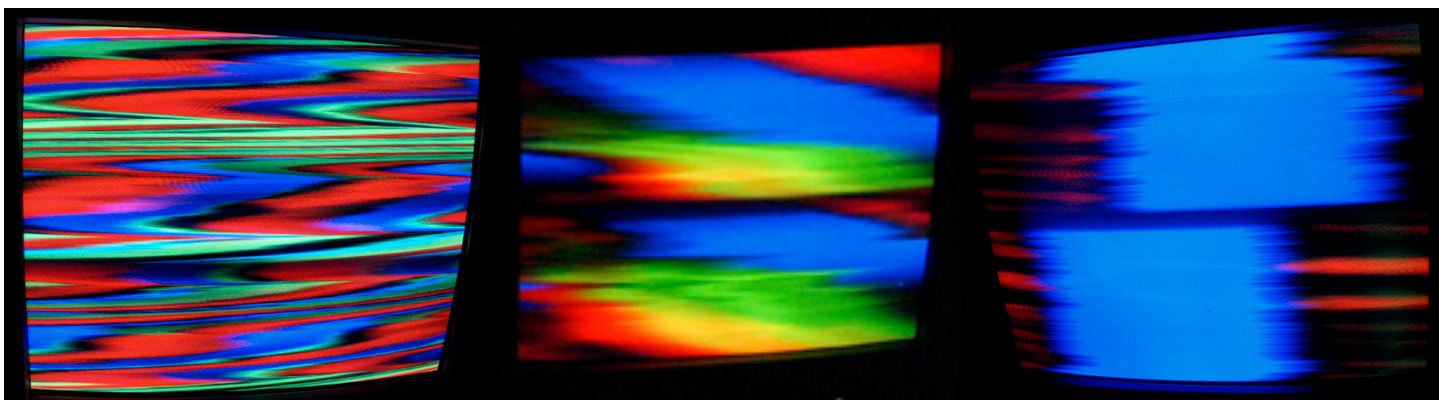# HACKING A VGA CRT TO BEND AUDIO INTO VIDEO

WHAT YOU NEED

-1 male VGA d-sub Connector[1]
-1 female VGA d-sub connector[2]
-Audio cables or jacks (1/4 inch, 1/8 inch, or RCA depending on your ideal output)
-22-gauge single-strand wire (stranded makes it difficult)
-Electrical tape and scissors
-Soldering iron and solder
-Wire strippers
-VGA signal generator or computer with VGA output. (Sending unstable signals can damage computer hardware, so I highly recommend using a VGA signal generator. These are difficult to find, but it I have seen them for less than $20 on ebay.)
-VGA CRT (tube) computer monitor (LCD will not work)

1   You could also use a male VGA breakout board, or cut into a VGA cable itself, though wire-identification then becomes difficult
2   You could also use a female VGA breakout board, or cut into a VGA cable itself, though wire-identification then becomes difficult

UNDERSTANDING A VGA CABLE

A computer monitor communicates through a **Video Graphics Array** (**VGA**) connector, which is organized into a 15 pin (3 rows of 5) adapter at either end that sends discrete (and, therefore, hackable) **RGBHV** (**R**ED, **G**REEN, **B**LUE, **H**ORIZONTAL-SYNC, **V**ERTI-CAL-SYNC) analog signals.

The most useful part of its organization is that the **R**ED, **G**REEN, and **B**LUE (**R**, **G**, **B**) colors of the monitor are controlled by three discrete pins—pins 1-3. These are the pins the stereo audio signal gets sent to. Pin 13 is **H**orizontal-sync, which controls the frame rate and of the displayed image, and pin 14 is the **V**erical-sync, which displays the pixel information. Pin 5 is ground, and pins 6-10 are the ground connections for the **R**, **G**, **B**, **H-SYNC**, and **V-SYNC**.

For this hack, wires need to be connection to pins 1 (**R**), 2 (**G**), 3 (**B**), 5-10 (ground), 13 (horizontal-sync), and 14 (vertical-sync)

NOTE: D-sub connectors with soldering terminals are labeled with small numbers to ensure you're soldering into the correct holes (this can get VERY confusing, as female soldering terminals are the opposite of male, and on top of that you're seeing them in reverse). To save time and avoid having to resolder, **be sure you're placing the wire into the correct terminal BEFORE applying any solder.**
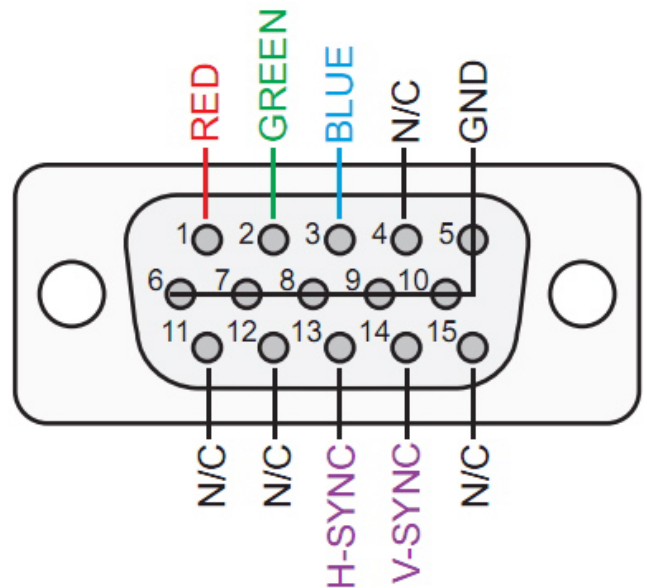
PIN 1:	RED
PIN 2:	GREEN
PIN 3:	BLUE
PIN 4:	-
PIN 5:	GROUND
PIN 6:	RED GROUND
PIN 7:	GREEN GROUND
PIN 8:	BLUE GROUND
PIN 9:	-
PIN 10:	SYNC GROUND
PIN 11:	-
PIN 12:	-
PIN 13:	HORIZONTAL-SYNC
PIN 14:	VERTICAL SYNC
PIN 15:	-

