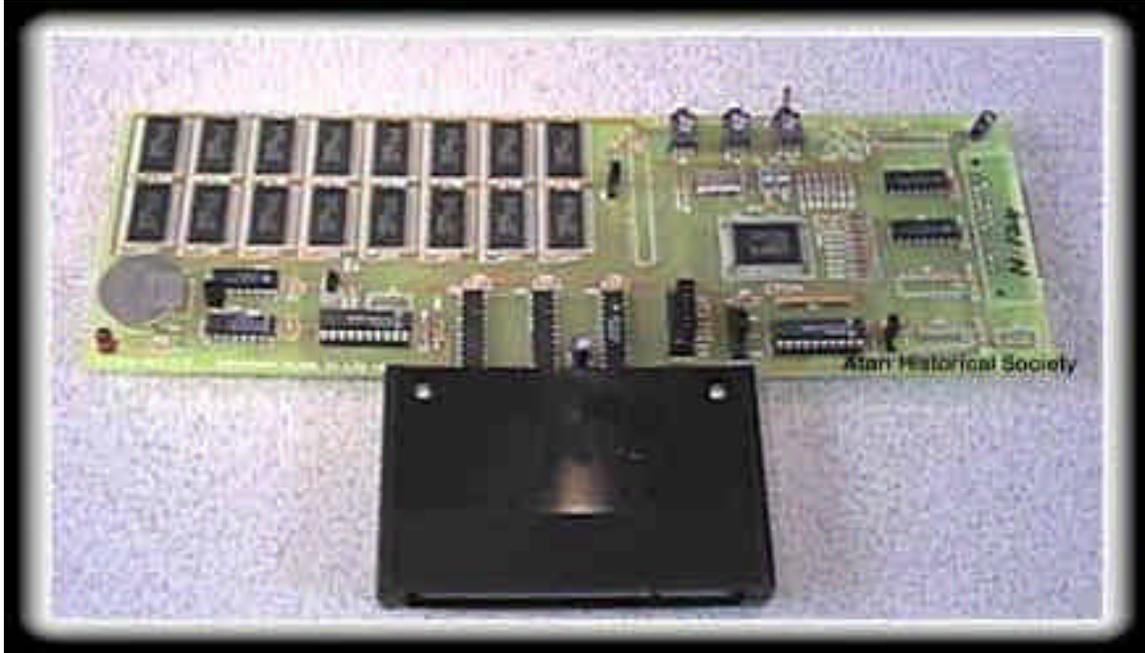# Jaguar Alpine Board Memory Upgrade
2MB to 4MB
by Glenn Bruner
19 November 2000

Before photo

I've created this informational document to help aid people who are lucky enough to own a Jaguar Alpine development board and are in need to upgrading to the 4MB version. I have just finished upgrading my Alpine board to 4MB. Now I would like to share briefly on how I did it. I've written this document for people who understand quite well about electronics and working with surface mount devices.

Before I begin, I would like to state this: "This upgrade is intended to be performed by people who are skilled with soldering, desoldering, circuit board repair, and safe handling of electrostatic sensitive devices (ESD). It should not be done with cheap equipment (I.E. - $5 soldering iron). The cost for the upgrade is considerable for the static RAM chips needed (8 chips at $18 each). These chips are in demand and are not normally carried by popular electronic sources (I.E. – Radio Shack, Jameco, Digikey, JDR Microdevices, etc). You have probably paid a small fortune for your Alpine board. Give some serious thought and research before attempting this upgrade, you could be out of a Alpine board with no hope of replacing it. **De-soldering the chips from the Alpine board is the most critical and dangerous part of this upgrade**. I WILL NOT be held responsible for any damage done by anyone attempting this upgrade. YOU ASSUME FULL RISK FOR YOUR JAGUAR AND ALPINE BOARD WHEN ATTEMPTING THIS UPGRADE. I have spent many hours studying the hardware aspect of the Alpine board and have made every attempt to make this information as accurate as possible."

STORY

It has been a rough 4 months in making this upgrade happen. My single biggest hurdle has been trying to find a source for the static RAM needed. The semiconductor industry is just terrible. It is difficult for an individual on the street to find someone who will sell them a small handful of chips. The lowest price I have found for the chips is around $13 each. But I had to buy in a quantity of 20 chips (and no less). The highest price I found was around $26 each where I could buy one at a time. You have to buy in quantities of 100 or 1000 to get a better price.

