sinclair

ZX81
ASSEMBLY INSTRUCTIONS

IMPORTANT: Read through the instructions before you start assembly.

If anything seems unclear or difficult, contact us for advice before going ahead.

1. PREPARATION

You will need a clean, dry and well lit workspace in which to assemble your kit. If possible, try to find somewhere where the parts can stay undisturbed in case you do not finish the kit all at once. It is a good idea in any case to split the work up – say assemble the circuit board one evening, then test it and put the case together the next evening. You will need these tools:–

(a) A light electric soldering iron, say 15 to 25 watts with a fine tip.
(b) Fine gauge solder with resin flux core; NOT acid flux.
(c) A pair of sharp sidecutters.
(d) A 'Pozidriv' screwdriver with a No. 1 point.
(e) A medium size ordinary screwdriver and/or a 4B.A. spanner.

The following items are optional, but useful:–

(a) A magnifying glass for examining solder joints and looking for short circuits.
(b) Some desoldering braid or other solder removing tool. Better still, take care that you put the components in right the first time – removing them can be very difficult.
(c) A piece of foam is useful to stop components falling out when you turn the board over to solder them.

2. PRECAUTIONS

There are not many integrated circuits (I.C.s) in the kit, but they are all fairly expensive items and most of them are susceptible to damage from static electricity. There is no cause for worry if a few precautions are taken:–

(a) Use the sockets supplied with the kit – never solder the I.C.s direct to the board – and keep the I.C.s in their protective packing until you are ready to plug them in.
(b) Never insert or remove the I.C.s or do any soldering with power applied to the computer.
(c) Use a soldering iron with a properly earthed bit.
(d) Carpets and clothing of man-made fibres, and synthetic soles on shoes, are prone to building up a static charge. Earth yourself by touching a large object, preferably metallic, prior to touching the I.C.s If you do get a shock, try changing your clothes or going barefoot (seriously!).

3. COMPONENT IDENTIFICATION

Before you start assembly, check the components against the component list (section 8) and make sure you know what each part is. We have tried to cover all different markings of the components, but variations are possible.

Note in particular that the computer's memory may be supplied *either* as two 18 pin I.C.s (IC4a & IC4b) *or* as one 24 pin device (IC4), and that assembly is necessarily different for each version.

Some components need to go in one particular way round:–

(a) The I.C.s have one end identified by a notch, and/or a spot or dimple next to pin 1. (See fig. 1). Note that all the I.C.s face the same way on the board, i.e. with their notches towards the edge connector.

FIG 1

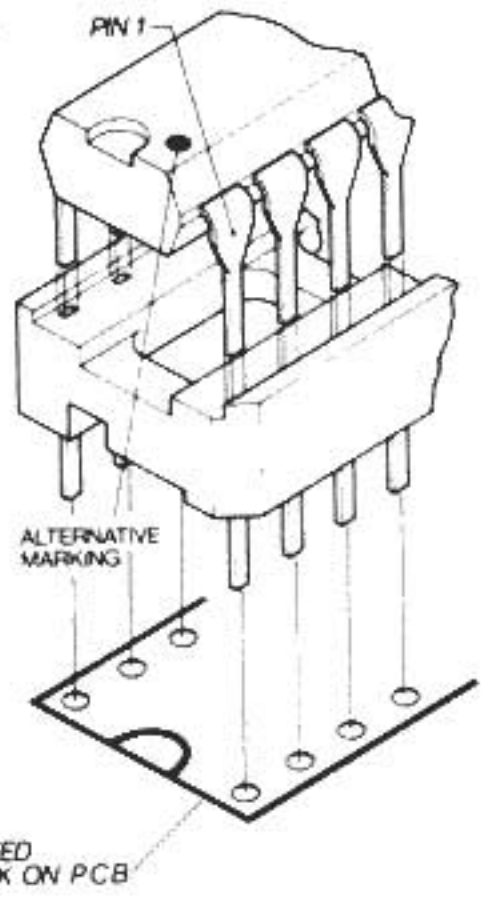


FIG 2

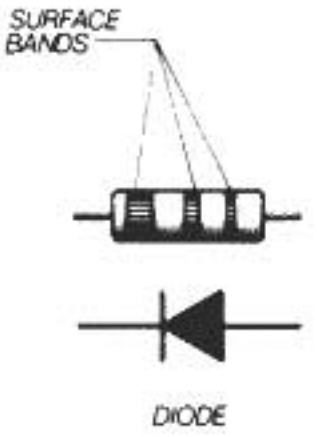
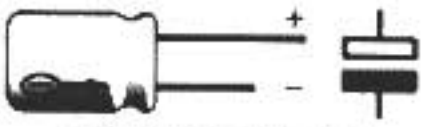


FIG 3



Although the I.C. sockets do not need to go any particular way round, you may like to put the bevelled corner at the notch end of the I.C. position as a reminder, since the semicircle printed on the board will be covered by the socket in some cases.

(b) The diodes (prefix D) have their + end identified by the band painted on the body – or in the case of components with several bands, the + end will be the widest band. This corresponds to the flat bar of the symbol printed on the board. (See fig. 2).

