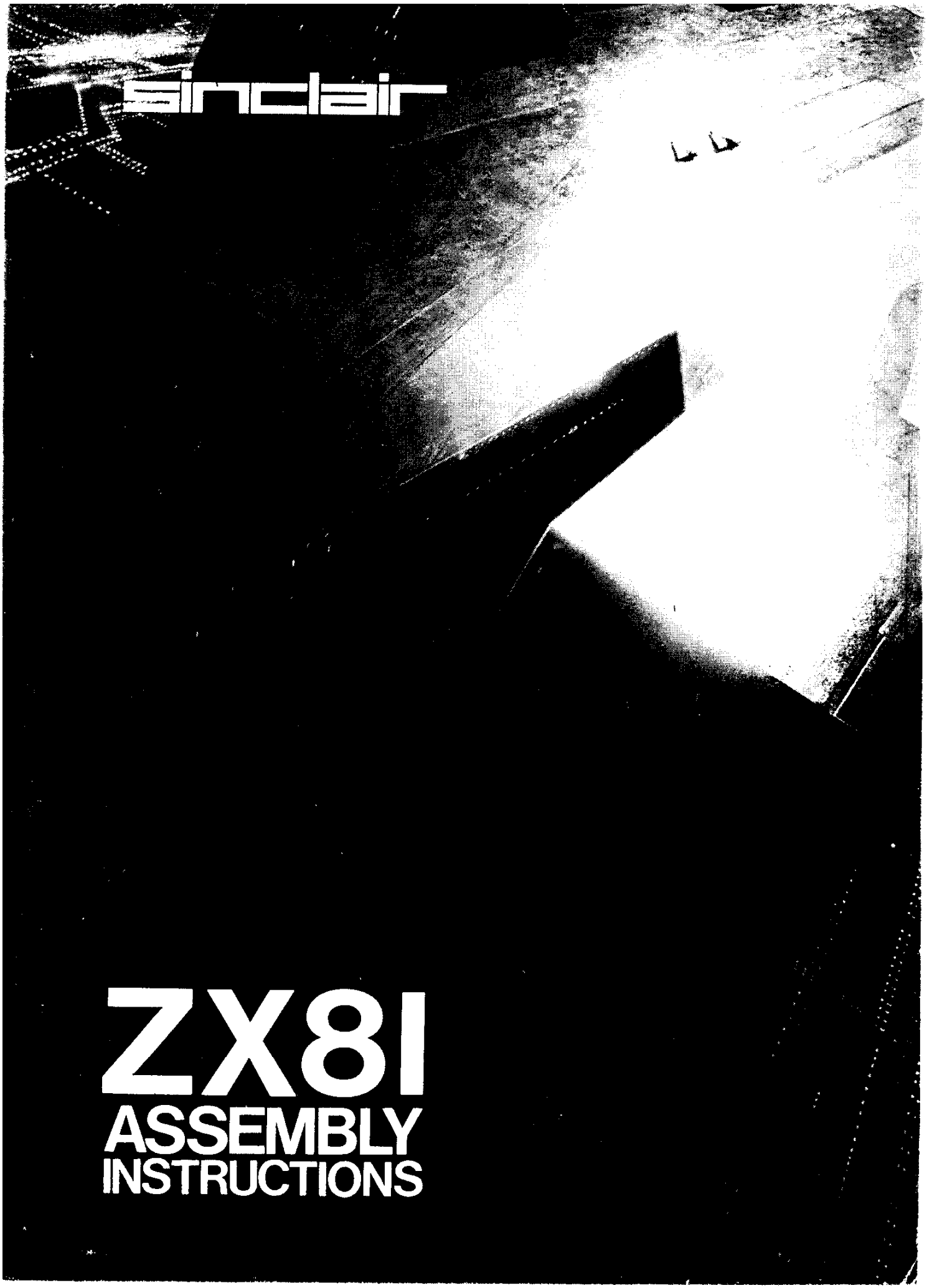
sinclair



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.

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

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

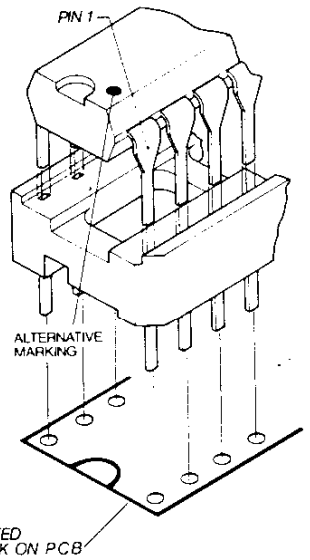


FIG 2

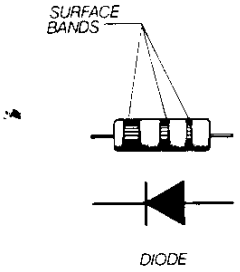
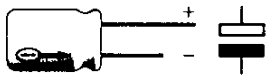


FIG 3



ELECTROLYTIC CAPACITOR

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

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

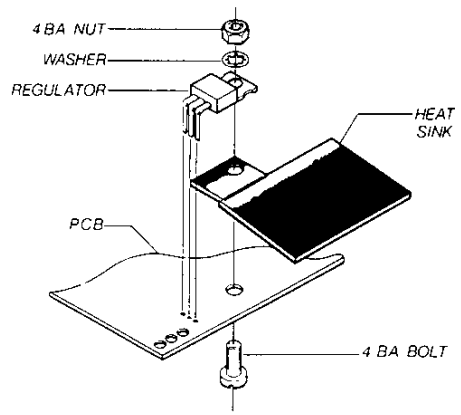
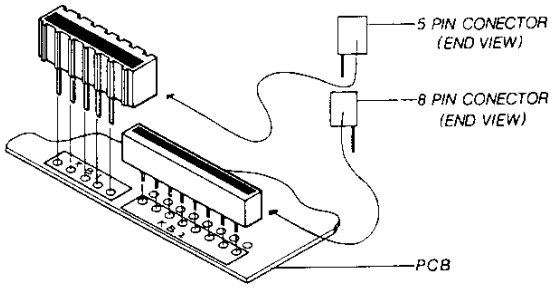


FIG 5



(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

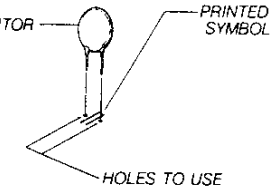
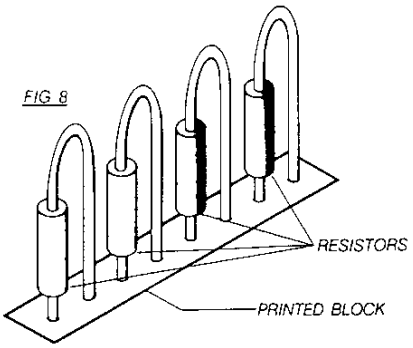


FIG 8



(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).

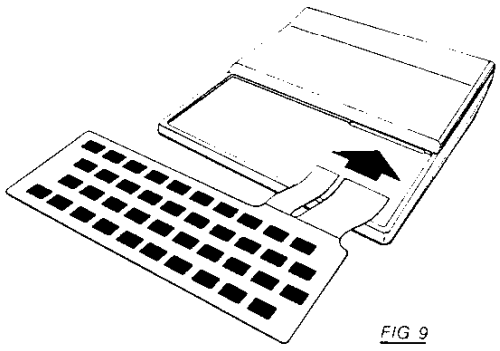


FIG 9

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

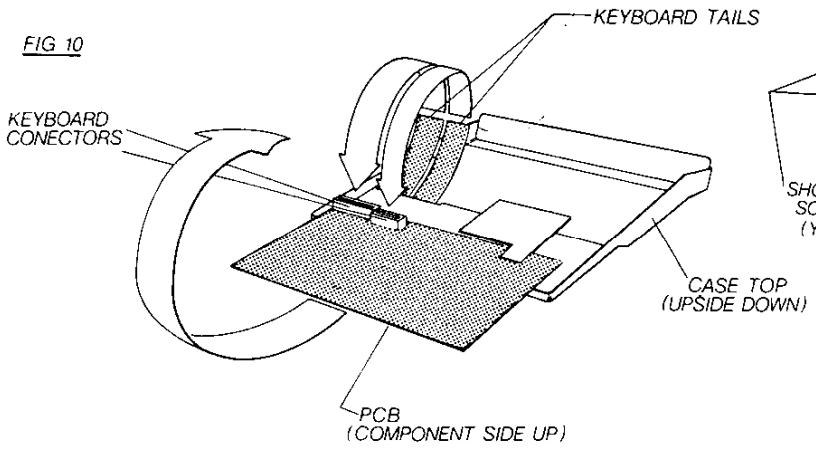
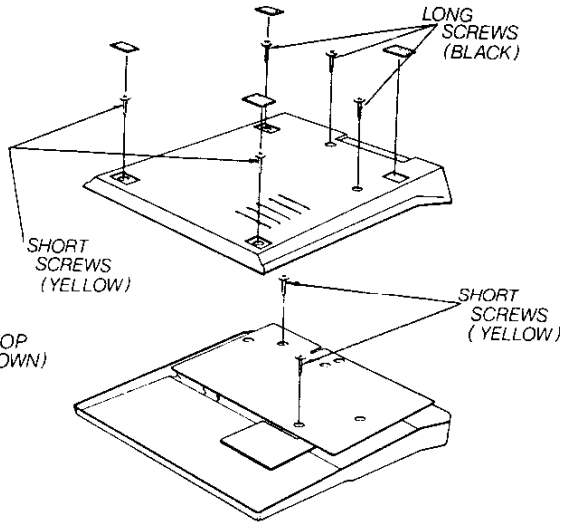


FIG 11



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	

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

(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	22 μ	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)

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

9. POWER SUPPLY

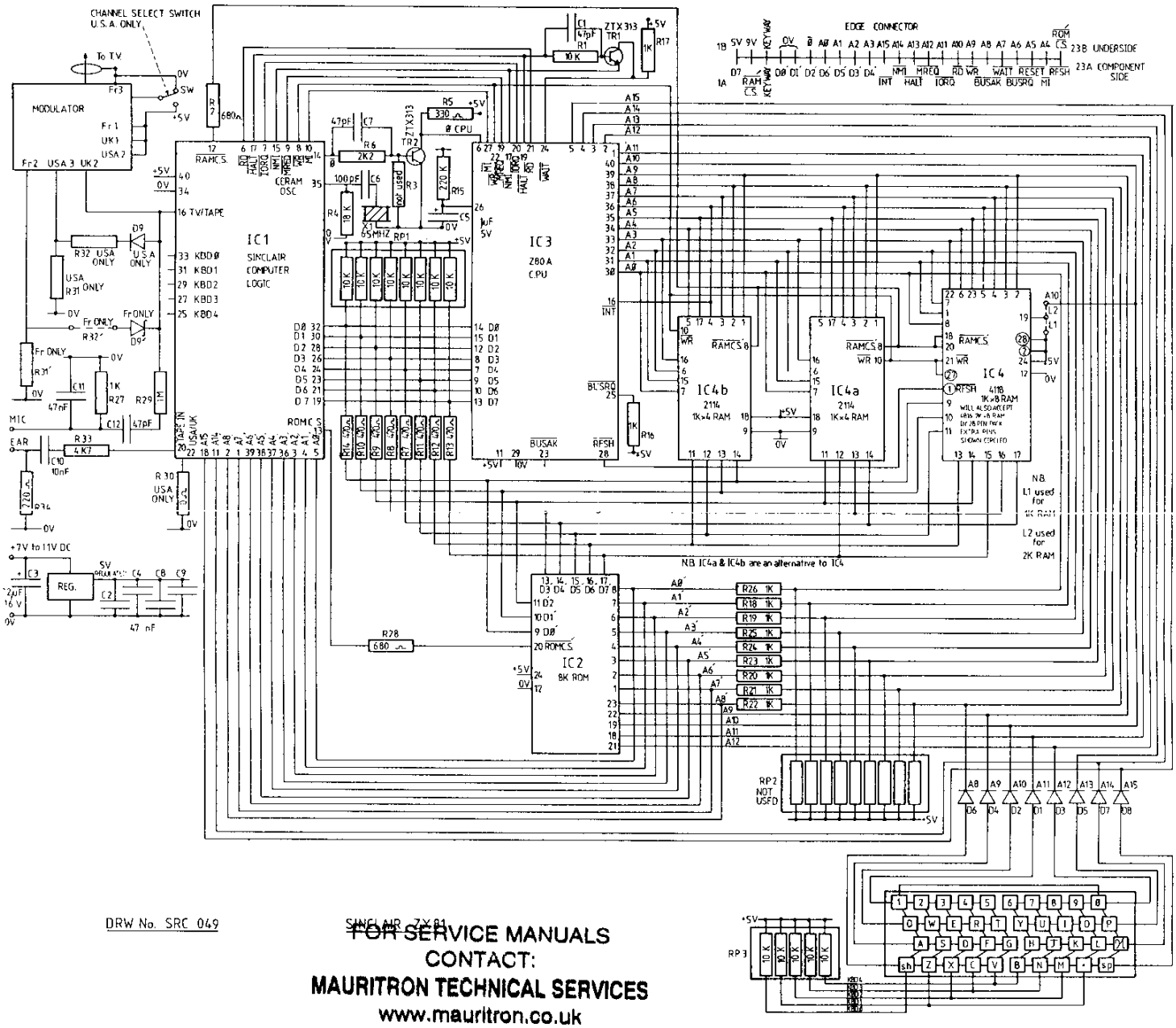
If you wish to use your own power supply with the ZX81, it should conform to these specifications:–
D.C. only – positive to the tip of the 3.5mm jack plug. Need not be regulated, but should be well smoothed.
Voltage – between 12 volts maximum and about 8 volts minimum (depending on smoothing) when on 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