I ended up purchasing from a company called Reptron (www.reptron.com) in Tampa, Florida. They are obviously to me a company that cares about doing business. They allowed me to purchase the chips I need (minimum quantity of 10) at a fair price of $18 each (keep in mind memory prices are always changing and this price I mentioned may be better or worse, that's why you research before you buy memory). It did take some work to get the order processed since I was just an individual and not a company/corporation. But it was worth the effort. As long as you got a credit card, they will do business with you. Special thanks goes to Jason Russell of Reptron. Without him, I wouldn't be writing this right now.

I did try and search for surplus electronic boards and see if I could find these static RAMs on a board of some sort. I've looked at PC/MAC motherboards, computer and laser printer network cards, video cards, I/O cards, SCSI cards, PCMCIA cards, laptops, and hard drives. About the only devices I've found that had anything close were high end Mac video cards and laser printer network cards. I found some Toshiba psuedo-static RAM chips on a DEC network card. I thought they were full static RAM, but I found out after I upgraded my board with them that they were static RAM that operated like dynamic RAM (I.E. – they require a memory refresh signal and the Jaguar doesn't provide memory refresh to cartridge based devices). I have not found any cards yet that contains the required static RAM. Enough of the history…on with the upgrade.

PARTS AND TOOLS
For this you will need as a minimum:
- Static RAM – 8 each (see below for part number reference)
- solder & solder wick
- Exacto knife
- solder paste (not solder flux, unless you prefer that)
- grounded tip solder station/iron (high quality for ESD work)
- dental pick or some sort or prying tool
- isopropyl alcohol
- cotton balls and Q-tips
- heat gun (available at art supply stores; used for embossing)
- tweezers (for picking up hot parts during initial desoldering process)
- small flat tip screwdriver
- magnifying glass (to inspect solder work)
- lots of patience

Quality soldering station made by Weller (Cooper Tools)

Heat gun, solder paste & wick, dental pick, alcohol

<u>UPGRADE STEPS</u>

1. **Carefully remove all 16 static RAM chips from the existing Alpine board using the heat gun (U9 thru U25)**. Be careful to keep the heat moving around the part your removing and not focus it too long in one area (you will burn the board and/or surround components and possibly pull up circuit traces). Make sure you have a good means of holding the board still because you will need both hands free (one to hold the heat gun, the other using the dental pick to slightly pry the part loose). Use the tweezers to pick up the parts as they are removed from the board. Work one chip at a

time but keep working until all chips are removed so that your board is only stressed like this once.

Another method that was suggested is to use a pre-heater to prevent damage to the solder pads and use an Exacto knife to slowly pry up the pins as you de-solder them.

Removed 128K x 8 Toshiba Static RAM from 2MB Alpine

2. **After board has cooled down, clean up excess solder left on circuit board**. This was an initial dilemma for me but I figured out a very effective method to do this. Using the solder paste, solder wick, and soldering iron to carefully remove the excess solder. First, coat the memory solder pads with solder paste. Take the solder wick push together on the braid to expand it. Place the solder wick over the area to clean up and place the solder iron over the wick to heat the area up. The solder paste will start to boil and solder will liquefy. The solder wick should be collecting the excess solder. Now just use a left to right motion over the pads and work your way across from one end to the other with the soldering iron and wick. Don't press down too hard or you may catch on a circuit trace that may come up. Done right, you will have cleaned the area down to the memory solder pads. Continue this process until all sixteen RAM locations are cleaned (want to make sure no electrical shorts are left behind).

