Building the HardMPU

Note: This guide assumes you already have soldering experience. While the HardMPU is not especially difficult to assemble, I suggest starting with something that does not go in your prized retro gaming computer as a first project.

Step 1: Inventory
Check that have the following items:
- 1x HardMPU Circuit Board
- 1x 9-pin male D-sub connector
- 1x 9-pin female D-sub board mount connector
- 1x D-sub backshell
- 1x MIDI cable
- 1x mounting bracket
- 1x Atmega1284 or 1284P microcontroller
- 1x 74LS240 chip
- 1x 74LS08 chip
- 2x 74LS74 chips
- 2x 74LS138 chips
- 2x 74LS374 chips
- 1x 6N136 chip
- 1x ½-amp fuse
- 1x 33uF tantalum capacitor
- 11x .1uF capacitors
- 2x 18pF capacitors
- 1x 3.3k ohm resistor (orange, orange, red bands)
- 3x 220 ohm resistors (red, red, brown)
- 3x 4.7k ohm resistors (yellow, violet, red)
- 1x 220k ohm resistors (red, red, yellow)
- 1x 1N4148 diode
- 1x 20MHz crystal
- 1x 6-pin header
- 1x 8-pin header
- 2x 10-pin headers
- 1x 12-pin header
- 2x jumpers
- 1x 8-pin DIP socket
- 3x 14-pin DIP socket
- 2x 16-pin DIP socket
- 3x 20-pin DIP socket
- 1x 40-pin DIP socket

Step 2: Check the board
The circuit board should be free of deep scratches. Check it carefully before assembling as it is easier to see issues now.

Step 3: Solder in the 1N4148 diode at position D1
Line up the band on the diode with the band on the board footprint.
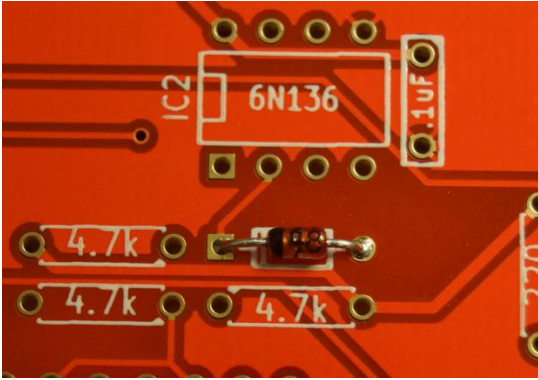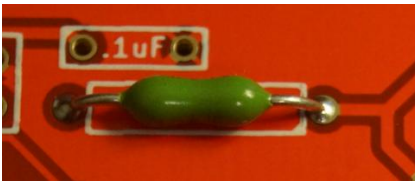

Check your soldering. The solder joints should be shiny and well adhered to the pad on the circuit board.

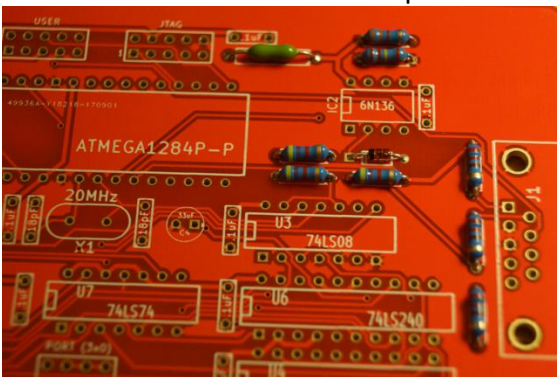Cut the lead flush with the top of the solder joint using side cutters.

Step 4: Solder in the fuse at position F1
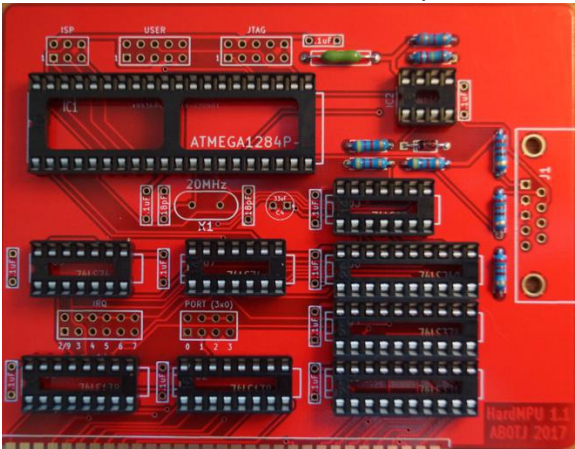Direction does not matter.

