

Euro-Apple Modifications
V. Sullivan

Conversion of Apple PCB #820-0014-01 18/02/83
For NTSC Color Video Output

Revision 1 03/01/83
Revision 2 23/at/83
Revision 3 18/02/83

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Source

<http://www.apple2.org.za/gswv/gsezi ne/GS.Worl dVi ew/v1999/Sep/EuroApple.Modi fi c ations/>

22 December 2002

* Notes on modifications:

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For NTSC Color Video Output

Notes

- 1) All integrated circuits (ICs), except the ROMs, are referred to by board grid location and pin number. For example B12-05 refers to pin 5 of the IC in row B, column 12. The row and column designations are printed on the top of the board, with the rows being horizontal and the columns being vertical. The ROMs are the six 24 pin chips in row F. They are referred to by their memory address which is printed on the board next to each socket. The six ROMs are D0, D8, ED, E8, F0, and F8.
- 2) All foil cuts are on the bottom of the board unless otherwise -stated.
- 3) For cuts on the top of the board, gently lift the black plastic part of the socket with a pair of large pliers or vise-grips, using a slight rocking motion along the long axis of the socket. When the plastic lifts it will leave the pins on the board. The specified cuts can now be made and then the plastic must be carefully pressed back into place BEFORE soldering to the pins. If this is not done the pins will move out of alignment. While the tops of the sockets are off be very careful not to touch the pins. They bend easily and if bent, will give contact problems.
- 4) The foil cuts may be made with a sharp Xacto knife if you take great care. A much better tool to use would be a small hand grinder, such as a Dremel, with a very small ball mill.
- 5) All jumper connections are made with #30 wire wrap wire unless otherwise specified.
- 6) Due to the modifications several of the ICs on the board become spare. These are C11, C2, and E1. Chips must be installed at C2 and E1 as sections of these chips are used during the modifications. No chip should be installed at C11. The socket may be used for the jumper from an additional RAM card if desired.
- 7) All of these boards were checked at the factory. Some worked and some did not. Those that worked had a written code placed in the white paint square in the upper left hand corner on the top of the board. If your board has no code there I strongly suggest that you look at your board, top and bottom, with a magnifying glass or low power microscope before doing any modifications. What you are looking for are foil bridges where the board was not etched enough, foil opens where the the board was etched too much or solder bridges where too much solder has caused a short circuit between two pins of an IC or Peripheral connector when there was not supposed to be a connection.
- 8) The modifications are presented in stages. There are several reasons for this:

- A) The reasons for doing each modification can be explained.
- B) The work can be done at several sittings, minimizing fatigue and thus chances for error.
- C) The work can be checked in smaller sections, minimizing the area of the circuit that would have to be checked in case of problems.
- D) You may wish not to do some sections of the modifications. Please make the modifications carefully and exactly as presented. A minor error can cause many hours of troubleshooting. Stop and check your work where suggested. If your board does not work find out why before digging yourself in deeper by making more modifications. These mods have been checked-by myself and other people. They have been checked for compatibility with language cards, Z80 cards, Apple disks, and Apple printers so there should be no interface problems. If you have questions consult me before cutting, if you have problems you cannot solve, consult me before cutting further.
- 9) The User 1 jumper is shown on page 2 of your schematics. This jumper is not marked in any way on the PCB. It is located as shown in figure 1 below.

fig1. GIF @8k

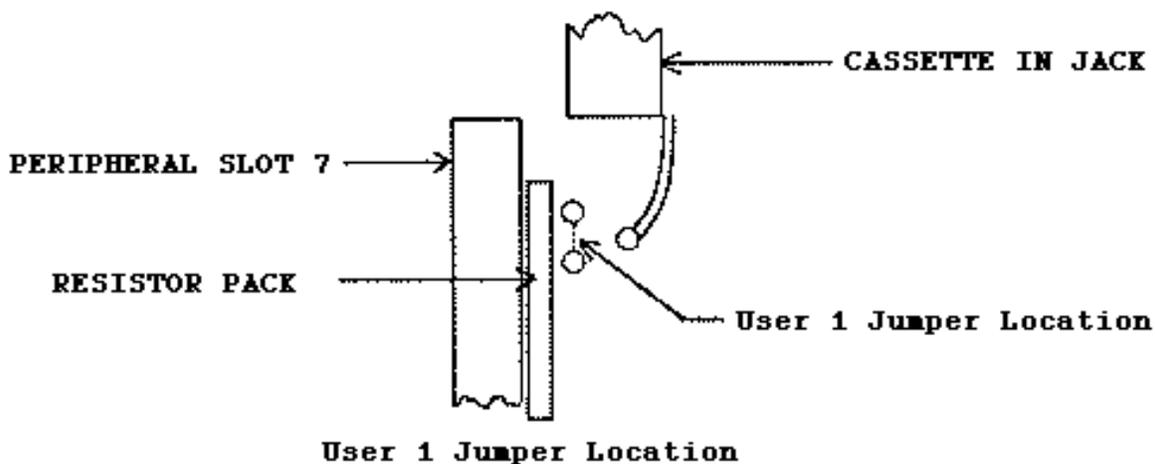


Fig. 1

10) I would like to thank Kirk Symons of CDC for much information and help, and also Eric Taada for help and moral support. I would also like to thank those of you who waited patiently for me to take the time to do this project properly. Good luck with your board.

