The CAT FEEDER

by David Ponting

THE TROUBLE WITH PETS IS THAT THEY TIE YOU TO THE HOUSE AND PREVENT YOU NIPPING OFF FOR THE ODD WEEKEND SIMPLY BECAUSE THEY NEED TO BE FED REGULARLY.

We have two cats. They are wonderful company and we wouldn't be without them for the world, but my wife and I are recently retired and it would be nice to exploit our new freedom and leave them for a few days at a time without having to rely on the kindness of neighbours to pop in every day to feed them. There is always a cattery of course but cats are unsettled by unfamiliar surroundings, and as pensioners, we cannot overlook the cost: two cats for a week, £65!

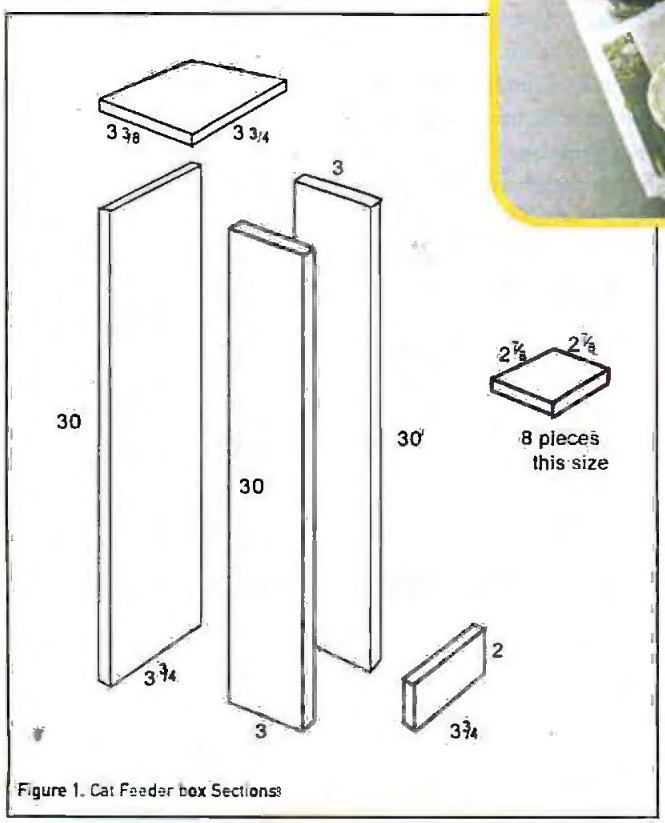


Figure 1. Cat Feeder box Sections

And so I investigated professionally made cat feeders at the local pet shop. Basically I found two kinds. The first had no more than two closeable compartments which could be set by a clockwork mechanism to open at different, predetermined times up to 36 hours into the future. It was made of light plastic and it seemed to me that a couple of hungry cats would have had it in pieces in no time flat.

The second type consisted of a dish divided into 4 quarters, each of which could be filled with food. An inverted bowl-like cover with a quarter segment cut away fitted on top of the food section, exposing a quarter of the food immediately. A clockwork motor rotated the upper lid very slowly indeed, exposing further sections as it wound down over a 36 hour period. This method gave three future feeds but its big drawback was that the rotation of the upper lid exposed the next meal infinitesimally slowly and my two cats were driven to desperation as the next segment came oh so slowly into smell and view. In fact they quickly found that they could tip the whole thing over and so get the lid section off anyway.

Consequently it became obvious that if my wife and I were going to get any holiday time away from our home we were going to need a bespoke cat feeder which would be substantial and reliable. But beyond that, it was essential that the cats could be fed over a much longer period than just a couple of days.

So what were our requirements? We started with something of a plus: our two cats had been properly brought up (from our point of view) and ate only dry food. Consequently in our cat feeder we had no need to keep future meals fresh and/or refrigerated. Further I took advice from our local vet and she was pretty clear that provided they have enough drinking water, dry food alone is a perfectly adequate diet for cats. She also said that if your cat insists that it will only eat the moist stuff, be reassured. However finicky it might appear to be, when your back is turned it will always eat (and enjoy) dry food eventually. In other words, if it is hungry enough to try it. So the design of our automatic feeder was to be built with only dry food in mind.

Secondly, as we have two cats, I arbitrarily decided that the maximum requirement was a feeder which would provide food for two cats for a period of up to a week.. As it turned out, building something to feed both animals for 8 days involved no greater complexity than feeding them for 7, so that became part of the specification.

Thirdly, as we normally feed our cats twice

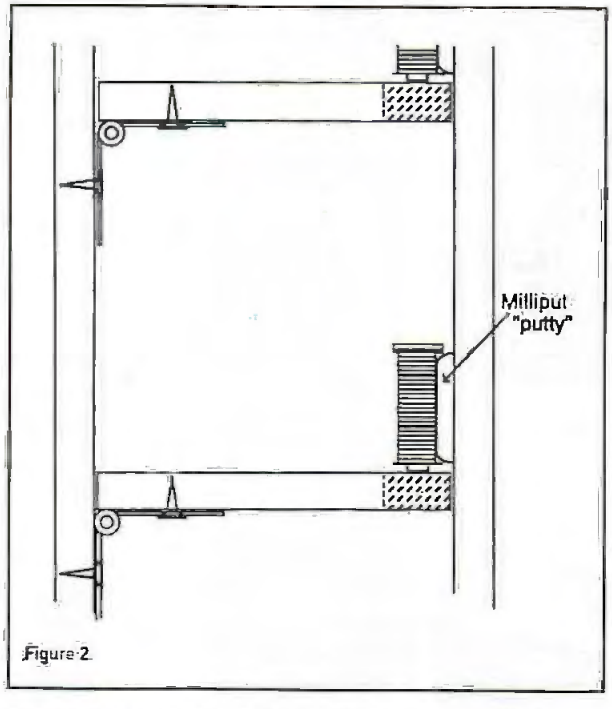


Figure 2

construction details.

