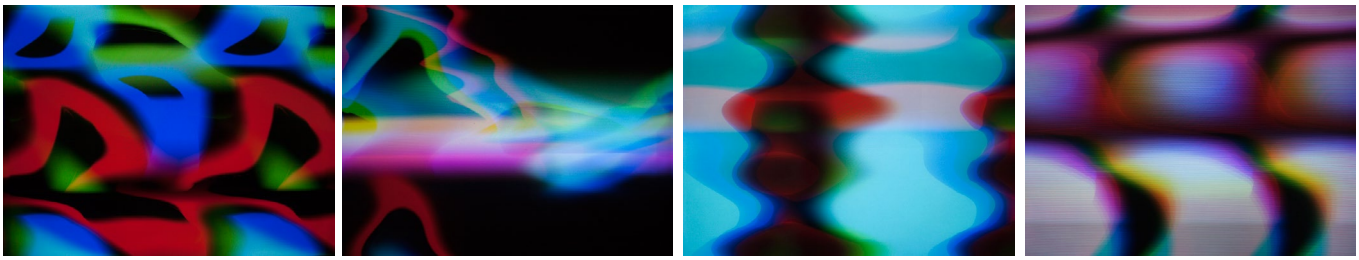
RGB.VGA.VOLT TUTORIAL 1: HACKING A VGA CABLE TO BEND STEREO AUDIO INTO SHORTED VIDEO

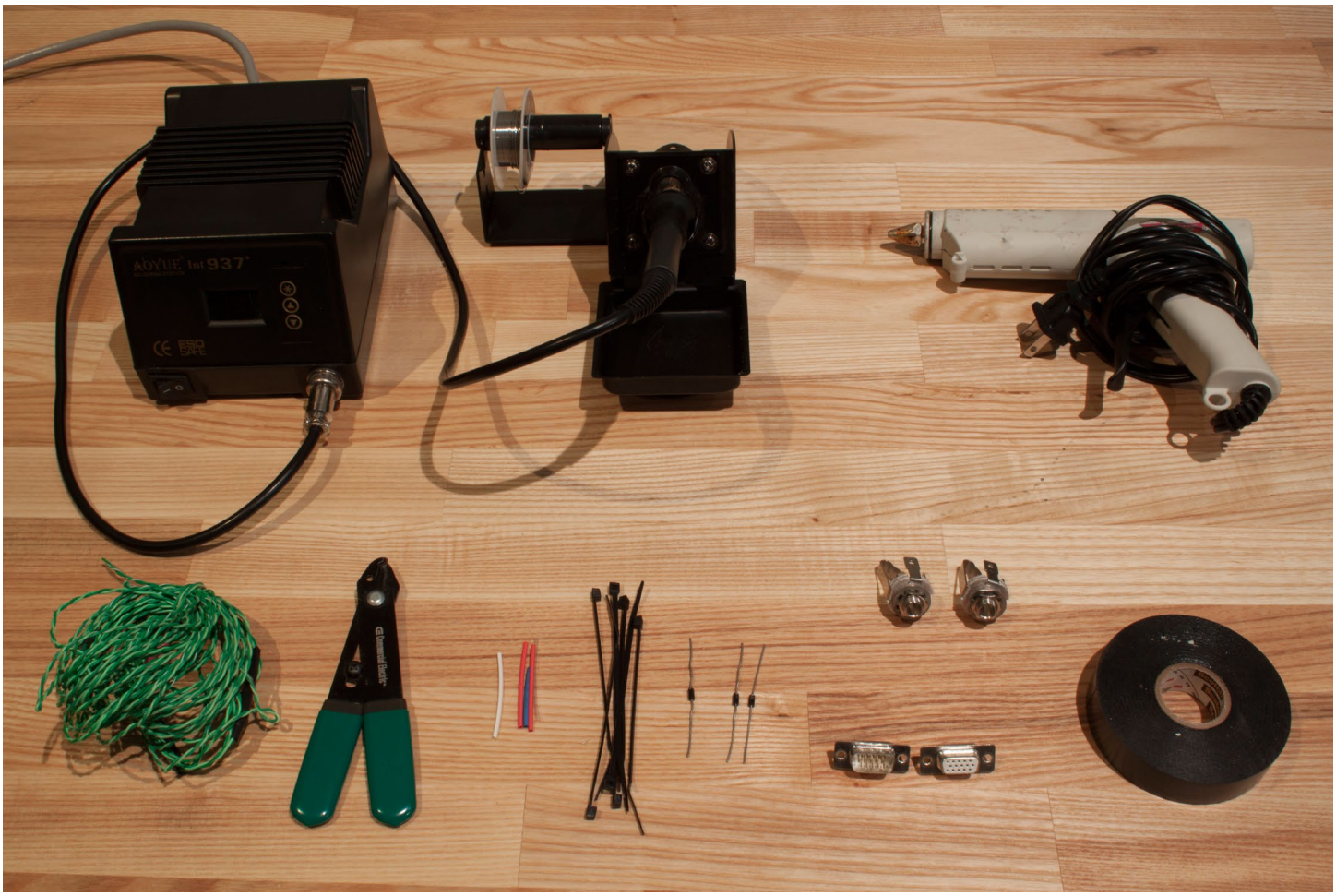


SUPPLIES NEEDED:

- A soldering iron and solder
- Wire clippers/strippers
- Electrical tape
- Stranded wire (22 gauge or smaller is easiest to solder)
- Male 15 pin 3-row d-sub connector
- Female 15 3-row d-sub connector
- Three diodes
- Two 1/4” audio jacks with solder terminals

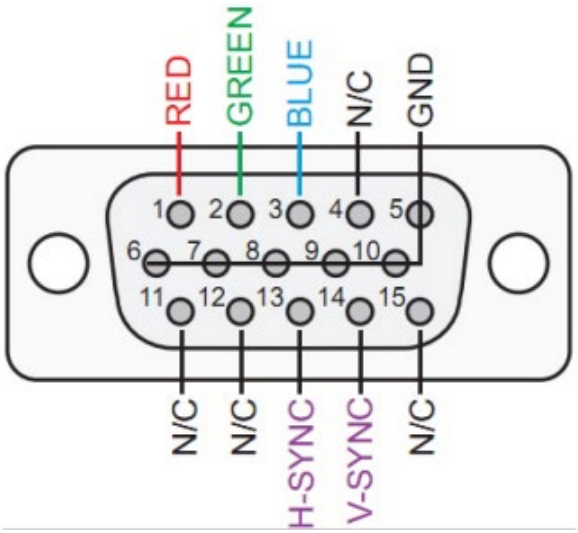
OPTIONAL SUPPLIES:

- Small heatshrink tubing (not much bigger than the wire you’re using)
- Hot glue gun and glue
- Several small zip ties



