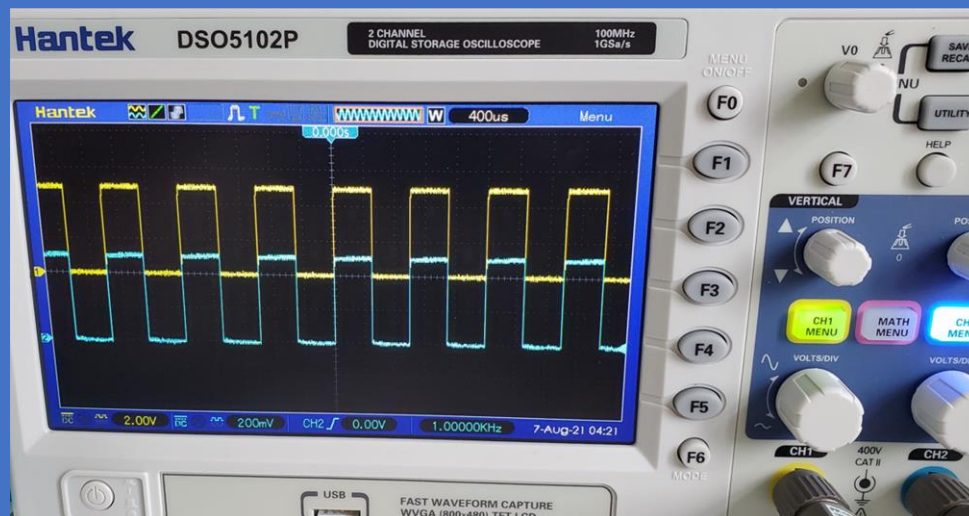


Rudy's Retro Intelligence



Apple II\II+ Personal Computer Diagnostics and Repair Manual

The purpose of this manual is help diagnose and repair the Apple II\II+ computers and is based on my work from over the years of repairs and input from others. Future versions will be available as more information is collected, tested and verified.

Included is the diagnostic section with suggested repairs based on the conditions present. Diagrams, card schematics and pinouts are also provided. Schematics for the Apple II\II+ computer itself can be found online and are **not** included here as there are some differences between revisions of the motherboard.

For Apple II\II+ clone computers, the diagnosis should work on these computers, however the placements of the IC and other parts may not line up with the diagram at the end of this documentation. You will have to do some additional research.

For the latest version of this document and other Apple II\II+ related information, use the links below.

<https://github.com/RudyRetroIntel/Vintage-Computer-Diagnostics>

You can find my video on the monitoring board here.

<https://www.youtube.com/@RudysRetroIntel>

Additional resources include:

- The Apple II Circuit Description by Winston Gayler
- Apple II Family of Computers Various Connectors Pinouts by Dr. Kenneth Buchholz
- Apple II Reference Manual by Apple Inc.
- How to Repair and Maintain your Apple Computer by Gene B. Williams
- ComputerFacts by Howard W. Sams
- Apple Instrumentation and Control: Circuits and Software by Jerome E. Oleksy
- Some schematics by Patrick Schafer and Apple Corp.
- Plus, my experiences over several decades of Apple II\II+\Clone repairs

*"Sharing knowledge, we can ensure that the Apple II\II+ computer can be repaired and enjoyed now and into the future.
Rudy's Retro Intel"*

***** This document is based on the work I have performed on my Apple II+ computer and is provided "as is". I\we do not take any responsibility for errors and\or damages that may occur when repairing your Apple II\II+ computer. This information is provided freely to all Apple II\II+ computer owners. Please ensure you know how to perform electronics\electrical work. If not, please contact someone who has these skills before starting. *****

Manufacturer	Apple Computer Co. 1978
Processor	MOS 65502
Speed	1.0Mhz
ROM	10K, 16K
Onboard RAM	16 or 32KB
Max RAM	48KB
Number of slots	7
Operating System	Apple DOS and CP/M with Z80 card
Max video resolution	various resolutions to 320x192x16 color. Composite monitor or RF Modulator to TV supported
Input\Output	Parallel and Serial
Speaker	Mono
Diagnostic Software	Apple II Dealer Diagnostics Apple-Cillian II - XPS Inc Apex II XPS Diagnostics IIe

Note. After repairs are completed, always run the diagnostic software and loop through all the tests as there may be other issues with the computer. Recommend that tests run at least 10 times without errors

Simple Apple II RAM Test

1. Go to the monitor (CALL -151)
2. Type in the following code (don't forget to add a space after 34:14 before pressing Return).

C050 C053 C054 C057 N 265:FF N 266<265.BFFEM 266<265.BFFEY 265:0 N 266<265.BFFEM 266<265.BFFEY 34:14
(Return)

The Apple II will go to HGR (High Graphics) mode and display white and dark graphics screen along with question marks and inverse "@" characters at the bottom of the screen. If some of the RAM ICs are bad, the address will be printed on the bottom of the screen.

Here are the row / address table

Row C : \$0000 - \$3FFF
Row D : \$4000 - \$7FFF
Row E : \$8000 - \$BFFF

Card configuration - Viewed left to right from power supply

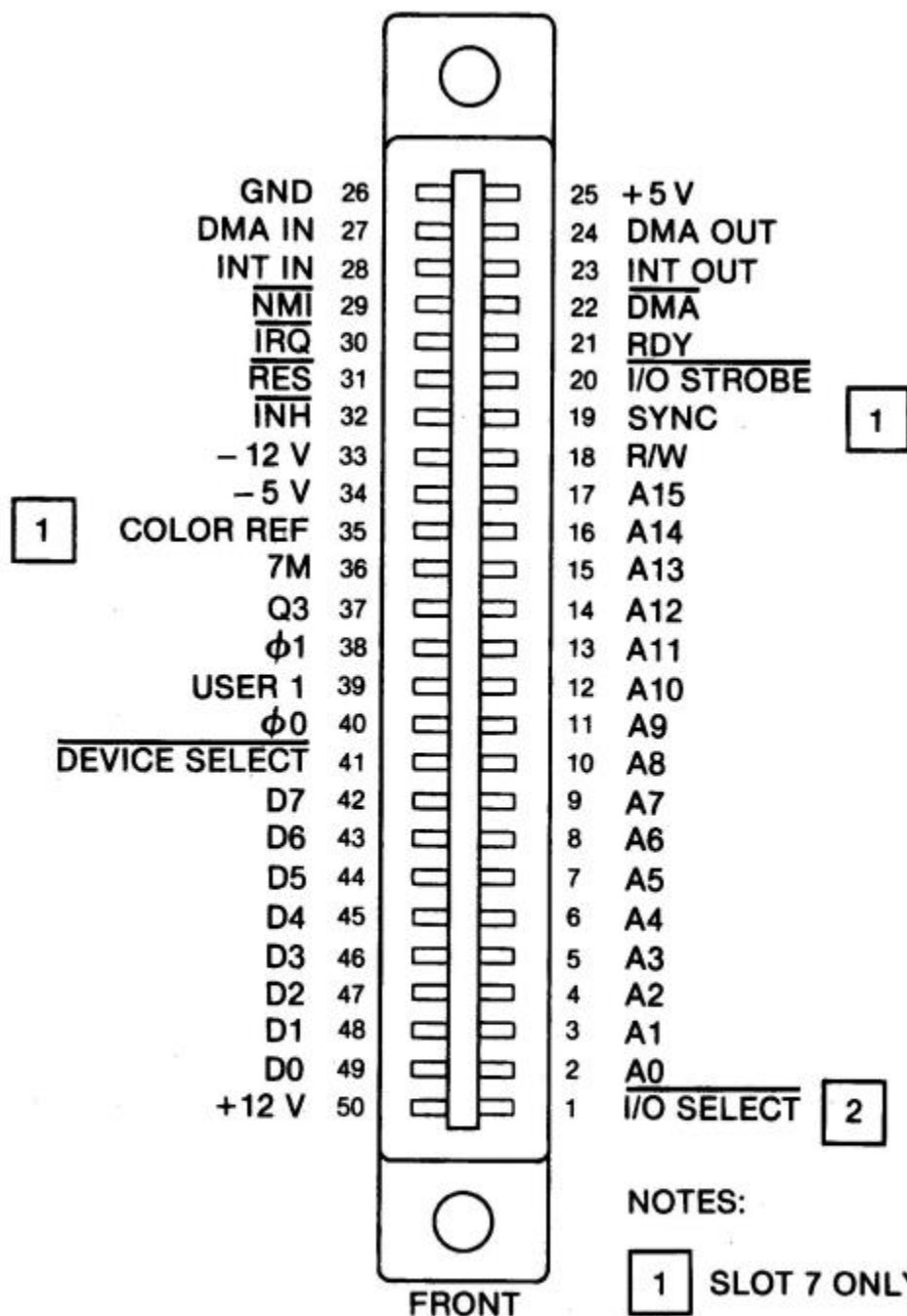
Slot 0	Language Card
Slot 1	Printer Card
Slot 2	Modem or Serial Card
Slot 3	80 Column Card
Slot 4	CP/M Card
Slot 5	Disk Drive Card 3 and 4
Slot 6	Disk Drive Card 1 and 2
Slot 7	Disk Drive Card 5 and 6

Quick Bad IC Connection Repair

Sometimes the Apple II series computer has a bad connection issue with the chips and the sockets. Before you start your diagnostics, open the computer and re seat all the chips. This is done by pressing down on all the chips to re seat them. You may hear a small cracking sound which is normal. Once done try to boot up the computer. Chips can get loose in the socket over time due to heat.

