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GREENBASE

Public Display Computer System (*version Spec/2.0*).

designed & built by P. Mobbs, for Banbury FoE.

Introduction.

Recently there has been a large growth in the number of interactive public computer systems, ranging from those in libraries run by local councils, to an expanding number in shop windows run by such people as the English Tourist Board or the AA. These systems show the potential of how computer based systems can help in communicating to the public. It would be great if the environmental movement could take hold of information technology and use it to promote 'green' ideas, but such systems are very expensive - *but there are alternatives!.*

My idea was to produce a stand-alone system, which was very simple to build and operate, to be used as part of a display by the local FoE group. Most importantly, I had to do it on a shoestring budget. The opportunity didn't present itself for some time, but then in 1990, the local museum asked me to do an exhibit as part of an exhibition on the M40 motorway, on behalf of Friends of the Earth. The computer database was the central feature of this exhibit, and works well because rather than the public just looking at something, it actually involves them in it!!.

It had to be called something, and as it was primarily an environmental database, I called it GREENBASE (much easier to say than Banbury Friends of the Earth Environmental Database).

The following describes the workings of a basic system along the lines of the GREENBASE system, a guide to possible uses and operation, and an idea of how much such a system would cost to construct.

Which Computer?.

The basic requirement for any computer which is to be used to create such a system is as follows:

1). It must have a large memory - at least 48kb or greater. Any smaller than this the options for programming and information display are reduced. Storing large amounts of text, unless a complex compression system is used, eats up large amounts of memory.

2). Easy loading of information - either from disc or tape. Disc is preferable because of speed and the advantage of random access, but it is possible to get by using '*ramdisc*' and sequential tape loading. The real drawback, using the Spectrum+128 for example, is that loading large amounts of data takes time - for the Spectrum it's about 22 minutes to load the complete system.

3). Ease of interfacing - it must be a simple operation to interface with the computer, and preferably doing so would not involve interfearing with the existing circuitry. Interfacing would only be required if the relay driver option was to be used.

The easiest system to used would be the Spectrum+ or Spectrum+128. The circuitry can tolerate the current drain to the interface without any need for additional buffering, and the Z80 processor makes the design and operation of interfacing hardware very easy. It would be relatively easy to modify Commodores, Orics, Dragons, and the early Amstrad home systems. BBC model A/B is extremely easy to interface with, as it actually contains the connections needed. All the above use tape storage.

The easiest disc based systems to use (apart from the BBC model A/B which has disc capability) would be the Amstrad PCW, the TRS-80 (if you could find one), and the Amstrad PC1512 (though it doesn't take easily to modification). Out of these the easiest would be the Amstrad PCW, as it is a simple system design, very compact in size, and spares for it are relatively cheap and easy to obtain.

Before starting work, and finding a redundant computer, it is necessary to decide what you want the machine to do, as once alterations are made it can be difficult. Also, you have to decide whether or not you wish to interface non-destructively (ie - using existing edge connectors / expansion ports), or you are going to take the machine apart and hardwire to the circuits inside (easier to make and control).

The Spectrum+128 (version 2).

Initially when using the Spectrum (*version 1*) I used an interface which allowed output, and input from a keypad - but this was rather slow, and utilising the interrupt routine on a Spectrum doesn't always produce the required result. Therefore I devised a much simpler (and cheaper) system - version 2 - the schematic diagram is on page 4.

The heart of the system, or the base system, is the computer, the TV display, and the cassette player for data loading. The details of the key interface and the alarm system are given below. The additional parts are the 8 line relay driver, and the continuous tape player (but the tape player is separate and not involved with the computer). These are also described below.

Enclosures.

All this, with whatever else you wish to include, has to be enclosed in a secure case. GREENBASE uses 6mm plywood, glued and pinned to a framework made from $^{7}/_{8}$ths inch square battons. The final enclosure was 4 feet high, 2 feet wide and 1 foot deep. It is this size because this uses the standard size sheets of plywood sold in most D.I.Y. stores. Three 4'x2' sheets, for the front, back and one cut down the middle for the sides - and two 2'x1' for the top and bottom. 9mm sheet was used for the base as this is the main load bearing area (the case, equipment and 50kg of bricks).

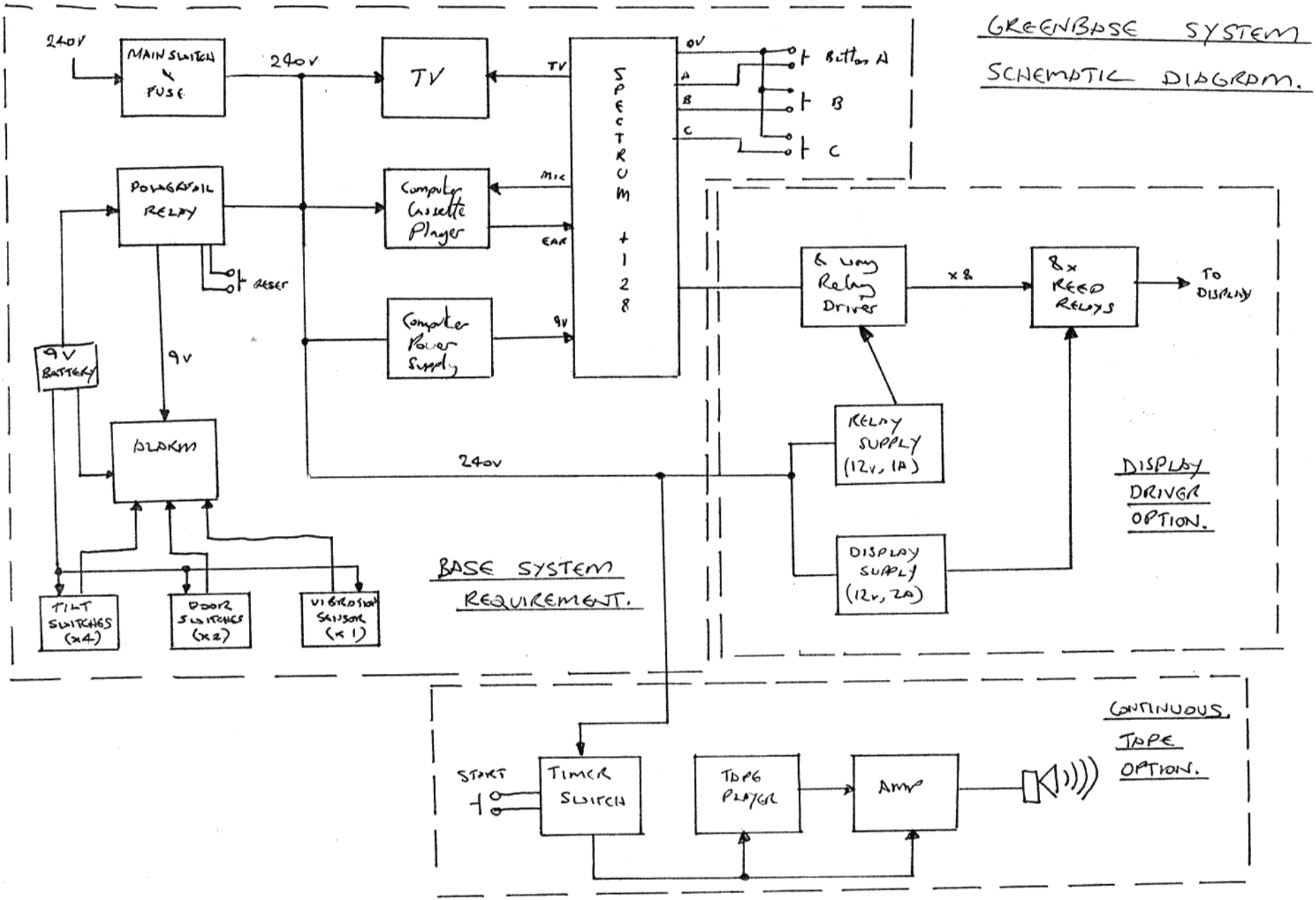
The important thing to remember when constructing the enclosure, especially when using wood, it to allow plenty of access top and bottom, and around any internal shelves, for ventilation. All the equipment produces heat, and this needs a route to convect away to ensure no part overheats. In GREENBASE there are small gaps at the top and bottom of the side door, and ventilation holes drilled in the back behind the TV (the main heat source). This keeps the running temperature down to about 30°C.