UNDERSTANDING A VGA CABLE

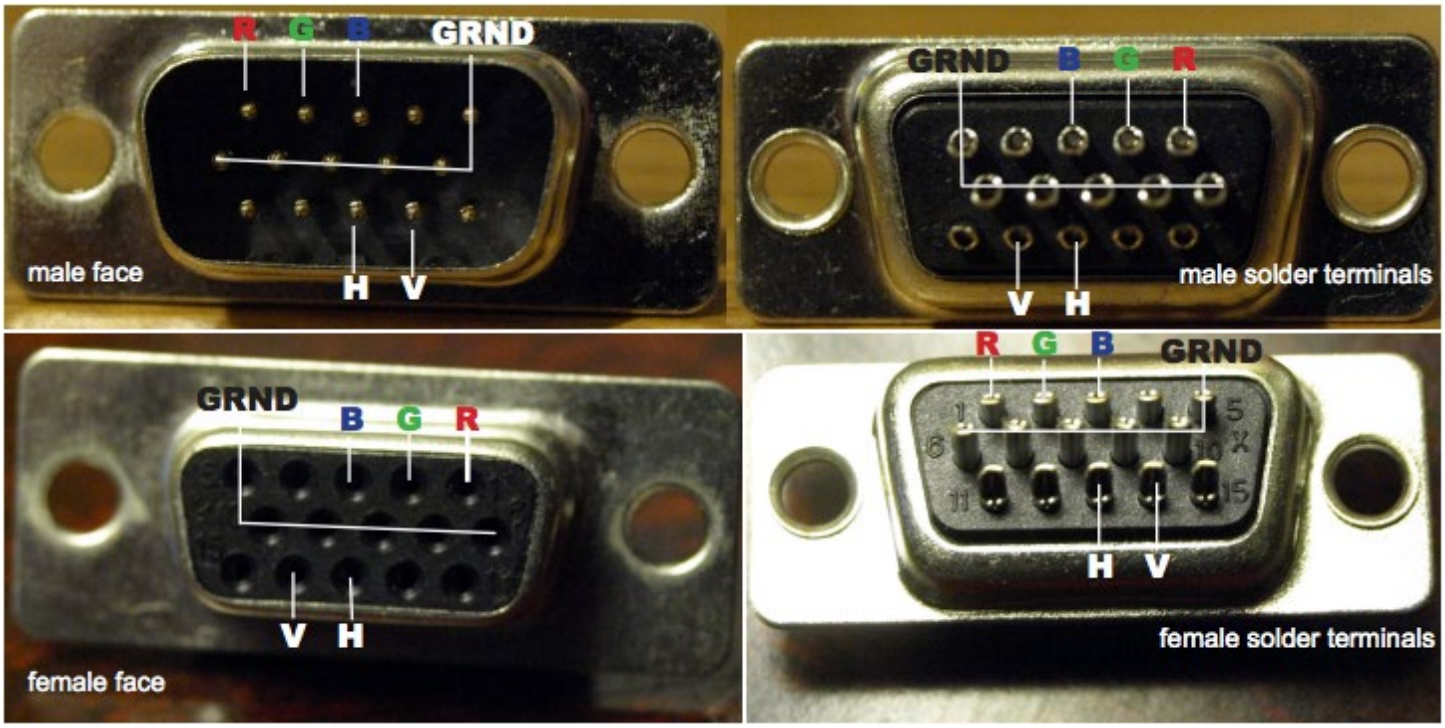
A cathode ray tube (CRT) computer monitor receives a video signal through a video graphics array (VGA) cable. VGA cables have adapters at either end with 15 pins (3 rows of 5) that send discrete (and, therefore, hackable) **RGBHV** (**R**ED, **G**REEN, **B**LUE, **H**ORIZONTAL-SYNC, AND **V**ERTICAL SYNC) analog signals.



PIN 1:	RED
PIN 2:	GREEN
PIN 3:	BLUE
PIN 4:	-
PIN 5:	GROUND
PIN 6:	RED GROUND
PIN 7:	GREEN GROUND
PIN 8:	BLUE GROUND
PIN 9:	-
PIN 10:	SYNC GROUND
PIN 11:	-
PIN 12:	-
PIN 13:	HORIZONTAL-SYNC
PIN 14:	VERTICAL SYNC
PIN 15:	-

The VGA pin-out graphic above and its corresponding table show the function of each of the cable's 15 pins. This hack requires connecting the red, green, and blue video pins (pins 1-3) that drive their corresponding ray guns inside of the monitor, the ground signal (pins 5-8 and 10), the horizontal sync (pin 13), and the vertical sync (pin 14).

Note: For this hack, I use one male d-sub connector (a connector with pins) and one female D-sub connector (a connector with holes for those pins) so that the DIY cable acts as an extension cable for the manufactured/commercial VGA cable used to connect to a monitor or distribution amplifier. D-sub connectors with soldering terminals are labeled with small numbers to ensure that you're soldering to the proper pins. They're also organized so that the center row is offset from the top and bottom rows, forming a sort of arrow. Soldering them can become confusing, as the male and female connectors are mirror images of one another (male connectors are numbered from left to right; female from right to left) and the solder terminals of each



THE HACK

1. SOLDERING THE D-SUB CONNECTORS

This part of the hack creates a DIY VGA cable. It requires soldering several wires into pins with very small soldering terminals which can be difficult for beginner solderers. Remember to use as little solder as possible, and to place the solder on one area the wire/pin while the soldering iron heats up a separate area, making sure that the solder melts into the pin/wire rather than globbing up on the iron.

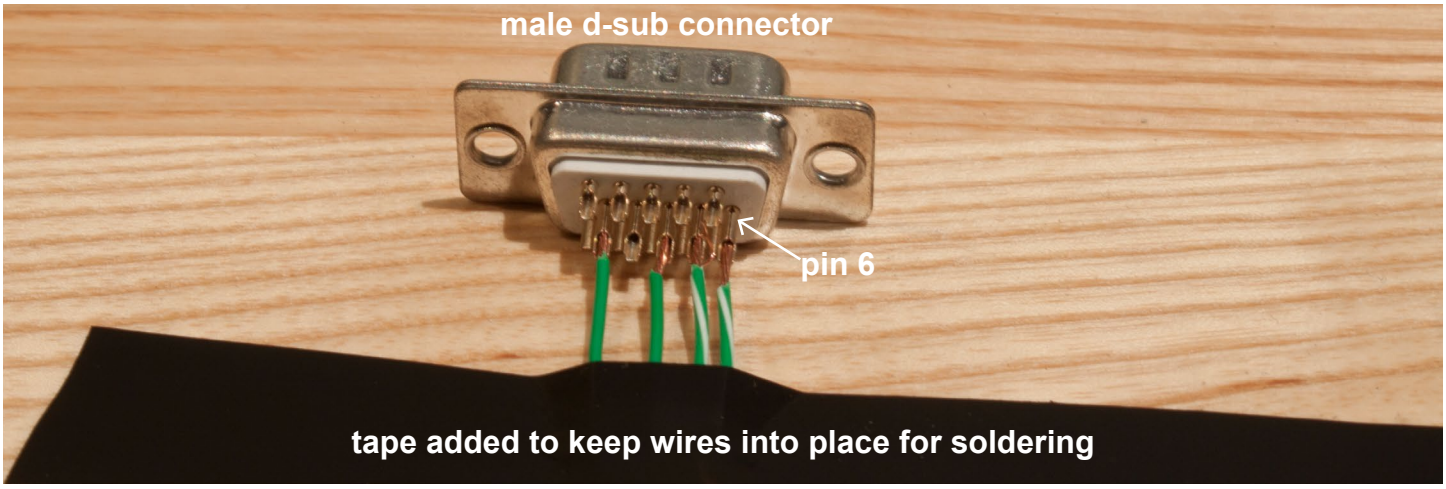
1.1 PREPARING

1. Cut 10 pieces of wire the exact same size. I recommend 8-12 inches (20-25 centimeters) in length.
2. Cut three of these wires in half two form six wires half the lengh of the rest.
3. Strip the edges of all wires about 1/8- 1/4 of an inch (3-6 millimeters) on both sides for the longer wires, and on one side for the shorter wires. On the other edge of the shorter wires, strip about 1/2 to 1 inch (1 - 3 centimeters) off.

