

E2P

A SECOND PROCESSOR
For the ACORN ELECTRON Plus One

CONSTRUCTION.

Construction is reasonably straightforward, as long as you work carefully with a fine tipped soldering iron and check the pads and tracks around every joint as you make it. Remember that you should not keep the iron in contact with components for longer than a few seconds, but this is still long enough for the solder to 'flow' between the pad and the component wire.

As this is a double sided board without through-hole plating, it is first of all necessary to make through board links in all the holes not intended for component mounting. These can be identified from the overlay diagram. Short lengths of wire should be inserted into each hole and soldered on both sides of the board. Take special care not to miss the ones that are under IC's as these will be impossible to fit later.

A lot of component leads need to be soldered on the top or on both side's of the board. Wherever there is a track coming to a pin it must be soldered.

Next fit all the IC's except the RAM's and the processor, taking care that they are the right way round. Then fit the resistors, capacitors and diode, taking care once again that the diode, electrolytic and tantalum capacitors are the right way round. Now fit the sockets for the RAM's and processor. Use insulating tape to protect the through board links before inserting the sockets. Solder in Link LK1.

Since the board was designed the circuit has been modified with the addition of IC20 and the E2PMOD sub-board. First six track cuts have to be made, one on top of the board and five underneath, as shown on the overlay. Mount IC20 and R2 on the top (copper side) of the sub-board. Ensure that all the components around IC1 and IC8 are lying flat on the board. Locate the 15 ⊗ through-link points on and close to IC1 and IC8, and solder 1/2 to 3/4 inch lengths of thin wire (wire-wrap wire is ideal) to stand vertically from the board. Carefully fitting each wire into its appropriate hole on the sub-board, lower the sub-board until it is lying, copper side up, on IC1 and IC8. Solder the wires onto the sub-board and connect 3 lengths of wire from the side pads on the sub-board to the points shown on the main board. Connect the 2 wire links underneath the main board.

USING WITH DISCS.

The E2PCODE program can be transferred to disc, where you also have the option of RUNning it by just pressing SHIFT-BREAK. To do this you should *RENAME E2PCODE !BOOT then *OPT 4,2

GENERAL PROGRAMMING POINTS.

You can no longer directly access any of the Electron memory area with PEEKs or POKEs, etc.. This can only be done with Osbyte calls or with Oswords 5 and 6. The example program given shows how to transfer a machine code program into the Electron RAM and call it using *CODE. The transfer uses Osword 6. For

more information on 0sbytes, etc. you should consult the Advanced User Guide. All *SAVEs and *LOADs should use a 32 bit addressing scheme, with files from the Second Processor having no prefix (ie. 0) and files from Electron memory having the prefix FFFF. Basic will do this automatically.

The memory available to you in the Second Processor is between PAGE and HIMEM, and anything below &8F that the language makes no use of (eg. &70 to &8F in Basic). In the Electron RAM all the usual areas are available, except between &2800 and &2FFF (because E2PCODE is there) or between Oshwm and Oshwm+&600 (because the character set is exploded). Again for more information on these terms see the Advanced User Guide.

PARTS LIST:

Resistors (all 1/4 watt)

R1	220R
R2	680R
R3-R10	470R
R12	4k7

Capacitors (all ceramic unless stated)

