I decided after finding 2 NES's at garage sale to modify the heck out of one. If I fried it I had 2 more, the one I've had since the 4th grade, and the other one I got at the garage sale. So, I had an expendable NES to play with. I did some reading online and one of the topics that peaked my interest was the differences between the NES and Japanese Famicom systems. Software wise these machines are nearly Identical, however there are slight hardware changes. The difference that got my attention was the fact that the Famicom has two pins on its 60-pin connector, audio in and audio out, which do not exist on the cartridge connector of a 72-Pin NES machine and were used for enhanced audio in some games as well as audio for the Famicom disk system. However, two pins labeled audio in and audio out do exist

on the US system's expansion port which was very rarely ever used. If this experiment would prove successful I would be able to route the enhanced audio from these certain famicom cartridges through my NES. This would not only mean modifying my NES, but also my 72-60 pin adapter. I have an adapter I purchased off E-bay many years ago. I know it functions because I have a Japanese copy of Donkey Kong. However, Donkey Kong does not include enhanced audio. I acquired a copy of Akumajou Densetsu to test my experiment.

This is the Japanese version of Castlevania 3. The music is noticeably enhanced from the US version. I will now cover the steps I've taken to determine the nature of the "audio in" pin on the expansion port.

In order to determine the correct pins for audio enhancement on the expansion port I referred to the diagram at http://nesdev.parodius.com/. The Diagram is pictured. I determined that Pin 3 was the audio in pin and therefore the enhanced audio coming from the famicom cart should be routed to this pin. The pins on the famicom cart, which are labeled in the photo with a red line, and a yellow line are the audio in and out pins. As you can see in the picture of the adapter the green lines aren't connected to anything.

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+--------------+
|expansion port|
+--------------+

          _______
        |*      \
VCC   >01]        [48<  VCC
VEE   >02]        [47<  VEE
AIN   >03]        [46]  --
/NMI   [04]        [45>  C.2
CA15   <05]        [44>  C.1
(51)   [06]        [43>  C.0
(52)   [07]        [42]  (16)
(53)   [08]        [41]  (17)
(54)   [09]        [40]  (18)
(55)   [10]        [39]  (19)
/C2R   <11]        [38]  (20)
C1.1   >12]  EXP.  [37>  /C1R
C1.3   >13]  PORT  [36>  C1.4
/IRQ   [14]        [35>  C1.0
C2.2   >15]        [34>  /C1R
C2.3   >16]        [33>  C1.2
/C2R   <17]        [32]  D0
C2.4   >18]        [31]  D1
C2.0   >19]        [30]  D2
C2.1   >20]        [29]  D3
VOUT   <21]        [28]  D4
AOUT   <22]        [27]  D5
VDD   <23]        [26]  D6
4MHZ   <24]        [25]  D7
        |_______/
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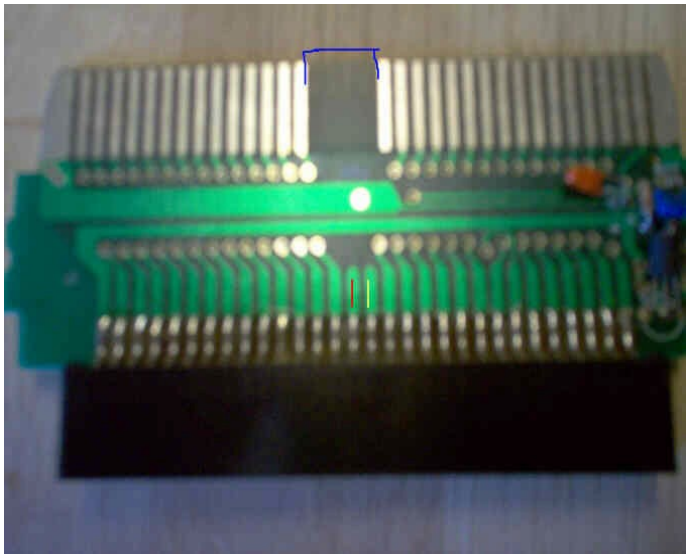
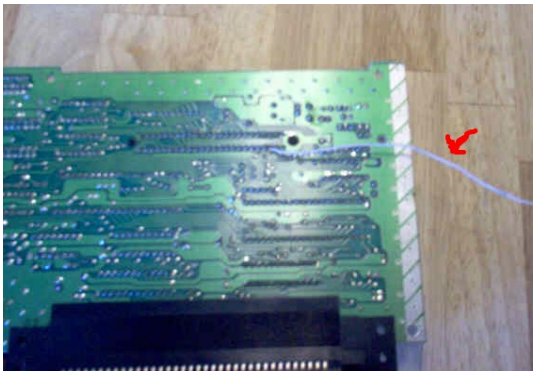