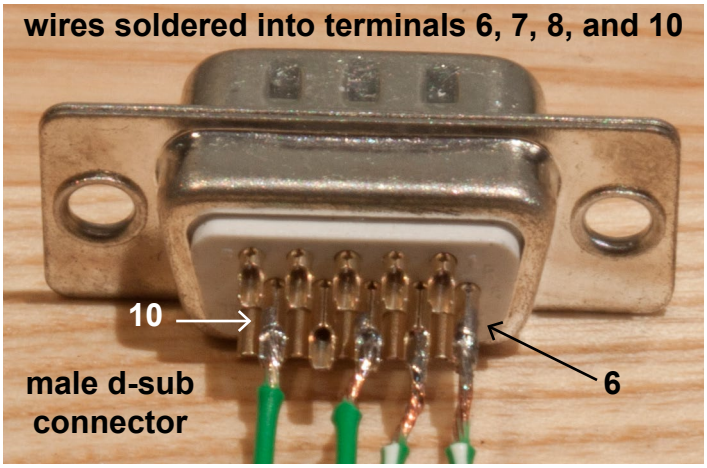
7 long cables with 1/4” stripped on either end
6 short cables with with 1” stripped on one end and 1/4” on the other

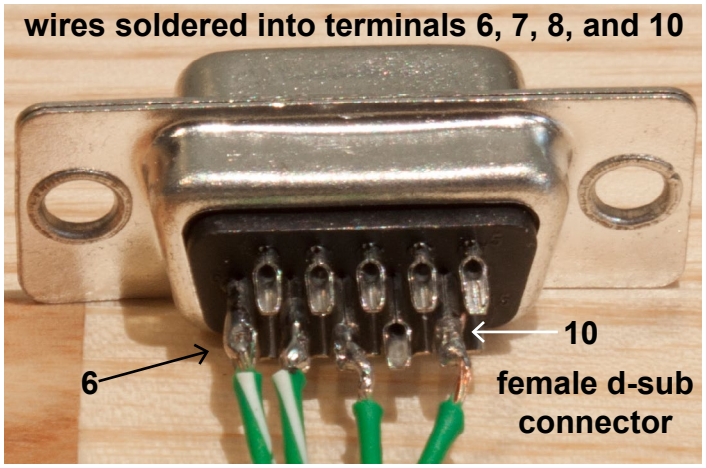
1.2 SOLDERING THE CENTER ROW (PINS 6-8 AND 10)

1. Place the male or female D-sub connector so that the center row’s solder terminals are facing up.
2. Place four of the long cables into the solder terminals for pins 6, 7, 8, and 10 (the solder terminals read from right-to-left on male d-sub connectore and left to right on female d-sub connectors; pin 6 is easy to locate because it extende beyond pins 1 and 11 which are aligned to be directly in line with one another. **NOTE:** you may need to trim some of the wire’s strands in order to succesfully fit the wire into the terminal.
3. Tape the wires into place with electrical tape.



4. Place a small amount of solder onto your soldering iron. Make contact with the tip of the gun where the solder was applied to an exposed area of the wire, avoiding the plastic of course.
5. Place the solder onto the part of the wire that is touching the solder terminal, and hold it there until the gun heats the wire and terminal enough to melt the solder into them both, bonding the two together.

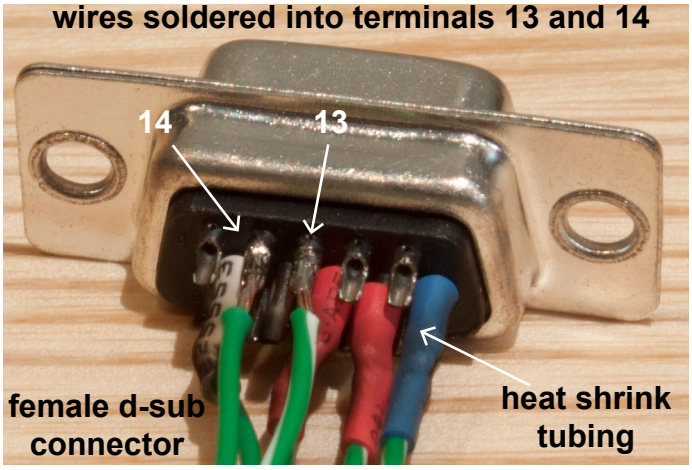




6. If you are using heat shrink wrap, add two pieces of it long enough to cover the solder terminal and exposed wire to each wire before moving on. Heat the tubes with a lighter or hot air gun once all termals and wires for the middle row of each connector have been soldered.
7. Once the first connector is finished, fit the wires *into their corresponding holes* in the other connector, being sure to place each cable in its corresponding pin. Unless you bought two different d-sub connectors, this should be a perfect mirror image. Refer to the diagram above and the numbers on each connector to ensure this is done properly.

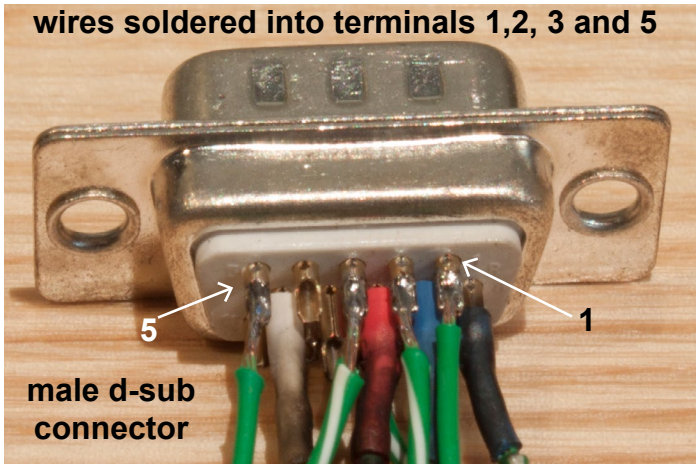
1.3 SOLDERING THE BOTTOM ROW (PINS 13 AND 14)

1. Following the same steps as 1.2 above, solder the remaining 2 long wires to terminals 13 and 14 on both d-sub connectors. Note that the bottom row's solder terminals have openings on the opposite side of those of the middle row, i.e. they face *down*.



1.4 SOLDERING THE TOP ROW (PINS 1-3 and 5)

1. Solder both ends of the final remaining long wire to the number 5 terminal of both the male and female d-sub connectors as described in 1.2.
2. Solder the shorter end of the 6 shorter wires to terminals 1-3 of the male and female d-sub connectors.

