

## Ripping Apart the Mini-SNES

Of all the game consoles in this book, the mini-SNES is the hardest to open. It doesn't use normal Phillips-head screws to hold the case together. No, that'd be too easy! Instead, it uses what I refer to as "[Nintendo](#) screws." You've probably noticed them on the backs of NES and SNES cartridges—they're rounded, with little notches around the edges. Normal screwdrivers are useless against them!

Now if a person was really patient (or bored), he could slowly turn the screws on the cartridges by pressing into the side notches with a pin and twisting. (I used to do this for "fun" with my Gameboy carts in study hall long ago.) But on the mini-SNES these pesky screws are deep inside a well and can't be reached (not even by Lassie). That leaves two ways to remove them and open up the system, as described in the following sections.

## Using a Nintendo screwdriver

This is the easier method, but you've got to buy a strange tool that isn't available at every corner drugstore. Instead, search an online auction site for "Nintendo screwdriver." You'll find listings either for screwdrivers or for just the bits. The size you'll need for the SNES is a 4.5 mm, but whether it's a bit or a screwdriver, make sure it's long enough to get to the bottom of the 1.3"-deep mini-SNES screw well.

## The "other" ways to open the mini-SNES

If you don't want to wait for an online auction to ship, or don't feel like spending \$8 on a tool you'll only use once, you can open a mini-SNES in one of the "other" ways.

I really don't want to say, "Kids: Ask a grownup for help with this," as the mere mention of those words sent my eyeballs rolling when I was a lad. So I shall rephrase: If you feel you might need help hacking and slashing into a Super Nintendo, have a person who is experienced with tools assist you in the following procedures.

### Grinding wheel

If you have access to a grinding wheel you can use it to open the mini-SNES using the steps listed below. (This is the preferred "other" method, so ask everyone you know if they have a grinding wheel that you can use before resorting to the screwdriver method.)

1. Hold one side of the SNES against the wheel and grind through the casing toward each screw. Figure 9-1 shows the correct "entry" points to use. Go along these lines, and I promise you won't hit anything important!

**Caution:** Like most spinning wheels of stone, the grinder can be

**Caution.** Like most spinning wheels of stone, the grinder can be dangerous. It can cut you if you touch it, cause bits of hot material to go flying into your eyes, or jerk parts out of your hands if you don't hold them tightly enough, sending them flying on dangerous trajectories. Therefore, you should always wear safety goggles when using one. If you need to hold a part close to the wheel, use a large pair of pliers, not your hands, and always wear work gloves.

**2.** Once you've ground a large hole near both screws on one side of the case, you should be able to see the screw posts inside. As shown in Figure 9-1, you'll only need to grind openings on one side of the case. You can now skip ahead to *Destroying the screw posts* on the next page.

**Figure 9-1**

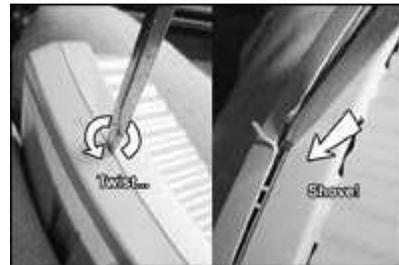
The correct approach angles for grinding into a mini-SNES.



## Use Your Large Flat-head Screwdriver

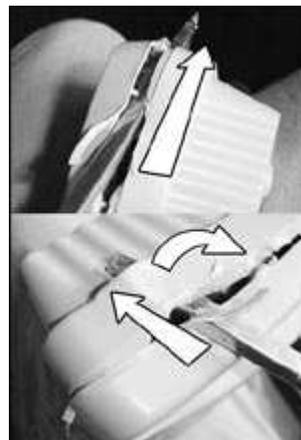
In Chapter 2, I suggested that having a big flat-head screwdriver around might be useful for portable building. Well, its time has come—if you don't have access to a grinding wheel, you can use the big screwdriver to open the mini-SNES:

- 1.** Stick the screwdriver into the seam between the halves of the case near a screw post as shown in Figure 9-2. Twist and shove it in until you get through. Take care not to get your fingers in there, as they may get pinched or cut.
- 2.** Once you've gotten the edge of the case open, you can push the screwdriver in and further open the case, as shown in Figure 9-3. You'll then have enough room to push the screwdriver out one of the slots on the rear, then pry up the screwdriver to pop out that section of plastic.



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**Figure 9-2**

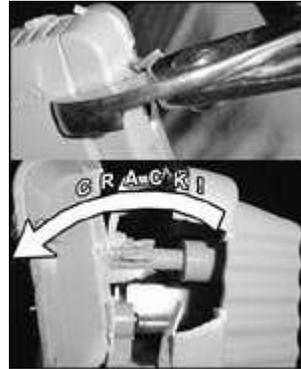


[click on image for full view](#)

**Figure 9-3**

Ripped and jagged plastic can cut you, so take care while doing this.

3. Take a large pair of pliers and grip on the outer edge of the hole you've created. Bend it up and snap it open as seen in Figure 9-4. You now have access to the screw post.



[click on image for full view](#)

**Figure 9-4**

4. Repeat Steps 1—3 for the other screw post on the same side—remember, you'll only have to expose the screw posts on one side of the unit. (See Figure 9-1 in the grinding wheel section.)

As a general rule, when you hack open the mini-SNES, you can smash up and wreck the front/top half of the unit all you want, but try not to bend or crack the rear half, because that is what the motherboard is attached to.

**Destroying the screw posts**

Using one of the previous methods, you've now exposed the plastic screw posts on one side of the mini-SNES. Time to destroy them!

1. Reach into the opening with a fairly hefty pair of pliers, and grab onto the screw post. Then bend it out (either sideways or toward the outside of the case) until the screw itself snaps free. You can also twist them to break the screw free. Do this for both exposed screw posts.
2. Now you should have one side of the SNES case unattached. If you want to go ahead and grind/pry open the other side that's perfectly okay, but a faster route is to just grab the sides, and rip it open! (See Figure 9-5.)



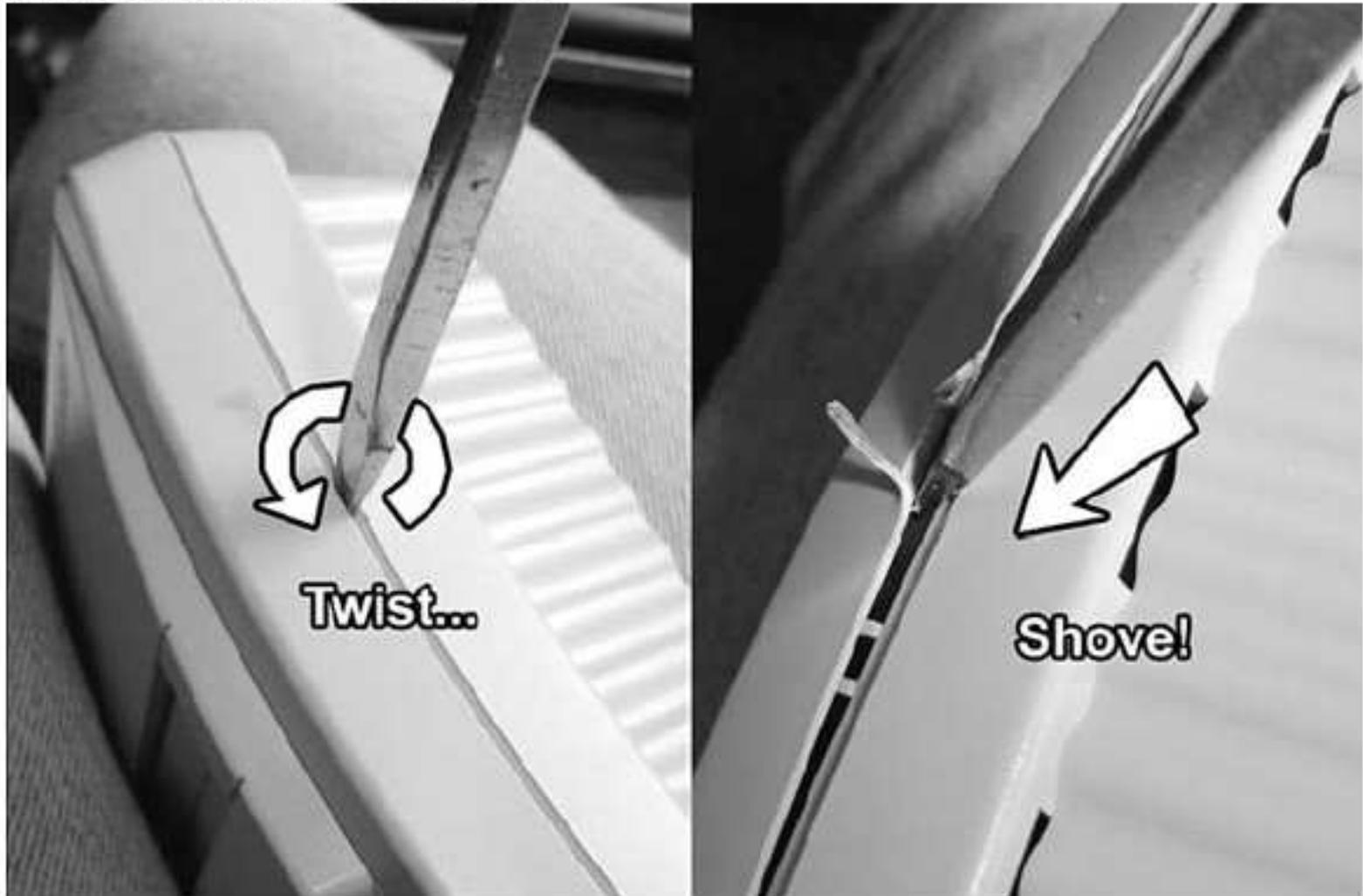
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**Figure 9-5**

The case of the mini-SNES is now open, allowing you to see the motherboard, cartridge slot, and heat sink.

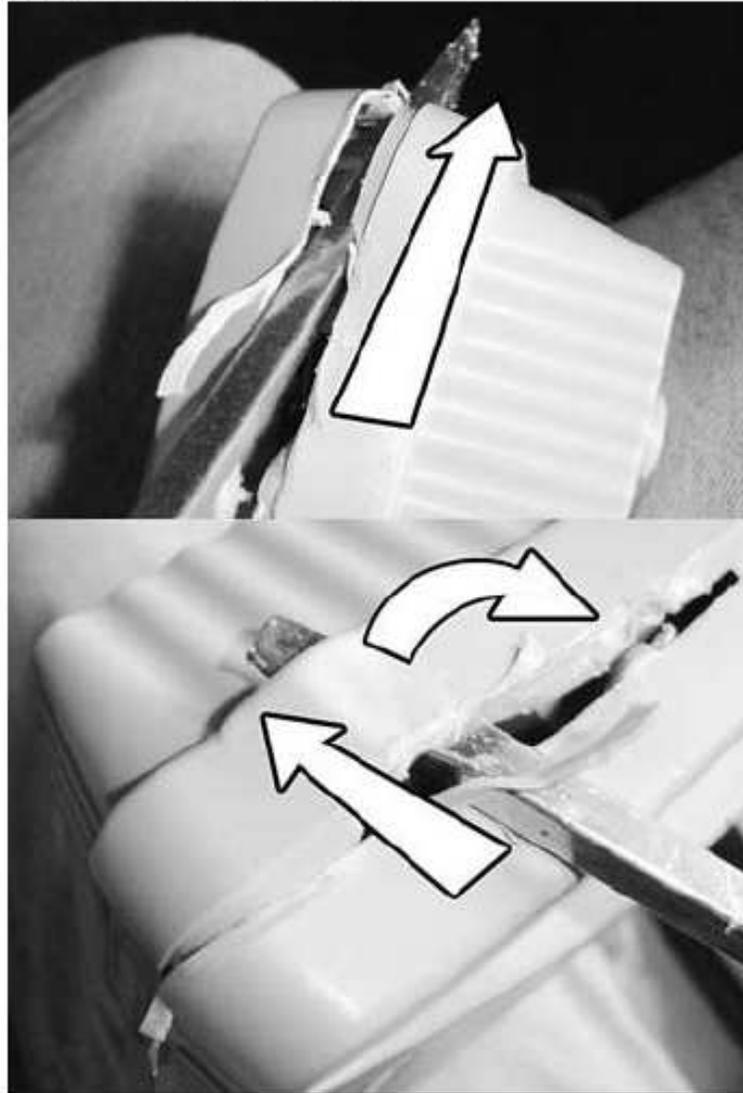
**Figure 9-2**

The screwdriver begins its attack on the mini-SNES.



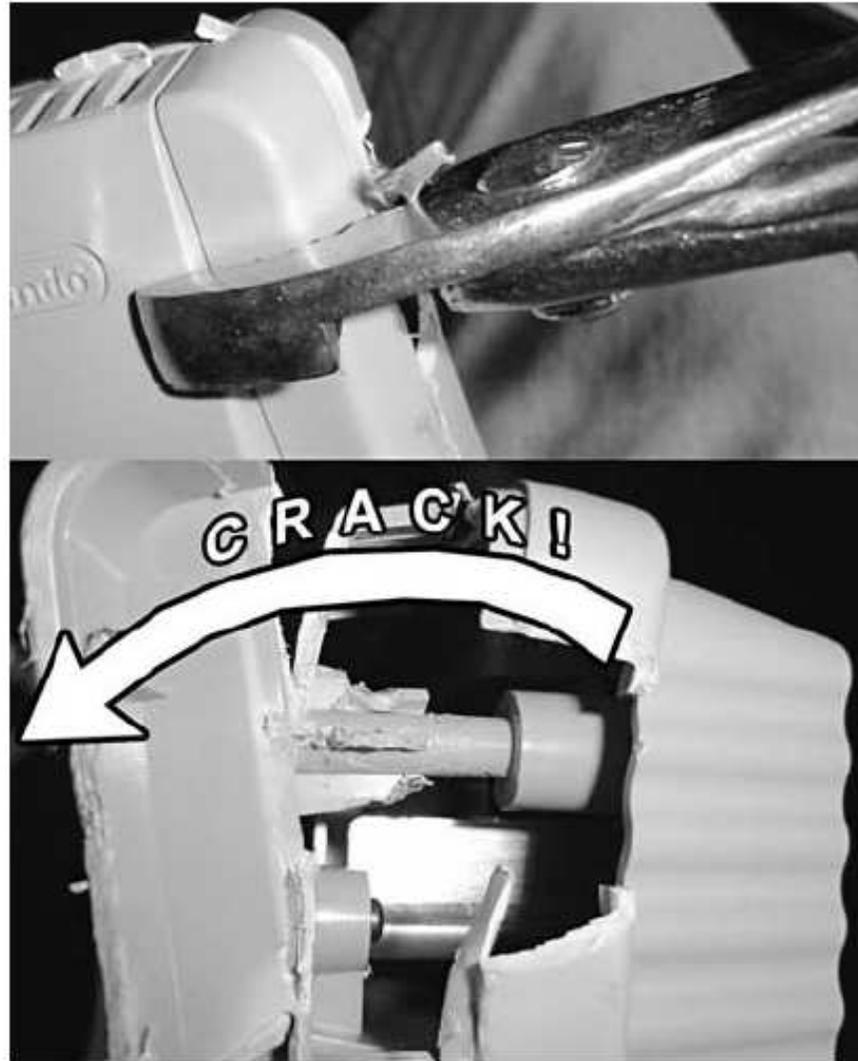
**Figure 9-3**

Separating the case further, and popping a section of plastic.



**Figure 9-4**

Prying the case open to reveal the screw posts.



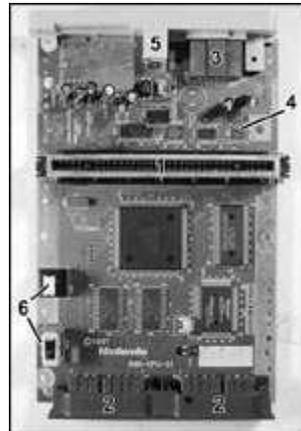
### **Taking Apart the Rest of the Mini-SNES**

With that pesky case out of the way, we can take apart the rest of the mini-SNES in a much more traditional fashion.

- 1.** Remove the seven Phillips-head screws that are visible on the SNES's motherboard. Four are on the lower part of the board, one is on either side of the cartridge slot, and one is up near the audio/video output jack.
- 2.** Next, find the 7805 regulator behind the big metal heat sink. (See Chapter 3 for info on them, with pictures.) Remove the single Phillips-head screw to detach it.
- 3.** Flip the motherboard over, and you'll see four Phillips-head screws near the top. Take them all out. You can now remove the heat sink. However, although the plastic portion will be slightly loose, it won't come off until you've done some desoldering. The SNES motherboard is now completely free of the case.

## Removing Some Things, Just Moving Others

In order to make the SNES motherboard useable for a portable, we're going to have to remove some stuff. Other things, such as those blue capacitors near the top, can't be completely removed, but rather have to be moved someplace else and reconnected. Before we begin, let's identify the internal parts of the SNES motherboard shown in Figure 9-6.

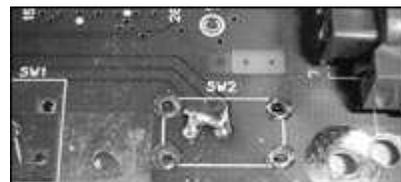


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**Figure 9-6**

Now that you know what those things are, we can start removing them! Get your desoldering iron heated up and do the following:

- 1.** Desolder the four leads on the *reset button* and the four leads on the *on/off power switch*. You can then pry these switches off the board using a thin flat-head screwdriver.
- 2.** Put a bit of solder between the switch contacts on the front of the board as seen in Figure 9-7. (You may want to use a short bit of paper clip.) This sets the SNES switch to a permanent "on," allowing you to turn the system on and off together with the rest of a portable's guts (such as the screen). Note that there is a little bit of green between the two contacts. This is the ground—try not to hit it with the solder, because this will short out the system.





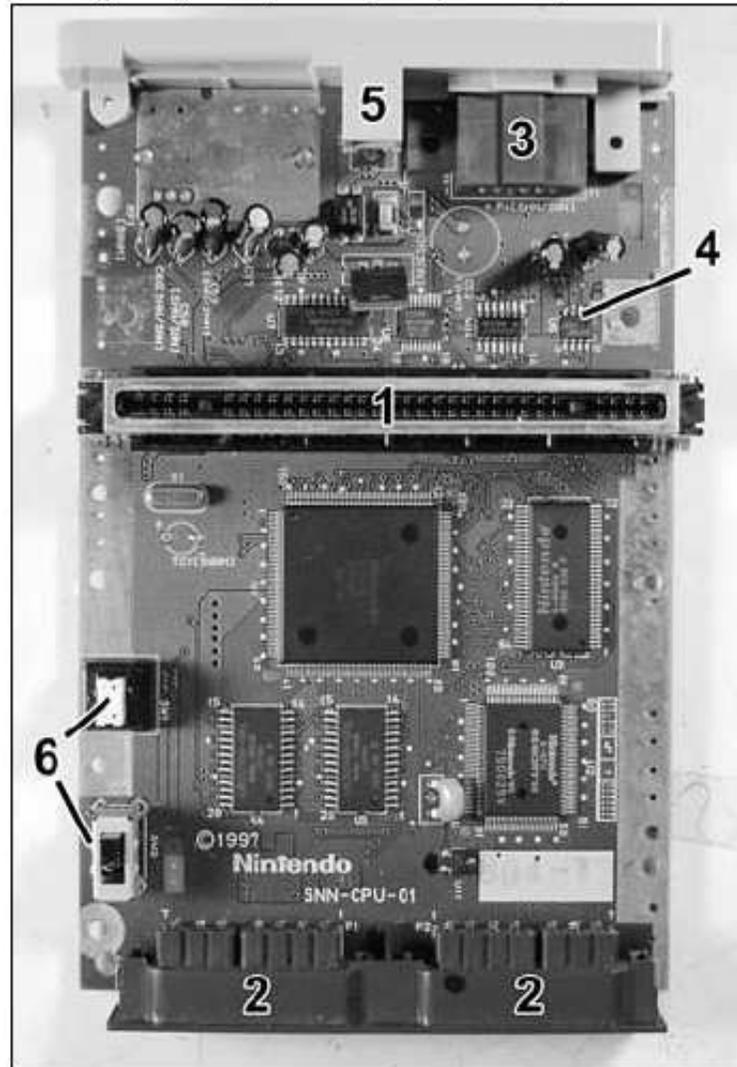
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**Figure 9-7**

- 3.** Desolder the twelve leads on the *audio/video jack* and the two big leads on the *DC input jack*. For the DC input jack leads, you'll probably have to melt and suck up a little solder at a time, as there's a lot of it there. Just keep working at it, and eventually you'll remove enough solder to pry the jack free.
- 4.** When all the solder is removed, pry the gray plastic backward, away from the main board. The DC jack will pull off with it, leaving the A/V jack behind. With the gray plastic removed, use a flat-head screwdriver to pry off the A/V jack as well.
- 5.** Yet another overly large (and thus portable-unfriendly) part consists of the *controller jacks*. Desolder the fourteen leads on the bottom of them (seven per port). The leads are rather thick, and it won't look like much solder is coming off them—that's because there wasn't much solder there to begin with, making them actually a little easier to desolder than your average lead. With the solder gone, rock the controller jacks back and forth until they pull free. You may also need to pry them off with a screwdriver.
- 6.** Desolder the three leads on the bottom of the 7805 regulator and remove it. Although this is an essential part, we'll discuss how to reconnect a new 7805 to the mini-SNES later in this chapter, and in both SNES portable projects.
- 7.** You'll notice some dark gray tabs on either side of the cartridge slot. These originally held the unit together, but now they're merely in the way. Using a large pair of pliers, grab onto each tab and bend it forward or backward. It should snap off easily. You've now removed everything on the mini-SNES board that you don't need. You'll need a power regulator, of course, but one can be hooked back up elsewhere so that it won't get in the way, as it would have if left in its original position. (More on this later.)