© Sinclair Research Limited 1981



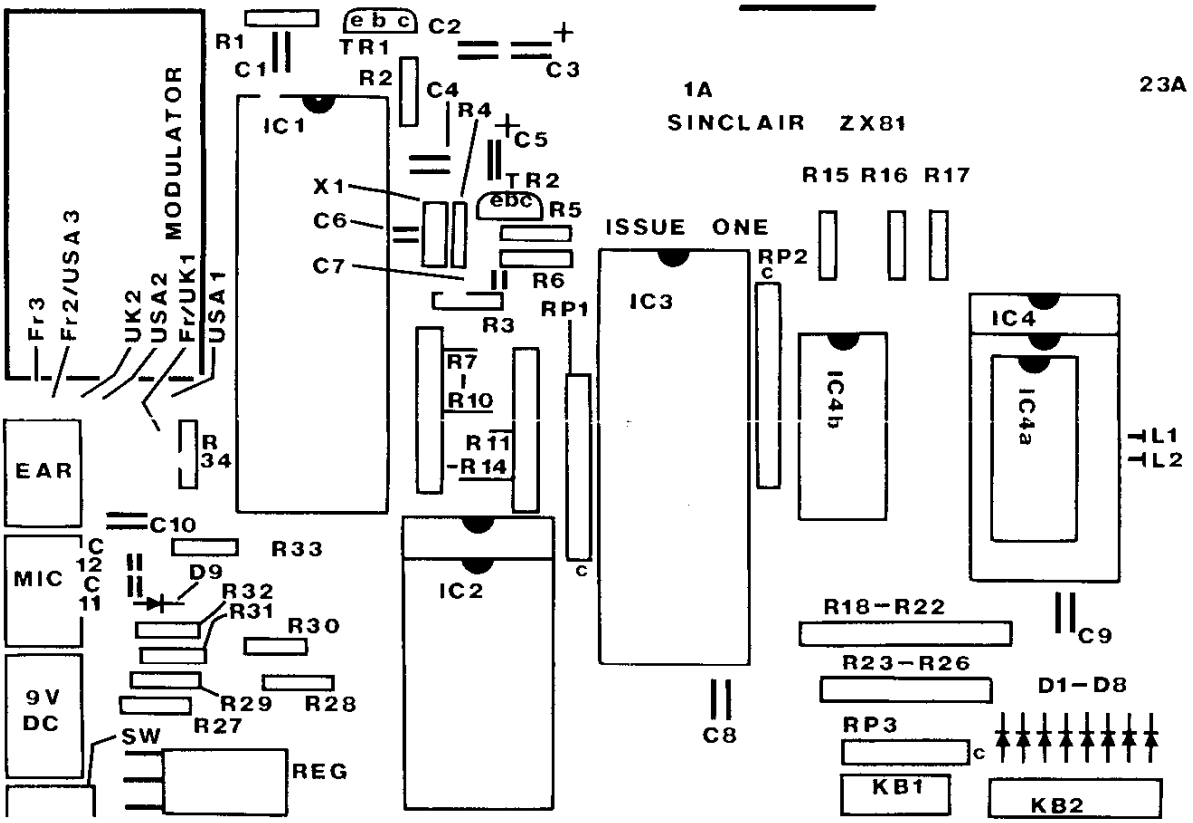
DRW No. SRC 049

SINCLAIR ZX81

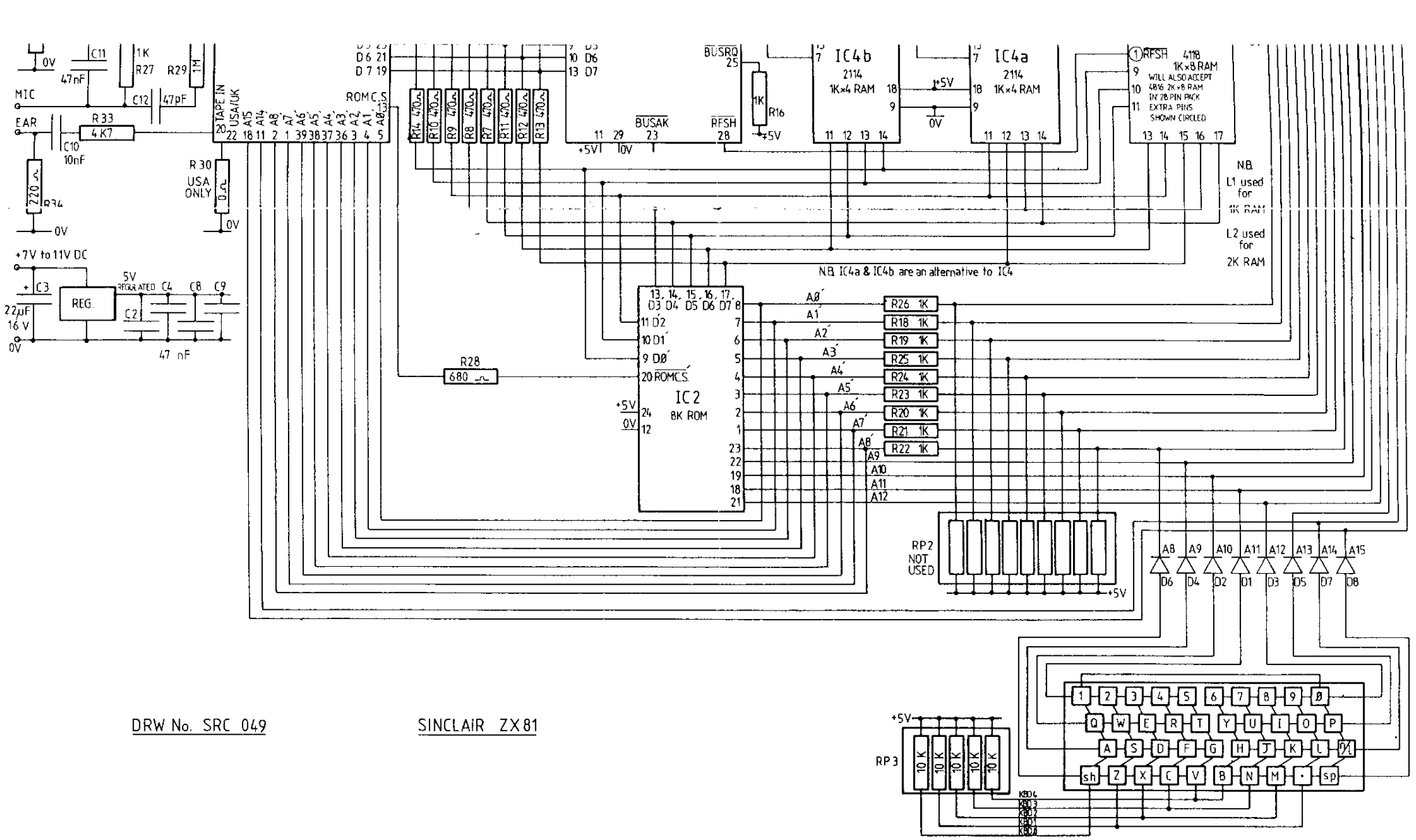
~~FOR~~ SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

FOR SERVICE MANUALS
contact
MAURITRON ELECTRONICS
8 Cherrytree Road, Chinnor
Oxon OX9 4QY.
Tel:- (0844) 51694

FIG 6



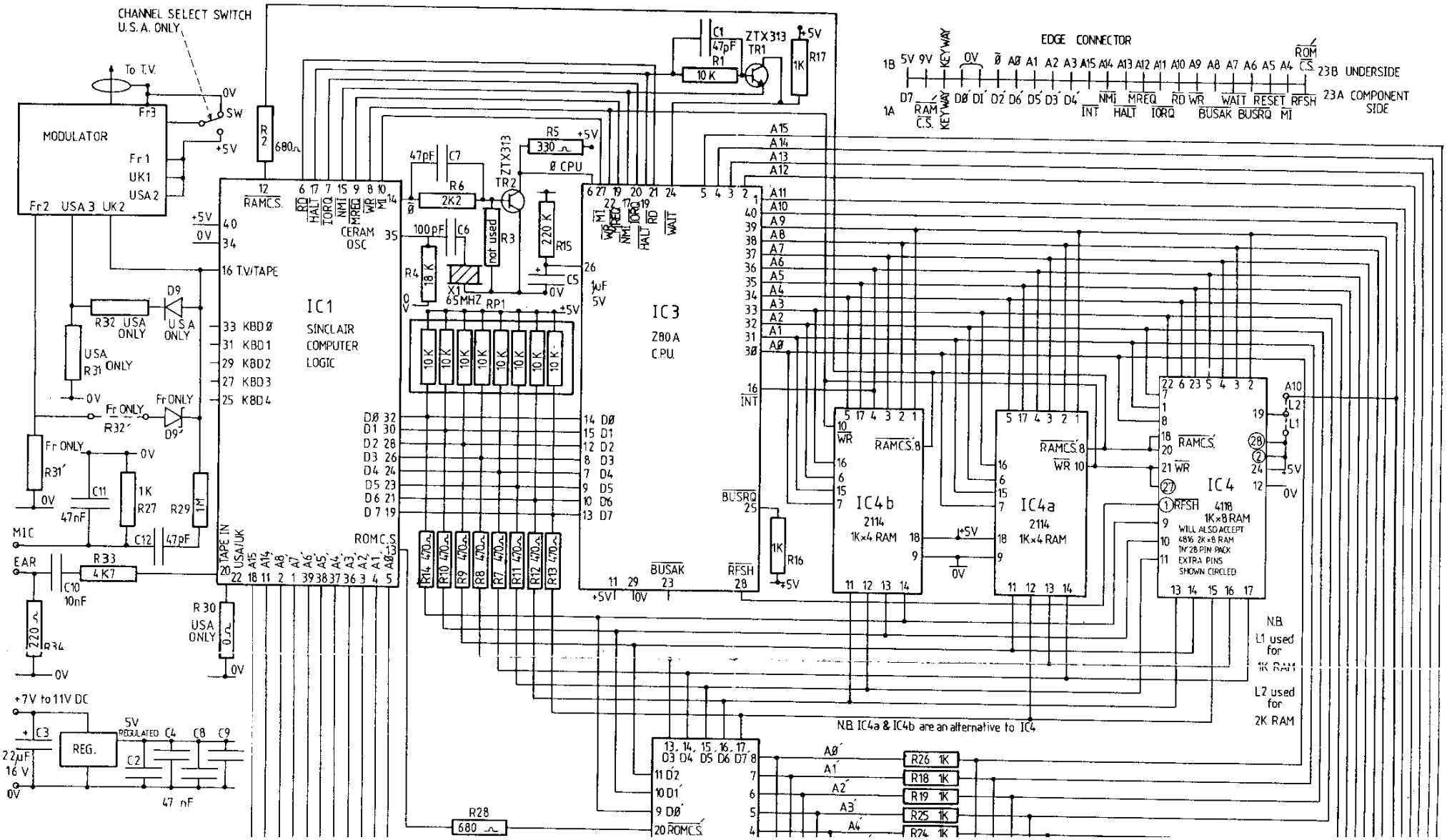
FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554



DRW No. SRC 049

SINCLAIR ZX81

FOR SERVICE MANUALS
contact


CHANNEL SELECT SWITCH
U.S.A. ONLY
To T.V.
MODULATOR
Fr3
Fr1
UK1
USA2
Fr2 USA3 UK2
SW
0V
+5V
R2 680Ω
IC1
SINCLAIR
COMPUTER
LOGIC
CERAM
OSC
RAMCS.
TV/TAPE
KBD0
KBD1
KBD2
KBD3
KBD4
IC3
Z80A
CPU
ø CPU
ZTX313
TR1
TR2
C1 47pF
R1 10K
R17 1K
R5 330
R6 2K2
C7 47pF
C6 100pF
R4 18K
X1 6.5MHZ
C5 1µF 5V
R15 220K
not used
R3
RP1
10K
D9
R32 USA ONLY
USA ONLY
R31 USA ONLY
Fr ONLY
R32'
D9'
R31'
C11 47nF
R27 1K
R29 1M
C12 47pF
MIC
EAR
R33 4K7
C10 10nF
R34 220Ω
R30 USA ONLY 0Ω
TAPE IN
USA/UK
ROMCS
BUSRQ
BUSAK
RFSH
INT
WR
IC4b
2114
1K×4 RAM
IC4a
2114
1K×4 RAM
IC4
4118
1K×8 RAM
WILL ALSO ACCEPT
4816 2K×8 RAM
IN 28 PIN PACK
EXTRA PINS
SHOWN CIRCLED
R16 1K
R14 470Ω
R10 470Ω
R9 470Ω
R8 470Ω
R7 470Ω
R11 470Ω
R12 470Ω
R13 470Ω
R28 680Ω
R26 1K
R18 1K
R19 1K
R25 1K
R24 1K
+7V to 11V DC
C3 22µF 16V
REG.
5V REGULATED
C4
C2
47 nF
C8
C9
EDGE CONNECTOR
1B 5V 9V KEYWAY 0V ø A0 A1 A2 A3 A15 A14 A13 A12 A11 A10 A9 A8 A7 A6 A5 A4 ROM C.S. 23B UNDERSIDE
1A RAM C.S. KEYWAY D0 D1 D2 D6 D5 D3 D4 INT HALT IORQ BUSAK BUSRQ MI 23A COMPONENT SIDE
N.B. IC4a & IC4b are an alternative to IC4
N.B.
L1 used for 1K RAM
L2 used for 2K RAM

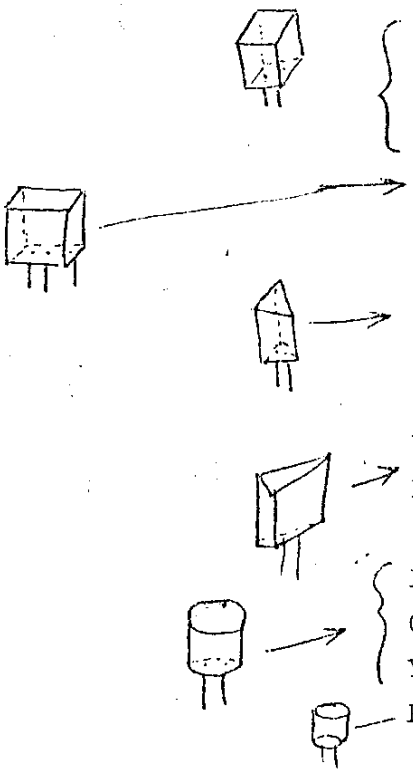
COMPONENTS & ACCESSORIES

FOR THE SUGGESTED APPLICATIONS FOR USER PORT

7416	25p
74LS47	40p
OA 91 diode	9p
0.2" LED RED	13p
0.2" LED GREEN	15p
Mounting Clip for Round Led	3p
Rectangular Led (Red Yellow or Green)	30p
Mounting Clip	7p

FND 507 (Single Digit Display)	110p
16 pin DIL Header Plug	60p
16 pin Header with 24" Cable Open ended	180p
Low current Solid State Buzzer	100p
6 Volt Relay (Single pole change-over) contact rating 1A 120V AC/241K	160p
Single pole push buttom	15p
Loud Speaker 64R - 80R	80p

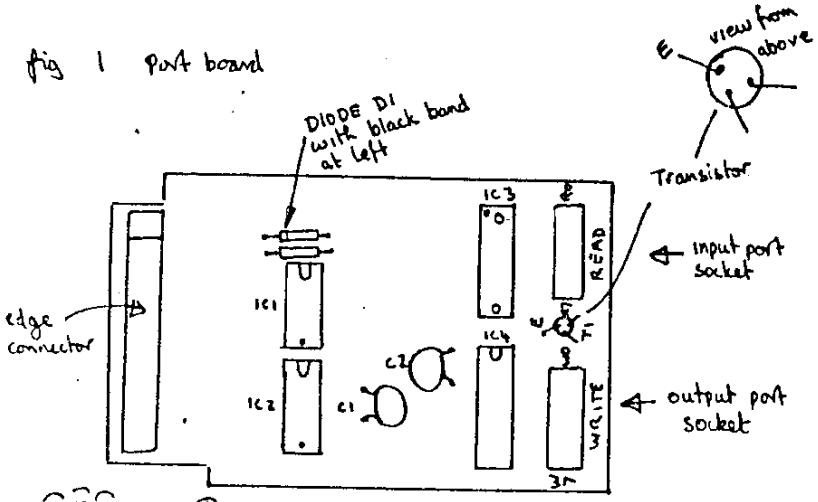
SHAPED LEDS



Green	V532p	31p
Pink	V530p	27p
Yellow	V533p	30p
Red/Orange	V518p	76p
Pink	V540p	27p
Yellow	V543p	30p
Green	V522 PB	42p
Yellow	V553 PB/L	42p
Pink	V550 PB	36p
Pink	V520/p	27p
Green	V522p	31p
Yellow	V523p	31p
Pink	V320p	27p

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

fig 1 Port board



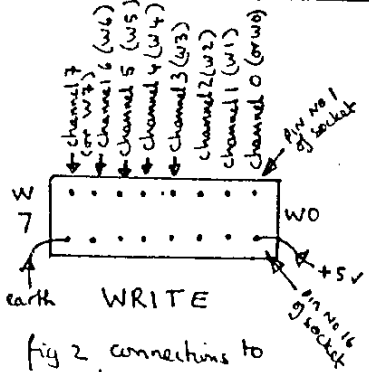


fig 2 connections to output port

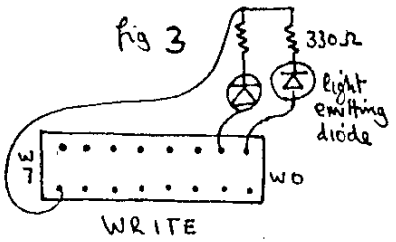


fig 3

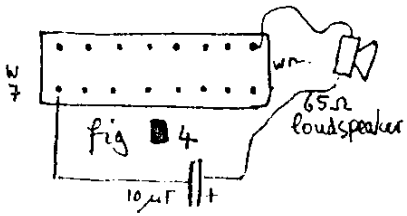


fig 4

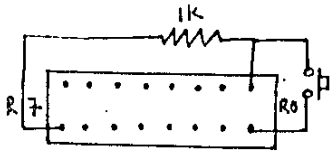
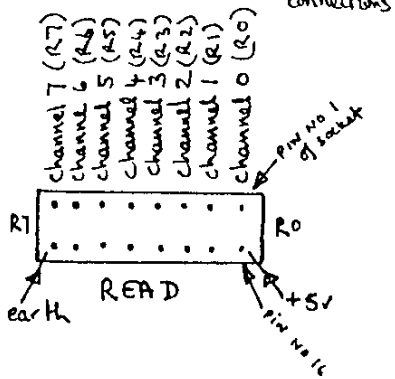


fig 6 push button on channel zero

fig 5 • input port connections



Figs 7+8 - Fixing RAM pack extender card on ZX81 port board

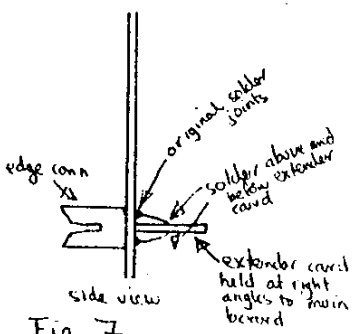
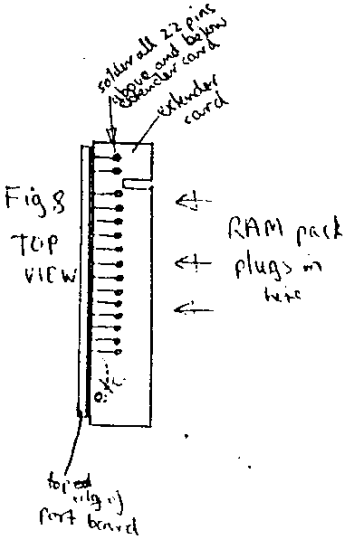


Fig 7



INCREMENTAL SERIES PLUG & SOCKET SWITCH SETTINGS APPENDIX B

General Notes:

Note the positions of the plug-and-socket switches (see Appendix A) and the numbering of the possible positions of the 5 connector plugs. Five distinct ranges of positions correspond to different selection functions described in detail below. There should normally be one plug in each of these ranges.