(c) The electrolytic capacitors (C3 & C5) will have a + or − symbol printed on them, and the + wire is usually longer. (See fig. 3).

(d) The transistors (prefix TR) go in the board as shown by the picture printed at their positions – i.e. with their rounded corners facing the edge connector.

(e) The jack sockets and modulator need to have their business ends (i.e. where the plug goes in) facing outwards, away from the components. This should be obvious by inspection of the board and case.

FIG 4

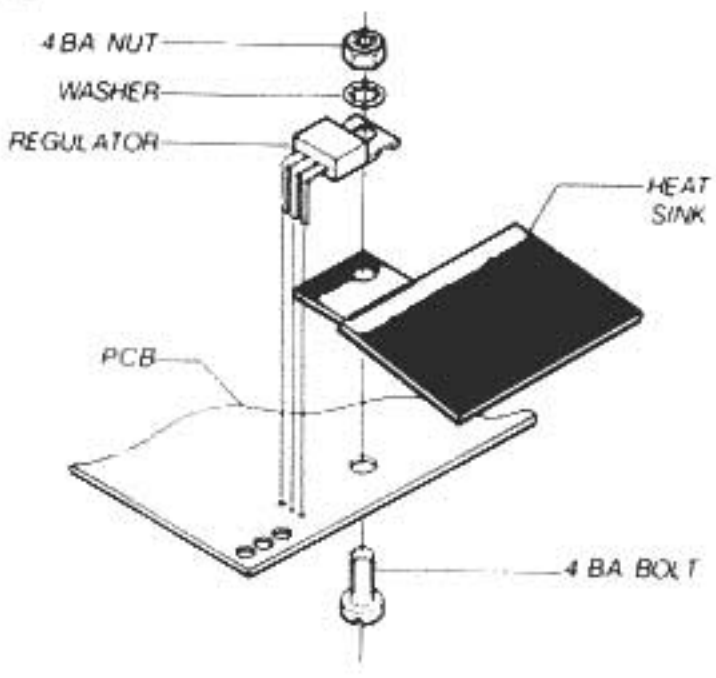
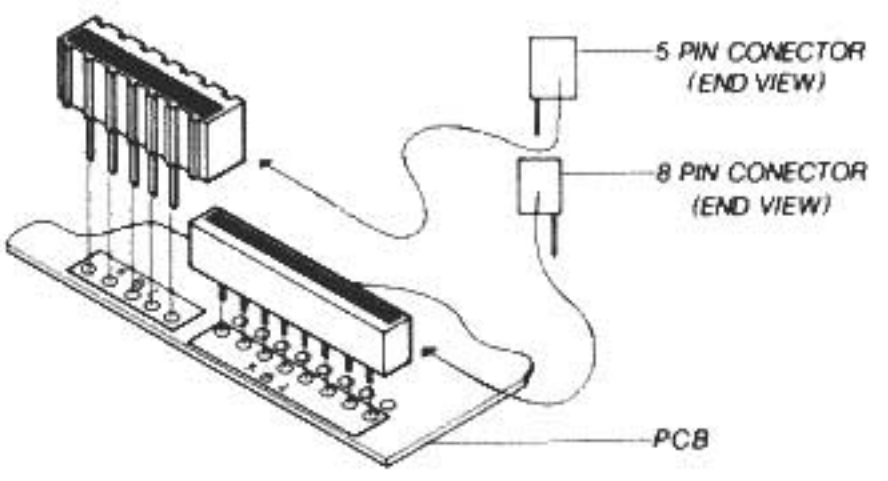


FIG 5



(f) The regulator (REG) and heatsink need to go in a particular way round – just follow fig. 4.

(g) The keyboard connectors KB1 & KB2 have their pins offset from their centre line, and KB1 goes the opposite way round to KB2. Make sure that in each case the body of the connector covers up the component number on the board. (See fig. 5).

(h) The resistor packs (prefix RP) have a 'common' end marked with a white dot. This should go at the end marked with a 'C' on the board.

(i) The single resistors, the rest of the capacitors, and the filter X1 may be put in either way round.

4. CIRCUIT BOARD ASSEMBLY

The circuit board will be supplied with one side printed with all the component locations – this is the side the components go. This printing is reproduced as fig. 6 (See reverse side of sheet) since some of the markings will be covered by components. All soldering is done on the other side which is coated with a green solder resist – this keeps the solder away from where it is not needed. The exception is the edge connector area which should be kept free of solder to ensure reliable connection to the RAM pack or printer if they are used. We suggest you assemble the components in the following order, although it is not compulsory:–

(i) Resistors, capacitors and IC sockets – do not plug the I.C.s in yet.
(ii) The diodes and transistors.
(iii) The 'large' components: the sockets, keyboard connectors, modulator, the regulator and heatsink.
(iv) Finally plug the I.C.s into their sockets.