The final enclosure is quite lightweight, and very portable. To prevent it being picked up and taken away 50kg of bricks and concrete blocks were fitted into the bottom. This also makes the whole thing more stable.

A wooden panel was fitted inside the door to take all the controls, mains and alarm system wiring. Plugblocks were put on the back of the case to allow simple connection to the relays and the display power supply.

The tricky bit is cutting out the hole to view the TV. This is easily done with a jigsaw. A perspex panel can then be fixed over the hole. Perspex usually comes in large sheets,

GREENBASE SYSTEM SCHEMATIC DIAGRAM.



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and the surplus left over from cutting the TV cover can be used to make see through leaflet racks (see diagrams on page 1.

Mains wiring and power supplies.

The mains wiring and the circuits for the relay and display power supplies is shown on page 6.

Everything in the system is independently switched and fused. This ensures greater safety and easier fault tracing. For the purpose of fault tracing indicators are fitted after fuses, and the power supplies have indicators at both the input and the output.

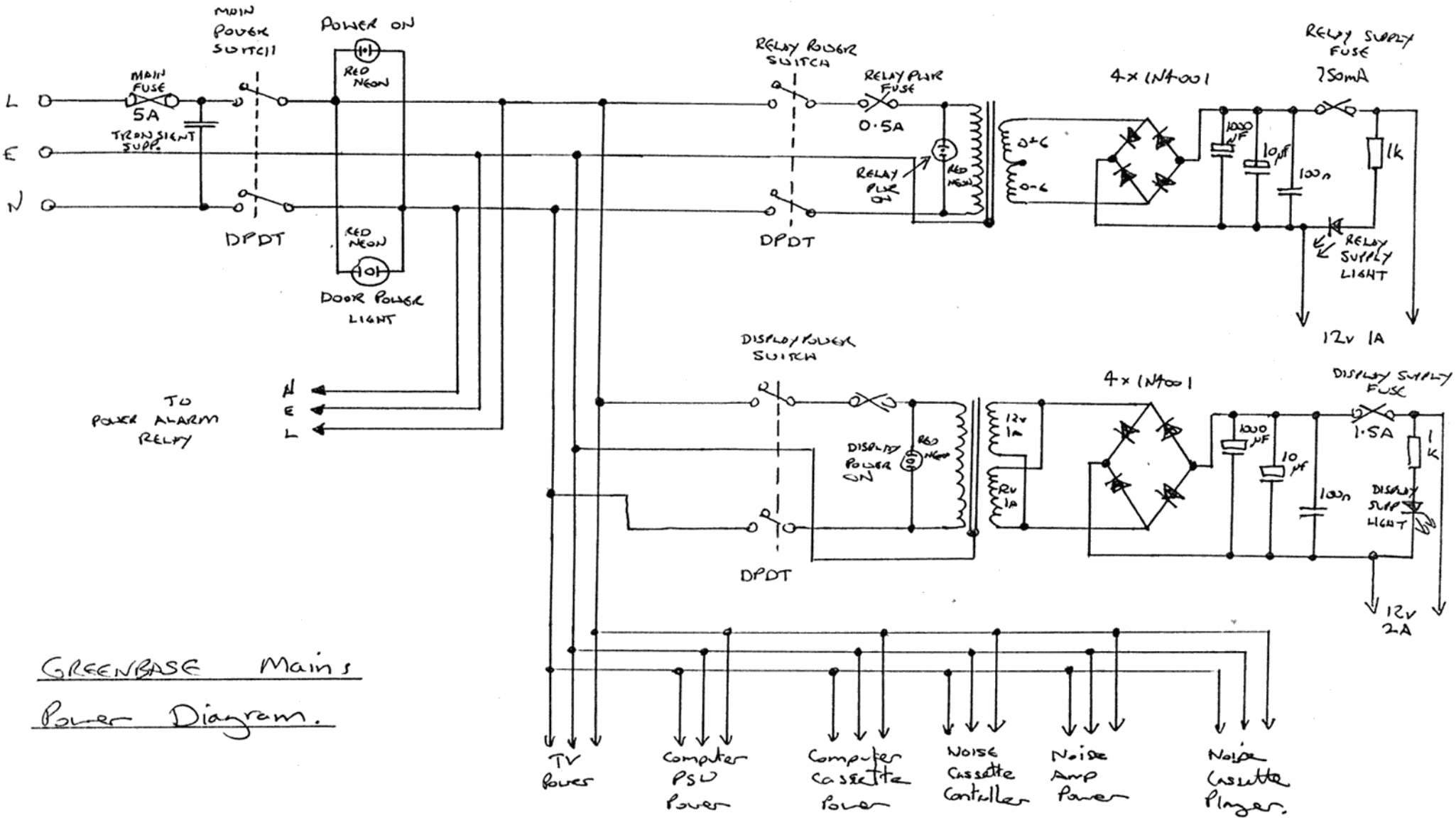
The design of the power supplies is not critical. The relay supply is 1A, 12v - the display supply is 2A, 12v. The design used is a full-wave rectifier with simple capacitive smoothing. Other designs would work as well, and because there is no need for regulation this cuts down costs. It would be possible to purchase ready made 12v supplies, but the simple design shown is much cheaper. Also, most of the parts shown are salvageable from old electrical equipment.