* Mod. 1 Sync counter

Modification 1

Sync Counter Apple Schematics Page 1

These modifications change the character timing of the Apple from European characteristics at 50 Hz to North American standards at 60 Hz. It also ensures that the internal clock signals and the signals on the peripheral connectors are correct.

Step 1) Cut all foils to / from the following pins:

- * D11-03
- * D12-03
- * D12-06
- * D14-03
- * D14-04 (Top and Bottom)
- * A14-04
- * A14-08
- * A14-09
- * A14-10
- * B12-13
- * A09-08
- * A13-09 (Top)
- * A13-13 (Top)
- * A11-01

Step 2) Connect the following jumpers using #30 wire.

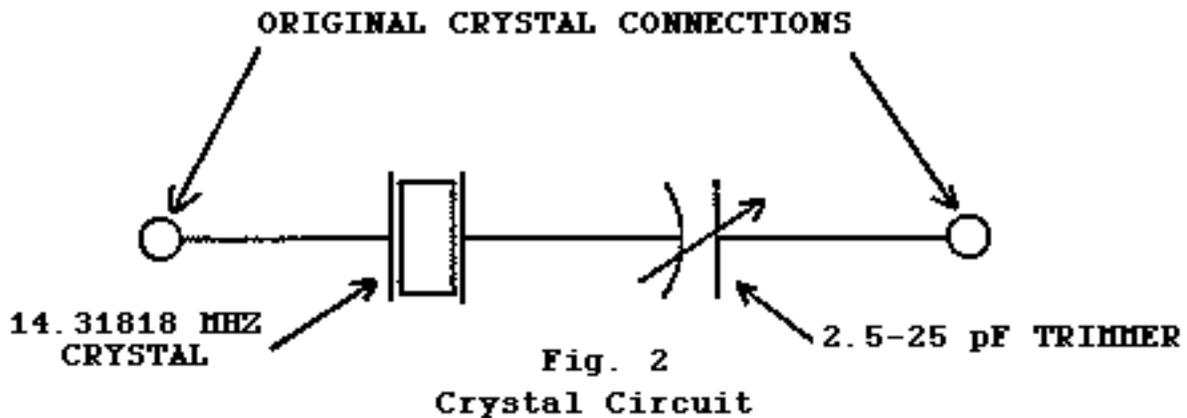
- * FROM -----> TO
- * D11-01 ----> D11-03
- * D12-03 ----> D12-06
- * D13-01 ----> D13-05
- * D14-01 ----> A14-09
- * B14-01 ----> A14-09
- * A14-08 ----> B12-13
- * A13-09 ----> A11-03
- * A11-01 ----> B14-03
- * A13-13 ----> B14-06
- * D12-01 ----> D12-03
- * D12-03 ----> D12-08
- * D14-01 ----> D14-07
- * D14-04 ----> D14-05
- * A13-12 ----> A14-10
- * A13-08 ----> B13-04
- * A14-04 ----> B14-07
- * A11-02 ----> B12-07
- * D13-12 ----> B12-05

* Crystal mod.

For NTSC Color Video Output

Step 3- Remove the crystal currently installed and replace it with the new crystal in series with the small green trimming capacitor. This capacitor is 2.5 to 25 pF. The circuit should be as in figure 2 below. The assembly should be held down with some RTV adhesive, but be careful not to get the RTV into the trimmer capacitor, or to allow the metal case of the crystal to contact any of the components on the board. If you will not ever wish to use any of the color features of Apple the new crystal may be installed without the trimmer capacitor.

fig2. GIF @12k



Step 4- Remove the small coil (L2) in the oscillator circuit in the lower right corner of the board and replace it with a 47 Ohm 1/4 Watt resistor.

THIS COMPLETES MODIFICATION 1

* Mod. 2 Video generator

Video Generator APPLE Schematics Page 5

These modifications ensure proper video sync generation at 60 Hz.

They are identical in concept to the mods listed by Apple. For 50/60 Hz conversion in this area of the circuit.

Step 1) Cut all foils to/from the following pins:

B10-03 (Top)

B10-06

E01-01

E01-02 (Top)

E01-03

Step 2) Connect the following jumpers using #30 wire:

FROM ----> TO

D12-11 ---> B10-03

E01-01 ---> B10-06

D11-14 ---> E01-02

E01-02 ---> E01-03

THIS COMPLETES MODIFICATION 2

* Mod. 3 Part 1 Processor (ROM Mod.)

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Modification 3 (Part 1)

Processor Schematics

This is a temporary modification, for testing purposes, to allow the use of the 2732 EPROMS included in your kit. Those connections listed as permanent will be used later and should be well done. The temporary connection will be removed later and need not be as carefully done. The complete EPROM modification is presented later. Note that in this section we are dealing with ROM address numbers rather than chip grid location numbers.