The general procedure for each component:–

(a) Identify the part and its position on the board and insert it into the appropriate holes, bending the leads if necessary. (But see later). In the case of components with a number of pins, make sure that they have all gone through their holes.
(b) Hold the part in position – if you bend its leads to do this, do not press them flat onto the board as this will make them difficult to cut and will encourage short circuits.
(c) Solder all the wires on the 'green side' of the board and, if they are long, trim them with the side cutters. No lead should stick out more than about 3mm or ⅛" from the solder side.

Some components need more detailed explanation:–

(a) The capacitors are represented by a capacitor symbol on the board, rather than a box as the rest of the components are. Fig. 7 explains how they fit in the board relative to the symbol.

FIG 7

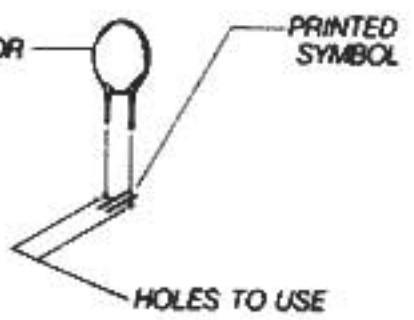
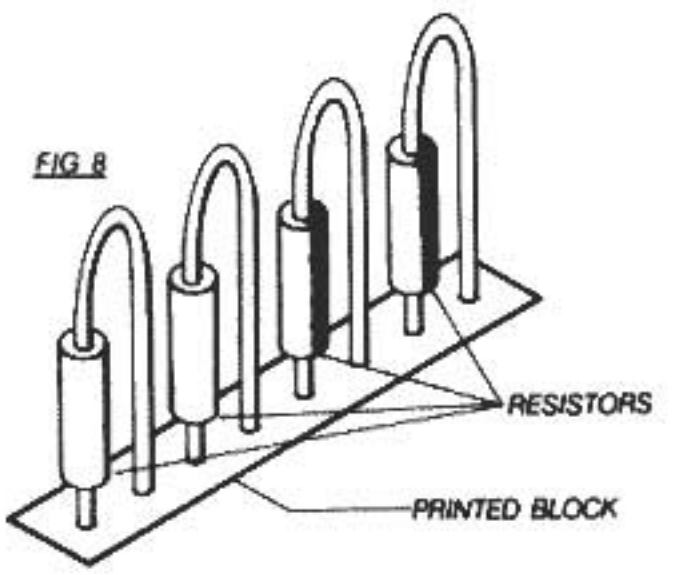


FIG 8



(b) There are four oblong boxes labelled R7-R10, R11-R14, R18-R22 and R23-R26. These all contain a row of resistors standing 'on end' as in fig. 8. Take care when mounting these: the length of bare wire up the side should not be allowed to short against anything else.
(c) IC2 and IC4 have two different sized boxes printed on the board: use only the holes corresponding to the smaller box.
(d) As previously mentioned, IC4 may be in either one or two packages. Only the appropriate IC sockets will be supplied, so make absolutely sure you know which version you have got before proceeding.

IMPORTANT:– If you have the 24 pin 4118 in your kit, a short wire link should be inserted in the holes at position L1. Use a component lead off-cut for this. DO NOT do this if you have two 18 pin 2114s, and do not put anything in position L2.
(e) When mounting the regulator, do not bend its leads too close to the plastic. Bolt it down firmly with its heatsink *before* soldering.
(f) Put the modulator's wires through the holes marked "Fr/UK1" and "UK2". Put each lead through the hole it is nearest to: do not cross them over. Do not try to bend the thick pins on the modulator: hold it in place by hand whilst soldering. The black card trim is a push fit over the aerial socket.
(g) The I.C.s will have their pins splayed out slightly and you may need to push them inwards slightly, e.g. by pressing against a flat surface, before they will fit the sockets. Make sure that each pin has in fact gone into its respective socket and that none are curled up under the I.C.

5. TESTING

The completed board should now be checked very thoroughly for stray blobs of solder, dry joints, leads not trimmed, etc. Also make doubly sure that all components are in the right place and the right way round, and that the "stand up" resistors are not touching anything else. If everything seems in order, the board may be tested before you put it in the case. Rest the completed assembly on an insulating surface (e.g. these instructions) making sure there are no wire offcuts or similar trapped underneath.
The keyboard's "tails" may now be plugged carefully into their connectors: the one with 5 stripes goes into KB1, the one with 8 stripes goes into KB2. These "tails" are quite fragile, so handle them gently.
The keyboard itself should sit (the right way up) just in front of the circuit board. *Do not* remove the backing paper from the keyboard at this point.
You may now connect the computer to the T.V. and power supply and try it out – see the main instruction manual for details.
Once you are sure the computer is working correctly, put it in its case – see section 7. Do not strain the keyboard connections unnecessarily by using it uncased.

6. FAULT FINDING

Experience with the ZX80 has revealed that the majority of faults on kits are due to bad soldering. If your computer does not work, switch it off and CHECK IT AGAIN. If you find a bad joint or short, shame on you! You should have checked more closely the first time. If you are sure the fault is in the circuitry, try these tests:–

(a) If the computer does not work at all, leave it on for a couple of minutes and feel the regulator – it should be getting warm. If not, check the power supply, and that the plug is in the right socket (the one nearest the keyboard). Otherwise, look at the connection to the T.V. and make sure it is tuned in properly – try between channels 33 and 39 UHF.