Keypad interfacing.

GREENBASE is controlled with three buttons. Rather than pressing the keys on the computer, it is better to have industrial standard push buttons which are guaranteed 1,000,000 operations before they go wrong. These are quite cheap at around £1.75 each. There are two ways of interfacing them.

1). Building a special interface to be used under software control. This is the option I used in version 1, which I did away with because of the hassles associated with using it.

2). Hardwiring to the existing keyboard matrix. This is what I do in version 2, as it is simpler, cheaper, and the operating system does the work for you automatically rather than having to program the machine to do so. There is no problem doing this on the Spectrum, or on other machines which use a similar keyboard hardware set-up, as the effect of the extra wiring on the impedance of the line is negligible. Dedicated keyboard chips which are found on the upmarket office systems (eg, Amstrad PCW, TRS-80 etc) might fowl up because of the extra current demand, but this can be simply got around by installing a Schmitt buffer (eg, use 74LS14) to correct the imbalance at the computer end.



GREENBASE Mains Power Diagram.

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To hardwire to the Spectrum is very easy. There are two IDC connectors Associated with one is a bank of resistors, with the other a bank of diodes. For three buttons you solder wires to the connector end of the first three diodes, and one wire to the connector end of one of the resistors. But connecting the three lines to one terminal of the three push switches, and the one line to all the other terminals of the switches, you set up an additional key matrix which the computer regards as its own. Programming then only involves using the instructions you normally used to input data from the keyboard.

Relay Driver Interface.

Refer to the diagram on page 8.

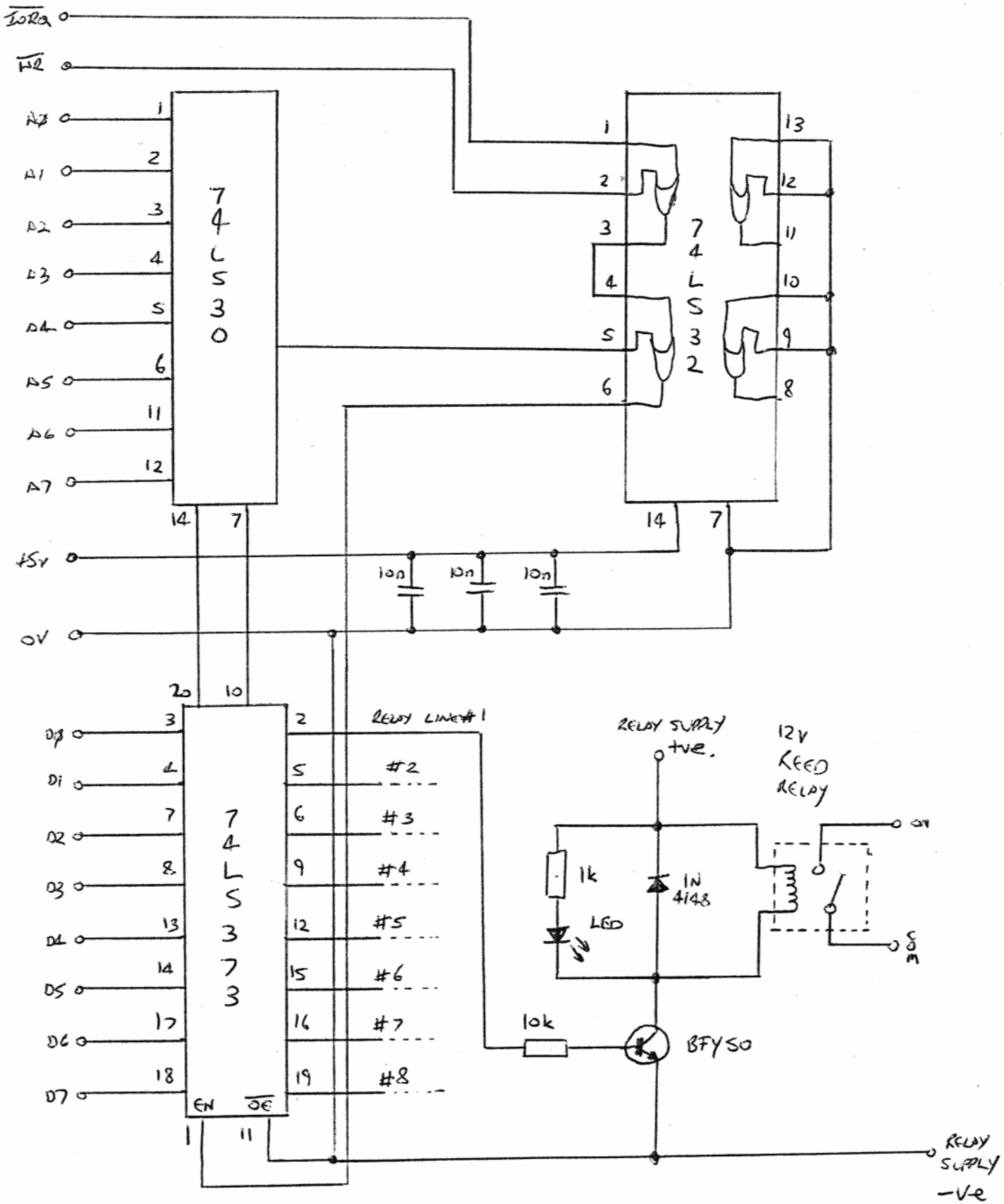
The relay driver is very simple, using only three inexpensive integrated circuits, and medium power transistors to drive the reed relays.