I have no skill with wood. Simple electronics I can cope with but wood seems to split if I as much as look at it. So, as far as I was concerned, the general construction had to be straight forward and made from a very much more user-friendly material than wood.

Now, where some people have discovered Smirnoff, I have found 'BCE Cellular Extrusions' which seems to be a kind of highly compressed version of polystyrene. It is a most forgiving material designed apparently for use as 'Cladding, Trims, Soffits and Fascias' (whatever they are) and available from most good DIY, Hardware and Building Outlets. You can cut it, file it, drill it and tap it, and even if your woodwork is as bad as mine, this plastic medium remains infinitely understanding. In addition BCE is much more hygienic and easier to keep clean than wood or metal, in fact perfect for a food dispenser. It seems to be available in a number of different cross sections, sizes and angles but I could only find it in one thickness: 3/8th inch, which is fine for our purpose. But because of this, all the working dimensions of BCE sections used in the cat feeder are given in imperial rather than metric units.

a day I wanted the feeder to have the potential to provide either a full meal for the cats once each day or half a full meal at 12 hour intervals. The latter would be an option to use when we were only going to be away from home for short periods. But for absences of more than 4 days, the feeder should be capable of providing a double, full-size feed just once in the day, and the cats would have to put up with that. Fortunately they do not squabble over their food and so can be fed together. And as most cats do, unless they are ravenous, they snack over a period rather than wolf everything down at once.

Having decided upon the general specifications, I started to think about the

The makers of dry food for cats recommend somewhere around 75 grams a day for the average adult cat and it so happens that the150 grams necessary for 2 cats will fit nicely into a 3 inch cube. And if your cat is too fat to be average, I suggest that you feed for the typical and enforce a diet while you are away on holiday.

The general shape of the feeder is a tube, 3 inches square in internal cross section, and of sufficient length to allow eight compartments to be created inside it. Each compartment needs to be separated from neighbours by hinged doors made of the same Cellular Extrusion. In use the compartments will be filled with food and the tube attached vertically to a convenient wall. In this position each door is held closed horizontally but at the correct moment and starting with the lowest, each can be released allowing the food in its compartment to fall out through the open lower end.

The overall height of the tube then must be tall enough to accommodate the eight, 3 inch compartments as well as the thickness of eight doors. However since the hinge of the bottom door has to be screwed to something, I increased the height of my tube a further 3 inches so that when the bottom door is hanging open, its lowest edge is level with the bottom of the tube. This results in an overall height of (8 x 3 inches + 8 x 3/8 inches + 3 inches) or 30 inches.