(b) If the computer works and then goes off, and the regulator gets very hot, it isn't bolted to the heatsink properly.

(c) If the cursor appears on the screen, but the keyboard will not enter, check firstly that the keyboard "tails" are properly in their connectors, and not twisted in any way. Also make certain that the diodes and the keyboard connectors are all the right way round.

(d) If the screen goes clear but there is not a cursor, try disconnecting the power supply and waiting a few seconds before trying again.

(e) If horizontal black and white stripes pass through the picture, suspect the power supply. If you are using your own supply, it may need to be better smoothed (if the computer is otherwise working) or of a slightly higher output. See the power supply specification (section 9).

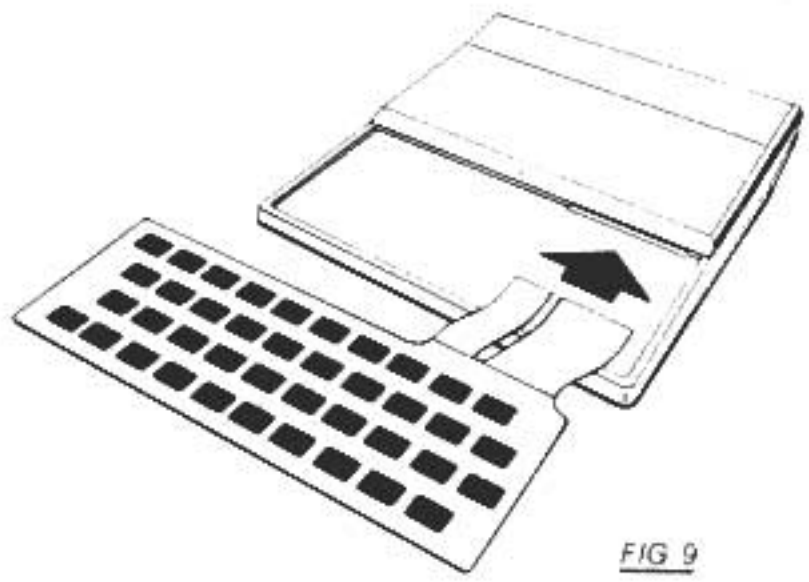


FIG 9

7 CASE ASSEMBLY

(i) Take the case top – the part with the raised "Sinclair" logo and "ZX81" printed on it – and feed the "tails" of the keyboard through the slot at the top right hand corner of the keyboard recess. Do not remove the backing paper form the keyboard yet, just locate it in the recess: see fig. 9. Hold the keyboard temporarily in place with a rubber band or a little sticky tape.
(ii) Hold the circuit board as in fig. 10 with the keyboard connectors next to the slot with the "tails" poking through. Plug the "tails" into their respective connectors as shown in the diagram, and turn the board over so that the components face into the case top behind the keyboard.
NOTE: Special attention must be made to ensure that the correct length of screw is used in the correct hole. The short screws are yellow in colour, the long screws are black in colour. Fig. 11 shows where