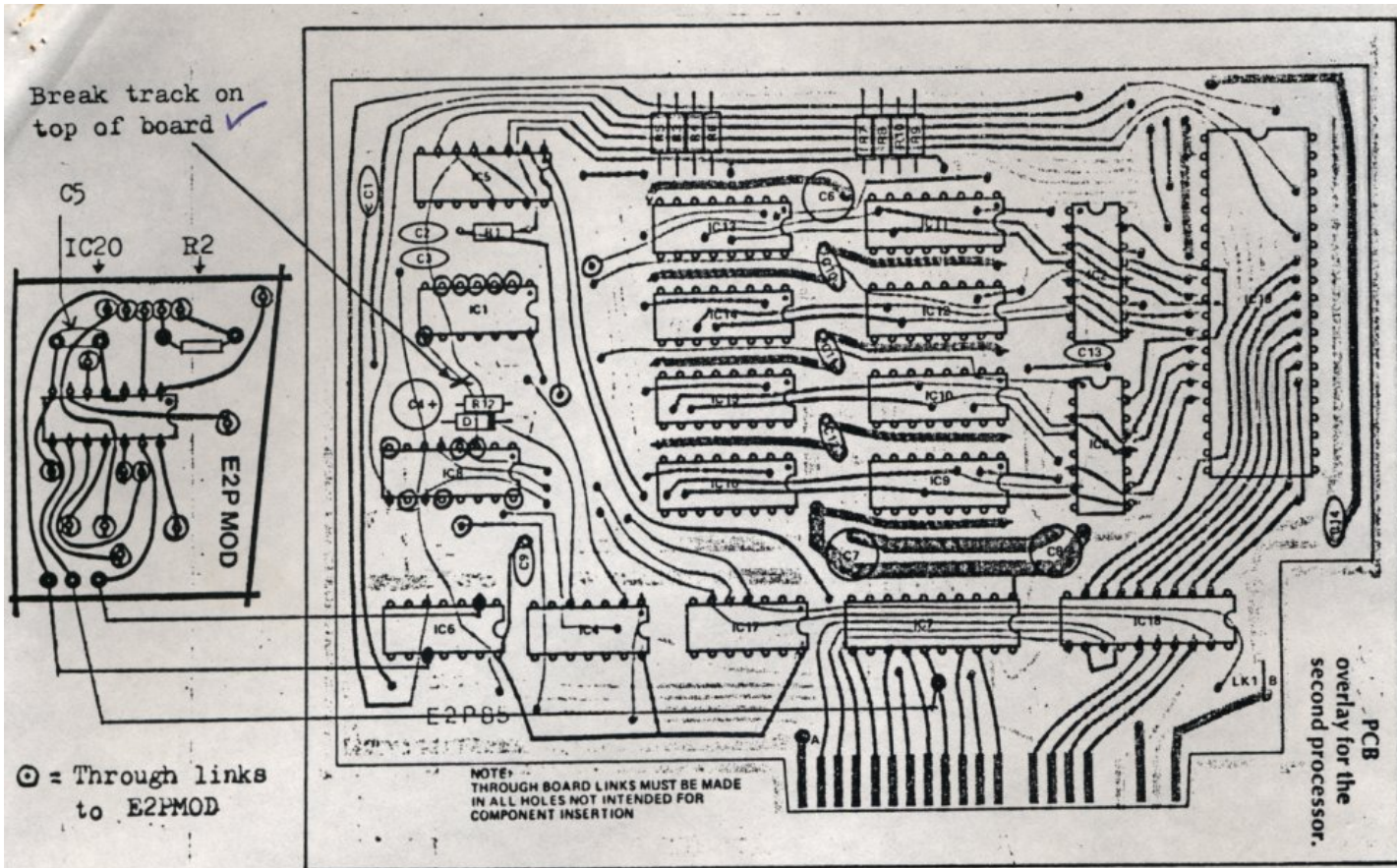
C1	470p
C2	47p
C3	68p
C4	100u electrolytic
C5	270p
C6-8	47u Tant.
C9-14	100n