Peripheral Connector Signal Description

<i>Signal</i>	<i>Description</i>
<u>I/O SELECT</u>	This line, normally HIGH, becomes LOW when the MPU references page \$Cn, where n is the slot number.
A0-A15	Buffered address bus.
<u>R/W</u>	Read/Write signal.
<u>SYNC</u>	On peripheral connector 7 only, connected to video timing generator's SYNC signal.
<u>I/O STROBE</u>	This line goes LOW during $\Phi 0$ when the address bus contains an address between \$C800 and \$CFFF.
<u>RDY</u>	RDY input on 6502.
<u>DMA</u>	Pulling this line LOW disables the 6502's address bus and halts the MPU.
INT OUT	Daisy-chained interrupt output to lower priority devices.
DMA OUT	Daisy-chained DMA output to lower priority devices.
+5v	+5v power supply. 500 ma is available for all peripheral devices.
GND	System ground.
DMA IN	Daisy-chained input from higher priority devices.
INT IN	Daisy-chained input from higher priority devices.
<u>NMI</u>	Nonmaskable interrupt.
<u>IRQ</u>	Interrupt request.
<u>RES</u>	System reset input.
<u>INH</u>	When this line is pulled LOW, all ROMs on Apple board are disabled
-12v	-12v power supply. Maximum current for all peripheral boards is 200 ma.
-5v	-5v power supply. Maximum current for all peripheral boards is 200 ma.
COLOR REF	On connector 7 only, this pin is connected to color reference signal.
7M	7 MHz clock.
Q3	2 MHz asymmetrical clock.
$\Phi 1$	MPU's phase one clock.
USER 1	This line, when pulled LOW, disables all internal I/O address decoding.
$\Phi 0$	MPU's phase 0 clock.
<u>DEVICE SELECT</u>	This line becomes active LOW on each peripheral connector when the address bus is holding an address between \$C0n0 and \$C0nF, where n is the slot number plus \$8.
D0-D7	Buffered bidirectional data bus.
+12v	+12v power supply. Maximum current for all peripheral boards is 250 ma.



NOTES:

1 SLOT 7 ONLY

2 SLOTS 1-7 ONLY

Apple II\II+ Symptoms and Diagnostics

Read the symptoms column and find the condition present. Next read across the row for the diagnostics.

Diagnostics of Apple II + (plus) - Symptom(s)	Boot	Power Light	Beep	Screen	Floppy Drive	Cassette	Diagnosis	Location
Boot and Startup Issues								
Will not boot, no power light, no beep and disk drive won't run (spin)	No	Off	No	No	No	???	Check power cord. Check power supply	Power Supply
Will not boot, power light on, no beep and drive won't run (spin)	No	On	No	No	No	???	74S86	B2
Will not boot, power light on, no beep and drive won't run (spin)	No	On	No	No	No	???	74LS195	C2
Will not boot, power light on, no beep and drive won't run (spin)	No	On	No	No	No	???	74LS153	C1
Will not boot, power light on, no beep and drive won't run (spin)	No	On	No	No	No	???	74S175	B1
Will not boot, power light on, no beep and drive won't run (spin)	No	On	No	No	No	???	74LS00	A2
Will not boot, power light on, no beep and drive won't run (spin)	No	On	No	No	No	???	74LS02	B13
Will not boot, power light on, no beep and drive won't run (spin)	No	On	No	No	No	???	Replace timing crystal	Motherboard
Will not boot and screen has garbage	No	Yes	No	Garbage	Spin & stops	???	F8 ROM	F8
Will not boot and screen has garbage	No	Yes	No	Garbage	Spin & stops	???	Bad CPU 6502	H7
Will not boot, screen shows APPLE II & drive spins then stops	No	Yes	Yes	APPLE II	No	???	ULN2003	Disk Card
Will not boot, screen shows APPLE II & drive spins then stops	No	Yes	Yes	APPLE II	No	???	Bad disk card	Disk Card
Will not boot, screen shows APPLE II & drive spins then stops	No	Yes	Yes	APPLE II	No	???	Bad stepper motor	Floppy Drive
Will not boot, screen shows APPLE II & drive spins then stops	No	Yes	Yes	APPLE II	No	???	Bad ribbon cable	Disk Card
Will not boot, screen shows APPLE II & drive spins then stops	No	Yes	Yes	APPLE II	Spin & stops	???	Bad disk, bad program, try another disk	Diskette
Will not boot, screen shows APPLE II & drive spins then stops	No	Yes	Yes	APPLE II	Spin & stops	???	Bad RAM (motherboard) IC 2116 in row C, D and/or E	Motherboard
Will not boot, screen shows APPLE II & drive spins then stops	No	Yes	Yes	APPLE II	Spin & stops	???	Bad RAM chip on language card	Language Card
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	Bad video cable	Video Cable

Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	Video connector bad or dirty	Motherboard
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	Bad monitor or brightness low	Monitor
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74LS00	A2
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74LS02	B13
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74S195	C2
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74LS04	C1
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74S161	D11, D12, D13, D14
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74LS74	B10
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74LS151	A9
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74LS194	A10
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74LS257	A8
Will not boot, and drive spins then stops	No	Yes	Yes	Blank	Spin & stops	???	74S86	B2
Unable to access, disk LED on	Yes	Yes	Yes	Good	LED on, no access	???	74LS174	B5
Unable to boot disk	Yes	Yes	Yes	Good	No boot	???	74LS138	C1
Unable to boot disk	Yes	Yes	Yes	Good	No boot	???	74LS138, 74LS153	H2
Unable to boot disk	Yes	Yes	Yes	Good	No boot	???	8T97	H3
Disk boots, screen goes blank	Yes	Yes	Yes	Blank	Yes	???	74LS194	B9
Goes into monitor, program dies after warm	No	Yes	Yes	Goes into monitor	No	???	ROM	E0
Goes into monitor, program dies after warm	No	Yes	Yes	Goes into monitor	No	???	74LS138	H2, H12
Goes into monitor, program dies after warm	No	Yes	Yes	Goes into monitor	No	???	ROM card slot	Slot 0
Issues with running								
Disk drive just spins or I/O error message appears	Yes	Yes	Yes	IO error message	No	???	Bad diskette - DOS 3.2 will not work on Apple II+, needs DOS 3.3	Diskette
Disk drive just spins or I/O error message appears	Yes	Yes	Yes	IO error message	No	???	Read Head - clean and try again	Floppy Drive
Disk drive just spins or I/O error message appears	Yes	Yes	Yes	IO error message	No	???	Bad drive card	Disk Card
Disk drive just spins or I/O error message appears	Yes	Yes	Yes	IO error message	No	???	Bad ribbon cable	Disk Card
Disk drive just spins or I/O error message appears	Yes	Yes	Yes	IO error message	No	???	MC3470	Disk Card

Disk drive just spins or I/O error message appears	Yes	Yes	Yes	IO error message	No	???	CA3146	Disk Card
Cannot write to disk but reads OK	Yes	Yes	Yes	Write error	Read\not write	???	Disk not formatted or Write tab on Drive able loose on disk card	Diskette
Cannot write to disk but reads OK	Yes	Yes	Yes	Write error	Read\not write	???	Connector dirty	Disk Card
Cannot write to disk but reads OK	Yes	Yes	Yes	Write error	Read\not write	???	74LS125	Floppy Drive
Cannot write to disk but reads OK	Yes	Yes	Yes	Write error	Read\not write	???	CA3146	Floppy Drive
Cannot write to disk but reads OK	Yes	Yes	Yes	Write error	Read\not write	???	MC3470	Floppy Drive
Cannot write to disk but reads OK	Yes	Yes	Yes	Write error	Read\not write	???	ULN2003	Floppy Drive
Cannot write to disk but reads OK	Yes	Yes	Yes	Write error	Read\not write	???	Write head dirty or damaged	Floppy Drive
Floppy drive operates intermittently for reads and writes	Yes	Yes	Yes	Good	R\W intermittent	???	Disk card connector dirty. Clean edge connectors	Disk Card
Floppy drive operates intermittently for reads and writes	Yes	Yes	Yes	Good	R\W intermittent	???	Overheating. Install fan	Motherboard
Floppy drive operates intermittently for reads and writes	Yes	Yes	Yes	Good	R\W intermittent	???	diskette tracking misalignment. Alignment with diagnostic software	Floppy Drive
Computer locks up and keyboard not responding	Yes	Yes	Yes	Frozen	Yes	???	Bad keyboard character ROM - 2513 char gen ROM	A5
Computer locks up and keyboard not responding	Yes	Yes	Yes	Frozen	Yes	???	74166	A3
Computer locks up and keyboard not responding	Yes	Yes	Yes	Frozen	Yes	???	74LS257	B6, B7
Computer locks up and keyboard not responding	Yes	Yes	Yes	Frozen	Yes	???	74LS174	B5,B8
Computer locks up and keyboard not responding	Yes	Yes	Yes	Frozen	Yes	???	74LS139	F2,E2
Computer locks up and keyboard not responding	Yes	Yes	Yes	Frozen	Yes	???	74LS20	D2