FIG 10

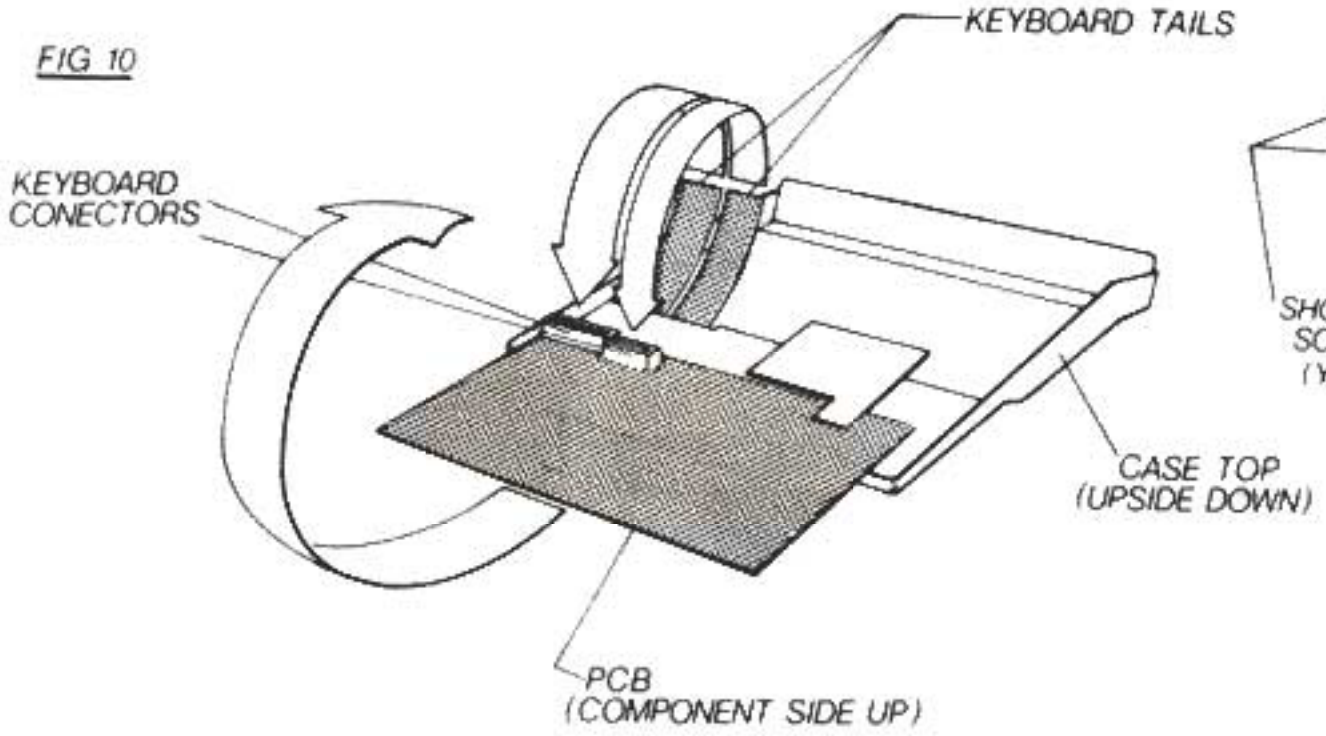
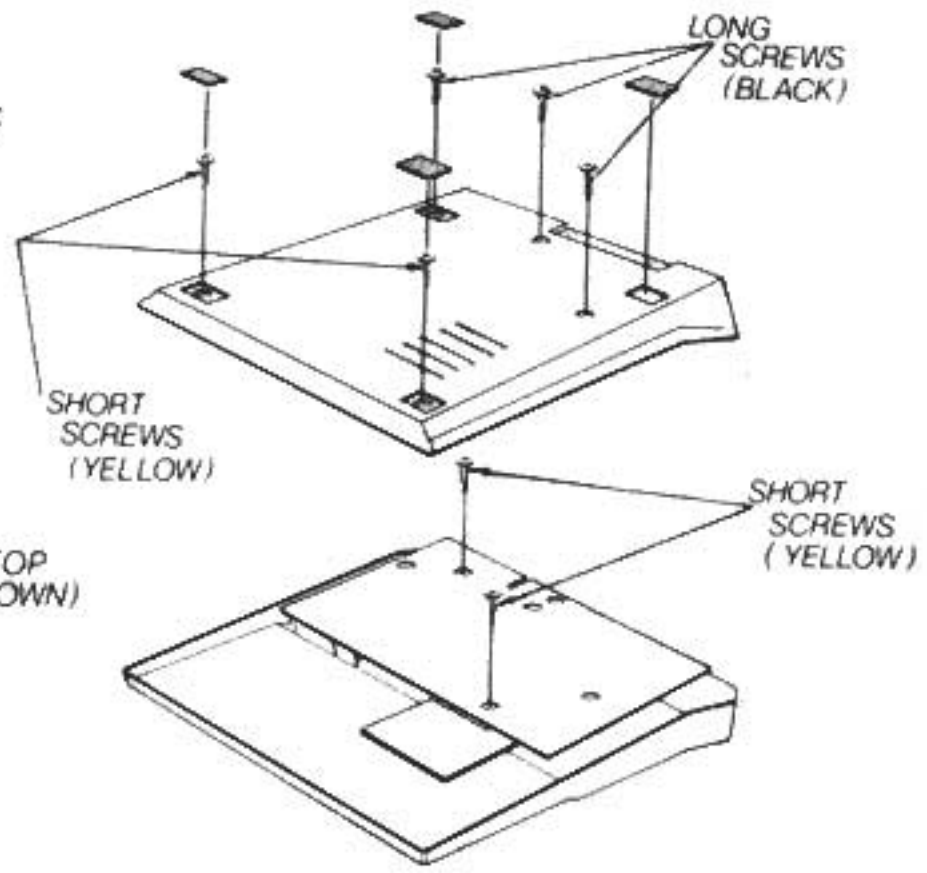


FIG 11



these locate. Serious damage will result if the long screws are inserted in the wrong holes.
(iii) Locate the board on the pillars in the case, make sure the jack sockets are behind the holes in the side, and screw it into the case. Only two holes need screws in them at this point – Fig. 11 tells you which two; the others are for the case bottom fixing. Since the screws will have to form their own threads in the plastic, they may be a bit stiff to turn the first time: therefore it is essential that the proper screwdriver should be used. An ordinary flat screwdriver will almost certainly slip, and may cause damage to the circuitry when it does. See the list of tools given in section 1.
(iv) Turn the case the right way up again, peel the protective paper off the back of the keyboard and stick it into its recess in the moulding (the keyboard is self adhesive – no extra glue is necessary). It would be as well to position the keyboard correctly the first time, to avoid damaging it by continual relocating. Locate the top edge of the keyboard against the top edge of the recess, and stick it down carefully, working gradually towards the lower edge. Have a dry run first if you are in any doubt. Do not try to stick the whole surface down in one go.
(v) After checking that the keyboard connections are still securely in place, locate the bottom half of the case and screw it to the top with the remaining five screws. Finally the rubber feet plug into four of the recesses, over the screw heads. Fig. 11 shows the location of screws and feet.
(vi) Give the computer a final check, and start using it. . . .

