. The BBC machine looks very good here, but using its highest resolution you do only have 3k of RAM left and you can only use two colours on the screen, so you can't do a lot with it. Even on the BBC model B you only have about 10k of RAM left. On the 48k Atari you have 30k of RAM left (nearly 40k if you're not using BASIC) and with this or 16k RAM you can have at least six colours at once.

But, in any case, the ability of a computer is not directly related to its highest possible resolution. On the Atari, most of the best games use low resolution graphics modes.

The next line on Sinclair's chart compares maximum memory and although Sinclair could not have known at the time Maplin can now supply Atari 400's with 48k RAM fitted.

To directly compare the Atari or BBC's sound generators with the Spectrum is ridiculous. Both are far and away superior to the Spectrum's one sound generator. The BBC has three and a noise channel and the Atari has four with volume and noise software adjustable on all four.

The number of colours available on the Atari is 16, but each can be displayed in 16 intensity levels which does give the impression of being different colours and it is in fact possible, though not easy, to display all 256 colours and levels on the screen simultaneously.

This fact then makes the next line on Sinclair's chart look pretty ridiculous since he claims you can only have 5 colours on the screen at one time. This is simply not true. Even in the highest resolution mode you can have six colours on the screen at once (there is usually a trade off between resolution and numbers of colours available). Another major advantage with the Atari is that different parts of one picture can actually be in different resolution modes simultaneously! — So the possibilities with the Atari really are far in advance of any other machine on this table. To be fair, comparing the graphics on the Spectrum with the graphics on the Atari is like comparing Meccano with the Empire State Building.

Flash is not available from the keyboard on the Atari, but is so easily implemented in software that it's not a factor worthy of serious consideration when choosing a computer.

Surprisingly Sinclair do not think the Atari has user-definable graphics characters, but don't worry, it has — and what you can do with them on the Atari is of course far, far better than on the Spectrum.

The only other point worthy of note is that the Atari cannot interface a normal cassette recorder, but as we've pointed out, the advantages of the Atari system far outweighs this fact.

The Atari is a very clever computer and if we had more space we could go into even more detail about its amazing capabilities. It can be used as a business machine, but it's not ideal; it wasn't designed to be. It was designed to be a home computer and this is where it excels. It was designed to be a complete system. It has got an enormous amount of software back-up.

It is the world's best home computer — and that's a fact!

NEW SOFTWARE FOR ATARI

This month we're pleased to announce another massive selection of titles available for the Atari computers.

Adventure Games

Ali Baba & The Forty Thieves	-D-32K-(BQ78K)	£27.95
Star Warrior	-D-32K-(BQ79L)	£28.95
Rescue At Rigel	-D-32K-(BQ80B)	£22.45
Invasion Orion	-D-32K-(BQ81C)	£18.95
Datestones of Ryn	-D-32K-(BQ82D)	£14.95
Crush, Crumble and Chomp	-C-32K-(BQ83E)	£22.48
Crush, Crumble and Chomp	-D-32K-(BQ84F)	£22.48
Temple of Apshai (Part 1)	-C-32K-(BQ85G)	£28.95
Temple of Apshai (Part 1)	-D-32K-(BQ86T)	£28.95
Upper Reaches of Apshai (Part 2)	-C-32K-(BQ87U)	£14.95
Upper Reaches of Apshai (Part 2)	-D-32K-(BQ88V)	£14.95
Curse of Ra (Part 3)	-C-32K-(BQ89W)	£14.95
Curse of Ra (Part 3)	-D-32K-(BQ90X)	£14.95
Mission: Asteroid	-D-40K-(BQ91Y)	£17.19
Ulysses & The Golden Fleece	-D-40K-(BQ92A)	£20.64
Softporn Adventure	-D-40K-(BQ93B)	£20.64
Zork I: The Great Underground Empire	-D-32K-(BQ94C)	£29.95
Zork II: The Wizard of Frobozz	-D-32K-(BQ95D)	£29.95
Deadline	-2D-32K-(BQ96E)	£34.95
The Battle of Shiloh (war game)	-D-40K-(BQ97F)	£29.95
The Shattered Alliance (war game)	-D-48K-(BQ98G)	£29.95

