

## Expand Your Memory

by John Moore

While there is a good number of 64K memory expansion boards available, the dedicated "hardware hacker" can add extra memory to his or her ADAM for about \$10. Interested?

First, remember that any changes inside ADAM will void any warranty you may have left. Since we have no control over it neither the author nor ECN may be held responsible for the results of your work.

This modification requires good soldering skills, experience in working with circuit boards and with integrated circuits and a degree of patience.

First you will need the raw materials! 8 - 4164 dynamic RAM memory chips (200 nanoseconds a less), and about a foot of fine insulated wire. The chips are widely available for about \$1.50 each - check the Computer Shopper.

Open your ADAM and work your way to the bottom board. This is the one with the expansion connector and the three expansion slots on it. The memory chips are above and to the right of the connector marked "J5." This is Slot #3 - the place where your 64K Ram card would have been plugged.

The memory chips themselves will be numbered in various ways, but will most likely have 4164 somewhere in there. On my board, the chips are labelled "TMS4164-20NL." The 20NL means 20 nanoseconds. Notice that the locator "notch" on the chips goes toward the back on the back row and toward the front on the front row (THIS IS VERY IMPORTANT)!

Now, prepare the expansion chips. Here is the way the little "bugs" are numbered. If you sit the IC on the table in front of you so that the "notch" points to your left, the bottom left pin is #1, the bottom right is #8, the top right is #9, and the top left is #16.

On each of your eight chips, carefully bend pin #15 up so that it is vertical (or nearly so). Do this carefully so that you don't break a pin. If you do, that chip is useless!

Now place one of the new 4164 chips on top of an existing chip. Be certain that the locator "notch" on both chips face the same way! Next, very carefully solder each pin on the new chip to the corresponding pin on the chip beneath it. There is a disc capacitor (C2) on the front row that may be troublesome. Carefully bend it out of the way as you solder.

You now have 8 new 4164 chips mounted "piggyback" on the old chips. Check your soldering very closely. You may well have created a solder "bridge" between pins. If you have, ADAM won't boot (but will otherwise be OK). Look carefully!

The final step is simple. Take the fine wire and connect each of the pin #15's of the new chips to the others. Finally, connect those pins to R15. This is a small resistor coded yellow-brown-black located between Slot #2 and Slot #3. There are two of them. You want the one nearer the back of the board. The wire connects to the side nearest Slot #3.