8. COMPONENT LIST

Note that some components are marked on the circuit board, but shown as "not used" in this list. Do not put anything in these positions.
(a) Resistors.
All resistors have four colour bands: the fourth may be gold or silver.

No.	Value	Markings	Comments
R1	10K	Brown Black Orange	
R2	680 Ω	Blue Grey Brown	
R3			Not used
R4	18K	Brown Grey Orange	
R5	330 Ω	Orange Orange Brown	
R6	2K2	Red Red Red	
R7	470 Ω	Yellow Purple Brown	
R8	470 Ω	"	
R9	470 Ω	"	

R10	470 Ω	"	
R11	470 Ω	"	
R12	470 Ω	"	
R13	470 Ω	"	
R14	470 Ω	"	
R15	220K	Red Red Yellow	
R16	1K	Brown Black Red	
R17	1K	"	
R18	1K	"	
R19	1K	"	
R20	1K	"	
R21	1K	"	
R22	1K	"	
R23	1K	"	
R24	1K	"	
R25	1K	"	
R26	1K	"	
R27	1K	"	
R28	680Ω	Blue Grey Brown	
R29	1M	Brown Black Green	Fourth band may be yellow
R30	———	———	Not used
R31	———	———	Not used
R32	———	———	Not used
R33	4K7	Yellow Purple Red	
R34	220Ω	Red Red Brown	

(b) Resistor Packs

No.	**Value**	**Markings**	**Comments**
RP1	8 × 10K	10KΩ	9 leads
RP2	———	———	Not used
RP3	5 × 10K	10KΩ	6 leads

(c) Capacitors

No.	**Values**	**Markings**	**Comments**
C1	47pF	47	Ceramic disc
C2	47nF	473 Z	"
C3	22μF	22μ	Electrolytic 16V min.
C4	47nF	473 Z	Ceramic disc
C5	1μF	1μ	Electrolytic 5V min.
C6	100pF	100, 101, n10	Ceramic disc
C7	47pF	47	"
C8	47nF	473 Z	"
C9	47nF	473 Z	"
C10	10nF	10n, 103	"
C11	47nF	473 Z	"
C12	47pF	47	"

(d) Semiconductors

No.	**Type**	**Comment**	
IC1	Sinclair Logic IC	40 pins	158 printed underside
IC2	2364	24 pins	
IC3	Z80A or D780C-1	40 pins	
IC4	MK4118	24 pins	
or			
IC4a	μPD2114LC or as IC4b	18 pins	

IC4b	μPD2114LC–1	18 pins
REG	7805	5 Volt regulator
TR1	ZTX 313	
TR2	ZTX 313	
D1-D8	1N4448	Colours: Yellow, yellow, yellow, grey
or	1N4148	Yellow, brown, yellow, grey
or	1S44	2 Yellow bands

Some diodes may have their number printed on them instead.

D9	————————	Not used
X1	CDA 6.5MC	3 lead ceramic filter.

(e) Other components
Modulator type UM1233
3 off 3.5mm jack sockets for power, ear and mic.
2 off 40 pin IC sockets
Either 2 off 24 pin IC sockets
or 1 off 24 pin and 2 off 18 pin IC sockets
KB1 5 way keyboard connector
KB2 8 way keyboard connector
Modulator trim (black card)
Ready made flat keyboard
Aluminium heatsink
4BA nut, bolt and washer for fixing regulator and heatsink
Printed circuit board
2 Case halves
4 Rubber feet
7 Self tapping Pozidriv screws – 3 Black (long), 4 Yellow (short)