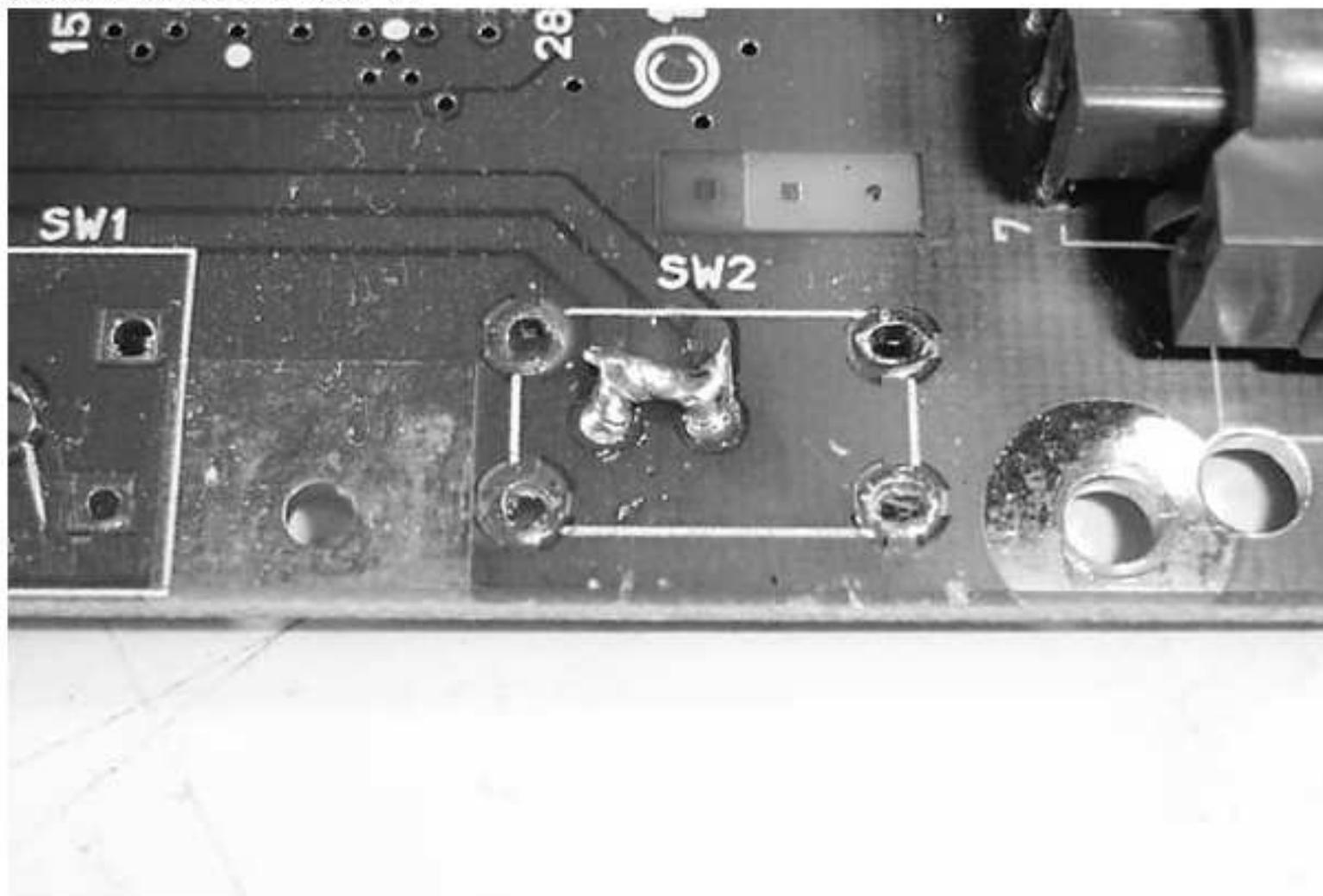
**Figure 9-6**

The SNES board with important parts labeled: 1) Cartridge slot connector 2) Controller ports 3) Audio/video output jack 4) Secret place to get left and right audio signals 5) DC power input 6) On/off power and reset switches



**Figure 9-7**

Jumping the power switch to be always "on."



## Rewiring All Those Darn Capacitors

Take a look at the mini SNES board. Notice how pretty much everything on it is fairly flat? That's because it mostly uses modern *surface-mount* components. These are components whose connections attach to—get this—the surface, and don't go through the board itself. That makes the mini-SNES a great machine to make into a portable!

Except, of course, for the eight chunky blue capacitors near the top of the board, and unfortunately the SNES needs these to run! Therefore, in order to make the SNES board as flat and portable-friendly as possible, they must be removed and rewired elsewhere, as described below.

If you're planning to use Chapter 11 to make a CNC-built SNES, then you should check the *Attaching the SNES board to the rear plate* section in that chapter to find out the slightly different way to perform the capacitor rewiring for that project. That will save you from having to do anything over.

**1.** Desolder the eight capacitors. Because of the nature of the mini-SNES board, this can be tricky, so here are a few tips:

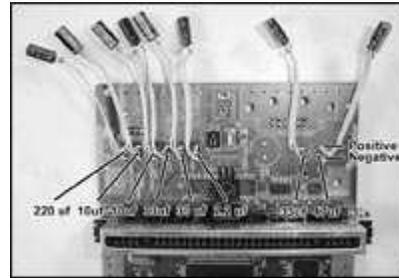
- ◆ If the capacitor won't come free after desoldering, rock it back in forth with one hand and heat up the leads. The leads will move, since they're being rocked back and forth, so that the solder won't remelt properly, thus making the capacitor loose and removable!
- ◆ Try resoldering the leads, then melt the old solder along with the new, and desolder it all again.

**2.** The eight capacitors are all different, but luckily, their rating is listed on each of them as a "uf " number. Figure 9-8 shows where to reconnect them based on these numbers. Use a two-strand of 2" ribbon cable for each. (Make sure that there are no stray strands flailing off the ends of the wires. These can cause short-circuits.)

**3.** These capacitors are polarized, meaning they each have a positive and negative lead. When reconnecting the capacitors, make sure that you hook the leads up the same way you found them. To check the polarity on a capacitor, look for the white band on one side near a lead—this indicates the *negative* lead. All the negative lead wires on the capacitors should attach to the lower row of holes, the ones closest to the cartridge connector.

**4.** After making sure that the hacked-up SNES works (in the next

section), put a thin strip of electric tape around the leads of each capacitor to keep them from touching other metal and shorting out.



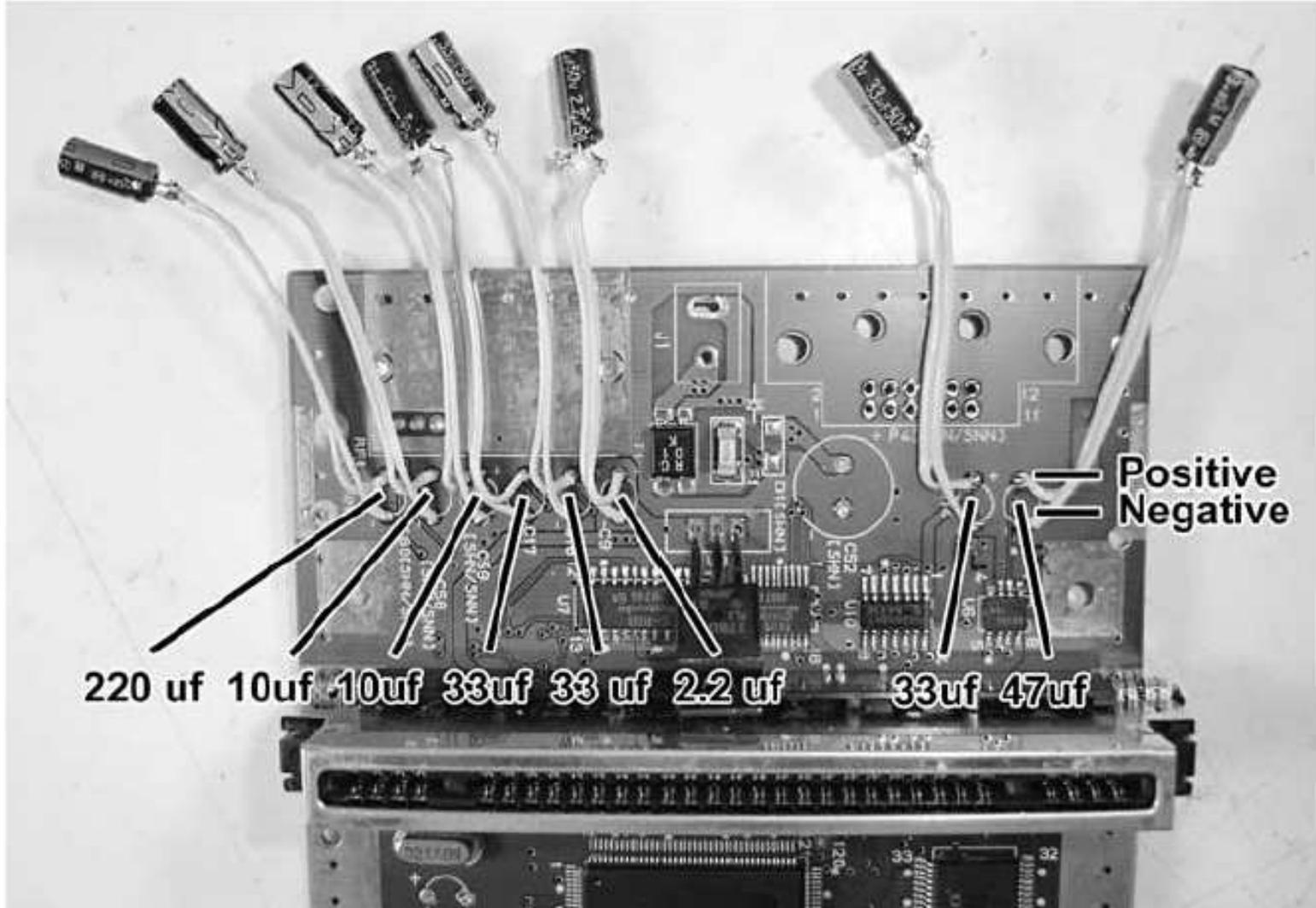
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**Figure 9-8**

The SNES motherboard is now a lot flatter and can fit into a portable case much better than it could have before. The placement of the capacitors and the length of the wires shown will work with both of the SNES portable projects I've designed for the following two chapters. If you're rolling your own SNES portable, you may need to position these capacitors in your own way, though the one here should work for most configurations.

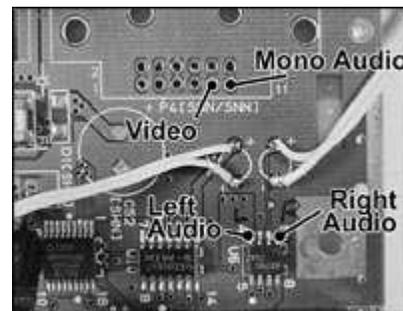
**Figure 9-8**

Reconnecting the eight capacitors.



## Reconnecting the Video and Audio Lines

Because you've removed the original audio/video jack, you're going to need a new way to get those signals off the motherboard. Figure 9-9 shows where to find the video, mono audio, and left and right audio signals on the mini SNES board.



*[click on image for full view](#)*

**Figure 9-9**

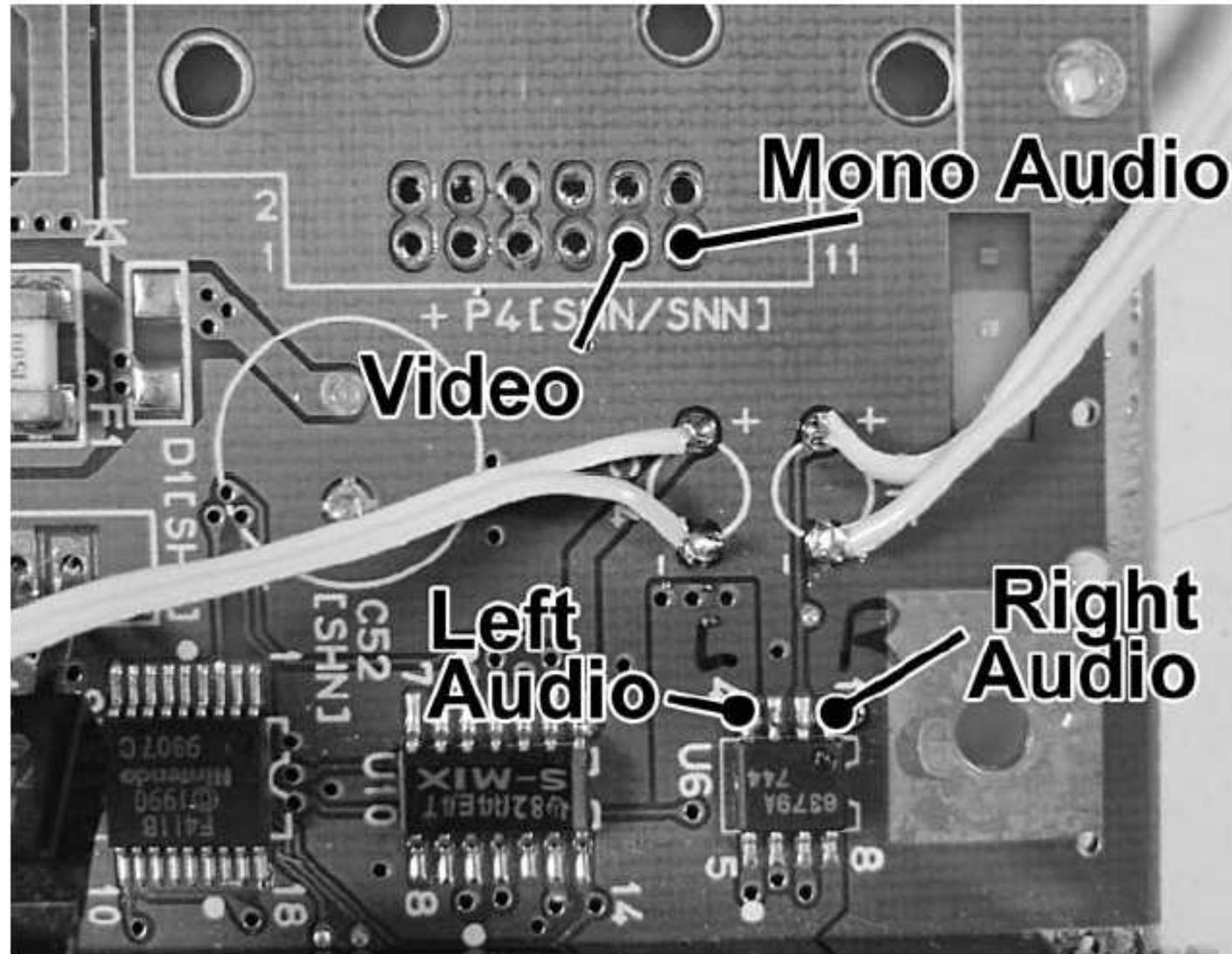
Some general notes about these connections:

- ◆ The mono audio source is for use with single-speaker pocket TVs.
- ◆ The small surface-mount IC will give you separate left and right audio signals. Use this for stereo sound when hooking up to the Sony PSOne screen. (More on this in the next chapter.)
- ◆ If the TV is hooked up to the same ground as the SNES, you won't need to attach separate grounds for the audio and video connections.

You can now hook the SNES board up to a video display, such as a pocket TV, and get the sound and picture through—except for one thing. The SNES isn't going to do squat without power going to it, so we'll discuss how to do that next.

**Figure 9-9**

Video, mono audio, and left and right audio sources.

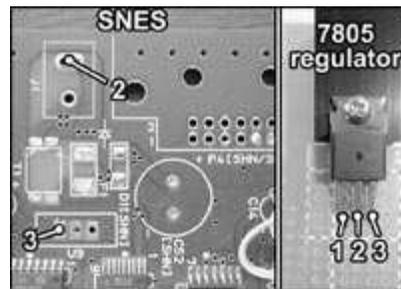


### Powering the SNES with Batteries

By this time the mini-SNES board should look pretty small and bare—but fear not, it will still work! Well, once we get some power going to it, of course.

The mini-SNES doesn't take much power, only about 350 mA at +5 volts. This can be provided to the system using a regulator, as described in Chapter 3. Here's how to hook one up to the SNES board.

1. You'll need one 7805 regulator (Radio Shack catalog #276-1770), a heat sink (Radio Shack catalog #276-1368), and a +7.5 volt (or higher) battery, as described in the next section. A piece of metal with a hole drilled in it can also be used as a heat sink.
2. Use a size-4 screw to attach a 7805 regulator to the heat sink. Insert the regulator in a piece of PC board as shown in Figure 9-10. You can mount the regulator however you like, as long as it has a heat sink and the leads don't short out against anything else. The ground (middle) connection of the 7805 can touch the heat sink, however.



*[click on image for full view](#)*

**Figure 9-10**

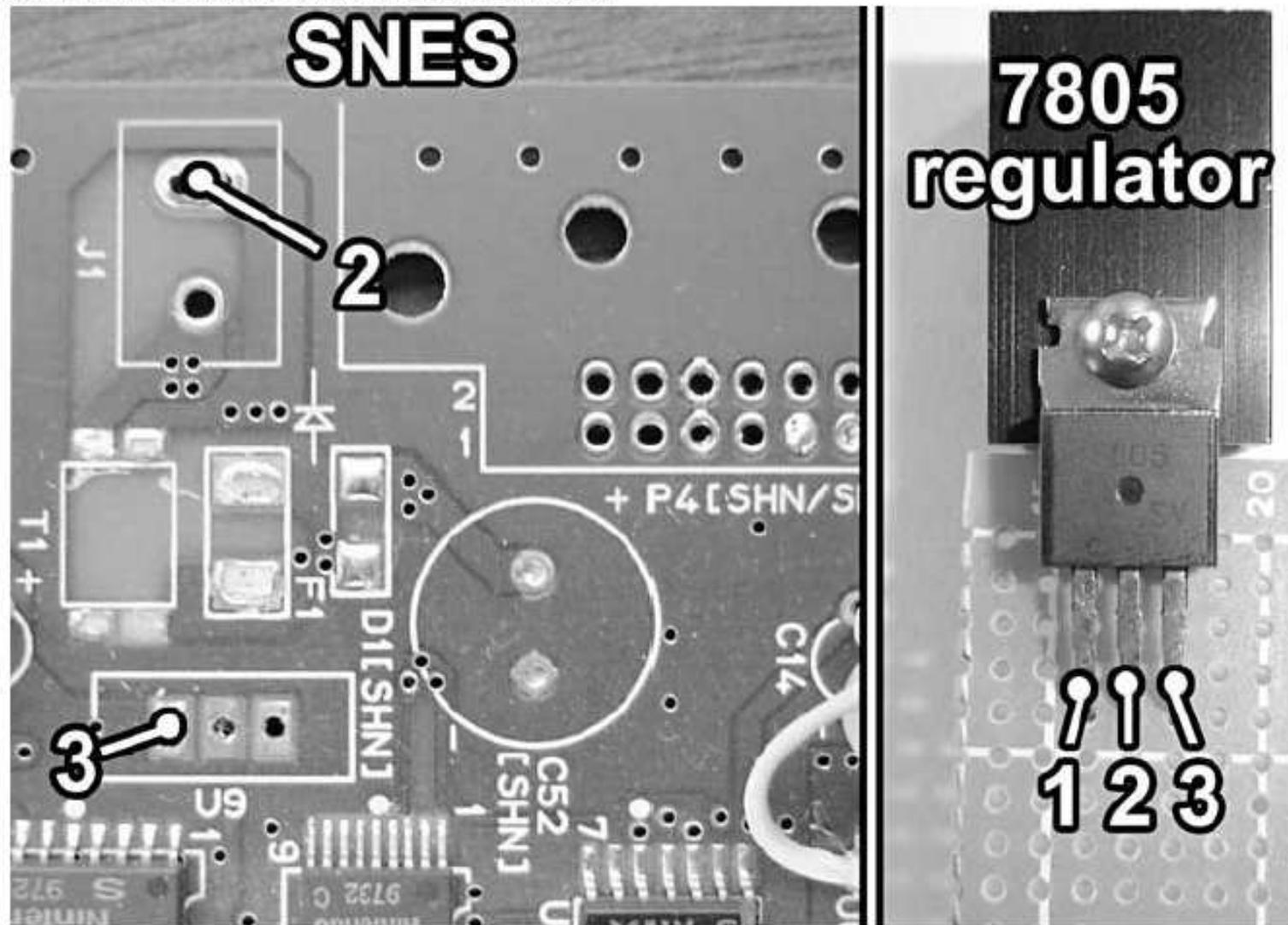
- ◆ Connect spot 2 on the SNES to spot 2 on the 7805 regulator. This is *ground*.
- ◆ Connect spot 3 on the 7805 regulator to spot 3 on the SNES. This is *+5 volts out to SNES*.
- ◆ Connect the negative lead of your battery to spot 2 on the SNES and the positive lead to spot 1 on the 7805 regulator. Spot 1 is *unregulated power in*. To use a switch to turn the SNES on and off, put it between the positive battery lead and spot 1.

This simple circuit will provide the correct amount of power to run your SNES. We'll talk about which batteries are good to use in the

your SNES. We'll talk about which batteries are good to use in the *Batteries to run the SNES* section. How to power the SNES is included in each of the SNES projects in the following two chapters. This is provided for reference or for those making their own style portables.

**Figure 9-10**

Hooking a new 7805 regulator and heat sink to the SNES.



## Easy Way to Power the SNES

A quick and dirty way to get a regulated power supply is to use the +5 volts coming off the pocket TV that you're using for your portable.

- 1.** Connect a wire to the +5 volts source from your pocket TV. This spot is indicated in Chapter 4. It's the same place you get +5 volts to run the white LEDs. This wire you've just connected is the *regulated power wire*.
- 2.** Connect the other end of the regulated power wire to spot 3 on the SNES board as indicated in Figure 9-10.
- 3.** Connect *ground*/spot 2 from the SNES to *ground* on the TV (also indicated in Chapter 4) or to the negative lead of the battery.

The SNES will now turn on when the TV does! The TV can be powered with the normal number of batteries it takes (typically four AAs), but you'll probably want to use batteries that store a lot of mAH, since you're powering two devices now. This method of powering the SNES will be used in Chapter 10.

One of the reasons that this works is because by using white LEDs instead of the bulb, you're saving about 50 percent of the power the TV usually consumes. This "extra" power can then be used to run the SNES.

### **Batteries to Run the SNES**

If you're going to be powering the SNES with a 7805 regulator, then the unregulated input voltage should be at least +7 volts. This is because once the battery drains below +7 volts, the regulator "drops out" and stops working. Here are some batteries that will work:

- ◆ A 7.2-volt rechargeable battery from Radio Shack. The Ni-Cd version has 2000 mAH of power and is catalog #23-330. The Ni-MH version has 3000 mAH of power and is catalog #23-431.
- ◆ A 9.6-volt rechargeable battery from Radio Shack. The Ni-Cd version (catalog #23-329) is the most common and it provides 1000 mAH of power.
- ◆ Both of the above battery types can be charged with the dual voltage Ni-Cd/Ni-MH charger (catalog #23-333).
- ◆ As usual, a Sony Infolithium Type L battery will work great and provide lots of power, but at an added cost.
- ◆ See Chapter 3 for more information on batteries and how they compare when powering game systems.

Once you've chosen a battery, you can connect it to the 7805 regulator and the SNES as described back in the *Powering the SNES with Batteries* section.

## Rebuilding the Controllers

What good is a hacked-up portable SNES if you can't control the game? This final section will discuss how to build you own custom SNES controller from scratch, and how to reconnect it to the game system.

