Appendix: ZX81 Hardware Modifications

These are all very simple modifications. They require no more electronic expertise than the ability to solder neatly. None of the programs in the other chapters require any of these modifications in order to make them run smoothly, but each suggestion more than pays for the small amount of trouble involved.

POWER SUPPLY

The Sinclair power supply gives an output of 9 volts DC via a 3.5 mm jack plug, with the tip of the plug positive. It is very convenient because all the works are contained within its very large, plug type body. The only lead is the 9 volt supply to the ZX81. If you bought a ZX81 kit without a power supply and wish to build one, then this one has definite advantages. If you have a power supply and plan to use your computer for long periods, you might still consider the four or five pounds that the components will cost, worth spending for the following reason.

The ZX81 voltage regulator is provided with a small heat sink which gets very hot. It is reasonable to assume that a machine which works at a high temperature and does a particular job, will not be as reliable as one which does the same job at a much lower temperature. The ZX81 will work as long as it is fed with DC current at a voltage between seven and eleven volts. The higher the feed voltage, the harder the voltage regulator has to work to drop it down to the five volts needed by the chips. The more work it has to do the hotter it gets and, as likely as not, the shorter will be the mean time between failures of the ZX81, baking quietly in all this waste heat. If the power pack were designed to deliver the minimum of seven volts, then all would be well until the first power crisis, when the mains voltage is dropped by twenty or so

volts. This would drop the output of the power pack below the seven volts required and switch off the machine. A good compromise is to design a power pack to run at eight volts. This has a significant cooling effect.

Some users have reported a mains pack failure after running the computer for long periods of time. The fuse inside the power pack fails and is difficult to replace because it is soldered in place. Another problem which has been mentioned is that the power supply issued with the machine sometimes causes a slow ripple to pass through the picture. The more meaty, lower voltage power supply eliminates the ripple effect from those machines which suffer from it, and at the same time is less likely to blow fuses.

You will need:

1) line supply-to-8V transformer rated at 2A
1) rectifier bridge circuit rated at 2 amps, 50 p.i.v.
1) 2000 µF electrolytic capacitor with a working voltage of at least 16 volts
1) 1 amp fuse and fuse holder.

If you are not too sure about building electrical equipment, then you should get an electrician to check over the power pack before you plug it in. You will be dealing with mains voltage and this can be very dangerous. The main things to check are that the transformer is connected the right way round, and that the tip of the plug to the ZX81 is positive. If the thick wires of the transformer are connected across the mains, then the ZX81 will blow up before the fuse has a chance to blow! Make sure that the thin wires of the primary coil are connected to the mains. Most transformers will have the primary and secondary connections marked.

The two amp rating on all the components takes into account the possibility of further peripherals being developed for the ZX81. These are appearing on the market at the time of writing and, by the time you read this, reviews should have appeared in the computing magazines. Many of these devices offer possibilities for the users who are interested in making the ZX81 work for its living and so it is wise to make provision for the power demands they will make. To comply with the relevant safety regulations, the unit must be mounted in a stout plastic (*not* metal) box, and all mains-carrying terminals must be insulated as well. The unit should be connected to the mains via a fused plug, fitted with a 1 amp or a 3 amp fuse.

When you have finished the power pack and wish to check the voltage and polarity of the plug, don't be alarmed at the high voltage reading on your multi-meter. The voltage will drop to its normal level when the power pack is loaded.

