

# Apple II E Repair Guide

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## INTRODUCTION

I bring this series to all of the Apple //E users who have experienced the unfair and outrageous prices that repairmen of computers (especially at Computerland) charge for their services, only to replace a \$0.50 chip. I myself have been charged \$75 to have a \$2.50 chip replaced, not to mention it took them two weeks to get to my computer to replace the damn thing. At the end of this series, most repairs on your computer you should be able to do on your own, and most for less than the cost of a movie.

Before I get heavily into this discussion, may I make a small suggestion? Print this out NOW! If you don't and your computer breaks down, then what are you gonna do? Yup, you are gonna pay big bucks.

Open your computer and take a look at the motherboard. Looks confusing, eh? Not really. The big black things are called integrated circuits, and these are what break down or fail most often. The other things we will not worry about at the moment.

Up and down the left side of the motherboard you will see letters A-F, and along the bottom the numbers 1-14. This is the way Apple locates their chips on the board - much like a city map with grids. Here are the names, and locations, and the approximate costs for each of the chips on the board. Don't let the names of the chips scare you or anything on this chart. It is mainly for information, and you won't need to know anything about the chips on the board (aside from the fact they are broken, which will come later).

IC #	Location	Description Notes
74LS02	B8	Quad 2-input NOR
74S10	C5	Triple 3-input NAND
74S109	C1	Dual JK Flip-flop
74LS125	E1	Tri-state quad buffer
74LS138	B5	Expandable 3/8 Encoder
74LS154	C10	4-16 decoder/multiplexer
74LS166	F5	8-bit serial in, parallel out shift register
74LS244	B1,B3	Tri-State octal line driver
74LS245	B2	Tri-State octal bus receiver
74LS251	C11	Tri-State 8-input multiplexer
74LS374	D3	Tri-State octal-D flip-flop
NE558	A12	Quad 555 timer
MC741	A11	Operational Amplifier
ULN2003	Analog Card	7-channel input (from Apple) driver
LM3146	Analog Card	Transistor Array (from Apple)
MC3470	Analog Card	Floppy disk (from Apple) read amplifier
MC3764	F6-F13	64k x 1 bit RAM
6502B	B4	8 bit microprocessor
KB ROM	D12	Keyboard ROM
VID ROM	F4	Video ROM
CD ROM	D10	Applesoft ROM
EF ROM	D8	Monitor ROM
HAL	D1	Programmed Array (from Apple) logic
IOU	D6	I/O unit (from Apple)
MMU	D4	Memory Mgmt Unit (from Apple)
AY3600	D14	Keyboard Decoder

Ok, that's all of the chips on the motherboard, and a few from the Analog card, that is the one inside your disk drive (apple drives only). If you need to order one of these chips from Radio Shack or some other local electronics store, then you ask for the chips by the number in the left hand column. For example, if your paddles were not working and the cables were good, you would need to start with the NE558 chip, and that is what you order. More about that later, though. Don't worry about the big costs of the ROM chips or the CPU. Most computer breakdowns are of the 74LSxxxx series and you will most normally have to deal with those only.

Now, before you go poking around your motherboard popping out chips and sticking them back in, a few tips and reminders to keep your apple running right, and how not to screw anything up.

- 1) Never touch ANYTHING in or on your computer, including your disk drives, before grounding yourself on something. Static electricity, especially in the wintertime can reach as high as 10,000 volts - enough to fry any of the delicate chips inside your computer.
- 2) Buy a chip puller. They are cheap, and you will save your fingers from getting pins from the chips stuck in them, and blood all over everything. 3) Always note the orientation of the chip you pull out, so that you can put the new chip in the same way. There is a notch in one end of the chip, or a dot at one end. Either way, be sure the new chip has the notch or dot in the same place as the old one.
- 4) Use power strips and surge protectors. The surge protector for obvious reasons, and the power strip for preventing wear and tear on the switches.
- 5) Keep your coke off the keyboard. Liquids can blow every chip they touch.
- 6) Take special care about static electricity when messing around with the CPU, the ROM chips, the MMU and the IOU chips. These are quite sensitive to static charges.
- 7) Don't open your monitor. This is stupid, xrays and 30kV's are running around inside and if you don't know what you are doing, you will have radiation damage, or worse yet, your parent will smile when they collect life insurance on you.
- 8) Don't pull cards out or put cards in when the power is on. You will kill either the card or the computer, I promise.
- 9) Check everything outside of the computer before you start fiddling around inside. Usually cables, switches or other shit like that are the cause of the problem.