Teach Yourself Programs

Kids 1 (3 programs)	-C-16K-(BG00A)	£9.95
Kids 1 (3 programs)	-D-24K-(BG01B)	£9.95
Kids 2 (3 programs)	-C-16K-(BG02C)	£9.95
Kids 2 (3 programs)	-D-24K-(BG03D)	£9.95

Learn Programming

Sound	-C-16K-(BG04E)	£11.95
Sound	-D-24K-(BG05F)	£11.95
Tricky Tutorials (all 6 in binder)	-C-32K-(BG06G)	£59.95
Tricky Tutorials (all 6 in binder)	-D-32K-(BG07H)	£59.95

Business Programs

Text Wizard	-D-32K-(BQ99H)	£69.95

Mini Word Processor	-C-32K-(BG08J)	£9.95
Mini Word Processor	-D-32K-(BG09K)	£11.95
File-It 2	-D-48K-(BG10L)	£34.95
Bob's Business (14 programs)	-C-32K-(BG11M)	£9.95
Bob's Business (14 programs)	-D-32K-(BG12N)	£9.95

Arcade Games

Pacific Coast Highway	-C-16K-(BG13P)	£24.95
Pacific Coast Highway	-D-16K-(BG14Q)	£24.95
Shooting Arcade	-C-16K-(BG15R)	£24.95
Shooting Arcade	-D-16K-(BG16S)	£24.95
Jawbreaker	-C-16K-(BG17T)	£20.64
Threshold	-D-40K-(BG18U)	£27.54
Shooting Gallery	-D-16K-(BG19V)	£16.95
Race In Space	-D-16K-(BG20W)	£16.95
Ghost Hunter	-D-16K-(BG21X)	£22.95
Crossfire	-C-16K-(BG22Y)	£20.64
Crossfire	-D-32K-(BG23A)	£20.64
Protector	-C-32K-(BG24B)	£22.95
Protector	-D-32K-(BG25C)	£22.95
Star Trek 3.5	-D-40K-(BG26D)	£18.95
Chicken	-C-16K-(BG27E)	£22.95
Chicken	-D-16K-(BG28F)	£22.95
Dodge Racer	-C-16K-(BG29G)	£19.95
Dodge Racer	-D-24K-(BG30H)	£19.95
Matchracer	-C-16K-(BG31J)	£23.95
Matchracer	-D-16K-(BG32K)	£23.95
Pathfinder	-D-32K-(BG33L)	£27.95
Deluxe Invaders	-D-16K-(BG34M)	£29.95
Raster Blaster	-D-32K-(BG35Q)	£22.95
Bug Attack	-C-24K-(BG36P)	£23.95
Bug Attack	-D-40K-(BG37S)	£23.95
Haunted Hill	-C-16K-(BG38R)	£16.95
Haunted Hill	-D-16K-(BG39N)	£19.95
Time Bomb	-C-16K-(BG40T)	£10.95
Time Bomb	-D-24K-(BG41U)	£12.95
Space Chase	-C-16K-(BG42V)	£10.95
Space Chase	-D-24K-(BG43W)	£12.95
Canyon Climber	-C-16K-(BG44X)	£24.95
Canyon Climber	-D-16K-(BG45Y)	£24.95
Tumble Bugs	-D-24K-(BG46A)	£24.95
Ricochet	-C-16K-(BG47B)	£14.95
Ricochet	-D-32K-(BG48C)	£14.95
Lunar Lander	-D-24K-(BG49D)	£14.95
Angle Worms	-C-8K-(BG50E)	£10.95
K-Razy Kritters	-E-8K-(BG51F)	£29.95
K-Star Patrol	-E-8K-(BG52G)	£29.95