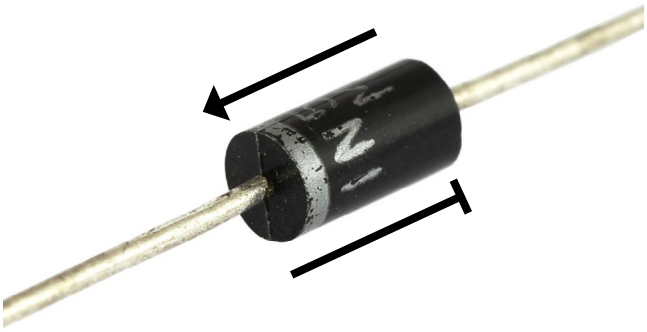


2. ADDING THE DIODES AND CONNECTING WIRES THE RED, GREEN, AND BLUE

UNDERSTANDING A DIODE

Diodes allow an electric current to flow in one direction while blocking it from flowing in the opposite direction. They are used in this hack because the computer you're stabilizing your VGA signal with (and other devices you might be using in your setup) may interpret the audio sent into the color pins as erratic signal behavior, shutting off or going to a "no signal" screen. It's therefore important to ensure that the diode is facing the proper direction, with its *forward* direction in which current is allowed to flow toward the VGA monitor or distribution amplifier, and its *reverse* direction in which current is blocked from flowing toward your computer. Because we're dealing with an audio and video signal rather than a higher current flow than something like a power supply, a rectifier diode isn't necessary but would still work.

A diode has an anode and cathode in the center of two solder terminals. The cathode, whch blocks current flow from reversing, is marked with a white or gray stripe, and reveals the direction in which current is allowed to flow (it flows in the direction of the side that the stripe is on, and does not flow in the opposite direction):



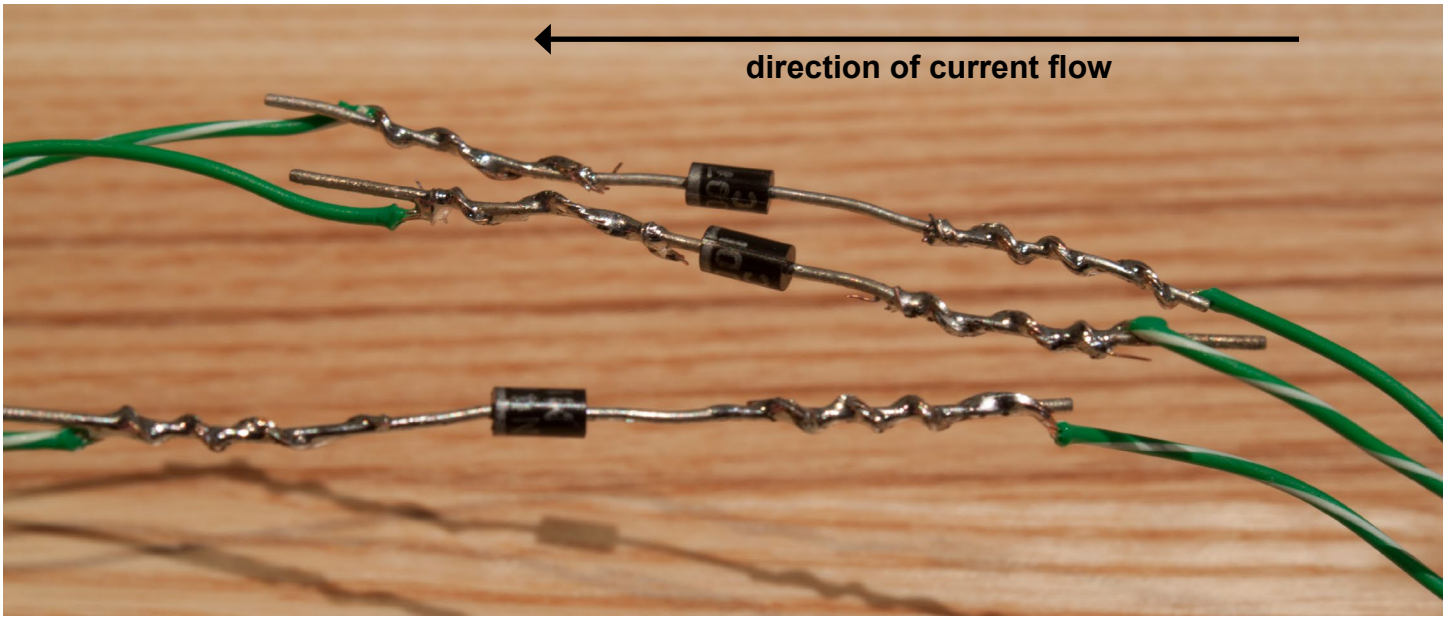
The electronic symbol for a diode, showing the direction of signal flow

The look of an actual diode, with signal flow in the same direction as above

In this hack, diodes will be placed between each of the wires the red, green, and blue pins of the d-sub connectors.