3. **Clean RAM locations with alcohol and cotton balls/Q-tips**. This is to clean up all the solder paste still on the board and prepare the surface for the installation of the chips. This is important, don't skip. If done right your board will look like this:
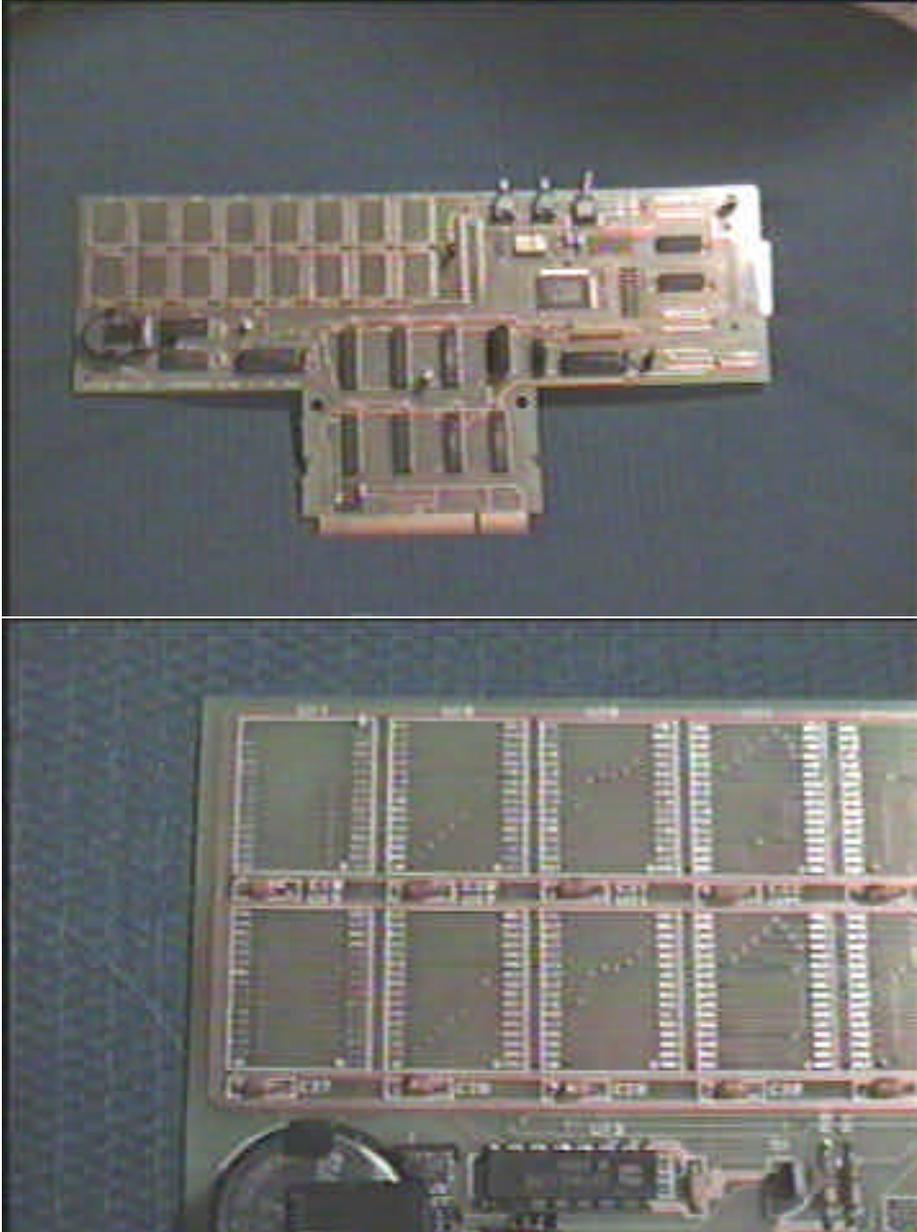
Cleaned board after initial RAM desolder process

4. **Begin installing chips one at a time**. Again, for this upgrade you need 8 chips.
   They must be 512k x 8, 32 pin, small outline package (SOP), 50-mil pin spacing,
   5VDC Vcc, minimum 3VDC battery back up capability, and meet the
   operating/standby current specs of the chips that were removed. The following chips
   are known to work:

   - Hitachi HM628512ALFP-7
   - Samsung K6T4008C1B-GL70 (former part # of KM684000 series)

The following chips were found through datasheet searches:

- Hyundai HY628400ALG-7
- Toshiba TC554001FL-70V

It is very important that part #'s are verified during ordering. I almost ended up buying dual in-line package (DIP) chips, which are too big to mount on the board. The letters and numbers at the end of the part # specify the packaging and speed of the RAM. When they say they have a substitute, get that part number and research it to ensure it's a suitable substitute.

When handling the chips, keep them inside their chip holder until your ready to install them. When installing, allow the chip to carefully slip out of the chip tube onto the board and handle the chips as little as possible with your fingers to avoid possible electrostatic discharge. If you have access to an ESD wrist strap, use it for precaution.

When placing the part on the board, ensure the notched end is facing down (towards the cartridge connector). Center the pins of the chip on the solder pads and ensure it's evenly positioned in the RAM location (not too much to the left or right or too far up or down). Carefully solder one corner down. Make sure IC is still centered and positioned correctly. You can apply heat to that corner and make adjustments until it's right. Then carefully solder the remaining pins (watch for solder bridges that may form). If solder bridges form, use the solder wick to remove the excess solder.