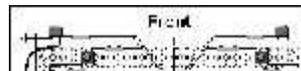
If you take apart a standard SNES controller, you'll find some buttons with rubber things under them and a circuit board. There's an IC (integrated circuit) on the board which is used to sense the buttons. However, it's a *surface mount* chip and therefore hard to remove using standard tools. Even if you could remove it, it's very hard to resolder it and hook it back up to anything. For these projects, the only useful parts of a SNES controller are the colorful buttons themselves.

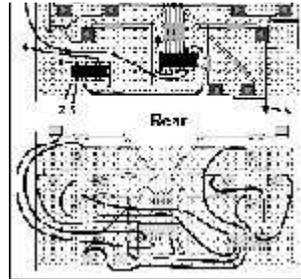
Okay, so if we can't use the guts of a SNES controller, what can we use? Why, two standard NES controllers of course! See, inside each NES controller is a 16-pin IC with the number "4021" on it. Wiring two of these together, along with buttons and resistors, recreates the hardto- remove IC in a SNES controller, allowing you to build our own controller with ease! (You can do this because the SNES controller works just like the NES controller—it just needs that extra IC to read the extra buttons.) Here's how to make a SNES controller:

### 1. Get the following parts:

- ◆ Two 4021 ICs from NES controllers.
- ◆ A PC board (Radio Shack catalog #276-147).
- ◆ Sixteen 10K-ohm, 1/4-watt resistors (Radio Shack catalog #271-1335).
- ◆ Twelve 6-mm tact switches (Digi-Key part #EG2495-ND, [www.digikey.com](http://www.digikey.com)). You can also use any small switch for the buttons/directional pad.
- ◆ Some wire.

2. Place the tact switches, 4021 ICs, and resistors on the front (non-copper side) of the PC board as shown in Figure 9-11. Note the position of the small dents on the ends of the ICs—they must be placed as shown in this drawing to work.





[click on image for full view](#)

**Figure 9-11**

**3.** Solder all components together where the leads touch each other in the drawing. As you can see, most of the wiring is done on the rear. Use the following guidelines:

- ♦ White lines indicate the leads coming off resistors. As you can see, many of these are connected together—this is the +5 volt source (same as connection # 1 to SNES).
- ♦ Black lines indicate wires.
- ♦ The arrows stand for *ground*, or *negative*. All grounds in this drawing connect to wire #5 going to the SNES.

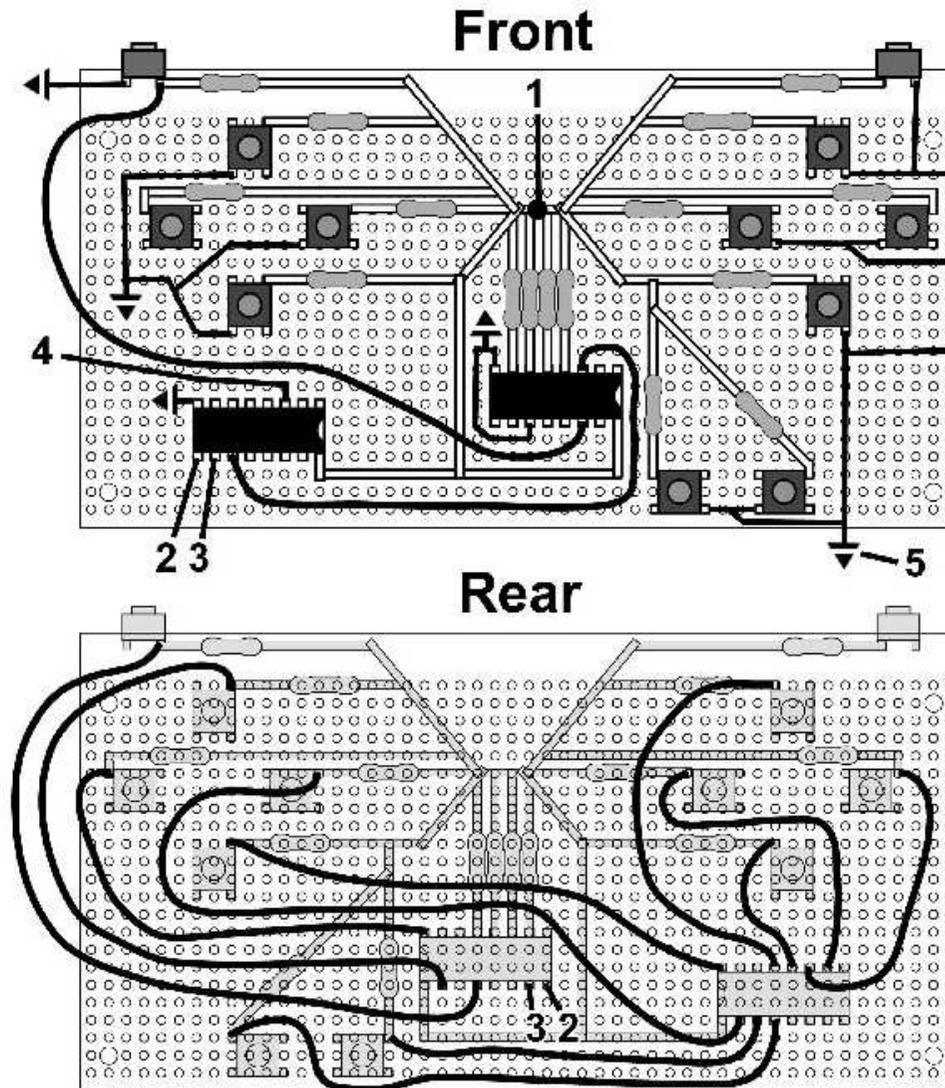
**4.** Connections 1 through 5 go to the Player 1 or Player 2 port on the SNES board, as shown in Figure 9-12. [Continued...](#)



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**Figure 9-12**

**Figure 9-11**  
Wiring two 4021 ICs together to make a SNES controller.



**Figure 9-12**

How the custom-made controllers hook up to the SNES board.



### Start Playing!

You can now hook this makeshift joystick up to a SNES and play games. The tact switches are positioned to fit with the plastic directional pads, and you can use the original plastic colored buttons as well. Naturally you're also free to make control buttons from any material you please.

Sometimes standard NES controllers can be hard to find, depending on the demand for them. As an alternative, you can grab two of the cheap joysticks pictured in Figure 9-13.



*[click on image for full view](#)*

**Figure 9-13**

These were third-party joysticks released for the NES in the late 1980s. They're dirt cheap at used-game stores now (\$5 at one place I checked, \$2 at another), and they contain the same 4021 IC as the regular NES controllers. Buy a couple of these and you'll be set. You can also get the 4021 IC from other NES controllers, such as the NES Advantage and the MAX. The rebuilding of the controllers is discussed in the instructions in the next two chapters. This tutorial is intended for those building custom portables of their own design and explains a little about how the controllers work.

### Chapter in Review

You can now play your hacked-up mini-SNES and run it off batteries! If you've got some cool ideas for a case, or want to install it in your car, or something, you should now have enough information to get you started. Otherwise, the next two chapters will take what you've learned and hacked so far, and allow you to build a complete portable SNES system out of it, either by hand or with CNC machinery.

Here's a quick recap of important stuff you've learned in this chapter:

- ◆ It's hard to open a mini-SNES case!
- ◆ You can remove a lot of stuff off the SNES board, but the blue capacitors have to be kept in order for the system to work.
- ◆ You can hook the audio, video, and power back up to the SNES after you've ripped those original parts off.
- ◆ A SNES controller works just like a NES controller except that it uses two 4021 ICs, since it has more buttons to keep track of.

### Materials You'll Need

In order to build this portable SNES, you're going to need to go around collecting (and buying) materials. The first things you'll need for this project are the major ones listed below:

- ◆ A mini-SNES with all the parts removed, as described in Chapter 9.
- ◆ A 5" PSOne screen, modified with white LEDs, as described in Chapter 4.
- ◆ A standard SNES controller. Since we'll only be using the buttons and directional pad (not the electronic guts), a nonworking one is fine.
- ◆ Two standard NES controllers, either actual Nintendo models or third-party controllers, such as the Quickshot joystick. Desolder the 16-pin 4021 ICs from both controllers as described in Chapter 9.

The rest of the parts fall into three basic categories: electronics, case-building parts, and decals. There are also some miscellaneous things to pick up as well, such as glue and sandpaper.

## Electronic Components

Table 10-1 shows a list of the electronic parts you'll need for this project. The most convenient place to get most of this stuff is from [Radio Shack](#). Using a common source such as Radio Shack allows us to standardize parts and layouts so that what you see in this book will match what you build yourself. (This especially applies to things such as the PC boards.) Most components at Radio Shack come in packages of more than one, so the list indicates how many packages you'll need, rather than an exact number of components.

**Table 10-1 Electronic Parts List**

Part name	Available from	Part or catalog #	Quantity/packages required
<b>10K ohm; 1/4-watt resistor</b>	Radio Shack	271-1335	4
<b>Grid-style PC board (2-3/4" or 3-11/16")</b>	Radio Shack	276-158	1
<b>1/8" panel-mount jack</b>	Radio Shack	274-251	1
<b>1/8" phone plug</b>	Radio Shack	274-287	1
<b>Battery holder; holds four AA batteries</b>	Radio Shack	270-391 or 270-383	2
<b>AA size Ni-MH rechargeable</b>	Radio Shack	2-pack: 23-525; 4-pack: 23-528	6 batteries
<b>Ni-MH/Ni-Cd battery charger</b>	Radio Shack	23-333	1
<b>DPDT submini slide switch</b>	Radio Shack	276-407	1
<b>Battery holder; holds four AA batteries</b>	Radio Shack	270-391a	2
<b>Tact switch; 6 mm</b>	Digi-Key	EG2495-ND	12

The tact switches can be obtained from Digi-Key, which has a handy Web site at [www.digikey.com](http://www.digikey.com). There's a minimum order of \$25, so it's not a bad idea to get your white LEDs at the same time.

The battery holders listed above will be used for their spring battery terminals. You can also get these from other devices such as hacked pocket TVs and old electronic devices. This will be discussed at more length in the Attaching the battery terminals section; you may wish to check ahead.

### Parts for Building the Case

Now let's move on to the materials you'll need for the actual construction of this portable's case. I'll list each item, what quantity to get, and where to find it.

- ◆ 1/16"-thick engraving plastic, 12" x 12" piece. This can be found at trophy/awards shops. (See Chapter 5 for more information.) I'd suggest a light gray SNES-style color.
- ◆ 1/16"-thick engraving plastic, 6" x 10" piece. Dark gray or black color. This will be used for the battery covers and other assorted small pieces. 6" x 10" is the minimum size needed, but it's not a bad idea to get a little extra (or ask for some scrap) in order to allow for mistakes ... or, as I like to call it, practice.
- ◆ 3/8"-thick balsa wood, 3" x 5". You can find this at hobby and model shops. It may come in a piece larger than 3" x 5", but will still be pretty cheap, and you'll have a few extra chances to cut the balsa parts correctly, which can be a little tricky.
- ◆ Aluminum strip, 3/4" wide, 1/16" thick, and 25" long. They have these in hardware stores near the screw aisle. Though you only need 25" of it, the stuff will likely come in a 4' or 6' length.
- ◆ Two aluminum strips, 1/2" wide, 1/16" thick, and 12" long. Depending on the store, these may come in the needed 12" lengths, though it's not a bad idea to pick up an extra one or two in case you need to rebend them. If you can find shiny steel strips, they'll look really cool and futuristic on your portable.

### Screws, nuts, and spacers

Don't leave the hardware store yet, because you'll also need the parts listed in Table 10-2.

Locate the section of the store that has a variety of screws and similar parts in a series of drawers. There's usually an entire aisle devoted to this.

**Table 10-2 Screws, Nuts, and Spacers Required**

Screw/nut Size	Type	Length	Quantity
<b>Size-6 screws</b>	Phillips; pan (round head)	3/8"	4
<b>Size-4 screws</b>	Phillips; pan (round head)	1 1/4"	2
<b>Size-4 screws</b>	Phillips; pan (round head)	3/4"	2
<b>Size-4 screws</b>	Phillips; pan (round head)	1/4"	4
<b>Size-4 nuts</b>	Standard	N/A	8

<b>Size-4 nylon washer</b>	Nylon; 1/4" outer diameter	1/4"	10
<b>Size-4 nylon washer</b>	Nylon; 1/4" outer diameter	3/4"	2
<b>Size-6 nut</b>	Standard	N/A	11
<b>Size-4 nut</b>	Standard	N/A	2
<b>Nylon hole plugs</b>	Fits 3/16" hole; black	1/4"	4

In addition, you'll also need six computer case screws. These are short, 1/4"-long size-6 screws that are typically used to hold PCI cards and the motherboard in desktop computers. The reason I suggest these is because they're cheap and because 1/4"-long size-6 screws are sometimes hard to find at hardware stores.

### Preparing the nylon spacers

We're going to be attaching size-4 nylon spacers to the front plate so that we can put size-6 screws into them. If this doesn't sound right, well—you're right. But if we thread the smaller size-4 spacer beforehand, it will accept a threaded size-6 screw. Here's how to thread them:

1. Grip each nylon spacer with a large pair of pliers, squeeze tight, and use a drill to drive a size-6 screw through it and back out again. This creates the threads.
2. Sand both ends of the spacer, so that glue will stick to it. Make a mark on the end that the screw entered from. This end should be up when you place these things.

## Decals

The way to make your portable unit really shine is to put some snazzy graphics on it. This also helps identify things like the brightness/volume controls and power jacks. In this section we'll discuss the two different ways of making graphics for your portable and how/when to apply them.

All the files are available on the companion Web site at [www.wiley.com/go/extremetech](http://www.wiley.com/go/extremetech), in a file called SNES1.

- ◆ Using your own printer. You can get some sticky-back adhesive printer paper and use it to make your decals. Print one of the following files: "SNES by hand Decals.ai," "SNES by hand Decals.pdf," "SNES by hand Decals.wmf," or "SNES by hand Decals.jpg." Make sure the printer is set to Actual Size, 100%, or No Scaling (the exact name varies by program). This ensures the decals print at the intended size and will fit your portable. To check, measure the big circle—it should be 5-3/4" wide. A thin dark line has been placed in the joystick and screen decals. Use your X-Acto knife to cut out these shapes. Try to cut just on the outside of the dark line so it won't be visible on the remaining decal.

If you're not using vinyl, you'll need something to cover the sides of your portable. You can use model paint, electrical tape, or any type of adhesive-backed colored material. (I'd highly suggest vinyl, however.)

- ◆ Sign shops/vehicle lettering shops. Most of these places have thermal vinyl printers these days. This is a machine that embeds color directly into sticky-backed vinyl, which can then be cut by another machine and used as decals. An advantage of decals made this way is that they are more durable and look better than ones you might print yourself. Here are the files to use:
  - ◆ The file "SNES by hand Decals.plt" will work for most shops that use the common Gerber equipment. It's all set and ready to go. I'd recommend printing it on a dark silver vinyl.
  - ◆ If they have a different system, you can provide them with one of the AI or PDF files, and they should be able to import that as an alternative. If you'd like to change some of the colors, the graphic artist on duty should be able to help you.

While you're at the sign shop, have them make you some 3/4" x 25" vinyl stripes. You'll need at least one, but they'll probably cut ten or so at a time, because it uses the same amount of vinyl.

Think of the extras as "error compensators." Pick a vinyl color that complements the engraving plastic you choose (for my portable, I used light gray). You can use these stripes to cover the sides of the unit later on, which is why the size is the same as that of the aluminum strips.

The graphics will be applied to various parts of the portable at different times during the construction procedure, so you should have them all made and ready before you begin.

### Miscellaneous Stuff You'll Need

Below are some other items you'll need for this project that don't neatly fit into the categories above:

- ◆ Fine-grade sandpaper.
- ◆ Several glue sticks.
- ◆ Superglue: The gel stuff doesn't spill but dries slower, whereas the liquid can spill but dries faster. Use whichever you're more comfortable with.
- ◆ One tube of two-part epoxy. Any two-part mix epoxy will work, even J-B Weld. "Quick" 5-minute epoxy is handy because it won't make you wait 24 hours to cure every time you use it.
- ◆ Extra package of X-Acto knife blades: There's a lot of cutting in this chapter, so be sure you're stocked up on blades. If the tip of the blade gets dull or breaks off, your cuts won't be as accurate, which can impair your project.
- ◆ Electric tape: This is for covering connections so that they won't short each other out. It can also be used to cover the outer walls of the case if you're not using vinyl stripes.
- ◆ An electric drill and the following bit sizes: 1/10" (or the closest you can find to it), 1/8", 3/16", and 15/64".
- ◆ A package of Velcro: The thin, elongated type works fine; you can cut it to size as needed.
- ◆ A 6" x 6" piece of screen-door mesh. Hardware stores usually have a roll they can cut you a piece from. The dark-colored plastic kind works best for this project.
- ◆ A piece of 1/10"-thick (or so) hobby foam, dark-colored. Check hobby stores or the crafts section of a megamart. Any sort of flexible, easy-to-cut foam-type material will work as long as it's close to 1/10" thick. It's going to be used for the shoulder buttons, so pick a color you'd like for that.

### Making the Front of the Case

The front of the case is only 3/4" thick, but it will contain almost all of the guts of the portable, minus the batteries. It has the big opening for the screen, as well as all of the game controls except for the shoulder buttons. The front of the case is the foundation of the entire portable. In this section we'll cut the front plate to form the shape of the case, then bend and attach the side walls out of 1/16"-thick aluminum to give it depth, so that it can enclose the guts.

#### Making the front plate

The front plate is a 1/16"-thick piece of engraving plastic that forms the main shape of the case. We'll cut it using a printed template, then cut and drill the holes in it for the various controls and openings.

All of the following files are available from this book's companion Web site at [www.wiley.com/go/extremetech](http://www.wiley.com/go/extremetech), in a file called "SNES by hand."

1. Download and print out the file "SNES by hand Front Plate.wmf " or "SNES by hand Front Plate.pdf," depending on which file your computer can open. Make sure that it prints at actual size, with no scaling. You may need to turn off borders and margins. Measure the width of the graphic after it prints—it should be 8-1/4" wide.

2. Cut the outside main shape of the paper pattern, and tape it down to your piece of engraving plastic as shown in Figure 10-2. Make a few extra slits as shown, so that you have additional places to hold down the paper with tape. 3. Use your X-Acto knife to make grooves along all the inside shapes, then along the outer shapes. Don't press too hard, or the knife may slip and cut too much plastic (or you).

FIGURE 10-2



*[click on image for full view](#)*

4. Once you've made the first groove on all shapes, remove the paper pattern. Use your knife to go back over all of the cuts and

make them a little deeper. Since the existing groove is guiding the knife, you can press a little harder this time. A few deep cuts over everything is fine, but the deeper you make the grooves, the easier the next steps will be.

5. Now, with all the shapes grooved at least twice (if not more), you can snap the main shape out of the plastic. Do this by bending the plastic backward, away from the colored front, along the grooved edges, with the groove on the outside of the bend. Pretend it's a sheet of paper you're trying to fold in half along the groove. Once it "folds" a certain amount, the weakened grooved portion will break.

6. Now you can remove the screen portion. Do this the same way that you removed the main shape, but only bend the edges of the screen backward until you can see a slight line appear on the back of the plastic. This line shows where the edge is. Make a few grooves along the line on the back of the plastic, and then bend the edge again. It should snap open in the middle. Repeat for each of the other four sides of the screen hole. Bend the screen out slowly and make a lot of grooves along the edges to help it. Overbending, or bending too fast, will cause the plastic to split open past the edges of the screen. The splits can be glued back in place, but should be avoided.

7. Once all four sides of the screen hole have splits in the seams, you can slowly work toward the corners, bending the plastic open as you go. Once you reach a corner, press it with your thumb to pop it out of the plastic. Do this for both corners on one side, and you should then be able to swing the plastic open like a door and pop loose the corners on the other side.

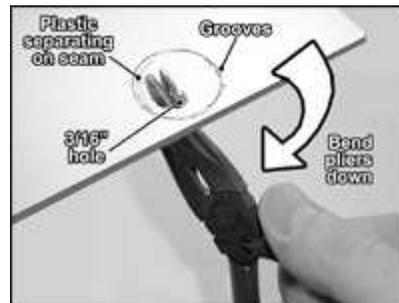
8. With the screen plastic removed, use a 3/16" drill bit to make a hole inside each of the remaining shapes on the front plate, except for the four small holes under the screen, for which you should use a 1/8" bit. For the directional pad, it's best to drill one hole inside each of the four arms.

9. With the pilot holes drilled, you can use them to remove the shapes. There are two methods to use, depending on the size and type of the shape.

- ◆ Smaller shapes: Use an X-Acto knife to carve away from the pilot hole along the sides of the shape. If you have a thin enough pair of needle-nose pliers, the following method will work as well.
- ◆ Larger shapes: Using your cutters or needle-nose pliers, grab onto the shape from below through the pilot hole. Then rotate the tool

the shape from below through the pilot hole, then rotate the tool to bend the grooves open. (See Figure 10-3.)

FIGURE 10-3



*[click on image for full view](#)*

10. When removing the plastic for the two large speaker holes on the lower left and right of the front plate, use needle-nose pliers to hold the lower portion as you pull the inner plastic out. This will keep the plastic from breaking on the thin edges.

You should now have a total of fourteen openings cut into the front plate. These include the holes for the directional pad, screen, brightness controls (two), volume controls (two), the four action buttons (X, Y, B, and A), the select and start buttons, and the two speaker holes.

If the engraving plastic does crack beyond the buttons or shapes, put a little superglue inside the crack and snap it back into place. An advantage to using textured engraving plastic is that it ensures these cracks are very hard to see if you've glued them nicely.

#### **Applying the first set of decals**

Now that the front plate is cut out, it's time to apply some decals! It's easier to do this now, because there are no buttons in our way yet, and we won't have to worry about messing up the LCD glass on the screen. Place the decals as follows:

- ◆ The "X/Y/B/A" decal fits between the four button holes. (X is the top button, and B, the bottom.)
- ◆ The "Select/Start" decal goes just below this, between the tilted curved slits, with "Start" on the right and "Select" on the left.
- ◆ The decal with the "+" shape goes around the directional pad hole.
- ◆ Finally, the main screen decal centers over the screen, and the

brightness/volume holes line up with the four holes near the bottom of the front plate.

If you're using graphics from a sign shop, put some water in a dish and add a drop of dish detergent. This creates a slightly soapy mixture that you can coat the sticky side of the graphics with to aid in the application.