MBSA (Memory Board Start Address select)

Selects the position in the 64K address space of the ZX81 microprocessor of the memory on the memory board.

Normally set to 2 so that memory runs from address 16K upwards.

1	0 (Start address of ZX81 8K ROM)
2	8K (1st free location above 8K ROM)
3	16K (Normal position of start of RAM)
4	24K
5	32K (1st free location above 16K pack)
6	40K
7	48K (1st free location above 32K pack)
8	56K
9	Nowhere! (ie memory board disabled)

ZRS (ZX81 (1K) RAM select)

Selects distance above MBSA of the 1K RAM on the ZX81 board thus allowing it to be placed diately above the memory on the memory board without any gaps and used normally.

10	MBSA (Set if no memory on memory board)
11	MBSA+2K (Set for 2K (ie 1 chip) on m boar
12	MBSA+4K (2 chips on memory board)
13	MBSA+6K (3 chips...
14	MBSA+8K (4 chips...
15	MBSA+10K (5 chips...
16	MBSA+12K (6 chips...
17	MBSA+14K (7 chips...
18	Nowhere! (ie ZX81 RAM disabled)

19	Unused
20	Unused

BSS ((Memory) Board Block Size Select)

If you wish the memory board to occupy only 8K of address space must set positions 22 and 24. Normal setting is 21 and 23(for 16K block size).

21	Must be set if more than 8K on memory boar
22	Set if 8K or less on memory board.
23	Set if more than 8K on memory board.
24	Set if 8K or less on memory board.

TRS (Total RAM Select)

Enables or Disables Adress line 15 to MBSA decoder.

25	Set if total RAM not more than 16K.
26	Set if total RAM is more than 16K.
27	Unused

Examples;

Hardware Configuration	Switch settings MBSA	ZRS	BSS	TRS
1. ZX81 with original 1KRAM still on ZX81 board with Incremental containing one 2K RAM chip. No external memory.	3	11	21,23	25
2. ZX81 with original 1K RAM still on ZX81 board with Incremental containing full 16K of RAM. No external memory.	3	18	21,23	25
3. ZX81 with 16K add-on pack and original 1K RAM still on ZX81 board with Incremental containing 2K of RAM.	5	11	21,23	26
4. ZX81 with 1K RAM still on ZX81 board and 48K external add-on memory with Incremental containing 8K of memory to give the maximum possible directly addressed RAM (56K = 64K - 8K ROM)	2	18	22,24	26

General Notes:

All RAM pack add-ons of 16K or over known to us (except for our own) have a built-in disable of the original 1K RAM on the ZX81 board. Hence it is not possible to use the 1K RAM on the ZX81 board if such an external memory is in use. As well as this it is necessary to make the Incremental RAM selection agree with the external memory - ie the ZR plug must be set for diable (see Appendix B).

Also, it should be understood, that the decoding for the 1K and 16K RAMS that exist in the ZX81 is only partial and ignores bit 15 of the address. If the total RAM is not mor than 16K it is as a result of this necessary to mask bit 15 of the address to the Incremen decoding and this is the purpose of positions 25 and 26 on the plug-and-socket switches. Clearly, if more than 16K RAM exists on the system it will be necessary to use bit 15 to differentiate between 16K blocks. Please refer to Appendix B for meanings of switch setting abbreviations.

Note - In the following table of switch settings NC meand - No change from the correct setting for Incremental memory running on its own.

	MBSA	ZRS	BBS	TRS
6K RAM packs e.g. Sinclair, Audio Computers etc.	5	18	NC	26
32K RAM packs. e.g. Audio Computers. Pins 3 and 14 Of IC3 on Audio Computer board should be directly connected to place second (16K) half of 32K at top of memory (ie from address 48K to 64K so that Incremental memory can be placed in between the halves giving 48K of continuous memory.	5	18	NC	26
48K RAM packs. e.g. Memotech. The remaining 8K of the 64K address space lying between the 8K ROM and the 48K RAM can be occupied by the Incremental board with the following switch settings to give the maximum possible directly addressed RAM of 56K.	2	18	22,24	26
8K RAM packs. Sinclair? Others? The Incremental can be placed immediately above as follows.	4	18	22,24	25

Others

Please call us for advice on any other packs that you may come across in the future concerning the packs mentioned above.

INCREMENTAL SERIES --- HINTS and TIPS

Extracting chips from their sockets.

Take your time. The danger is that you are exerting a lot of force and suddenly one si end of the chip comes away bending the remaining pins drastically. For this reason it a good idea to lever the chip out with a screwdriver or pencil thus avoiding sudden mo Care should be takeh when levering not to damage the tracks under the socket (if the so is of the open window type). It is usually possible to actually lever on the socket. Note that the chip body is extremely rugged - it is the pins which are fragile and whic will stand only so much bending back and forth.

Insertion of chips into their sockets.

This is more difficult than extraction. Again, do not hurry.
It is possible to align the pins to the socket holes (ie getting them straight in line with the rigth distance between the rows) by grasping the chip firmly by the ends betwe thumb and forefinger and pressing a row of pins flat down on the table being careful to avoid sudden slips. Once the pins are reasonably well aligned the chip should be placed in the socket (the right way round!) with the pins located in the holes in the socket plastic (but not yet in the connectors). It can theh be jiggled into place keeping a close eye for caught pins which are starting to bend.

Pin numbers of chips.

By convention, with the chip on the table before you standing on its pins with the indentation at the end of the chip body away from you, the pins are numbered starting at 1 at the far corner on the left, down the left side and back up the right side to the far right hand corner. It is frequently disastrous to insert chips the wrong way round in their socket and apply power.

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

You will require a small conventional screwdriver, a small phillips (cross headed screw screwdriver and the ZX81 manual.

Refer to Appendix A for description of board layout.

Remove all leads and attachments from your ZX81.

Place ZX81 on table before you as for normal use.

Turn ZX81 over as though it were the front cover of a book.

Peel off the footpads located at the NW, SW, and SE corners of the bottom of the ZX81.

Completely loosen the five small recessed bolts which are now visible and lightly replace footpads to avoid losing the three corner screws.

Lift of the bottom of ZX81 case and put it aside.

Remove the two additional bolts now visible, remembering their position.

Note that the ZX81 board is now attached to the keyboard half of the case by just a thin ribbon cable which you must take care not to damage. We do not recommend that the ribbon be removed from its socket on the ZX81 board and there is no necessity to do this if thes instructions are followed.

Taking care not to strain the ribbon cable, turn the ZX81 board (not the case) over as though it were the top card on a deck (ie. the heat sink (big rectangle of metal) goes under the board and away from you).

Turn to the chapter in the ZX81 manual entitled 'How the computer works' which contains a picture of what now lies before you. Note the positions of the CPU and the 1K RAM.

Take the memory board and find the positions of the ROM CS and the RAM CS depicted thereon With these depictionsuppermost and towards you, position the memory board over the ZX81 board with the 40 protruding pins lying directly over the CPU on the ZX81. This is the position of fitting which you should now remember.

If the Sinclair 1K RAM is socketed (rather than soldered to the ZX81 board) then remove it and put it aside. (see section entitled 'Hints and Tips' for advice on removal and insertion of chips)

Remove CPU from ZX81 and insert it into memory boardbeing sure to match indentation at end of CPU body with paint spot on memory board.

Remove the 14BA bolts (there are 4) and washers from their guides on the memory board. Note - you could fit the memory board directly in this position but this would necessitate the removal of the ribbon cable from its socket in order to turn the board assembly back on its tummy for reassembly of the case. - Instead make sure you know the poistion of fitting before going on to next step.

Swivel the ZX81 heat sink to the extreme right to be sure of clearing thememory board when fitting. Do not forget to move it back later!

Turn ZX81 board back on its tummy (ie components downward).

Turn ZX81 (including case) round 180 degrees so that heat sink is away from you.

Lift ZX81 board with left hand slipping memory board underneath it and around the ribbon cable and into poition with the other hand (ie so that pins are directly under ZX81 CPU socket).

Carefully insert pins into ZX81 CPU socket with even pressure from thumbs on CPU body - Be extremely careful to be sure that all 40 pins are going in straight and are not bending. Do not insert too far into the socket - the correct depth of insertion will be automatically attained on fitting the four bolts.

PTO

Having fitted the memory board to your ZX81, now remove anything you may have p in to the expansion port. Then -

(i) Turn on your ZX81 and wait a few seconds for the cursor to appear.

i IF the cursor came up as normal THEN GOTO (iv).

(iii) The cursor hasn't come up so try turning on ZX81 a couple more times. If still unsuccessful the problem is almost certainly a bad connection between the memory b and the ZX81 board. So -

IF you have a multitester THEN

Test all 40 pins of the CPU connect through to the ZX81 board.
Test all 4 bolt guides connect to track on ZX81 board.
Check that washers are not causing shorts on ZX81 board.

IF all connections seem OK then it is likely that there is a fault in the memory board so GOTO end - testing failed.

IF you do not have a circuit tester then remove the memory board and check that no pins are bent over. If they are it may be possible to straighten it again without breakage. If one breaks then there is nothing for it but the soldeeing iron!

(iv) Find out the contents of RAMTOP (see ZX81 manual if interested) as follows - Type in

PRINT PEEK 16389

the result will come up on the screen and should be checked against the table below. Note that if the original 1K RAM has been removed from the ZX81 board that the RAMTOP value should be 4 less than the figure in the table. If this is the case and RAMTOP is correct then you may plug in the removed 1K chip (if it is 1K of course) to the first available socket on the memory board - at the same time you ought to move the plug selecting the 1K RAM to disable (position 18) to avoid the ZX81 decoding fighting the memory board decoding and consuming unnecessary current.

TABLE of correct RAMTOP values.

No. of 2K chips fitted to memory board.	Corresponding value of RAMTOP
0	
1	68
2	76
3	84
4	92
5	100
6	108
7	116
8	124
	128

IF RAMTOP does not correspond to the number of memory chips then
Note the actual value obtained
Obtain the value of location 16388 (type in PRINT PEEK 16388 to get this) and note
Call us.

end.

(Continued)
Position the four bolts and washers back into their original positions except that now of course they pass through corresponding holes in the ZX81 board. Note that if they do not push in freely they may be lightly screwed in.

Engage the bolts in the nuts soldered to the ends of the bolt guides to take the memory b firmly up to the ZX81 board establishing a rigid structure and firm electrical connectior between the bolt guides and the ZX81 board track. Check that the washers are not causing shorts on the ZX81 board (this can happen if the ZX81 board coatings are worn away - the washers are there to prevent such wear from the bolt heads.)

(Note that it is possible in this situation to fit the top three memory chips next to the CPU (ie it is not necessary to separate the memory board from the ZX81 board in order to them)).

IMPORTANT!!!!!!!!!!!!!!!!!!
IMPORTANT!!!!!!!!!!!!!!!!!!

DO NOT FORGET TO MOVE THE HEAT SINK BACK as follows - Swivel the heat sink hard up against the protecting pin on the memory board - Failure to do this can cause a disastrous short on the ZX81 board!

Position the board assembly snug into the ZX81 case top ensuring that the fourcase lugs have cleared the holes provided for them in the memory board.

Refit the two bolts securing the ZX81 board to the keyboard half of case (in the correct positions).

(Note that in this situation the first five memory sockets are accessible as well as all 26 positions of the plug-and-socket switches).

Replace the bottom half of ZX81 case - the securing of the five bolts can be postponed till testing is successfully completed).

Test (see section on testing).

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

REMOVING

Remove all leads from ZX81.

Remove bottom of ZX81 case (see 'Fitting').

Remove the two bolts securing board assembly to keyboard half of case.

Remove the four 15BA bolts & washers securing the memory board to the ZX81 board.

Place a medium size screwdriver between memory board and ZX81 CPU socket and carefully Lever the boards apart being sure not to bend pins as they come out of CPU socket. Make sure that the point of the screwdriver pushes on the ZX81 CPU socket and not on board tracks which might be so damaged.

FITTING OF ADDITIONAL MEMORY CHIPS.

Remove all leads and attachments from ZX81 and remove bottom of case (See 'Fitting').

Note that the memory sockets are numbered from 1 to 8 (see Appendix A) and will normally be filled in that order.

IF the sockets 1 to 5 are already filled THEN
Remove the two bolts securing board assembly to keyboard half of case.
Carefully place whole assembly with keyboard uppermost and move keyboard to expose memory sockets (do not strain the ribbon cable). Support the board with fingers as you plug in the memory chip to the first available socket (see Hints and Tips).
ELSE IF sockets 1 to 5 are not all filled then simply plug in chip to first available

When all is well, insert the diode and transistor the correct way around - as indicated in fig 1. Finally insert the 4 ICs, again consult fig 1 for polarity. ICs inserted the wrong way around will almost certainly be destroyed when the board is plugged in - so be particularly careful here.

When construction is complete, plug in the board, and apply power to the ZX. Again the machine should operate as normal - if not, check that the ICs are correctly inserted, and that there are no board shorts.

Once the board is functioning there are many tests and experiments that may be performed - including full frequency range audio output - see articles in Personal Computer World (October and November 1981). But here are some introductory notes:

Output Port

Connection to the port are shown in fig. 2. There are 8 separate output channels, and they may be controlled with a single poke statement: POKE 25000, X for the ZX80 or POKE 11000,X for the 81. X may be any integer between 0 and 255. With X=0 all output lines are set to logic low, whilst 255 sets them all high. To set any one channel high while leaving the remainder low, the following values should be used:

POKE VALUE (X)	CHANNEL ACTIVATED
1	0
2	1
4	2
8	3
16	4
32	5
64	6
128	7

Thus the command POKE 25000, 16 (or POKE 11000, 16 on the 81) will set channel 4 high, leaving the others low. Setting a high output on a number of channels is achieved by combining the data. Thus POKEing the value 12 (=8+4) will set channels 2 and 3 high.

When a channel goes high it may be used to trigger a variety of devices. Fig 3 shows LED indicator lamps attached to channels zero and one. To light these, execute POKE 25000, 3 (or POKE 11000, 3 on the ZX81).

Relays may be controlled from each channel as shown in the application notes, and sound output may be produced by connecting a high impendence (eg 65 ohm) loudspeaker to the ouput plug as in fig. 4. The following programs will produce blips on the loudspeaker:

```
10  REM ZX80 BLEEP
20  FOR A = 1 TO 100
30  POKE 25000,1
40  POKE 25000,0
50  NEXT A
```

```
10 REM ZX81 BLEEP
15 FAST
20 FOR A = 1 TO 100
30 POKE 11000,1
40 POKE 11000,0
50 NEXT A
```

To produce a higher frequencies and more interesting effects it is necessary to use a machine code subroutine, and complete programs for this on both ZX80 and 81 are given in the applications notes, and in PCW.

TECHNOMATIC LIMITED

17 BURNLEY ROAD
LONDON NW10 1ED

Telephone: 01-452 1500 01-450 6597

12c

DEG ZX80/81 PORT - NOTES TO ACCOMPANY KIT

The following is provided:-

1	Double sided PCB
4	Ics labelled 1 - 4
1	Diode (IN914) (glassy)
1	Resistor (1K)
2	Capacitors (100nF) (round and flat)
2	14 Pin Dil Sockets
2	16 Pin Dil Sockets
2	20 Pin Dil Sockets
1	23 x 2 0.1" edge connector
2	16 Pin Header Plugs
1	2N2926 (green) Transistor
1	RAM pack extender card (ZX81 only)

Construction

Begin construction as follows: Insert and solder in the 6 1 C Sockets, putting in the largest ones first. Next solder in the 2 3 way edge connector, but if the board is for use with the ZX81 do not trim short the wires protruding through the underside of theboard, because these will be used for connecting the RAM pack extender card. (this is not possible on the ZX80) Note that the edge connector whould have a plastic plug at pin 3. Be very careful not to bridge adjacent tracks when soldering this socket. To reduce the risk of this you can leave unsoldered any pins that don't appear to join up to a track on the underside of the board. Insert the two capacitors and resistors, and solder these.