9. POWER SUPPLY

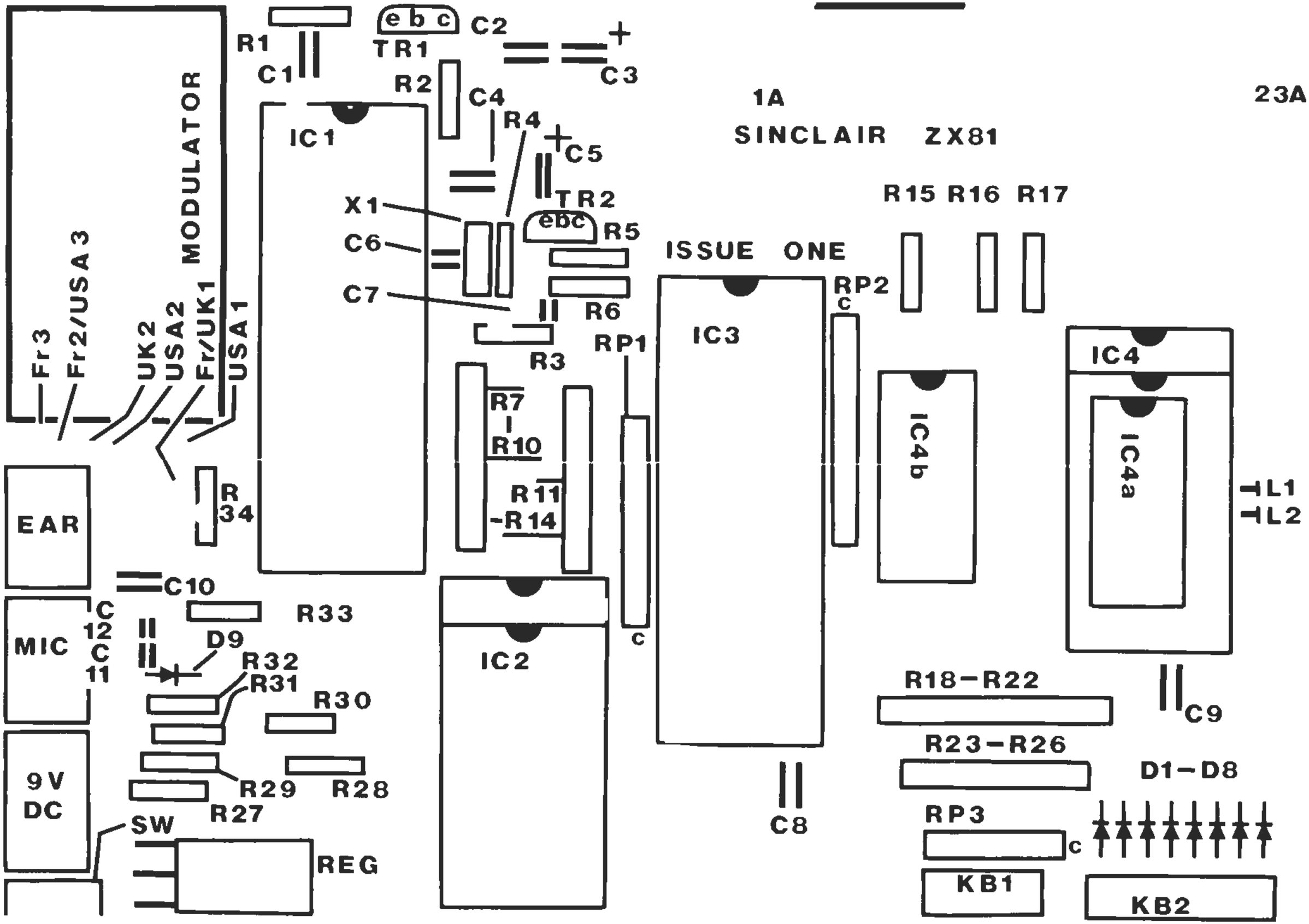
If you wish to use your own power supply with the ZX81, it should conform to these specifications:–
D.C. only – positive to the tip of the 3.5mm jack plug. Need not be regulated, but should be well smoothed.
Voltage – between 12 volts maximum and about 8 volts minimum (depending on smoothing) when on load.
Current – not less than 600mA, or 1.2A of the printer is to work from the same supply.