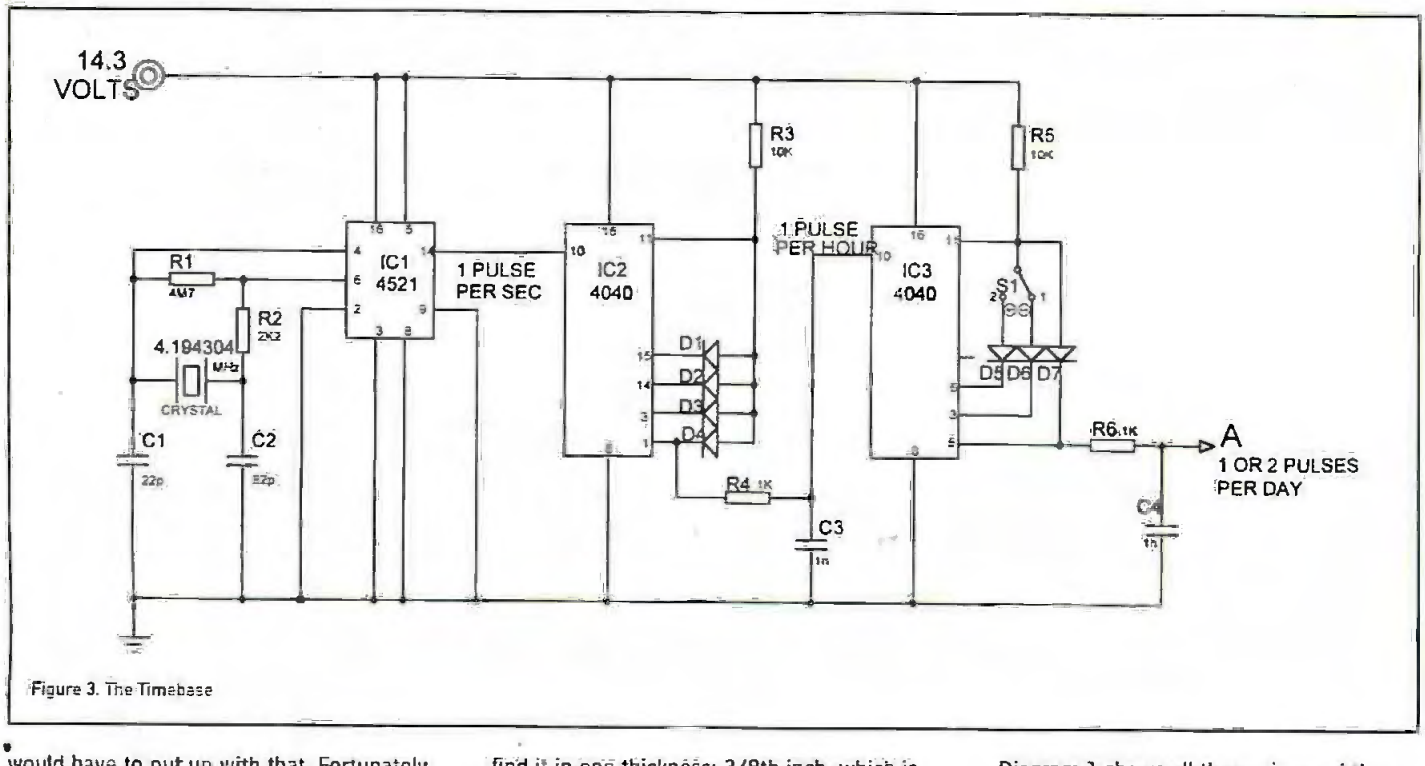


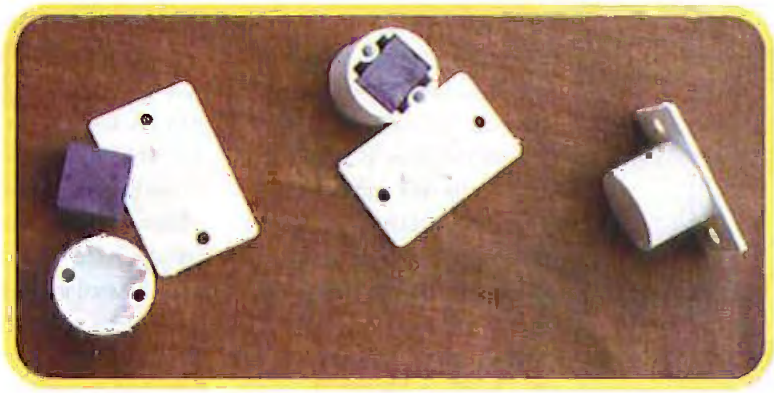
Figure 3. The Timebase

Diagram 1 shows all those pieces of the feeder box which are made from Cellular Extrusion. The back section of the tube is 3 3/4 by 30 inches and each side piece is 3 by 30 inches. The back section is screwed onto the rear edges of the two side panels, and the top is cut 3 3/4 by 3 3/8 inches to allow this piece to be screwed onto the top edges of

the back and both sides. The construction so far will be a long box with its lower end and front face open. To strengthen the base a small piece of Extrusion, 3 3/4 inches by 2 inches is secured in place across the bottom of the front face. All these pieces can be screwed together using 1 inch, No. 4 wood-screws. No countersunk holes need be cut as Extrusion is soft enough to indent as each screw is tightened. But for the moment screws should not be driven home completely as the remainder of the assembly will require that the side sections of the box be taken apart again for further work.

Finally, the eight hinged doors. These are to fit very loosely when they are held horizontal in the box. Consequently they should not be 3 x 3 inches but about 2 7/8 inches square. Then, using 3/8th wood screws, one face of each door is screwed to half a small hinge. When buying hinges check that they will turn very freely and, if necessary, open up the metal around the pins if they are too tight.

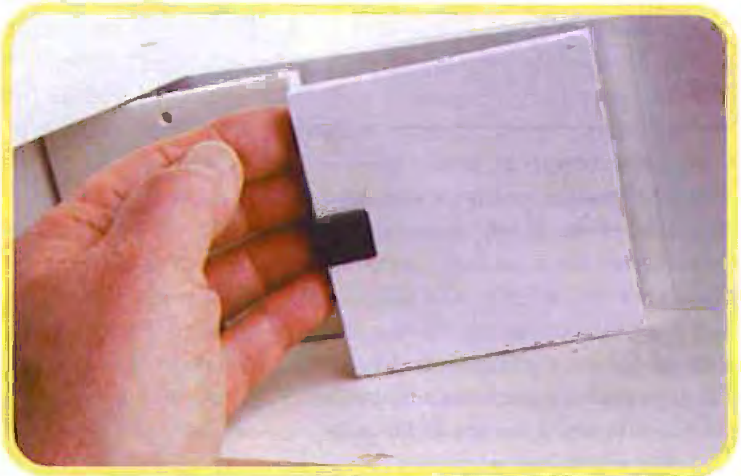
Small magnets are used to hold the doors closed. A very convenient source is the magnet which can be reclaimed from the round version of magnetic reed switches normally used as door-open sensors in a burglar alarm system. Each reed switch comes as a pair: the magnetic half is the one with no connection terminals. Conveniently the flat face peels away from the cylindrical section, revealing a small magnet only fractionally thicker than the material of the door. Cutting into the door edge a square which is slightly smaller than the magnet allows it to be secured in place just by friction. Magnets obtained from these reed switches may be square or rectangular but both types work.



The flat face of a reed switch peels away from the cylindrical section, revealing a small magnet.

However, before any magnets are fitted, get all eight together and stack them one on top of the other to ensure that each has the same magnetic pole uppermost. Then without turning them over, fit the magnets into their doors.

When all the doors have their hinges and magnets fitted, they can be screwed in place.



Check that each door is centred on the panel and rotates freely between horizontal and hanging (more or less) vertically

