**Converting a Production Major Havoc PCB to Support Major Havoc – The Promised End**

Draft 1.10 – 8/11/2021

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**Important Note:** In Spring 2021, I decided to move away from the TMS-5220 Speech chip for this game because it just wasn’t going to cut it on the female and higher pitched voices. Since an adequate ADPCM daughterboard has now been designed, this will be the path forward. The upside is that many of the most complex mods that were originally in this document for the GAMMA/Speech side of the PCB, are no longer needed. That makes the modifications substantially easier now. HOWEVER.. if you have already done the GAMMA mods you will need to undo some of those mods in order to be back in line for functional speech. Read the section at the end about undoing mods. This new mod is effective as of Promised End ROM version 0.77. Versions prior to 0.77 can be wired with the TMS5220 as it will work with limited speech samples (prototype…. Yay!)

**Summary**

In order to support the updated ROM’s, several modifications need to be performed on the production Major Havoc PCB. The modifications are moderately challenging (no cutting however) and you should understand that you might harm your PCB if you make mistakes, do not perform these modifications if you are not willing to accept the risks. If done cleanly, the mods are easily reversible because no cutting is required to support Major Havoc – The Promised End.

Overall, only ONE major thing needs to be accomplished in order to run the updated ROM images.

1. Expand the Paged Alpha ROM space

The overall process involves adding a single IC to a ‘Spare’ location on the production PCB.

The modified PCB **\*will\*** still support running production ROM’s if you care to revert back and if you modify to instructions, you can run original ROM’s on a modified PCB by simply pulling the new IC @ 5S and putting in the original ROMs.

ROM Notes: In the ROM section of this site, refer to the ROM Information.txt file on details about the ROM files and what devices are required for each image. You will need different EPROM’s than the stock Major Havoc ones… notably, there are (2) 27256[32K], (5) 27128[16K], (1) 272001[256K] and (1) 2764[8K] EPROM’s required.

Note on Machine Pin Sockets vs Flat Pin Sockets: I actually find the flat sockets to work better even tho they are cheaper. The pins bend out to solder on very nicely. Also, on machine pin sockets, the bottom of the socket pin may inadvertently short to the pin in the socket below, if that happens, it may damage the circuitry. Be aware of those contact considerations. I now suggest you use a flat socket for the speech IC @ 11N if it is not already installed.

**Parts List**

The following parts are required for each upgrade Section

Alpha + Gamma CPU (Required):

1. (1) 16-Pin DIP Socket (machine pin or flat)
2. (2) 28-Pin DIP Socket (flat pin suggested, see notes)
3. (1) 74LS174 Hex Flip-Flop
4. (1) 10K 1/8 W resisitor

Speech Components (Optional):