Step 1) Cut the foil between pins 20 and 21 on EACH of the six ROM sockets in row F. DO NOT cut the other foil that leads to pin 20.

Step 2) Connect the following jumpers using #30 wire:

- * FROM ROM F8-18 -----> TO ROM F8-12 (Temporary)
- * FROM ROM D8-21 -----> TO ROM E0-21 (Permanent)
- * FROM ROM E0-21 -----> TO ROM E8-21 (Permanent)
- * FROM ROM E8-21 -----> TO ROM F0-21 (Permanent)
- * FROM ROM F0-21 -----> TO ROM D0-21 (Permanent)

Step 3) Connect two 1K Ohm 1/4 Watt resistors as follows:

- * Resistor #1 From ROM F8-21 -----> ROM F8-24 (Permanent)
- * Resistor #2 From ROM D8-21 -----> ROM D8-24 (Permanent)

* Insertion of ICs

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Integrated Circuit Insertion

You are now ready to insert all of the ICs into your Apple board. This is a fairly straight forward task of matching the chip type numbers printed on the board with the type numbers on the chips. There are however a few exceptions, which are noted below. All of the chips have their pins slightly spread and these must be bent carefully in, so that the chips will fit easily in the sockets. If this is not done the pins will bend underneath the chip when it is pushed into the socket and this causes a very hard to find fault. Install the TTL and linear chips first, then the RAMs, ROMs, and 6502 CPU. When working with these last three types of chips you should ground yourself to avoid static damage to the chips. The ROM address numbers are printed on the paper labels on the top. The ROM labeled CGEN is an exception and is explained below. Do not insert it now. Make sure that pin 1 on all chips, as denoted by the notch or dot is next to the pin 1 mark on the board (small white square for each socket).

EXCEPTIONS

- 1) The RAM chips have no numbers on the board. Use the chips labelled 5290J or TMS4116. Do not insert a RAM at location C11.
- 2) The three 8T97 chips are replaced with either 74LS367 or 54LS367.
- 3) There are 6 ROM chips labeled HN462732G. These chips are installed as indicated by their address number in row F.
- 4) There are no chips installed at location A7, C11, J14. The ROM chip labeled D2716D and/or CGEN is the character generator. It is used with the adapter circuit board in the location called 2513 (A-3). Gather together the adaptor board, the 24 pin socket and the 24 pin blue or grey header. If your adaptor board had the holes drilled skip step (a).
 - a) One of the rows has 3 double pads, drill the holes in this row and also the middle row of the other three rows.
 - b) Install the 24 pin socket from the blank side of the board. Line up pin 1 of the socket with the dot on the copper side of the board. Solder the socket.
 - c) Take the 24 pin header and place the surface with the split pin ends flat on the foil side of the board so that the split pins rest on the two rows of pads without the holes drilled out. Note that these two rows of pads are offset just like the split pins.
 - d) Solder the split pins to the foil from the side. This is difficult to do so take care not to cause solder shorts etc. 7
 - e) Solder about a foot of #30 wire into each of the three holes next to pins 15, 19 and 22 of the socket. These wires will be referred to as CGEN 15, CGEN 19, CGEN 22 in later steps.

6) Plug the header into the 2513 socket on the board, matching pin i on the CGEN ROM with pin 1 on the socket. If this assembly is too high for your case (later) remove the 2513 socket and solder the header pins right into the holes. Do not do this until all the other mods are done or you will find it awkward to cut some tracks around A1.

7) Connect CGEN 1 9 temporarily to A1-8
You should now have all of the chips inserted into the board.

END OF CHIP INSERTION SECTION

* Test phase 1, Power supply hookup

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Test Phase 1

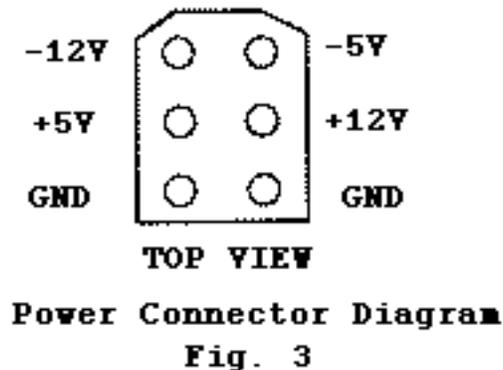
You are now ready to test your first phase of modifications. You will need a power supply of at least.

- * +5V at 1.5 Amps
- * +12V at 0.5 A
- * -5V at 100 mA
- * -12V at 100 mA

If you use peripherals with your Apple you will need a larger power supply such as that shown in Appendix 2. The power supply connector should be unsoldered and wires connected in its place. A diagram of the connector is shown in Fig 3. The connections to the +5V and +12V and Ground should be quite heavy (#16). The -5V and -12V can be #18.

Power Connector Diagram

Figure 3 @8k



You will also need a keyboard, a video monitor or a TV set with a modulator and a small loudspeaker.