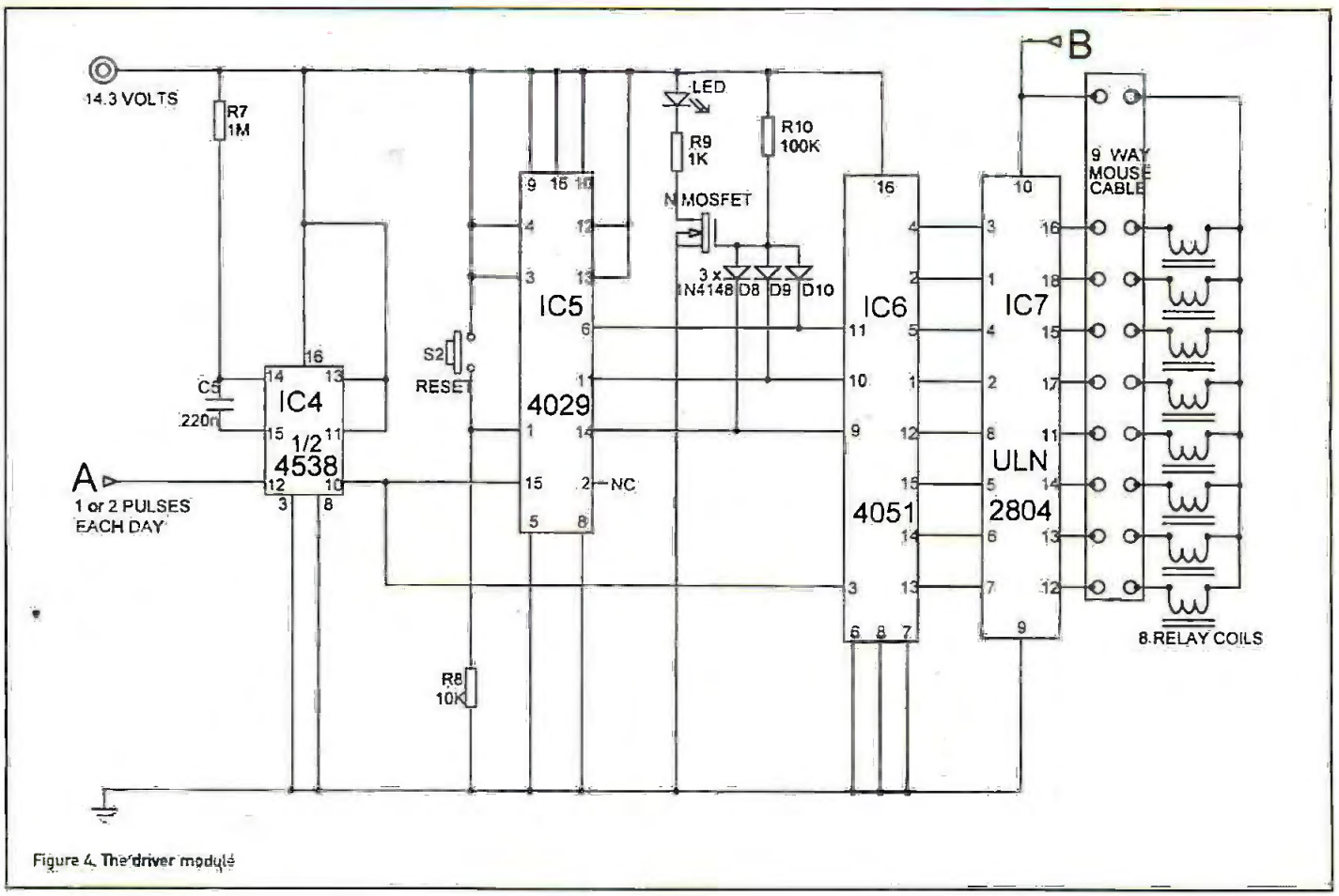
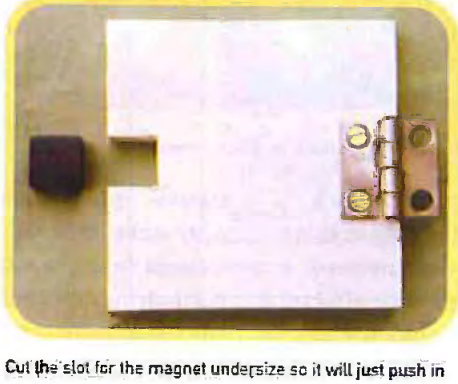


Figure 4. The driver module

Remove the left panel of the feeder box and mark its inner face with horizontal lines: the first 3 inches from the top, the second 3/8ths down from that line, then 3 inches from that line, then 3/8ths from that; and so on until 16 lines have been drawn. These represent the positions of the top and bottom faces of all 8 doors.

Now the second half of the hinges can be screwed to the inside of the left panel. The lines drawn should help to get all the doors fixed in the correct positions but it is probably worth mentioning that as the doors are to drop down by rotating in a clockwise direction as seen from the front, the hinge should be underneath its door when it is attached to the left side panel. Check that each door is centred on the panel and rotates freely between horizontal and hanging (more or less) vertically.



Cut the slot for the magnet undersize so it will just push in

Diagram 2 shows how the hinge is to be attached to its door and left side; the permanent magnets are embedded in the centre of the right edge of the door. The diagram also shows how each magnet is attracted to the core of an electro-magnet.

Further details about these and how the doors are then operated is given later.

That is most of the construction completed but before the rest is described, I want to get to the part I find much more interesting: the electronics. The project has been designed using only standard components which are easily obtained.

The complete circuit can be built on one, single-sided printed circuit board. There are no problems about making this PCB if you prefer to etch your own, but it does need to have a full-size earth plane in order that all ground points are connected.