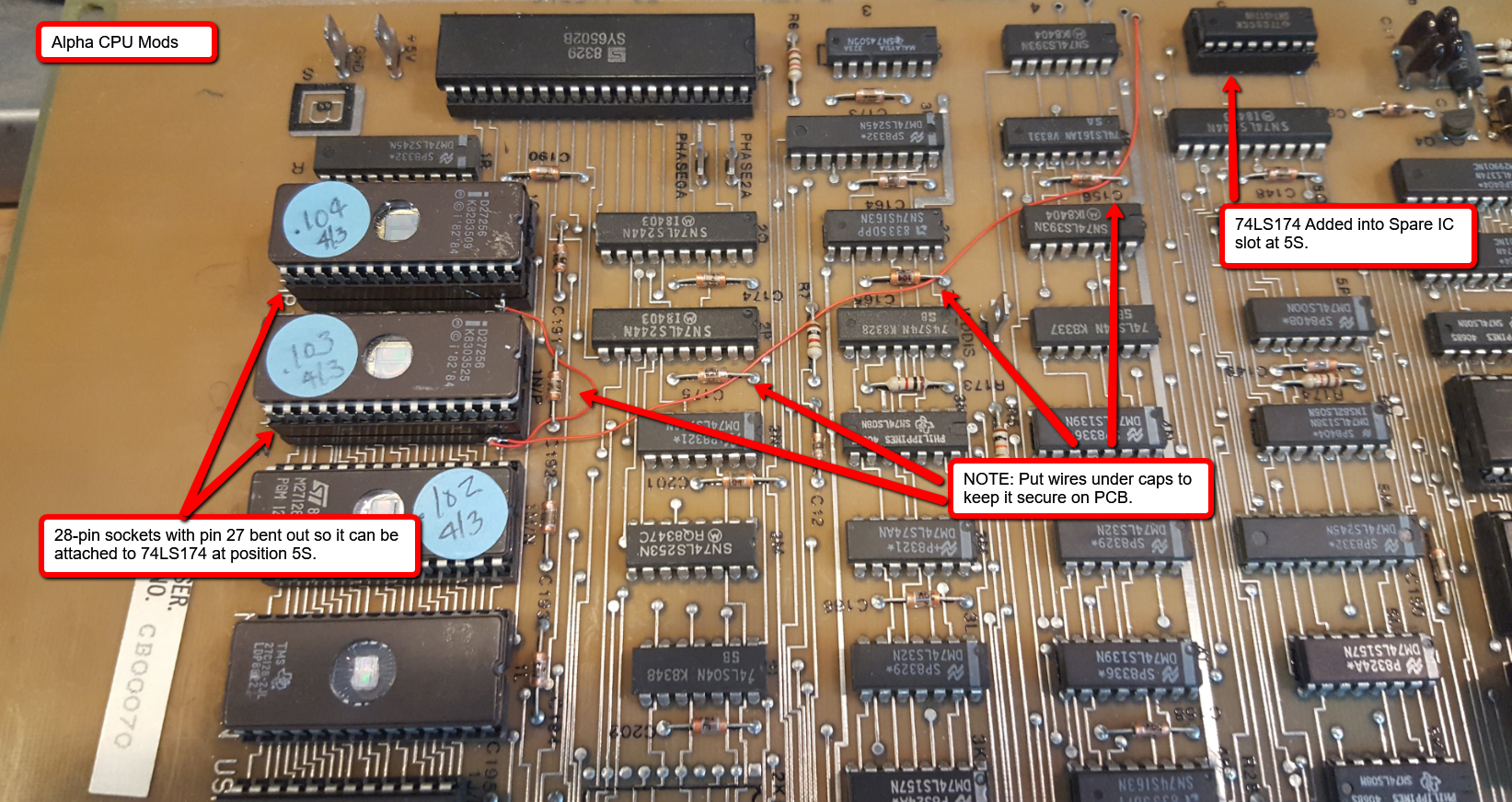
1. (1) 10K 1/8w resistor
2. (1) 4.7K 1/8W resistor
3. (1) jumper wire
4. (1) .22uf 50v Mylar Capacitor
5. (1) 28-pin DIP Socket (note: some PCB’s have the Speech IC socket already stuffed @ 11N)
6. (1) HavocADPCM daughterboard, info on how to build or buy on the main page.

**Alpha Upgrade Procedure:**

1. Remove the ROM’s at locations 1Q and 1N/P (Paged ROM)
2. Solder in a 16-pin DIP socket @ location 5S.
3. Take 2 28-pin DIP sockets and bend pin 27 outwards horizontally so it will stick out when the socket is inserted, you will be soldering wires to these.
4. Plug your modified socket into the main sockets @ 1Q and 1N/P
5. On the component side, solder a wirewrap wire (30ga Kynar suggested) between pins 27 on 1Q and 1N/P. This line is the chip select for the added Paged ROM space. When you solder to the pin, I suggest that you wrap the wire around the pin so it doesn’t just pop off when you solder to it. You will be soldering another wire to the pin @ 1N/P for reference.
6. Now, moving to the solder side (underside of the PCB) we will start adding the new wires for the page select.
7. Solder a wire from the new socket @ 5S, pin 1 (Reset) to the Alpha CPU 6502 @ 2S pin 40.
8. Solder a wire from the new socket @ 5S, pin 9 (Clock) to the Address Decoder 74LS138 @ 5N pin 10.
9. Solder a wire from the new socket @ 5S, pin 13 (D2) to the Data Buffer 27LS244 @ 5R pin 16.
10. Solder a LONG wire from the new socket @ 5S, pin 12. You are going to then take this wire up to a through hole in the PCB (see picture below) and then route this wire under capacitor leads to help guide the wire towards the ROM socket @ 1N/P… solder this wire neatly to pin 27 @ 1N/P.
11. Solder your 10K 1/8W resistor from 5S pin 12 (step above)… to 5S pin 16 (+5v).. this is simply a pullup resistor.