On the Spectrum, there is enough spare current on the busbars (dues to the simple design of the Spectrum) to support the interface without the need of additional buffering, making the whole job very simple. Other more complex machines may on occasion malfunction under certain conditions if buffering is not used. The interface is addressed at I/O port 255, which is the easiest address to decode. The decoding is done by the 74LS30 (8 input NAND gate - it checks that the address is 255) and two gates of the 74LS32 (quad 2 input OR gate - it ensures that it is an I/O write operation triggering the 74LS30).

A byte on the data bus is latched into the 74LS373 (8 bit D-type 3 state latch) when the decoding logic takes enable (pin 11) low. Output enable (pin 1) is wired to OV, so that it outputs the contents of the latch continuously. Each of the eight data bits then controls a relay via a BFY50 transistor, or any similar transistor which can sink in excess of 200mW without damage. The current interface uses BC182's which sink 300mW and just get by - but BFY50's should really be used. In addition, a LED indicator is fitted to each relay to show if it is operational or not - this assists in fault finding. Writing a logic '1' to a particular line will turn the relay on, and resetting it to logic '0' will turn it off.

At initial power up the 74LS373 might contain a random value, so the first thing the program should do is clear the latch to logic '0'. The Relay Power supply can then be applied to the relay driver without the apparatus driven by the relays going haywire.

RELAY DRIVER CIRCUIT



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Alarm system.

Refer to the diagram on page 10.

The value of the equipment means that an alarm system is essential if the unit is out in public. GREENBASE has a separate system which runs continuously. Power is only consumed when the system is activated, and thus the batteries powering it will last many months before they need replacing.

The alarm is disabled by a key switch inside the enclosure. This is double security as you need a key to turn off the alarm, as well as to open the door. However if I built another I would mount the keyswitch so that you can turn off the alarm before opening the door, because the museum assistants hate trying to get the key in with the alarm screaming at them.

The alarm is triggered in one of four ways:

1). **Power Alarm** - this is a 240V relay, wired in such a way that if the power goes of briefly, or is disconnected, it turns itself off, and thus turns the alarm on, until it is reset. When switching on the computer it is activated by pressing a button. When the system is turned off, but it is necessary for the alarm to operate, there is a switch to isolate the relay from the alarm system.

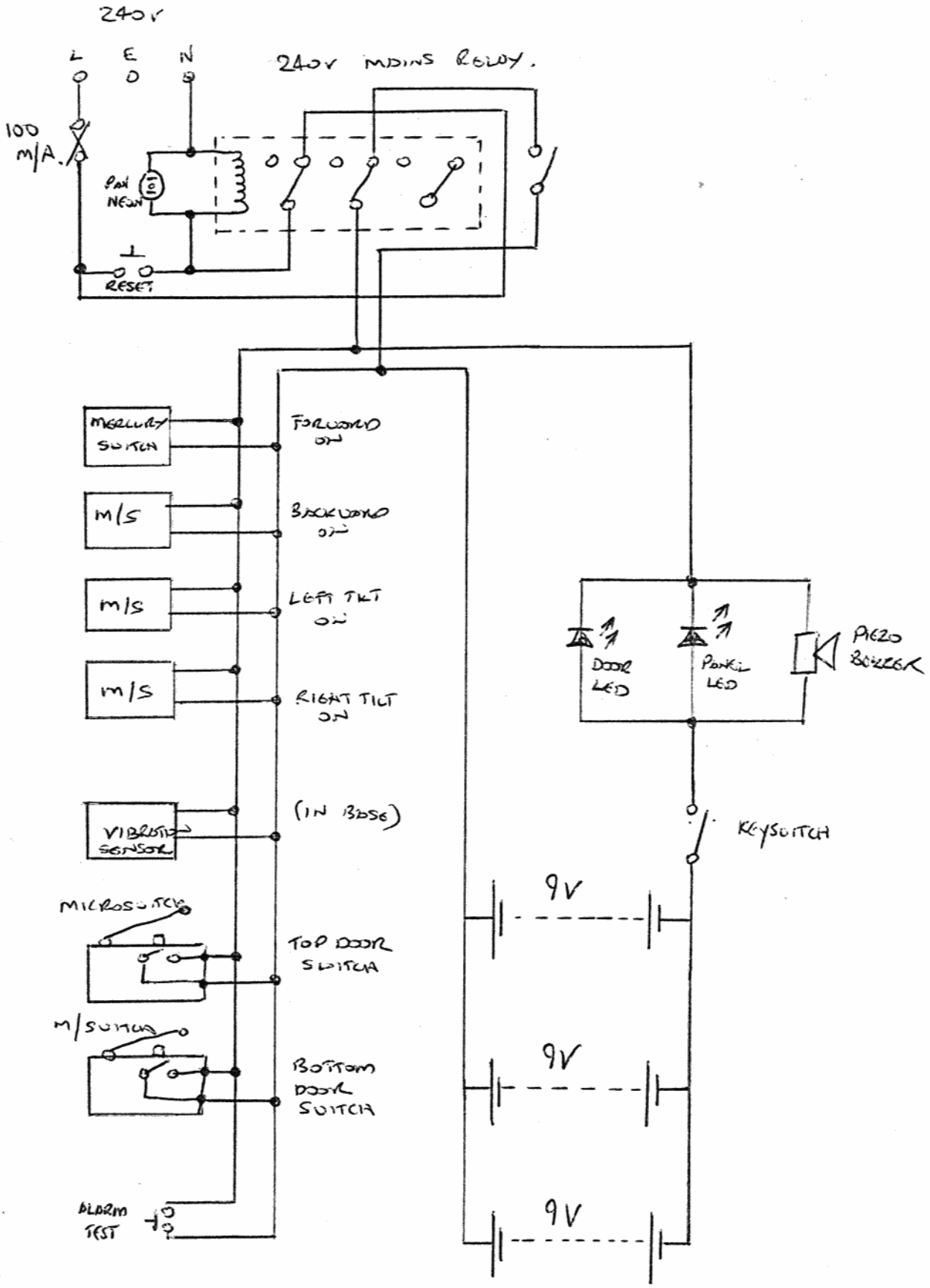
The power alarm has two advantages. Firstly if the power goes off briefly the computer will loose its memory - the alarm would then go off to indicate this. Secondly, if someone deliberately unplugs the unit, it will alert the operators.