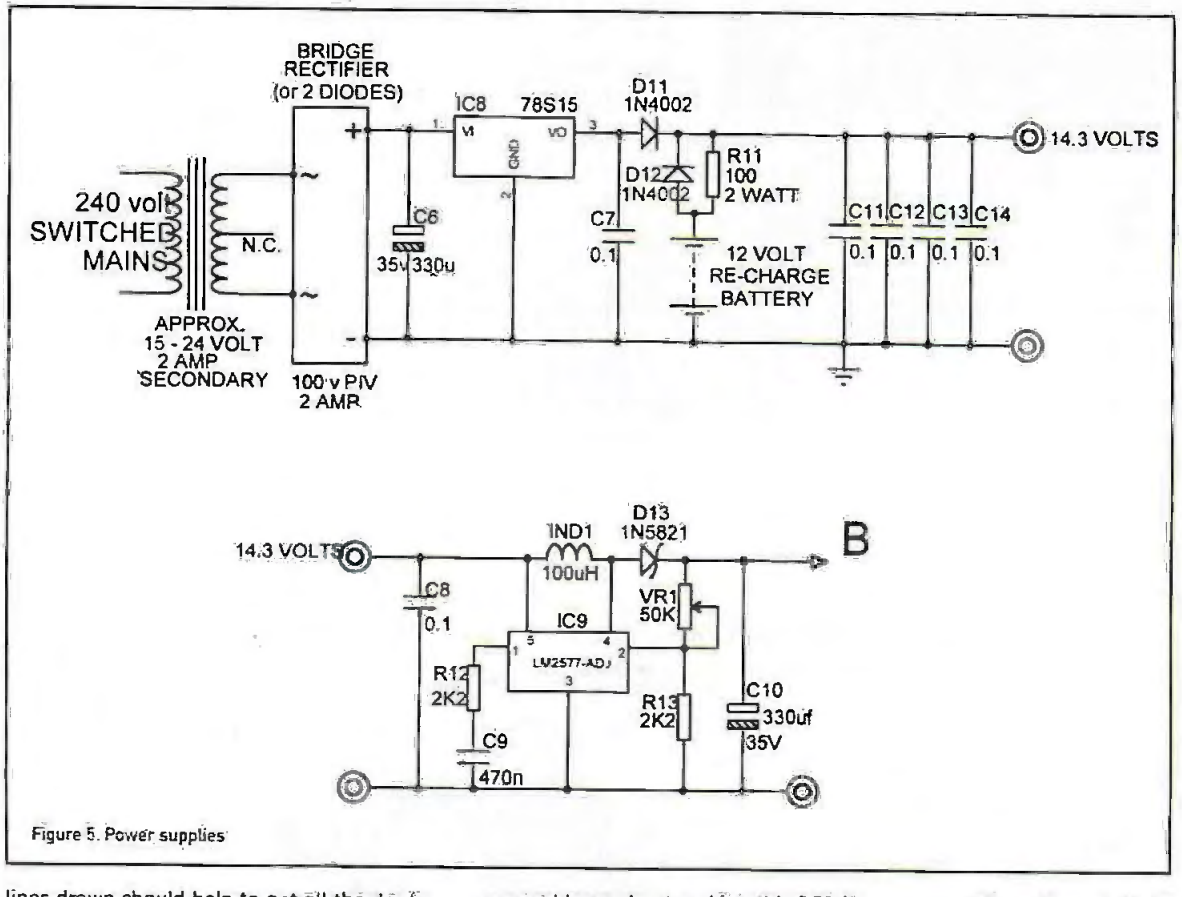


Figure 5. Power supplies

For easier description, the circuit breaks down into three modules of which the first is the Timebase.

The feeder needs to be driven by a real-time clock in order that the cats are fed regularly at more or less the same time every day. IC1 is a CMOS 4521 oscillator/divider chip. Using a standard 4.194304 MHz crystal, the circuit set up around pins 4 and 6 outputs one pulse per second from pin 14. This is input into pin 10 of a CMOS 4040 chip used here as a programmable divider. When wired as shown, IC2 divides by 3600 the input frequency of one per second, consequently outputting from pin 1 a pulse every hour. R4 together with C3 forms a low-pass filter which suppresses any spurious switching spikes. The output of one pulse per hour is input into pin 10 of IC3, also set up as a divider. With S1 in position 1 it divides by 24 and in position 2 by 12. Consequently the output at A is either 1 pulse every 24 hours or 1 pulse every 12. Again the R6/C4 combination eliminates spurious spikes.

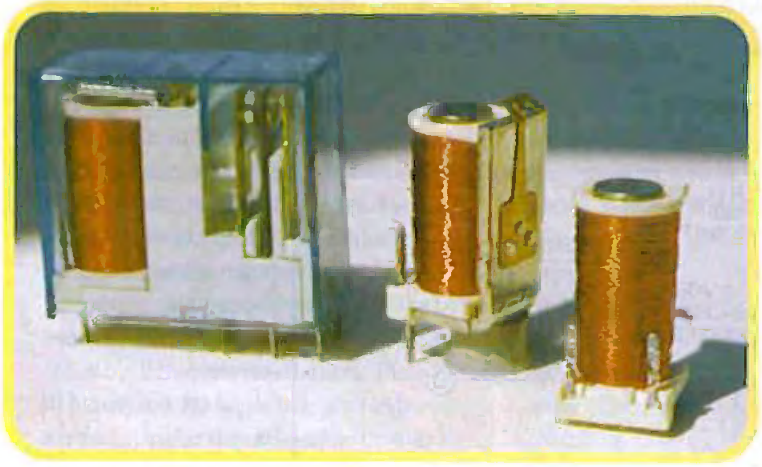
The 1 or 2 pulses per day from A on the Timebase Module connect to pin 12 of IC4, the input of one of two monostables in the CMOS 4538. On the rising edge of each input pulse, a clean, approximately quarter-second pulse is output at pin 10, the exact length being determined by R7 and C5, the timing elements for this monostable. Grounding pin 3 ensures that the second (and unused) monostable on board this chip is reliably switched off. The output pulse at pin 10 is sent both to IC5 pin 15 and to IC6 pin 3.

Dealing first with the CMOS 4029 Binary/Decade Up/Down counter. Holding its pin 9 high results in the counter counting in binary rather than decimal, and holding pin 10 high makes the IC count up. The binary total at any time is output from pins 6 (least significant digit, LSD), 11, 14 and 2 (most significant digit, MSD), incrementing from 0000 to 1111. For normal counting, pin 1 is held low by R8 but when taken high by pressing button S2, the total is reset to 1111 because all the 'jam' inputs (pins 4, 12 13 and 3) are held high. The maximum count for this IC is 1111 but in this application output pin 2 is left unconnected as we only need to use the eight numbers from 000 to 111.

Diodes D8, D9 and D10 together with R10 form a three input AND gate. Hence the N-channel MOSFET will only switch the LED on when the binary number from IC5 is 111. Consequently when Reset button S2 is pressed the LED will always light and we can be assured that the next pulse at IC5 pin 15 will increment the count to 000.

Whatever the binary output of IC5 happens

to be, this binary number is input into pins 11 (LSD), 10 and 9 (MSD) of Multiplexer/Demultiplexer IC6 which is used here as a one-pole 8-way switch. Depending on the binary number present on its pins 11, 10 and 9, common input pin 3 is directly connected to one specific output pin selected from 13, 14, 15, 12, 1, 5, 2 and 4: for example, 000 joins pins 3 and 13, 011 joins pins 3 and 12, and 111 joins pins 3 and 4.



The electro-magnet removed from the relay

All these separate outputs are connected to corresponding inputs on the high current driver IC7.