Next solder the through connections at all the remaining holes that have solder pads on the upper side of the board except

EITHER the three marked 'A' if the board is for use with a ZX81 (note that the third 'A' is somewhat obscured by the edge connector)

OR the two marked B if it is for a ZX80. The through connections require a piece of wire to be passed through the board, and carefully soldered both sides before clipping off.

At this point, and before inserting the ICs or the diode and transistor, plug the board into the ZX80/81, and plug the power plug into the computer. The cursor should appear, and the ZX should work normally. If it does not, there is a short circuit somewhere on the board - probably between a pair of adjacent tracks. The short can be traced (after unplugging the board) using a multimeter on the ohms range, or other continuity tester (eg battery and bulb) - or you can search visually. If it is a solder bridge then you must resolder the point, but you may find that you can clear the short by passing a small screwdriver blade between the offending tracks.

Input Port

Connections to the input port are shown in fig 5. Again there are 8 separate channels, and they may be read with a single PEEK statement. The command PRINT PEEK (25000) on the ZX80, or PRINT PEEK 11000 on the 81 will print a value between 0 AND 255 representing the state of the 8 lines. If any line is held at logic low it will contribute a zero to this figure. If it is at logic high it will contribute a value corresponding to the data on the POKE table above. Thus if channels zero and 7 are high, but the rest low, the value printed by the PEEK statement will be 129 (=128+1), and so on.

The circuit of fig.6 shows a single push button connected to channel 7. When the button is pressed, channel 7 will go high - otherwise it is kept low by the resistor to ground.
To test the state of the switch, use an expression such as:

IF PEEK (25000)>127 THEN GO TO 100 (ZX80)
or IF PEEK 11000 >127 THEN GO TO 100 (ZX81)

This will cause a jump to line 100 if the switch is closed. Note that if nothing is connected to any channel, it will resume a high state so that PEEKing the port with nothing connected should produce a value of 255. If it does not, then all board connections should be checked.

Further applications details are given in the applications booklet.

RAM Pack Extender Card

Once the port is working satisfactorily on both input and output, the extender card should be soldered in. This allows the simultaneous use of the RAM pack and port board on the ZX81, though this is not possible on the ZX80. The extender card solders to the rear of the edge connector to effectively extend the extension plug at the rear of the ZX81. See Figs 7 & 8. To wire up the card, first bend the edge connector pins towards each other so that the card just fits between them. Then position the card between them as in Figs 7 and 8. The card should be positioned with notch outwards (i.e away from the main port board), and exactly at right angles to the port board. Now carefully solder the 22 upper and 22 lower pins to the extender card, keeping the card at right angles to the main board.

When you have checked that there are no solder bridges, you should be able to plug the RAM pack into the extender card, and the port onto the ZX81. To use this tandem arrangement satisfactorily, the ZX81 and extensions should be kept on a flat surface to avoid poor contacts through flexing of the board. If the system fails to operate with the RAM connected, try flexing the arrangement and reinserting the power plug. All boards should be inserted as far as they will go.

Note when using the RAM pack as well as the port board you will not be able to drive so many external devices (lamps, relays etc) with the output port. If in doubt, check that the ZX81 is not getting too hot.

Errata

There are two minor corrections to the circuits issued in the applications booklet and in PCW.

1. In all applications using the high impedance loudspeaker, this should be connected via a 10 mfd capacitor to earth as shown in fig 4 of the attached sheet, and not directly to the positive supply as in PCW.

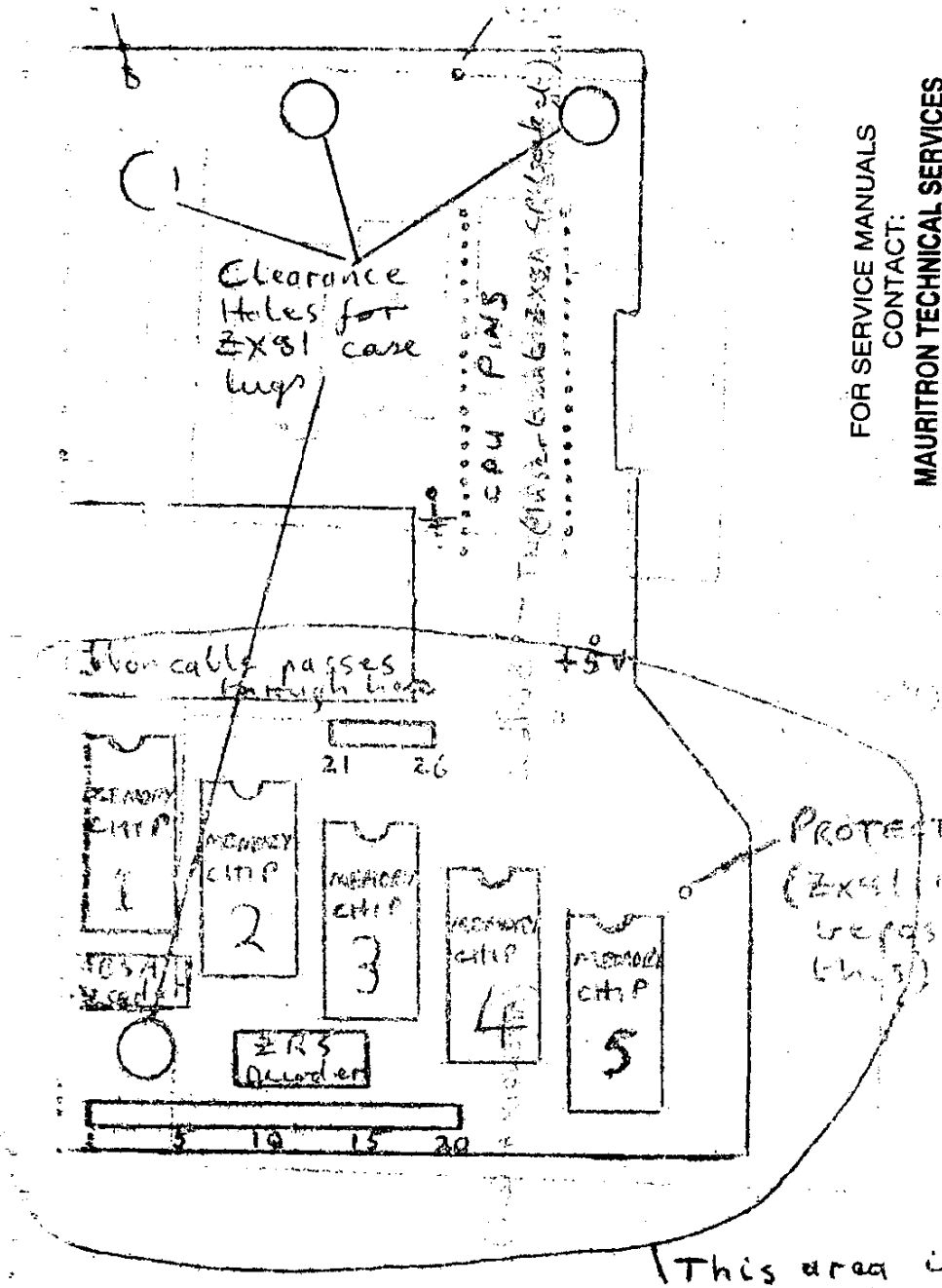
2. In all applications of the solid state buzzer, this should be connected between the particular channel that it is used with, and the positive supply (pin 16), rather than earth (pin 9). The polarity of the buzzer should also be reversed, so that its red lead is on the positive supply. It will function as connected in the applications circuit, but it works more effectively as described here.

Loudspeaker

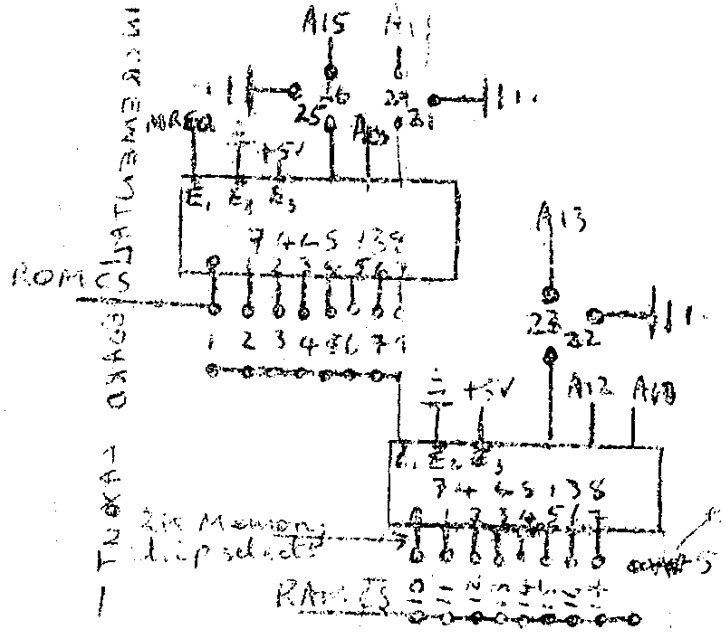
A suitable loudspeaker for audio output may be obtained from Technomatic Limited at 80p + P&P + VAT.

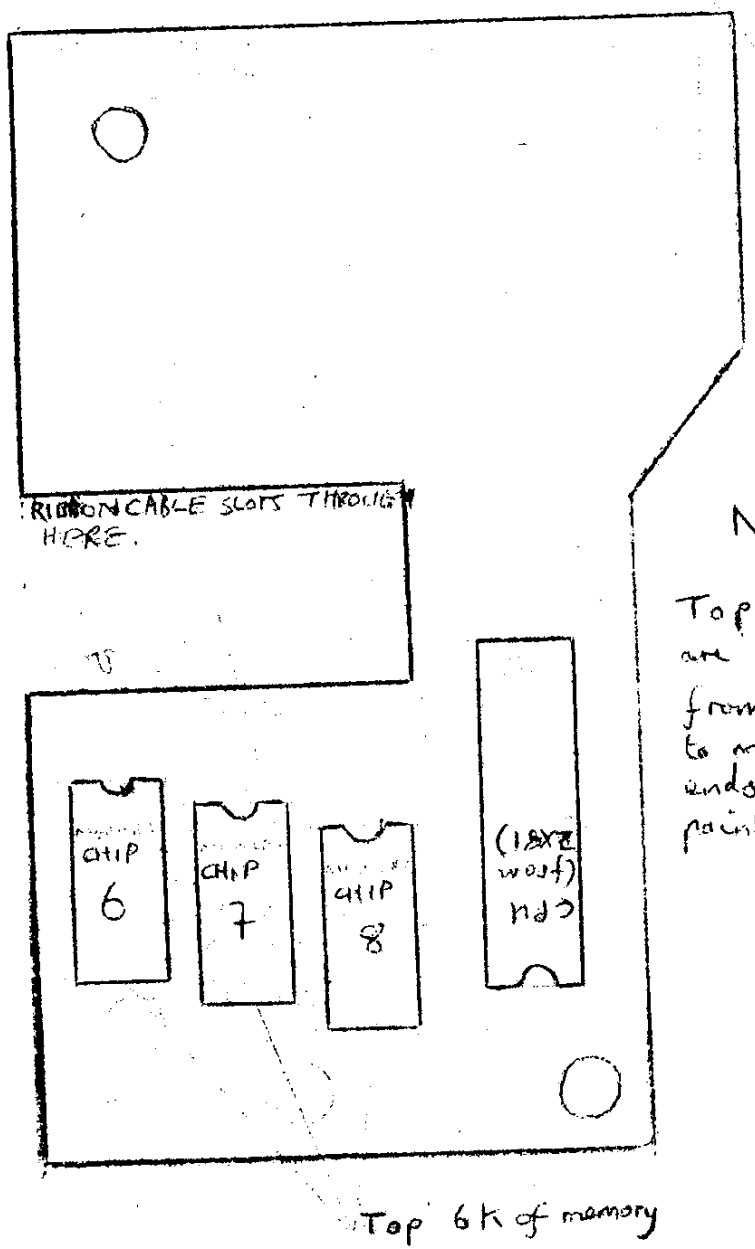
FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554