Semiconductors

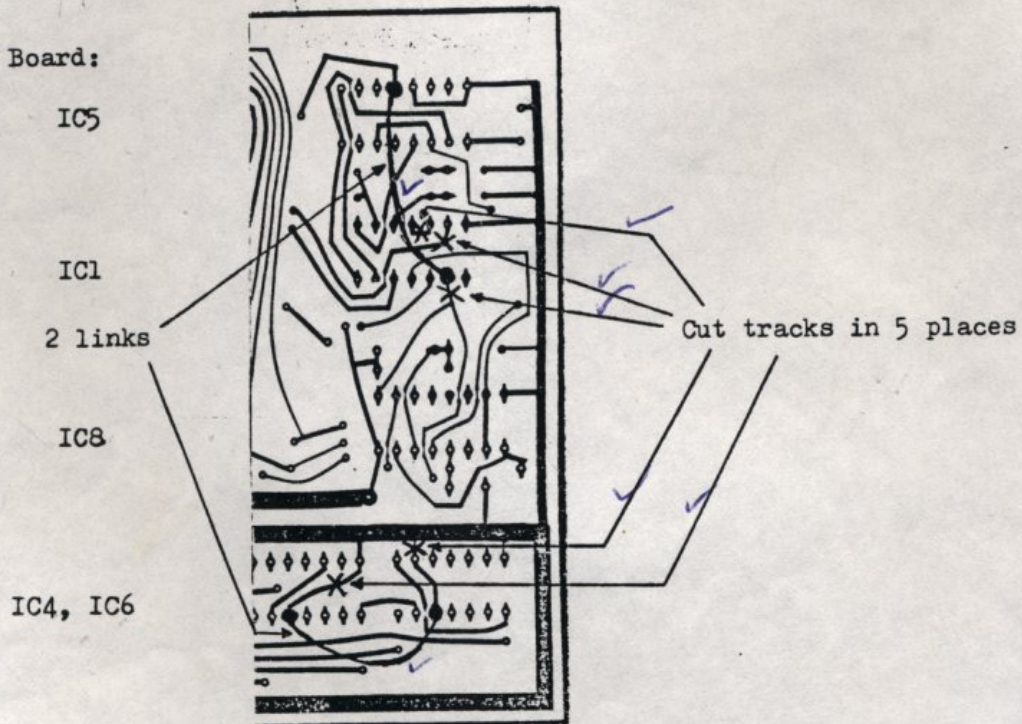
IC1	74LS14
IC2,3	74LS257
IC4,6	74LS393
IC5	74LS157
IC7,18	74LS245
IC8	74LS279
IC9-16	4I64-15/4864P-2 150nS DRAMS
IC17	74LS21
IC19	6502A/65C02
IC20	74LS02
D1	1N4148

Miscellaneous

40 pin DIL skt
8 x 16 pin DIL skts
wire for links



Part of Bottom of Board:



TESTING AND SETTING-UP.

Carefully examine the board for any shorts between tracks. Use the multimeter on ohms range to test continuity from IC19 to IC's 9-16, 18, 2 and 3 and from IC7 to IC's 9-16, 2 and 3.

Before starting testing you should type in and SAVE the two test programs.

ALWAYS SWITCH OFF BEFORE FITTING OR REMOVING THE BOARD OR ANY COMPONENTS.

With the RAM's and processor removed from the board RUN Test Program 1, Strings of eight '1's will scroll up the screen. Switch your multimeter to a milliamps range and carefully place the negative probe on pin 10 of IC18 and the positive probe on pin 9 of the same IC. The left hand '1' should change to a '0' and the reading on the meter should be well under 1 milliamp. No other columns should change to '0'. If they do, look for shorted tracks around IC18, the RAM's or the processor. If there was no change in the display look for broken tracks or badly soldered joints around IC18 or IC's 8 and 17. Move the positive probe along pins 8 to 2 of IC18 and repeat the observations, checking that the '0' moves along the columns on the screen. Now move the positive probe to pins 2 and 14 of each RAM socket and pins 26 to 33 of the processor socket and the same results should be obtained. When you have finished this test switch off and insert the RAM's and the processor into their sockets.

For the next test the board should be in the front socket of the Plus One.

RUN Test program 2 and two '0's should be printed on the screen. If not, look for broken tracks, bad joints or shorts around IC7, IC5, IC1 or the RAM's and check continuity with the multimeter.

```
*RUN E2PCODE. You should get:    SECOND PROCESSOR
                                   BASIC
                                   >_
```

(there will be a short pause between each line being displayed).

If this does not happen, look again for broken tracks, shorts, etc., especially between the processor, IC2 and IC3, and the RAM's.

If the circuit still does not work, try it again tomorrow, then contact me, *giving* me as much information as you can about what happens and what is displayed on the screen.

If you wish to send the board for me to look at, please enclose £10 service charge.