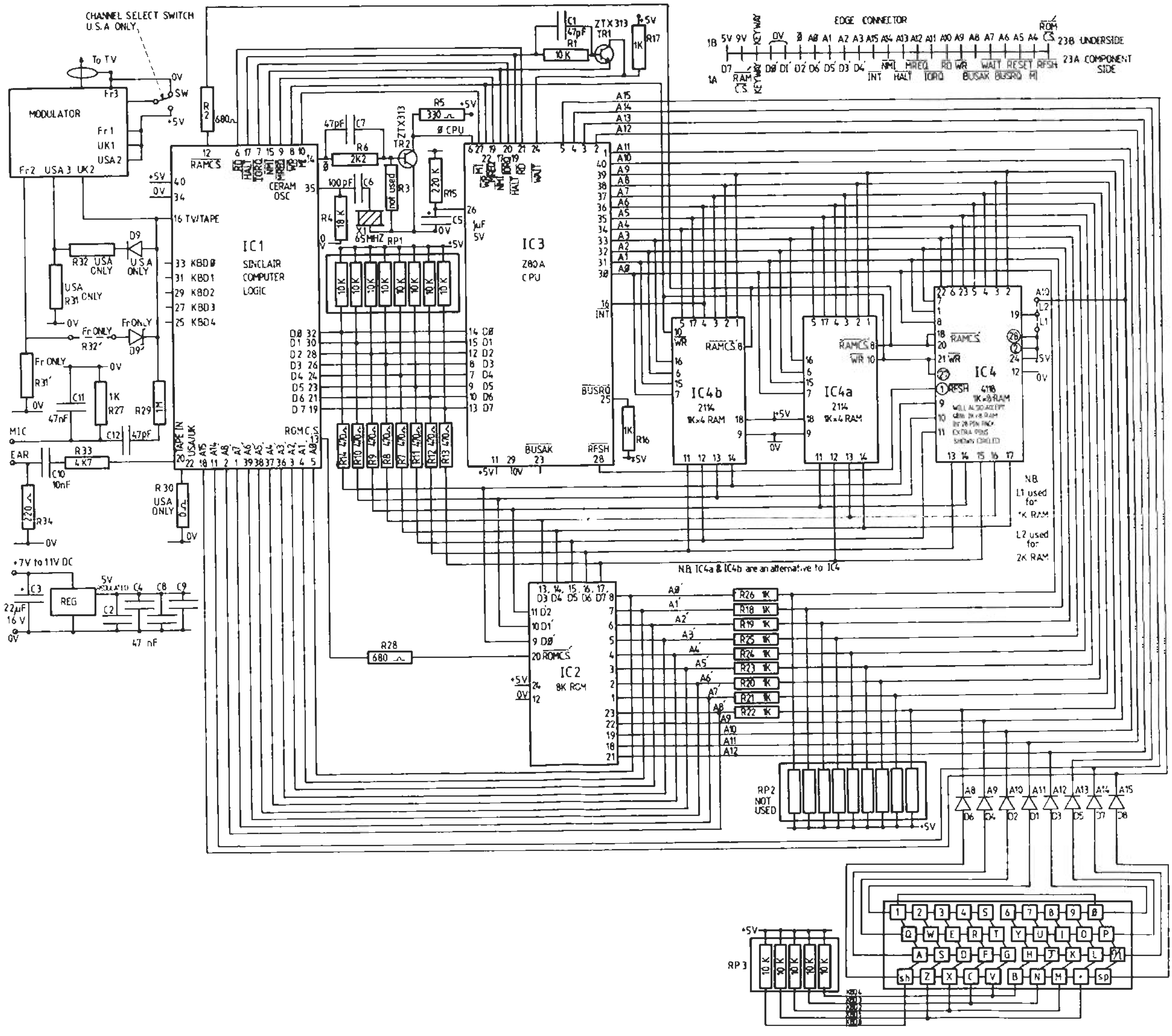
10. SERVICE

We will repair your completed ZX81 kit for a fixed fee of £10.00. We cannot assemble your kit for you, nor can we start work until the fee is received. In exceptional cases, say if the I.C.s have been damaged by being put in the wrong way round, we may ask for an additional payment.
On the other hand, if the trouble was due to faulty components supplied by us we will refund the full service fee. We strongly advise you, therefore, to be very certain that you have checked the computer *thoroughly* for mistakes before returning it: see also the hints in section 6.
If you do return your ZX81, pack it well and enclose a note giving your name and address, and explaining the symptoms of the trouble and any tests you may have done. Please return to this address:

Sinclair Research Service Dept.
Chesterton Mill
French's Road
Cambridge
CB4 3NP

FIG 6


1A
SINCLAIR ZX81
23A
ISSUE ONE
MODULATOR
Fr3
Fr2/USA3
UK2
USA2
Fr/UK1
USA1
R1
C1
TR1
C2
C3
R2
C4
R4
C5
IC1
X1
C6
C7
TR2
R5
R6
R3
RP1
IC3
RP2
R15 R16 R17
IC4
IC4b
IC4a
L1
L2
R7
R10
R11
R14
R34
EAR
C10
R33
MIC
C12
C11
D9
R32
R31
R30
R29
R28
R27
9V
DC
SW
REG
IC2
C8
C9
R18–R22
R23–R26
D1–D8
RP3
KB1
KB2



CHANNEL SELECT SWITCH U.S.A ONLY
To TV
MODULATOR
EDGE CONNECTOR
23B UNDERSIDE
23A COMPONENT SIDE
ZTX313
TR1
R17
1K
C1
47pF
R1
10K
R2
680
R5
330
ø CPU
C7
47pF
R6
2K2
TR2
ZTX313
R3
not used
R15
220 K
C5
1µF
5V
C6
100 pF
R4
18 K
X1
6.5MHZ
RP1
IC1
SINCLAIR
COMPUTER
LOGIC
CERAM
OSC
IC3
Z80A
CPU
IC4b
2114
1K×4 RAM
IC4a
2114
1K×4 RAM
IC4
4118
1K×8 RAM
WILL ALSO ACCEPT 6BIK 2K×8 RAM IN 28 PIN PACK EXTRA PINS SHOWN CIRCLED
R16
1K
NB L1 used for 1K RAM
L2 used for 2K RAM
NB IC4a & IC4b are an alternative to IC4
IC2
8K ROM
R28
680
RP2
NOT
USED
RP3
D9
USA ONLY
R32 USA ONLY
R31 USA ONLY
R32' Fr ONLY
D9' Fr ONLY
R31' Fr ONLY
C11
47nF
R27
1K
R29
1K
C12
47pF
MIC
EAR
C10
10nF
R33
4K7
R34
220
R30
USA ONLY
+7V to 11V DC
C3
22µF
16 V
REG
5V REGULATED
C2
C4
C8
C9
47 nF