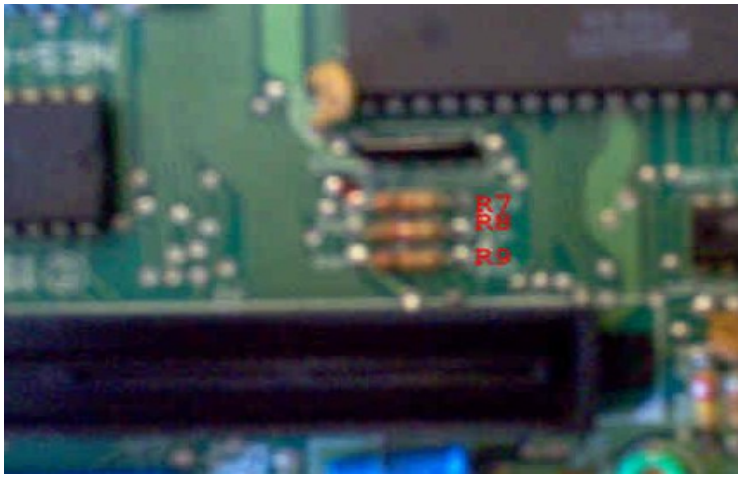
On the expansion port pins 6 - 10 and 38 - 42 connect directly to the cartridge slot. This is part of the reason why there are 72 pins on an American cart. My first instinct was to jumper the two audio pins in the cartridge adapter to these expansion port pins and then jumper those pins to pin 3 and 22 (audio out) on the expansion port. However, if you'll notice the missing pins on the adapter marked with a blue bracket you'll see why this proved impossible. The missing pins are the pins that connect to the expansion port. I looked in to purchasing another adapter with these pins intact but I didn't like the price. So, because they didn't bother to include the unused pins on my current adapter I decided to use a wire and connector.

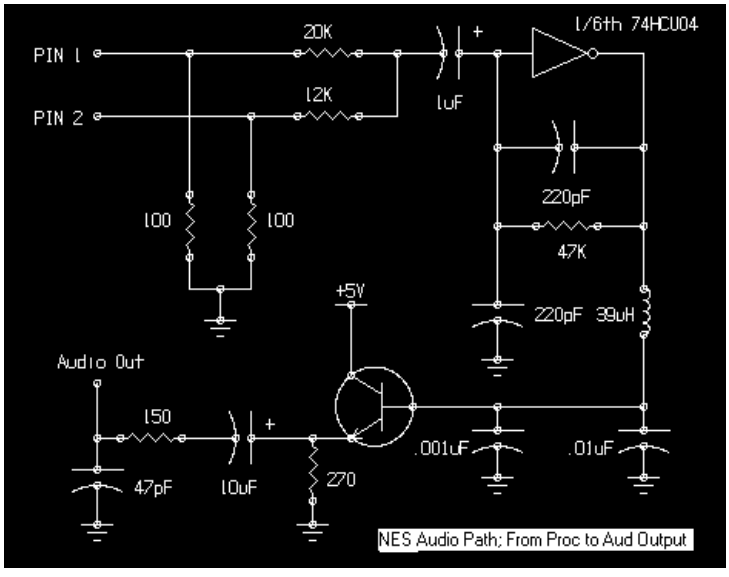
In order to discover the nature of the "audio in" pin I decided to attempt to input an analog audio signal

to this pin to see if it would mix with the NES audio.