Step 5: Solder in the resistors
The value is marked in the footprint on the board. The direction of the resistors does not matter.

Step 6: Solder in the chip sockets
- Check that the notch in the socket is lined up with the notch in the board footprint before soldering.
- I like to solder one leg of the socket, and then push on the socket while reheating the solder to make sure the socket is flush with the board. Then solder the remaining pins.
- Sockets are optional, you can solder the chips directly to the board. This makes a more reliable connection but makes repairs more difficult.


Step 7: Solder in the crystal
Direction does not matter here either.
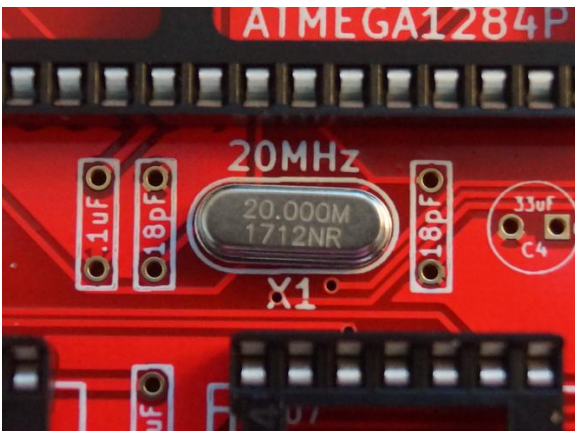
Step 8: Solder in the capacitors.
- The value is marked in the board footprints.
- You may have received 18pF capacitors with a different lead spacing than what is on the board. This is not a problem, just do not insert the capacitor too far or it will break. See picture below.
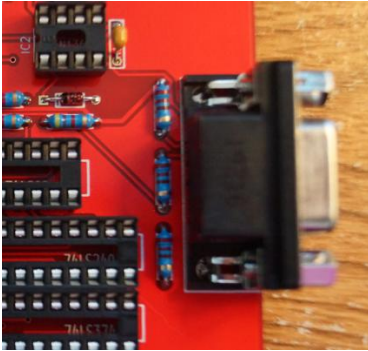- The long leg of the 33uF tantalum capacitor goes in the square pad on the board.