**Speech Upgrade steps:**

1. If you do not have a socket installed @ location 11N, install one now Photos:



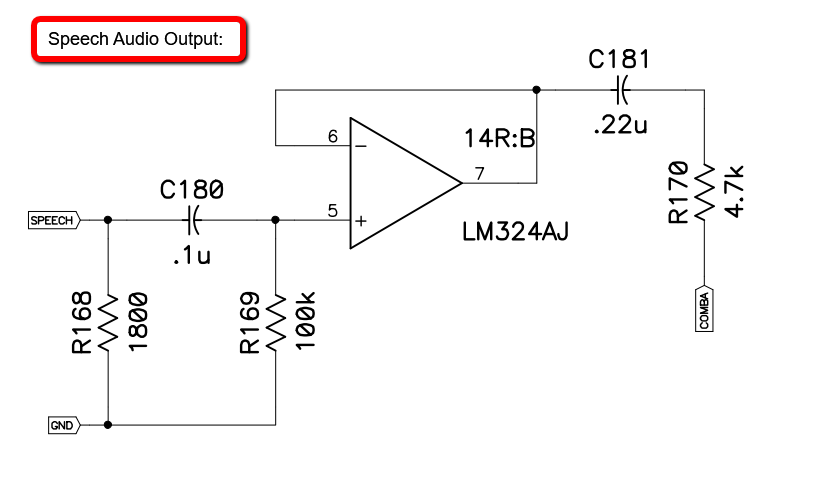
A circuit board

Description automatically generated

NOTE: 10K resistor not show here yet, photo coming soon.

Full size Images can be found here - <https://github.com/jessaskey/mhavocpe/tree/master/Conversion/Photos>

Speech Circuit – Blatantly borrowed from Mark Spaeth



IF YOU HAVE PREVIOUSLY MODDED YOUR PCB:

To revert, you don’t need to uninstall all the devices, just a few. You need to do the following…

1. Remove the additional 28-pin socket and jumper wire for the ROM @ 9S. This is going back to a 27128 now and requires no modification.
2. Remove the 7905 3-Pin Regulator
3. Remove the 14-Pin 74HC04
4. REPAIR the trace that was cut coming off of pin 10 of 11N. It should now run fully out towards the edge of the PCB and up towards the POKEY on the solder side.

Document History:

* Draft 1.10 – 8/11/2021 – Added resistor to Alpha mod and fixed a couple typos.
* Draft 1.9 – 4/16/2021 – Updated GAMMA mods after switching to ADPCM speech.
* Draft 1.8 – 2/22/2021 – Added more detailed steps for TMS5220 speech circuit modifications.
* Draft 1.7 – 2/12/2020 – Fixed annotation typos on PCB Solder Side, started adding pictures and better documentation for Speech Section.
* Draft 1.6 – 5/12/2018 – Added Speech Schematics from Mark Spaeth.
* Draft 1.5 - 5/2/2018 – Added notes on EPROM sizes required.
* Draft 1.4 - 5/1/2018 – Fixed mis-labeled location 5R with correction location 5S.
* Draft 1.3 - 4/19/2018 – Added text on photos
* Draft 1.2 – 4/15/2018 – Added photos
* Draft 1.1 – 2/12/2018 – Rewrites of descriptions
* Draft 1.0 – 1/15/2018 – Initial draft