CIRCUIT SCHEMATIC



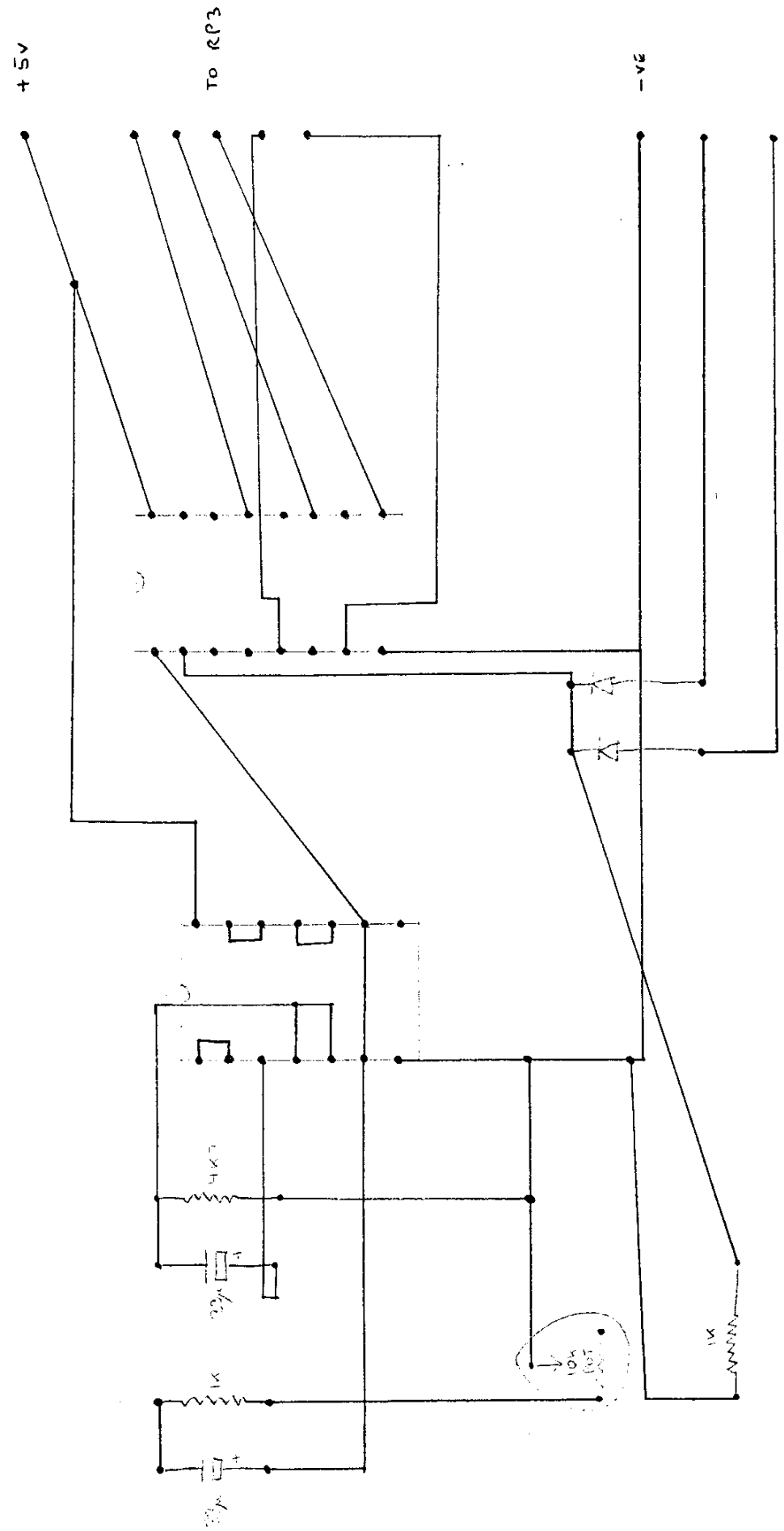


Top 6K of memory

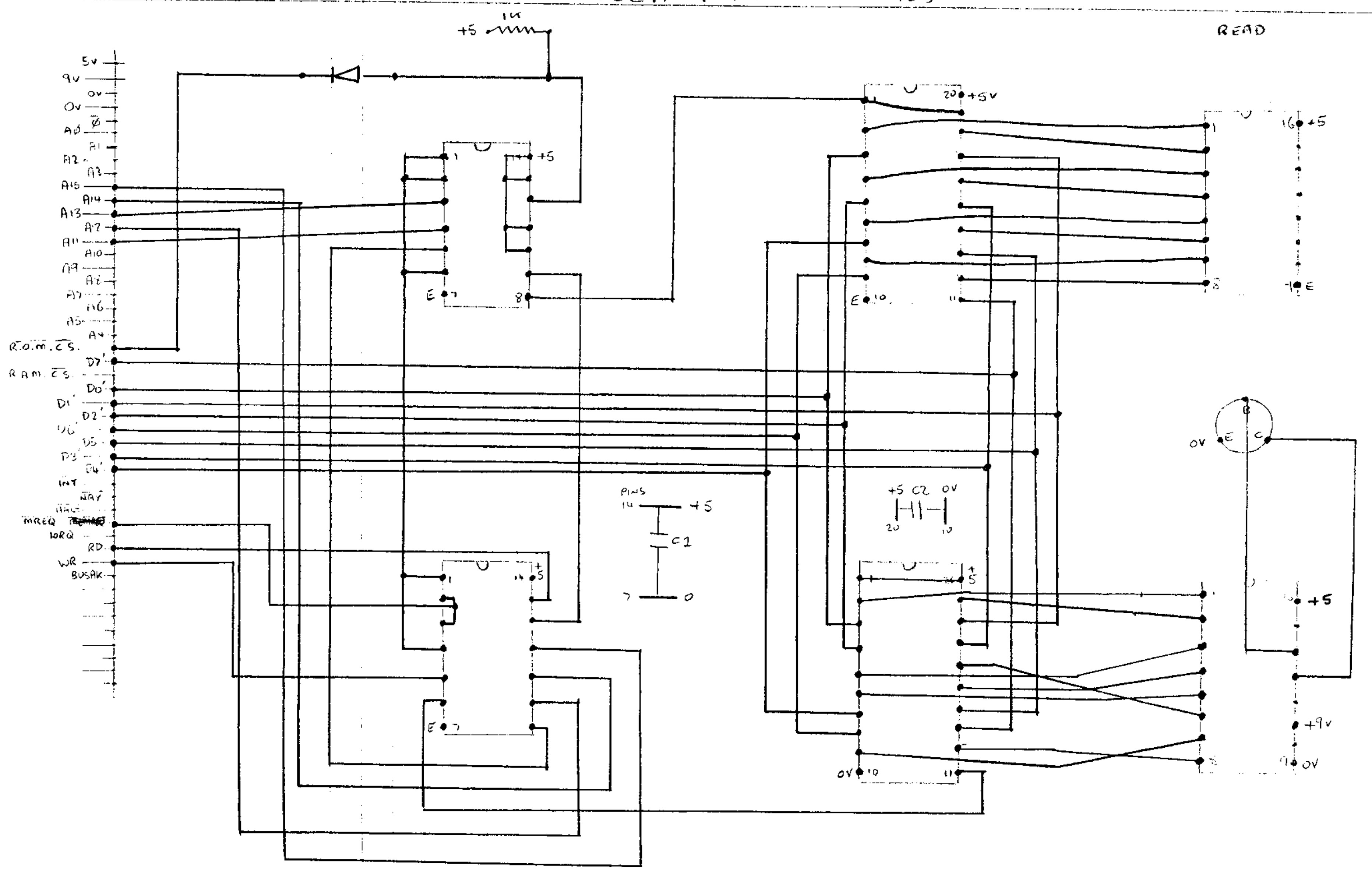
NOTE!!!

Top 3 Memory Chips are different way round from CPU!! Be Sure to match Indentations at ends of chip bodies with paint spots on board.

REPEATING KEY UNIT

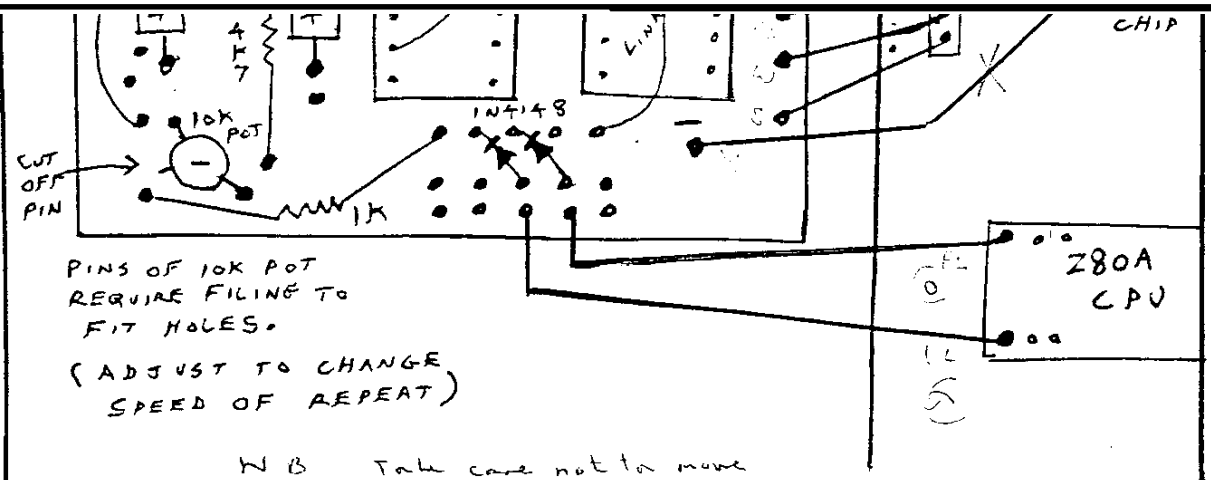


USER PORT



IC3
READ
+5
1K
5V
9V
0V
A0
A1
A2
A3
A15
A14
A13
A12
A11
A10
A9
A8
A7
A6
A5
A4
R.O.M. CS.
D7'
RAM. CS.
D0'
D1'
D2'
D6'
D5'
D3'
D4'
INT
MREQ
IORQ
RD
WR
BUSAK
+5V
+5 C2 0V
C1
PINS 14
+9V
0V

ZX81 KEY MODULE



PINS OF 10K POT REQUIRE FILING TO FIT HOLES.

(ADJUST TO CHANGE SPEED OF REPEAT)

NB Take care not to move 2 links when soldering I/C sits

© H.H.8 1981

ZX81 KEY MODULE

KIT Solder sockets then other components into positions shown. Plug in the two IC's, checking notched end is as indicated. Solder two links under board.

Connections to computer

Remove ZX81 bottom. (Remove feet and unscrew.) Connect the nine wires as in diagram to the underside of the computer's PCB, soldering to terminals.

Use short stiff wires. The module will fit inside case.

Test all keys to make sure they repeat and adjust pot to give required speed.

PARTS

1	P.C.B
1	14 pin chip
1	16 pin chip
1	14 pin socket
1	16 pin socket
2	33μF capacitors
2	1K resistors
1	4K7 "
1	10K pot
2	1N4148 diodes

© HH9 1981

BEFORE UNPACKING

PLEASE NOTE ! - the position of the 40 protruding pins protected by the block of polystyrene foam. We suggest that this protection be retained until actual fitting. Also we strongly recommend the fitting and testing of the memory board as supplied before carrying out any adjustment to switch settings, plugging in extra chips etc.. Finally, from bitter experience, we think it worth reading the instructions right through before doing anything else.

Supplied by: EAST LONDON ROBOTICS,
Finlandia House,
14, Darwell Close,
East Ham,
LONDON E6 4BT

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

CONTENTS.

APPENDIX FOUR

This table shows, in more or less alphabetical order (except where not convenient), each Z80 instruction and either its hexadecimal code, or the words "table 1", "table 2", or "table 3". In such a case, looking up the appropriate table will give the hexadecimal code required. This appendix also lists the flags that are altered by each instruction. Usually it will be impossible to test flags H and N, but note that PUSH AF followed by POP BC allows you to test all of the flags by then examining the register C. The symbols used here are:

@	The flag is altered by the instruction.
-	The flag is NOT altered by the instruction.
0	The flag becomes zero.
1	The flag becomes one.
?	Random.
x	Special case. An explanation will be given.

INSTRUCTIONS Opcode	Hexcode	FLAGS S Z - H - P N C
ADC A,r	table 1	@ @ - @ - @ 0 @
ADC HL,s	table 2	@ @ - @ - @ 0 @
ADD A,r	table 1	@ @ - @ - @ 0 @
ADD HL,s	table 2	- - - @ - - 0 @
ADD IX,s	table 2	- - - @ - - 0 @
ADD IY,s	table 2	- - - @ - - 0 @
AND r	table 1	@ @ - 1 - @ 0 0
BIT b,r	table 1	? @ - 1 - ? 0 -
CALL pq	CDqqpp	- - - - - - - -
CALL c,pq	table 3	- - - - - - - -
CCF	3F	- - - x - - 0 @
(the H flag becomes the previous value of the C flag.)		
CP r	table 1	@ @ - @ - @ 1 @
CPI	EDA1	@ x - @ - x 1 -
CPD	EDA9	@ x - @ - x 1 -
CPIR	EDB1	@ x - @ - x 1 -
CPDR	EDB9	@ x - @ - x 1 -
(in these four instructions Z is 1 if BC becomes 0, and P/V is 1 if A equals (HL).)		
CPL	2F	- - - 1 - - 1 -
DAA	27	@ @ - @ - @ - @
DEC r	table 1	@ @ - @ - @ 1 -
DEC s	table 2	- - - - - - - -
DI	F3	- - - - - - - -
DJNZ e	10ee	- - - - - - - -
EI	FB	- - - - - - - -
EX AF,AF'	08	- - - - - - - -
EX DE,HL	EB	- - - - - - - -
EX (SP),HL	E3	- - - - - - - -
EX (SP),IX	DDE3	- - - - - - - -
EX (SP),IY	FDE3	- - - - - - - -
EXX	D9	- - - - - - - -

INSTRUCTIONS Opcode	Hexcode	FLAGS S Z - H - P N C
HALT	76	- - - - - - - -
IM 0	ED46	- - - - - - - -
IM 1	ED56	- - - - - - - -
IM 2	ED5E	- - - - - - - -
INC r	table 1	@ @ - @ - @ 0 -
INC s	table 2	- - - - - - - -
IN A,(n)	DBnn	- - - - - - - -
IN r,(C)	table 1	@ @ - @ - @ 0 -
INI	EDA2	? x - ? - ? 1 -
IND	EDAA	? x - ? - ? 1 -
(Z equals 1 if B becomes 0)		
INIR	EDB2	? 1 - ? - ? 1 -
INDR	EDBA	? 1 - ? - ? 1 -
JP pq	C3qqpp	- - - - - - - -
JP c,pq	table 3	- - - - - - - -
JP (HL)	E9	- - - - - - - -
JP (IX)	DDE9	- - - - - - - -
JP (IY)	FDE9	- - - - - - - -
JR e	18ee	- - - - - - - -
JR c,e	table 3	- - - - - - - -
LD (BC),A	02	- - - - - - - -
LD A,(BC)	0A	- - - - - - - -
LD (DE),A	12	- - - - - - - -
LD A,(DE)	1A	- - - - - - - -
LD I,A	ED47	- - - - - - - -
LD R,A	ED4F	- - - - - - - -
LD A,I	ED57	@ @ - 0 - x 0 -
LD A,R	ED5F	@ @ - 0 - x 0 -
(P/V is set to interrupt storage flag)		
LD SP,HL	F9	- - - - - - - -
LD SP,IX	DDF9	- - - - - - - -
LD SP,IY	FDF9	- - - - - - - -

INSTRUCTIONS Opcode	Hexcode	FLAGS S Z - H - P N C
LD rl,r2	table 1	- - - - - - - -
LD s,mn	table 2	- - - - - - - -
LD A,(pq)	3Aqqpp	- - - - - - - -
LD s,(pq)	table 2	- - - - - - - -
LD (pq),A	32qqpp	- - - - - - - -
LD (pq),s	table 2	- - - - - - - -
LDI	EDA0	- - - 0 - x 0 -
LDD	EDA8	- - - 0 - x 0 -
(P/V is 0 if BC becomes 0)		
LDIR	EDB0	- - - 0 - 0 0 -
LDDR	EDB8	- - - 0 - 0 0 -
NEG	ED44	@ @ - @ - @ 1 @
NOP	00	- - - - - - - -
OR r	table 1	@ @ - 0 - @ 0 0
OUT (n),A	D3nn	- - - - - - - -
OUT (C),r	table 1	- - - - - - - -
OUTI	EDA3	? x - ? - ? 1 -
OUTD	EDAB	? x - ? - ? 1 -
(Z is 1 if B becomes zero)		
OTIR	EDB3	? 1 - ? - ? 1 -
OTDR	EDBB	? 1 - ? - ? 1 -
POP AF	F1	x x x x x x x x
(flags are determined by the byte at the top of the stack.)		
POP s	table 2	- - - - - - - -
PUSH AF	F5	- - - - - - - -
PUSH s	table 2	- - - - - - - -

INSTRUCTIONS Opcode	Hexcode	FLAGS S Z - H - P N C
RES b,r	table 1	- - - - - - - -
RET	C9	- - - - - - - -
RET c	table 3	- - - - - - - -
RETN	ED45	- - - - - - - -
RETI	ED4D	- - - - - - - -
RLA	17	- - - 0 - - 0 @
RL r	table 1	@ @ - 0 - @ 0 @
RLCA	07	- - - 0 - - 0 @
RLC r	table 1	@ @ - 0 - @ 0 @
RLD	ED6F	@ @ - 0 - @ 0 -
RRA	1F	- - - 0 - - 0 @
RR r	table 1	@ @ - 0 - @ 0 @
RRCA	0F	- - - 0 - - 0 @
RRC r	table 1	@ @ - 0 - @ 0 @
RRD	ED67	@ @ - 0 - @ 0 -
RST 00	C7	- - - - - - - -
RST 08	CF	- - - - - - - -
RST 10	D7	- - - - - - - -
RST 18	DF	- - - - - - - -
RST 20	E7	- - - - - - - -
RST 28	EF	- - - - - - - -
RST 30	F7	- - - - - - - -
RST 38	FF	- - - - - - - -
SBC A,r	table 1	@ @ - @ - @ 1 @
SBC HL,s	table 2	@ @ - @ - @ 1 @
SCF	37	- - - 0 - - 0 1
SET b,r	table 1	- - - - - - - -
SLA r	table 1	@ @ - 0 - @ 0 @
SRA r	table 1	@ @ - 0 - @ 0 @
SRL r	table 1	@ @ - 0 - @ 0 @
SUB r	table 1	@ @ - @ - @ 1 @
XOR r	table 1	@ @ - 0 - @ 0 0

APPENDIX SIX

OLD ROM SYSTEM VARIABLES:

Decimal	Hex	Name
16384	4000	ERR.NR
16385	4001	FLAGS
16386	4002	PPC
16388	4004	E.ADDR
16390	4006	E.PPC
16392	4008	VARS
16394	400A	E.LINE
16396	400C	D.FILE
16398	400E	DF.EA
16400	4010	DF.END
16402	4012	DF.SZ
16403	4013	S.TOP
16405	4015	X.PTR
16407	4017	OLDPPC
16409	4019	FLAGX
16410	401A	T.ADDR
16412	401C	SEED
16414	401E	FRAMES
16416	4020	V.ADDR
16418	4022	ACC
16420	4024	S.POSN
16422	4026	CH.ADD

NEW ROM SYSTEM VARIABLES:

Decimal	Hex	Name
16384	4000	ERR.NR
16385	4001	FLAGS
16386	4002	ERR.SP
16388	4004	RAMTOP
16390	4006	MODE
16391	4007	PPC
16393	4009	VERSN
16394	400A	E.PPC
16396	400C	D.FILE
16398	400E	DF.CC
16400	4010	VARS
16402	4012	DEST
16404	4014	E.LINE
16406	4016	CH.ADD
16408	4018	X.PTR
16410	401A	STKBOT
16412	401C	STKEND
16414	401E	BERG
16415	401F	MEM
16417	4021	SPARE1
16418	4022	DF.SZ
16419	4023	S.TOP
16421	4025	LAST.K
16423	4027	DB.ST
16424	4028	MARGIN
16425	4029	NXTLIN
16427	402B	OLDPPC
16429	402D	FLAGX
16430	402E	STRLEN
16432	4030	T.ADDR
16434	4032	SEED
16436	4034	FRAMES
16438	4036	COORDS
16440	4038	PR.CC
16441	4039	S.POSN
16443	403B	CDFLAG
16444	403C	PRBUFF
16477	405D	MEMBOT
16507	407B	SPARE2

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
3	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
4	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
5	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
6	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
7	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
8	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
9	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
A	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
B	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
C	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207
D	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
E	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
F	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255

There are fundamental differences between machine code programming and BASIC programming. One of the most fundamental differences is that of LINE NUMBERS.