male face

male solder terminals

female face

female solder terminals
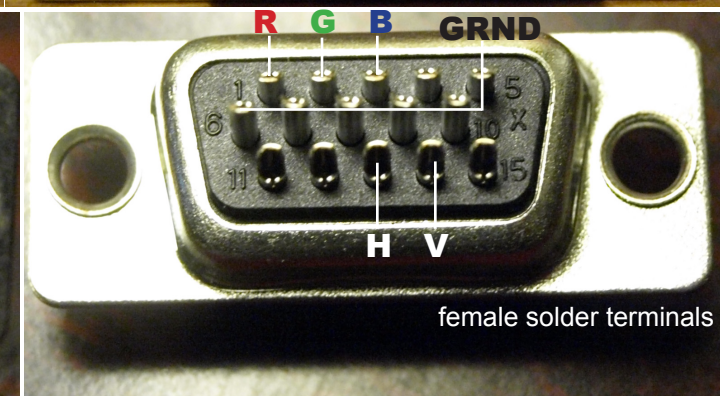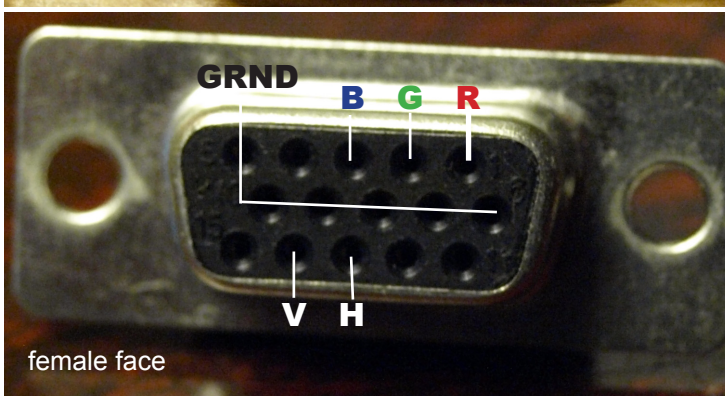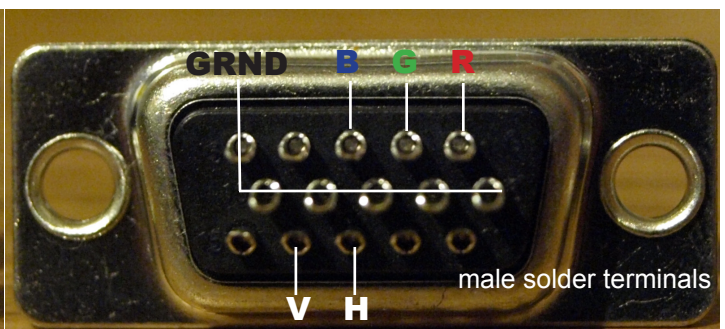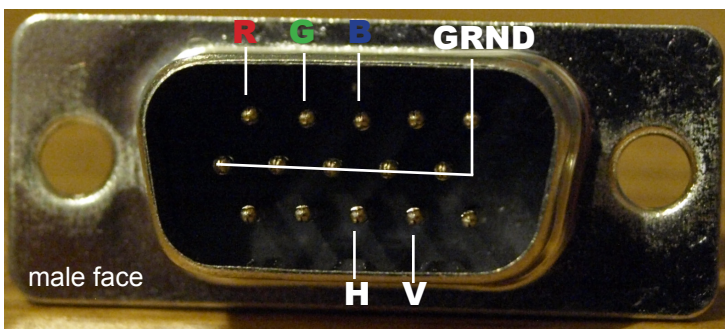
THE HACK

1. SOLDERING THE D-SUB CONNECTOR

This is the most difficult part of the hack. 15-pin d-sub connectors contain solder terminals to connect wires to 15 pins. For the purpose of this hack, only 10 of the 15 pins need to be soldered to.

1.1 PREPARING

-Cut 3 pieces of single-strand wire about 6 inches in length. Make sure that all pieces are as close to being the same length as possible.

-Strip one end of each 6-inch piece of wire a quarter of an inch (this end will be soldered to the d-sub connector), and the other end half an inch (this will be soldered to the wire connected to the female d-sub connector.
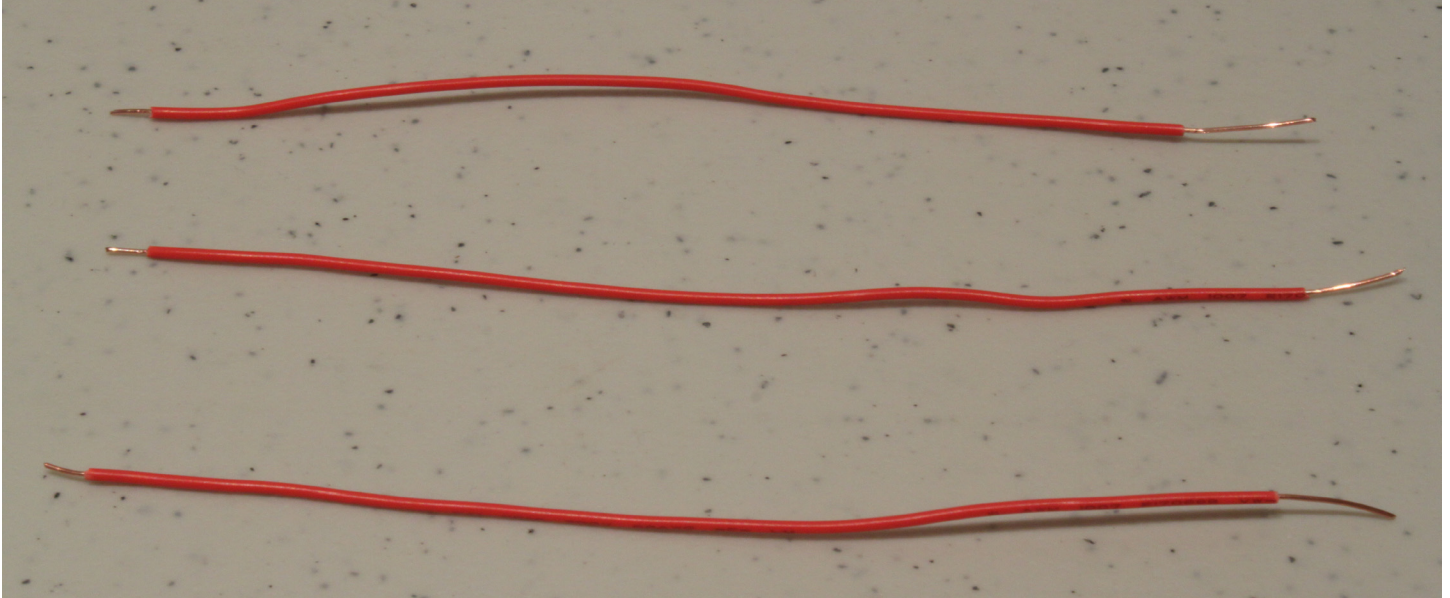
-These wires are for the **R**, **G**, and **B** pins of the male and female d-sub connectors separately.