In order to input an analog audio signal in to this pin a soldered a wire to pin 3. The wire I used was the copper wiring out of a cat5 cable. I find that cat5 cable is very versatile. You can see the wire in the picture labeled with a red arrow. But I had to find an audio source to experiment with and a way to bridge the gap. I decided to use a scrap of wire that has an earphone plug on one end. That way my audio source could be one that outputs audio via a headphone jack. I connected this wire to the copper wire I soldered to the board with an alligator clip wire. I then of course grounded the wire to the edge. The sound source I elected to use was my Nintendo DS. It was what was handy, and it has an earphone plug. With everything attached I fired up the NES with Super Mario Brothers inserted. I turned on the DS and didn't hear anything. I decided to turn the DS all the way up. Still nothing. Then I turned the TV all the way up. Bingo! I could hear the sound coming from the DS very faintly. For some reason the sound was mixing, but was too faint to hear. I then removed the metal shield from the expansion port to see the board better and traced pin 3 to where it lead. My discoveries? It lead directly to a resistor. Matter of a fact, it lead directly in to a resistor which, along with two other resistors, mixed all the NES audio in to one mono output. These resistors are labeled R7, R8 and R9. R9 is the resistor that connects to pin 3 on the expansion port. Pins R7 and R8 connect directly to pins 1 and 2 of the CPU which output the normal NES audio. At this point all 3 audio lines converge and are mixed to one mono audio line. So this confirmed that pin 3 on the expansion port was just an analog input that mixed directly with the NES audio, but why was it too muffled to hear? I decided to bypass R9 to see what would happen and to see if maybe it was dropping the signal too low. I could hear the DS just fine. But, it did not mix. It would just override the normal NES audio. Obviously this isn't what the designers had intended. And obviously the normal NES audio is audible without bypassing R7 and R8
when a licensed device is attached to the expansion port so something has to be different.



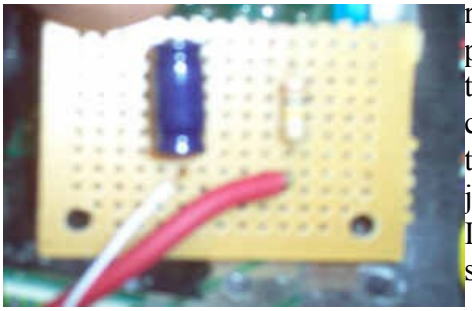




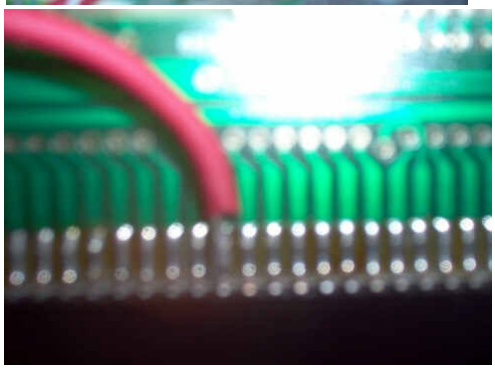
Note: On some board revisions R7 and R8 are inverted. They still do the same thing.

In order to investigate the difference in the normal analog NES input coming from the CPU and the external analog source, once again I referred to nes nesdev.parodius.com and found a diagram of the NES sound pathway. I discovered that the audio is connected directly to ground with two 100 ohm resistors.
In this diagram the 20k and 12k resistors on top are R7 and R8. R9 does not appear on the diagram, however you can see from the diagram that they all mix at this point. I decided my next experiment should be attempting to ground the DS audio output with a 100 ohm resistor just as the normal NES audio is. I connected the DS audio to ground through a 100 ohm resistor I happened to have and then to pin 3, then grounded the DS audio normally. Success! I could hear the DS audio and the normal NES audio perfectly.

All mixed together nicely. However, I wasn't convinced this was the best coarse of action for the game audio. I wanted to get the volume just right. So, I consulted the work of others on various forums as well as documentation to see how others had done it. I know, why didn't I just do that in the first place? Because this way was more fun! I discovered that the best results come from passing the audio through a 100k ohm resister and a 4.7 uF capacitor. I went to Radio Shack and bought the stuff. Along with the

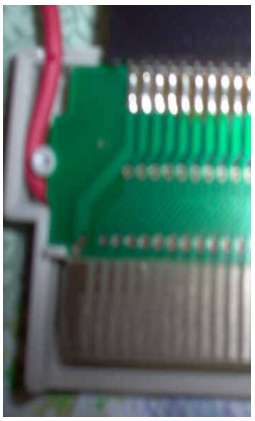


resistor and capacitor I also bought a 20 foot spool of red test probe wire, some banana plugs and a breadboard for soldering it all together. I soldered the capacitor and resistor to the breadboard and jumpered them together. I attached the wires as shown. The red test