Video Monitor

A standard NTSC (North American) colour or B+W video monitor should be connected to the RCA phone plug at the right rear corner of the board.

Keyboard

An ASCII keyboard must be connected to the socket at A-7. The cable to plug in to this socket is supplied in your kit of parts. The color Black 1 is on one outside edge of the cable. The color Green 2 is on the other outside edge. The other colors are 1 or 2 depending on which edge they are closest to. The chart

on the next page shows how to connect your keyboard. For those who have the small Microswitch keyboard the connections for the other end of the cable are also shown.

* Keyboard hookup

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Keyboard Connection Table

* Socket A6	Color	Function	Microswitch Keyboard
* Pin Number			Edge Conn Number

* 1	White 1	+5 Volts	3
* 2	Violet 1	Strobe	1
* 3	Green 1	Reset	14
* 4	Orange 1	NC	17
* 5	Brown 1	Bit 6	10
* 6	White 2	Bit 5	9
* 7	Violet 2	Bit 7	11
* 8	Green 2	Ground	4
* 9	Blue 2	NC	18
* 10	Grey 2	Bit 3	7
* 11	Black 2	Bit 4	8
* 12	Red 1	Bit 1	5
* 13	Yellow 1	Bit 2	6
* 14	Blue 1	NC	16
* 15	Grey 1	12 Volts	2
* 16	Black 1	NC	13

On the Microswitch keyboard edge connector pin number 12 is the keying-slot and pin 15 is not used. When wired by these instructions the "Break" key in the upper right hand corner of the keyboard is the reset switch for the computer. If you are using a keyboard other than the Microswitch the reset line must be grounded momentarily to reset the computer. The strobe may be of either polarity, but it must have a rising edge while the output from the keyboard is valid. When plugging the keyboard connector cable into the socket at A6 make sure that the pin 1 indication on the blue connector lines up with the pin 1 indication on the board.

Speaker Connection

The two leads from a small 8 Ohm speaker should be connected to the speaker plug located in the lower right corner of the board near the crystal

* Initial power up

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Powering Up

It is now time to throw the switch. If everything is OK the speaker will beep and the screen will say "APPLE][" at the top. You are in Applesoft basic and can start programming if you want. If the machine does not power up like this, or you smell smoke, turn it off and check over your work and ensure all of the power supply voltages are correct and the other connections are proper. If you have an unsolvable problem then give me a call. Your Apple is now functional but not fully modified. I suggest that you use it for a few days both to make sure that it will keep working and also for you to gain some experience with it which may help you with it later. Some of the additional mods are optional, and I suggest that you read the reason for a mod before you proceed with it. If in doubt, ask me for further clarification. While you have the machine up and running you should connect a frequency counter to B14-3 and adjust the crystal trimmer capacitor for a reading of 3.579545 MHz. If you have no counter do not worry, an alternate procedure is given later.

THIS COMPLETES TEST PHASE 1

* Mod. 3 Part 2 Processor (ROM Mod.)

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Modification 3 (Part 2)

Processor Schematics

This is the second part of the EPROM modification. It gives you access to the Integer Basic and original Apple Monitor that are stored in the lower half of the 2732 EPROMs. The modification also re-arranges the ROM select lines and ROM output enable lines to lower the power consumed by the ROMs. This results in cooler ROM operation and a lighter load on the power supply, which will also stay cooler and have more power left for peripherals.

Step 1) Remove the temporary jumper from ROM F8-18 To ROM F8-12.

Step 2) Remove the six ROMs in row F from their sockets and remove the black plastic part of the socket, being careful of the pins.

Step 3) Isolate pin 18 of each of the six ROMs by cutting the foils. This can be most easily done by five cuts on the top of the board, one each under ROMs D8, E8, F0, and F8, and by cutting the foil on the bottom of the board that connects to the plated through hole (PTH), under ROM E8. This is the foil that passes between pins 14 and 15 of the 6502 chip.

Step 4) Isolate pin 20 of each of the six ROMs by cutting the foils. This is done on the bottom of the board for all ROMs except D0, where it is done on the top of the board.

Step 5) Cut all foils to/from the following pins EXCEPT keep the foil between E01-08 and E01-09 on the bottom of the board.

E01-08 <-----> E01-09 (Top) <-----> E01-10

Step 6) Obtain two small switches suitable for mounting on the front panel of your computer and some light stranded wire such as #28. The switches will be used to select between the various software options as shown in Fig 5. The switches should be wired as shown in Fig 4. You should note that the lower half of ROM D8 is not programmed at this time. If you develop machine language routines that you want to access from either monitor while the basic selection is Integer or from Integer Basic itself you may store them in this ROM between addresses D800 and DFFF.