Computer locks up and keyboard not responding	Yes	Yes	Yes	Frozen	Yes	???	74LS138	F12
Computer locks up and keyboard not responding	Yes	Yes	Yes	Frozen	Yes	???	Defective CPU - 6502	H7
Floppy drive does not work	No	Yes	Yes	Good	???	???	Disk card connector dirty. Clean edge connectors	Disk Card
Floppy drive does not work	No	Yes	Yes	Good	???	???	Overheating. Install fan	Motherboard
Floppy drive does not work	No	Yes	Yes	Good	???	???	diskette tracking misalignment. Alignment with diagnostic software	Floppy Drive
Floppy drive does not work	No	Yes	Yes	Good	???	???	Check ICs	Motherboard
Floppy drive does not work	No	Yes	Yes	Good	???	???	74LS138	H2 and H12
Floppy drive does not work	No	Yes	Yes	Good	???	???	8T97	H3
Intermittent Reset	Yes	Yes	Yes	Good	Yes	???	74LS32	C14
Intermittent Reset	Yes	Yes	Yes	Good	Yes	???	74LS00	A2
Intermittent Reset	Yes	Yes	Yes	Good	Yes	???	ROM	E8
Continuous reset	???	Yes	Yes	Good	???	???	74LS257	B7
Random characters at keybd reset	Yes	Yes	Yes	Good	Yes	???	74LS08	B11
Random characters at keybd reset	Yes	Yes	Yes	Good	Yes	???	F1 jumper block	pre rev7
Works w/16K RAM but not with 32K or 48K	Yes	Yes	Yes	Good	Yes	???	74LS139	F2
Works w/16K RAM but not with 32K or 48K	Yes	Yes	Yes	Good	Yes	???		RA02,03
No reset with disk card	???	Yes	Yes	Good	???	???	74LS138	H2, H12
Beep, no prompt or cursor	Yes	Yes	No	No prompt\curs or	???	???	74LS153	E11
Beep, no prompt or cursor	Yes	Yes	No	No prompt\curs or	???	???	74LS283	E14
Beep, no prompt or cursor	Yes	Yes	No	No prompt\curs or	???	???	9334	F14
Issues with Display								
Screen all white with no other displayed	No	Yes	No	All white	No	???	74LS194	B4, B9
Screen no display or video	???	Yes	???	Blank	???	???	Bad monitor or brightness low	Monitor
Screen no display or video	???	Yes	???	Blank	???	???	Bad monitor	Monitor
Screen no display or video	???	Yes	???	Blank	???	???	Bad video cable	Monitor
Screen no display or video	???	Yes	???	Blank	???	???	74LS195	C2
Screen no display or video	???	Yes	???	Blank	???	???	74LS02	B13
Screen no display or video	???	Yes	???	Blank	???	???	74LS00	A2
Screen no display or video	???	Yes	???	Blank	???	???	74LS161	D11, D12, D13, D14
Screen no display or video	???	Yes	???	Blank	???	???	74LS04	C11

Screen no display or video	???	Yes	???	Blank	???	???	74LS74	B10
Screen no display or video	???	Yes	???	Blank	???	???	74LS151	A9
Screen no display or video	???	Yes	???	Blank	???	???	74LS194	A10
Screen no display or video	???	Yes	???	Blank	???	???	74LS257	A8
Screen no display or video	???	Yes	???	Blank	???	???	74S86	B2
Screen no display or video	???	Yes	???	Blank	???	???	M3904	Q3
Screen no display or video	???	Yes	???	Blank	???	???	74LS51	C13
Screen blank, no display	???	???	???	Blank	???	???	Bad monitor or brightness low	Monitor
Screen blank, no display	???	???	???	Blank	???	???	Bad monitor	Monitor
Screen blank, no display	???	???	???	Blank	???	???	Bad video cable	Cable
Screen blank, no display	???	???	???	Blank	???	???	74LS175	B1
Screen blank, no display	???	???	???	Blank	???	???	74S86	B2
Screen blank, no display	???	???	???	Blank	???	???	74LS00	A2
Screen blank, no display	???	???	???	Blank	???	???	74LS153	C1
Screen blank, no display	???	???	???	Blank	???	???	74LS195	C2
Screen blank, no display	???	???	???	Blank	???	???	74LS51	C13
Screen has no colour	Yes	Yes	Yes	No colour	Yes	???	No colour burst signal	Motherboard
Screen has no colour	Yes	Yes	Yes	No colour	Yes	???	74LS51	C13
Screen has no colour	Yes	Yes	Yes	No colour	Yes	???	74LS11	B12
Screen has no colour	Yes	Yes	Yes	No colour	Yes	???	74LS02	B13
Screen has no colour	Yes	Yes	Yes	No colour	Yes	???	Capacitors	C2, C3
Screen has no colour	Yes	Yes	Yes	No colour	Yes	???	Inductor	L1
Screen with no vertical sync (synchronization)	Yes	Yes	Yes	No vert sync	Yes	???	74LS161	D11, D12
Screen with no vertical sync (synchronization)	Yes	Yes	Yes	No vert sync	Yes	???	74LS51	C13
Screen with no vertical sync (synchronization)	Yes	Yes	Yes	No vert sync	Yes	???	74LS32	C14
Screen with no horizontal sync (synchronization)	Yes	Yes	Yes	No horz sync	Yes	???	74LS161	D13, D14
Screen with no horizontal sync (synchronization)	Yes	Yes	Yes	No horz sync	Yes	???	74LS51	C13
Screen with no horizontal sync (synchronization)	Yes	Yes	Yes	No horz sync	Yes	???	74LS32	C14
Screen with no cursor or bad cursor display	Yes	Yes	Yes	No cursor	Yes	???	74S86	B2
Screen with no cursor or bad cursor display	Yes	Yes	Yes	No cursor	Yes	???	Bad character generated	Motherboard
Screen with no cursor or bad cursor display	Yes	Yes	Yes	No cursor	Yes	???	74LS08	B2
Screen with no cursor or bad cursor display	Yes	Yes	Yes	No cursor	Yes	???	74LS02	B13
Screen with no cursor or bad cursor display	Yes	Yes	Yes	No cursor	Yes	???	74LS166	A3

Screen with no cursor or bad cursor display	Yes	Yes	Yes	No cursor	Yes	???	Bad timer circuit 555	B3
Screen no cursor flash or bad inverse	Yes	Yes	Yes	Bad flash	Yes	???	74LS02	B13
Screen no cursor flash or bad inverse	Yes	Yes	Yes	Bad flash	Yes	???	74LS08	B11
Screen no cursor flash or bad inverse	Yes	Yes	Yes	Bad flash	Yes	???	Bad timer circuit 555	B3
Screen with no text	Yes	Yes	Yes	No text	Yes	???	Text mode bad	Motherboard
Screen with no text	Yes	Yes	Yes	No text	Yes	???	74LS151	A9
Screen with no text	Yes	Yes	Yes	No text	Yes	???	74166	A3
Screen with no text	Yes	Yes	Yes	No text	Yes	???	74LS194	A10
Screen with no text	Yes	Yes	Yes	No text	Yes	???	No clock pulse	Motherboard
Screen with no text	Yes	Yes	Yes	No text	Yes	???	74S86	B2
Screen with no text	Yes	Yes	Yes	No text	Yes	???	Bad 2513 char gen ROM	A5
Screen with no text	Yes	Yes	Yes	No text	Yes	???	74LS257	A8
Screen with wrong characters	Yes	Yes	Yes	Wrong Chars	Yes	???	2513 char gen ROM	A5
Screen with wrong characters	Yes	Yes	Yes	Wrong Chars	Yes	???	Bad keyboard, bad keyboard ribbon cable or bad key(s)	Keyboard
Screen has annoying colour tint	Yes	Yes	Yes	Colour tint	Yes	???	Adjust colour trim	F14\H14
Screen with bad graphics. Bad hi and Low res but text good	Yes	Yes	Yes	Hi\Low Res	Yes	???	Bad hi\low-res pixel generated	Motherboard
Screen with bad graphics. Bad hi and Low res but text good	Yes	Yes	Yes	Hi\Low Res	Yes	???	74LS194	B4, B9
Screen with bad graphics. Bad hi and Low res but text good	Yes	Yes	Yes	Hi\Low Res	Yes	???	Hi\low res not activated	Motherboard
Screen with bad graphics. Bad hi and Low res but text good	Yes	Yes	Yes	Hi\Low Res	Yes	???	74LS257	A8
Screen with bad graphics, No hi res graphics but low res and text good	Yes	Yes	Yes	Hi res	Yes	???	Hi res signal stuck low	Motherboard
Screen with bad graphics, No hi res graphics but low res and text good	Yes	Yes	Yes	Hi res	Yes	???	74LS257	C12
Screen with bad graphics, No hi res graphics but low res and text good	Yes	Yes	Yes	Hi res	Yes	???	Page signal stuck in low res or text	Motherboard
Screen with bad graphics, No hi res graphics but low res and text good	Yes	Yes	Yes	Hi res	Yes	???	74LS08	A11
No video, no reset	No	Yes	???	No video	???	???	Check\Replace crystal	Motherboard
No video, no reset	No	Yes	???	No video	???	???	2N4258	Q1,Q2 below crystal