**Note:** If the engraving plastic has a texture, you shouldn't use water to apply the vinyl, or it won't stick as well.

### Attaching Screw posts to the Front Plate

With the front plate cut and decal'd, we can now attach screw posts to the back (inside) of it. These allow us to connect components to the front plates, and screw posts of different heights allow the components to be placed at different depths depending on how thick they are. To apply the screw posts, do the following:

1. Download and print the file SNES by hand "Front Screw Posts.pdf " or "SNES by hand Front Screw Posts.wmf." You'll see a bunch of circles with a smaller circle inside and a number next to them. Use your X-Acto knife to cut out the outer hole of each circle.

The resulting holes should be 1/4" wide. You should also cut the outside main shape of the case and a few of the button holes to help you position it correctly.

2. Sand the back of the front plate and wipe off the resulting dust. This will allow the glue to stick better. Tape the front screw post pattern to the back of the front plate as shown in Figure 10-4. If you make a few extra slits near the sides of the pattern, you'll have more areas to tape down. Finally, use superglue to attach the correct length spacer into each hole. Be sure the end that you drilled into is facing upward. (See the materials list under Preparing the nylon spacers.)

FIGURE 10-4



*[click on image for full view](#)*

3. There are also a total of six size-4 nuts glued onto the back of the front plate, four of them on the sides of the screen hole. Before gluing them in position, sand one side of them. (Sanding nuts may sound ridiculous and, well, it is. But it helps glue stick to them.) Place the nut so that the flat edge is parallel to the flat edge of the screen.

4. Remove the paper pattern from the front plate—you may need to cut some portions loose with your X-Acto knife.

5. Attach a size-4 nut to the top of the two lower 1/4" nylon spacers, as shown in Figure 10-5. Center it by threading a size-4 screw through and placing it in the nylon spacer below—just be sure not to glue the screw down with the nut! [Continued...](#)

FIGURE 10-5



[click on image for full view](#)

### Bending and Attaching the Front Walls

Now, with all the screw posts attached to the front plate, it's time to bend the front walls and glue them down. This will be done in sections using your 1/16"-thick, 3/4"-wide piece of aluminum.

1. Sand the edge of the aluminum that will be touching the front plate, and make sure the edges of the back of the front plate are sanded as well—this helps the glue stick better to both surfaces.
2. Start by making a 90-degree bend around a standard pencil with 2-1/2" of aluminum remaining after the bend, as shown in Figure 10-6.
3. The bend should match the corner of the front plate near the joypad. Pencil in a 3/8"- high by 5/8"-wide rectangle on the metal, as shown in the Figure 10-6. This will be where the power switch goes. Cut down the two vertical slits with a hacksaw, and then grab the resulting tab with large pliers, and bend it out. Check that the power switch fits the hole; we'll be installing it later on.
4. To glue down the first bend, start by placing drops of superglue along the edge of the front plate. Then press the aluminum bend down and hold it for about 15 seconds. The superglue should now be holding, but take care not to let the long extending portion of aluminum hang down, or it will snap it loose. The best way is to keep everything on top of a somewhat large table. (So don't do this around dinnertime.) [Continued...](#)

FIGURE 10-6



[click on image for full view](#)

### Attaching the Front Walls, Continued

5. After the superglue is set, mix up a small amount of quick 5-minute epoxy. By "a small amount," I mean that when both parts are mixed together it's a blob about the size of a quarter—any more than that will be wasted. Use toothpicks to apply it to the inside seam of the first aluminum bend. This will further secure the wall. Wait 5 minutes. (This is exactly as long as Bruce Springsteen's "The River," so use that song as reference if you're a fan of The Boss.)

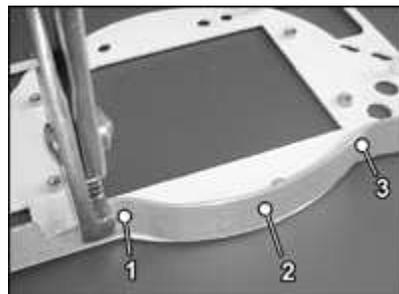
6. You can now make the second bend, which is along the top circular curve. Grasp the last glued portion of the aluminum with your pliers—this creates a bend point and keeps the glue from snapping loose. (See Spot 1 in Figure 10-7.)

7. Bend the aluminum away from the case to make the top of the circle, then back down to make the other side (Spot 2).

8. Finally, use the pliers to make a bend on the other side of the circle to match the straight portion (Spot 3).

When bending shapes such as the half-circle, it's important to bend the aluminum farther than you need. This is because when you let go, it'll spring back because it has a kind of memory. The idea is that if you bend it farther, it'll end up in the place you actually want it to go when it springs back. If you have to hold the aluminum in place when you glue it, then chances are it still wants to spring back, and it may break the glue bond after you let go.

FIGURE 10-7



[click on image for full view](#)

9. Glue this second bend down as described above. The glue should go from point 1 to 3 (as shown in Figure 10-7) but no farther. After the glue cures, it's time for bend #3! Start by gluing down the straight portion—Spot 1 in Figure 10-8. Put epoxy on the base of the 3/4" screw post to strengthen it, but only on the inside, so that it

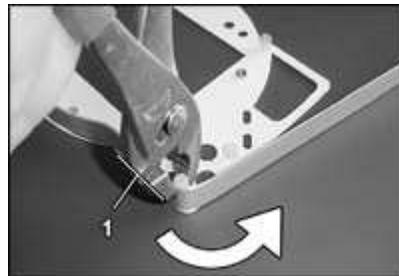
won't get in the way of the aluminum wall.

10. Let this portion set for about half an hour so that the epoxy can harden further— there's going to be a lot of strain when we make this next bend. Clamp onto the screw post and aluminum with your big pliers, and then bend the aluminum around the case, as seen in Figure 10-8.

11. Continue to bend the aluminum around the case in this fashion until it reaches where it began. Don't glue the rest of it down yet; simply check that the aluminum lines up with the edges of the engraving plastic. Make a mark where the aluminum meets the beginning, and use your hacksaw to cut it off at this point.

12. You can now glue the rest of the aluminum to the engraving plastic. First use superglue, then epoxy, as you did with the first bend.

FIGURE 10-8



[click on image for full view](#)

13. While the epoxy is curing, place a flat object over the walls (such as a big book) and a heavy object on top of that (such as more books or a bowling ball) to press down on it all. This keeps the walls as straight as possible. Even if you're using quick epoxy, it's best to leave the case to sit like this for at least a few hours so that the epoxy can cure as much as possible.

14. Take a look at the lower right-hand corner of the front half of the case, viewed from the rear, as seen in Figure 10-9. Make a mark  $\frac{1}{4}$ " from the screw post, and  $\frac{3}{8}$ " up from edge of aluminum. This will be where the power jack goes.

15. Use a  $\frac{15}{64}$ " bit to drill out a hole on this mark. [Continued...](#)

FIGURE 10-9



[click on image for full view](#)

### **Adding Details to the Front of the Case**

Now that the front half of the case is built, we'll add a few final details to it before moving on to the rear half of the case. These are mostly cosmetic, but essential nevertheless.

1. Cut small pieces of screen mesh and superglue them on the inside of the speaker holes. For best results, put two layers of mesh over each hole, one with the holes going left to right, the next with the holes going along a diagonal. This ensures a dense-looking mesh.
2. Take your 26" x 3/4" stripe of gray vinyl, and place it around the front of the case. Cut out the holes in the gray vinyl where the power switch and power jack holes are.
3. Place the on/off decal just below the power switch hole, with "ON" on the side closest to the center of the unit. Place the "Charge" decal over the power jack hole with the ends of the long decal going left and right along the wall. Start and end the vinyl stripe at the power switch—this way the seam is mostly covered by the on/off decal.

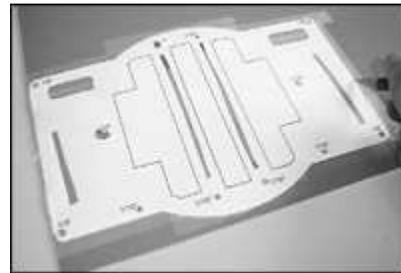
The front half of the case is now ready to have electronics and parts installed into it.

### Making the Rear Portion of the Case

We can now make the rear portion of the SNES's case. It will consist of a rear plate with a battery compartment on the back. The rear plate does not have a side wall as the front did. (Go ahead, breathe a sigh of relief.)

1. Print the file "SNES by hand Rear Plate.wmf " or "SNES by hand Rear Plate.pdf." Tape it down on some engraving plastic, as you did with the front plate pattern.
2. First, drill the holes. They are 1/10" and 1/8" in size on the rear plate. It's useful to have a decent variable-speed drill for this—the kind where the harder you squeeze the trigger, the faster the drill spins. Cheap drills have only a couple of speeds. Center the bit over the circle, and drill slowly at first for greater accuracy. Once you see plastic being chipped away, you can increase the speed and finish the hole. If you go full-speed right away, the bit may slip off the mark and put the hole in the wrong place.
3. Once you've drilled all the holes, you can make grooves along all the shapes and edges, as shown in Figure 10-10.

FIGURE 10-10



*[click on image for full view](#)*

4. With all the lines sliced, remove the paper pattern. You can now drill out and remove the five inner plastic shapes, as you did with the button holes in the front plate. These shapes are the two battery holes, the cartridge slot, and the holes for the left and right shoulder buttons.
5. Print out the file "SNES by hand Rear Screw Posts.pdf " or "SNES by hand Rear Screw Posts.wmf." Cut out the outer shape, the four screw holes, and a few of the inside shapes for reference. Tape this pattern to the inside of the rear plate. Glue four 1/4"-long nylon spacers into the indicated places.

The rear plate itself is now ready to have the battery compartment attached to it.

### Building the Battery Compartments

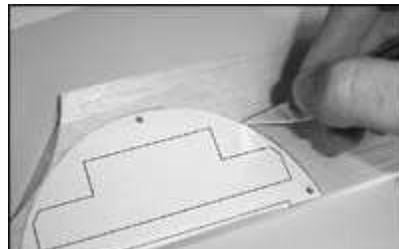
Now, with the rear plate cut, we can make the two battery compartments. Each holds three AA batteries, for a total of six batteries in this unit. We'll use the balsa wood to give the compartments depth, and then cover the wood with metal and engraving plastic, so that you'll only see it when the compartments are open.

#### Cutting the balsa wood battery risers

The first step is cutting the balsa wood battery risers. Balsa wood is fairly easy to cut with an X-Acto knife, allowing us to make compartments to hold the batteries in place. To cut the risers, follow the following procedure:

1. Print out the file "SNES by hand Battery Risers.pdf " or "SNES by hand Battery Risers.wmf." Cut out the two main shapes on the paper and tape them, one at a time, to your 3/8"-thick piece of balsa wood, as shown in Figure 10-11.
2. Start by drilling the three screw holes with a 1/10" drill bit. Then use your X-Acto knife to cut along the inside lines. Drag the knife in a smooth motion along the lines—don't "saw" with it. Every time you make a cut, the knife will go deeper. About three cuts should be enough to go completely through the material. Remove the center portion first, and then cut the outer shape. The side of the balsa wood with the pattern is the front, and you may want to make a small mark to indicate this.
3. Repeat these steps for the other battery riser. Keep the knife as straight up and down as possible—this will ensure that the edges of your balsa wood part are straight too, and allow for better gluing when you attach the walls. The walls are thin in some portions of these parts. However, if the wood breaks, you can easily reconnect it with superglue. Slush a lot of glue on the thin portions even if they don't break—it will create a kind of protective "shell."

FIGURE 10-11





*[click on image for full view](#)*

You should now have two balsa parts cut. One of them has the notch for the cartridge, and we'll refer to this one as the notched battery riser from here on out.

### Applying the Metal Siding

Now that the balsa battery risers are cut, you can apply the metal siding to them. This covers the imperfections of the wood, and also looks cool. The method for doing this is somewhat similar to that for making the side walls for the front of the case, but the metal is glued on the sides of the balsa wood rather than the edges. We'll start by putting metal on the notched battery riser first.

1. Get out your 1/2"-wide x 12"-long thin metal strips. Sand one side of the strips with fine-grit sandpaper. If there's a plastic coating on one side, leave it on there for now and sand the other side—the plastic coating will protect the surface of the metal while you work with it. If no side comes covered with plastic, sand the side that looks the worst.

2. Make a center mark on the sanded side of each piece. The pieces that I got were 12" long, so the mark was, well, 6", of course. Place several drops of superglue on the center spot and press the notched battery riser against it, as seen in Figure 10-12. The back of the riser should be flush with the edge of the metal, and the front (the side that had the paper pattern on it) should have a 1/8" gap above it.

FIGURE 10-12



[\*click on image for full view\*](#)

3. Let this cure for a few minutes, holding the balsa firmly against the metal. If the sides of the balsa aren't perfectly straight (which is probably the case, since it was cut by a human) be sure that whatever wood is touching the metal has glue on it and the metal itself looks straight. This is why the balsa is on the inside—the metal will make it look straight when everything is done.

4. After the center point is cured and well attached, bend the metal sides up and make a mark on the aluminum where the sharp corner is, near the screw hole. Then make a mark 1/2" up from that. Cut the metal off at this second mark using tin snips or heavy scissors.

the metal off at this second mark using tin snips or heavy scissors. Pre-bending the metal strips can make this process easier, but it may have the side effect of not looking as even and smooth in the end.

5. Bend the metal over the wood at the sharp bend spot. There are a couple of ways you can do this, and naturally each has its own pros and cons:

By hand: Least damaging, but the corner may not be as tight.

Using big pliers: Gets a tighter bend, but might scratch the metal (although if you're covering the metal with vinyl, this isn't a problem, of course). For aesthetic protection, put some paper between the plier teeth and the metal and then bend it, even if there's a plastic coating on the metal.

Pre-bending the corner using a vise: As with the pliers, this can mar the metal, so use paper or cloth to protect it. However, using a vise can result in a nice tight bend.

6. Once you've made the bend, glue down the last portions of the metal. Finally, cut a 3-3/4"-long portion of metal, and glue it inside the notch for consistency. The finished notched battery compartment should look as shown in Figure 10-13.

FIGURE 10-13



*[click on image for full view](#)*

7. Repeat the procedure for the other unnotched battery riser. If you're using a standard 12" piece of metal, you'll notice that the ends don't quite meet after being bent around the wood. Glue a small portion of metal in there to bridge the gap.

You've now built the battery compartments. In the next few sections we'll make covers for them and attach them to the rear plate.

If you're concerned about how well you can manually cut these last

If you're concerned about how well you can manually cut these last portions of metal, keep in mind that they'll be mostly hidden when a cartridge is installed. (Shhh! Trade secret.)

### **Making the Battery Compartment Covers**

Okay, let's make the battery compartment covers. These will use Velcro stuck to the balsa wood riser to hold the batteries in place. There is no file for cutting them, so instead we'll trace the shapes by hand. The reason? The covers must fit over the battery compartments, and since those were made of balsa wood and bent metal, there's a very slim chance that a computerdesigned pattern will match a human-built half-circle. Not to rip on humans (being one myself ), but it's true.

1. Place the battery compartment down on the front of the engraving plastic and trace around it with a pencil. If you want to use a dark color for the battery doors, you should trace the battery compartment shapes onto a piece of paper, and then tape that to the front of the engraving stock for cutting. You could mark and cut the black engraving stock from the back, but it doesn't always make as clean of a break as doing it from the front.

2. Make grooves along the lines and snap the shape out of the engraving plastic, as you did with the plates. We'll put Velcro on the doors and battery compartments a little later on. The shape you make by tracing will be a little bigger than the actual piece was. Because of this, cut slightly inside the line to create the correct shape in the engraving plastic. It may take a couple of tries to get it perfect but that's why I suggested getting extra engraving plastic back in the materials section.

### **Attaching the Battery Compartments to the Rear Plate**

With the battery compartments and their covers ready, we can now start attaching things to the rear plate. Don't worry—we're in the final stretch of building the case, and we'll start the actual wiring of electronic guts very soon. With that pep talk out of the way, here's how to attach the battery compartments.

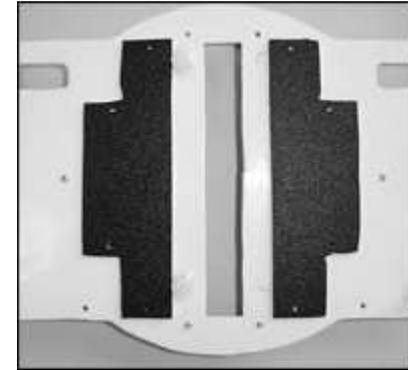
1. Place the battery risers against the rear plate of the unit. The notched battery compartment should be on the left. On the right side of the battery compartment, place the SNES "brag" label decal just to the side of the unnotched battery compartment. (There's a curve on the decal for reference.)
2. Insert 1/2"-long size-4 screws into the two side screw holes in each compartment and the two lower ones to secure the compartments to the rear plate. (We'll put screws in the top two holes later.)

Now it's time for the morale-boosting break—we've done quite a bit and you may feel weary. Go ahead and hold the rear plate against the front half of the unit. Presto! It's almost like it's actually done, isn't it? Feel the depth, the smooth lines, the sleekness of it all. Pretend you're playing your favorite SNES game . . . on a beach . . . at sunset . . . Feel better yet? Back to reality! I had to give you a breather since this next part is a little tricky—making the battery backers! This sounds like an organization that collects donations door-to-door, but it's actually two parts cut out of engraving plastic that hold the battery terminals. To make them, do the following:

1. Print out the file "SNES by hand Battery Backers.pdf " or "SNES by hand Battery Backers.wmf." Cut the outside shape, and then tape the pattern down to some scrap engraving plastic. (The reason they're stuck together like two Tetris blocks that should get a room is so that you'll only have to make one cut down the middle, instead of two separate cuts.)
2. Use a 1/10" bit (or similar size, such as 5/64") to drill the holes, and then make grooves with your knife along the lines, just like when you cut the front and rear plates. Remove the paper, recut the grooves, and snap the pieces free.
3. Superglue the battery backers to the inside of the rear plate as shown in Figure 10-14 (where the four screw posts are). The long edge of each battery backer should line up with the hole, and the rest of it will overlap the hole so that the glue has someplace to stick. On the inside of the battery compartments, all the holes should be showing, at least a little. As long as you can get one wire down each,

you'll be okay. [Continued...](#)

FIGURE 10-14



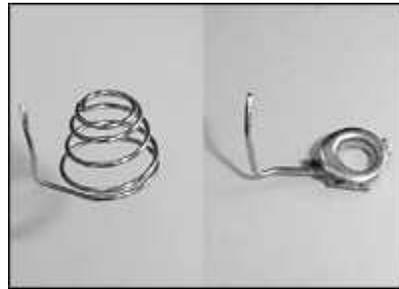
[click on image for full view](#)

### Attaching the Battery Terminals

With the battery backers in place, it's time to install the battery terminals. You can tear apart an old device to get these (such as a junk Walkman, flashlight, or pocket TV from one of the other projects in this book), or cut apart a battery holder from Radio Shack. A few that will work for disassembly are catalog #270-391 or catalog #270-383. (A photo of these battery holders can be seen in Chapter 11.) Snip the plastic apart on the battery holders with your cutters to get the terminals out. However you get your terminals, you'll need four of the springy negative ones and four disc-shaped positive ones. To install them on the battery backers, use the following procedure:

1. Bend the lead coming off each terminal as shown in Figure 10-15. You may notice some metal flared out on the back of the disc-shaped positive terminals—use your big pliers to squash it flat so that the disc stays on the wire.

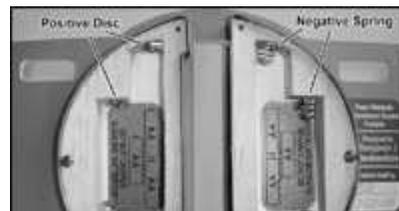
FIGURE 10-15



[click on image for full view](#)

2. Place the terminals and decals inside the battery compartments as shown in Figure 10-16, snaking the leads down the holes. The best way to get the terminals in good position is to actually put batteries in, so that they will press the terminals into the proper positions. This is especially true of the positive disc-shaped terminals—they should be centered on the battery as well as possible.

FIGURE 10-16



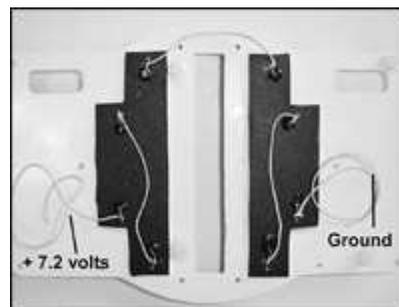


[click on image for full view](#)

3. Once the terminals are in place, you can then place a bit of superglue on the leads on the other side of the plate. Once the superglue dries, you can remove the batteries and use epoxy to secure the leads permanently. Just be sure that some bare metal is showing on the inside so you can still connect wires! You may also want to use small bits of engraving plastic to put behind the terminals to support them, as seen in the figure. It mostly depends on how well the balsa part ended up being cut.

4. Hey, remember your soldering iron? I know we haven't used one yet in this chapter, but now's the chance! Attach wires to the back of the rear plate as shown in Figure 10-17. Melt the solder strand directly on the terminal wires for best results—this allows the rosin core of the solder to adhere to the metal of the terminal.

FIGURE 10-17



[click on image for full view](#)

Use 10" wires for the positive 7.2 volts and ground wires. These will be the positive and negative battery wires. Color them red for positive and black for negative so that you can tell them apart after the SNES board is installed. As you can see, the battery terminals have drops of epoxy on them, and there's also a little epoxy in each drill hole.

#### **Putting Velcro on the battery compartments and covers**

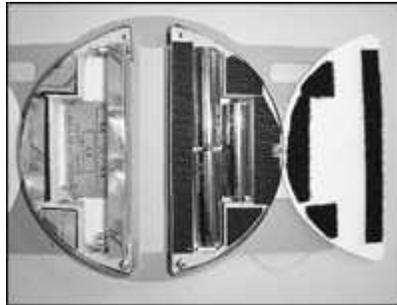
The easiest way to attach the battery compartment covers is with Velcro. Here's how:

1. Cut up pieces of Velcro, and put them on the balsa as seen in

Figure 10-18. Cut identical pieces for the doors themselves and place them Velcro-side down on the balsa pieces.