2). **Tilt Switches** - this ensures that the unit cannot be tipped over or moved without the alarm going off. Four mercury switches (for each axis = forward, backward, left and right) switch on if the enclosure is tipped more than 15° from virtical in any direction.

3). **Door Switches** - two lever and ball SPDT microswitches are mounted at the top and bottom of the door. When the door opens the levers are released and switch on the alarm. The used of two guards against anyone trying to force the top or bottom of the door, as they act independently of one another.

4). **Vibration Sensor** - this is a miniature device mounted in the base of the unit. The only way to move the unit without triggering the alarm is vertically, but its weight makes this difficult. This device triggers the alarm if banged or bashed at the base - eg, by picking up the unit and dropping it.

ALARM SYSTEM



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The alarm is a high power piezo pulse tone sounder, which produces a lot of noise for very little power. At £1.50 they are also cheaper then many other sounders. In addition there are two flashing 10mm LED's, one on the alarm control panel and one on the outside of the door. The three 9v batteries wired in parallel should be able to power this set up for many hours before failing.

Continuous Tape Player.

This was a later addition to the system, and simply plugs into the mains socket inside. It is made of two 240 volt timing relays, salvaged from a control panel scrapped off from a local company. These cost about £30 each new, but a similar system could be made for £15 at the most.

In a similar manner to the power fail alarm relay, they are wired so that the first relay operates the second, and the second disconnects both. The 'on-time' of the second relay is adjustable from ten seconds to three minutes. The first is always set at half a second.

When a button on the display, IS PRESSED it turns on the first relay. After half a second, this turns on the second relay. The second relay operates a standard cassette player and an amplifier.

The cassette player contains a continuous message tape, such as that used in a telephone answering machine, and is constantly switched to play. When power is applied it plays the cassette, with the output from the ear socket amplified and played through a loudspeaker on the display, until such a time as the timing on the second relay is completed, and it turns off the power. It can then be restarted again by pressing the button on the display.

For the museum display, the tape contained a recording of motorway noise, amplified to about 8 watts, and it runs for 1 minute (from a 30 second message tape).

Programming and Operation.

The computer is programmed in BASIC - the most common language used. I have already developed a range of software to run on the Spectrum to allow the easy production and editing of information pages to use with the database system software.

Using the SAVE LINE command on the Spectrum, it is possible for the system to run without any operator intervention. After turning on the power, the operator need only press

one button on the computer, and then press play on the tape recorder. The program does the rest.

The program itself also incorporate features making it easy to use. If for example someone leaves the unit and doesn't press a button for 2½ minutes, the program automatically goes into 'demo' mode. It leaves whatever it was doing and displays a predetermined set of information pages. Someone coming to the system only has to press a button to get back to the start again. From the three 'public' buttons it is impossible to interfere or stop the program, so it should function perfectly OK until it is turned off. At the time of writing the system has been running for seven weeks without a single error!!.

The database program I have written comprises the following:

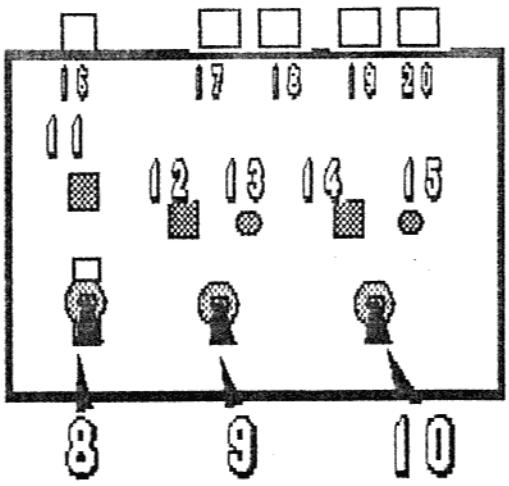
Up to sixty pages of information. Each page consists of twenty lines, each 32 characters long. The pages are organised into thirteen sets, each set having up to ten pages assigned to it. The pages, title of the set, and the list of pages within a set are easily edited using a second program. The fourteenth set, which has no name, is the demo set, and contains the list of up to ten pages the computer runs through in demo mode. The fifteenth set, which has a name, is the exhibition set. The first of the ten pages comes up as normal, but pages 2 - 9 operate the relay driver interface. Page 10 then comes up as normal.

A multiple choice quiz, containing 100 questions, each question 64 characters long, three multiple choice answers for each question, each answer being 32 characters long, and a 64 character explanation for each question if the user gets the answer wrong. The question, answers, and explanation, can be easily edited from the program mentioned above.

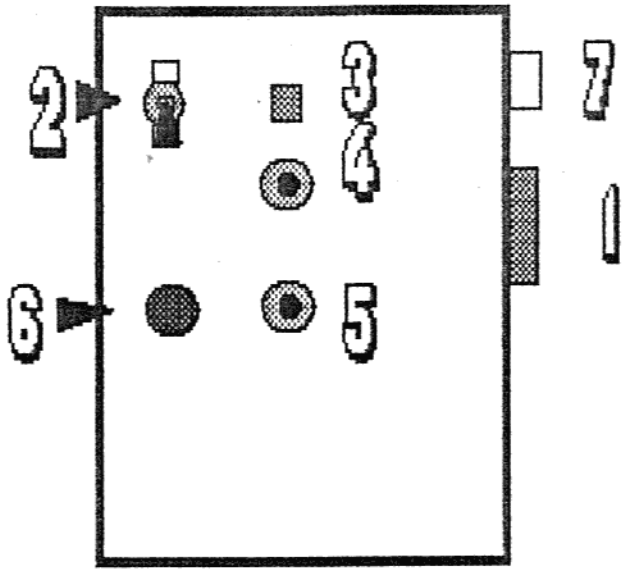
A simple program editor, not as complex as the separate program mentioned above, but it allows instant editing of any information on the system, and then records a new copy of the program and information on the cassette recorder.

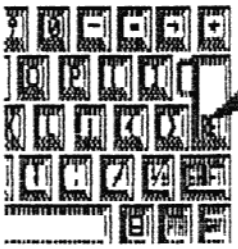
Theoretically it is possible to make the computer run any program you wish, the only limitation is that the public only have three buttons to press, and the characters these buttons activate are fixed permanently and cannot be changed (however, if you were to program in machine code, you could get around this problem). The options for uses are therefore fairly limitless.