-Cut an additional **7** pieces of single-strand wire about 12 inches in length, making sure that all pieces are as close to being the same length as possible.
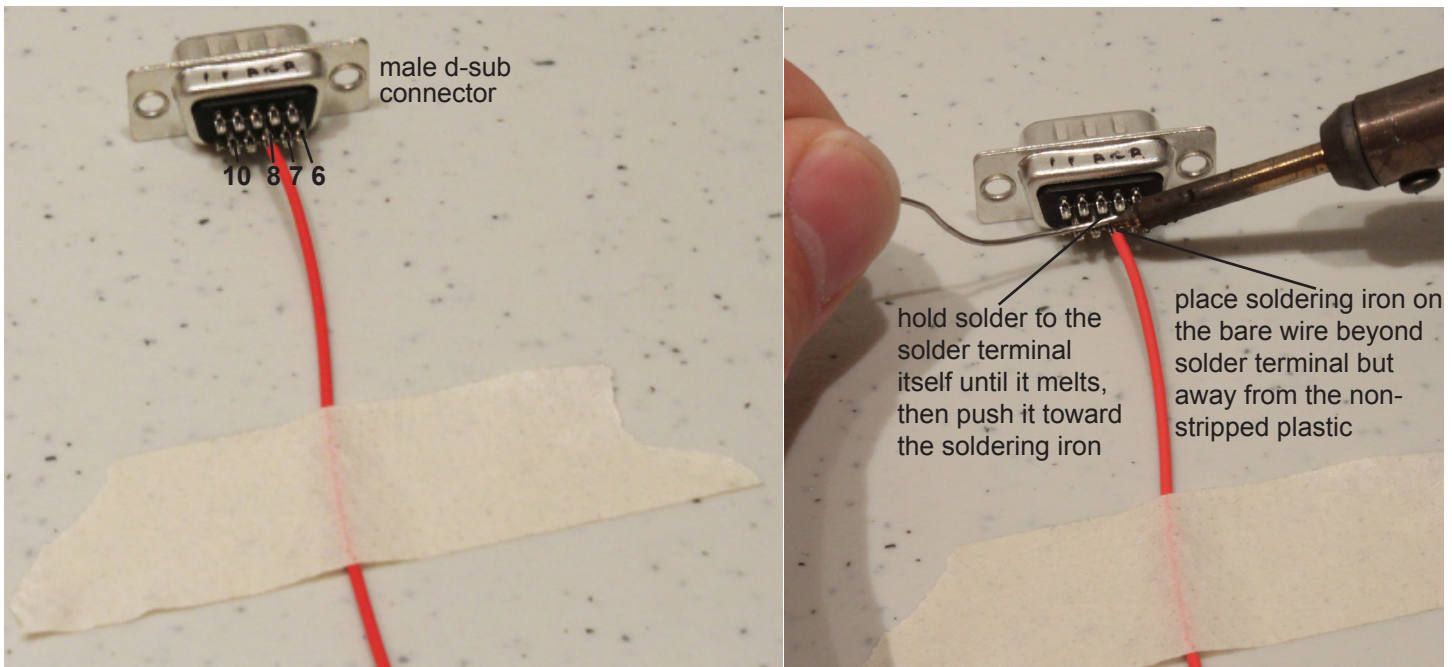
-Strip both ends of each wire a quarter of an inch.
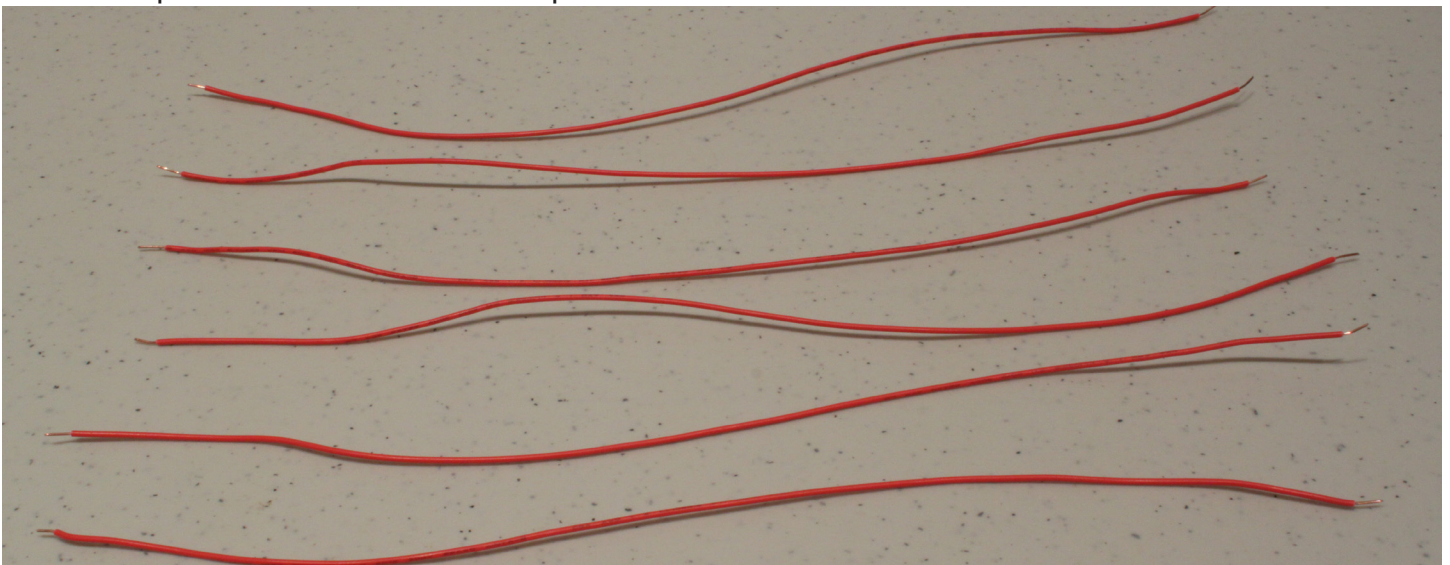
-These wires will connect the ground pins and **H** and **V** sync pins on the male d-sub connector to the ground pins and **H** and **V** sync pins on the female d-sub connector.

1.2 SOLDERING THE GROUND PINS IN THE MIDDLE ROW

-Solder 4 separate pre-cut 12 inch wires to solder terminals **6**, **7**, **8**, and **10** (note that pin 9 is not necessary to solder) of the male d-sub connector.

male d-sub connector

10 8 7 6

hold solder to the solder terminal itself until it melts, then push it toward the soldering iron

place soldering iron on the bare wire beyond solder terminal but away from the non-stripped plastic

TIP: When soldering into the solder terminals, it works best to slide the wire into the terminal and then tape the wire to the table you're working on to act as a "third hand", holding it in place while you solder the wire.