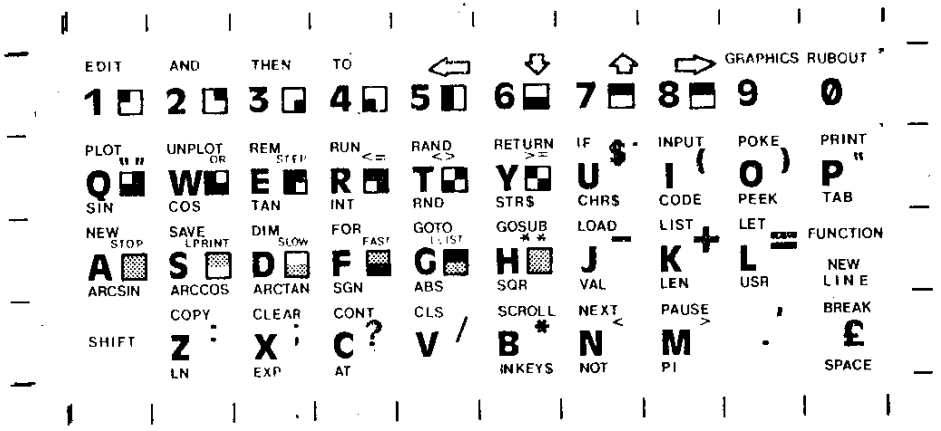
As you know, every BASIC instruction in a program must be preceeded by a line number, so that the computer knows in which order to execute them. If no line number is given the computer will interpret the instruction as a COMMAND and will execute it immediately.

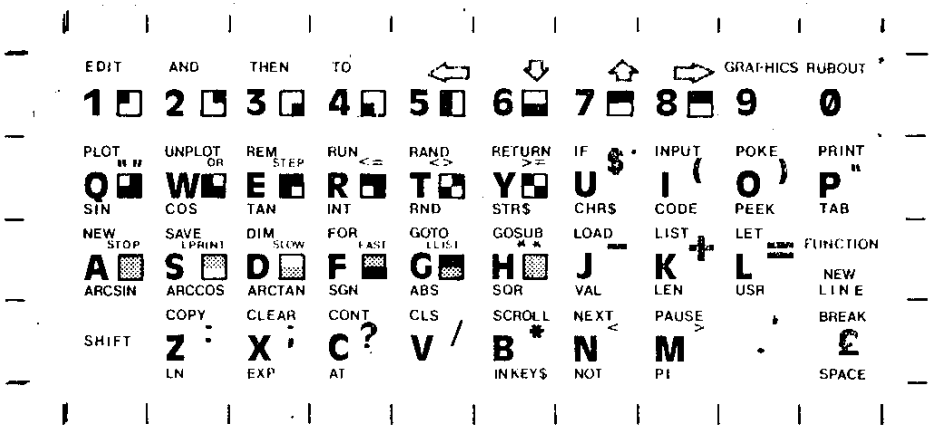
In machine code, there are no line numbers. Also, the ZX80/81 will not allow you to use machine code instructions as commands, they MUST form part of a program. The instructions are executed in the order that they are stored. For example, if the computer had just finished executing the instruction which was stored in location 30000, it would then go on to execute the instruction held in location 30001. It will continue in this way until it recieved an instruction telling it to do otherwise.

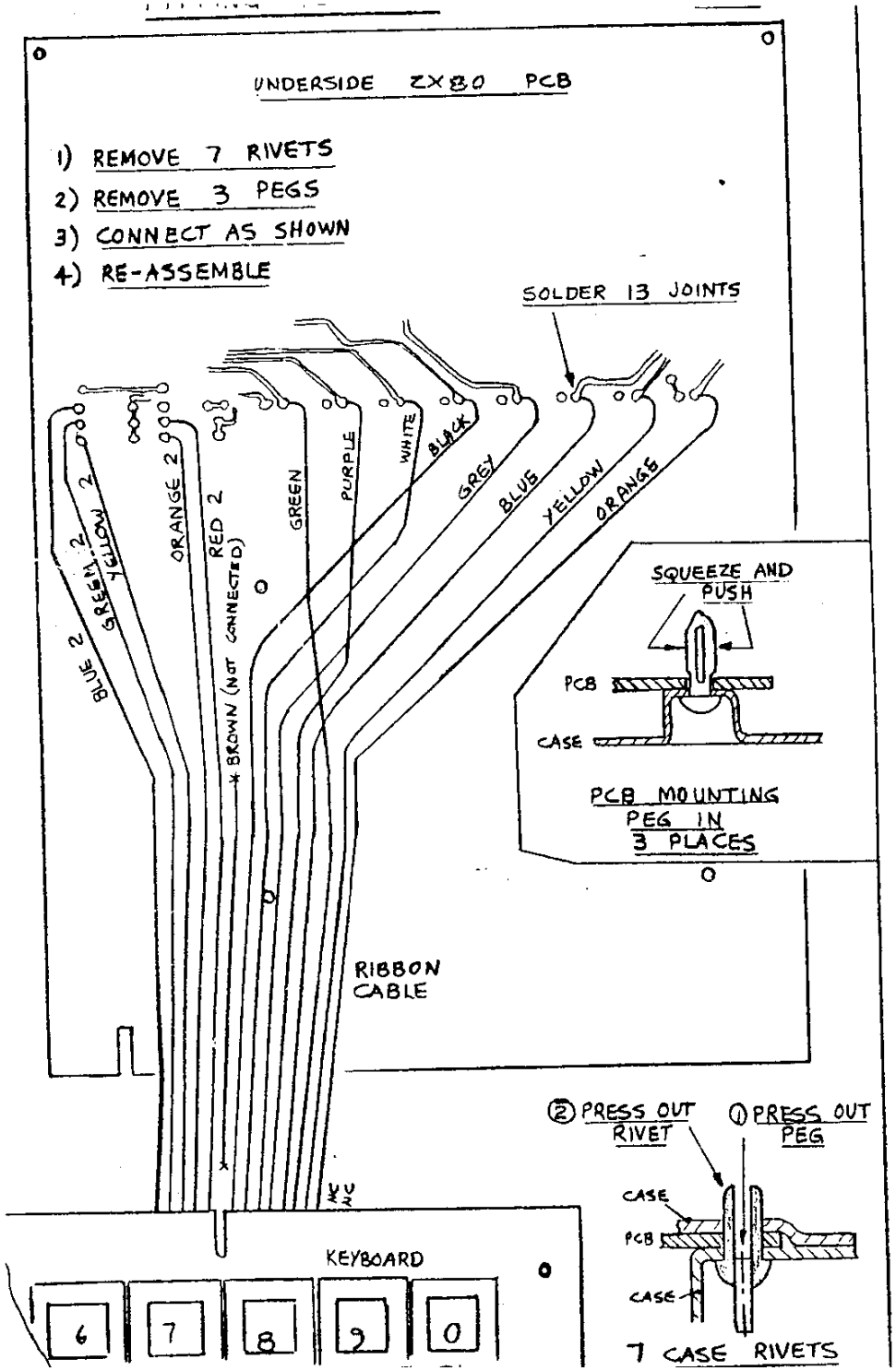
Unlike BASIC, it will NOT automaticly stop when it reaches the end of the program. It will plough right on through the addresses, and every time it finds a number which is not zero it will simply treat that number as a code for some instruction and try to execute it. Usually this will result in what is called a CRASH.

ABOUT CRASHING

Crashing is the name we give to what happens when your (up until now at least moderately well-behaved) Sinclair machine unwittingly tries to execute something it shouldn't, or if there is a drastic mistake in your machine-coding which will


EDIT AND THEN TO GRAPHICS RUBOUT
1 2 3 4 5 6 7 8 9 0
PLOT UNPLOT REM RUN RAND RETURN IF INPUT POKE PRINT
Q W E R T Y U I O P
SIN COS TAN INT RND STR$ CHR$ CODE PEEK TAB
NEW SAVE DIM FOR GOTO GOSUB LOAD LIST LET FUNCTION
A S D F G H J K L
ARCSIN ARCCOS ARCTAN SGN ABS SQR VAL LEN USR NEW LINE
SHIFT COPY CLEAR CONT CLS SCROLL NEXT PAUSE BREAK
Z X C V B N M £
LN EXP AT INKEY$ NOT PI SPACE


EDIT AND THEN TO GRAPHICS RUBOUT
1 2 3 4 5 6 7 8 9 0
PLOT UNPLOT REM RUN RAND RETURN IF INPUT POKE PRINT
Q W E R T Y U I O P
SIN COS TAN INT RND STR$ CHR$ CODE PEEK TAB
NEW SAVE DIM FOR GOTO GOSUB LOAD LIST LET FUNCTION
A S D F G H J K L
ARCSIN ARCCOS ARCTAN SGN ABS SQR VAL LEN USR
COPY CLEAR CONT CLS SCROLL NEXT PAUSE BREAK
SHIFT Z X C V B N M
LN EXP AT INKEY$ NOT PI SPACE



REDDITCH ELECTRONICS

21 FERNEY HILL AVENUE REDDITCH WORCESTERSHIRE B97 4RU
TEL REDDITCH (0527) 61240 PROPRIETOR C. C. LOCKYER

RE77 KEYBOARD CONSTRUCTION NOTES.

First check the contents of your kit, which should contain the following:-

Quantity	Description	Quantity	Description
1	RE77 PCB	26"	Link wire
40	Keyswitches	8"	Sleeving
40	White keytops	18"	20 way ribbon cable
40	Clear key covers	1	Legend Set

Fit sixteen short wire links as shown on fig 1, then fit two long wire links which should have sleeving. Put the 40 keyswitches into place. Note that the pins in the switches are offset from the centre, and if you try to put the switches in the wrong way round the switch body will foul the wire links.

Having placed the switches, putt a sheet of card over them, turn the Printed circuit board over and solder the switches. Check that all the switches are resting firmly on the P.C.B. and are straight.

Fit the 40 white keytops and push on firmly. Take the legend set and place it on a firm card. Using a steel rule and a sharp knife, cut out the letters using the edge markers as guides. You may prefer to draw faint lines and use scissors.

Using your computer or handbook as a guide, place the legends one at a time on the keytop and push on the clear plastic top.

If you have purchased the RE77B connector solder the ribbon cable to it (4 of the wires are unused and may be removed). If you do not wish to use a connector the cable may be soldered to the PCB. The completed keyboard may now be fitted to your ZX80 or ZX81. First study the connection details for your computer. (Fig 2 and fig 3) (More details on figs 4 and 5)

Carefully solder the ribbon cable to the computer PCB as indicated. The ribbon cable may now be run out of the case underneath the RAM pack connector. Recheck all your soldering, then test your computer and new keyboard.
Fold your keyboard cable under your ZX80/81. Push the computer to the back of your desk with your new keyboard in front. This way you have no untidy twists in your cable.

FITTING KEYBOARD TO ZX80 AND ZX81

FIT RIBBON CABLE TO POSITIONS SHOWN BUT ON UNDERSIDE NOT TOPSIDE AS INDICATED

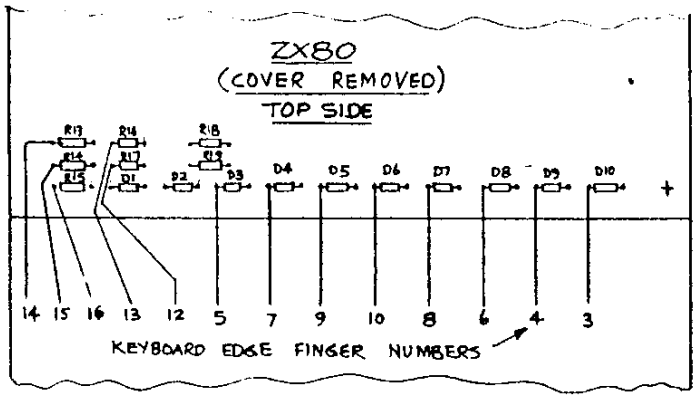


FIG 3

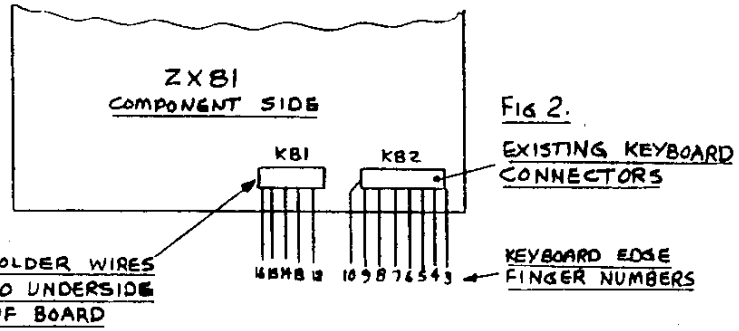


FIG 2.

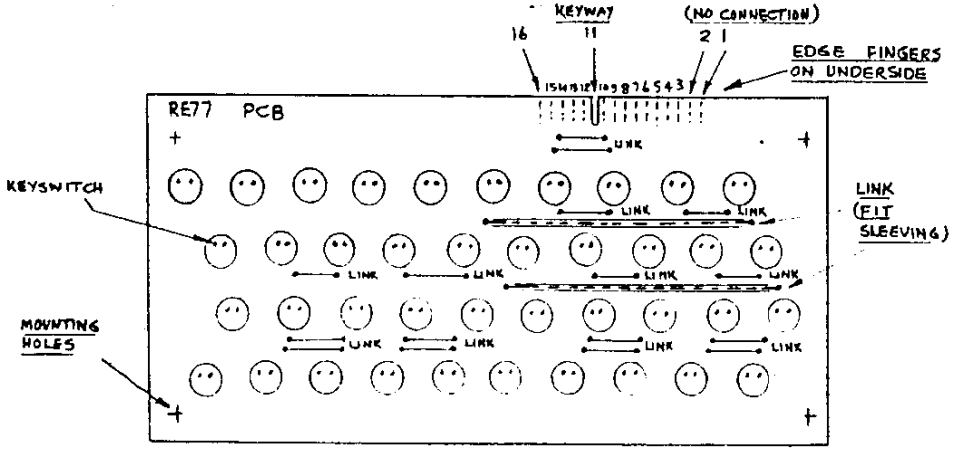
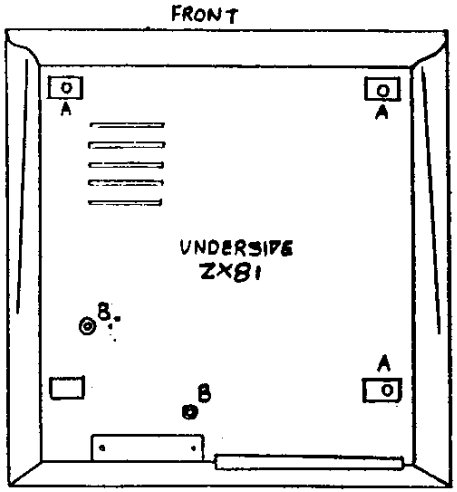


FIGURE 1

FITTING TO ZX81

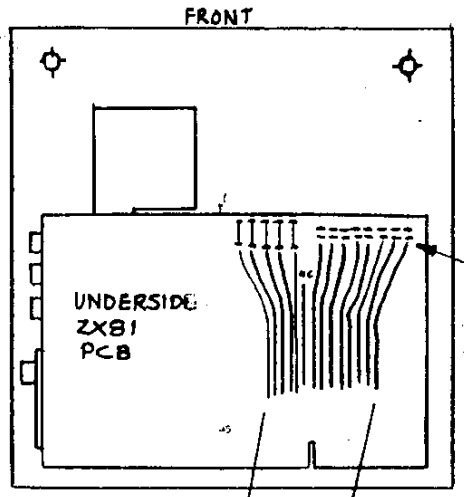
FIG 4



① PEEL OFF 3 RUBBER FEET 'A'

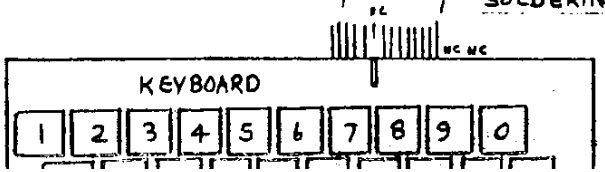
② REMOVE 3 SCREWS AT 'A'