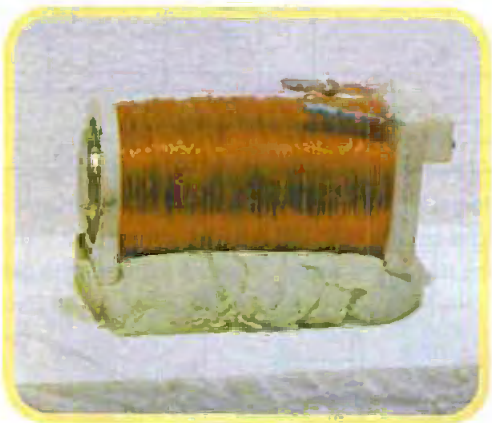
Now it is possible to see what happens to the quarter-second pulse from IC4 pin 3 into both IC5 pin 15 and IC6 pin 3. On the rising edge of this pulse the binary number being output from IC5 is incremented by 1. Immediately IC6 pin 3 is connected to a different output pin and the same quarter-second pulse is switched to a new input of IC7. This results in a high current quarter-second pulse from its corresponding output. It can be assumed that each new pulse from IC4 clocks the 4029 faster than the old output from IC7 can be operated So each new pulse triggers a high current output from the next one in line and there is no initial 'leak' from the previous output.

So now we are at the stage where we have to consider exactly how the doors of the feeder are operated.

I first looked at a number of mechanical systems using solenoids but besides the high cost of eight of them, I found that the cams and bearings which were needed to release the doors were difficult to cut and shape, not to mention the precision necessary to position and secure them if the mechanism was not to jam.

There had to be a simpler solution. Electro-magnets holding to small pieces of ferrous metal embedded in the surface of each door seemed a better idea but this appeared to have three serious drawbacks. First, to keep a door closed, current had to flow through its electro-magnet all the time until the door was released. Consequently the total current needed initially to hold all 8 doors shut was far too high for battery back-up which I intended to include in the design against the possibility of mains failure. Secondly, the easiest way to recharge the feeder with food was to disconnect it from the drive unit. Of course with no power supply the doors would not stay shut. Thirdly, I could not find suitable electro-magnets anywhere at any price!

I tackled the third problem first. Relays use electro-magnets and the ones in miniature relays I found the near perfect solution. They are small, relatively inexpensive and the relays are constructed so that the coil can easily be liberated. The electro-magnet in a 6-volt, 60 ohms relay coil, made by Finder (Part No. 4031-9006) is probably the easiest to remove from its case but a similar coil from almost any small 6-volt relay of this type will do. Better news still is that this kind of relay is frequently to be found in the lists of surplus items available from many suppliers: I bought all of mine at three for £1!



Use Milliput Putty to secure the electro-magnet

Having removed the electro-magnet from the relay, the only other preparation needed is to trim the supply pins which extend beyond the end of the coil and to cut away the flat vertical metal section that would otherwise run its full length. . This cut needs to be made with some care so that neither saw nor vice can damage the winding and the remaining tags of the coil.

Solutions to the other problems followed. It occurred to me that if a permanent magnet was embedded in the surface of the door instead of just a small piece of ferrous metal, the doors would stay shut without power because the magnet would hold onto the soft iron axis of the coil. Then, if a current pulse through the coil could produce a magnetic field strong enough to oppose that of the permanent magnet, the like poles created would repel and the door would open. And it did! However, to produce a large enough electro-magnetic field I had to use quite a high current, i.e. the 6 volt coil with a much higher voltage. In fact I found experimentally that I needed about 24 volts to produce a big enough reverse field for reliable release of the doors. Now I know that this sounds like poor practice but it really is not. Twenty-four volts applied to a 60 ohm relay coil makes it pretty warm but not hot enough to burn out even if kept connected indefinitely. In this circuit the burst of 24 volts at 2/5ths amp lasts for about a quarter of a second and produces no discernable increase in temperature.

So this solved both the other problems: no current is wasted in just keeping the doors closed, and they are held firmly shut without applied power while the feeder is being recharged with food.

The prepared relay coils should now be fixed into the feeder. Remove the right side panel from the box and mark horizontal lines across the inside face, with the first 3 inches down from the top, the second 3 3/8ths down from that, the third 3 3/8ths down from that, and so on until 8 lines have been drawn. Also draw one full-length vertical line to divide the same face in half. The 8 relay coils should be glued to this surface, each on the centre line and with the protruding end of its soft iron core level with a horizontal line. Probably the best way to glue the relay coils in the correct position is to use Milliput Putty which is prepared by kneading together equal amounts of yellow and grey putty sticks. When they are mixed so that no coloured streaks remain, use small amounts to attach the relay coils. The fact that using this kind of putty results in the coils being held well proud of the surface is in fact an advantage. Leave the putty to set hard for 24 hours and do not be disturbed if all the coils immediately spring off as soon as the board is subsequently worked on. Now that the rock hard Milliput has provided the coils with a flat surface they can all be immovably re-glued with a more elastic adhesive such as Bostik.

Drill small holes through the side panel close to where the coils are fixed so that two

power supply wires for each coil can be brought to the outside of the box. Then reattach this panel to the rest of the feeder and check that each door will be held closed by its magnet. It is also worth checking to see if a brief 24 volt pulse to each coil from a bench supply will release its door. If it fails to open, connect the supply the other way round but also note that if the magnets have been correctly fitted, every door should be released with its coil connected to the supply with the same orientation.

The transformer should be able to deliver 15 to 24 volts at 2 amps and the printed circuit board will allow the use of either a single secondary with a 2 amp bridge rectifier or two 1 amp diodes for use with a centre-tapped winding. The full-wave rectified output is smoothed by C6 and regulated by a 78S15 IC. This is the 2 amp version of the standard 7815. C7 largely eliminates high frequency ripple on the output of the voltage regulator.