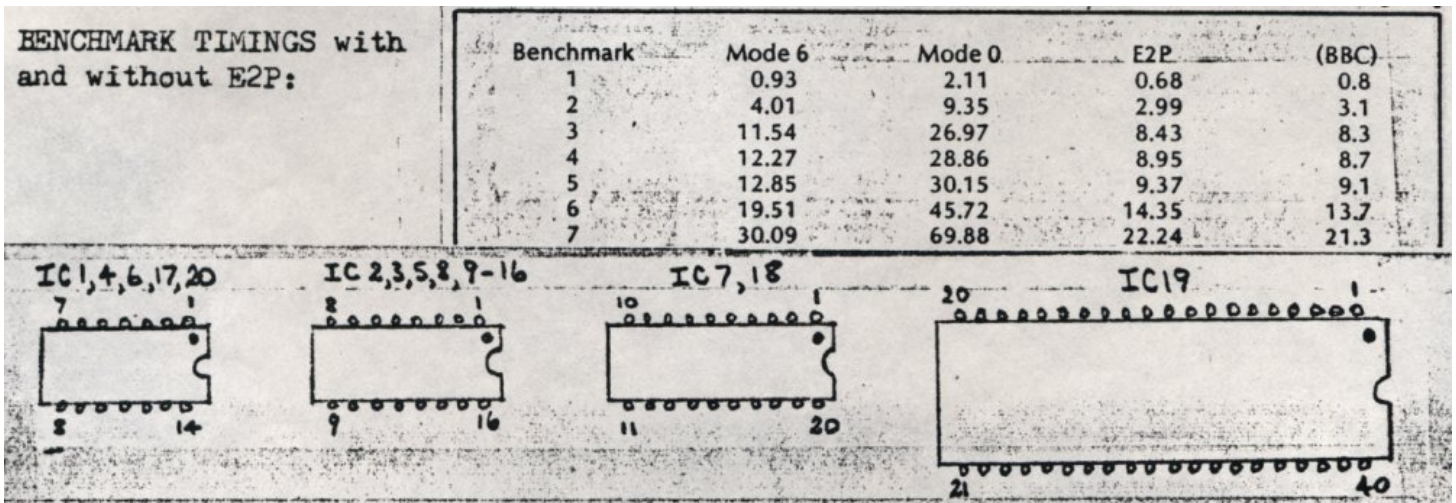
RESETTING THE SYSTEM.

There are various ways of resetting the system once the Second Processor has started up:

Pressing BREAK on its own will Reset into the Second Processor with the current language.

Pressing CTRL-BREAK will Reset into the Second Processor with the default switch-on language.

Pressing B-BREAK will Reset into the Electron processor and the Tape filing system, so the words "SECOND PROCESSOR" will not appear on the display.



TEST PROGRAM 1.

```
10 REPEAT
20 A% = ?&FCE5
30 FOR I = 1 TO 8
40 IF (A% AND 1) = 1 PRINT "1"; ELSE PRINT "0";
50 A% = A% DIV 2
60 NEXT
70 PRINT
80 UNTIL FALSE
```

TEST PROGRAM 2.

```
10 DIM O% 100
20 FOR I = 0 TO 2 STEP 2
30 P% = O%
40 [ OPT I
50 .start PHP:SEI:LDA#3:JSR&E3A0
60 LDX#0
70 .loop1 TXA:STA&8000,X:INX:BNEloop1
80 .loop2 TXA:CMP&8000,X:BNEend
90 INX:BNEloop2
100 .end LDA&8000,X:PHA:LDA#&B
110 JSR&E3A0:PLA:PLP:RTS
120 ]:NEXT
130 R% = USR(start)
140 PRINT~((R% AND &FF00) DIV &100),~(R% AND &FF)
```