You will be placing the chips in the following memory locations:
- lower 2MB – U9, 10, 11,12
- upper 2MB – U14, 15, 16, 17

5. **When you have the chip soldered in place, use an ohmmeter (continuity checker) to ensure connection to the board**. I would go down and check each pin with an adjacent memory location and look for spots that didn't have a low ohm reading (less than 1 ohm). I would then use the soldering iron to reheat that spot to get a proper connection to form. Not all pins are common among all memory locations. Three pins are unique to a certain sequence of chip locations. All pins are common among the memory IC's except for the following:

- Pin 29 (read/write signal)
    - U9, 14, 18 and 22 are connected to U34 Pin 19
    - U10, 15, 19, and 23 are connected to U34 Pin 18
    - U11, 16, 20, and 24 are connected to U34 Pin 17
    - U12, 17, 21, and 25 are connected to U34 Pin 16
- Pin 22 (chip enable 1 signal)
    - U9, 10, 11, and 12 are connected to U13 Pin 12
    - U14, 15, 16, and 17 are connected to U13 Pin 11
    - U18, 19, 20, and 21 are connected to U13 Pin 10
    - U22, 23, 24, and 25 are connected to U13 Pin 9
- Pin 24 (output enable signal)
    - U9, 10, 14, 15, 18, 19, 22, and 23 are connected to U33 Pin 5

- U11, 12, 16, 17, 20, 21, 24, and 25 are connected to U33 Pin 7

6. **Once step 6 is complete and repeat steps 4 and 5 for each remaining IC**. This is where the patience comes in. Doing this project carefully and methodically will ensure that this works the first time you plug it in.

7. **Take one last look over the board for any potential problems**. Look for missed solder bridges, splashed solder, broken traces, etc. Here is what the finished board should look like:
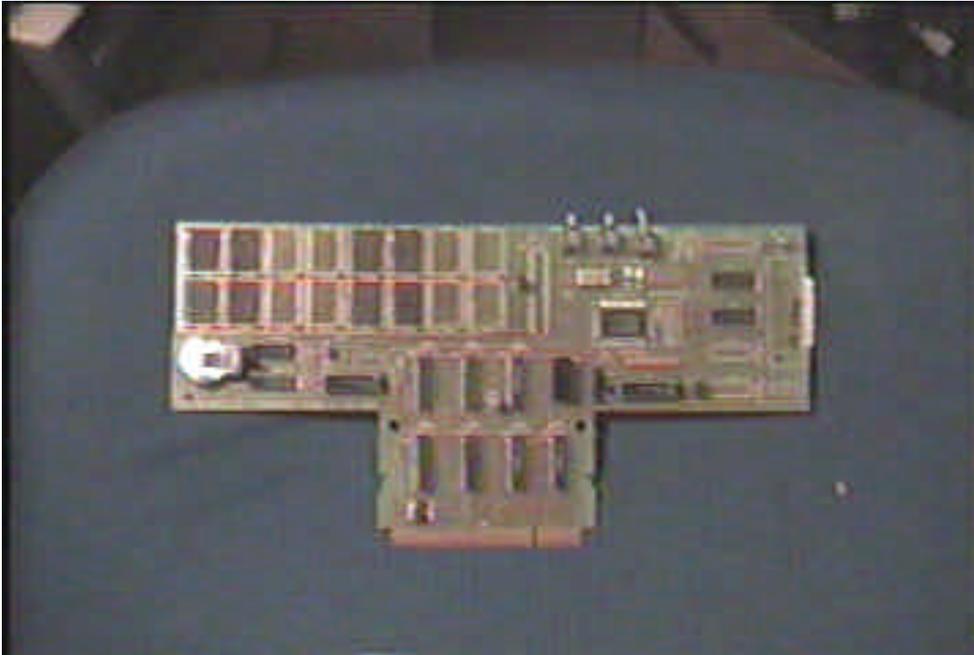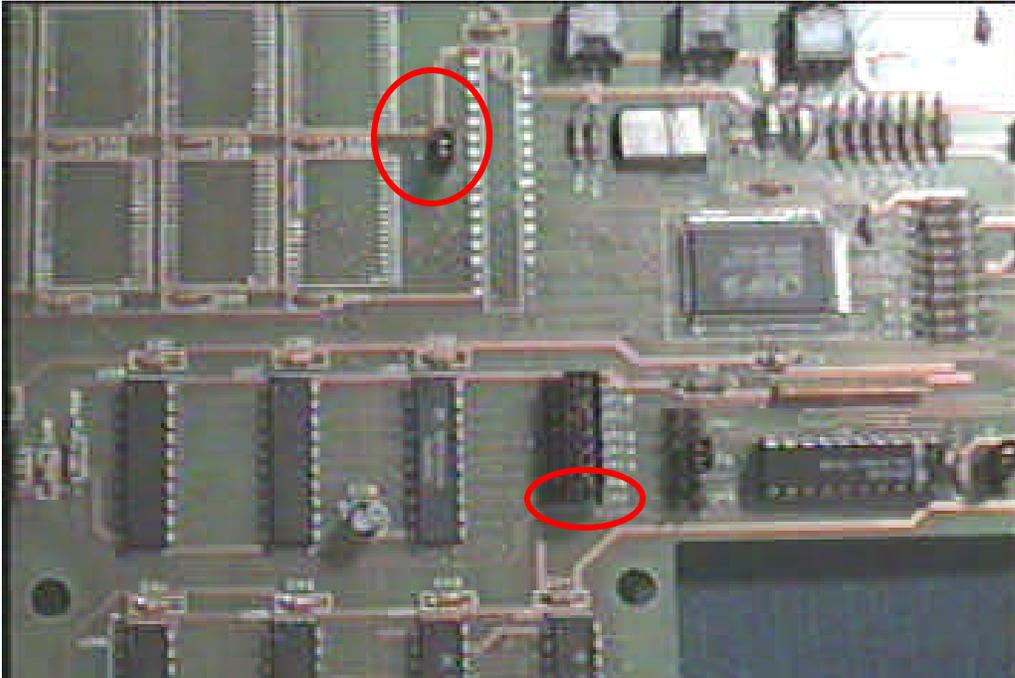