③ REMOVE 2 SCREWS AT 'B'



SOLDER TO UNDERSIDE OF EXISTING KEYBOARD CONNECTOR

RIBBON CABLE (AFTER CONNECTING TO ZX81 FEED THROUGH SLOT IN CASE BOTTOM BEFORE SOLDERING TO KEYBOARD)



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

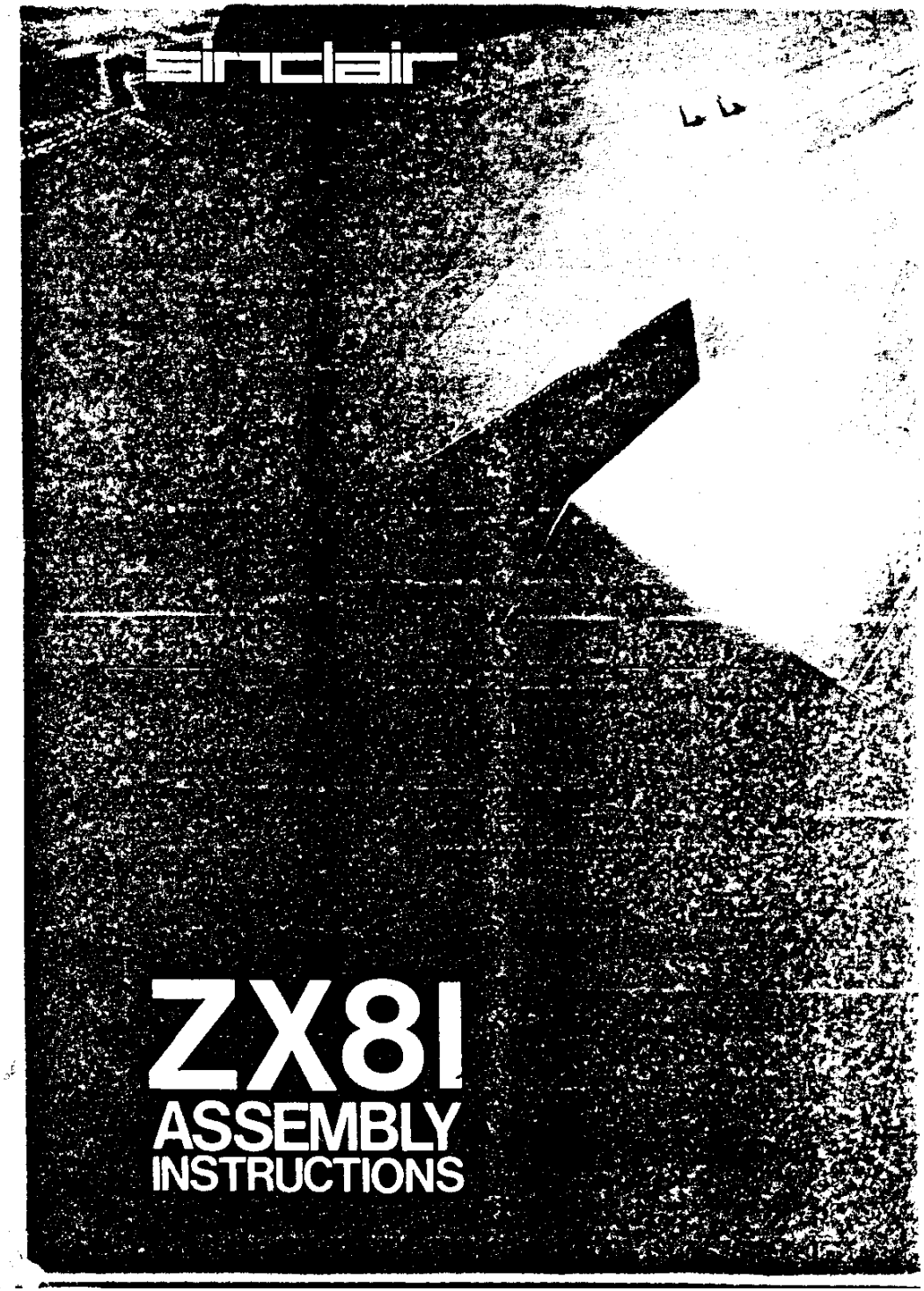
If you wish to use your own power supply with the ZX81, it should conform to these specifications:–
D.C. only – positive to the tip of the 3.5mm jack plug. Need not be regulated, but should be well smoothed.
Voltage – between 12 volts maximum and about 8 volts minimum (depending on smoothing) when on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

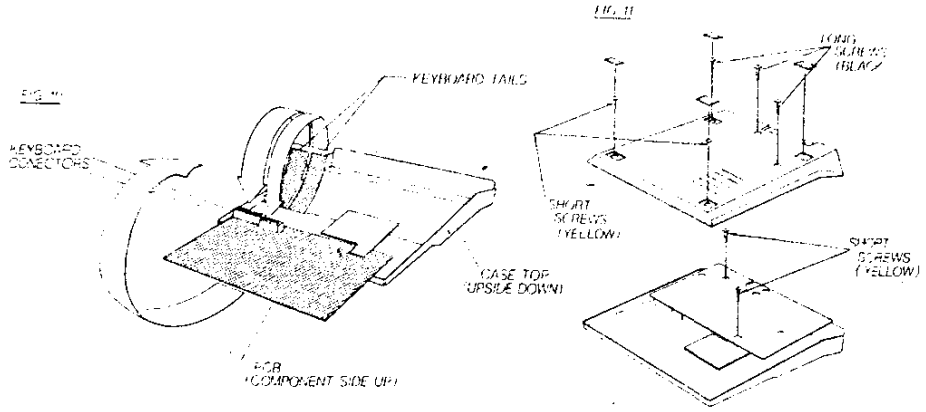
10. SERVICE

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

© Sinclair Research Limited 1981





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	15K	Brown Black Orange	
R2	680Ω	Blue Grey Brown	
R3			Not used
R4	18K	Brown Grey Orange	
R5	330Ω	Orange Orange Brown	
R6	2K2	Red Red Red	
R7	470Ω	Yellow Purple Brown	
R8	470Ω	"	
R9	470Ω	"	

R10	470Ω	"	
R11	470Ω	"	
R12	470Ω	"	
R13	470Ω	"	
R14	470Ω	"	
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

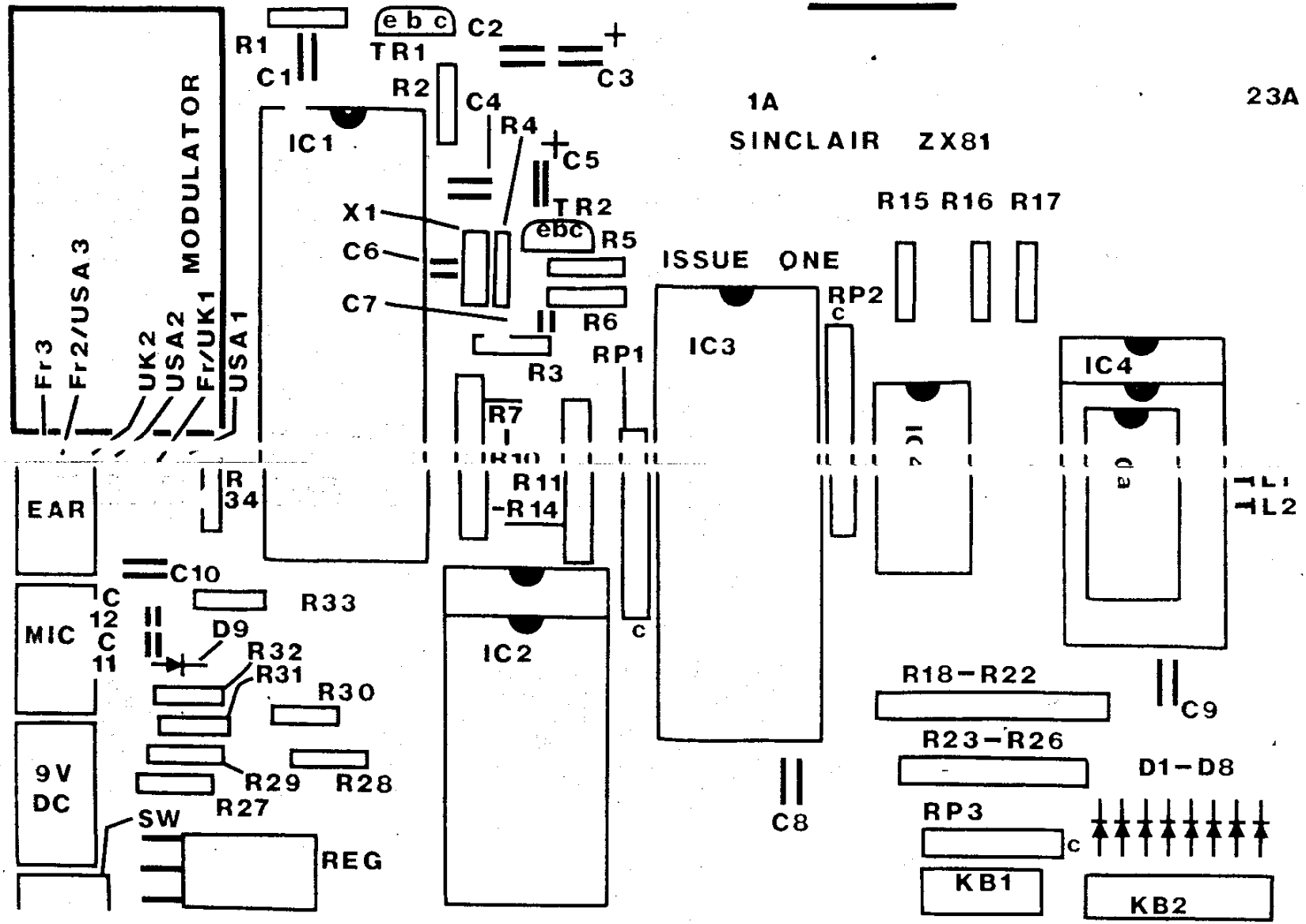
(c) Capacitors

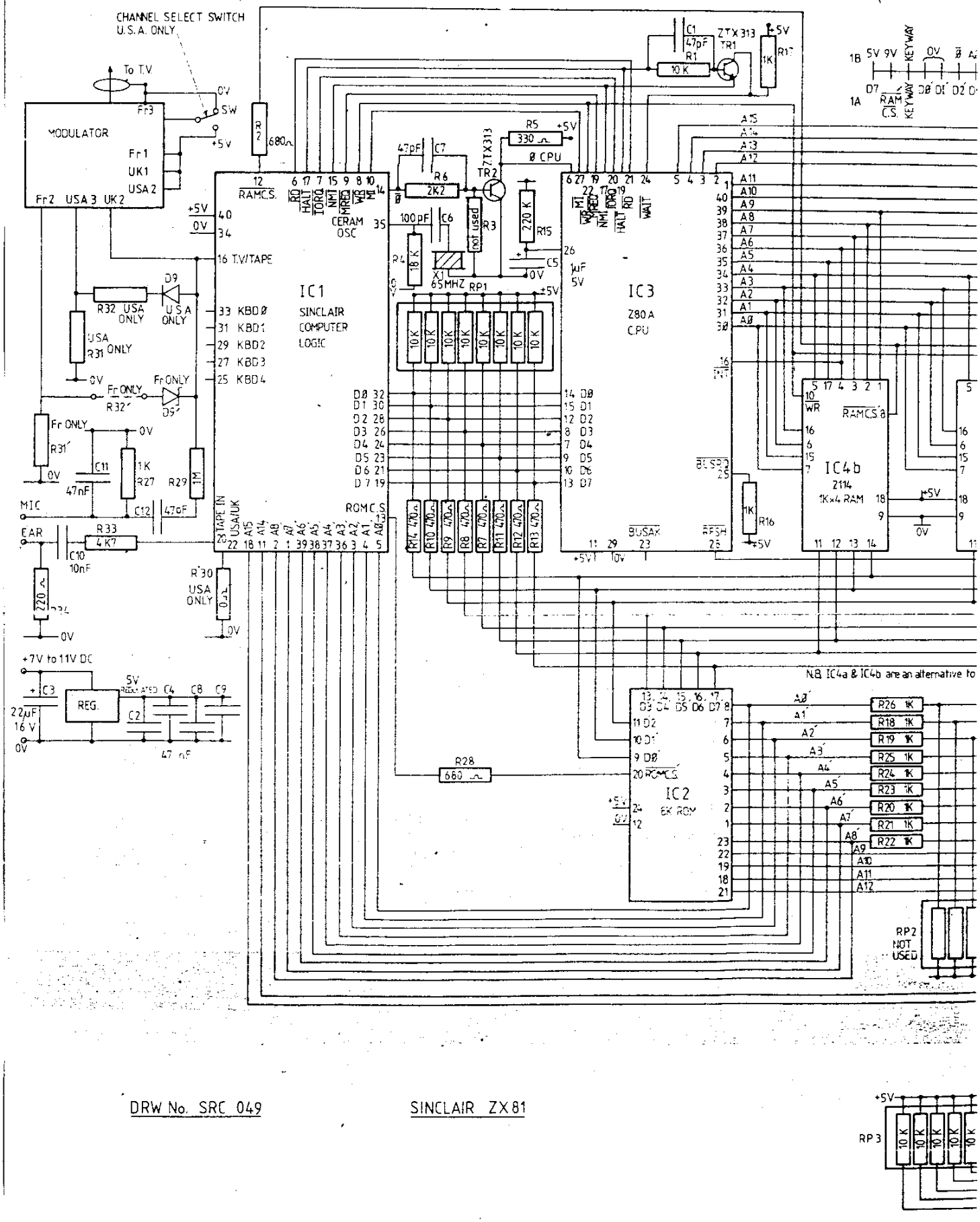
No.	Values	Markings	Comments
C1	47pF	47	Ceramic disc
C2	47nF	473 Z	"
C3	22µF	22µ	Electrolytic 16V min.
C4	47nF	473 Z	Ceramic disc
C5	1µF	1µ	Electrolytic 5V min.
C6	100pF	100, 101, n10	Ceramic disc
C7	47pF	47	"
C8	47nF	473 Z	"
C9	47nF	473 Z	"
C10	10nF	10n, 103	"
C11	47nF	473 Z	"
C12	47pF	47	"