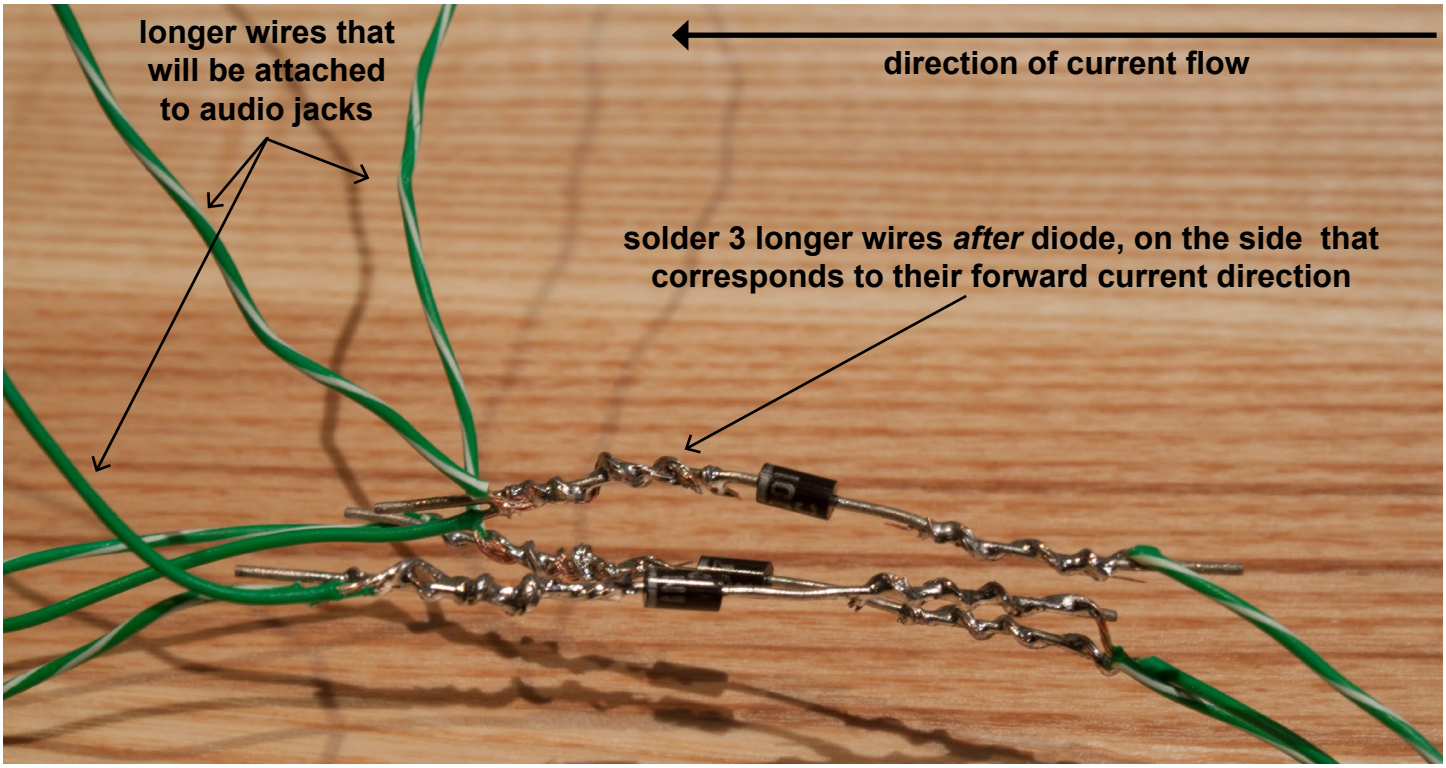
2.1 PINPOINTING THE PROPER CURRENT DIRECTION

1. Keeping in mind that the point of the diode is to ensure that no audio current flow back into your computer, check whether the dongle that outputs your computer's VGA signal is male or female. **Most often a computer's VGA cable will output via a female VGA connector.** Set the diode up so that its *forward* direction reflects this (if your computer outputs via a female connector, put the cathode/striped side of the diode toward the female connector so that current continues to flow in this direction).
2. Once you know the proper direction, use them to connect the wires attached to the red, green, and blue solder terminals of the male and female d-sub connectors by wrapping the longer stripped wire around the diode's solder terminal.
3. Once the wires are properly wound together, apply a generous amount of solder.



2.2 WIRING THE AUDIO JACKS TO THE RED, GREEN, AND BLUE PINS

1. Cut three more wires 8-12 inches (20-25 centimeters) in length.
2. Strip an inch off of both sides of all three wires.
3. Wrap one of those two sides to the soldered diode and wire on the side with the gray or white stripe (i.e. the forward direction side),
4. Once the wires are properly wound together, apply a generous amount of solder.



5. Cover the exposed wire and the diode completely with electrical tape.

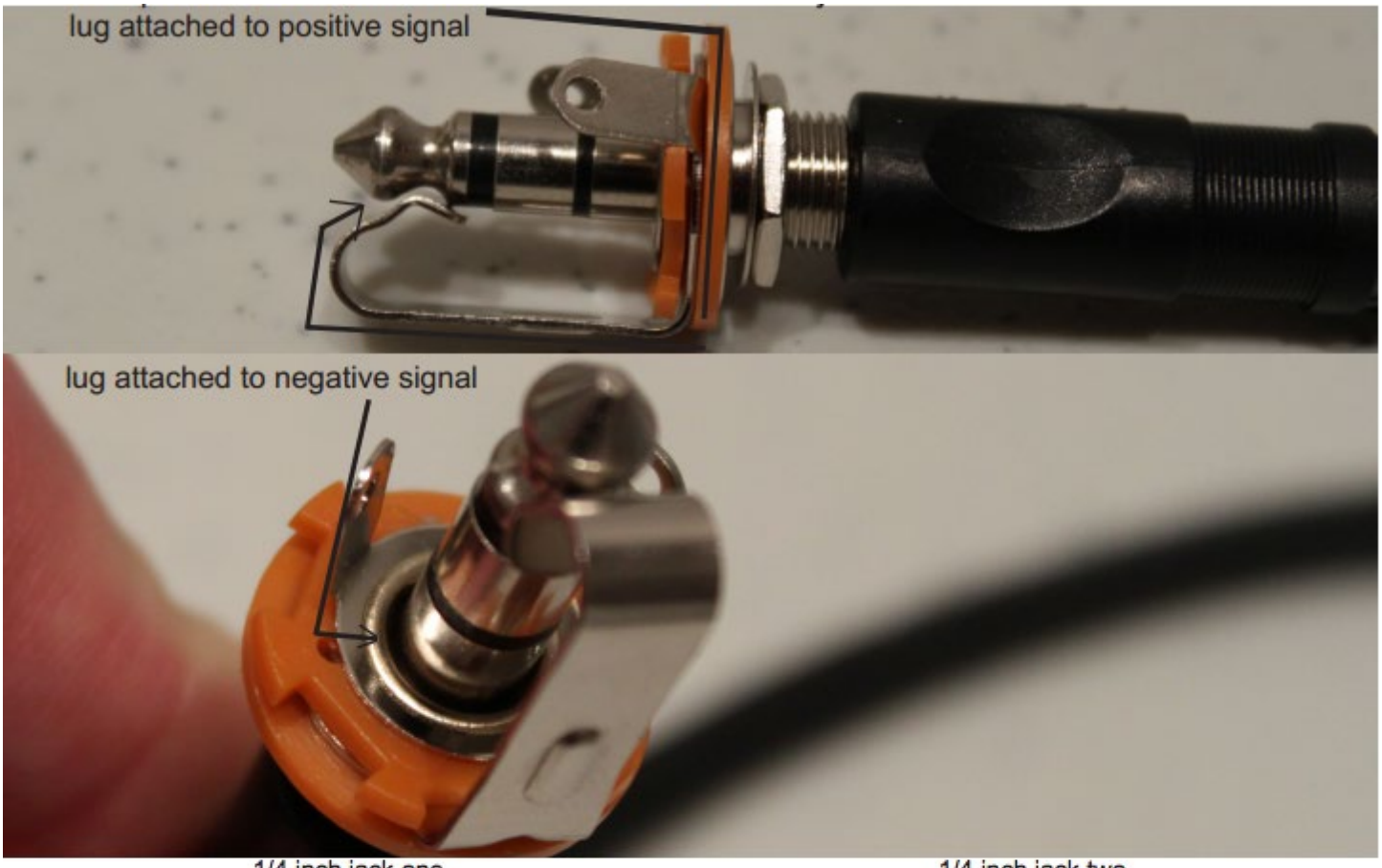
3. CONNECTING THE RED, GREEN, AND BLUE PINS TO AUDIO JACKS

UNDERSTANDING AN AUDIO JACK

-Mono 1/4 inch jacks make contact with the audio adapter at two points, one being the positive connection and the other the negative. Both points of contact have their own solder lugs.