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Poker Solitaire	-D-16K-(BG53H)	£14.95
Reversi	-D-16K-(BG54J)	£19.95
Gomoku	-D-16K-(BG55K)	£19.95
Micro Painter	-D-48K-(BG56L)	£29.95

Utilities

Disk Detective	-D-16K-(BG57M)	£24.95
Disk Manager	-D-32K-(BG58N)	£22.95
Filemanager 800	-D-40K-(BG59P)	£74.95
Programming Aids Package 1	-C-16K-(BG60Q)	£9.95

Computer Languages

Inter-LISP 2.0	-D-48K-(BG61R)	£87.00
Tiny-C	-D-48K-(BG62S)	£64.95

CLASSIFIED

MUSICAL FOR SALE

KORG KR55 digital rhythm, latest model, as new, sell, £145 or swop Yamaha PS keyboard or Korg WT12 Chromatic tuner. K. Ritch, Deerness, Orkney Isles 0856 74-206.

TRANSCENDANT DPX multi voice synthesiser. Fully operational PO Wertran piano/string ensemble, little used, £290 o.n.o. Phone 021-706 9465, ask for John.

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MATINEE ORGAN, complete and fully working, £300. Rayleigh 747314.

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FOR SALE Maplin Matinee Organ Two 49 note manuals, 13 note pedal board, 30 rhythms etc. As specified in March 1981 issue of this magazine. Perfect order, £300. Telephone Hornchurch 45446.

CHOROSYNTH P.C.B. from 'Elektor' March 1980. Brand new, excellent condition. Tel. Sunderland 284117.

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ZX81 TOUCH-TYPING course. Learn at home at your own speed. I can guarantee from experience that results are excellent. Cassette based for 1K machines. Even professional typists have problems with Sinclair board system. Complete for £20. Post paid. Mr. Moover, 5, Brook Road, Southville, Bristol, BS3 1AJ.

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CASIO FX602P for sale, almost new, with program library. Offers? Mr. Stone, 8, Boulton Grove, Hull HU9 3ED or phone (0482) 781517 after 7 p.m. (not Sundays).

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ZX81+16K RAM+4K Graphic ROM+User definable graphics + PSU, including £38 worth of tape programmes. Excellent condition. Total worth £195. Selling price £99. 01-672 9883. Steve, evenings only.

ZX81 SOFTWARE — 1K Pack One: Moonlander, Dodgems, Mastermind, £1. Pack Two (1K): Hangman, Sub Hunt, Super-Bowl, Bomber Attack, £1. Both as listings + instructions. Also 16K: Nightmare Park 12K, £3.50; Nibblers 4K, £1.50; Bombber Attack 3K, £1; Zombies 5K, £2; Galactic War 10K, £3; Tank 4K; £2. On tape + instructions. G. Smith, Brynllwyd, Capelseion, Aberystwyth.

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.

ROCKWELL AIM65. 16K Static Ram. 8K Monitor/Editor, 8K Basic. 4K Assembler, Printer, PSU, Cased. £350 o.n.o. Paper tape punch plus PSU £100 o.n.o. Optical tape reader with PSU £50 o.n.o. Buyer collects Darlington (0325) 64477.

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ALTEK ALT 3 B.F.O. metal detector, £12. R. England, Marshwood, Bridport, Dorset.

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SEAVOICE RT 660 Multi-Channel dual watch marine transceiver, as new, £150. Also 12 channel marine band scanning monitor, £50. Phone Clacton-on-Sea 860903.

CLEAROUT: Wireless Worlds 74-81, £10; TEAC AN180 Dolby 'B' Unit, £25; Garrard Battery T/Deck £5; Brennel Mk 5 T/Deck (old), £5; 3 pairs Atari h/phones, new, £2 each; 3 radio spares, mic stands with booms, £20 each, 1 Ortofon VMS 20E, £15; 1 Prokit mixer (modified) with PSU, £95. Ring Dave, Erith (03224) 33190 office hours.