To give an idea of how the whole thing functions, the operating instructions are reproduced below:



POWER CONTROL





COMPUTER KEYBOARD.

ALARM CONTROL.

KEY.

1). Alarm Mainswitch.
2). Power Alarm Switch.
3). Power Alarm On Light.
4). Power Alarm Reset.
5). Alarm Test.
6). Alarm On Beacon.
7). Power Alarm Fuse. (0.1A)
8). Main Power Switch.
9). Relay Power Switch.
10). Display Power Switch.
11). Power On Light.
12). Relay Power Light.
13). Relay Supply Light.
14). Display Power Light.
15). Display Supply Light.
16). Main Fuse. (5A)
17). Relay Power Fuse. (.5A)
18). Relay Supp. Fuse (.75A)
19). Disp. Power Fuse. (1A)
20). Disp. Supp. Fuse. (1.5A)
21). Computer 'ENTER' Key.

STARTING UP GREENBASE...

After opening door, the alarm should be sounding. If it is not read CHECK ALARM. To begin, all the switches should be in the down position, and all the lights except the alarm beacon should be off. With the key, turn off the ALARM MAINSWITCH. The alarm should now be off.

Now push the MAIN POWER switch up into the on position. The MAIN POWER LIGHT should come on, and the TV and computer will come on.

Make sure the tape in the cassette player is at the beginning. Press the ENTER key on the computer keyboard and then start the tape playing. The program takes just over 20 minutes to load. If after this time the program does not start, read COMPUTER FAULTS.

When the program is running push the RELAY POWER and DISPLAY POWER switches up into the on position. Then push the POWER ALARM SWITCH up, and then press the RESET button firmly. If the POWER ALARM LIGHT fails to come on, read MAJOR FAULTS.

All the lights, except the ALARM BEACON should now be on. Switch the ALARM MAINSWITCH into the on position, and the alarm should sound. Now close the door, and the alarm should stop. If it doesn't stop with the door properly closed, read MAJOR FAULTS.

TURNING OFF GREENBASE...

After opening the door, switch every switch on the control panel off by pushing it down. ***Do not turn off the alarm mainswitch!!.*** Close the door and the alarm should go off.

RESTARTING GREENBASE...

Should the program hang up and fail to function, or the power goes off and the program is lost, turn everything off and start again from STARTING GREENBASE.

ALARM SYSTEM....

It is important that the alarm system is operational at all times. The alarm system is battery powered, and consists of for tilt switches, one vibration sensor, two door switches, and a power failiure warning system for when the computer is operating. If the door is closed properly, the box is standing upright, the computer has mains power whilst switched on, and the case is not being banged or subjected to extreme vibration, then the alarm should be off. If it will not go off then (and only then) turn off the alarm with the key and goto MAJOR FAULTS.

CHECKING ALARM....
Should the alarm fail to operate when you open the door, check the alarm mainswitch is on. If it is and the alarm is not on then goto MAJOR FAULTS.

COMPUTER FAULTS....
If whilst the program is loading "TAPE LOADING ERROR" comes up on the TV screen, fast forward the tape to the end and turn over the tape, turn everything off and start again. If it still won't load, try the backup tape. If that won't load, goto MAJOR FAULTS.

SHOULD THE FOLLOWING OCCUR :
1). The computer program not load.
2). The alarm system not work.
3). A light on the control board fails to come on when it should.
4). The alarm system fails to turn off when it should.
5). Any of the buttons fail to work.
6). Any part of the display fails to work when it should.
7). Any part of the system fail to work, or it over heats or smells hot.

THIS IS A MAJOR FAULT AND YOU SHOULD TAKE THE FOLLOWING ACTION...

1). Turn the system off, including the alarm if is a fault with the alarm, lock the door and disconnect from the mains.

2). Phone Paul Mobbs on Banbury 261864 for assistance. DO NOT ATTEMPT TO FIX IT YOURSELF.

Costing out.

Below is a rough account of the cost of building a similar system (with the relay driver but no continuous tape system), with new parts or second hand and salvaged parts. The cost of the second hand option is not complete, and only indicates what you can expect to pay for some items.

Item.	New.	S/H - salvage.
Enclosure (wood, glue, hinges locks etc).	£40.00	£15 min.
Spectrum+128	£140.00	£40+.
TV (black/white port.).	£80.00	£35+
Cassette player.	£20.00	£5+
Keypad.	£5.50	< £2.00
Interface IC's.	£1.50	hard to find.
Reed relays.	£12.00	hard to find.
Transistors etc.	£4.50	< £2.00
Switches.	£7.50	< £3.00
Keyswitch.	£6.00	hard to find.
Piezo buzz.	£1.50	hard to find.
Flash LED's x2	£2.00	hard to find.
Alarm sensors.	£14.00	hard to find.
12v 1A transformer.	£5.50	< £3.00
12v 2A transformer.	£10.00	< £5.00
Rectifiers & cap's.	£15.00	< £7.50
Neon indicators & LED's.	£3.50	< £1.00
Power alarm relay.	£2.50	hard to find.
Odds & Sods (wire, plugblocks, sockets solder etc).	£25.00	< £15.00
Total.	£400.00	£175.00

The second hand figure includes the cost (new) of hard to find parts. In practice it is easy to get these figures down if you get people to donate parts of the equipment from redundant things around there house - this is really just the TV, computer and cassette player. This would bring down the price to (new) £160 and (SH/salvage) £95. In practice the salvage/SH figure will rise if you have to buy in - knowing a local electrical repair man/ radio amateur etc, will be the easiest way to get spares. You will of course need someone to put it all together. I am prepared to put together a box containing all the electrics, and to modify the computer - costs to be agreed in each individual case. I wouldn't want to build the enclosure, etc as this is time consuming.

Summary.

Information technology is a powerful tool, and '*Green*' organisations should be embracing this technology in order to get our message across more effectively.

This has been demonstrated in Banbury, not noted for its up-to-date thinking or wealth, where the GREENBASE computer has taken (on average) £1.20 a week in donations (which has paid for about 250 A4 information sheets to go in the leaflet racks) and has gained Banbury FoE much needed publicity and some new members. But the main thing is that over half the people coming into the museum have used the system and the information on it - we're communicating with them 7 hours a day, six days a week.