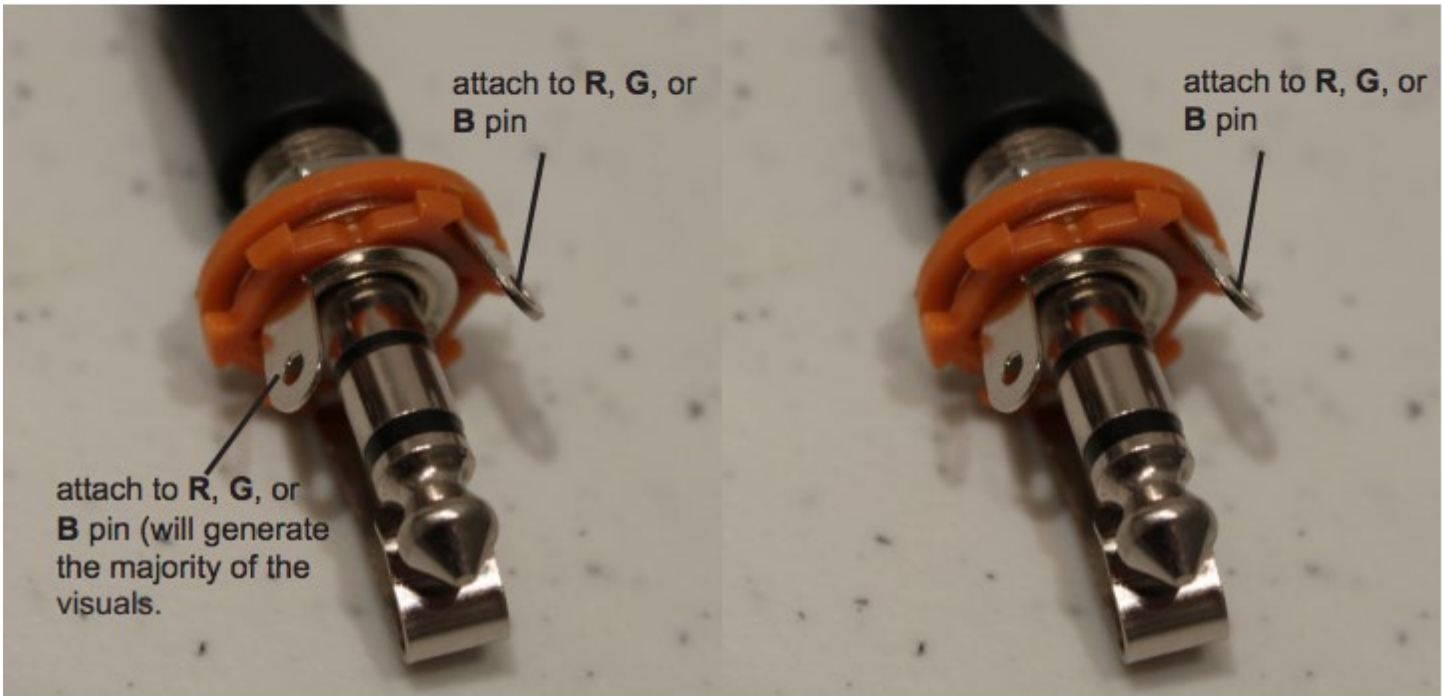
-The lug making contact with the tip of the adapter is the positive signal. The positive lug on one jack will be attached to 2 color pins.

-The lug making contact with the base of the adapter is the negative signal. This lug on one of the jacks will be connected to the one of the color pins and will form the majority of the visuals.