IMPORTANT: Make sure you solder the middle row of terminals (pins **6**, **7**, **8**, and **10**) before soldering the top and bottom row, or else it will be almost impossible to access those terminals with the soldering iron.


male d-sub connector

10   8   7   6

11
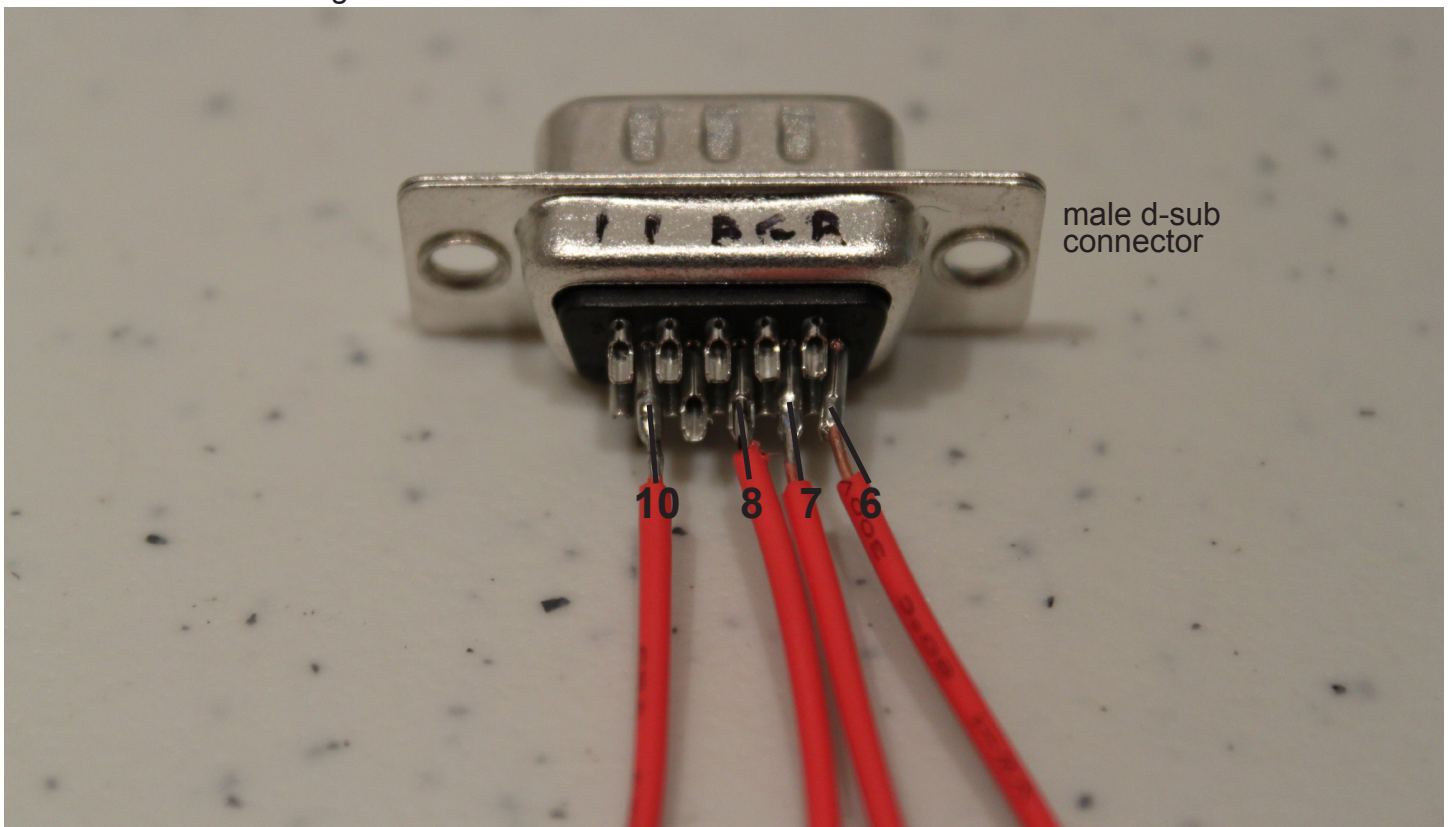
-Solder the other end of those wires into the corresponding solder terminals **6**, **7**, **8**, and **10** on the female d-sub connector.

female d-sub connector

6   7 8 10

male d-sub connector

female d-sub connector
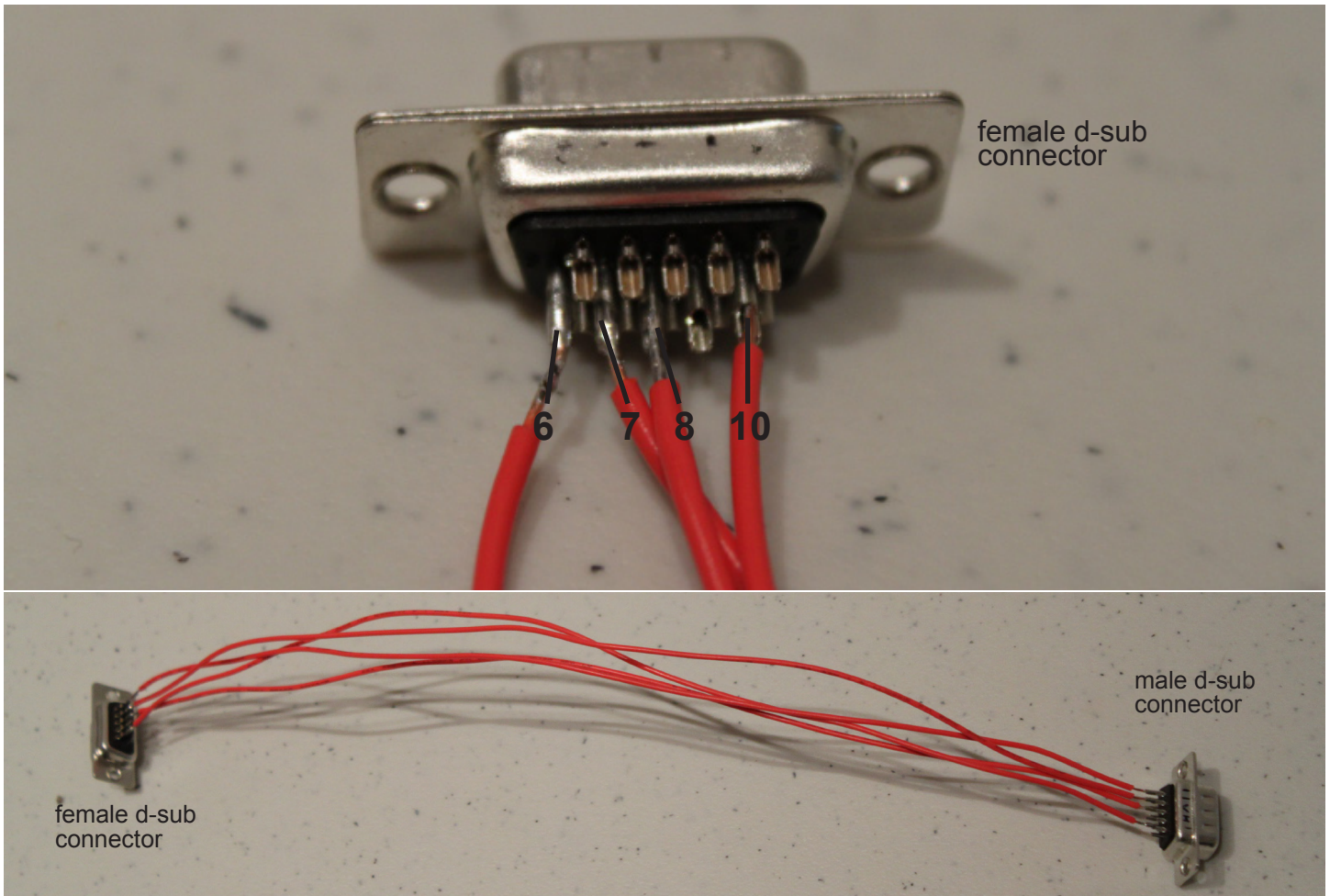
1.3 SOLDERING THE H AND V SYNC PINS