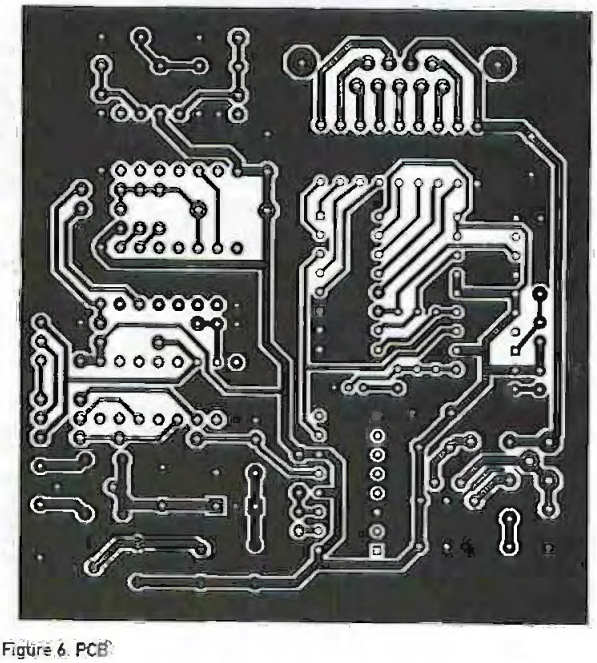


Figure 6. PCB

As I mentioned above, quite early on in my thinking it had occurred to me what a disaster it would be if the mains supply failed at a time when a compartment door of the feeder ought to have opened. That one blocked door would prevent any more food from being dispensed. If mains failure happened early in a holiday period, the cats would really suffer. Consequently, proper battery back-up had to be incorporated into the design and had to provide sufficient power to run the whole system for at least a few hours. R11 allows the trickle charging of a maintenance-free, sealed lead-acid 12 volt battery of around 1 ampere-hour capacity. A fully charged battery of this type will drive the whole feeder for many hours. So if the mains supply is interrupted when the feeder is in use, the battery will take over and diode D11 will prevent the battery from discharging the wrong way back through the voltage regulator. At the same time D12 will short R11. This arrangement means that there will be no discernable power spikes or gaps within the system either at mains failure or on recovery. Note that the circuit is only fully off when both the mains and the battery are disconnected and if the feeder is to be left unused for a period, the battery must be unplugged or it could be damaged by too deep a discharge.

Note that D11 reduces the normal working voltage of the circuit to about 14.3 volts. This is a suitable voltage for battery charging but when the battery is the sole source of power D12 will reduce its output to about 13.6 volts.

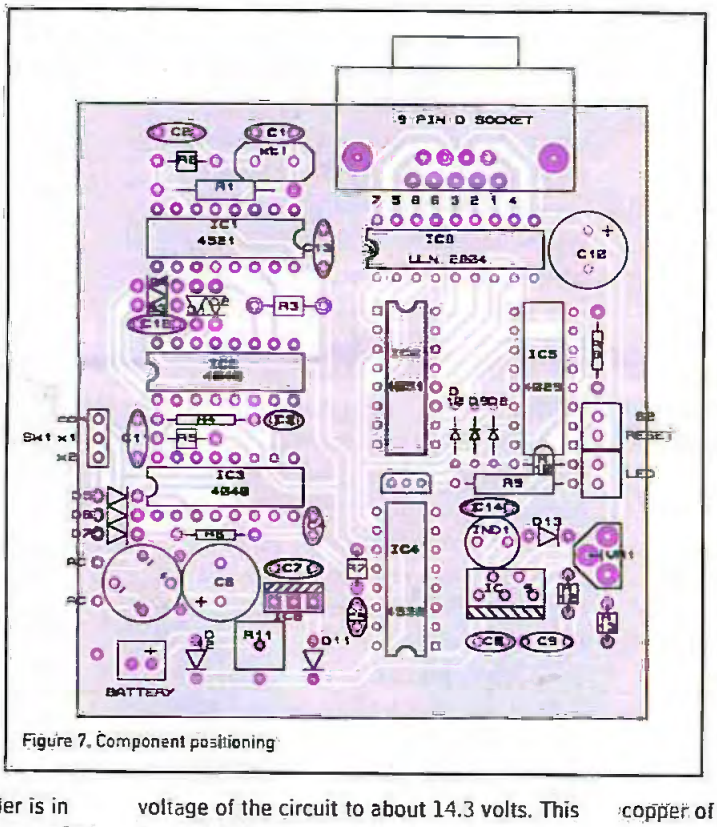


Figure 7. Component positioning

A few (so far unmentioned) capacitors, C11-14, are distributed throughout the electronics to de-couple the system where necessary and to limit the harm that power interruption glitches might otherwise cause.

The second power supply is a DC-to-DC converter, employing a 5-pin IC very similar to, and just as easy to use as the familiar LM317 variable voltage regulator. Fixed voltage versions of the LM2577 are available but the -ADJ type allows the output voltage to be set by selecting the ratio of VR1 to R13: Output Voltage = 1.23 1 + (VR1/R13) . In general, input voltage to this IC can be anywhere from 3 ? to 40 and the output voltage can be set to provide up to 60 volts. The current should be limited to a maximum of about ? amp.

As there is around a 2 volt drop across each active switch in IC7 and my relay coils need 24 volts to open the doors, this DC-to-DC converter must supply about 26 volts. VR1 allows this output to be set. A critical component is D9 which must be a Schottky diode, the same or similar to the type shown.

The DC-to-DC converter is required to supply, albeit briefly, 26 volts at 2/5ths amp. Assuming that the converter is 100 efficient (and it will be nowhere near that!) the required input current at 14.3 volts will be nearly 3/4 amp. Inefficiency, together with the power requirements for the rest of the circuit, mean that occasional 1 ? amp surges occur. This accounts for the recommendation that the transformer should be able to supply 2 amps. The above might seem to imply that both D11 and D12 should be 2 amp diodes but this is not really necessary. The data sheet for the 1N4002 shows that it will carry 30 amps for brief periods and 2 amps for rather more than 2 seconds. Such diodes have to be designed in this way as they are often required to charge large capacitors which initially present a virtual dead short!

That completes the description of how the circuit works.