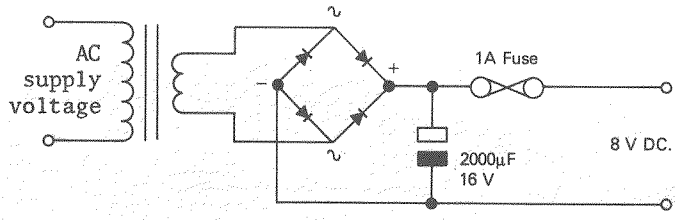
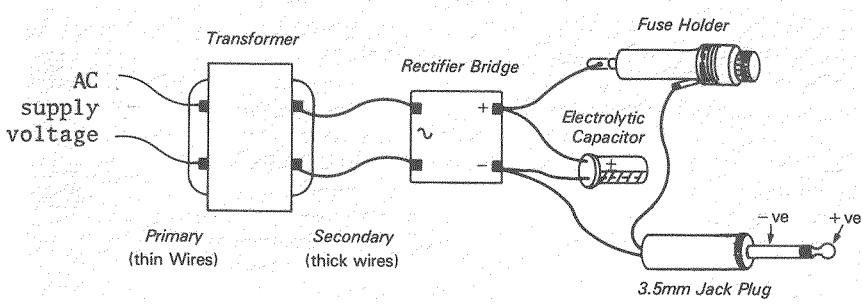

AC
supply
voltage
1A Fuse
8 V DC.
2000µF
16 V

Figure A.1


Transformer
Rectifier Bridge
Fuse Holder
AC
supply
voltage
Electrolytic
Capacitor
Primary
(thin Wires)
Secondary
(thick wires)
– ve
+ ve
3.5mm Jack Plug

EXTRA MEMORY

At first, when the ZX81 was introduced, it was thought that the 3K RAM pack that many ZX80 users possessed would not work on the ZX81. A very minor modification to the printed circuit will make the extension work on both the ZX80 and ZX81. Remove the three plastic rivets and take off the back half of the case. The chips will now be visible and it is important to work on the side of the board where you can see the components.

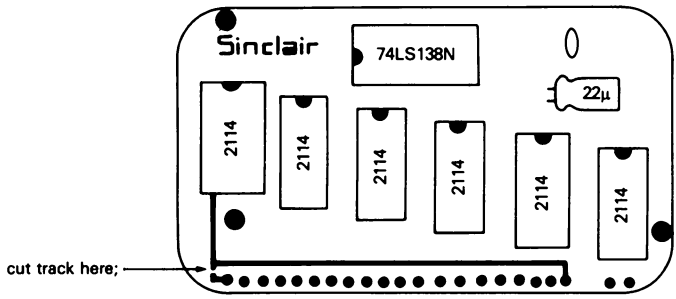


Figure A.3

All that is needed to make the 3K RAM pack work on *both* machines is to cut the track shown. To test the modification, plug in the pack, switch on and key in the following line:

```
10     DIM A ( 102 , 6 )
```

and RUN the program. You should be rewarded with a report code 0/10 indicating that the array of 612 numbers (102 × 6) has been successfully set up. Such an array requires at least 3060 bytes of space in the RAM. On the ZX80 the smaller RAM pack will give 4K of memory but the ZX81 switches off the 1K of memory on the main board when the extra RAM is attached. If the RAM pack is plugged in permanently the two 2114 chips can be removed and used in a 3K memory board. (Just a thought for those readers who have a small memory pack with less than the full complement of six 2114 chips installed!)

If you thought that the previous modification was simple, what will you think of the next? The press has been full of reports of programs being lost from the ZX81 whilst the 16K RAM pack is in place. The main cause of this problem seems to be the fact that the RAM pack is mounted at 90° to the main board and is thus liable to move a little on its mounting points. The lead in the solder coating of the edge connector contacts will become coated with lead oxide quite quickly and make the surface conduct badly in places. Slight movement of the RAM pack on a less than scrupulously clean solder track causes momentary loss of power and more than momentary

loss of program. There are three cures. The first is to fit the ZX81 with "radio spares" self-adhesive feet. These lift the computer high enough to ensure that the RAM pack is clear of the ground and the connector is not flexed when you press the keys. This is usually a complete cure for RAM problems. The second is to steady the RAM pack on its mountings with a piece of plasticine between the back of the computer and the front of the RAM pack. The appearance of the second cure is a little less technical than might be desired but the improvement in reliability is worth all the odd comments from onlookers. The third cure will be given in detail under the heading "eliminating the tangle".