Anyone with moderate experience in mains wiring and carpentry can put this thing together. Please note that these are not plans - this is a very vague description - plans can be supplied. For a small charge, I can do the modification work to the computer chosen, and programming. Advice on the phone (if you call me) is free though!. Any group could have one of these, taking version 2 as an example, for between say £150 and £450.

If you wish to see it, GREENBASE continues at Banbury Museum until June 29th. After that it will be totally reprogrammed, and will do an exhibition in the main library on various environmental issues - linking these to books in the library and local organisations taking action on these issues. This should run from mid-July to September.

If you would like more information on the subject, or have any queries, or would like advice on building such a unit, please get in touch.

In peace.

Paul Mobbs,
Banbury Friends
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3 Grosvenor Rd,
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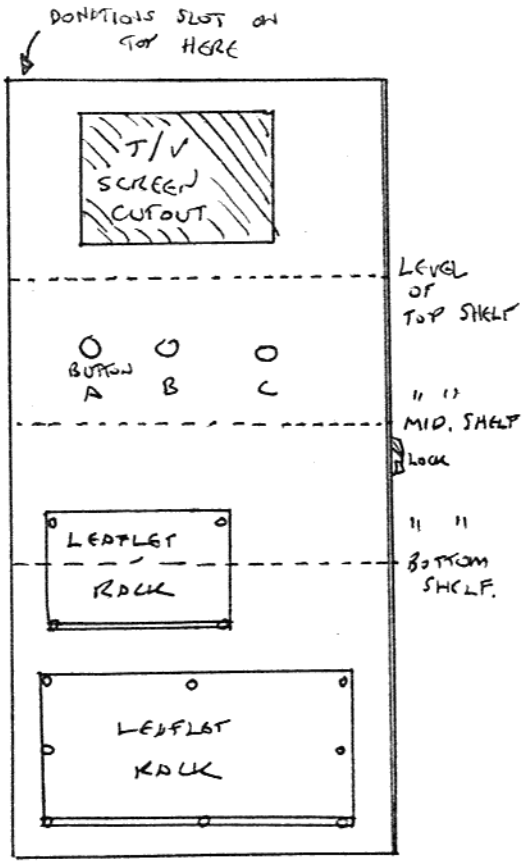
0295 261864.

NB. The R&D cost to me personally (I haven't charged the group (they haven't got it!) has been around £195. A donation for this information would be appreciated!.

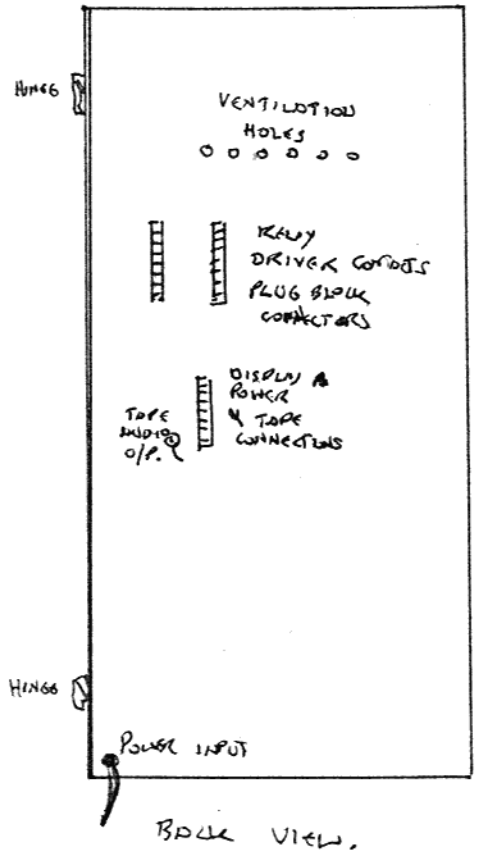
##########

BANBURY FOE GREENBASE SYSTEM.

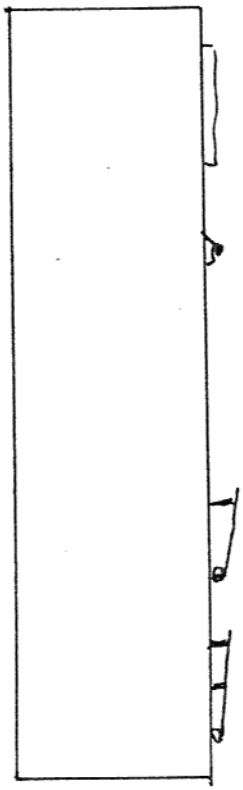
SCALE
12" (30 cm)



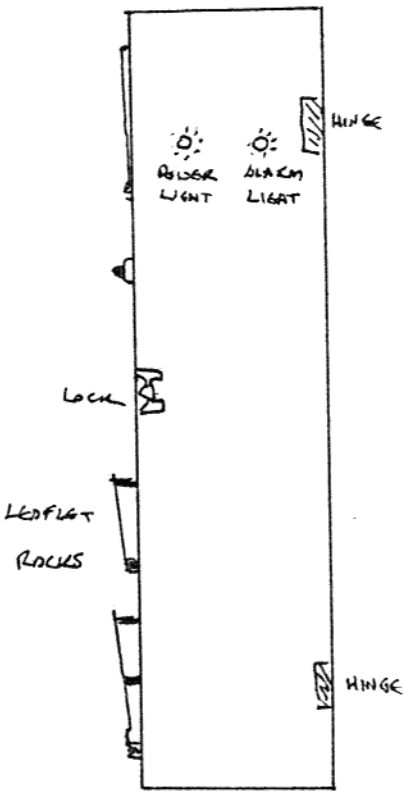
FRONT VIEW.