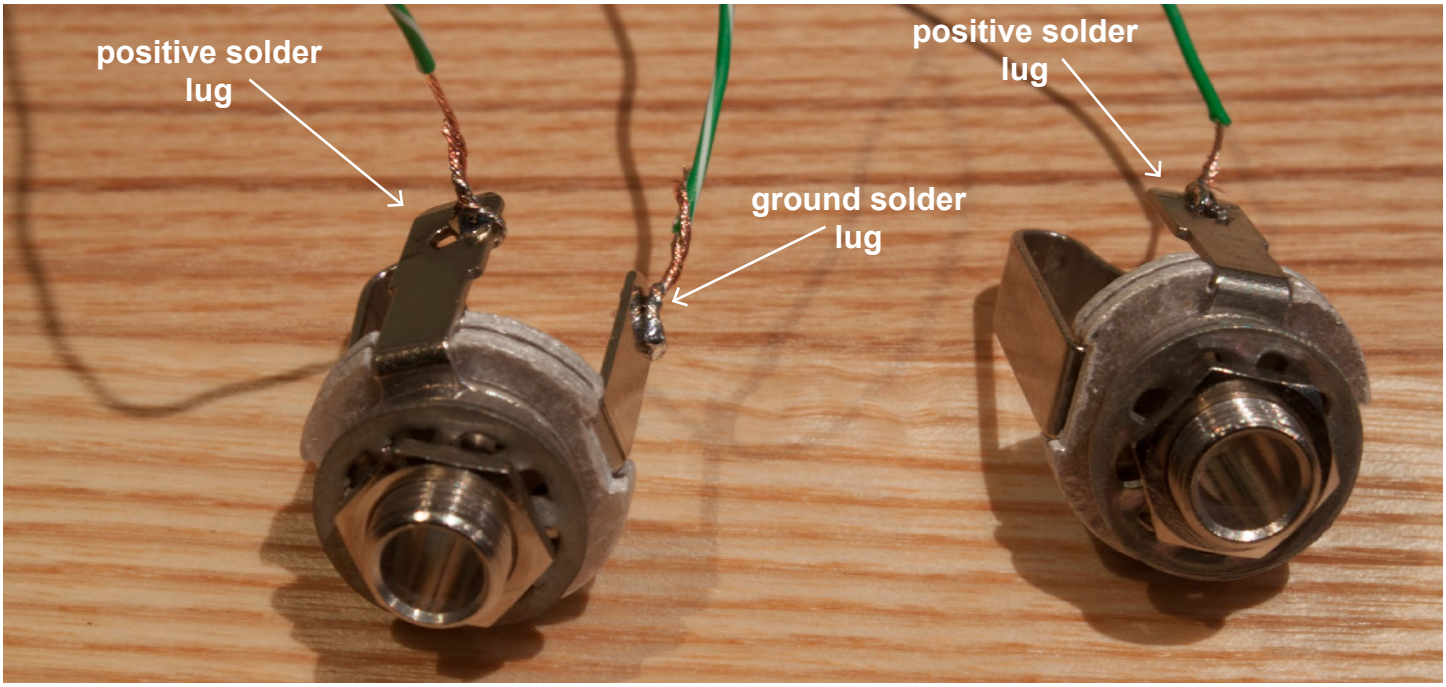
1/4 inch jack one

1/4 inch jack two

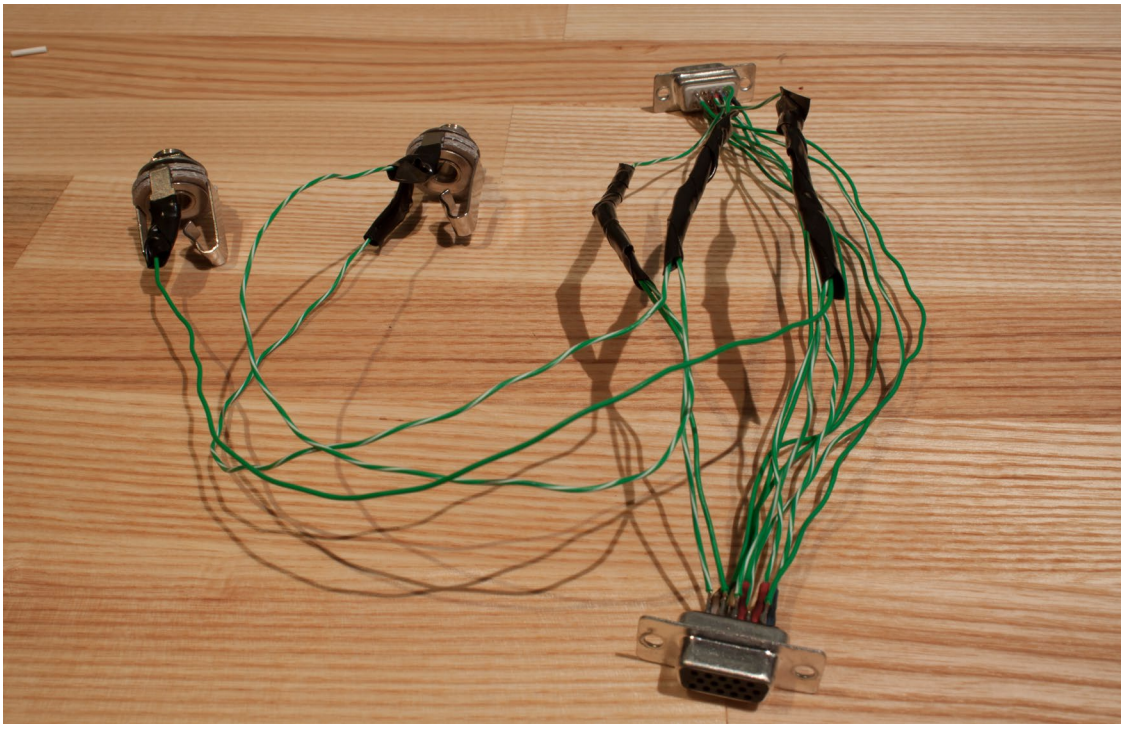


-This hack connects two color pins to the positive solder lugs of both audio jacks, and the remaining color pin to one ground solder lug of one of the audio jacks. This is what shorts the VGA video signal, enabling the bright and vivid visuals that would be impossible to attain with a properly wired VGA cable.
Note: the color pin that is grounded make up the majority of the signal, so choose the color you like best. The device will still function properly no matter which color you choose.

1. Once you decide which color (red, green, or blue) you want to make up the majority of your synthesizer's color pallette, solder that color's pin to the ground solder lug on one of the audio jacks.
2. Solder the remaining two wires to the positive solder lugs on both of the two audio jacks. This will mean that one wire is connected to one of the audio jack's positive solder lug, one wire is attached to the other audio jack's positive solder lug, and the third wire is attached to the ground solder lug of one of the audio jacks (it doesn't matter which--it will still have the same effect).