No video, no reset	No	Yes	???	No video	???	???	74LS00	A2
No video, no reset	No	Yes	???	No video	???	???	74LS194	A10
No video, no reset	No	Yes	???	No video	???	???	74LS151	A9
No video, no reset	No	Yes	???	No video	???	???	74LS175	B1
No video, no reset	No	Yes	???	No video	???	???	74S86	B2
No video, no reset	No	Yes	???	No video	???	???	74LS74	B10
No video, no reset	No	Yes	???	No video	???	???	74LS02	B11
No video, no reset	No	Yes	???	No video	???	???	74LS153	C1
No video, no reset	No	Yes	???	No video	???	???	74L195	C2
No video, no reset	No	Yes	???	No video	???	???	74LS51	C13
No video, no reset	No	Yes	???	No video	???	???	74LS32	C14
No video, no reset	No	Yes	???	No video	???	???	74LS20	D2
No video, no reset	No	Yes	???	No video	???	???	74LS04	C11
No video, no reset	No	Yes	???	No video	???	???	74LS16	D11-D14

No prompt/cursor	???	Yes	???	No prompt\cursor	???	???	555 timer	B3
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Chars. moving, appearing randomly on screen	Yes	Yes	Yes	Char moving\random	???	???	74LS04	C11
Blank white screen	???	???	???	Blank white	???	???	74166	A3
Blank white screen	???	???	???	Blank white	???	???	74LS174	B5,8
Blank white screen	???	???	???	Blank white	???	???	9334	F14
Blank white screen	???	???	???	Blank white	???	???	6502	
Blank dark grey screen	???	???	???	Dark grey	???	???	74LS74	B10
Screen goes blank when disk boots	Yes	Yes	Yes	Blank during boot	Yes	???	74LS194	B9
Video goes blank during RAM test	Yes	Yes	Yes	Blank with RAM test	Yes	???	74S86	B2
Videos wavers	Yes	Yes	Yes	Wavers	Yes	???	74LS04	C11
Video distorted, reset OK	Yes	Yes	Yes	Distorted video	Yes	???	74LS20	D2
Top of video missing/distorted	Yes	Yes	Yes	Missing top video	Yes	???	74LS02	B14
Video pushed down/to right	Yes	Yes	Yes	Push down to right	???	???	74LS02	C13
Can't write to upper left screen	Yes	Yes	Yes	Upper left	???	???	74LS151	A9
Top 3 lines HIRES gone	Yes	Yes	Yes	Top 3 lines missing HIRES	???	???	74LS74	A11
Rolling video	Yes	Yes	Yes	Rolling video	???	???	74LS32	B14
Rolling video	Yes	Yes	Yes	Rolling video	???	???	LS04	C11
Video all scrolls	Yes	Yes	Yes	All video scrolls	???	???	74LS153	E11
Inverse video, cursor not flash	Yes	Yes	Yes	Inverse\no flash prompt	???	???	74S86	B2
Inverse/incorrect prompt	Yes	Yes	Yes	Inverse\bad prompt	???	???	F8 ROM	F8
Split video 4 corners	Yes	Yes	Yes	Video Split	Yes	???	74LS175	B1
Split video 4 corners	Yes	Yes	Yes	Video Split	Yes	???	74LS153	C1

Split location prompt	Yes	Yes	Yes	Split prompt	Yes	???	74LS04	C11
Split location prompt	Yes	Yes	Yes	Split prompt	Yes	???	74LS283	E14
Horizontal lines/junk chars.	Yes	Yes	Yes	Horz lines\junk bars	???	???	74LS174	B5,8
Distorted color bars	Yes	Yes		Horz lines\junk bars	???	???	74LS02	A12
Vertical bars/cold start	Yes	Yes	Yes	Vertical bars	???	???	F14-9334	F14
Vertical bars/cold start	Yes	Yes	Yes	Vertical bars	???	???	74LS257	C12
Vertical bars/cold start	Yes	Yes	Yes	Vertical bars	???	???	74LS161	D12
Vertical bars/cold start	Yes	Yes	Yes	Vertical bars	???	???	2513 char gen	A5
Vertical bars HIRES	Yes	Yes	Yes	Vertical bars HIRES	???	???	74LS194	B4
Left margin vertical white bar	Yes	Yes	Yes	Left margin vert white bars	???	???	74166	A3
Graphics/color bars broken up	Yes	Yes	Yes	Graph\color bars broken up	???	???	74LS194	B4,9
No page 2 HIRES						???	Open trace	B11-6 to R1-10
Black squares w/left to right moving chars.	Yes	Yes	Yes	Black squares\left moving char	???	???	B12,13-74LS11, 74LS02	B12,13
No cursor	???	???	???	No cursor	???	???	0.1uf cap above 555 B8	B8
Inverse flashes instead of steady inverse	Yes	Yes	Yes	Inverse flash	Yes	???	74LS08	B11
Smellers chars./vertical bars	Yes	Yes	Yes	Small\movin g char	???	???	74S86	B2
Moving chars	Yes	Yes	Yes	Moving char	Yes	???	74LS04	C11
Random chars at reset	???	Yes	Yes	Random char	???	???	74LS08	B11
Part graphics/part text chars.	Yes	Yes	Yes	Part graphic\text	Yes	???	74LS74	A11
Random char entire screen	???	???	???	Random char entire screen	???	???	2513 char gen	A5
Junk chars/ after warmup	Yes	Yes	Yes	Junk char	???	???	Microhenry choke	27
Video shows only top halves of letters, you get 2 tops instead of a top and a bottom	Yes	Yes	Yes	Half letters	Yes	???	74LS08	H1
Video shows only top halves of letters, you get 2 tops instead of a top and a bottom	Yes	Yes	Yes	Half letters	Yes	???	2513 char gen	A5
Adds chars, and scrolls from bottom	Yes	Yes	Yes	Add char\scrolls	Yes	???	74LS257	B6,7
Adds chars, and scrolls from bottom	Yes	Yes	Yes	Add char\scrolls	Yes	???	74LS138	F12
Adds chars, and scrolls from bottom	Yes	Yes	Yes	Add char\scrolls	Yes	???	74LS74	B10
Issues with Keyboard - Old Style								
Keys with no response or some key with press	Yes	Yes	Yes	Bad key press	Yes	???	Bad key(s)	Keyboard
Keys with no response or some key with press	Yes	Yes	Yes	Bad key press	Yes	???	keyboard ribbon cable	Keyboard

Keys with no response or some key with press	Yes	Yes	Yes	Bad key press	Yes	???	Bad character generated	Motherboard
Keys with no response or some key with press	Yes	Yes	Yes	Bad key press	Yes	???	2513 char gen	A5
Keys with no response or some key with press	Yes	Yes	Yes	Bad key press	Yes	???	74LS138	F13
Keyboard shows wrong characters	Yes	Yes	Yes	Wrong Characters	Yes	???	Bad character generated – ROM	A5
Keyboard shows wrong characters	Yes	Yes	Yes	Wrong Characters	Yes	???	74166	A3
Keyboard shows wrong characters	Yes	Yes	Yes	Wrong Characters	Yes	???	74LS257	B6, B7
Keyboard shows wrong characters	Yes	Yes	Yes	Wrong Characters	Yes	???	5740 encoder	U1
Keyboard shows wrong characters	Yes	Yes	Yes	Wrong Characters	Yes	???	74LS174	B5,B8
keyboard shows repeated characters	Yes	Yes	Yes	Repeated character	Yes	???	Key bounce	Keyboard
keyboard shows repeated characters	Yes	Yes	Yes	Repeated character	Yes	???	74LS74	B10
keyboard shows repeated characters	Yes	Yes	Yes	Repeated character	Yes	???	74LS02	A12
keyboard shows repeated characters	Yes	Yes	Yes	Repeated character	Yes	???	74LS04	C11
keyboard shows repeated characters	Yes	Yes	Yes	Repeated character	Yes	???	5740 encoder	U1
keyboard shows repeated characters	Yes	Yes	Yes	Repeated character	Yes	???	7400	U1
Keyboard repeat not working	Yes	Yes	Yes	Not repeating	Yes	???	Bad key contact	Keyboard
Keyboard repeat not working	Yes	Yes	Yes	Not repeating	Yes	???	Bad timer circuit 555	B3
Series of letters don't work (for example "9", "6", "5" or "Q", "ESC", "A", "Z", "1")	Yes	Yes	Yes	Wrong Characters	Yes	???	Encoder (331-5740)	bad traces
No control function	Yes	Yes	Yes	Good	Yes	???	7400	U1
No control function	Yes	Yes	Yes	Good	Yes	???	4.7K Ohm	R1
No shift chars	Yes	Yes	Yes	Good	Yes	???	U4 (7400)	U4
No output at all	Yes	Yes	Yes	No	Yes	???	5740 (encoder), bad cable	encoder
No keyboard strobe	Yes	Yes	Yes	Good	Yes	???	7400	U1, check pin 3
No keyboard strobe	Yes	Yes	Yes	Good	Yes	???	5740 encoder U1	U1
No output/wrong output	Yes	Yes	Yes	Wrong Characters	Yes	???	U2 (7404)	U2
Encoder not being clocked	Yes	Yes	Yes	Good	Yes	???	encoder U4 (7400) pin 3 on encoder	U4
Repeat key does not work	Yes	Yes	Yes	Good	Yes	???	U3 (555 timer)	U3
Characters repeat after unit warm	Yes	Yes	Yes	Wrong Characters	Yes	???	5740 encoder U1	U1
Keyboard failures (keybd. OK)	Yes	Yes	Yes	Good	Yes	???	74LS257	B6,7