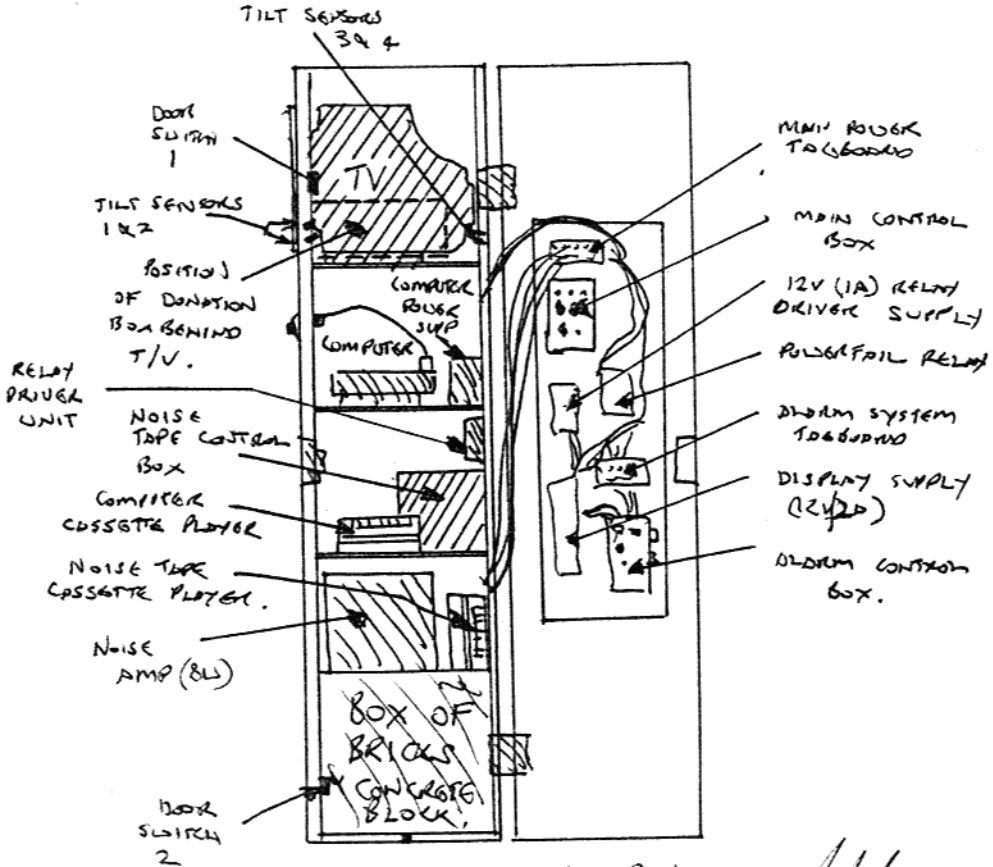
BACK VIEW.



LEFT SIDE VIEW



RIGHT SIDE VIEW



RIGHT SIDE, DOOR OPEN.

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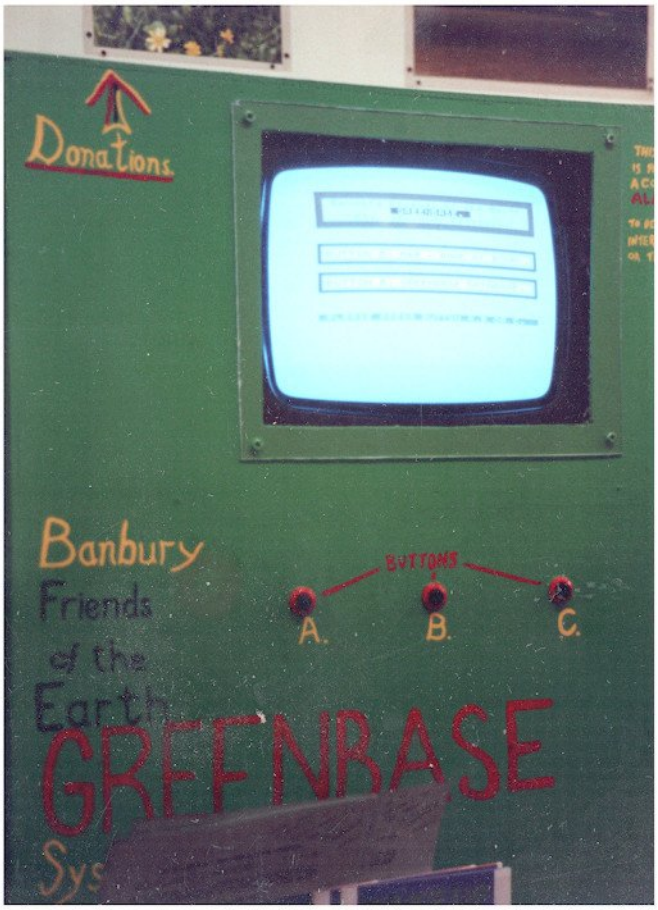
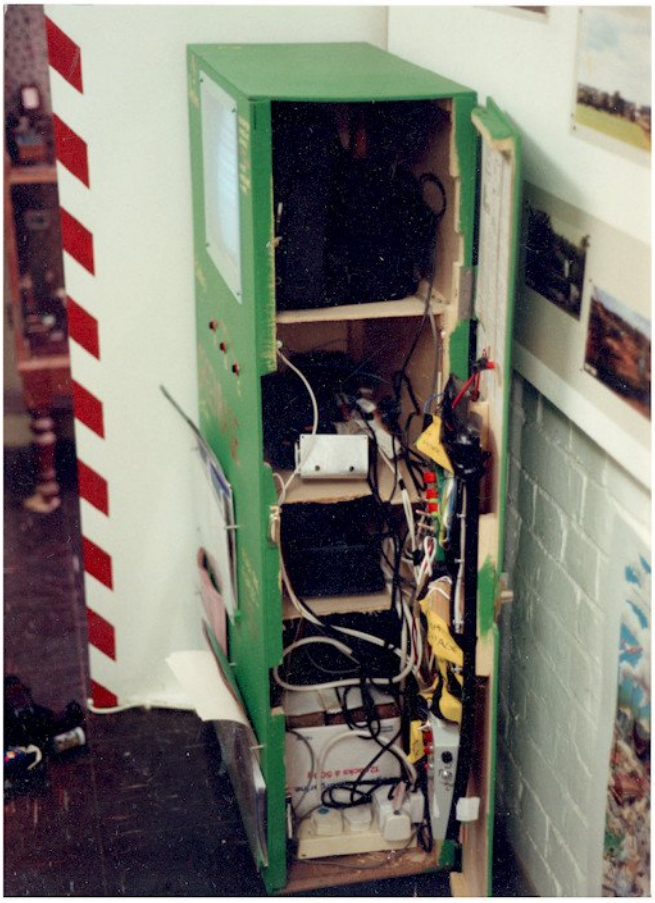
BANBURY
FRIENDS
OF THE
EARTH


Donations
Banbury
Friends
of the
Earth
BUTTONS
A.
B.
C.
GREENBASE




ALARM
CONTROL