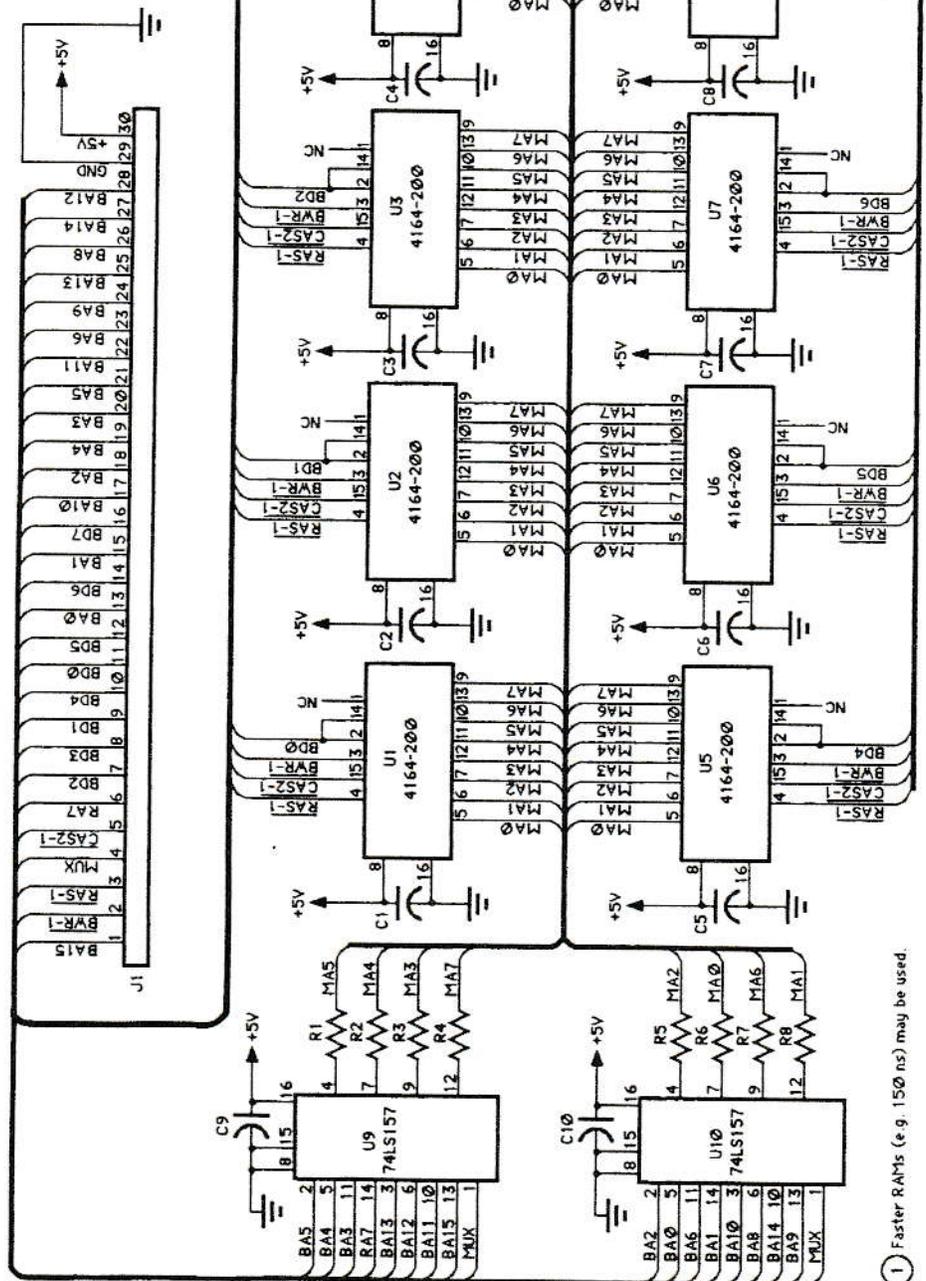
If you have completed these steps properly, you are now finished. Reassemble your ADAM, but don't put all the screws back in yet. Connect all the peripherals, and boot the machine. If SmartWRITER comes up, you are probably OK. If you have AdamCalc or BACKUP+ v. 3.0, start them running. Both will check the presence of expansion RAM.

If this test passes, you may consider the RAM functional. As one last check, boot CP/M and PIP something to Drive M:. The command `PIP M:=A:PIP.COM[v]` will copy PIP itself to the RAM Drive and will verify that an exact copy was made (the [v] switch). If the transfer goes OK - you're home free!

In my experience, the most likely trouble is the solder bridge between pins. Use no more solder than is necessary. If you get a bridge, the computer probably won't boot - not even Smartwriter. The good news is that this usually will not damage the chips. Once the bridge is cleared, everything will work fine.

If you don't have the necessary skills, check with a TV repairman or a Ham Radio operator in your area. The work is delicate, but not beyond the capabilities of the average technician. A side effect of this modification is that you don't need to add any extra suppression, since the busses on the main board have already been suppressed.

- R1-R8 47Ω ±5% 1/4 W resistors
- C1-C10 0.1 μF ceramic disc capacitors
- U1-U8 4164-200 ns 1x64 Kbit RAMs
- U9-U10 74LS157 quad 2-to-1 line data selectors
- J1 edgecard connector 2x15 0.1" centers



|    |        |
|----|--------|
| 30 | +5V    |
| 29 | GND    |
| 28 | BA12   |
| 27 | BA14   |
| 26 | BA8    |
| 25 | BA13   |
| 24 | BA9    |
| 23 | BA6    |
| 22 | BA11   |
| 21 | BA5    |
| 20 | BA3    |
| 19 | BA4    |
| 18 | BA2    |
| 17 | BA10   |
| 16 | BD7    |
| 15 | BA1    |
| 14 | BD6    |
| 13 | BA0    |
| 12 | BD5    |
| 11 | BD0    |
| 10 | BD4    |
| 9  | BD1    |
| 8  | BD3    |
| 7  | BD2    |
| 6  | RAS-1  |
| 5  | CAS2-1 |
| 4  | RA7    |
| 3  | RAS-1  |
| 2  | BVR-1  |

FRONT  
EXPANSION SLOT 3  
(TOP VIEW)  
COMPONENT SIDE TO RIGHT

**COLECO ADAM  
64K EXPANDER**  
PLANS BY  
RICHARD F. DRUSHEL  
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① Faster RAMs (e.g. 150 ns) may be used.