### **This series is divided into 5 Parts:**

- 1) Start-Up Problems
- 2) Run Problems
- 3) Display Problems
- 4) Keyboard Problems
- 5) Other I/O Problems

## Part I - Start-Up Problems

This section covers all problems that occur at the time you turn the power on, or at start up, including no power, no boot up, no beep and no display.

1) No power light, no beep, drive won't run:

Probable defect:

- 1 74LS125 at E1 is bad (replace and test)
- 2 74S109 at C1 is bad (replace and test)
- 3 74S02 at B8 is bad (replace and test)

2) Power light on, no message, no beep:

Probable defect:

- 74S02 at B8 is bad (replace and test)
- 74S109 at C1 is bad (replace and test)

3) Power light on, message, no beep:

Probable defect:

- (Experts only) PAL 16R8/8323T at D1 is bad

4) System won't boot, power light on, drive won't run, garbage on screen:

Probable defect:

- Bad EF ROM at E10 (replace and test)
- Bad 6502B at C4 (replace and test)

5) System won't boot, power light on, message on screen, drive won't boot:

Probable defect:

- Clean connector pins
- Clean or replace ribbon cable
- Bad ULN2003 on analog card (replace and test)
- Bad regulator on analog card (replace card)

6) System won't boot, everything on, drive keeps running:

Probable defect:

- Reseat disk, check disk, check cable, reseat card.

7) System won't boot, disk drive runs and then stops:

Probable defect:

- Bad DOS
- Bad Disk
- Bad RAM chip on motherboard (f6-14) replace and test

8) System boots and then stops, no display:

Probable defect:

- Video cable bad (replace and test)
- Video connector bad (replace)

- Brightness knob on monitor?
- 74LS02 at B8 bad (replace and test)
- 74LS10 at C5 bad (replace and test)
- 74LS166 at F5 bad (replace and test)
- 74LS374 at D3 bad (replace and test)
- IOU at E5 bad (replace and test)
- 2732 ROM at F4 bad (replace and test)

## Part II - Run Problems

1) Disk drive will not read (I/O error or disk just runs on and on)

Probable Defect:

- Bad Disk
- Wrong DOS
- Disk not seated
- Read head not reading
- Cable loose or bad
- Bad chip on analog card

Remedy:

- Replace Disk
- Try another disk
- Reseat disk
- Replace head
- Reseat or replace cable
- Replace Analog Card

2) Disk drive will not write (read is OK)

Probable Defect:

- Write protected
- Protect switch bad
- Disk not formatted
- Cable bad or loose
- Corroded connectors
- Bad 74LS125
- Bad CA3146
- Bad MC3470
- Bad ULN2003
- Bad Write head
- Head alignment off

Remedy:

- Remove tab
- Replace switch
- Format disk
- Check/Replace cable
- Clean connectors
- Replace (analog card)
- Replace (analog card)
- Replace (analog card)
- Replace (analog card)
- Replace
- Realign head

3) Disk reads or writes occasionally

Probable Defect:

- Cable corrosion
- Connector corrosion
- Noise interference
- Disk tracking off

Remedy:

- Clean connector pins
- Clean connector pins
- Good luck!
- Realign head

4) Occasionally keyboard locks up and computer locks up

Probable Defect:

- Program error
- No keyboard output

Remedy:

- Debug program
- ?

- |                 |                  |
|-----------------|------------------|
| • Bad RAM chip  | Replace and test |
| • Bad MMU chip  | Replace and test |
| • Bad CPU at C4 | Replace and test |

## Part III - Display Problems

### 1) No Display - Screen all White

Probable Defect:

- Shift register latch-up
- ROM data hung up

Remedy:

Replace 74LS166 at F5 and test  
Replace 2732 character ROM (F4)

### 2) No Display - No Video

Probable Defect:

- Bad Cable
- Low signal
- Bad monitor
- Bad 74LS02 at E8
- Bad 2N3906 at A14
- Bad 2N3904 at A14
- Bad 74LS10 at C5
- Bad 74LS166 at F5
- Bad 2732 ROM at F4
- Bad 74LS374 at D3
- Bad IOU at E5
- Bad PAL 16R8 at D1

Remedy:

Replace and test  
Adjust brightness  
Test monitor  
Replace and test  
Replace and test  
Replace and test  
Replace and test  
Replace and test  
Replace and test  
Replace and test  
Replace and test  
Replace and test

### 3) No Display - Screen Black

Probable Defect:

- Brightness bad
- Bad monitor
- Bad IOU at E5
- Bad 2732 ROM at F4

Remedy:

Adjust  
Test monitor  
Replace and test  
Replace and test

### 4) No Color

Probable Defect:

- Bad IOU at E5
- Capacitor C32 shorted
- Inductor L3 Bad

Remedy:

Replace and test  
Replace (soldering required)  
Replace (soldering required)

### 5) No Synchronization

Probable Defect:

- Bad IOU at E5
- Bad monitor

Remedy:

Replace and test  
Replace or repair

6) Bad cursor or no cursor

Probable Defect:

- Bad EF ROM at E10
- Bad 2732 ROM at F4

Remedy:

Replace and test  
Replace and test

7) Bad inverse or flash

Probable Defect:

- Bad 2732 ROM at F4

Remedy:

Replace and test

8) No text

Probable Defect: Remedy:

- Bad 2732 ROM at F4
- Bad IOU ROM at E5

Replace and test  
Replace and test

9) Video - Bad color

Probable Defect:

- Bad HAL at D1

Remedy:

Replace and test

10) Bad Graphics (lo and Hi bad); text ok

Probable Defect:

- Bad IOU at E5

Remedy:

Replace and test

11) Bad Graphics (HI), low and text ok

Probable Defect:

- Bad IOU at E5

Remedy:

Replace and test

## Part IV - Keyboard Problems

### 1) Bad key action - some keys or no keys work

Probable Defect:

- Bad Key
- Bad or loose cable
- Bad AY3600 at E14
- Bad 2716 ROM at E12

Remedy:

- Replace key
- Check and replace cable
- Replace and test
- Replace and test

### 2) Bad key action - prints wrong characters

Probable Defect:

- Bad 2716 ROM at E12
- Bad AY3600 at E14

Remedy:

- Replace and test
- Replace and test

### 3) Bad key action - unwanted repeat

Probable Defect:

- Bad AY3600 at E14
- Bad capacitor C71

Remedy:

- Replace and test
- Replace (soldering required)

### 4) Repeat key won't work

Probable Defect:

- Bad Key
- Bad AY3600 at E14
- Bad Capacitor C70

Remedy:

- Replace and test
- Replace and test
- Replace (soldering required)

### 5) Key top pops off

Well, just glue that sucker back on or get a new keyboard.

## Part V - Other input/output problems

### 1) Speaker - volume too low

Probable Cause:

- transistor Q5 marginal

Remedy:

- Replace (soldering required)

### 2) Speaker - won't click

Probable Cause:

- Bad speaker
- speaker wires bad or loose
- Bad transistor (Q5)
- Bad IOU at E5

Remedy:

- Replace speaker
- Check or replace
- Replace (soldering)
- Replace and test

### 3) Cassette - can't load data

Probable Cause:

- Bad cable
- Volume not set properly
- No signal on tape
- Bad LM741 at A11
- Bad 74LS251 at C12
- Bad 74LS154 at C10

Remedy:

Replace and test  
Retry at different volume  
Replace tape  
Replace and test  
Replace and test  
Replace and test

### 4) Cassette - Can't write data

Probable Cause:

- No signal to tape
- Tape bad
- Bad IOU at E5

Remedy:

Reconnect or replace cable  
Replace tape  
Replace and test

### 5) Game paddle - does not work at all

Probable Cause:

- Bad cable
- Bad 558 timer at A12
- Bad 74LS251 at C12
- Bad 74LS154 at C10

Remedy:

Replace  
Replace and test  
Replace and test  
Replace and test

### 6) Game paddle button won't work

Probable Cause:

- Button bad
- Broken wire

Remedy:

Replace button  
Replace wire

### 7) Game Paddle - knob does not work correctly

Probable Cause:

- Bad pot in paddle
- Broken wire in cable

Remedy:

Replace pot  
Replace wire

### 8) Card in peripheral slot does not work

Probable Cause:

- Bad 74LS138 at B5
- Bad 74LS154 at C10
- Bad 74LS10 at C5

Remedy:

Replace and test  
Replace and test  
Replace and test



Additional hints:

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Look and smell and feel the chips in your computer for things that seem to be bad or out of place. Feel for hot spots, smell for blown capacitors, etc. Notice anything out of the ordinary and replace it if it doesn't look, smell or feel right. You can search for heat-blown chips by cooling each chip one at a time with freon from a can and examining the results on the operation of your computer. If you find a chip that allows the computer to work cold, but when it warms up, phooey, replace it.