Diagrams 6 shows the bottom copper of the PCB, and Diagram 7 is included to help in the correct insertion of components. It is always good practice to turn pre-set variable resistors to their centre positions before they are soldered into a PCB and this is true of VR1 in this design. When the board is completely populated and being tested, check that with VR1 at its centre of travel, the voltage on pin 10 of IC8 is about 15 volts. Increasing the resistance of VR1 should increase the voltage to a maximum of

about 30. You may find your relay coils need a different voltage to the 26 volts which will reliably release the doors of my feeder. So when testing out your system, VR1 should be carefully adjusted to set the voltage at pin 10 of IC8 to just a little more than the minimum necessary to do the job.

On the PCB the outputs from IC7 terminate in a right-angle, D-type, 9 pin socket. All the wires from the 8 relay coils should be soldered to a similar socket fixed at the top of the right hand side of the feeder box. Wire up the relay coils to the socket preferably with rainbow wire so that connection mistakes are avoided. Ensure that when the PCB and the feeder box are connected by a standard 9 way, male-to-male serial cable, IC7 pin 10 will be common to all the coils, the first coil is also connected to IC7 pin 12, the last to pin 16 and all the others are correctly paired off in between. Also cover the surface wires on the feeder with a piece of plastic channelling to prevent the cats from playing with the otherwise exposed connections.

One of the things we have not so far considered is how the front face of the box will be closed off. I made a front panel out of 5 mm perspex so that I could see the doors opening and so be reassured that they were not jamming. If you want the same assurance, you will need to cut a piece of perspex which is 3 3/4 inches wide and about 29 inches in length. This means that when it is in position and butt-joins with the small piece of Extrusion at the bottom of the front face, the perspex will overlap the top of the box by about an inch. This exact dimension is unimportant but a little overlap at the top will allow a finger grip for removing the front face when it has been finally fitted.

In order to fill the feeder with food, this cover must be easy both to remove and replace but it also needs to be immoveable (from the cat's point of view) when fitted. I used two, 28 inch lengths of 3/4 inch angle-plastic, and cut (with scissors!) one face of each to be 3/8ths wide. With the feeder box horizontal the perspex was placed in position and small screws were used to screw the prepared sections of the angle-plastic onto each side face of the feeder, leaving the front panel trapped top to bottom by the 3/8th faces. Consequently when the feeder needs filling, the perspex can be slid out vertically from its side glides but is securely held in place when the feeder is in use.

And finally the electronics and back-up battery must be fitted into a suitable box which will provide access to the switches and the LED, as well as permit the serial cable to mate with the D-type 9-way socket on the PCB.

This is a simple circuit which does not allow the exact setting of the moment when the first door will open but as a rough guide it will do so about 6 hours after the unit is first connected to the power source if the option of twice-a-day feeding has been selected, and after about 12 hours if the cats are to be fed once a day. After the first door is opened, the rest will open at the same time (or times) on the following days.

It has been over six months now since I completed my cat feeder. As I explained at the beginning, my purpose in making it was to provide my wife and me with the opportunity to go away for a long weekend or even the odd week without having to inconvenience someone else with the feeding of our cats. However we soon discovered two things during the early days when the feeder was being fully tested with food but while we were actually at home. The first was that the cats quickly became familiar with getting their meals from the feeder and not from us; and the second was that they stopped bothering us at the times when we would otherwise have fed them ourselves. In consequence of this new knowledge, we now use our feeder all the time, whether we are away or not. Every four days the LED lights and the feeder is empty. After disconnecting the 9-way cable from the feeder, it is lifted from its screws in the wall, placed on its back and the front panel slid out. Then all 8 compartments are charged with food, the front panel replaced and the feeder dropped back onto its two retaining screws. With the LED still lit we know that the next pulse from IC4 will open the door of the lowest compartment and the rest will follow in due course. However, if for some reason the feeder needs to be recharged with food before it is completely empty, the Reset button must be pressed to light the LED and ensure that the next pulse is directed to the bottom door, when the first of a new set of 8 meals will be supplied.

The feeder reliably takes care of feeding our cats for up to 8 days when we are away but I should also point out that they have the freedom of a cat-flap and therefore full access to the great outdoors from a protected space in the house. They also need and are given a very generous supply of water as well.

The full cost of materials and components for this project is about the same as boarding two cats in a cattery for a week. Consequently one week-long holiday and the feeder will have paid for itself!

Our cats have been wonderful friends to us but it is nice to get away from them and the house once in a while. The cat feeder has given us such opportunities. I hope that you will enjoy making your own feeder and then be able to experience the freedom that using it allows.

Parts List

Resistors	
R1	4M7
R2,12,13	2K2
R3,5,8	10K
R4,6,9	1K
R7	1M
R10	100K
R11	100, 2 watt
VR1	50K, vertical pre-set
Capacitors	
C1	22p
C2	82p
C3,4	1n
C5	220n
C6,10	330uf, 35 volts
C7,8,11,12,13,14	100n
C9	470n
Integrated Circuits	
IC1	4521 CMOS
IC2,3	4040 CMOS
IC4	4538 CMOS
IC5	4029 CMOS
IC6	4051 CMOS
IC7	ULN 2804
IC8	78S15 2 amp Volt Reg
IC9	LM2577-ADJ
IC Sockets	
16 pin DIL	x 6
18 pin DIL	x 1
Crystal	
X-tal	4.194304 MHz
Diodes	
D1,2,3,4,5,6,7,8,9,10	1N4148
D11,12	1N4002
D13	1N5821 Schottky
LED	5 mm. round, yellow
Bridge Rectifier	100 PIV, 2 amp (or 2 x 1N4002)
Switches	
S1	SPDT
S2	Press-to-make
Miscellaneous	
Transformer	15-24volt sec, 2 amp
Battery, sealed lead-acid	12 volt, 1.2 amp
9 way serial 'Mouse' cable	Male-Male
2 x D-range, 9-way sockets	Right Angled
8 x relays	6 volt coil
8 magnets	
Reed switches	
8 small hinges, etc.	