2. Peel the backing off, then press down the door—all the Velcro will be automatically in the right place! [Continued...](#)

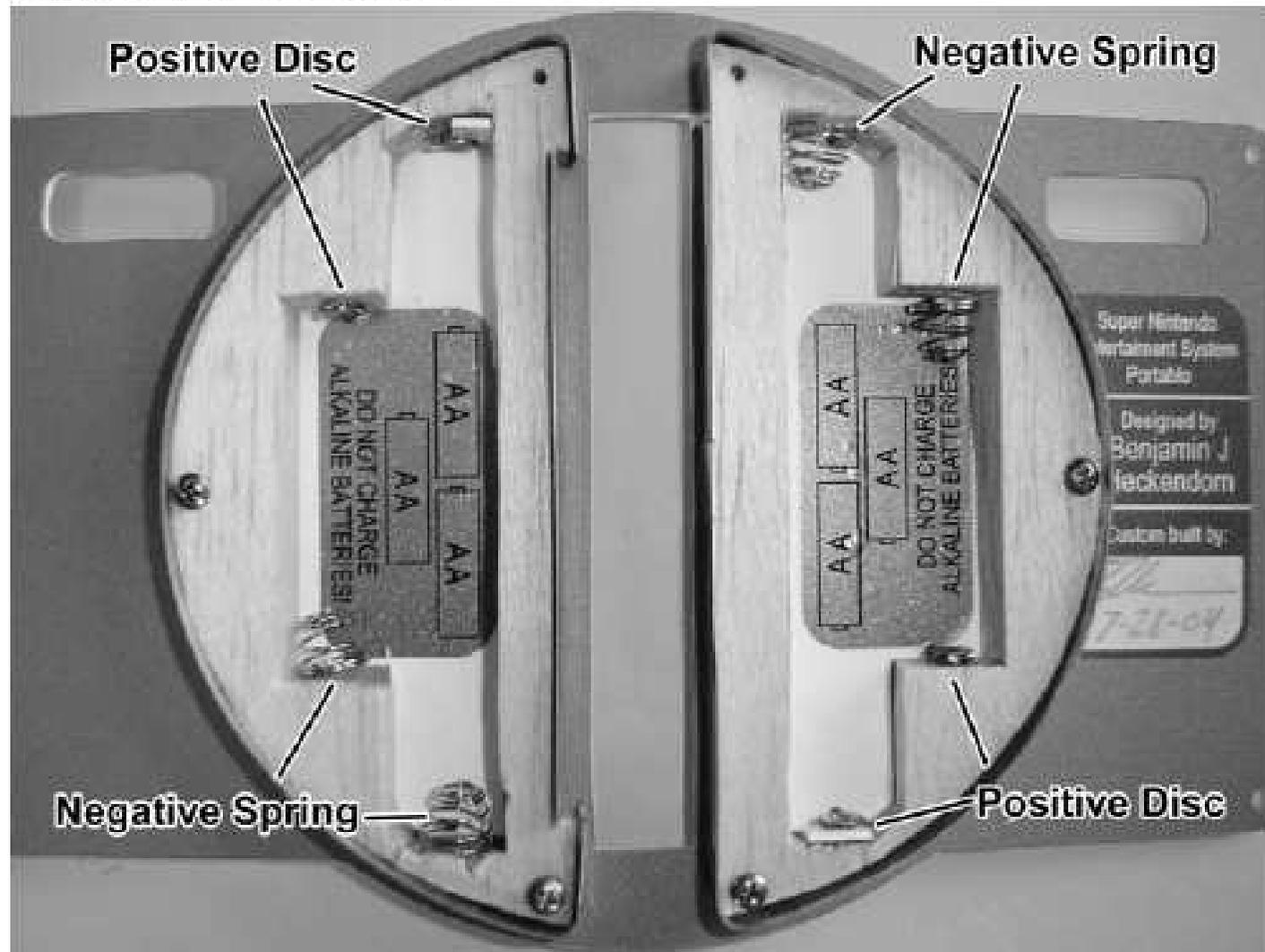
FIGURE 10-18



[click on image for full view](#)

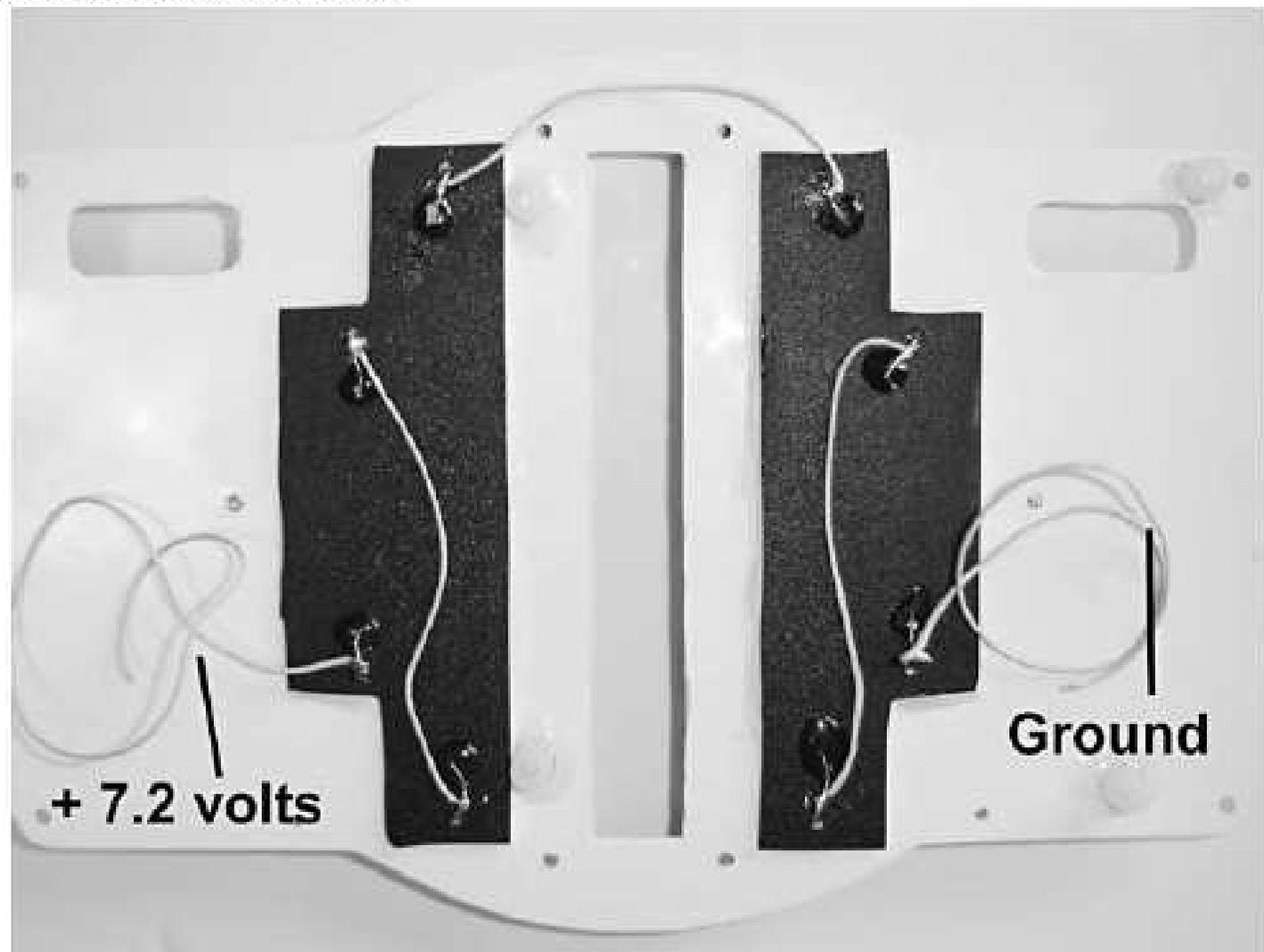
**FIGURE 10-16**

The placement of the battery terminals and decals.



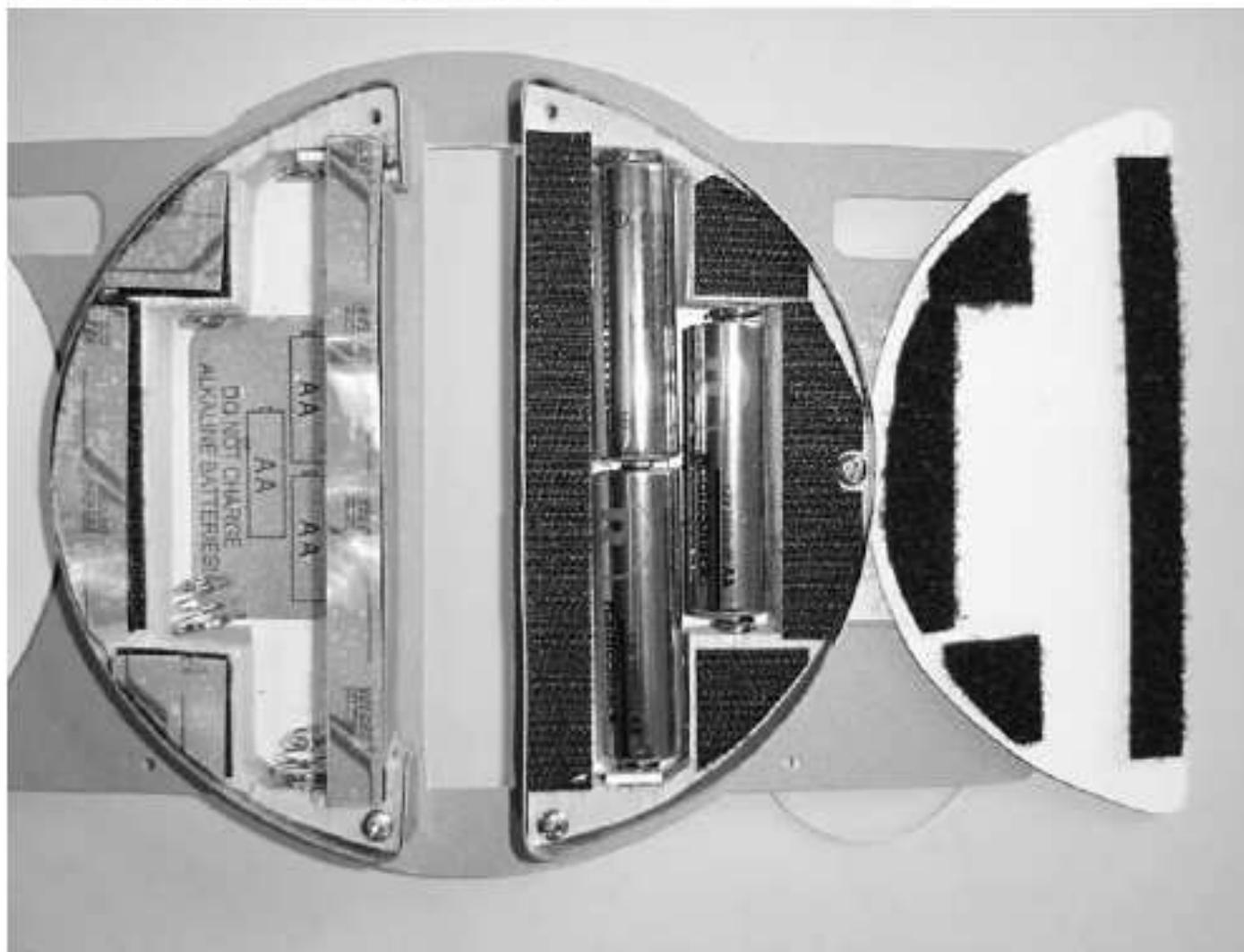
**FIGURE 10-17**

Attaching power wires to the battery terminals.



**FIGURE 10-18**

Velcro placement on the battery compartments and covers.



### Wiring the Unit

At this point both the front and rear of the case are finished. Now we can start the actual wiring! This will involve installing the PSONe screen, making the PC boards that contain the buttons for the controls, installing the SNES board, and then wiring all of these things together so that the SNES can run.

#### Installing and wiring the PSONe screen

The PSONe screen will install to the inside of the front plate between the four size-6 nuts. Before it's secured in place, the new brightness and volume buttons will need to be made, since they fit between the screen and the plate.

1. Cut two pieces of 1" x 1/4" engraving plastic, and hot-glue them to the back of the front plate over the volume and brightness holes, as seen in Figure 10-19. You can then accurately superglue the nylon hole plugs to the engraving plastic pieces from the front. Once they're attached, remove the glue to pull the buttons free.

FIGURE 10-19



[\*click on image for full view\*](#)

2. Superglue a size-4 nut between the black caps—this will provide the proper depth when they are placed in the case.
3. We can now move onto the screen and speakers. Desolder the wires off both speakers and extend the plugs by about 2", as shown in Figure 10-20.

FIGURE 10-20





[click on image for full view](#)

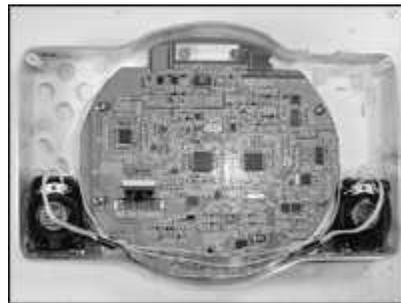
4. Place the volume and brightness buttons into the holes on the front of the unit. Disconnect the two white plugs from the bottom of the PSOne screen. Plug the extended speaker wires into their original jacks on the screen, near the volume and brightness buttons.

5. Carefully set the screen into the front of the case as seen in Figure 10-21. Then use four 3/8"-long size-4 screws to secure it to the four nuts around the screen hole.

6. Place the speakers over the mesh and hot-glue them in place.

[Continued...](#)

FIGURE 10-21



[click on image for full view](#)

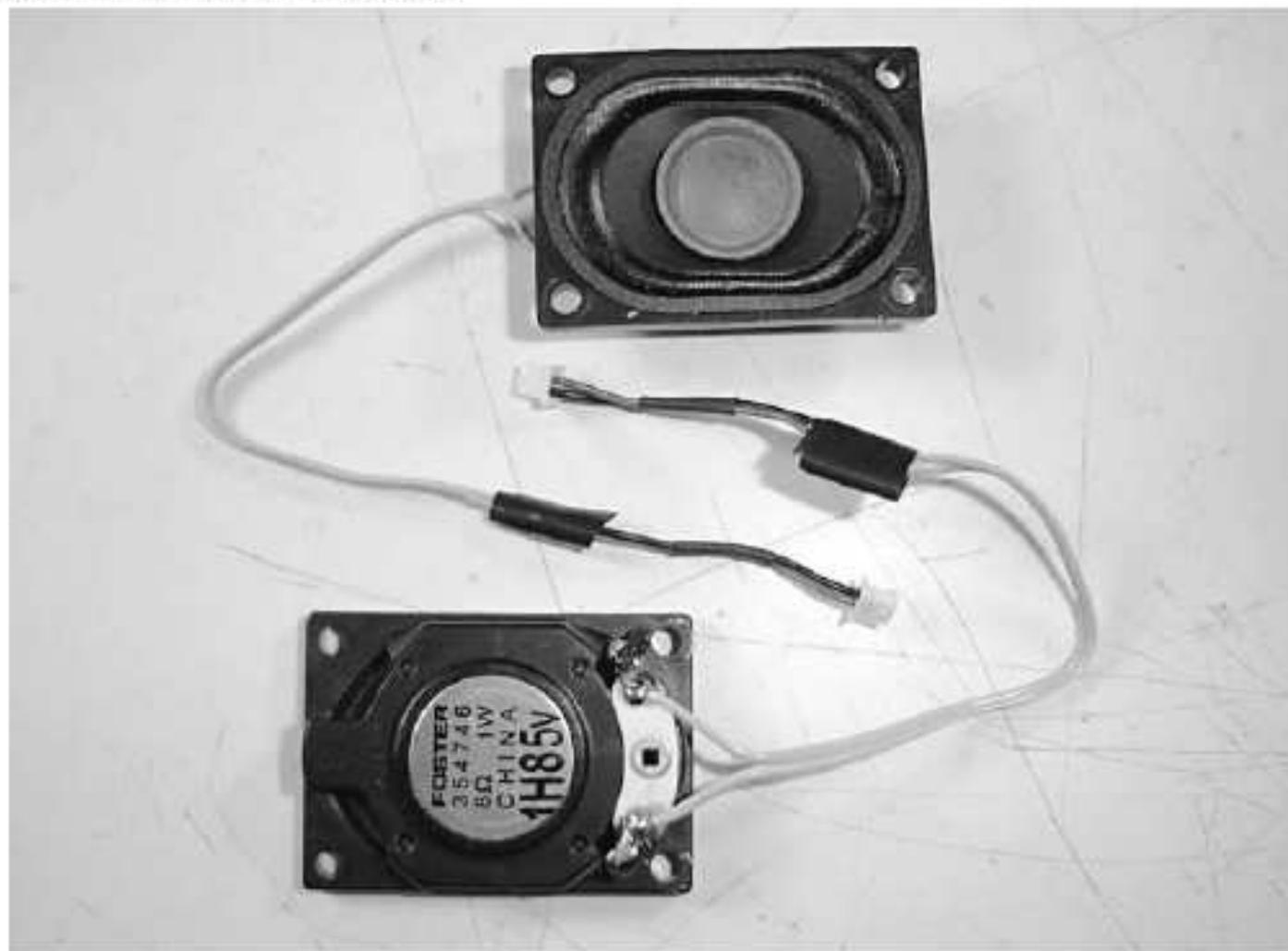
**FIGURE 10-19**

Front and back of the new brightness and volume buttons, glued in place.



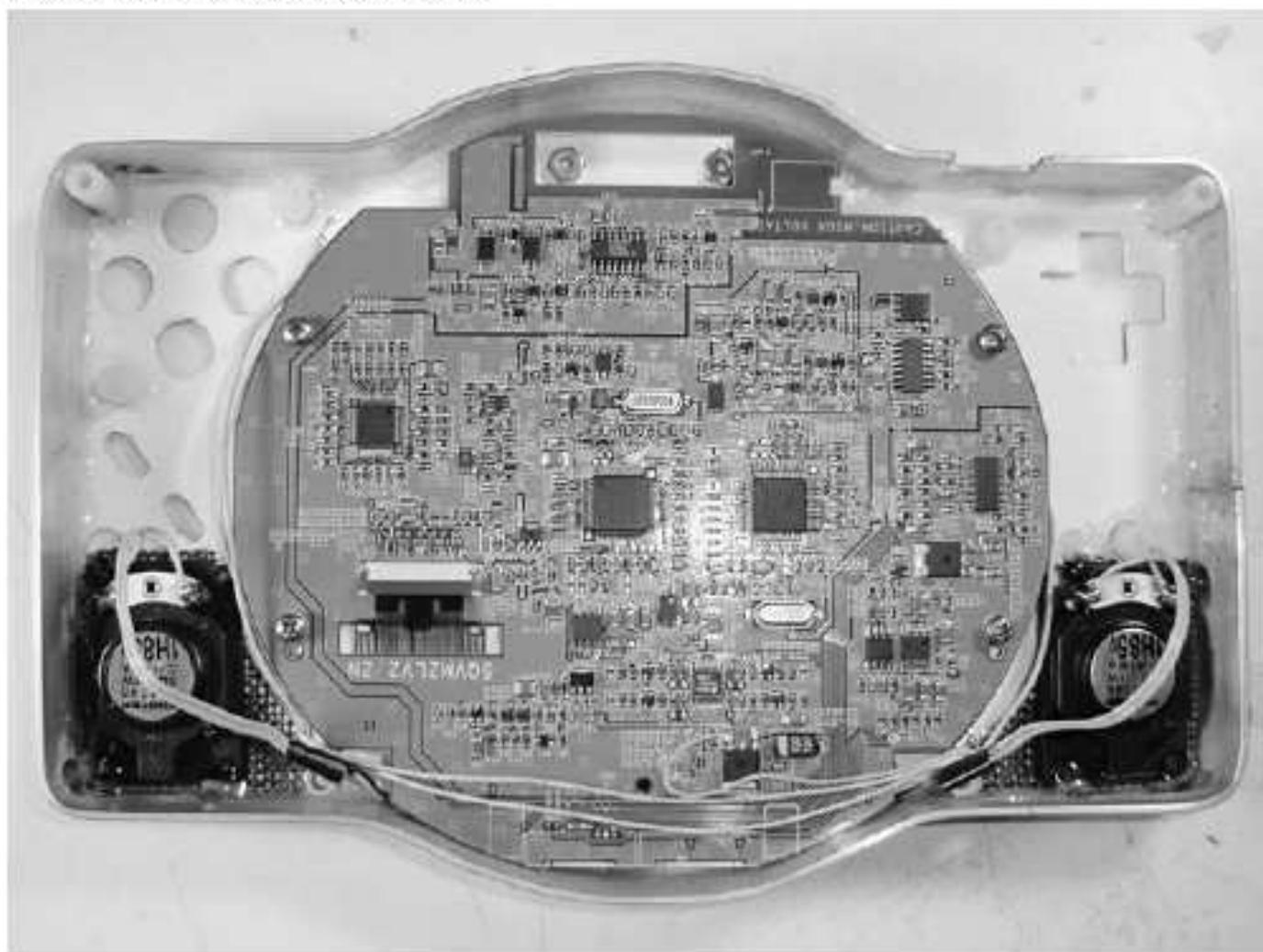
**FIGURE 10-20**

The PSOne speakers with new, longer plug wires.



**FIGURE 10-21**

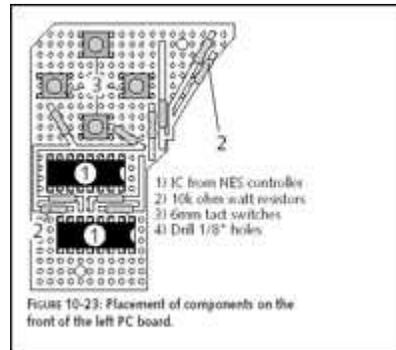
The PSONe screen inserted into the front of the case.





on a resistor, so you can use it to make almost all of the connections required. Put the resistor leads through the holes that they're shown to end at in the drawing. Solder them to the copper on the other side, but don't snip the excess off yet, as it may be handy when wiring the back.

FIGURE 10-23



[click on image for full view](#)

4. The holes on the drawing will match those on your PC board. Place the resistor leads in the holes specified, and solder them in place on the other side—you can snip off the excess lead later. The actual connections from the resistor leads to the switches and ICs will occur on the back of the board.

5. The spots where the white lines "meld" into each other indicate that you should solder the resistor's leads to each other at that point.

6. Be sure that the ICs are placed correctly, with the dents on the right-hand side (as they appear in the drawing).

Now that the components have been placed on the front of the board, it's time to make connections on the back of the board. Using wires or bits of extra lead taken off the resistors, make the connections shown in Figure 10-24.

- 1) IC from NES controller
- 2) 10k ohm watt resistors
- 3) 6mm tact switches
- 4) Drill 1/8" holes

FIGURE 10-24



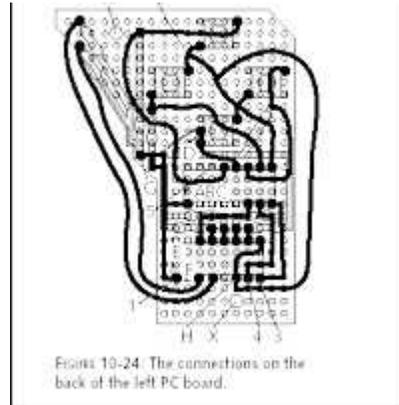
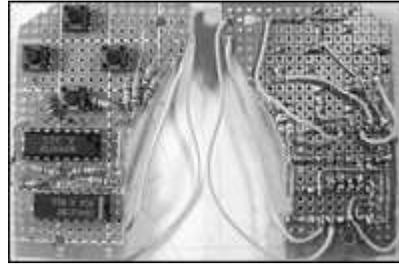


FIGURE 10-24 The connections on the back of the left PC board.