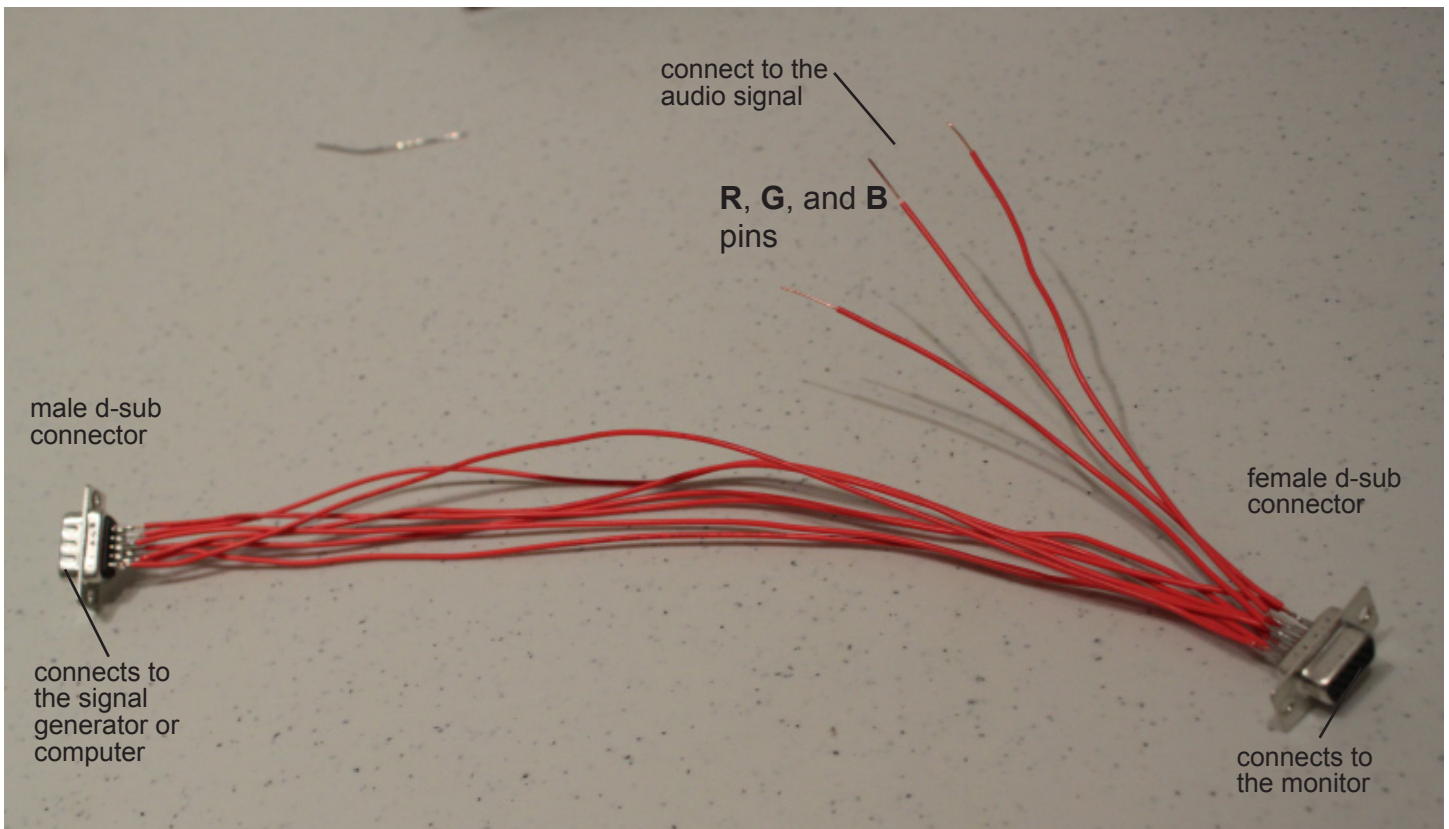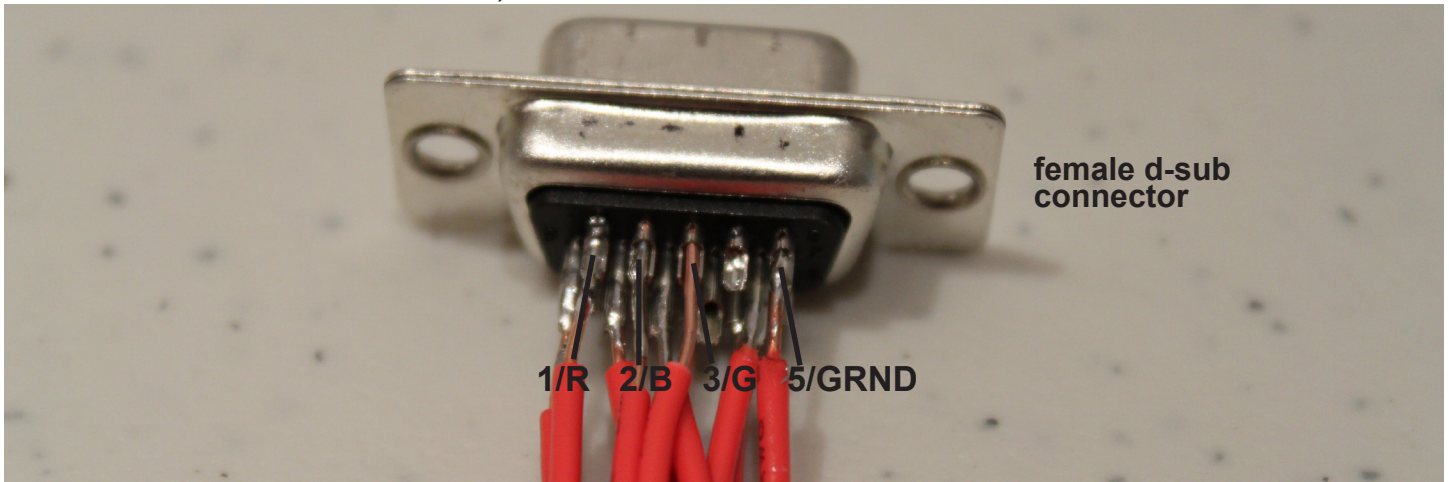-Solder 2 separate pre-cut 12 inch wires to solder terminals **13** and **14** of the male d-sub connector.