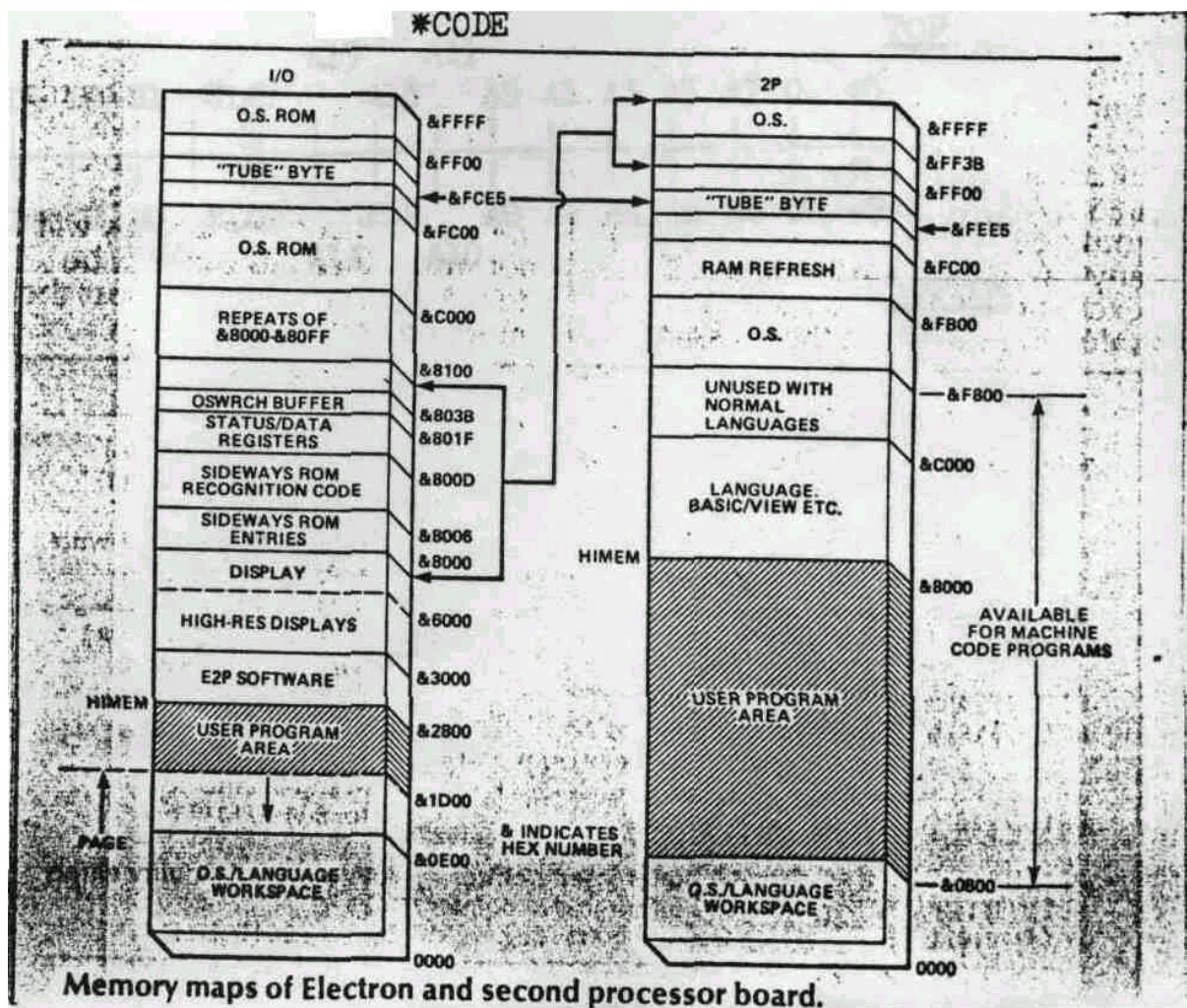
EXAMPLE OF HOW TO RUN PROGRAM ON I/O PROCESSOR.

```
10 osword = &FFF1
20 DIM osw6blk 5, code% length_of_code
30 FOR pass = 4 TO 6 STEP 2
40 O% = code%
50 P% = run_address
60 [ OPT pass
.
.
1000 ]:NEXT
1010 !osw6blk = &FFFF0000 + run_address
1020 X% = osw6blk MOD 256
1030 Y% = osw6blk DIV 256