*[click on image for full view](#)*

1. Use wires or bits of extra lead for the thick black lines. The circles at the ends of them indicate where they should be soldered to leads.
2. On the lower IC, you can see several short connections from the resistors to the IC. These can be accomplished by simply blobbing solder between the two copper pads.
3. In order to keep them from criss-crossing on the drawing, some wires are shown longer than necessary. (This excludes the connections with a labeled length of wire.)
4. The connections to the IC leads labeled 1–5 should be made to a 10"-long five-strand of ribbon cable. On the unattached end, make a mark on the #1 wire for later reference. This five-strand of cable will go to the SNES board and connect to the controller.
5. Connections A–H should be made to an 11"-long eight-strand of ribbon cable. On the unattached end, make a mark on the "A" wire for reference. This cable will connect to the buttons on the right PC board.
6. Drill 1/8" holes at the spots marked "X."
7. The two resistor connections in the upper left of this drawing will go to the left and right shoulder buttons later on. Okay, that wraps up the left board. The front and back of it should look like what's shown in Figure 10-25. Please note, the 1–5 and A–H ribbon cable connections are not shown so as not to obstruct the rest of the board. These connections will appear in later photos, however. [Continued...](#)

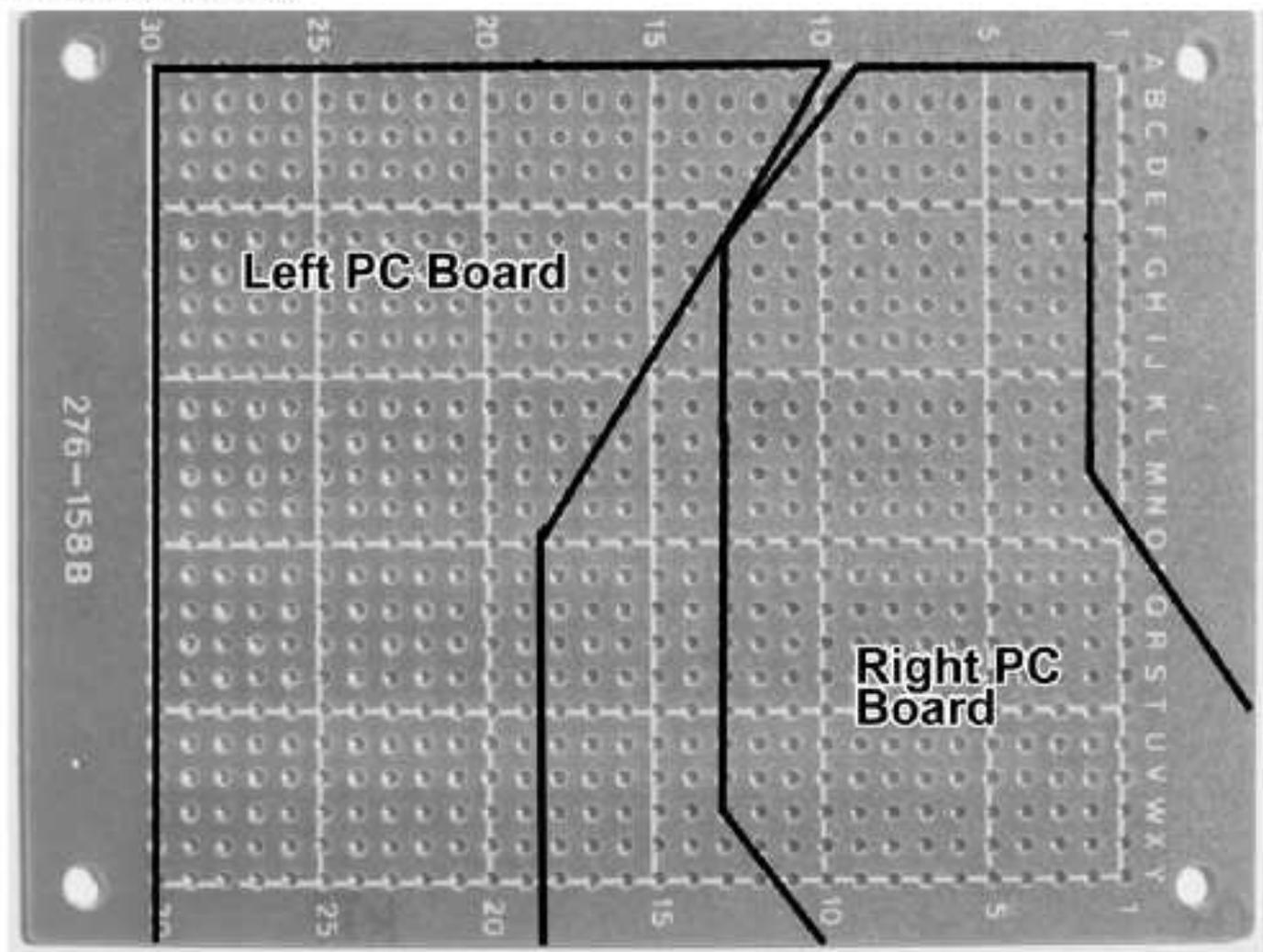
FIGURE 10-25



[click on image for full view](#)

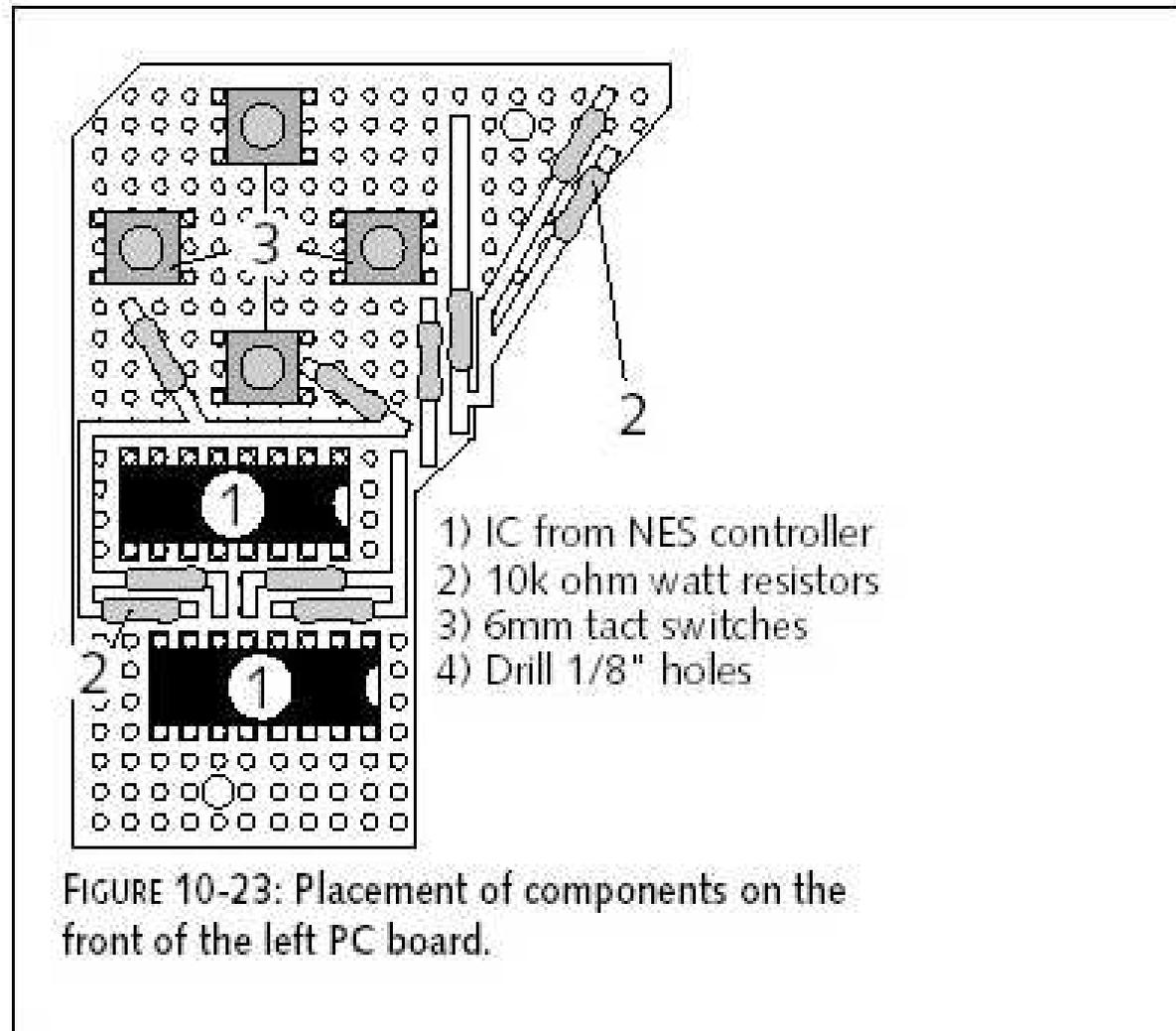
**FIGURE 10-22**

Where to slice the 276-158b PC board.



**FIGURE 10-23**

Placement of components on the front of the left PC board.



**FIGURE 10-24**

The connections on the back of the left PC board.

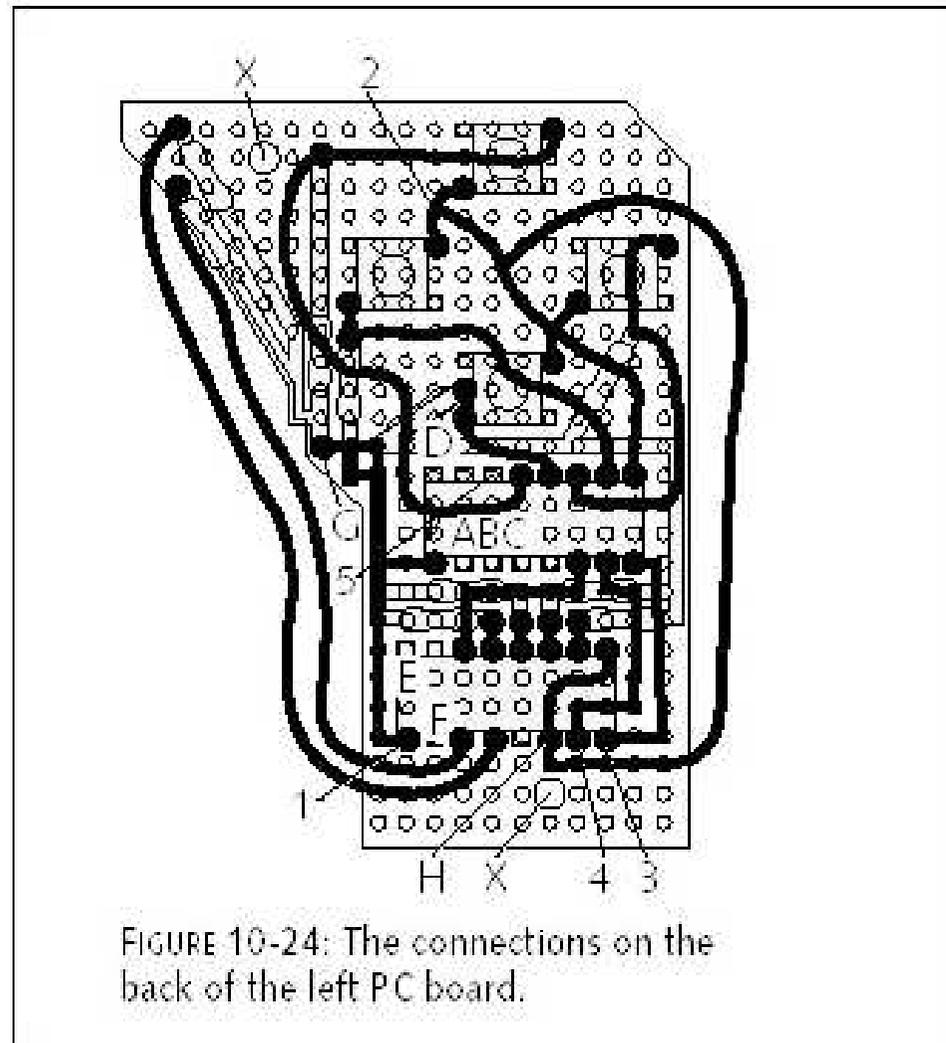
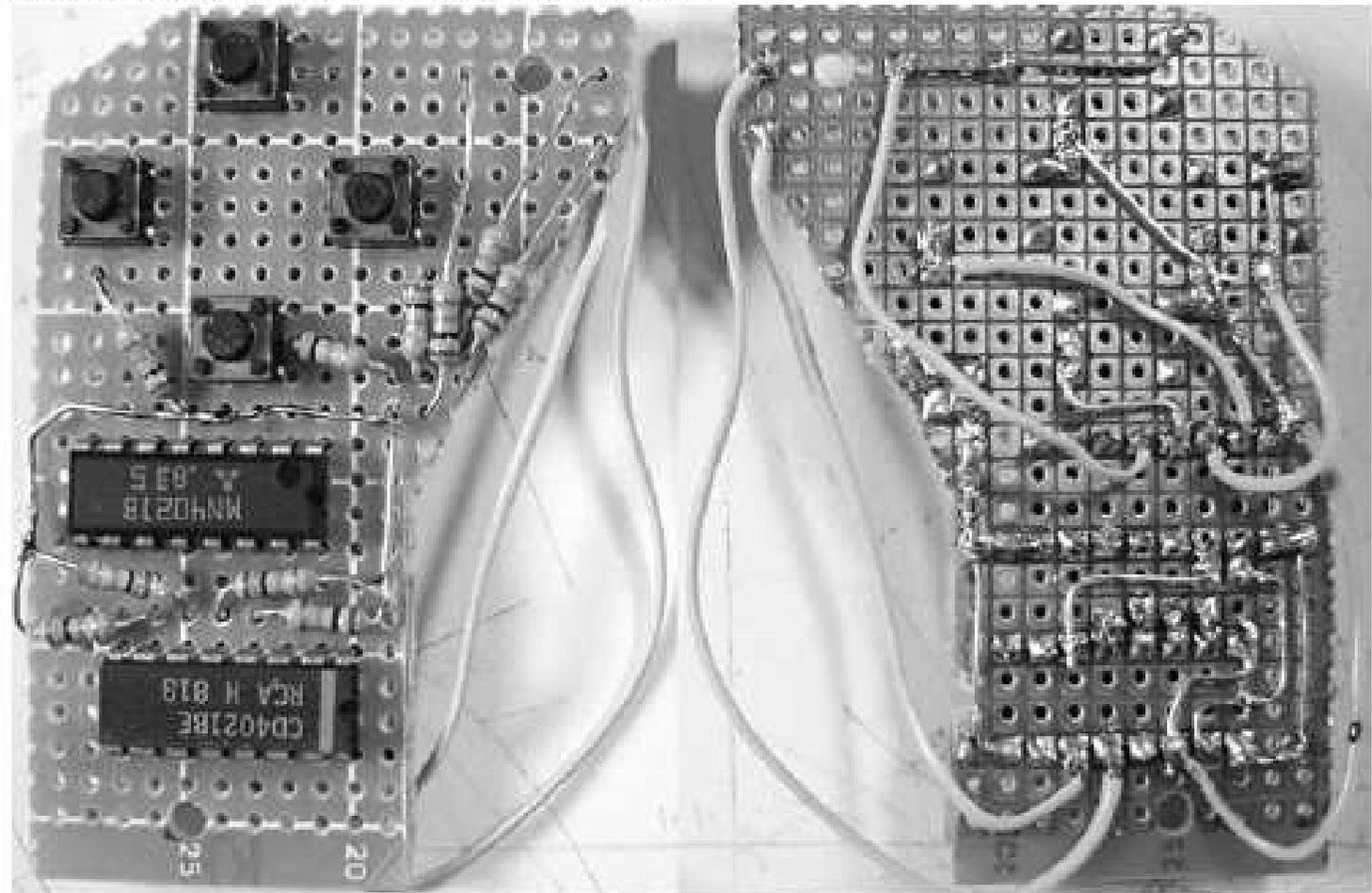


FIGURE 10-24: The connections on the back of the left PC board.

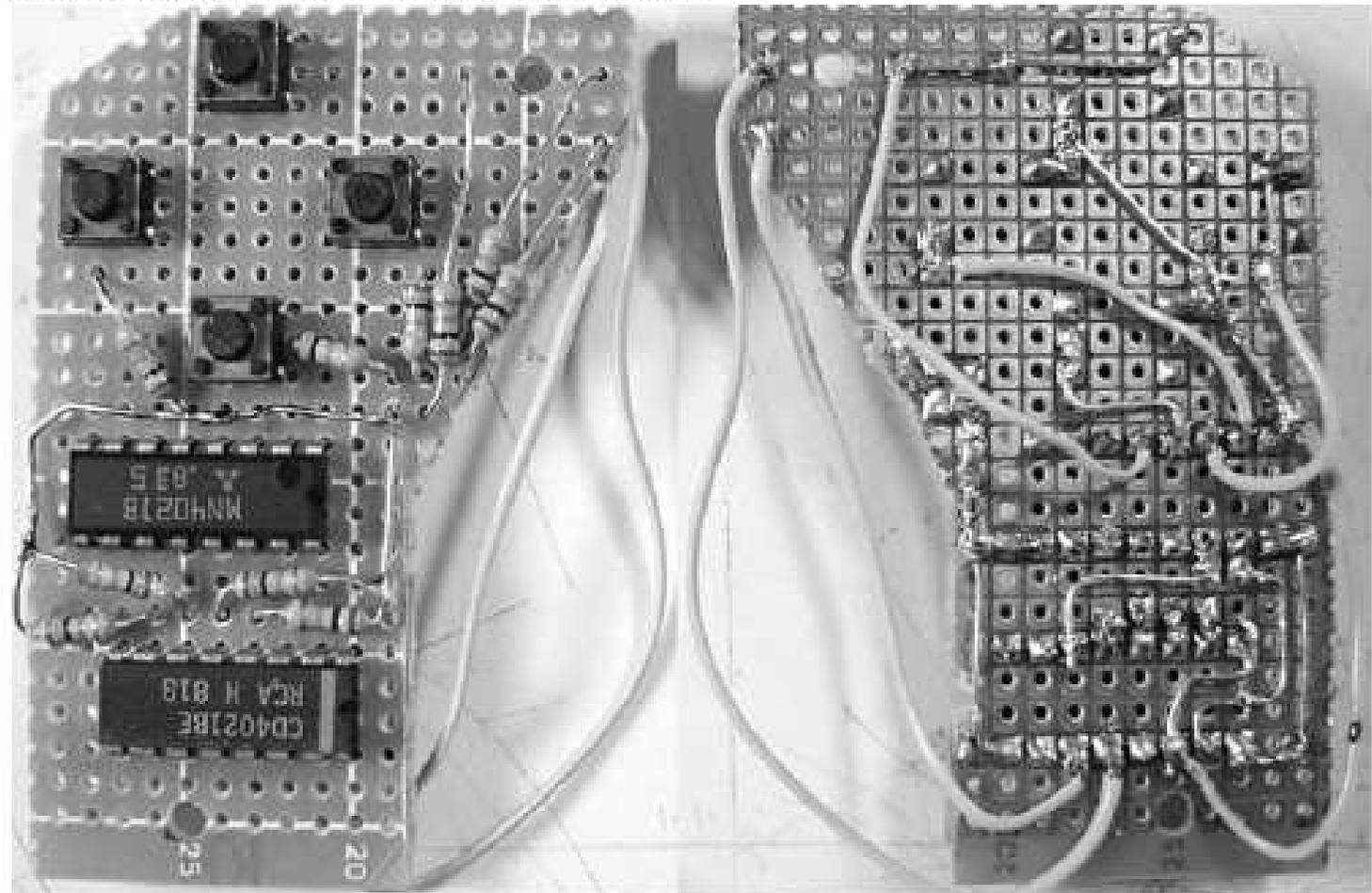
**FIGURE 10-25**

The front (left) and back (right) of the completed left PC board.



**FIGURE 10-25**

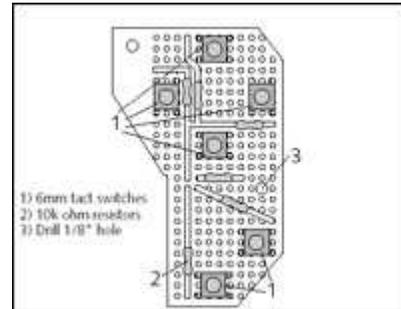
The front (left) and back (right) of the completed left PC board.



### Right PC Board

Next we'll wire up the right PC board, which is the one that goes under the X/Y/B/A, select, and reset buttons. Start by placing components on it as shown in Figure 10-26.

FIGURE 10-26



[click on image for full view](#)

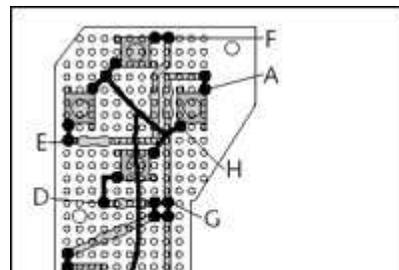
- 1) 6mm tact switches
- 2) 10k ohm resistors
- 3) Drill 1/8" hole
- 4) Drill 1/8" holes

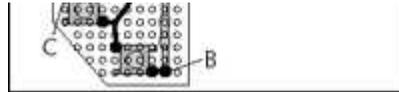
1. Use 10K-ohm, 1/4-watt resistors for all the gray tube-like shapes. Solder their leads to the board as described in the previous section.

2. Place 6-mm tact switches in the spots marked "1." Solder all four of their leads to the copper pads on the back of the board. (Note how the tact switches have their leads pointed in different directions. Be sure to place all the tact switches to match this drawing.)

3. Drill 1/8" holes in the spots marked "3." Now, with the components placed on the front of the right PC board, you can make the connections on the back of it, as shown in Figure 10-27.