A PROPER KEYBOARD

The low cost of the ZX81 is, to a considerable extent, due to the low cost of the keyboard. There are advantages to the installation of a normal keyboard; there is more room for "person sized" fingers and it is possible to "touch type" on a keyboard which is not almost completely flat. There are on offer, several bleepers which indicate to the typist each time a keystroke has been successful. Such annoying devices would be unnecessary if you could feel a key making contact.

Keyboards specially designed for the ZX81 are sold by several manufacturers, and these are in general the best bet. From time to time you will come across old keyboards in junk shops, on jumble sale stands at computer shows, or in surplus stores. Most of these are coded in some way and need to be stripped down to remove the intricate interconnections of the keys under the board. If you attempt such a job, make sure that no hidden connections remain, by checking *all* the keys with a multimeter for each keystroke.

When the keyboard has been stripped down so that it is no more than a set of isolated switches, it can be wired up as shown in the diagram (Figure A.4). Choose two contacts per key from the several you will probably have and use the same two on every key. Connect up one set of contacts as shown in the top diagram and connect the second set up as shown in the lower drawing. If you wish, you can make extra keys available if there are more than forty buttons on your board. These could form a number pad with an extra decimal point if you intend doing a lot of number work on the computer. Bring out the fly leads and connect them to the underside of the computer board as shown. The connections will be easier to sort out if you can use a different colour for each connection. If you use the underside of the board, then the original keyboard will still function and the two can be used together if required. This might be useful for games.