HI-FI FOR SALE

SONY SU92 Audio Cabinet, walnut finish, satin chrome trim, tinted door. Takes all 17" wide audio units (3), base holds plus 100 LPs, invisible castors. Immaculate. New Dec. '81. Offers around £70. Also Garrard AP76 Transcription Deck, teak plinth smoked dust cover. Fitted "Shure" mag. cart, "M95EJ", Elliptical Diamond Stylus with 60" heavy sheathed twin Goldwire phono lead and gold-plated phono/plugs each end. Immaculate. New Aug., '81 Stylus, unused. Offers around, £85. Total both £149, will split. Ring Hardaker BFD., 0274-394073 to 21.00 any day.

ADC LMF-1 carbon-fibre arm + SME adaptor; looks and sounds like the new Linn LV.X, £35. Quad valve amplifiers, £60. Praktika SLR + 28mm + 200mm + 3XT. conv etc, offers. Write: Chris, 9, Wilton Grove, Leeds LS6 4ES.

ONE CASSETTE, brand new portable recorder and mains. Send for details please, £40 o.n.o. Please send for details car stereo, auto reverse, radio car cassettes for sale, AM CB radio. Send for details, no callers, Albert, 6, Haig Avenue, Chatham, Kent, ME45UP.

SONY TAF45 stereo amplifier, 50W, 3 months old, perfect, £85. King Tempo Bb clarinet, immaculate, £90. Ring Stuart Ibbotson, Kendal (0539) 21818.

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WANTED

SERVICE MANUAL for Grundig Radio Model 2035 W/3D/GB AM/FM. L. J. Channing, 8, Brymore Close, Bridgwater, Somerset TA6 7PL.

WANTED. E421 TRANSISTOR, also information on U441 Transistor, which is not listed in "Towers" F.E.T. Handbook. Box No. 3.

CASH WAITING for fair offer of "Leak TL/25 Plus" Mono Power Amplifier and/or spare valve set (preferably new). Telephone D. Bradly on Welwyn Garden 23308 (after 4 p.m.).

If you would like to place an advertisement in this section then here's your chance to tell Maplin's 120,000 customers what you want to buy or sell, absolutely free of charge. We will publish as many advertisements as we have space for. To give everyone a fair share of the limited space, we will print 30 words free of charge. Thereafter the charge is 10p per word.

Please note that only private individuals will be permitted to advertise. Commercial or trade advertising is strictly prohibited in the Maplin Magazine.

Please print all advertisements in bold capital letters. Box numbers are available at £1.50 each. Please send your advertisement with any payment necessary to: Classifieds, Maplin Mag, P.O. Box 3, Rayleigh, Essex SS6 8LR.

For the next issue your advertisement must be in our hands by 6th October 1982.

WORKING WITH OP-AMPS (Continued from Page 13)

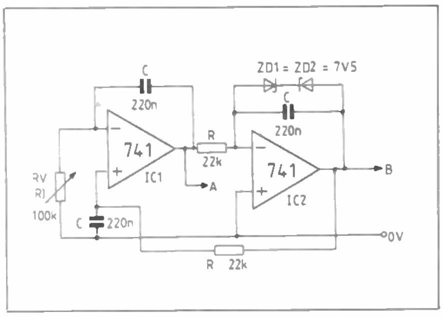

Figure 11. The quadrature oscillator.

The Sine-Square Converter

Having produced the required sinewave, the next step is to square it off. A very simple way of doing this is to use the op-amp comparator, shown in Figure 10. The inverting input is tied to 0V and the sinewave input is applied to the non-inverting input. Every time the input goes positive, even by a fraction of a milli-volt, the output goes into positive saturation, and for negative half-cycles at the input, the output goes into negative saturation. So the sinewave is very efficiently converted into a square-wave, which can then be integrated, using a standard op-amp integrator, to develop the triangular waveform.