-Solder the other end of those wires into the corresponding solder terminals **13** and **14** on the female d-sub connector.

H V

male d-sub connector

V H

female d-sub connector

12
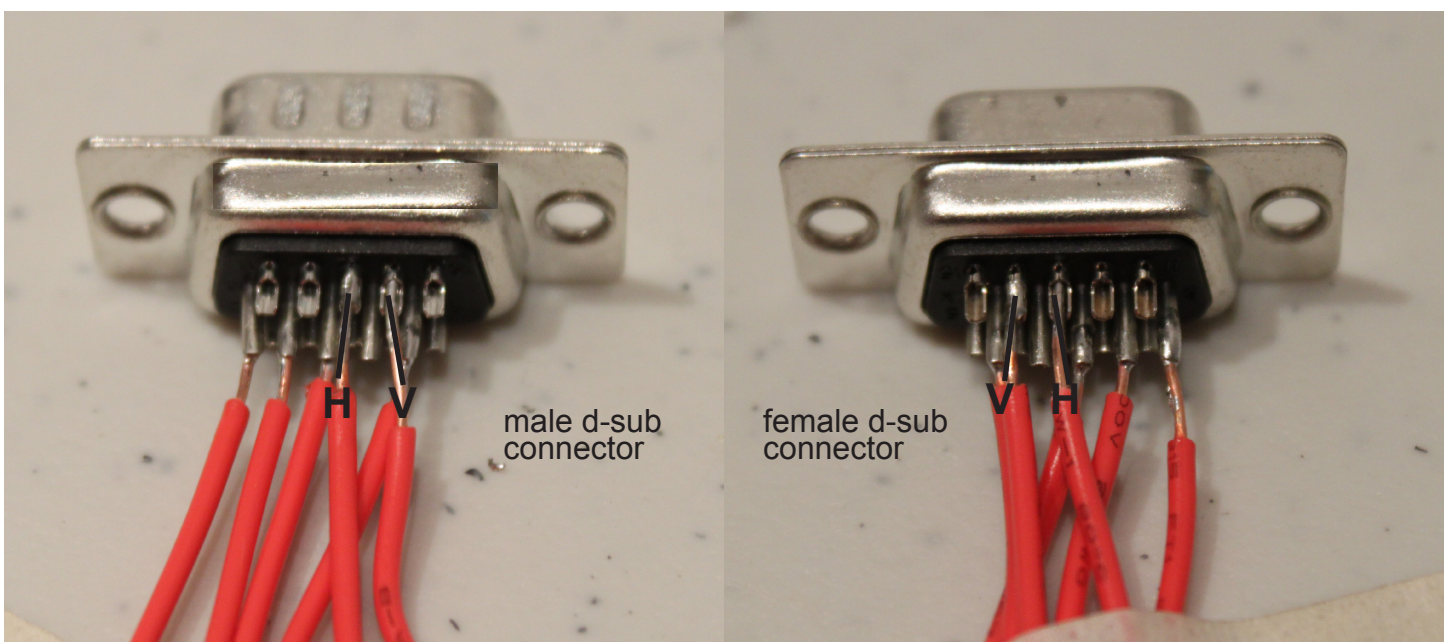
1.4 SOLDERING THE R, G, AND B PINS AND REMAINING GROUND PIN

-Use the remaining pre-cut 12 inch wire to solder terminal **5** of the male pin to terminal **5** of the female pin, completing the ground connection.

-Take the 3 pre-cut 6 inch wires. Solder the end that has been stripped to a quarter of an inch into solder terminals **1**, **2**, and **3** on the **FEMALE** d-sub connector (it is unessecary to solder them to the male d-sub connector).

female d-sub connector

1/R   2/B   3/G   5/GRND

connect to the audio signal

R, **G**, and **B** pins

male d-sub connector

female d-sub connector

connects to the signal generator or computer
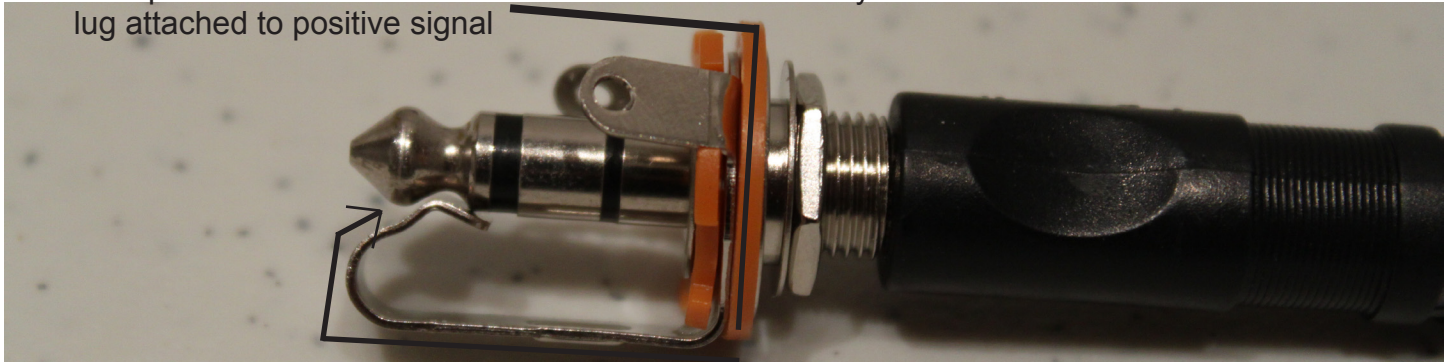
connects to the monitor