Positive Lead
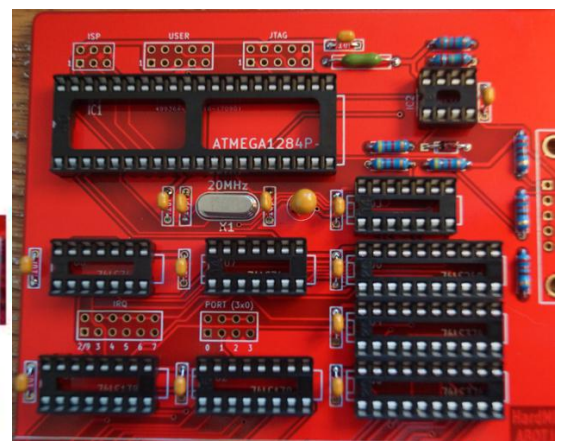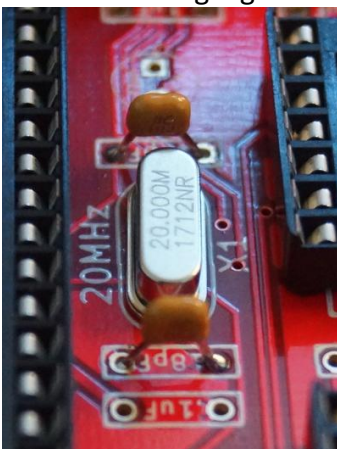
Step 9: Solder in the pin headers
The same trick with soldering one pin first (like the sockets) applies here too.
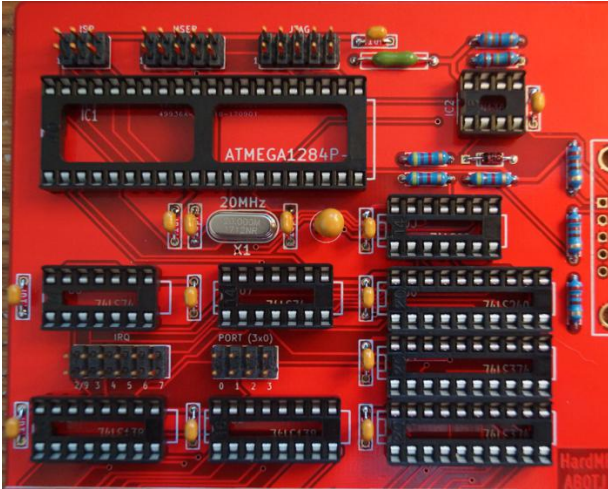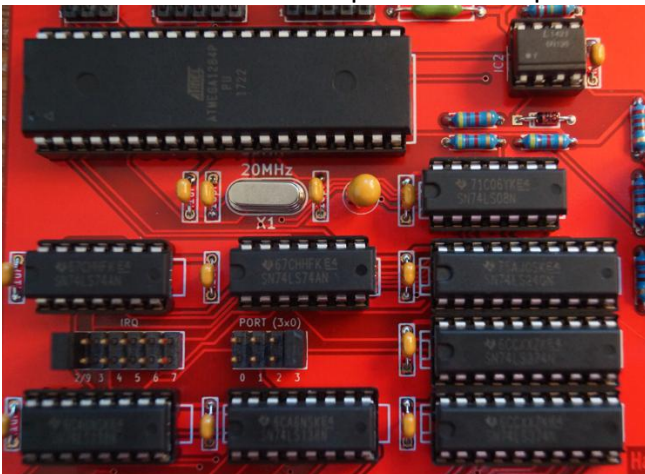
Step 10: Solder in the DE9 connector

Step 11: Insert the chips into the sockets (if you are using sockets)
Be sure to align the notch in the chip with the notch in the socket. The 6N136 has a dot instead of a notch.
Be careful to not bend the pins of the chips.

Step 12: Set the IRQ and Port jumpers
The standard setup is IRQ 2/9 and Port 330.

Step 13: Attach the mounting bracket

Remove the screws from the DE9 connector, then thread them back in through the mounting bracket. Do not over tighten the screws, but make them tight enough that they won't come out when a connector is threaded into them later.
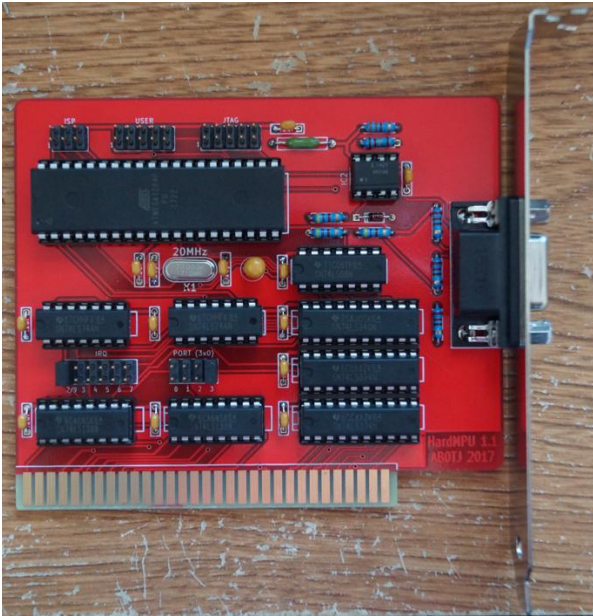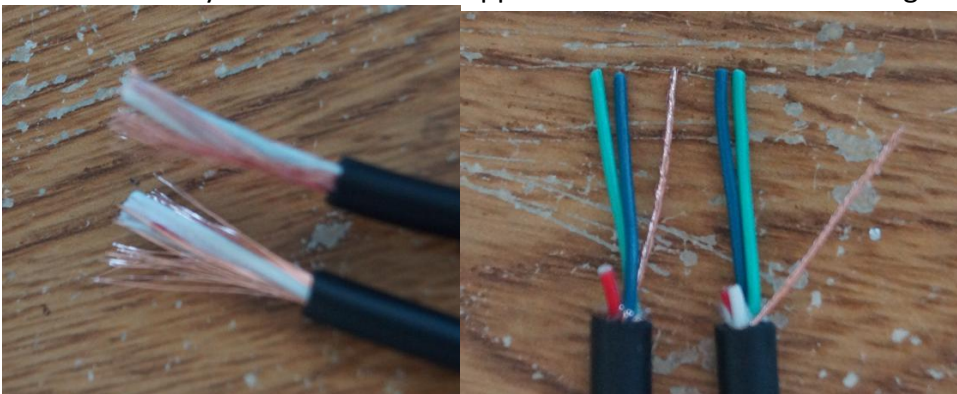