Keyboard failures (keybd. OK)	Yes	Yes	Yes	Good	Yes	???	74LS74	B10
Keyboard failures (keybd. OK)	Yes	Yes	Yes	Good	Yes	???	74LS04	C11
Issues with Keyboard - New Style								
No keyboard output	Yes	Yes	Yes	No	???	???	Encoder (331-0931)	U1
No Data Strobe (no keybd output)	Yes	Yes	Yes	No	???	???	0.1 microfarad cap	C6
No Data Strobe (no keybd output)	Yes	Yes	Yes	No	???	???	74LS00	B3
No Data Strobe (no keybd output)	Yes	Yes	Yes	No	???	???	74LS00	B4
Incorrect data out	Yes	Yes	Yes	No	???	???	74LS04	B5
Incorrect data out	Yes	Yes	Yes	No	???	???	74LS00	B3
P, Return, and : keys repeat	Yes	Yes	Yes	Wrong Characters	???	???	R10 to 3.0K ohm 1/4-watt resistor	R10
Sound issues with speaker								
Speaker volume very low	Yes	Yes	Low volume	Good	Yes	???	Amplifier transistor MPSA13	J13
Speaker has no sound	Yes	Yes	No	Good	Yes	???	Bad speaker	Motherboard
Speaker has no sound	Yes	Yes	No	Good	Yes	???	Speaker wires bad or disconnected	Motherboard
Speaker has no sound	Yes	Yes	No	Good	Yes	???	74LS74	J12
Speaker has no sound	Yes	Yes	No	Good	Yes	???	MPSA13	J13
Noisy speaker	Yes	Yes	Noise	Good	Yes	???	74LS08	H1
Noisy speaker	Yes	Yes	Noise	Good	Yes	???	74LS257	J1
Noisy speaker	Yes	Yes	Noise	Good	Yes	???	74LS20	D2
Noisy speaker	Yes	Yes	Noise	Good	Yes	???	Jumper blocks	except rev 7
Pulsating data, speaker clicks	Yes	Yes	Clicks	Good	Yes	???	74LS08	H1
Cassette tape Issues								
Cassette will not load data	Yes	Yes	Yes	Good	???	Not loading	Bad cassette drive	Cassette
Cassette will not load data	Yes	Yes	Yes	Good	???	Not loading	Bad cassette cable	Cassette
Cassette will not load data	Yes	Yes	Yes	Good	???	Not loading	Cassette volume too low	Cassette
Cassette will not load data	Yes	Yes	Yes	Good	???	Not loading	Bad cassette tape	Cassette
Cassette will not load data	Yes	Yes	Yes	Good	???	Not loading	LM741	K13
Cassette will not load data	Yes	Yes	Yes	Good	???	Not loading	74LS251	H14
Cassette will not load data	Yes	Yes	Yes	Good	???	Not loading	74LS138	F13
Cassette will not save data	Yes	Yes	Yes	Good	???	Not saving	Bad cassette drive	Cassette
Cassette will not save data	Yes	Yes	Yes	Good	???	Not saving	Bad cassette cable	Cassette
Cassette will not save data	Yes	Yes	Yes	Good	???	Not saving	Cassette tape bad	Cassette
Cassette will not save data	Yes	Yes	Yes	Good	???	Not saving	Signal not sent. Data out error	Motherboard
Cassette will not save data	Yes	Yes	Yes	Good	???	Not saving	74LS74	J13

Cassette will not save data	Yes	Yes	Yes	Good	???	Not saving	74LS138	F13
Game Paddle Issues								
Game paddle not working. No response	Yes	Yes	Yes	Good	Good	Good	Bad paddle cable	Game Paddle
Game paddle not working. No response	Yes	Yes	Yes	Good	Good	Good	Bad timer circuit 558	H13
Game paddle not working. No response	Yes	Yes	Yes	Good	Good	Good	74LS259 or N9334	F14
Game paddle not working. No response	Yes	Yes	Yes	Good	Good	Good	74LS251	H14
Game paddle not working. No response	Yes	Yes	Yes	Good	Good	Good	74LS138	F13
Peripheral Cards Issues								
Card in peripheral slot does not work	Yes	Yes	Yes	Good	Good	Good	Bad card	Card
Card in peripheral slot does not work	Yes	Yes	Yes	Good	Good	Good	Slot not being accessed	Motherboard
Card in peripheral slot does not work	Yes	Yes	Yes	Good	Good	Good	74LS138	H2, H12

Apple II Card Diagnostics

*** Ensure Apple II works without card installed first ***

Symptom(s) and Diagnostics	IC Location	Comments
ROM Card		
Computer will not restart\reset	74LS09 74LS244 74S74 74LS11	
FP will not work or INT	74S74 D0 ROM 74LS138	
ROM test failure	74LS09 74LS138	
Apple reset when switch is up	Clean or replace switch	
Serial Card		
Will not boot	74LS109 P8 Prom P7 Prom 74LS365	
Prom test fails even after replacement	Q6-MPSU51 Q1,Q2-2N3906	
Receiving error	Q7-2N3904 74LS125	
Transmit error	Q4-2N3904 74LS109 Q3-2N3906	
Parallel Card		
Computer will not reset	P9 Prom P1 Prom 74LS74 Q1-2N3906 Q2-MPSU51	
Floppy drive will not boot	74LS74 Ensure Apple works without card installed	

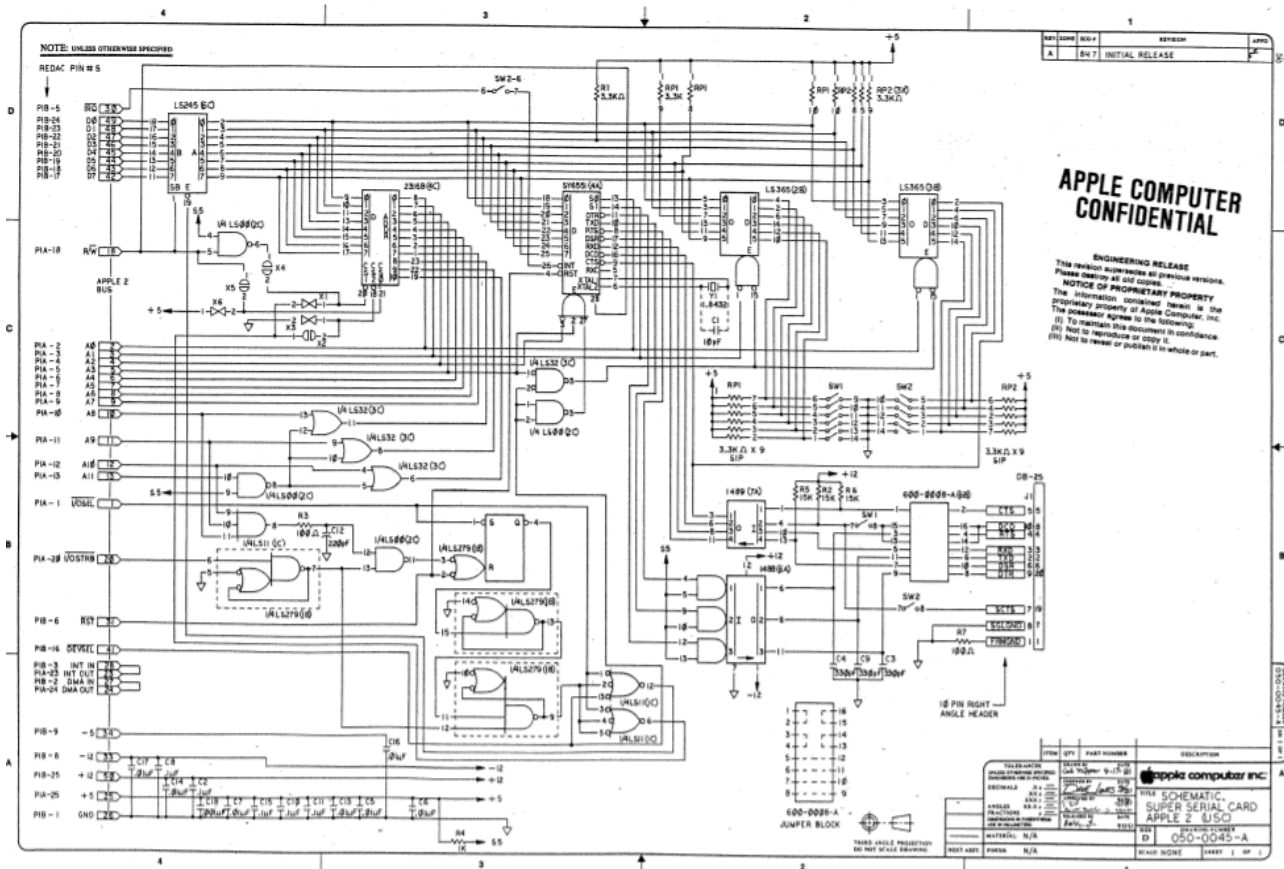
PR#n command prompt doesn't return cursor	Q2-MPSU51	
Incorrect data being printed	74LS174	
Will not acknowledge data	B2 -74LS74	
Data not ready error	B2 -74LS74	
Language Card		
Computer will not reset	74LS09 D0 ROM	
Runs Integer but not Apple soft	74LS09	
Will not rest	AutoStart ROM Bad RAM 74LS02 74LS175	
RAM fails tests	Bad cable Bad RAM	
Bank switching not working	74LS86 74LS00 74LS09 74LS08 74LS74 74LS20 74LS175	
Apple Floppy Drive and Disk II controller		
Computer will not boot	74LS259 74LS323 74LS05 PROM P5 74LS259 74LS05 74LS323 NE556	Controller board Controller board Controller board Controller board Controller board Controller board Controller board Controller board
Drive motor runs continuously	74LS174 74LS125	Controller board Analog board, behind drive
Drive motor not working	10K Pot	Controller board