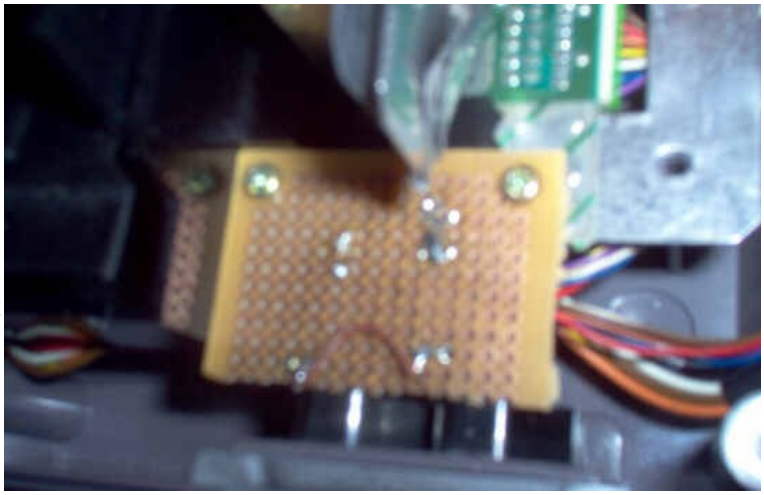
probe wire went to the new sound input port on the back. Pictured to the right is the internal and external views of the port I added to the back of the NES.
In addition to adding this port to the NES I also modified the 72-60 pin cartridge adapter with a piece

of red test probe wire. I soldered the wire to the audio pin on the 60 pin connector (Pictured above). It all fit together nicely as you can see.
On the other end of the wire I attached a banana plug suitable to plug in to the new audio in port on the back of the NES.

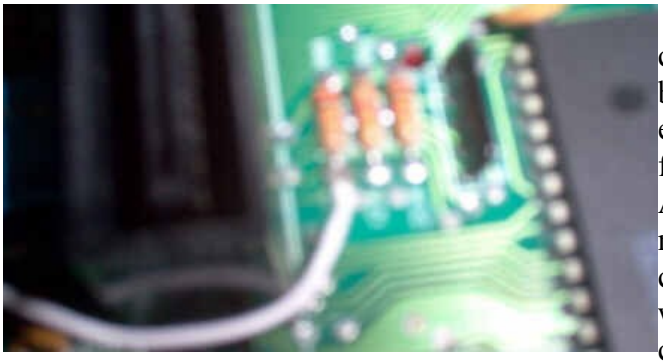


Now that all the soldering was finished I had to find a suitable place to mount this new little board that would be a permanent part of this NES.

I looked all inside and decided that right next to the cartridge chamber was a perfect spot. There were already two screws perfectly placed to screw it down with and it sat nicely on top of the controller ports. I had to bend the shielding back a bit to clear some room, but otherwise it fit fine. I put a bit of black tape under it just to be sure it didn't rub the main board. You can see in this picture my lovely sloppy soldering job!



The bit of copper wire out of the cat 5 cable got re-soldered directly to the resistor.



I wanted to make sure it had a good solid connection and wouldn't come off. I then put it all back together nice and snug just like I found it. All except for a few screws. I say as long as it doesn't fall apart there are plenty of screws.
After putting it back together I waited patiently for my copy of Akumajou Densetsu to arrive. When it came I was pleased to find that the modification was a complete success. The wire from the cartridge adapter comes out of the front and connects to the back but you'd never know that a portion of the music you were hearing was being sent through that red test probe wire. Just to hear the difference I unplugged the banana plug while the music was playing and just as I expected a portion of the music could not be heard. I put it back and the music was back. This verified that the mod was successful. Pictured here is the unit, complete with a new paint job and blue power LED. You can see the new audio cable coming out the front.

In addition to the sound mod I also disabled the lockout chip. All you have to do to disable it is to cut pin 4. I would have attached pin 4 to ground but I broke it off. It still works either way though.

So that's how I modified an American NES to play the enhanced audio from Japanese carts.

Here is a sloppy MS-Paint overview.