FIGURE 10-27

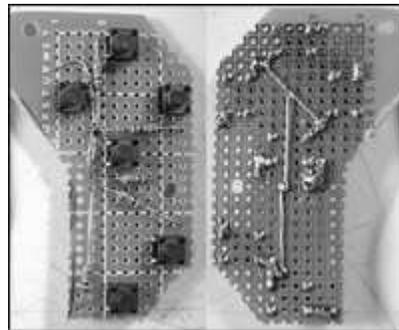




*[click on image for full view](#)*

1. Use wires or bits of extra resistor lead to make the connections indicated by black lines. The circular ends show the points at which to solder the wires/leads.
2. Spots A-H should be connected to the ribbon cable coming from the spots on the left PC board with the same labels. This interconnects the boards. The ribbon length I suggested in the previous section may seem a bit long considering how close these boards will be in the case, but this length will allow us to position the cable better later on. Figure 10-28 shows the completed right PC board (sans connections A-H). [Continued...](#)

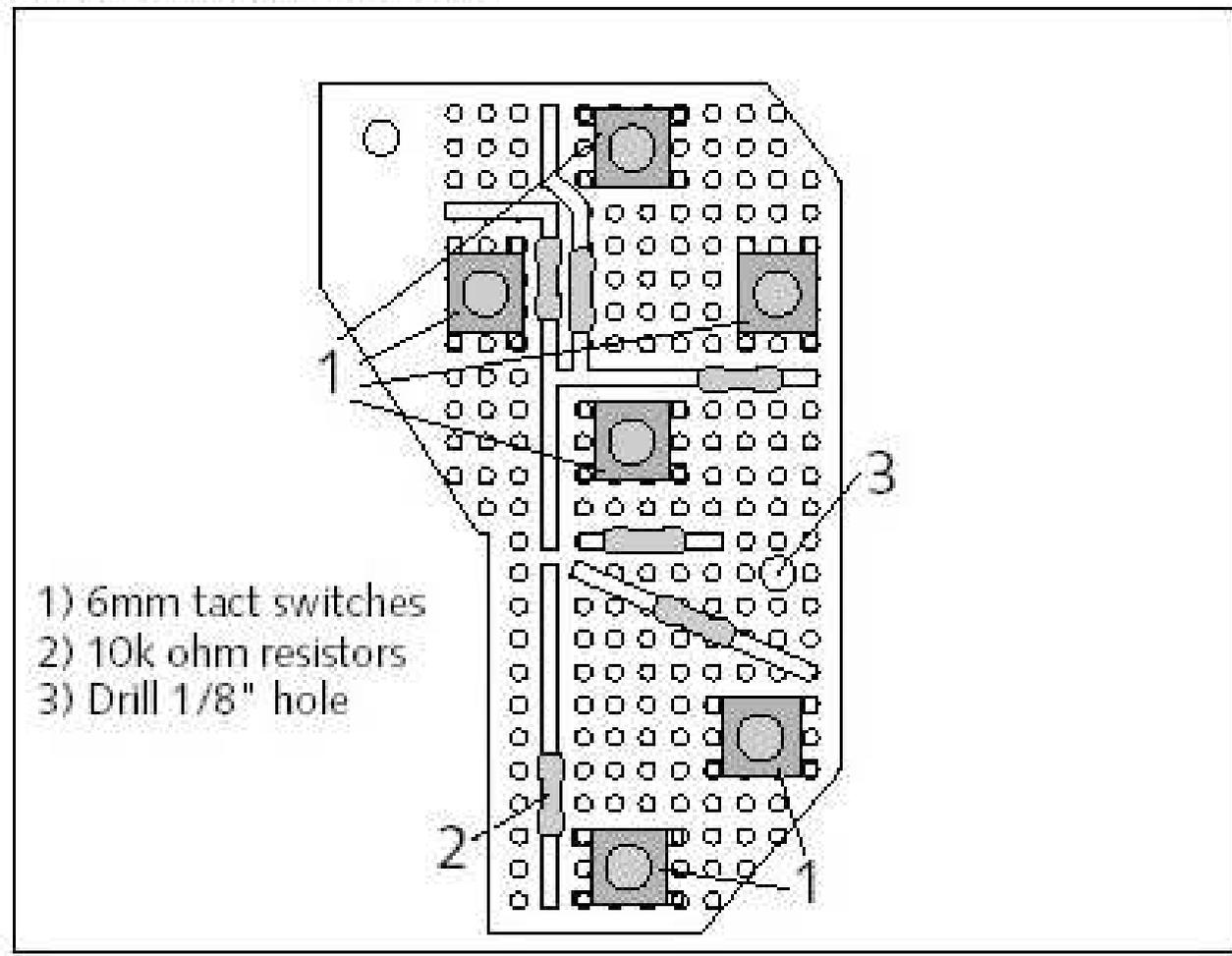
FIGURE 10-28



*[click on image for full view](#)*

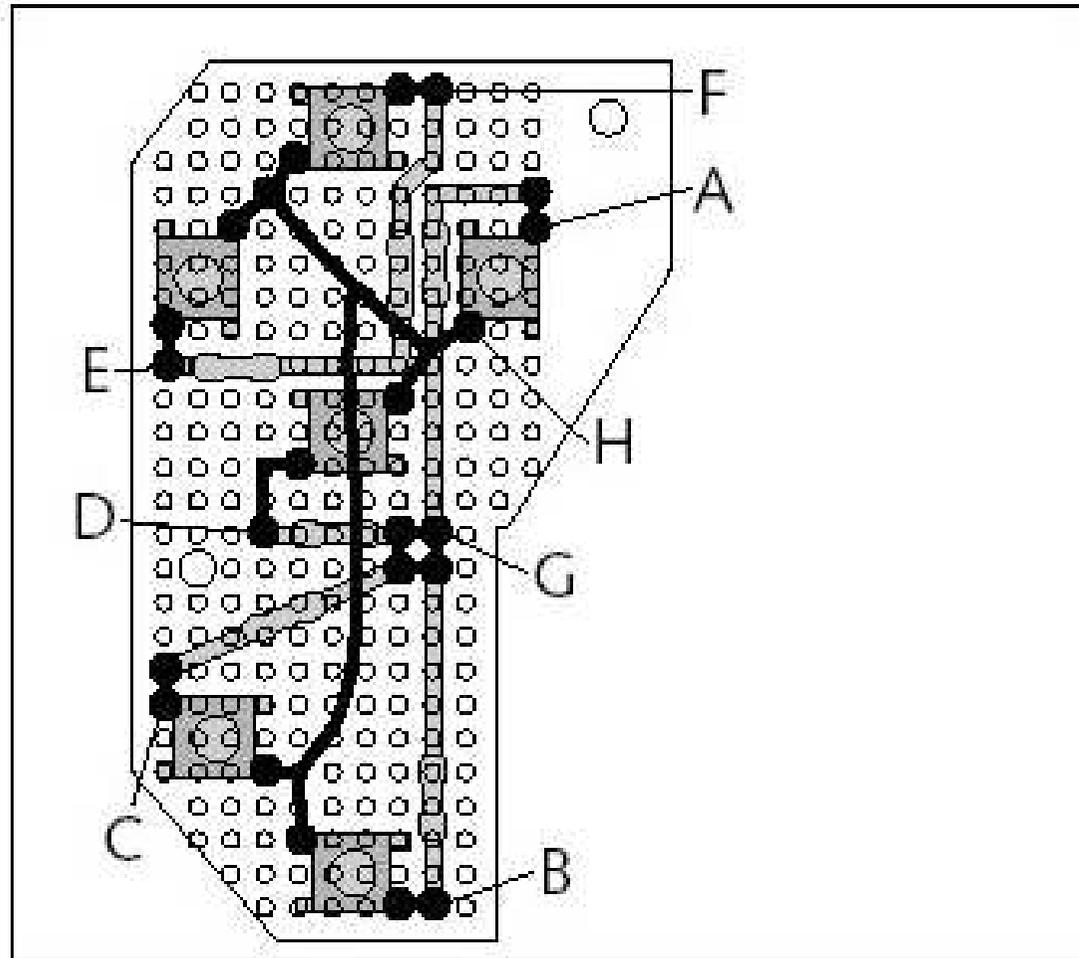
**FIGURE 10-26**

Placing components on the front of the right PC board.



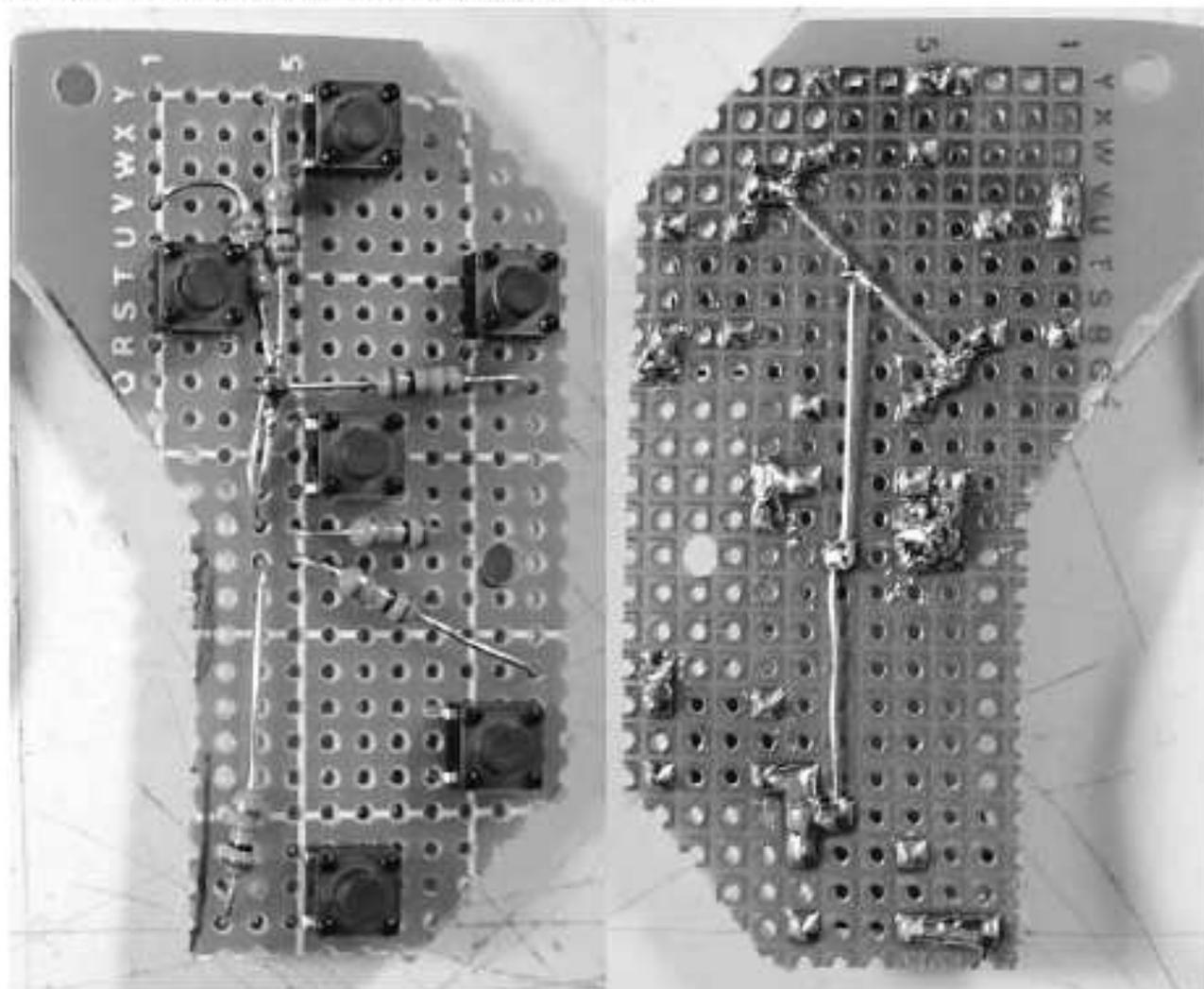
**FIGURE 10-27**

Connections to make on the back of the right board.



**FIGURE 10-28**

The front (left) and back (right) of the completed right PC board.

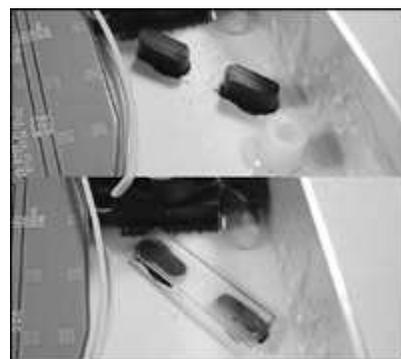


### Installing the PC Boards

Before screwing down the PC boards, you'll need to place the buttons first. The rubber select/start button will need to be modified for this. As-is, it's just too thick, and would stick above the case like a sore thumb.

1. Slice off the bottom of the select/reset buttons to leave about 3/16" of length from the tops. The actual length depends on how far you want the buttons to stick above the surface of the case. If the sliced buttons are 1/8" thick, they'll stick 1/16" above the case, and if they're 1/4" they'll be 3/16" above. A size of 1/8" is the minimum.
2. Lay the front of the case down on a flat surface, then set the select/reset buttons in their holes as shown in Figure 10-29, with the cut ends up (inside the case).
3. Next, cut a 1/4" x 1" piece of thin plastic. By "thin," I mean thin like the stuff from a soda bottle or a plastic tub-o'-margarine lid—engraving plastic is too thick for this.
4. Place a dab of superglue on each button and press the plastic piece onto them. As the cuts may not be perfect, you should keep pressure on the plastic so that as much surface contacts the buttons as possible. Hold it for a minute or two, then release. Your custom select/reset button is made!

FIGURE 10-29



[click on image for full view](#)

5. Place the B/A/X/Y buttons and control pad disc in their holes.
6. Use four computer case screws to attach the PC boards to the screw posts on the front plate. If one of the PC boards doesn't quite fit around the PSOne screen's motherboard, you can do one of two things:

arnings:

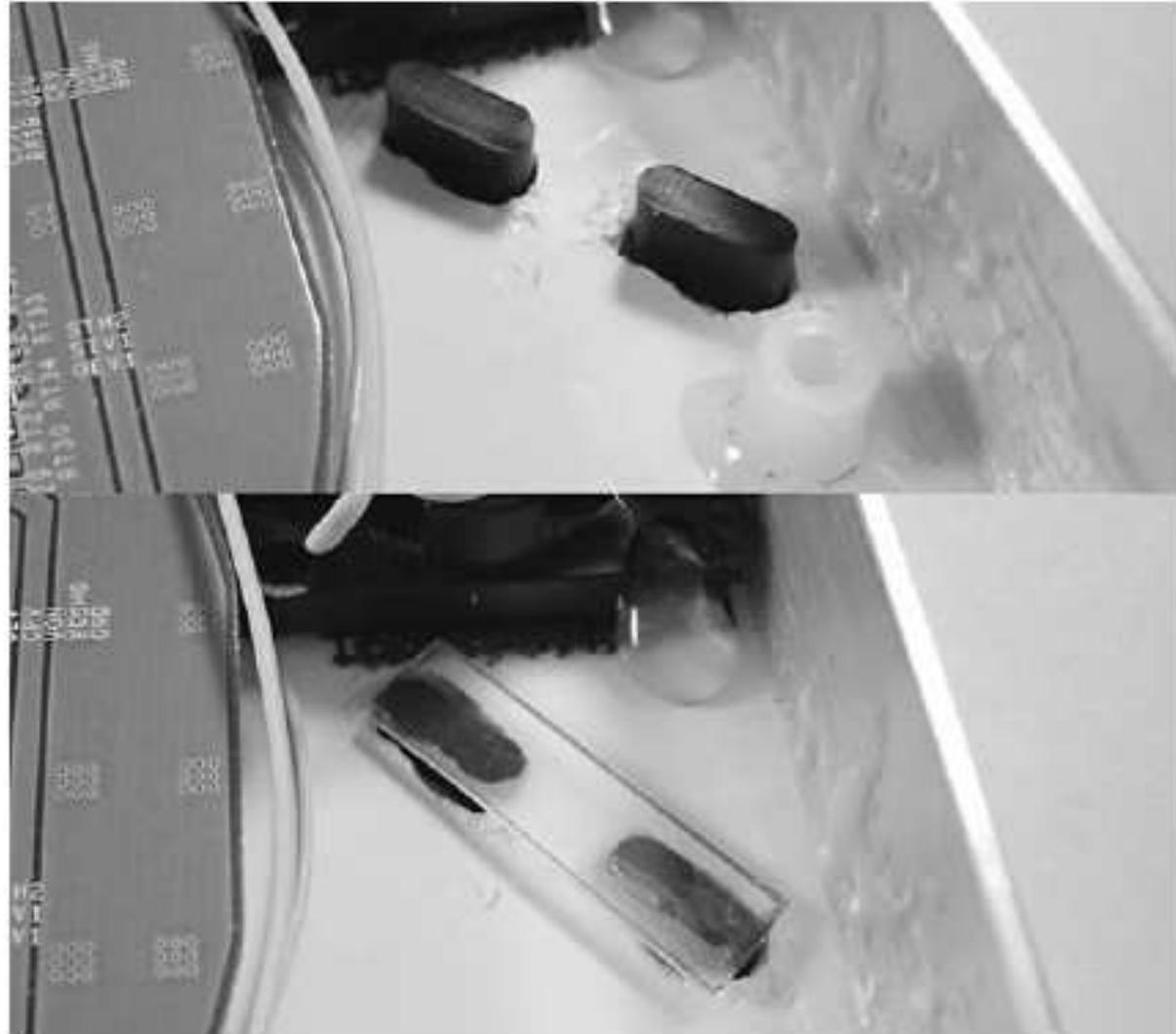
Since the PC board ends up being lower (it and the PSOne board won't be level to each other), try to get it past the PSOne screen, and then secure it.

Use an X-Acto knife or cutters to shave off a little more of the edges of the PC board that are blocked by the PSOne screen.

7. Tuck the ribbon cable(s) between the two boards, up toward the top of the PSOne board, or even under it if that works better. (This is why I suggested overly long cables.) This gets the cables out of the way of the SNES board when it's installed.

**FIGURE 10-29**

The select/reset buttons placed in the front of the case.



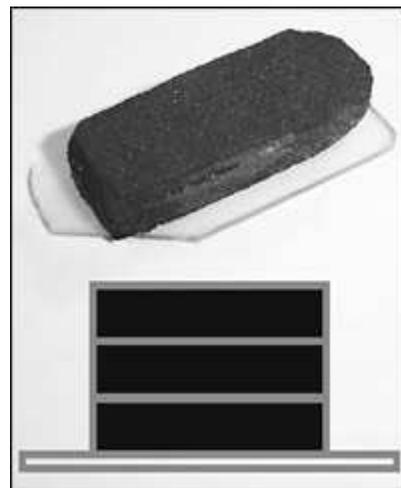
### Making the Left and Right Shoulder Buttons

The left and right shoulder buttons are the only buttons we're building from scratch for this unit—the original right and left shoulder buttons from a controller are too curvy to work. The new shoulder buttons need to be about 1/4" thick and have a back plate on them so that they don't fall out of the case. For easy cutting, I choose a 1/10"-thick piece of black hobby foam, available in the crafts section of your local supermart or hobby store. Here's how to make the buttons:

1. Cut and stack the foam to make a piece three layers deep. Place it under the shoulder button hole in the rear of the case, and carve out the shape with an X-Acto knife. Be sure you cut through all three layers.
2. This will create three loose pieces of foam. Superglue them together to make one solid piece. You can then trim down the sides to make it look smoother.
3. Cut a thin piece of plastic slightly larger than the foam piece, as seen in Figure 10-30. (Use the same kind of plastic that you used for the select/start button mod.)
4. Sand one side of the plastic and superglue the foam to it in order to complete the button.

Repeat Steps 1–4 to make the other button. [Continued...](#)

FIGURE 10-30



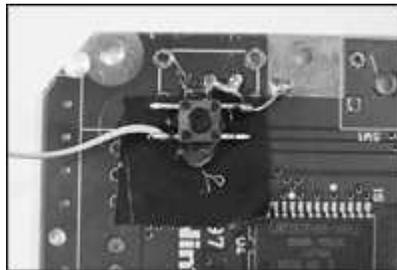
*[click on image for full view](#)*

### Installing the SNES Board

Now that the shoulder buttons are built, we're almost ready to attach the SNES board to the rear of the case. Desolder the 7805 regulator from the SNES if you haven't already done so (this is covered in Chapter 9). As we install the SNES board, we'll also add tact switches to it, and the rear plate to be used with the shoulder buttons we just built.

1. Take a look at Figure 10-31—it shows the corner of the SNES board where the power switch used to be. Put a couple layers of electric tape on the board as shown, then hotglue a tact switch in place. Bend the leads out so that the switch can sit flat.
2. Use your cutters to snip the corner of the board away, also shown in Figure 10-31. This allows the SNES board to fit in the curvy-edged case.

FIGURE 10-31



[\*click on image for full view\*](#)

3. Connect a 10" wire to the tact switch as shown, and connect the opposite lead on the switch directly to ground (the metal edge) on the SNES board using a bit of lead or wire. Hold the SNES board against the rear plate and line up the screw holes. You can then make sure the tact switch will be in the center of the shoulder button.
4. Before we can screw down the SNES board, we also need to connect two 10" wires to get left and right audio. Look back in Chapter 9, in the Reconnecting the video and audio lines section. It contains a photo of where to get both audio signals off an IC. Use this photo as reference for your connection here. Make a mark on the free end of one of the wires so that you can tell which is which later on.
5. You can now use four computer case screws to attach the SNES board to the rear plate, as shown in Figure 10-32. Make sure you get all the loose wires out from under it, including the battery wires.

There are lots of holes in the SNES board, so if you want you can snake the wires through some of them. The capacitors that you rewired in Chapter 9 should all go to one side, as shown.

FIGURE 10-32



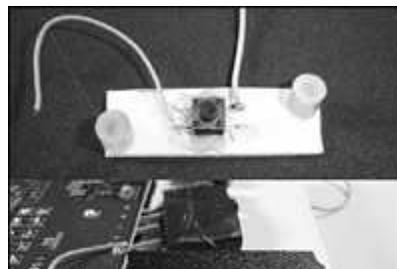
[click on image for full view](#)

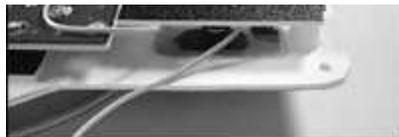
Use hot glue or electric tape to get the capacitors out of the way, as shown in Figure 10-32 previously.

6. Look at the right side of the SNES board in the previous photo. Note how a 1/4" x 1/4" square has been removed from the upper right corner, as well as a 1/4" x 1/4" 45-degree triangle from the lower right corner. Use your cutters to remove these same areas on your SNES board. This allows screw posts to fit past the SNES board. (As you assemble the unit, you may need to remove additional material from these spots for things to fit.)

7. Let's install the switch for the other shoulder button. Cut a piece of engraving plastic 1-5/8" wide by 1/2" high. Superglue a 1/4" nylon spacer in each corner, and hot-glue a tact switch in the middle, as shown in Figure 10-33. Solder a 2" wire to one terminal and a 10" wire to the other.

