

Testing HNF's Apple-1 board

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Written for an attempt to power up and test the Apple-1 board, owned by the HNF in Paderborn, labelled 75, Number 38 in the Apple-1 Registry.

Note that the operation manual uses the form *Apple-1*, i.e. with a hyphen and a plain (arabic) digit.

A) The Plan

While it might be considered to first remove all ICs and test the power first, the risk of removing and inserting seems to be much larger than the risk of damage by wrong power, if lab power supplies are used. In particular as some critical paths can be checked with a continuity tester before switching on the power.

The capacitors in the power section are not numbered in the original; for reference, they are here numbered C101, C102 and C103 for the large ones, and C104 to C107 for the small ones.

Required

Required are, details in the notes below:

- The board, properly mounted on a rigid base
- Lab power supplies for $\pm 17V$ and 9V
- Video monitor 60Hz vertical sync capable
- Molex KK 396 6-pol female connector for the power supply, with cables to the power supplies
- Molex KK 396 4-pol female for the video, with coaxial cable and proper connector to the monitor
- Parallel keyboard with Apple-1 pinning and flat ribbon cable for 16-pol DIL socket

Instead of an Apple-1 keyboard, an Apple II keyboard may be used, with either a proper cable or an interface to convert the pinning, and two flat ribbon cables; the Keyboard available:

- does activate reset with CTRL-RESET
- has no key for CLEAR SCREEN
- does not have keys for all ASCII characters (not required)
- does not light the power indicator in the white key cap (lamp defective)

B) Proceedings

1. With a continuity tester, check some connections on the board (list below)
2. Connect the board to the power supplies, the video monitor and the keyboard.
3. Power on.

4. The screen should show a stable picture.
5. Measure voltages (list below)
6. Hit CTRL+RESET on the keyboard.
7. The screen should blank with just a backslash in the top left corner, and a blinking cursor just below.
8. Type FF00, then Enter. Screen should show (in the next line:) FF00: D8
9. Type FF00.FF07, then Enter, results in FF00: D8 58 A0 7F 8C 12 D0 A9
10. Reset and type: 0:A9 00 AA 20 EF FF E8 8A 4C 02 00 R, then Enter.
11. Fills the screen with ASCII Characters.

C) Continuity tests

Ground connections:

- Pins 5 and 6 of the power plug
- diodes middle GND
- C101 case
- C102 +
- C103 case
- C104 +
- C105 case
- C106 +
- C107 case
- D14 (74161) pin 8
- D13 (555) pin 1
- D12 (7404) pin 7
- DRAMS MK4096 pin 16
- A7 (6502 CPU) pin 1, pin 21
- A4 (6820 PIA) pin 1
- A1 (PROM) pin 8

Power connections:

- pin 1 power to diodes
- pin 2 power to diodes
- pin 3 power to diodes
- pin 4 power to diodes
- diodes +8V to C101 +
- diodes +15V to C103 +
- diodes -15V to C102 case

+5V net:

- C105 +

- D14 (74161) pin 16
- D13 (555) pin 4, 8
- D12 (7404) pin 14
- DRAMS MK4096 pin 9
- A7 (6502 CPU) pin 8
- A4 (6820 PIA) pin 20
- A1 (PROM) pin 16

+12V net:

- C107 +
- DRAMS MK4096 pin 8

-5V net:

- C104 case
- DRAMS MK4096 pin 1
- IC C3 (2519) pin 16

-12V net:

- C106 case
- IC C3 (2519) pin 5

D) Voltage probes

Always use other pole of capacitor as reference ground.

+5V:

C105 +

-5V:

C104 case

+12V:

C107 +

-12V:

C106 case

E) Notes

Pin 15 to Pin 16

Note 10 on the schematics and the text on page 1 say that *For normal operation, pin 15 should be jumped to Vcc (+5V, pin 16)*. This is neither an option on the board, nor done by a solder bridge on the actual board. Thus, it is done in the cable / plug.

Strobe polarity

In the Manual, on page 1 left column bottom: *The strobe can be either positive or negative, of long or short duration.*

However, the source code of the Monitor (line 33) says: *Programmed to respond to low to high KBD strobe*

Bank selection

Note 8 in the schematics specify that *W jumperd to CS1*, setting the second 4k RAM bank to 1xxx. On the board, however, W is jumperd to CSE, which is the correct setting to run BASIC provided on tape.

Z is correctly jumperd to D, for PIA access.

Tape interface

Requires that CSC is jumped to R, which is the case.

Power supply

The 6 pin PCB connector might be a Molex KK 369 (Raster 3.96mm).

According to the manual, two transformes with 8..10V~ and 28V~ are proposed, each with a center tap, which is not used for the 8V~ transformer, and grounded for the 28V~ one, which thus supplies 2x14V~.

These are connected as follows:

Pin	
1	8-10V ~ floating
2	8-10V ~ floating
3	14V~ versus ground
4	14V~ versus ground, phase 180°
5	GND
6	GND

A laboratory power supply could be used:

Pin	
1	+10V 1.5A (3A)
6	GND
3	+17V 1A
4	-17V 1A
5	GND

Then each path supplies 2V for diode drops and 3V for the regulators.

Video output

The 4 pin connector might be a Molex KK 369 (Raster 3.96mm) used as follows:

Pin	Signal
1	+5V
2	composite video (FBAS)
3	GND
4	+12V

The signal uses the US TV system:

- 60 frames/sec
- 480 lines visible
- 525 lines total
- 15.75 kHz line frequency

Using a video monitor for 50Hz vertical deflection might not properly synchronise due to the 20% larger US frequency; the 1% higher line frequency is less critical.

Cable from (Apple-II) Keyboard to Apple-1

uses 12 of 16 pins:

II	Signal	1	Comments

1	+5V	16	
2	Strobe	14	
3	Reset	1	pushbutton to ground
4	N.C.		
5	B6	7	
6	B5	6	
7	B7	8	
8	GND	9	
9	N.C.		
10	B3	3	
11	B4	2	
12	B1	54ER	
13	B2	4	
14	N.C.		
15	-12V	11	
16	N.C.		
1	Signal	II	Comments

1	Reset	3	
2	B4	11	
3	B3	10	
4	B2	13	
5	B1	12	
6	B5	6	
7	B6	5	
8	B7	7	
9	GND	8	
10	+12V		not used
11	-12V	15	
12	CLR		Clear Screen, not used
13	N.C.		
14	Strobe	2	
15	B8	1	connect locally to I:16
16	+5V	1	