The Quadrature Oscillator

Having dealt now with several circuits that produce different time-related waveforms, it is interesting to consider a circuit in which the waveforms are identical but differ by a fixed phase angle, whatever the frequency. The actual phase angle is 90° so that the sinewaves are in 'quadrature', hence the name of the circuit, which appears in Figure 11. Two integrators are used, IC1 and IC2, the former being a non-inverting type and the latter an inverting type. The frequency of the output waveforms is determined by the time constants obtained from three resistors and three capacitors, known as R and C respectively on the basis that they are nominally equal. In practice, one of the resistors is a potentiometer RV, which is carefully adjusted until the given outputs A and B are obtained, best viewed on a double-beam CRO. If RV is turned too far one way, the circuit stops oscillating, and if too far the other way, the waveforms become a triangle and a square-wave! However, the correct setting of RV is easily found and the sinewaves are then quite stable and of excellent waveform. An amplitude limiter is included in the form of two zener diodes connected back to back.

The formula for the frequency of operation is that $f=1/(2\pi R.C)$ and, with the values given in Figure 11, the circuit oscillated at 33Hz. It will work quite happily over a wide range of frequencies. For example, with R=47k; C=220n, the frequency is as low as 14Hz and with R=1k; C=47n, the frequency is then 3.7kHz. At the higher frequencies a smaller value of RV makes the setting less critical.

AMENDMENTS TO CATALOGUE

The following points have come to our notice since the last issue of this magazine.

Page 20
The picture of the 2m Rubber Duck (YG15R) shows a UHF plug, but the item is supplied with a BNC plug as stated in the text.

Page 47
The Lift-off Hinge (YL04E) is now cadmium-plated, not chrome-plated.

Page 84
Euroboard 4-way (WY16S) does not have a neon indicator.

Page 125
Pan Neon Amber (RX82D) now has a small square face.

Page 145
Photo-Etch PCB (BW19V) is now being supplied in a smaller size: 160 x 100mm (Eurocard size).

Page 258
For WQ18U we are now supplying AY-3-1015D. This IC is directly equivalent to AY-5-1013A except that it requires only a single 5V supply. Therefore no connection must be made to pin 2.

CORRIGENDA

ZX81 KEYBOARD KIT AMENDMENT

Additions To 'Connecting To ZX81'

Before connecting the keyboard to your ZX81, use a meter set to read d.c. volts and measure between 0V and pins 1 to 8 (SK2), and pins 1 to 5 (SK1) in turn. This test must be performed with the power supply plugged in and switched on, and without the keyboard connected to the ZX81. There should be no voltage present at these pins until a key is depressed.

VIC20 Programs Corrected

Colour Demonstration Program

```
10 PRINT ⊐
20 FOR D = 7680 TO 8185 : POKE O, 224 :
   NEXT O
30 C = INT (RND(1)x506) + 38400
40 A = INT (RNO(1)x8) : IF A<1 THEN 40
50 POKE C, A : GOTO 30
```

Joystick Demonstration Program

```
10 PRINT ⊐ : X = 7680 : Z = 0 : V = 1 : POKE
   37154, 127
20 FOR C = 38400 TO 38960 : POKE C, 6 :
   NEXT C
30 A = PEEK (37151) : POKE X, 224
40 IF A = 122 THEN X = X-22 : V = V-1 :
   IF V<1 THEN X = X+22 : V = V + 1
50 IF A = 118 THEN X = X+22 : V = V+1 :
   IF V>23 THEN X = X-22 : V = V-1
60 IF A = 110 THEN X = X-1 : Z = Z-1 :
   IF Z<0 THEN X = X+1 : Z = Z+1
70 IF PEEK (87152) = 119 THEN X = X+1 :
   Z = Z+1 :
   IF Z>21 THEN X = X-1 : Z = Z-1
80 GOTO 30
```

Other Amendments

Issue 3 Page 20 Figure 5a
R5 should be a 47k, not a 100k as shown.
R16 should be an 820R, not a 4k7 as shown.