Stepper motor	ULN2003 Cable	Analog board, behind drive
Drive will not boot\load OS	PROM P5 Q1 PROM P6 74LS125 Q2 74LS132 74LS05 74LS259 Head alignment	Controller board Analog board, behind drive Controller board Analog board, behind drive Controller board Controller board Controller board Controller board
Diskette write issues	CA3146 74LS125 CR3 (IN4148-analog) ULN2003 74LS05 P6	Analog board, behind drive Analog board, behind drive Analog board, behind drive Analog board, behind drive Controller board Controller board
Floppy motor speed test shown no information	MC3470 74LS125 74LS174 74LS132	Analog board, behind drive Analog board, behind drive Controller board Controller board
Floppy motor speed extremely high	74LS05 CA3146	Controller board Analog board, behind drive
Cannot write, protect is always enabled	Cable 74LS323 PROM P6	Controller board Controller board
Read and write errors	74LS05 ULN2003 PROM P5 or PROM P6	Controller board Analog board, behind drive Controller board

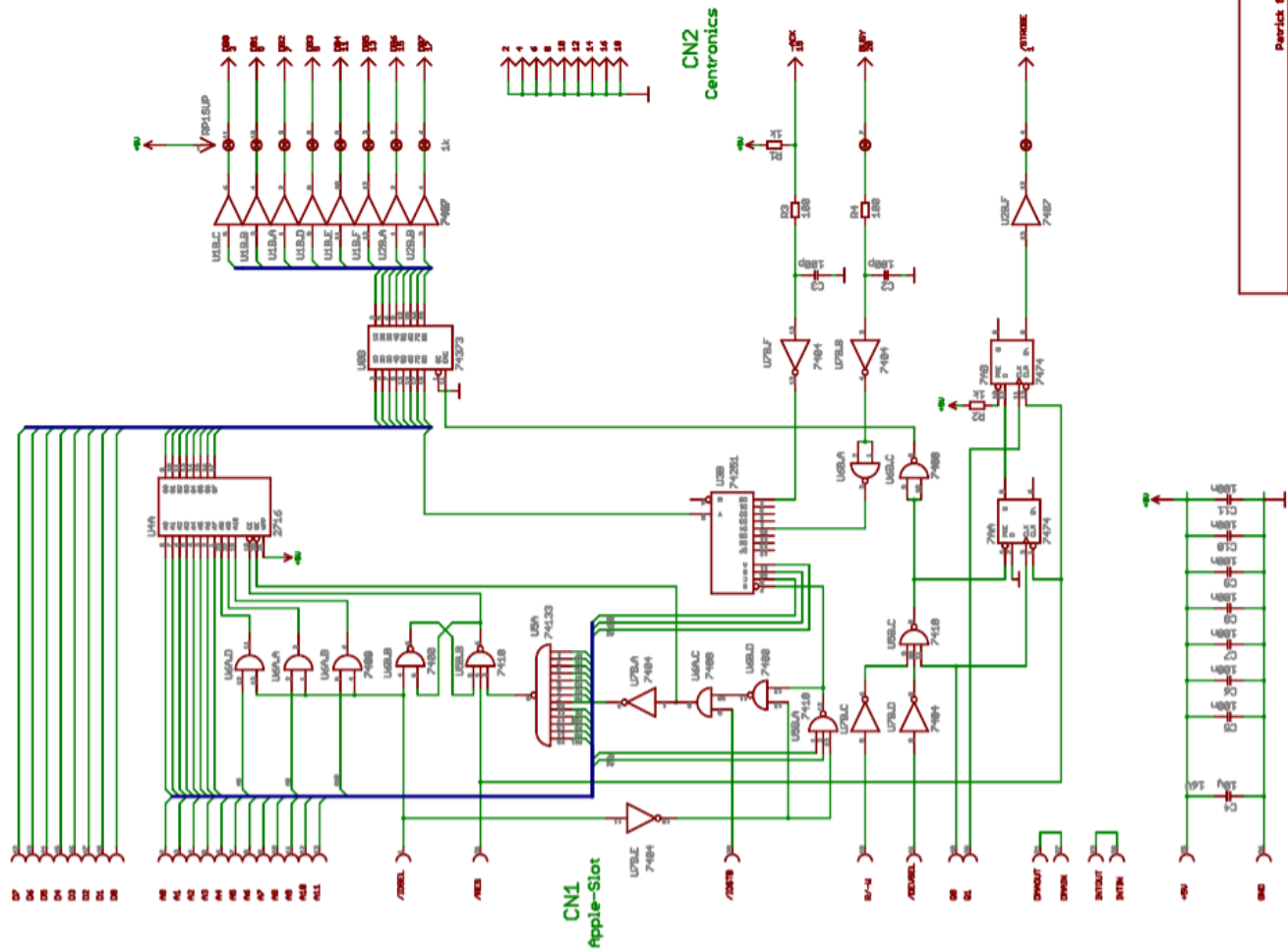
ROM Card



Serial Card

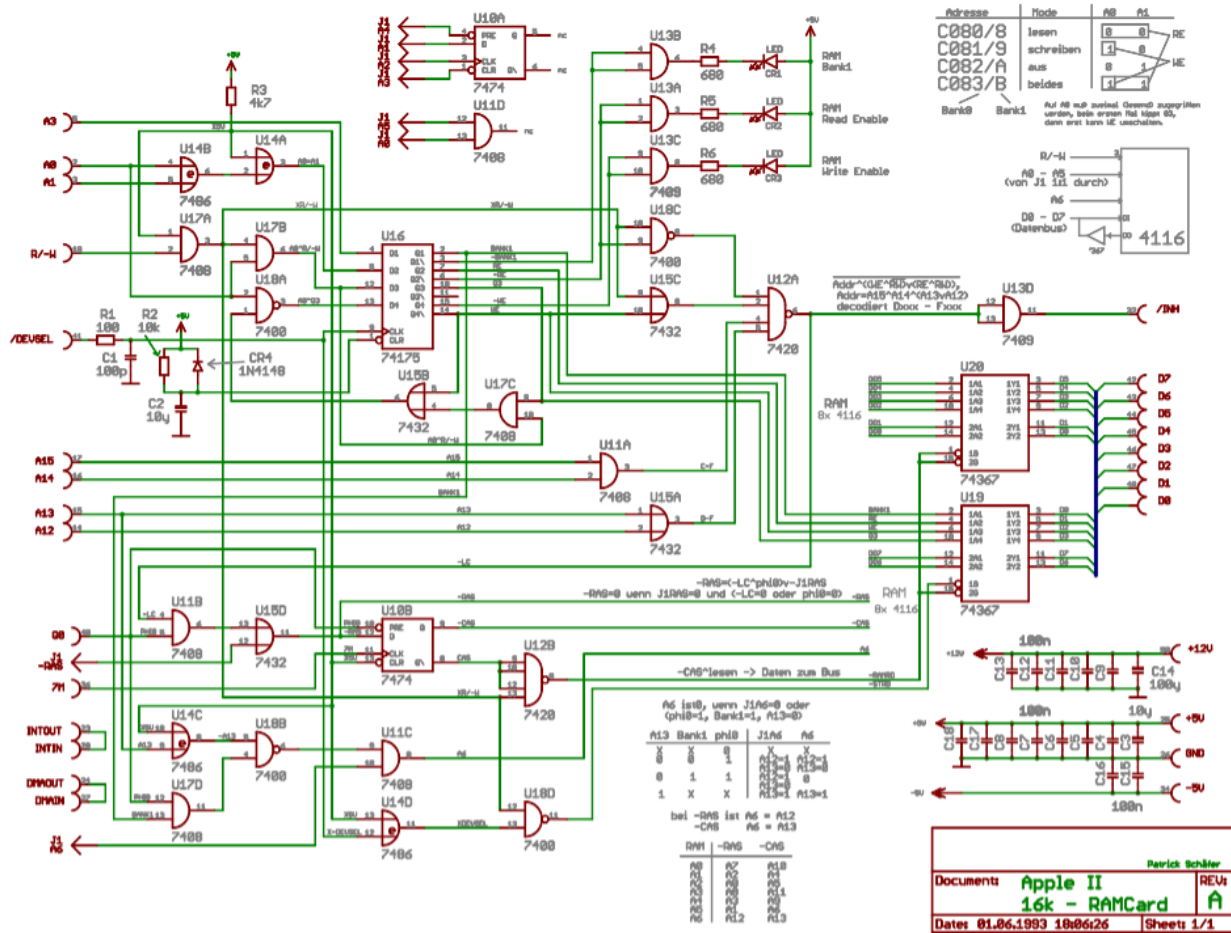


Parallel Card

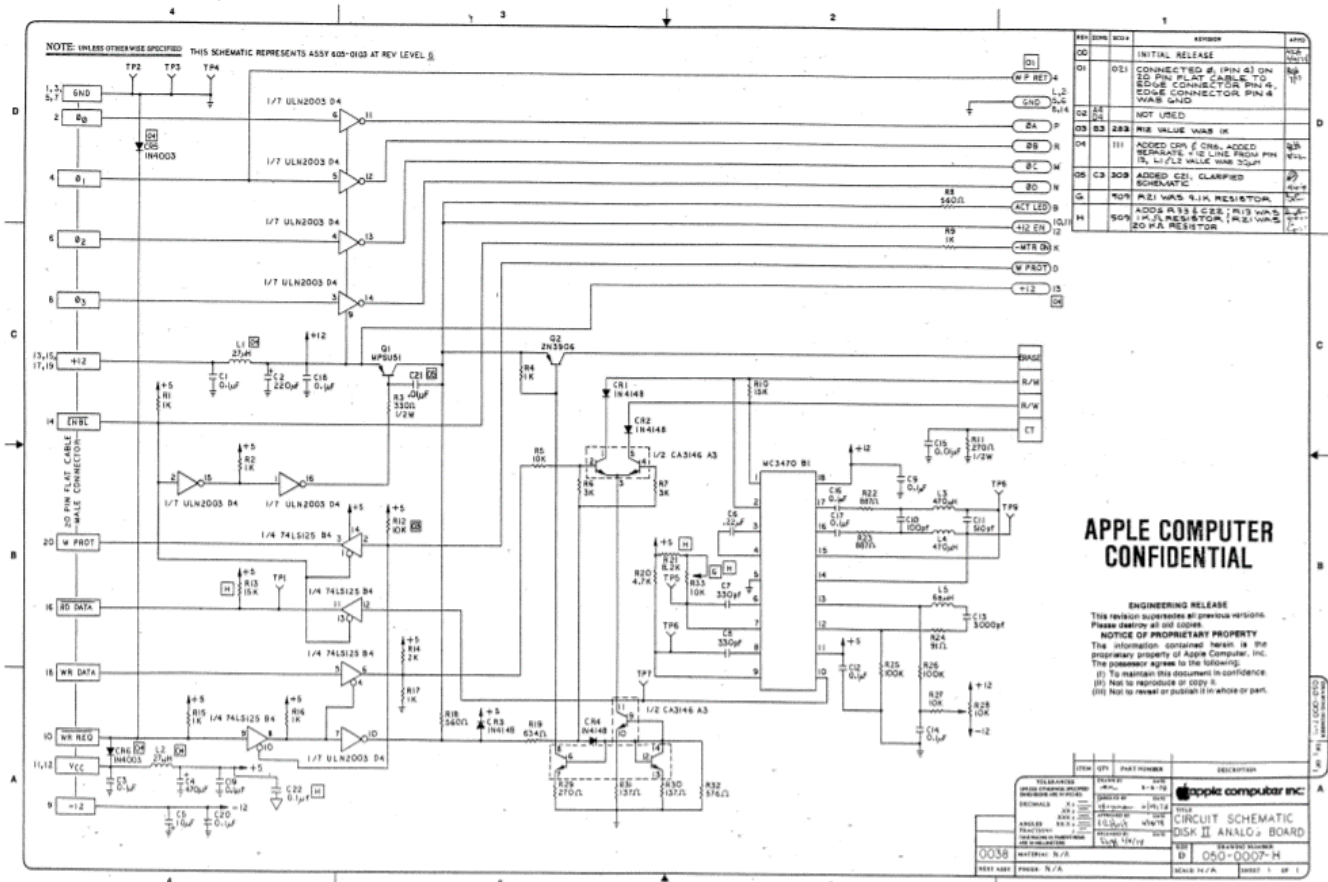


Document	Apple II	Patrick Schlier
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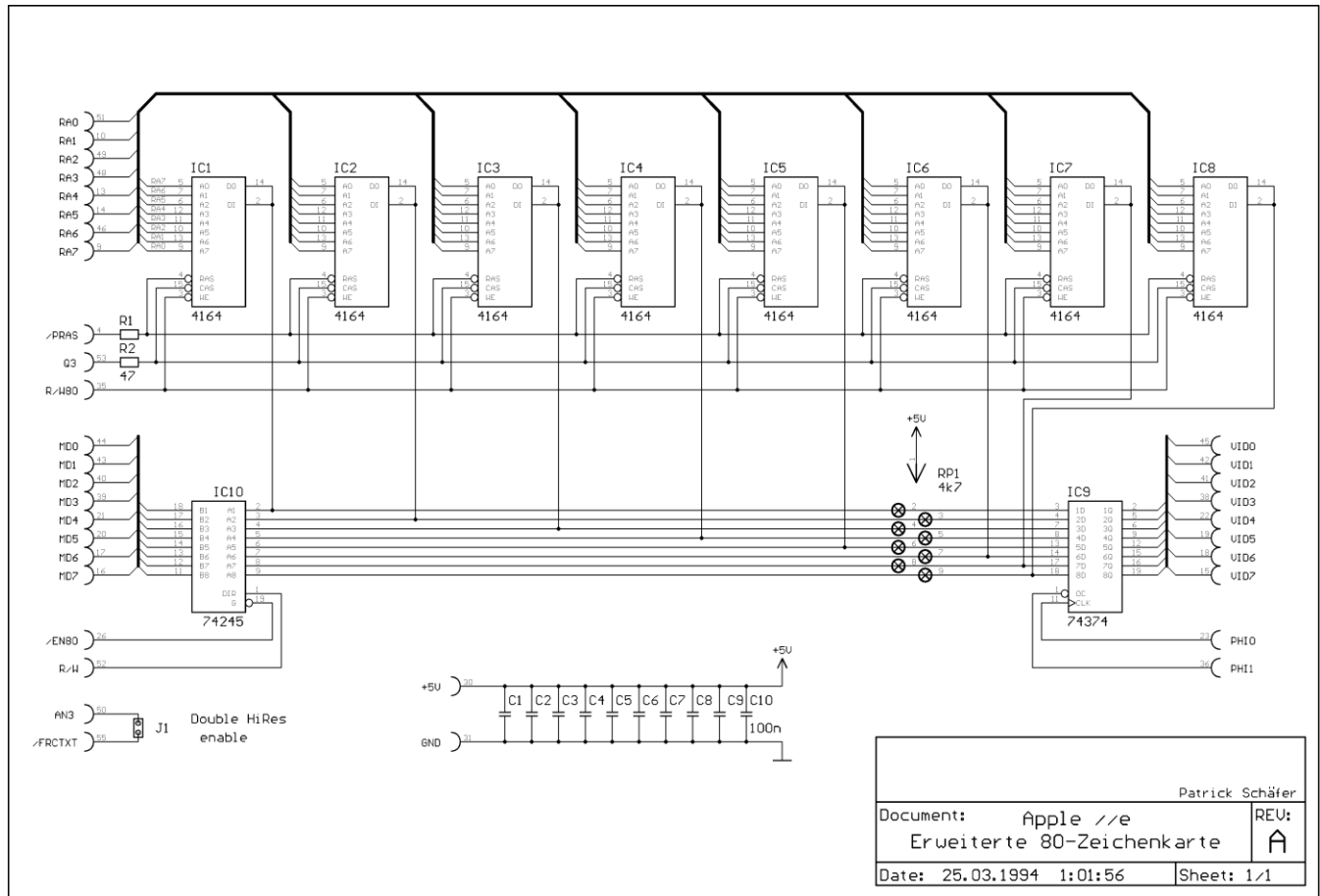
Language Card