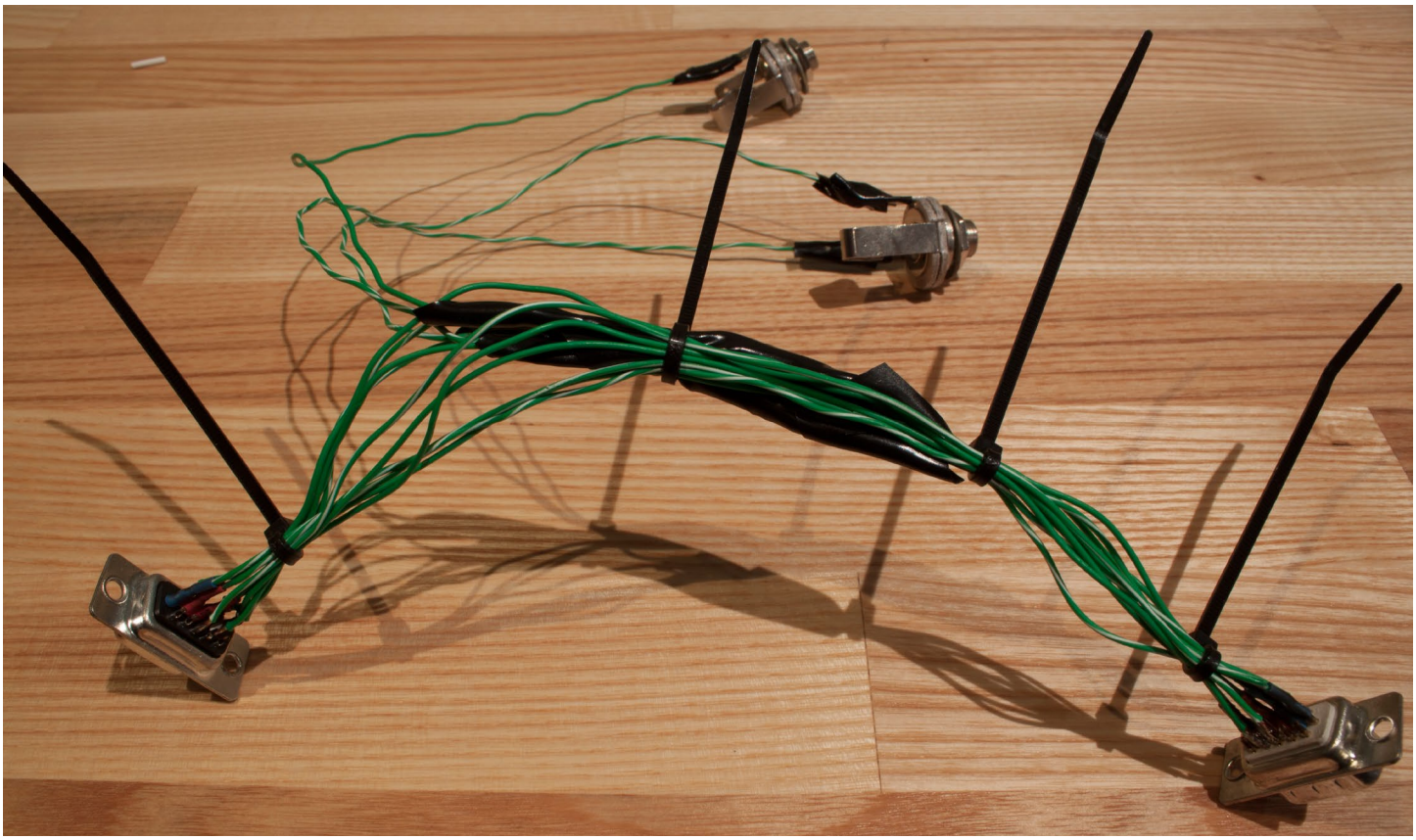


3. Cover all exposed wire and the diodes with electrical tape.

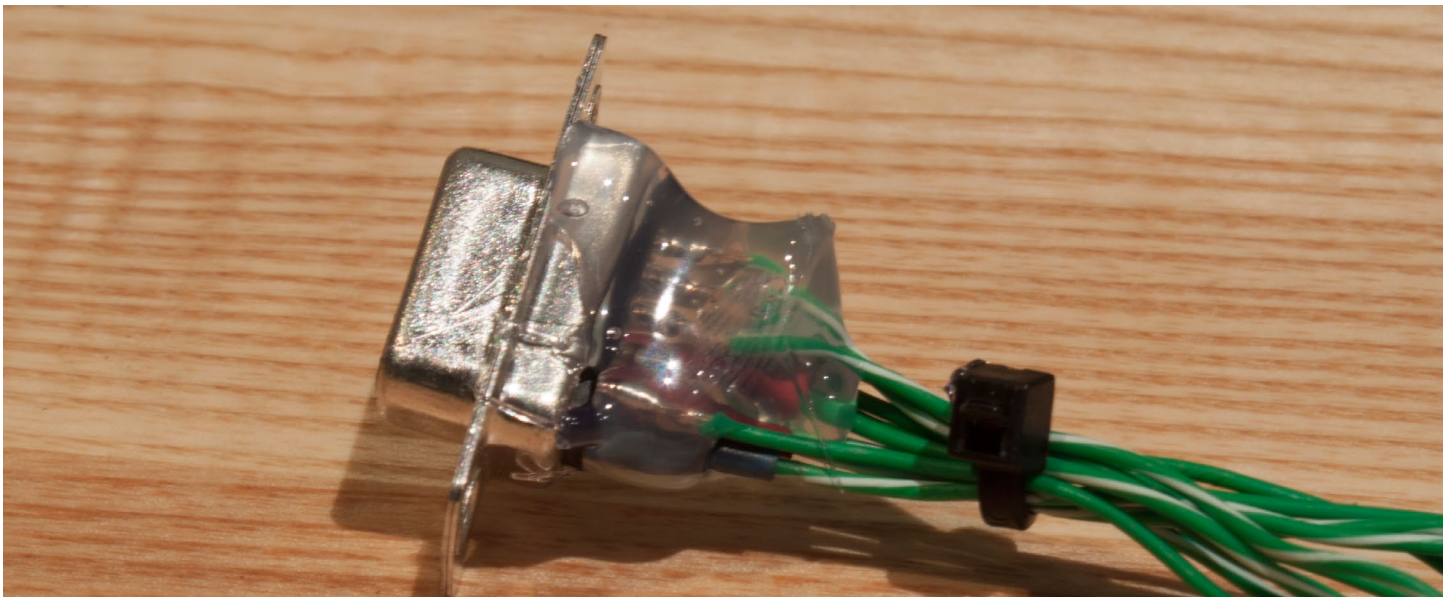


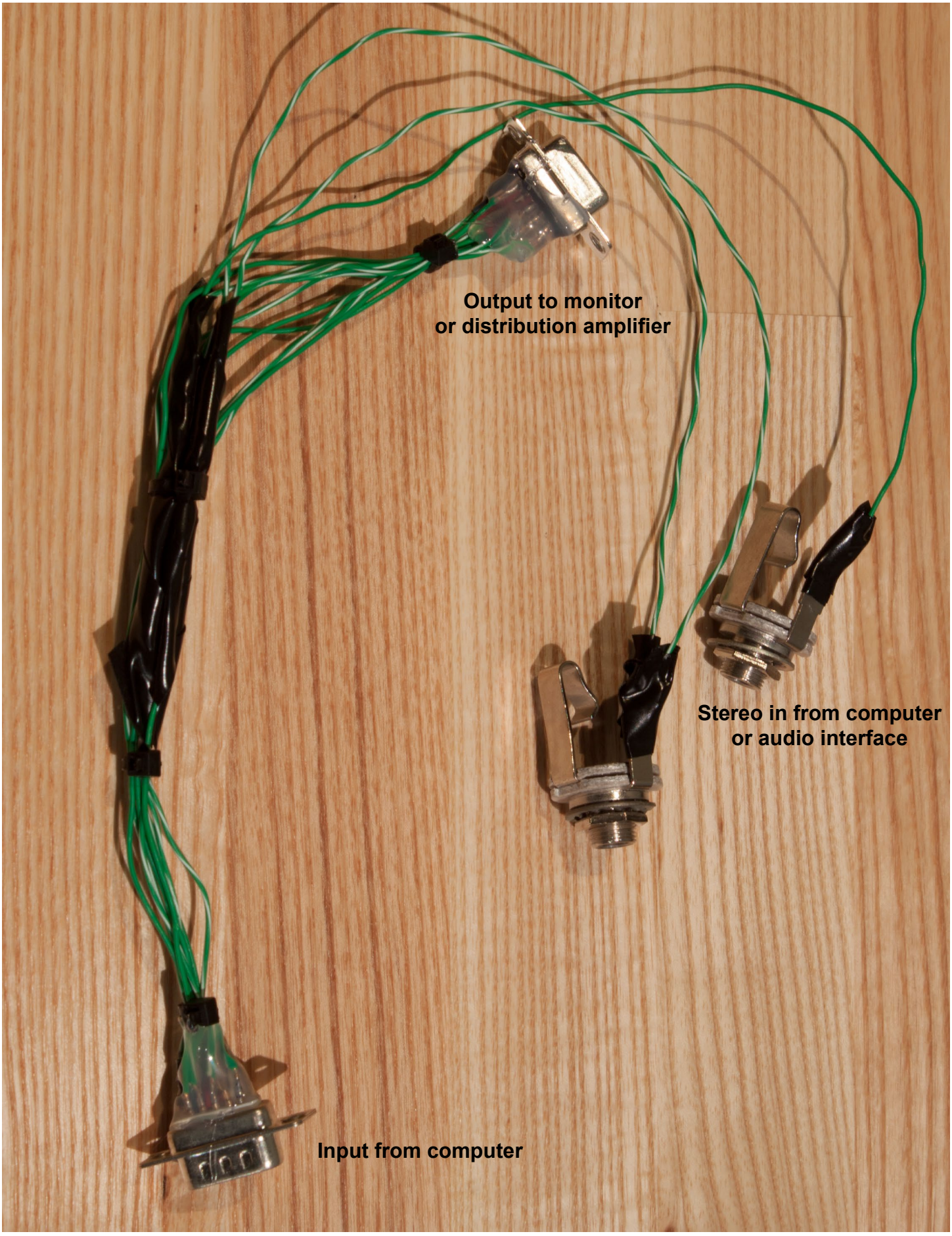
4. FINISHING UP

1. Apply 4-5 (depending on your cable length) small zip ties to keep the DIY VGA cable in place, especially where the cables make contact with the solder lugs. You don't need to zip tie the wires going to the audio jacks, as you'll want those detached from one another.



2. Trim the zip ties and apply glue from a hot glue gun to the wire and solder terminal joints of the d-sub connectors to ensure that they will stay in place.
3. **At this point test the device with by sending a VGA signal from your computer to a VGA monitor to ensure it is working. If it isn't, check the wire connections and make sure you soldered into the proper terminals.**
4. You can keep the cable as is, if you want to further stabilize it, box it up into a project box or found box (a cigar box, a VHS case, etc) to keep everything carefully in place.




Output to monitor
or distribution amplifier
Stereo in from computer
or audio interface
Input from computer

Emai questions/comments/suggestions to: jconno@saic.edu

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