* Switch 1 Open = Autostart Monitor,
* Switch 1 Closed = Original Apple Monitor
* Switch 2 Open = Applesoft Basic
* Switch 2 Closed = Integer Basic

Software Selection Table

Fig 4 @8k

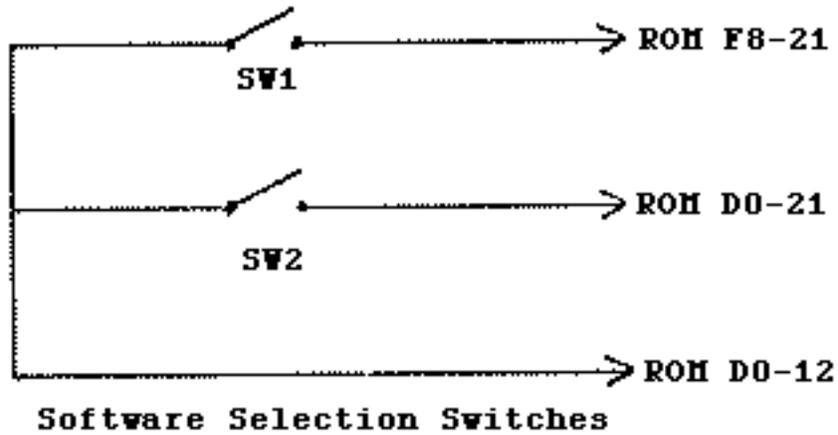


Fig. 4

Step 7) Connect the following Jumpers using #30 wire.

- FROM-----TO
-
- ROM D8-18-----PTH whi ch ROM D8-20 USED to connect to.
 - ROM E0-18-----PTH whi ch ROM E0-20 USED to connect to.
 - ROM E8-18-----PTH whi ch ROM E8-20 USED to connect to.
 - ROM F0-18-----PTH whi ch ROM F0-20 USED to connect to.
 - ROM F8-18-----PTH whi ch ROM F8-20 USED to connect to.
 - ROM D0-18-----F12-13
 - ROM D0-20-----ROM F8-20
 - ROM F8-20-----ROM F0-20
 - ROM F0-20-----ROM E8-20
 - ROM E8-20-----ROM E0-20
 - ROM E0-20-----ROM D8-20
 - ROM D8-20-----E01-10
 - E01-08-----Peripheral Connector 0 pin 32

It is now time to check modification 3. With both software selection switches open connect the computer as before and turn on the power. The computer should work exactly as before. If it does not recheck your work. You can now try some other software. With switch 1 closed a reset will put you in the original

monitor. Basic may be accessed by typing "Control B. Return". You return to the monitor by typing "Call-151, Return". If switch 2 is closed when you access Basic you will be in Integer Basic with the prompt a>". If you are in either monitor the prompt is "*". At this time you should get some books and start reading. Again I suggest that you use the computer for a few days to gain experience and to make sure that everything will continue to work.

THIS COMPLETES MODIFICATION 3

* Mod. 4 Video selector

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Modification 4

Video Selector Schematics

This modification allows you to obtain additional colors in the high resolution graphics mode.

Step 1) Cut all foils to/from the following pins:

B01-05 <-----> B01-13 <-----> B01-14

C02-02 (Top and Bottom) <-----> C02-03 <-----> C02-05

B03-01 <-----> B03-14 (Top) <-----> B03-t5 (Top)

A06-01 (Top) <-----> A06-02 (Top and Bottom)

Step 2) Connect the following jumpers with #30 wire.

(FROM -----> TO) ----- (FROM -----> TO)

(B01-05---->B01-08) ----- (D14-14----->B01-14)

(B01-13---->A05-10) ----- (A06-13----->B03-02)

(B03-02---->C02-02) ----- (C02-05----->B03-01)

(C02-03---->C01-03) ----- (B03-13----->B03-15)

(B03-12---->B03-14) ----- (A06-01----->A06-02)

(A06-02---->A06-08) ----- (A05-10----->B07-13)

* Color graphics test

Euro-Apple Modifications

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Again it is time to fire up the machine and check your work. The following program checks the low resolution graphics. It can be run in either Applesoft or Integer Basic.

Color Bar Program

```
* 10 OR : C=- 1
* 20 C=C+1 : COLOR=C
* 30 VLIN 0,39 AT 2*C
* 40 IF C<16 THEN GOTO 20 : END
```

The following program was written by Andre Pilon and checks the high resolution graphics. It must be run in Applesoft Basic.

Andres' Theme

```
* 5 HGR
* 10 C=INT (RND (1) * 7 )
* 15 HCOLOR=C
* 17 SPEED = RND (1) * 250
* 20 LET X = INT ( RND ( 1 ) * 279 )
* 30 LET Z = INT ( RND ( 1 ) * 160 )
* 40 H PLOT 139,80 TO X,Z
* 50 GOTO 10
```

If either of these programs runs, but you get only shades of grey on a color monitor or TV set the likely problem is that the crystal frequency is off. If you have a frequency counter, measure B14-3 and adjust the crystal trimmer capacitor for 3.579545 MHz. If you do not have a counter adjust the trimmer for the center of the range where you get a color display on the monitor. If your monitor is black and white and these programs produce shades of grey then your graphics circuits are probably OK, however the frequency might still be off.