1040 A% = 6
1050 FOR B% = 0 TO length_of_code
1060 osw6blk?4 = code%?B% ,
1070 CALLosword
1080 !osw6blk = !osv6blk +1
1090 NEXT
```

```

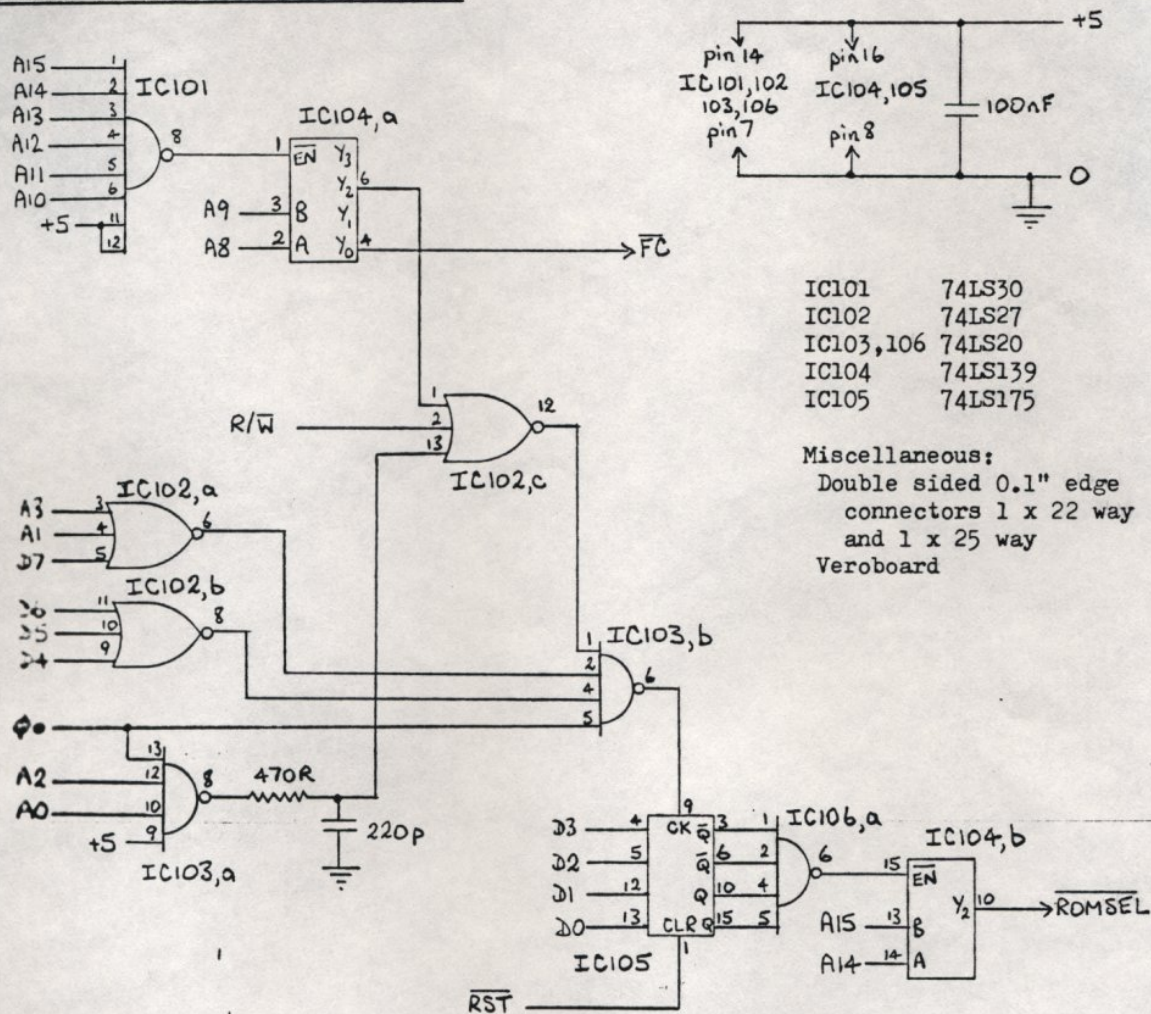
1100 !osw6blk = &FFFF0200
1110 osw6blk?4 = run_address MOD 256
1120 CALLosword
1130 ?osw6blk = 1
1140 osw6blk?4 = run_address DIV 256
1150 CALLosword
1160 *CODE