2. SENDING AUDIO SIGNALS TO THE R, G, AND B PINS

To connect audio to the **R**, **G**, and **B** signals of a VGA cord in a way that shows all colors discretely the three cords have to be connected to the left channel, the right channel, and the ground of an audio signal. The pin connected to the ground signal generates the majority of the visuals, so I prefer to connect the **RED** pin. The left and right channels can be connected to the **BLUE** or the **GREEN** pins interchangably. This tutorial has you connecting the pins to two mono 1/4 inch jacks though, depending on your ideal output, you could also use 1/8 inch jacks or RCA jacks.
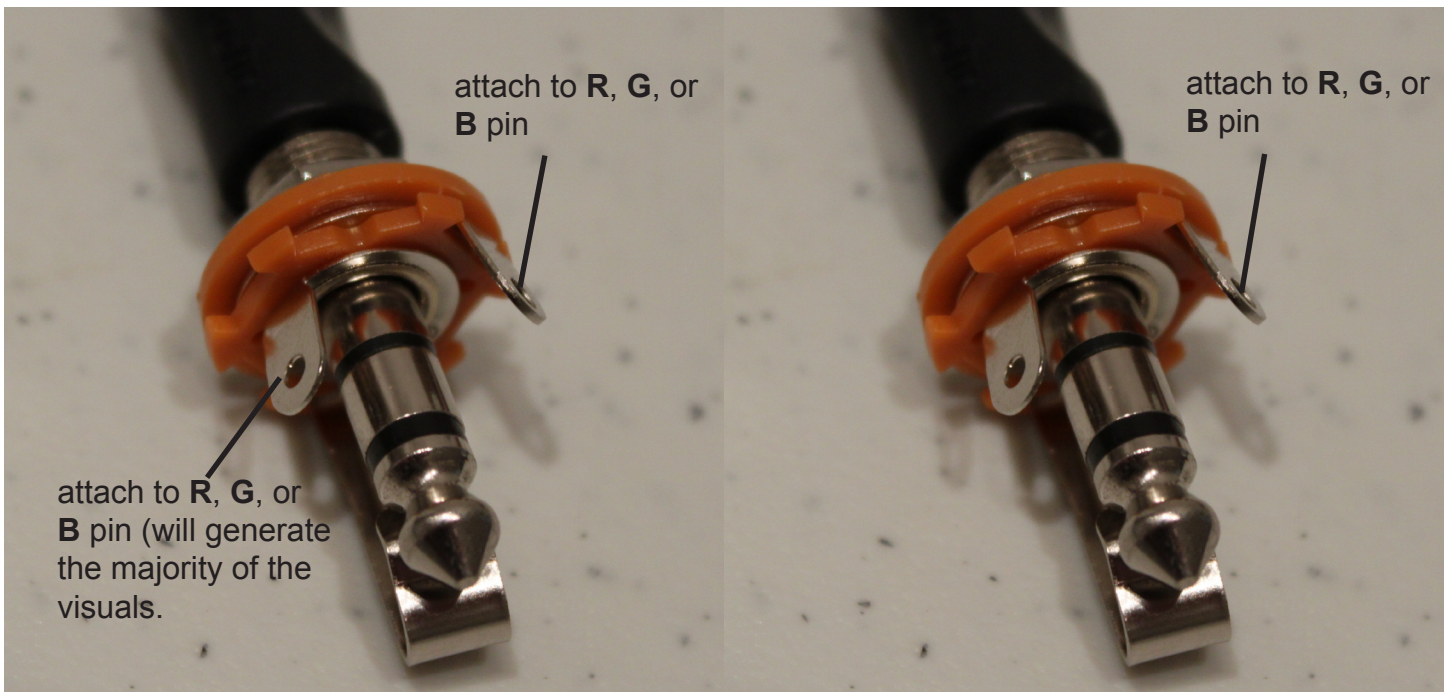
2.1 UNDERSTANDING A 1/4 INCH AUDIO JACK

-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 contat 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.

-Experiment with different combinations to see which you like best.

lug attached to positive signal
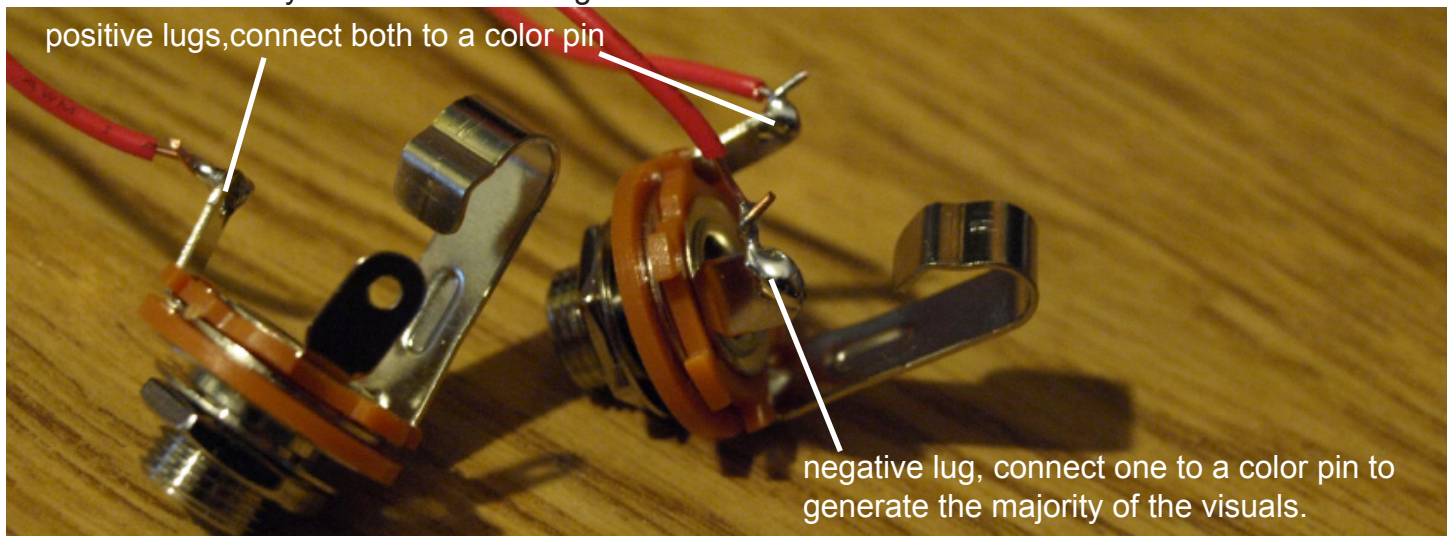
lug attached to negative signal

1/4 inch jack one

1/4 inch jack two

attach to **R**, **G**, or **B** pin

attach to **R**, **G**, or **B** pin

attach to **R**, **G**, or **B** pin (will generate the majority of the visuals.

2.2 SOLDERING THE 1/4 INCH JACKS

-Cut three 6-inch wires and strip both ends 3/4 of an inch on all.

-Connect one end of 2 of the wires to each positive solder lug on both jacks by putting the wire half-way through the hole and twisting it to hold it in place, then solder them together.

-Connect one end of the remaining wire to a negative solder lug on one of the two audio jacks the same way and solder them together.

positive lugs,connect both to a color pin

negative lug, connect one to a color pin to generate the majority of the visuals.