Step 14: Cut the MIDI cable in half.

Now we're going to build the MIDI cable. Cut it in half to make two cables, label one IN and one OUT.
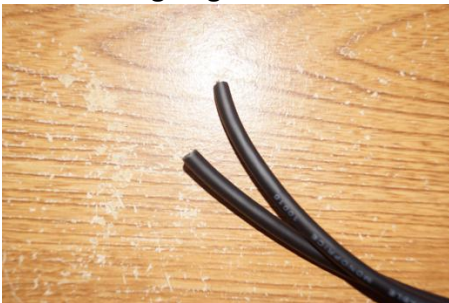
Step 15: Prepare the ends of the MIDI cable

- Strip about 1 inch (25mm) of the outer jacket from each cable
- Cut the red and white wires near the outer insulation. We won't need them.
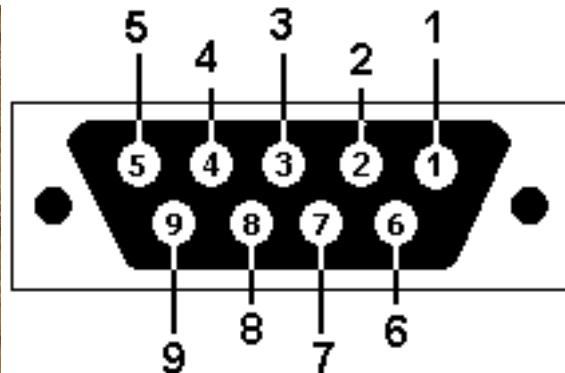- Cut away about half of the copper insulation. Twist the rest together.

Step 16: Get ready to attach the DE9 connector.
- Twist the copper shields of the two cables together and tin them.
- Strip about 1mm of the green and blue wires and tin the ends.

Step 17: Solder the wires to the DE9 connector
Pin 1 - Out Green
Pin 2 - Shield
Pin 5 - In Green
Pin 6 - Out Blue
Pin 9 - In Blue

(rear of connector)

Step 18: Put the connector in the backshell
The size of the wire is sufficient for strain relief. The included strain relief tabs are not needed.

Step 19: Enjoy!
Your HardMPU is now ready to be installed in your computer. Here are some tips.
- Disable or change the port of MPU401 functionality on any soundcards installed in your system. They will conflict with the HardMPU.

- Grab the configuration utility from https://github.com/ab0tj/HardMPU/blob/master/bin/hardmpu.com - it is not required for use but it can be used to activate the special functions such as Sysex Delay. Run the utility with the -? command line switch for usage info.
- The MIDI cable marked OUT designates out from the computer, so this plugs into the MIDI IN port of your MIDI device, and vice-versa.
- Hack the HardMPU! The USER port on the board has a lot of potential for interesting uses, and there is plenty of space in the microcontroller for new firmware features. A couple of jumpers on the USER port can also be used to route the second UART interface of the microcontroller to the DE9 connector. See the schematics and firmware at http://github.com/ab0tj/HardMPU for more information.