```



Electrons without Plus Ones.

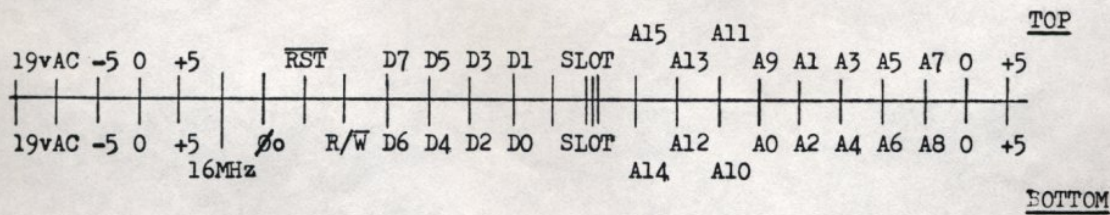
INTERFACE TO ELECTRON EDGE CONNECTOR.



IC101	74LS30
IC102	74LS27
IC103,106	74LS20
IC104	74LS139
IC105	74LS175

Miscellaneous:
 Double sided 0.1" edge
 connectors 1 x 22 way
 and 1 x 25 way
 Veroboard

Electron Edge Connector:



See next page for E2P connections.

CONNECTING TO THE BBC COMPUTER.

Hardware modifications:

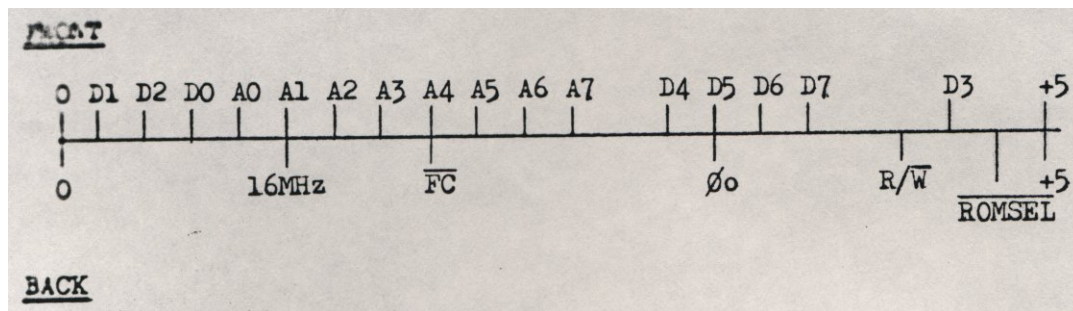
Locate pin 5 of IC4 on the board and cut the two tracks, one on the top and one underneath, that go to this pin. Connect pin 13 of IC4 to pin 6 of IC8 and connect pin 13 of IC5 to pin 14 of IC5.

Changes to Test Programs:

In program 1 change FCE5 to FEE5 in line 20.
In program 2 change LDA#3 to LDA#socket_number_of_E2P
In program 2 change LDA#&B to LDA#tsocket_number_of_BASIC
In program 2 change JSR&E3A0 to STA&F4:STA&FE30

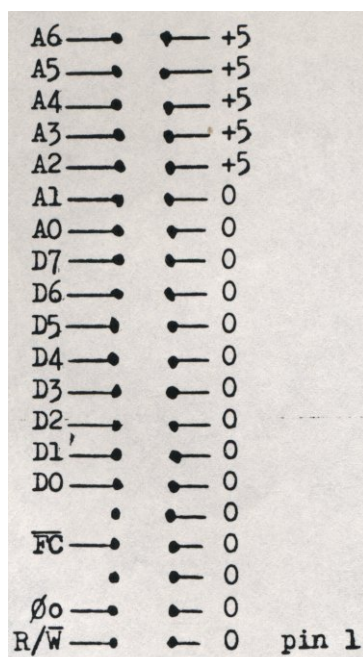
To connect the board to the BBC you will need a Tube connector and a 28 pin DIL ???ter plug to fit into a spare sideways ROM socket.

E2P connector: (double sided 0.1" 22 way)



These connect to the Tube plug as follows:

(The details of the plug are from the Advanced User Guide, I take no responsibility for them!)



And on the 28 pin DIL plug:

A7 to pin 3
ROMSEL to pin 20

IMPROVEMENTS TO THE E2P OPERATING SYSTEM.

The operating system software that I *am* currently supplying for the Electron is version 2.2. This has several important extra facilities over the previous versions that I have supplied. Because of this it is somewhat longer and takes up memory from &2500 to &2FFF in the I/O processor (Electron), instead of from &2800 as described in the instruction sheet.

Extra commands are provided:

- CALL &F800 - allows machine code programs to be loaded, which may overwrite the current, language. The > prompt is replaced by a * and you then use operating system or filing system * commands.
- *GO - is similar to CALL in Basic but can be used from other languages. Addresses should be entered in hexadecimal (without the &), eg, *GO F800. Just typing *GO will return to the previous language, providing it has not been overwritten.
- *E2POFF - completely disables the second processor and allows you to use the whole of Electron memory, overwriting the E2P operating- system. You can then run your games software, or disc utilities that require all the memory in the Electron. The second processor memory will not be affected and you can retrieve it by running E2PCODE again.