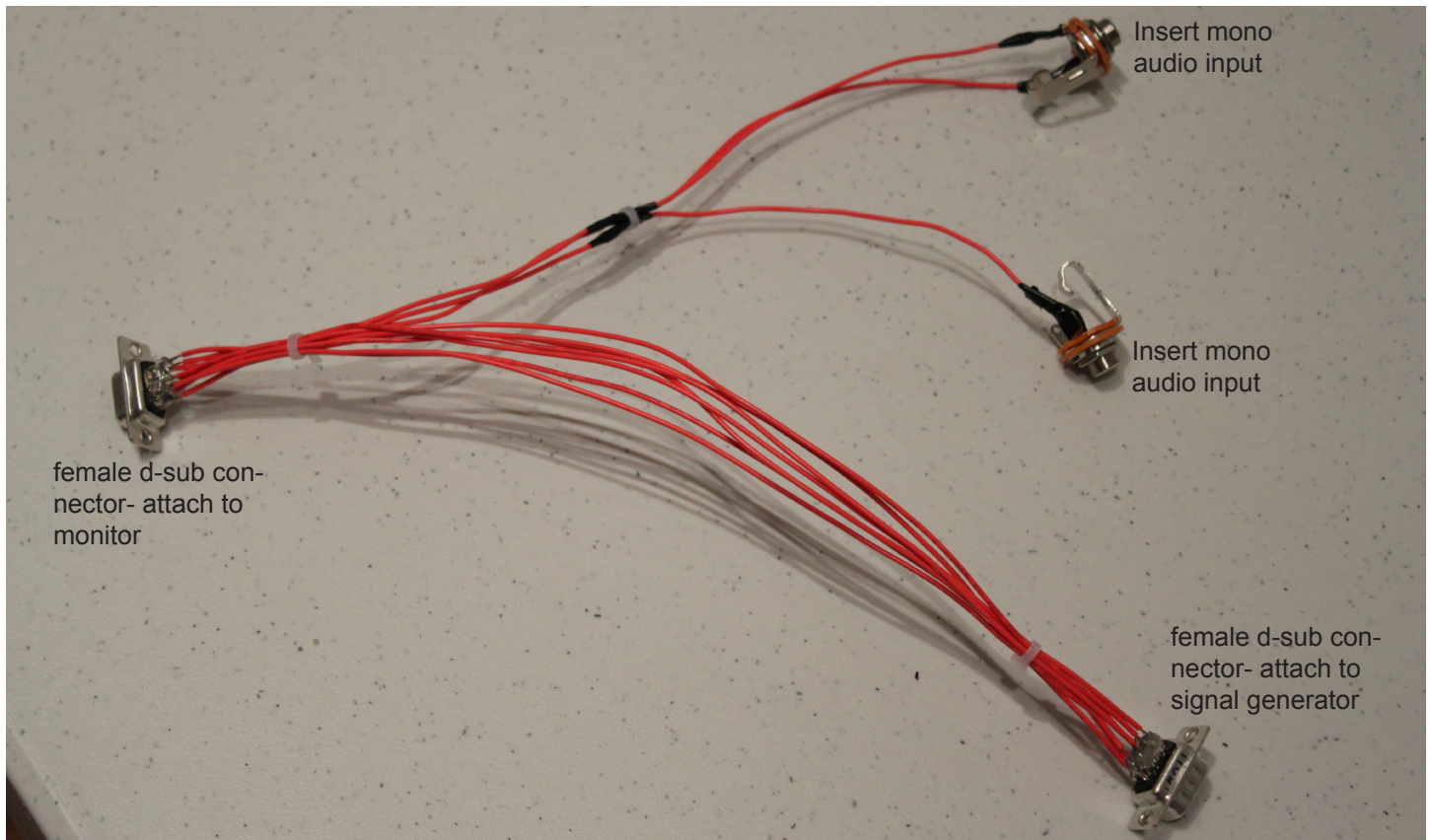## 2.2 CONNECTING THE 1/4 INCH JACKS TO THE R, G, AND B PINS

-Solder the other end of the wire attached to the NEGTIVE lug of one of the audio jacks to one of the wires soldered to the color pins.

-Solder the other ends of the wires attached to the POSITIVE lugs of each of the audio jacks to the 2 of the wires attached to color pins

-(It doesn't matter which pin goes to which lug, just make sure two are attached to each of the positive signals and one is attached to one of the negative signals).
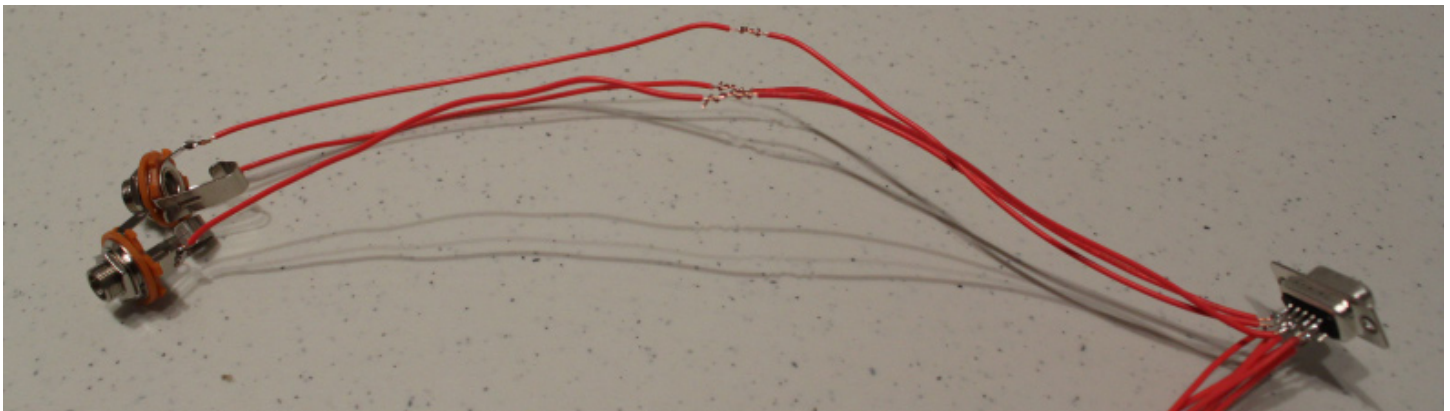
3. FINISHING UP

-Wrap the connections of the audio cable to the **R**, **G**, and **B** pins with electric tape.

-You may want to apply glue form a glue gun to the solder terminals of the male and femal d-sub connectors to keep the wires firmly in place, especially if you weren't using shrink wrap tubing.

-You may want to use zip ties or electric tape to keep the wires organized and together.

Insert mono audio input

Insert mono audio input

female d-sub connector- attach to monitor

female d-sub connector- attach to signal generator

4. CONNECTING THE HACK

-The female end of the hacked VGA cord connects to the VGA cord that goes to the VGA CRT computer monitor.

-The male end of the hacked VGA cord needs to be stabilized by being connected to a VGA signal generator.

-You could also add potentiometers to the connection between the audio and the color pins with switches to control the level of each signal.

-Experiment with the setup. Add additional audio signals to the color pins. Connect multiple color pins to the same audio signal. Plug in a synthesizer or a function generator to have complete control of the visualized waveforms. Try to do more than just send a stable stream of audio into the monitor.

IMPORTANT NOTE: You could stabalize the VGA signal through a computer or a VGA output from a laptop, but the hardware of the computer may be damaged after sending audio into the hacked VGA cord for prolonged periods of time. Because the audio is being sent to the ground of the VGA cable in order to have the red, green, and blue signal of the monitor discretely hacked, it is possible that raw voltage could be thrown back into the computer in a way that could damage the Hardware. Because of this, I highly recommend using a VGA signal generator.