Finished Alpine Board
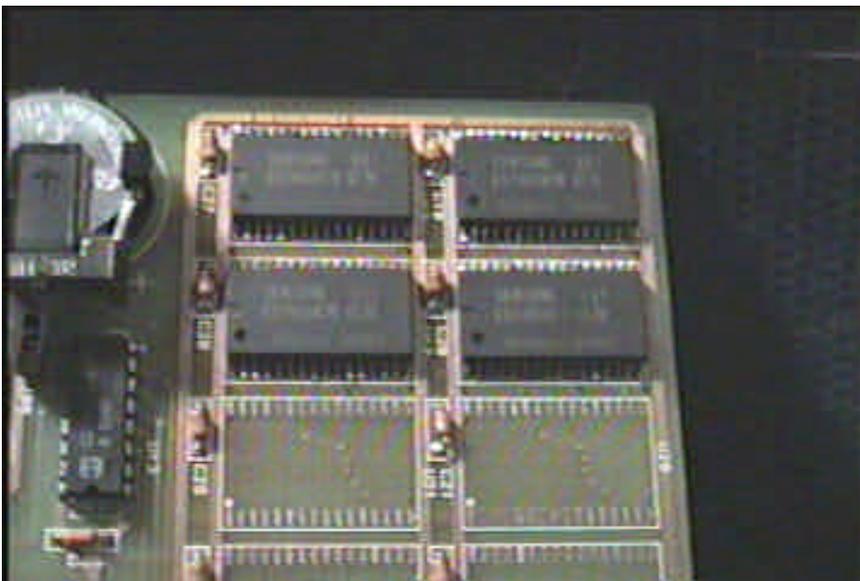
Close up view of newly installed chips

8. **Adjust board jumpers for new 4MB configuration.** There are three jumpers that need to be moved, JP6, 7 and 8. JP6 will be jumpered on the center and lower pin (towards the cartridge connector). JP7 and 8 will be jumpered on the center and right pin (in-line with JP's 9 thru 14).

9. **Plug your board in and try it out**. Use a large game image (like Doom or Kasumi Ninja) to load into the Alpine memory and test the board. Try modifying memory locations using the Windows Debugger (WDB) and see if the information is retained. Or use the attached MEMTEST program that came with this document to test the memory.

This memory test program is one that I adapted from Motorola. It's written in 68000 and is loaded at memory location $4000 in the Jaguar memory. It will test all RAM between $800000 to $BFFFFF (entire 4MB cartridge window). It is a bare bones memory test that provides a single pass or fail result in 68000 register D1. The memory test does a all zero's write, all one's write, and alternating patterns of one's and zero's for all memory locations.

Use the following to procedure to run the program:

- Install Alpine board in your developer Jaguar and connected to your PC parallel port
- Go to the directory were the MEMTEST program is stored and start WDB (wdb<enter>)
- While turning on your Jaguar, hold down the A button on controller one. This puts the remote debugger in low RAM instead of the default location inside the ROMULATOR (Alpine board)

- You should see a message on the WDB screen indicating that the Jaguar and Alpine are talking to each other and that the remote debugger is in DRAM.
- Enter the following command, "AREAD MEMTEST.COF"
- 68000 program counter should be pointing at location $4000
- Type in 'G' and enter. Program should start running. It will take some time to test the memory (around 10 minutes). If everything is working correctly, register D1 will contain the value $12345678. If something didn't pass, D1 will contain $DEADDEAD.

Well, that's it. If you have any questions, please email me at glenn_b18@yahoo.com.