(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	

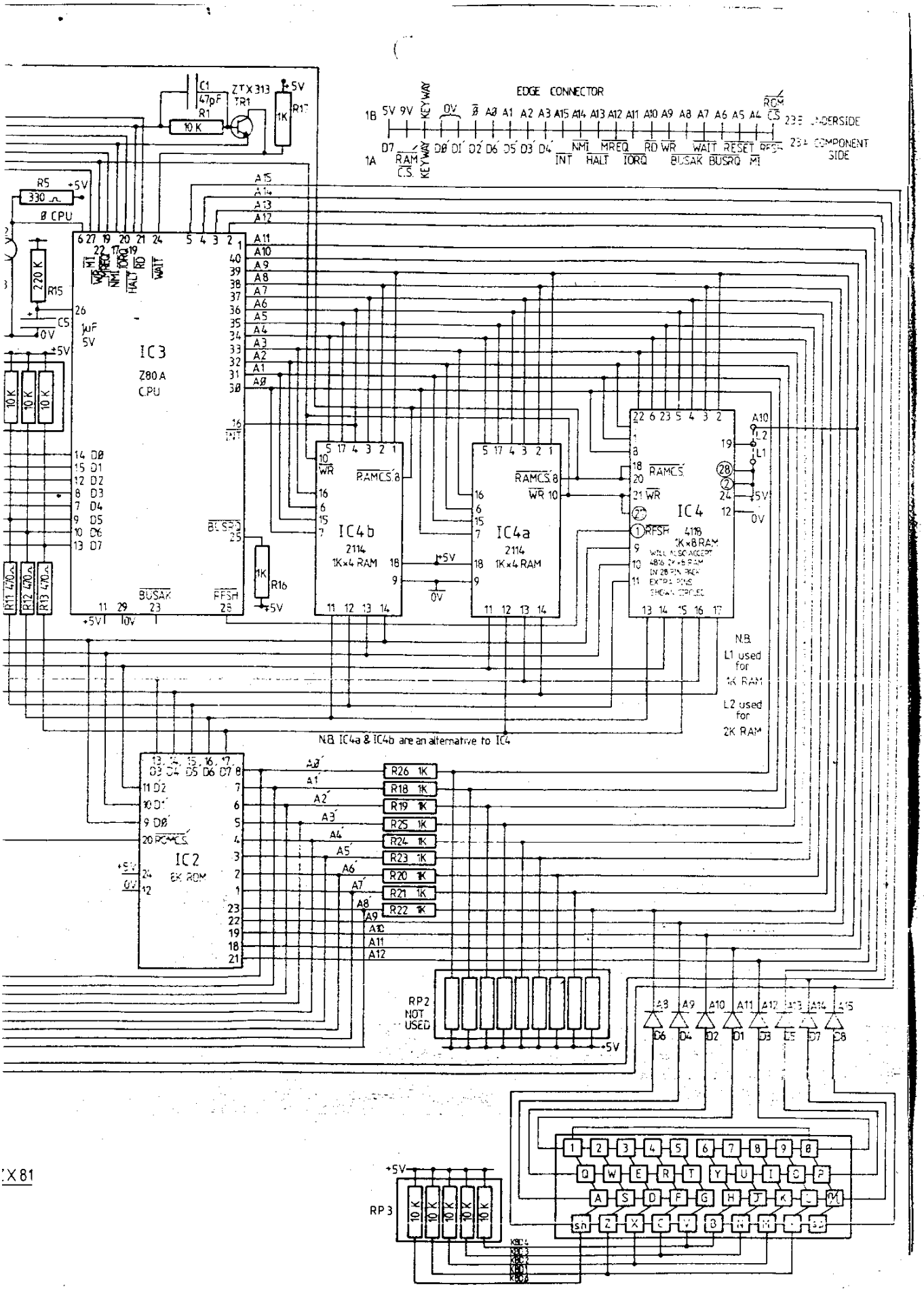
FIG 6


1A
SINCLAIR ZX81
23A
ISSUE ONE
MODULATOR
Fr3
Fr2/USA3
UK2
USA2
Fr/UK1
USA1
R1
C1
TR1
e b c
C2
C3
R2
C4
R4
C5
IC1
X1
C6
C7
TR2
ebc
R5
R6
R3
RP1
IC3
RP2
R15 R16 R17
IC4
R7
R10
R11
-R14
R34
EAR
C10
R33
MIC
C12
C11
D9
R32
R31
R30
9V
DC
R29
R28
R27
SW
REG
IC2
C8
R18-R22
R23-R26
D1-D8
RP3
KB1
KB2
C9
IL1
IL2



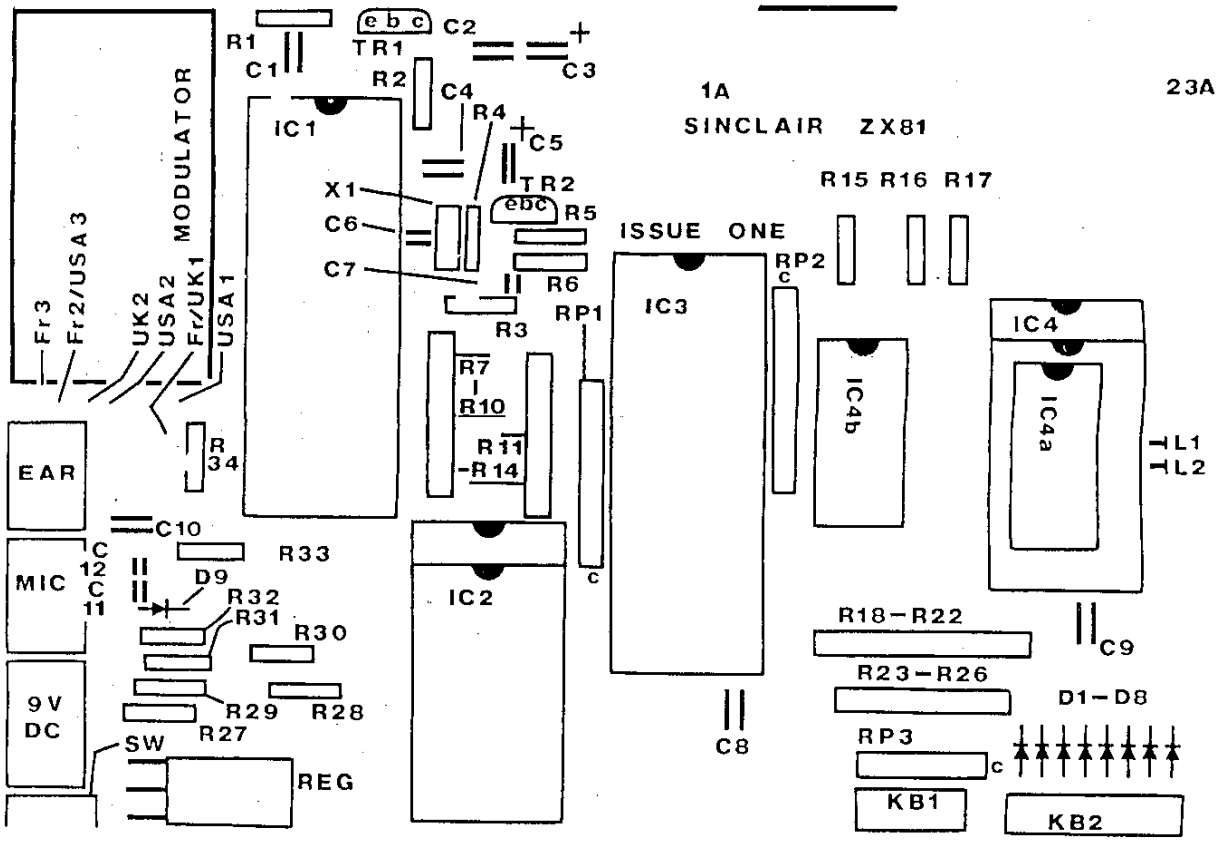
DRW No. SRC 049

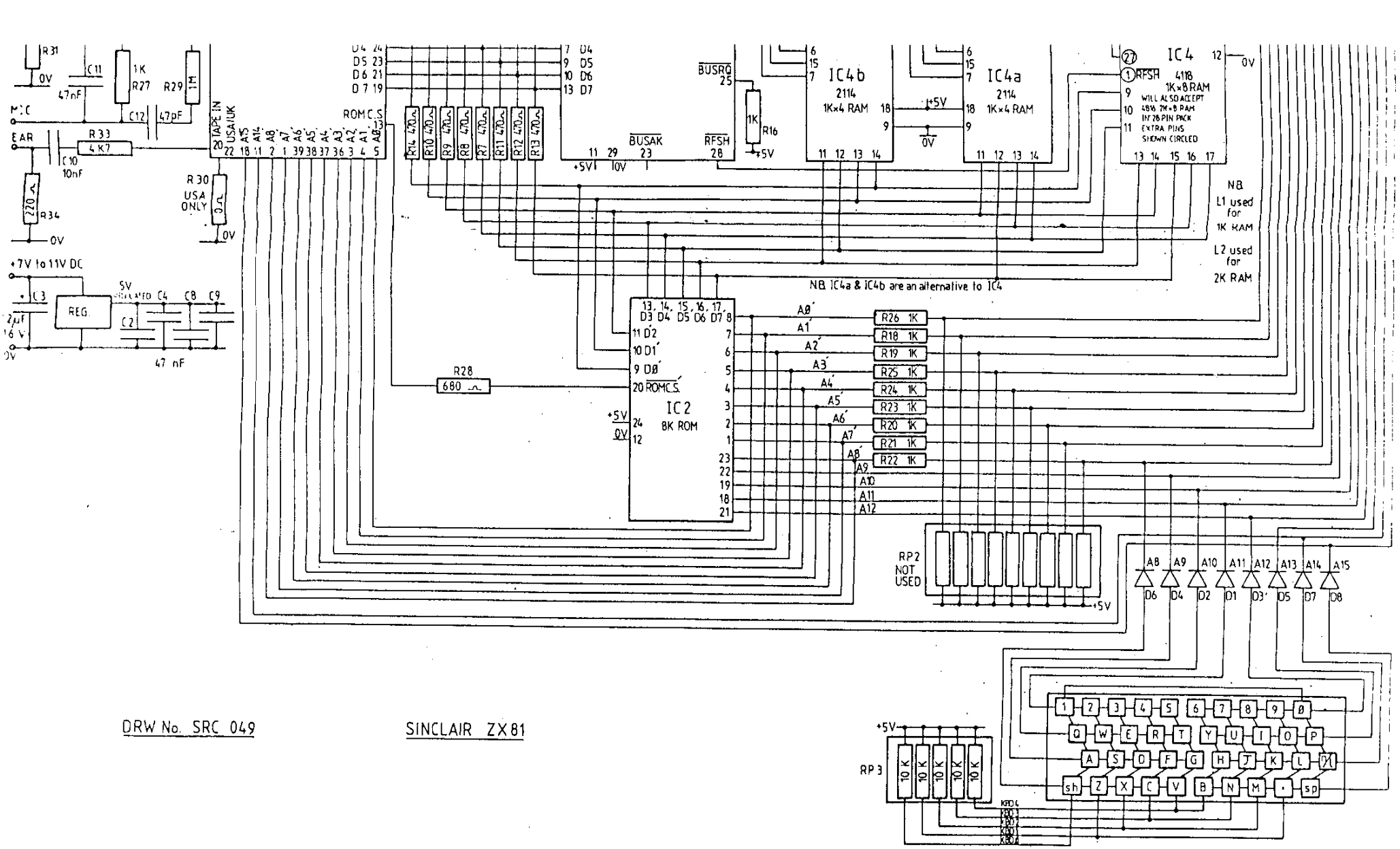
SINCLAIR ZX81


EDGE CONNECTOR
1B 5V 9V KEYWAY 0V Ø A0 A1 A2 A3 A15 A14 A13 A12 A11 A10 A9 A8 A7 A6 A5 A4 ROM CS 23B UNDERSIDE
1A D7 RAM C.S. KEYWAY D0 D1 D2 D6 D5 D3 D4 INT NMI HALT MREQ IORQ RD WR BUSAK WAIT BUSRQ RESET MI RFSH 23A COMPONENT SIDE
IC3
Z80A
CPU
IC4b
2114
1K×4 RAM
IC4a
2114
1K×4 RAM
IC4
4116
1K×8 RAM
IC2
8K ROM
N.B. IC4a & IC4b are an alternative to IC4
N.B.
L1 used for 1K RAM
L2 used for 2K RAM
RP2 NOT USED
RP3

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

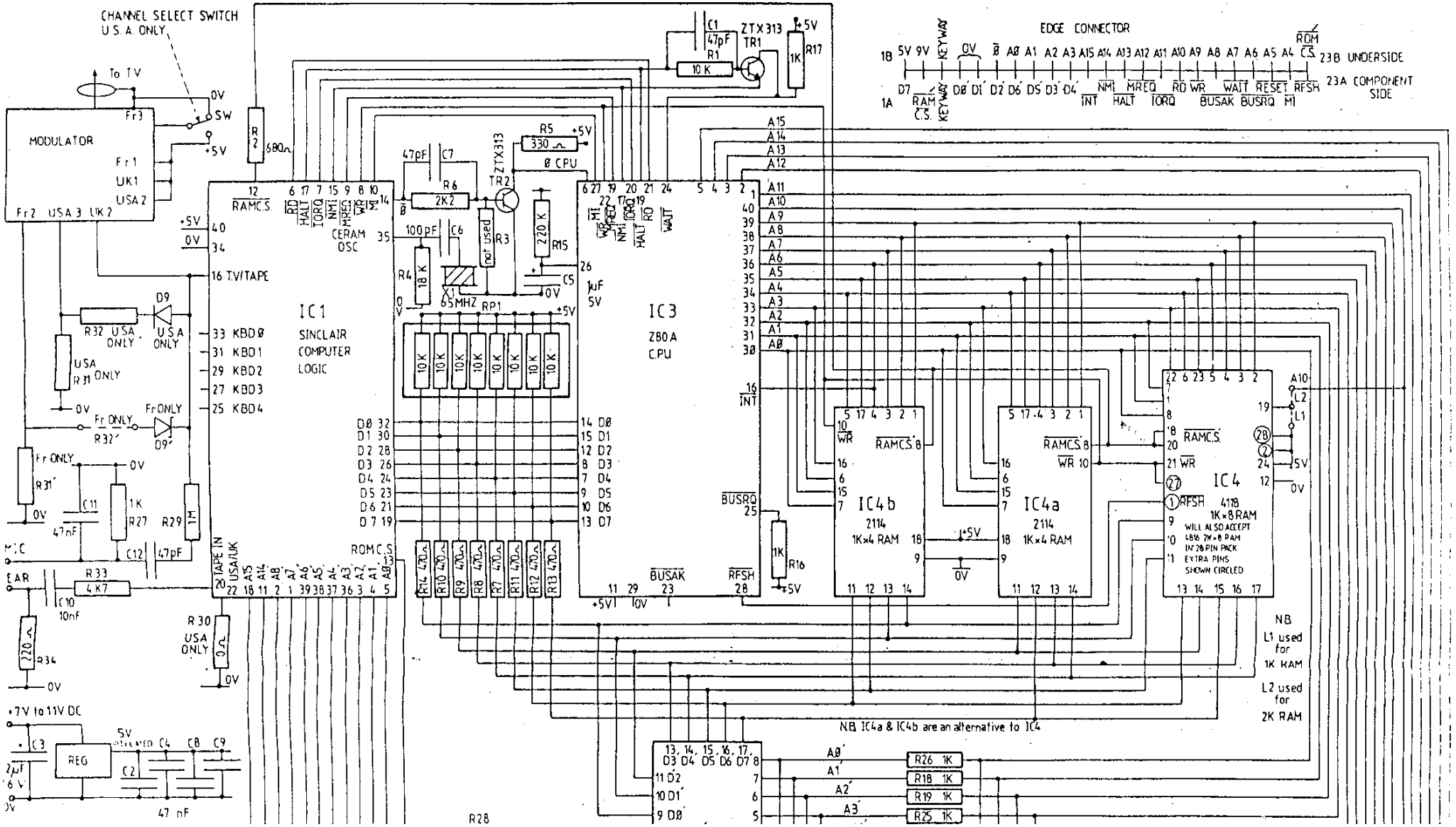
FIG 6





DRW No. SRC 049

SINCLAIR ZX81


CHANNEL SELECT SWITCH
U.S.A. ONLY
To TV
MODULATOR
Fr1
UK1
USA2
Fr2 USA3 UK2
SW
0V
+5V
R2 680Ω
C1 47pF
R1 10K
ZTX313
TR1
R17 1K
EDGE CONNECTOR
1B 5V 9V KEYWAY 0V Ø A0 A1 A2 A3 A15 A14 A13 A12 A11 A10 A9 A8 A7 A6 A5 A4 ROM C.S. 23B UNDERSIDE
1A D7 RAM C.S. KEYWAY D0 D1 D2 D6 D5 D3 D4 NMI MREQ RD WR WAIT RESET RFSH INT HALT IORQ BUSAK BUSRQ M1 23A COMPONENT SIDE
R5 330Ω
Ø CPU
TR2 ZTX313
47pF C7
R6 2K2
100pF C6
not used R3
220K R15
R4 18K
X1 6.5MHZ
C5 1µF 5V
RP1
IC1
SINCLAIR
COMPUTER
LOGIC
IC3
Z80A
CPU
CERAM OSC
RAMCS
TAPE IN USA/UK
16 TV/TAPE
33 KBD0
31 KBD1
29 KBD2
27 KBD3
25 KBD4
D9 USA ONLY
R32 USA ONLY
R31 USA ONLY
Fr ONLY
R32' Fr ONLY
D9'
R31' Fr ONLY
C11 47nF
R27 1K
R29 1M
C12 47pF
MIC
EAR
R33 4K7
C10 10nF
R34 220Ω
R30 USA ONLY 0Ω
+7V to 11V DC
REG
C3 2µF 16V
C2 47nF
C4 C8 C9
5V REGULATED
D0 D1 D2 D3 D4 D5 D6 D7
R14 R10 R9 R8 R7 R11 R12 R13 470Ω
ROM C.S.
BUSRQ
BUSAK
RFSH
R16 1K
IC4b 2114 1K×4 RAM
IC4a 2114 1K×4 RAM
IC4 4118 1K×8 RAM
WILL ALSO ACCEPT 4816 2K×8 RAM IN 24 PIN PACK EXTRA PINS SHOWN CIRCLED
NB IC4a & IC4b are an alternative to IC4
NB
L1 used for 1K RAM
L2 used for 2K RAM
R26 1K
R18 1K
R19 1K
R25 1K
R28