END OF MODIFICATION 4

* Mod. 5 Video generator

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Modification 5

Video Generator Schematics Page 5

These modifications finish the wiring up of the character generator so that upper and lower case letters can be accessed. Note that special software is required to handle this, you don't just push the shift key on your keyboard! This mod also makes changes to the game controller port at J14 so that all sections operate properly and corrects a 1 bit video shift problem that the European Apple has. If you want to demonstrate this problem to yourself type "GR" and then "TEXT". The entire screen except for a few lines~at the bottom will show "G". If you look carefully at the right and left edges of the screen you will notice that one edge has 2 dots and the other has none. This modification will correct this problem and put one dot at each edge of the screen. Another problem that this mod corrects is an error in Apple's programming of the Auto-start monitor that causes improper initialization of the annunciators in the game controller port. This is normally not a serious problem but in the Euro-Apple it would cause it to initialize in the lower case mode on power-up.

Step 1) Cut all foils to/from the following pins:

A01-03 (Top) <----- A01-04 (Top) <----- A01-05 (Top)

A01-10 (Top) <----- A01-11 (Top) <----- A01-12 (Top)

A01-14 (Top) <----- F14-12 (Top)

Step 2) Remove the temporary connection from CGEN-19 TO A01-08.

Step 3) Connect the following jumpers with #30 wire:

FROM ----- TO ---AND--- FROM ----- TO

A01-12 <-----> A03-08 ----- A01-11 <-----> A03-07

A01-10 <-----> A03-06 ----- A01-05 <-----> A03-05

A01-04 <-----> A03-04 ----- A01-03 <-----> A01-14

F14-12 <-----> J14-12 ----- H14-01 <-----> J14-04

F14-12 CGEN-19 Wire

A12-05 CGEN-22 Wire

A01-03 CGEN-15 Wire

Step 4) Change the 1K Ohm resistor, (R12), connected between F14-15 and +5 Volts to a 10K 1/4 Watt resistor. Connect a 10 uF 15 Volt capacitor from F14-

15, (+ side), to F14-08, (-side). This step forces a power on reset of F14 so that when using the old monitor the character generator is initialized in the upper case only mode.

Step 5) Apple made an error in the program in the Autostart monitor ROM. This error causes the machine to Autostart in the Upper case + Lower case mode. On page 36 of the Apple Reference Manual they state that the Annunciators initialized as follows.

```
* ANO = 1
* AN1 = 1
* AN2 = 0
* AN3 = 0
```

This is not true, in fact the exact opposite is true. AN3 must be fixed for the UC + LC mod to work properly. The other ones may be fixed if you desire. To fix this you will need an EPROM programmer or you will have to return the F8 ROM to me for reprogramming. (That is the price you pay for taking the ROMs before I had checked everything out.) Please specify if you want just AN3 or all 4 fixed. The changes are all in the F8 ROM.

ADDRESS CONTENTS ANNUNCIATOR

```
* 0A70 change from 58 to 59 0 optional
* 0A73 change from 5A to 5B 1 optional
* 0A76 change from 5D to 5C 2 optional
* 0A79 change from 5F to 5E 3 necessary
```

Again it is time to fire it up and check your work. Get into Applesoft and type some junk on the screen and hit return a couple of times. Type in POKE -16289, 0 and the screen should change to lower case. Type POKE -16290, 0 and it goes back to upper case. To display a combination of UC and LC characters on the screen at the same time you go to UC + LC mode (POKE -16289, 0) and then store characters that are to be upper case as inverse video in the apple memory. Appendix 1 contains the article from which this mod was taken and it has more explanation including the instructions to modify the Apple Writer text editor for use with this modification. Be aware that there are some inconsistencies and inaccuracies in this article. You will probably be as confused as I was.

* Peripheral connector mod/Power distribution mod

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Peripheral Connector Modification

Peripheral connector #7 on the Euroapple had the VA signal attached to pin 39 for use as the line phase alternation signal by a PAL color adaptor board. To make this connector conform to the American Apple do the following.

- 1) Isolate pin 39 of the peripheral cone. #7
- 2) Jumper with #30 wire per. cone. #7 pin 39 to #6 pin 39

Power Distribution Modification

This modification is designed to reduce the amount of noise on the power lines in the RAM and ROM area.

1) If you look between chips C6 and C7 on the top of the board you will see a PTH. There is also a hole between chips D6 and D7, and E6 and E7. Using #24 solid wire connect jumpers from each of these three holes to the +5 Volt rail which runs on the bottom edge of the board near column 1 of the chips.

- 2) Connect 0.1 uF bypass capacitors between the following points.

FROM <-----> TO

C07-01 <-----> C07-16

D07-01 <-----> D07-16

ROM E0-12 <-----> ROM E0-24

ROM E8-12 <-----> ROM E8-24

ROM F0-12 <-----> ROM F0-24

END OF MODIFICATION 5

* Concl usi on

Euro-Apple Modi fi cations

V. Sullivan

Concl usi on

Time to fire it all up again and see if it works. If it does you are now the proud owner of a fully modified Euroapple that is quite a bit more powerful than your average Apple II +. As Andre Pilon said after he copied about 200 program tapes for us, "All you bastards owe me a case of beer", except I don't drink.

