

Expanding the Memory to 20k

Submitted by [Tom Owad](#) on May 26, 2004 - 3:37pm [Organization](#) [Apple](#) [Apple I](#)

INSTRUCTIONS FOR EXPANDING THE APPLE-1 MEMORY TO 20K

The procedure consists of replacing one row of type 4096 memory chips (the X row) by 4116 chips, each of which has a capacity of 16384 bytes rather than 4096, and providing the circuits to address the new memory. Note that each chip gives one bit: to make up a byte, the computer uses one bit from each of the eight chips.

WARNING

The new memory will cover the addresses from 0000 to 3FFF. This includes the base page, which is vital to any operation of the computer, even using the Monitor without basic. Thus if you use one chip that has a bad bit in the base page area, it may prevent operation of the computer even if everything is installed correctly. You can sometimes check if that is happening by interchanging chips. If the symptoms change when you do that, you have to suspect a bad chip. Even if everything works fine, you should check all the memory occasionally.

Unfortunately, I don't know any source of 4116 memory chips that is completely infallible. A good supplier should at least be willing to exchange any defective chips. I have obtained good chips (and some bad ones which they replaced) from Electrolabs (P.O. Box 6721, Standord, CA 94305, phone 415-321-5601).

(1) Install 2 16 pin DIP sockets in the breadboard area at the pwer-supply end.

(2) On the back of the printed-circuit board, cut the trace between W6-15 and X6-15. Cut the trace between X7-13 and the feed-through point between rows A and B.

(3) Remove chip B8 (74S257), and bend out pin 14 so that it does not make contact. Reinsert it in its socket, leaving pin 14 sticking out to the side.

(4) In the jumper area near the center of the board, cut the solder jumper between X and CS0.

(5) Install wires from the new 74153 socket pins:

1 Jumper to pin 8 7 BII-13 (X7)

2 37-1 (74S257) 8 D9-8 (74161)

3 B10-23 (74154) 14 B5-1 (74S257)

4 D10-23 (74154) 14 B5-1 (74S257)

4 B10-22 16 D9-16 (/4161)
5 D9-14 Pins 9,10,11,12,13,15 no connection
6 Jumper to pin 5

(6) Install wires from new 74139 socket:

1 Jumper to pin 8 12 BII-15 (X7)
2 Jumper to pin 14 13 B10-20 (74154)
3 Jumper to pin 13 14 B10-21 (74154)
4 H2-1 (7410) 15 B6-12 (74S257)
8 D11-8 (74161) 16 DII-16 (74161)
Pins 5,6,7,9,10,11 no connection

(7) Install a 74153 and a 74139 in their respective sockets in the breadboard area.

Install new 16k memory chips (4116) in sockets X0 to X7.