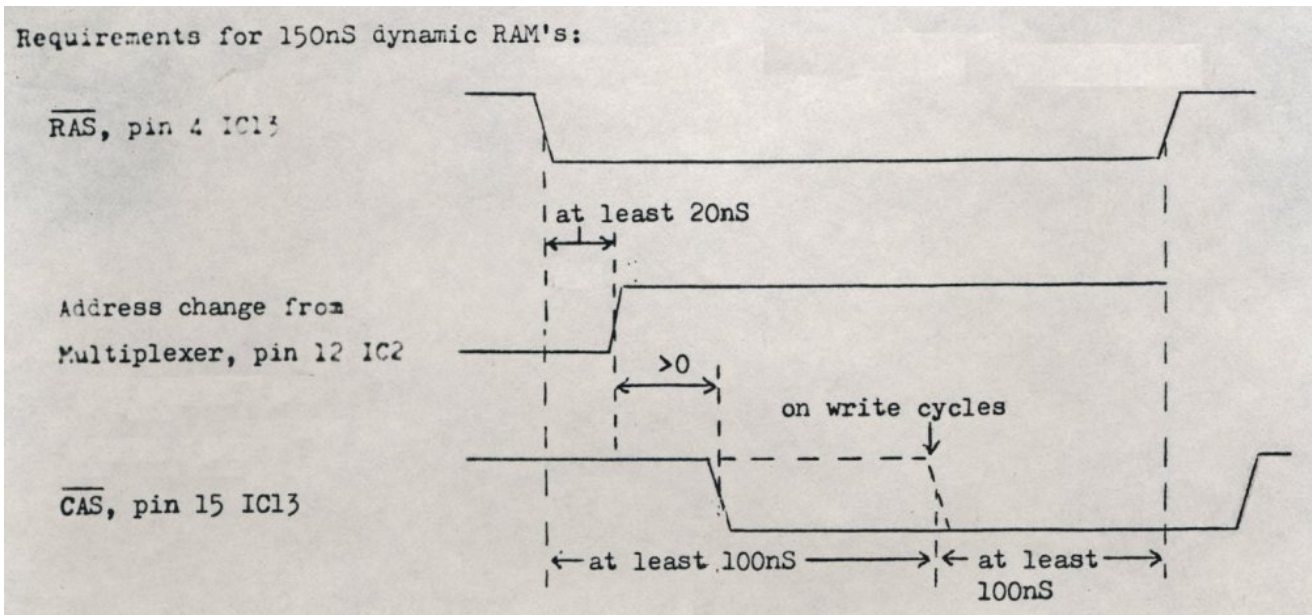
The HELP messages have been expanded and improved, and- the operating system now checks that ROM's transferred over the Tube are 6502 language ROM's.

The above features are not present on the cassette supplied to BBC users, who still get version 1,3. This is because version 3.2 for the BBC is EPROM based. It uses memory at &FDOO to &FDFF instead of &8000 to &80FF for data transfer. The 28 pin DIL header plug is not used but a link is required to the NPGFD signal on the 1MHz bus. The block of BBC memory from &2800 to &2FFF is not required.

All the above features are included as well as a *E2PON command to switch the FROM on.

Version 3.2 is available in an EPROM for £5 or as an EPROM image on cassette for you to program your own EPROM or load into sideways RAM. The cassette is free of charge if you return your original cassette to me.

TESTING E2P TIMINGS (Requires a Dual Beam Oscilloscope).



1. Remove processor, IC19.
2. Connect probe 1 of 'scope to pin 4 of IC13 and trigger off negative edge. Set timebase to display whole of negative section of /RAS signal.
3. Short pin 13 of IC2 to 0 volts.
4. Connect probe 2 of 'scope to pin 12 of IC2 and check that address delay is at least 20nS. If not adjust C2 accordingly. Remember what the delay is,
5. Connect probe 2 of 'scope to pin 15 of IC13 and check that /CAS delay is at least as much as the address delay, If not adjust C5.
6. Short pin 3 of IC5 to 0 volts and check that the /CAS delay increases to at least 100nS.
7. Remove all shorts.
8. LOAD Test program 2. Add line 55 .loop LDA &8000: JMP loop, and RUN it.
9. Repeat steps 2,4 and 5, adjusting C1 instead of C2 in step 4.
10. Change line 55 to .loop STA &8000; JMP loop, and check that /CAS times are correct with respect to RAS on-write cycles. If not adjust R2/C3.

OTHER ELECTRON PROBLEMS.

Some Electrons produce very noisy clock signals which upset the operation of E2P. If you have checked everything else and your system still does not work then this may be your problem. The cure for this is to cut the tracks on the 16MHz input and, if you are not using a Plus Three, the ϕ_0 input and connect a 74LS14 Schmitt trigger IC as shown (it can be "piggy-backed" on IC17 for 0v and 5v connections.)