Happy computing!

APPENDIX

* Upper & Lowercase Mod

APPENDIX 1 MODIFICATIONS TO THE APPLE II DISPLAY

UPPER AND LOWER CASE LETTERS

John Macdougall

(from THE APPLE ORCHARD, starch/April 1980, pp. 57-60)

This article describes a simple modification to the Apple II which can be used to display upper/lower case letters when using the Apple Writer Text Editor, or can be used to display an alternate character set. The modification consists of removing the existing 2513 character generator ROM and replacing it with a 2716 EPROM. The 2716 contains two character sets. The first is the standard duplicate of the 2513 and the second is a special set which, for example, works with the Text Editor characters.

Since the 2716 is not pin compatible with the 2513, an interconnect pattern is needed. In addition, certain connections must be made to the main board. To do this effectively, a small circuit board is used which holds the 2716 and plugs into the 2513 socket. Three wires from this board then go to the main board.

How the Circuit Works

Imagine that your character generator ROM has two character areas. The first of these is an upper case area and the second is a lower case area. Switching between these two areas can be accomplished by using a high address bit. This turns out to be very appropriate to the Apple Text Editor since it in fact stores the characters such that upper case characters have the high bit set low so that they will display in inverse video. This bit is picked up from pin 5 of A12 and is used to select the ROM area from which the display character is selected. There is one problem with this method, and that is that the high bit set low tells the Apple hardware to set an inverse character. The result of this simple modification is that we now have lower case but the upper case is still in inverse video. The solution is to put into the ROM the inverse characters so that although the Apple thinks it is displaying an inverse character it is really displaying the inverse of an inverse.

There is still a problem when you come to observe the resulting characters. They have funny lines and extra information which is very distracting. This is solved by getting at the shift register parallel load inputs and setting them with a sixth bit from the ROM. To do this they must be lifted from ground and connected to the little board. Thus pins 3 and 14 are cut and the lead from the 2716 is connected to the 74166 pins.

A final refinement to the system is to make the selection of mode software selectable. So rather than put a switch on the circuit board, the mode select address pin is connected to the game socket at annunciator 3. The latch which provides this output always comes up with a low output on power-on. The addressing is arranged so that this gives the normal Apple character set. The result is that, to the unsuspecting, user, the system configuration looks

exactly as he has always seen it and he will never know that there is now a lower case present. The case can be set and reset as follows.

To set lower and upper case

```
* -> POKE -16289,0
* (Annunciator 3: on)
```

To set upper case only

```
* -> POKE -16290,0
* (Annunciator 3: off)
```

For use with the Text Editor, the conversion to lower case can be made automatic by putting the lower case POKE into the editor HELLO program as follows:

```
* 5 D$="": REM CONTROL D
* 10 PRINT D$; "NOMON I, O, C": CALL -936
* 20 POKE 1010, 191: POKE 1011, 157: POKE 1012, 56
* 30 POKE -16289, 0
* 40 PRINT D$; "BRUNTEDI TOR"
* 50 END
```

Other Features

Because of the independent character sets with this system, it is possible to have additional characters. The special characters which can be accessed by this system as currently implemented are as follows:

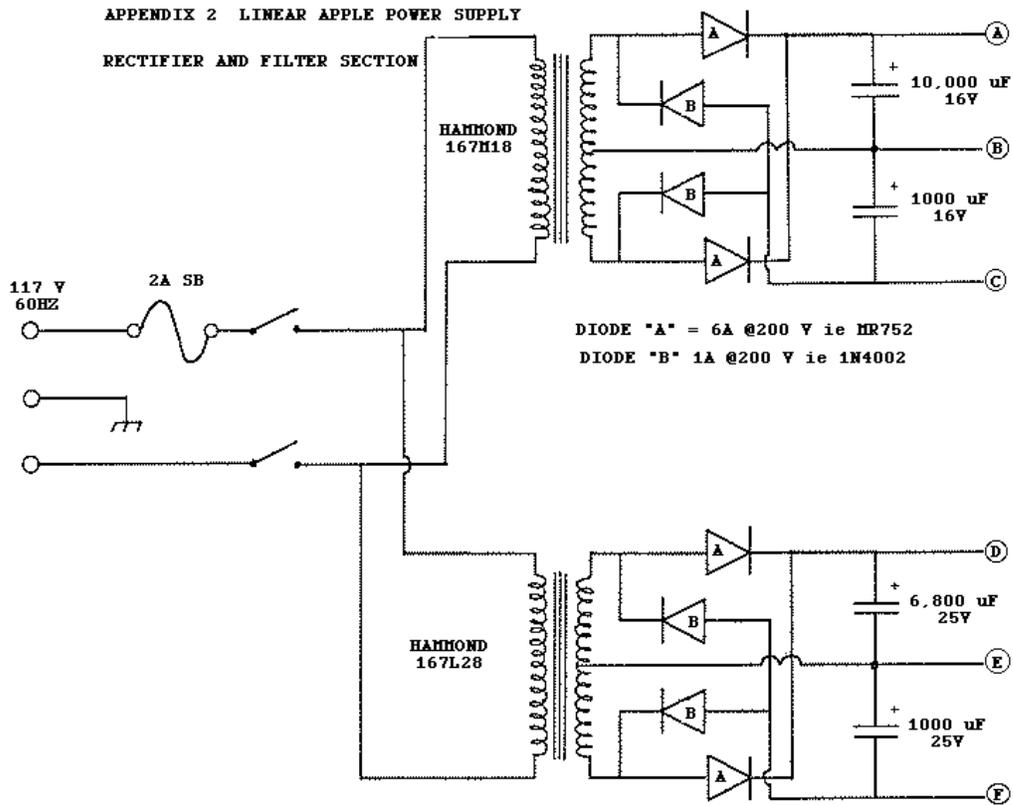
```
* [ - esc-control-n
* ] - esc-shift-m
* - control-n
* - shift-m
* ~ - shift-n
* - esc-shift-n
```