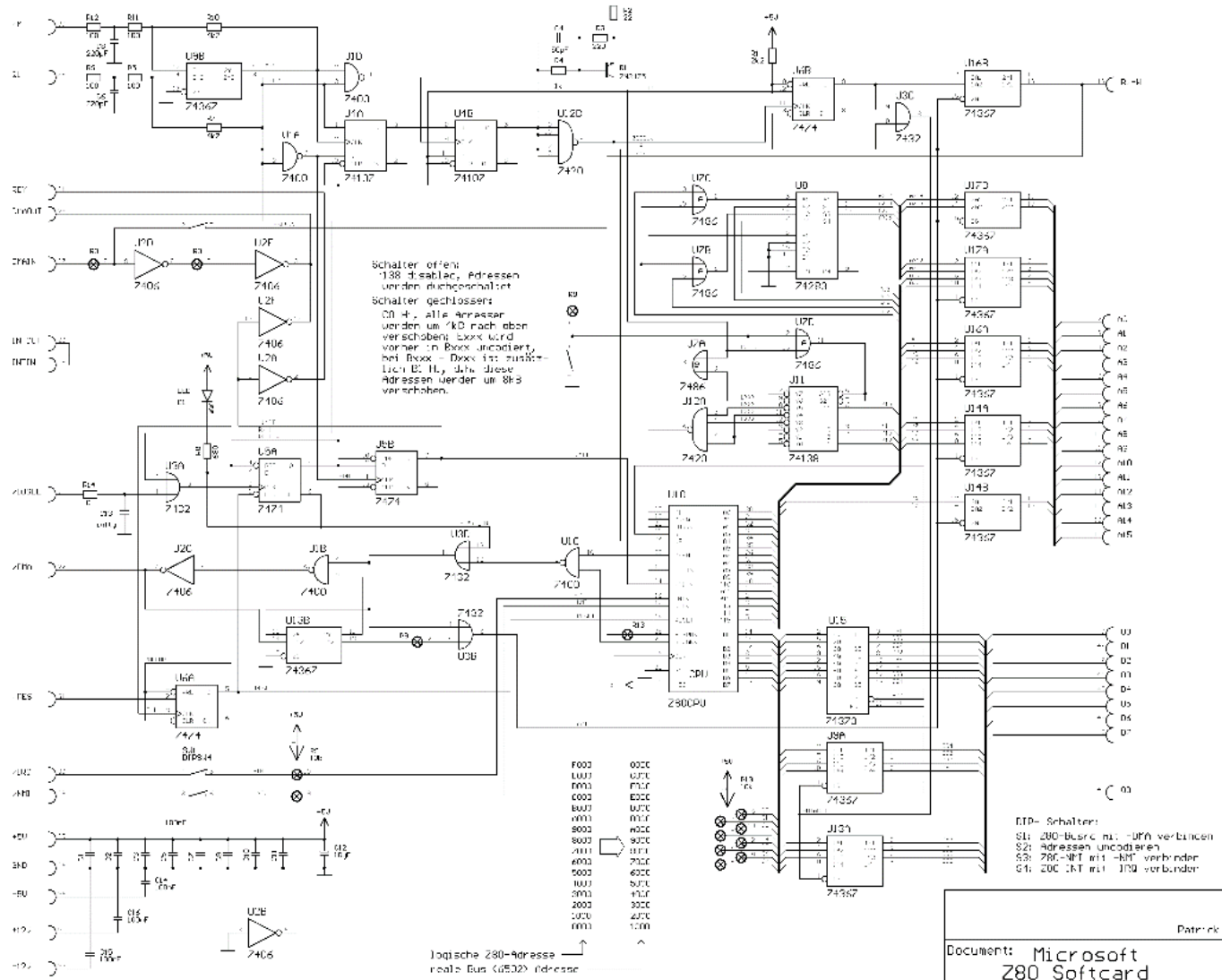
Disk II Card



80 Column Card



Z80 Card



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Sheet: 1/1		Author: Patrick Schäfer	

Apple II and II+ Keyboard

Pin	Name	Description
1	+5V	+5 Volts power; total current drain must be less than 120 mA.
2	Strobe	Strobe output from keyboard. May be of either polarity & pulse should be at least 10 microseconds for each key press.
3	RESET	Microprocessor's RESET line. Normally high, pulled low when RESET key is pressed.
4	NC	No connection
5	DATA	1 of 7 bits ASCII keyboard data input.
6	DATA	1 of 7 bits ASCII keyboard data input.
7	DATA	1 of 7 bits ASCII keyboard data input.
8	GND	System ground.
9	NC	No connection
10	DATA	1 of 7 bits ASCII keyboard data input.
11	DATA	1 of 7 bits ASCII keyboard data input.
12	DATA	1 of 7 bits ASCII keyboard data input.
13	DATA	1 of 7 bits ASCII keyboard data input.
14		
15	-12V	-12 Volts power. Keyboard should draw less than 50 mA.
16	NC	No connection

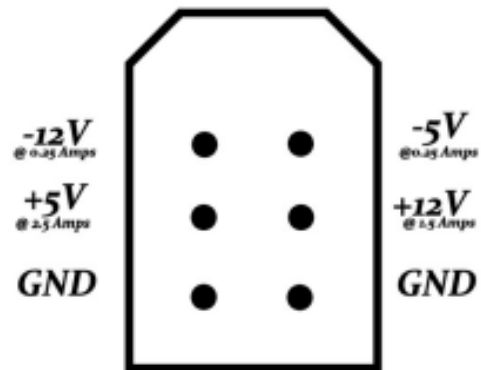
Signals for Floppy Drive Controller

Signal	Function	Unidisk	IIc	IIc+ / IIgs	Disk II
GND	Ground	1-4	1-4	1-3	1, 3, 5, 7
-12V	-12 Volts DC	5	5	5	9
+5V	+5 Volts DC	6, 16	6	6	11, 12
+12V	+12 Volts DC	7, 8	7, 8	7, 8	13, 15, 17, 19
WRPROT	Write Protect	10	10	10	20
PH 0-3	Stepper Motor Phases	11 - 14	11 - 14	11 - 14	2, 4, 6, 8
WREQ	Write Request	15	15	15	10
DRVEN	Drive Enable	17 (9)	17	17 (9)	14
RDDATA	Read Data	18	18	18	16
WRDATA	Write Data	19	19	19	18
EXTINT	External Interrupt	-	9	-	-
3.5DISK	Apple 3.5 Drive Enable	-	-	4	-
HDSEL	3.5 Drive Head Select	-	-	16	-
	(not connected)	-	16	-	-

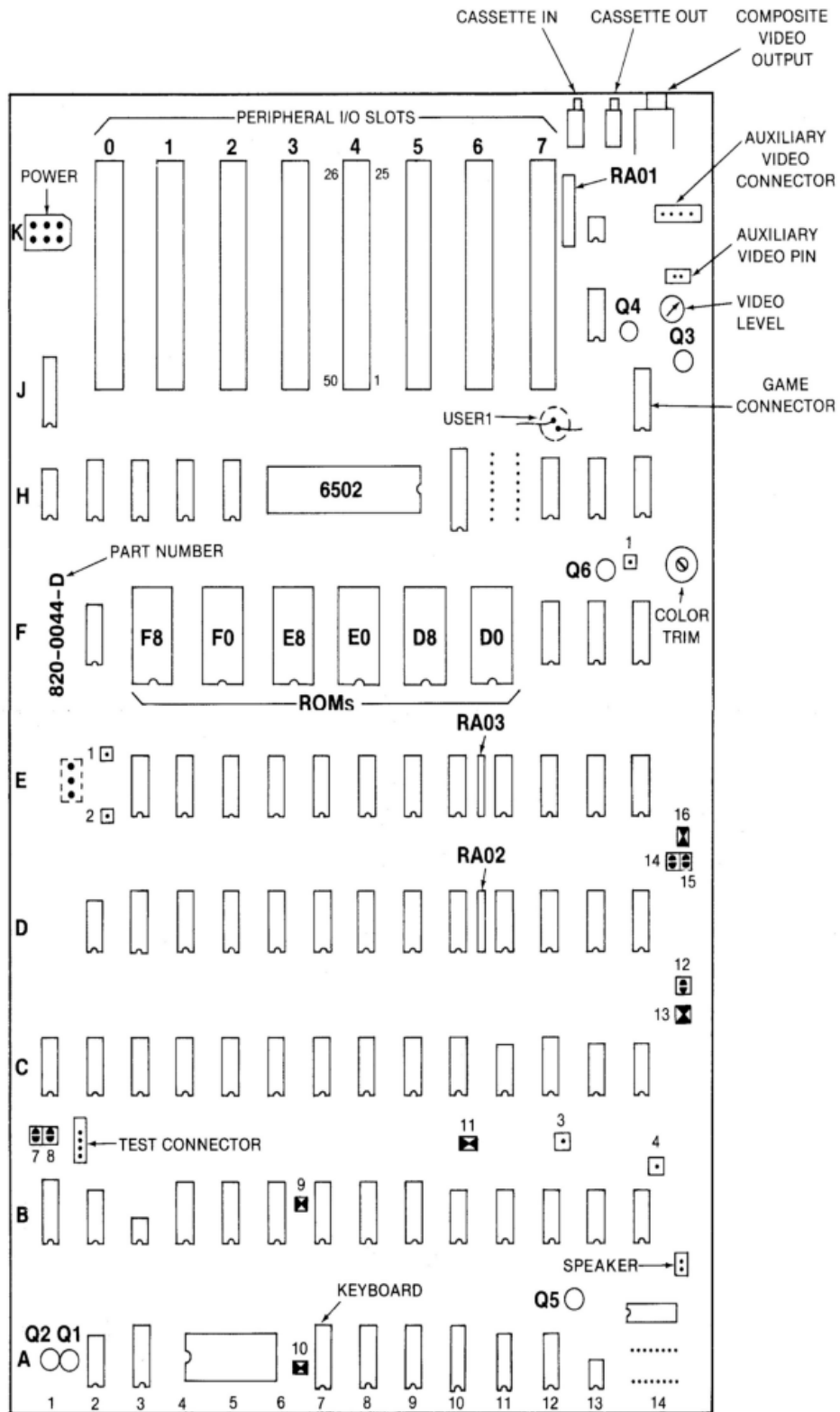
Joystick Connection

9-pin Male Connector	Function	16-pin IC-style Connector
Pin 2	+5V	Pin 1
Pin 7	Button 0	Pin 2
Pin 5	X-axis	Pin 6
Pin 8	Y-axis	Pin 10
Pin 1	Button 1	Pin 3
Pin 3	Ground	Pin 8

Apple II+ Power Supply Connector



Apple II Mother Board Layout – Search the internet for full Apple II schematics



Rudy's Retro Intelligence



Apple II\II+ Personal Computer Diagnostics and Repair Manual