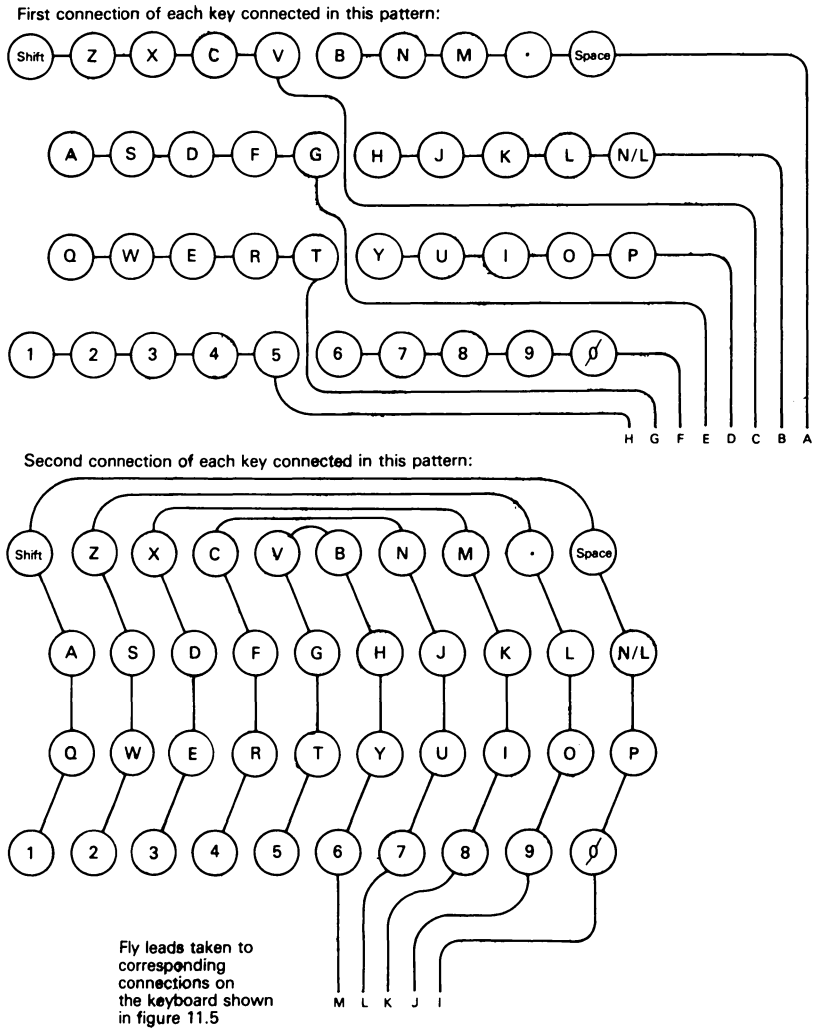


Figure A.4 *Underside of the keyboard and interconnection of the keys*

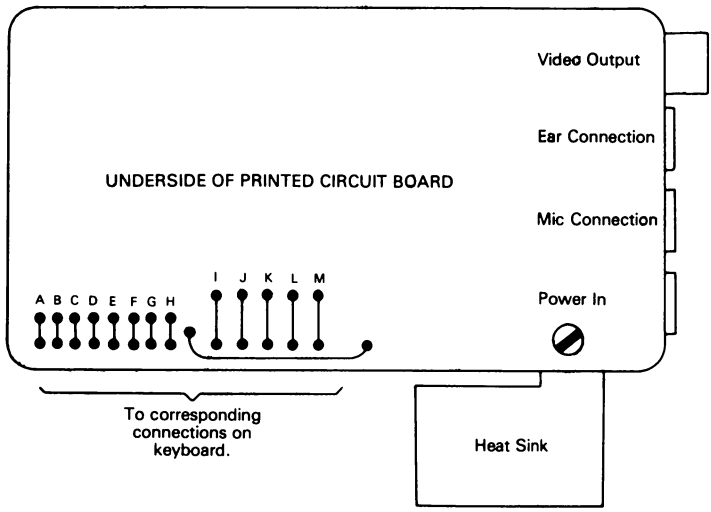


Figure A.5 Linking the ZX81 to a normal keyboard

This is the largest project in the chapter and the wiring will take some time to complete and will need careful checking. The cost is likely to be low and, as the likelihood of damage to the equipment is very small; don't be put off. The computer will remain available during the project as the bulk of the work is done on the keyboard alone. When attaching the leads to the computer some important precautions must be taken. The chips will not take kindly to being blasted with AC, even the small amount that leaks from a grounded iron. The safest plan is to heat the iron thoroughly and then switch off both the computer and the iron before attempting a joint. The tinned leads can be quickly soldered in place before the iron cools and the iron can be soon brought back to temperature between each lead. This sounds more involved than it really is. There are only thirteen leads to solder. Alternatively, use a ceramic-shafted iron.

Re-designating the keys is a job that can be off-loaded onto an artistic friend. The job consists of filling the recess of each key (they are usually concave) with something like car body filler, sanding this smooth and priming it in some way to receive the ink drawing of the key characters and finally, sealing with a durable, transparent film. The self adhesive Sinclair keyboard can be cut up and used but the area of adhesive is small and the characters tend to move around on the keys and look untidy.

ELIMINATING THE TANGLE

Even with the plasticine pad in place, I have had problems when a lead has been joggled while I have been sorting through papers on the table. The cure was a little elaborate but resulted in a much more professional looking set up and no further program losses. The ZX81 was stripped out of its plastic box and mounted securely in a case built on the pattern of an executive brief case. The deck of the case was laid out to take my tape recorder and the keyboard, tilted slightly forward for more comfortable typing. Underneath the deck all the wiring was soldered in place, not plugged. The most important job of this type was to solder the 16K RAM pack to the printed circuit board of the computer using ribbon cable. This meant removing the RAM pack from its case, opening out the two halves to make it lie flat on the base of the case, and then securing it in place so that the computer and the memory did not move relative to one another. This was necessary because the soldering was "tack" soldering to the top of the board to very small areas of strip, and such joints are not very robust.

It is not necessary to go to such lengths if you don't feel up to the task. The RAM pack can be connected to the board in the normal way in the box and secured in place to avoid the memory-losing joggling. The main benefit of the case is the lack of tangle and the more orderly nature of the computing area, which is conducive to more ordered programming.

More Real Applications for the ZX81 and ZX Spectrum

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