After construction is complete, carefully check all connections. Then install the board, making doubly sure the proper locations are selected. Be sure to add the previously mentioned POKES to the Applewriter program. Then resave for future use. You now have a very sophisticated text editor for your Apple. You will now enjoy typing letters, since what you see on the screen is what you get on the printer.

good luck. .

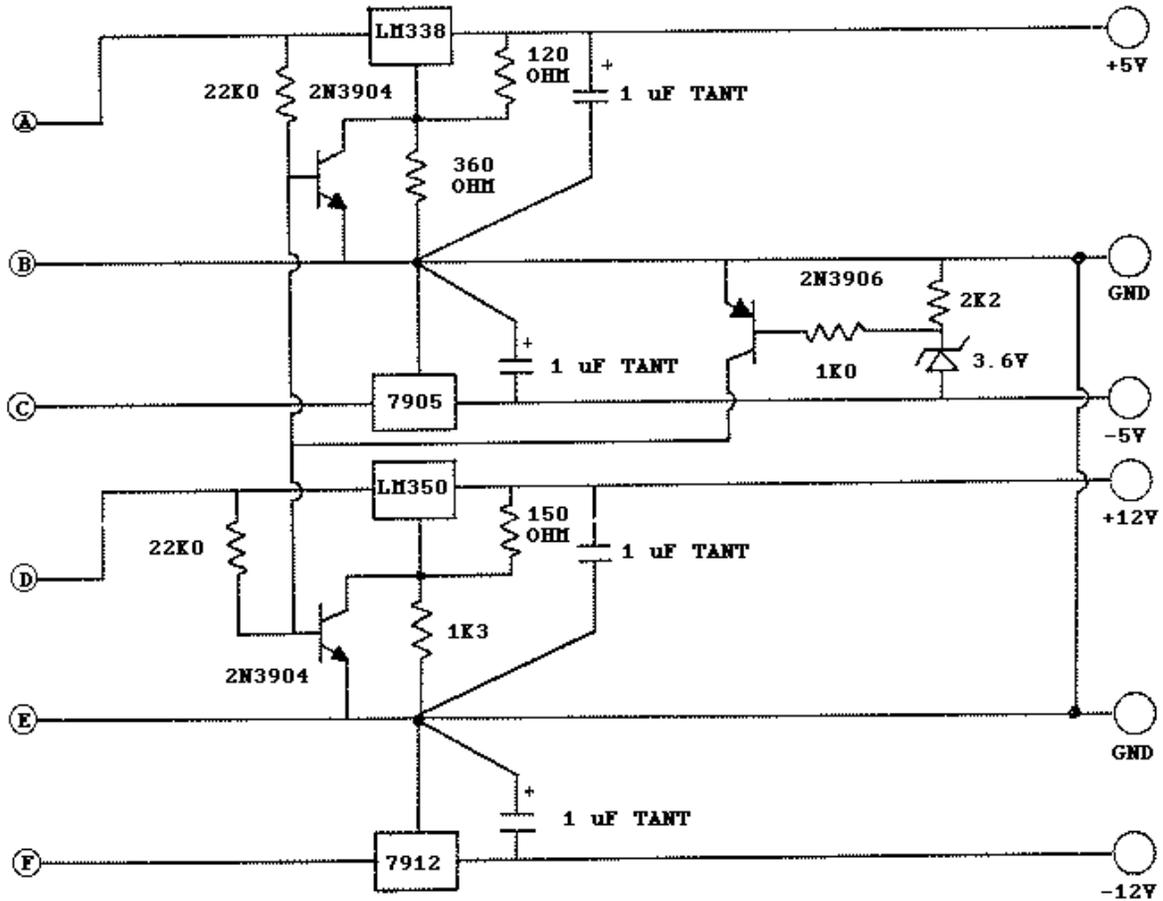
POWER SUPPLY

* Rectifier and Filter Section gif @24k



* Apple Linear Power Supply (regulator Section) gif @24k

APPENDIX 2 APPLE LINEAR POWER SUPPLY REGULATOR SECTION



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