FIGURE 10-33



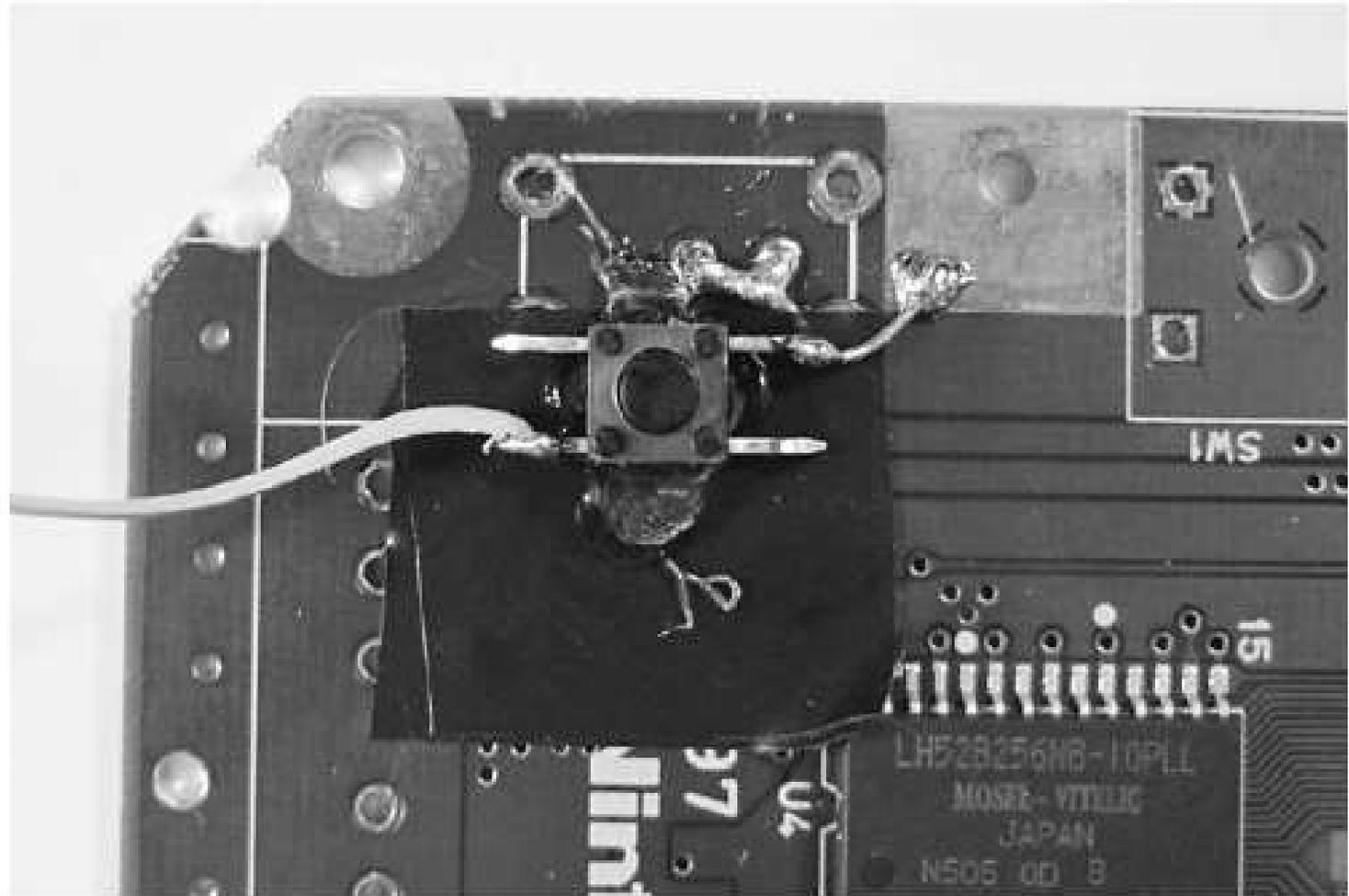


*[click on image for full view](#)*

8. You can then superglue this in place over the left shoulder button, as shown. Be sure it's well glued, so that it won't pop loose during an intense Street Fighter II battle. Connect the short 2" wire to ground on the SNES. Ground is any of the metal striping on the sides of the board. The SNES board and the left and right shoulder buttons are now installed onto the rear plate.

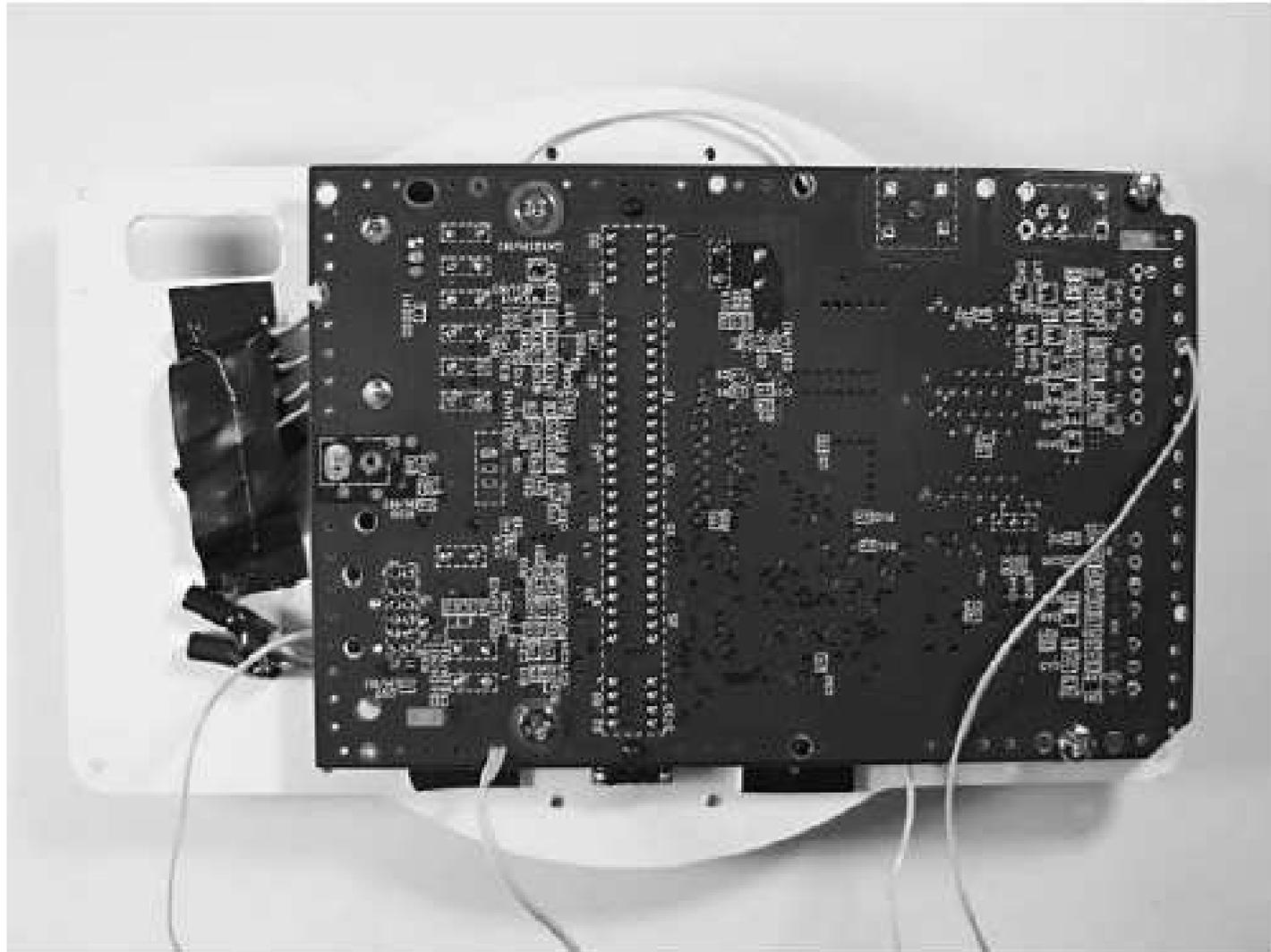
**FIGURE 10-31**

Placing a tact switch on SNES board and snipping the corner.



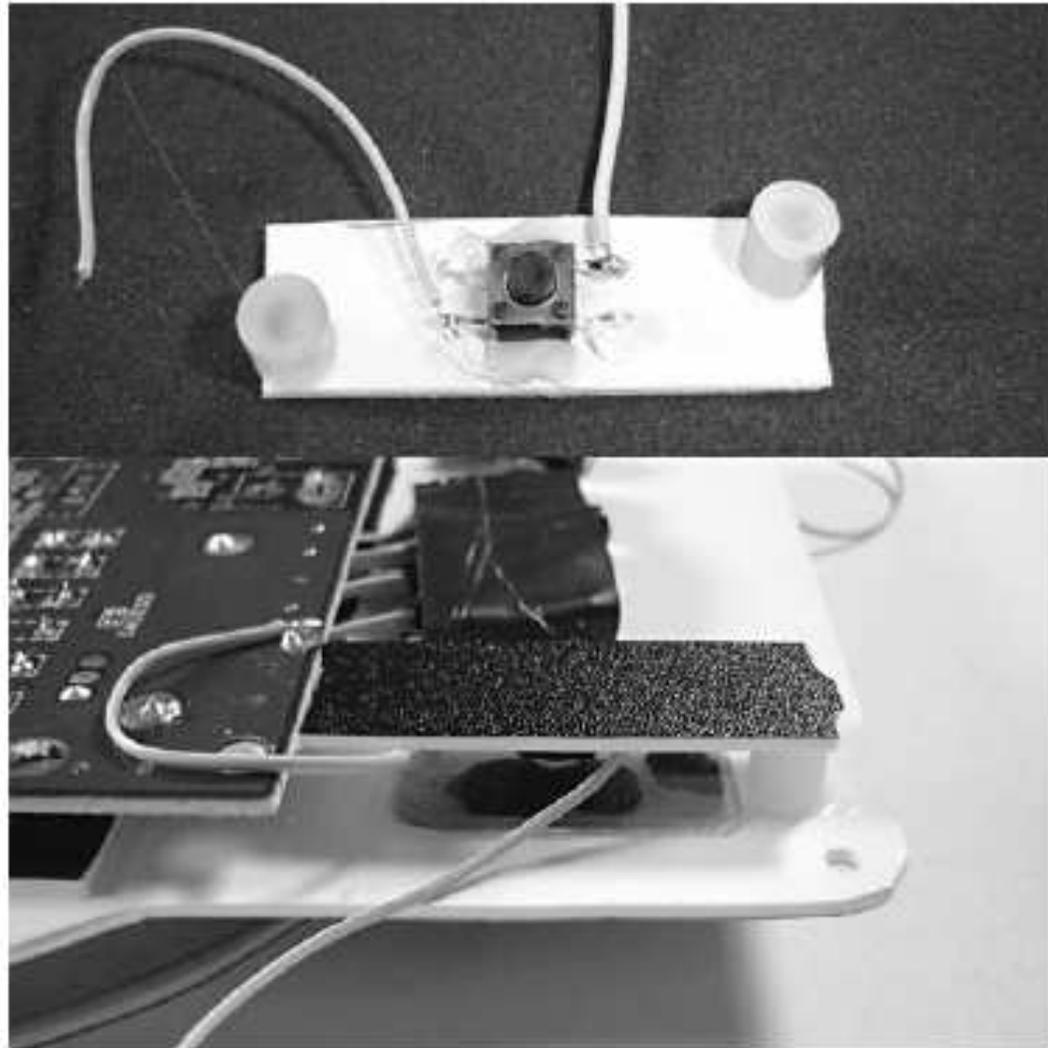
**FIGURE 10-32**

The SNES board screwed to the rear plate.



**FIGURE 10-33**

The tact switch and spacers attached to the engraving plastic.

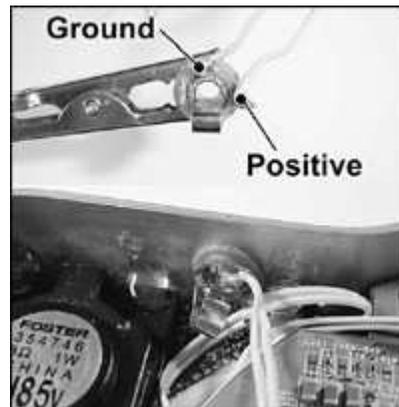


### Installing the Power Jack

With the rear of the unit prepared, we can now go back to make some more connections in the front of the case, beginning with the battery charging jack.

1. Take the 1/8" panel-mount jack (Radio Shack catalog #274-251) and attach two 4" wires to it, as shown in Figure 10-34. One wire connects to the center ring; this is ground. The other wire connects to the large bending tab; this is positive.

FIGURE 10-34

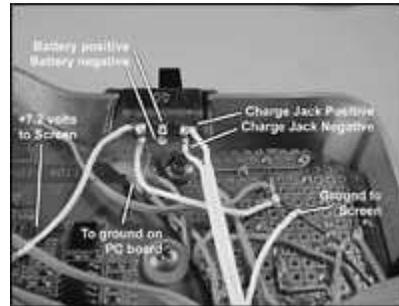


[click on image for full view](#)

2. Once the jack is wired, insert it into the hole in the wall of the unit. You can then secure it with the nut on the outside. Check that the leads coming off the jack aren't touching any bare metal. You should also insert the 1/8" phono plug into the jack and make sure that the ground wire isn't touching the tip (positive) of the plug. By installing the jack, you've made the entire aluminum wall of the unit ground, kind of like in a car. Be sure that no positive-voltage wires and no connections other than ground connections touch the outer wall. There shouldn't be any, but be aware of this in order to avoid short circuits.
3. Take your Radio Shack catalog #275-407 DPDT switch and insert it into its slot as shown in Figure 10-35. Drill two small holes in the aluminum to insert the screws. Wire the switch as described in the following steps.
4. Connect the positive and negative (ground) wires from the charge jack as shown.
5. Use a 5" wire for the 1.7 2 volts to screen wire. This will be

5. Use a 5" wire for the +7.2 volts to screen wire. This will be connected to the PSONe screen soon.
6. Use a short 1" wire to make the to ground on PC board connection.
7. Connect a 2-1/2" wire to the ground on the PC board. This will be ground to screen, and will be connected to the PSONe screen soon.

FIGURE 10-35



*[click on image for full view](#)*

Reference Figure 10-35 when instructed to connect positive and negative from the battery to the on/off switch. If you insert the wires through the eyelet holes on the switch's leads, make sure the top and bottom ones don't touch each other. That would be bad—short-circuit city! The charging method this unit uses is quite simple. The battery power will connect to the two center terminals. When the unit is switched on (switch goes toward the center of unit) the battery terminals are connected to the screen and SNES. When the unit is off, the battery terminals are connected to the charge jack. If there's no charger attached, then the unit is simply off.

If the charger is plugged in, it sends its charge directly into the batteries. How a DPDT switch works is explained in more detail in Chapter 3.

Just below and to the left of the power switch, you'll see a small 7805A regulator on the PSONe screen board, as shown in Figure 10-36.

FIGURE 10-36





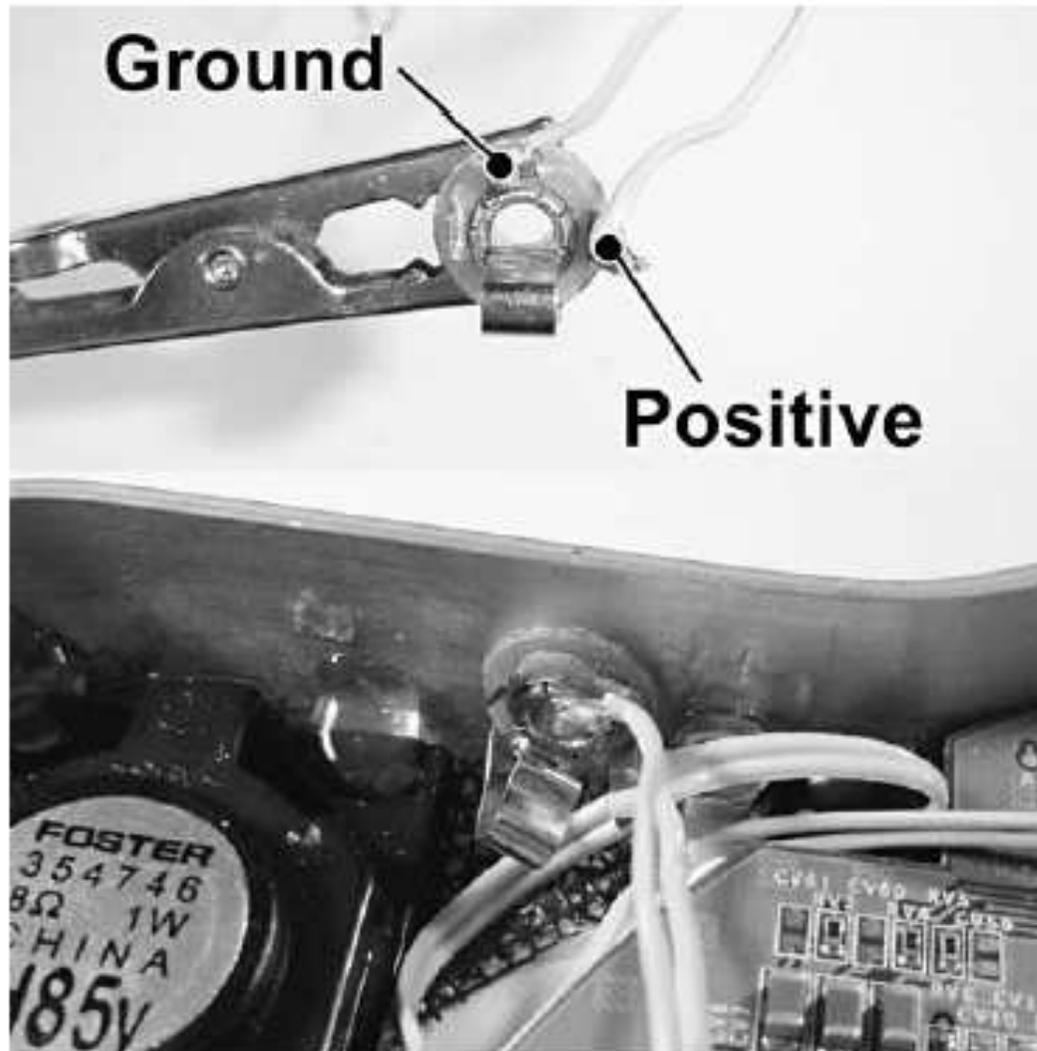
*[click on image for full view](#)*

1. Connect a 5" wire to the spot marked +5 volts to SNES.
2. To connect the ground to screen wire that comes from the left PC board, use your X-Acto knife to scrape away the green on the PSONe screen's board in the spot shown. Once you have a small area of bare copper showing you can solder the ground to screen wire to it. Tug it with your tweezers to make sure it's well attached.

There are actually two 7805A regulators on the PSONe screen—this is the upper one. We used the lower one to get +5 volts to the LEDs in Chapter 4.

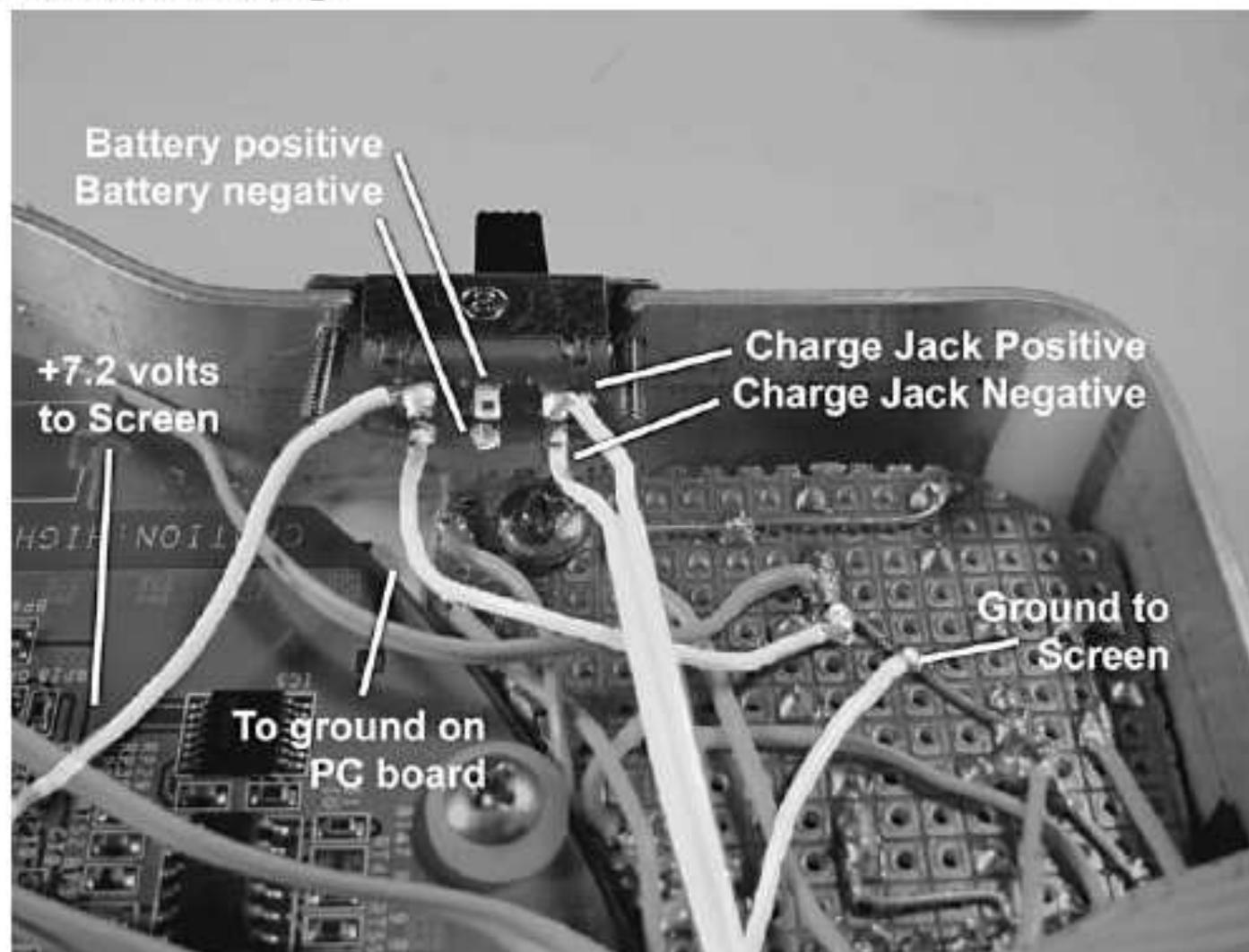
**FIGURE 10-34**

Wiring the charging jack and installing it in the unit.



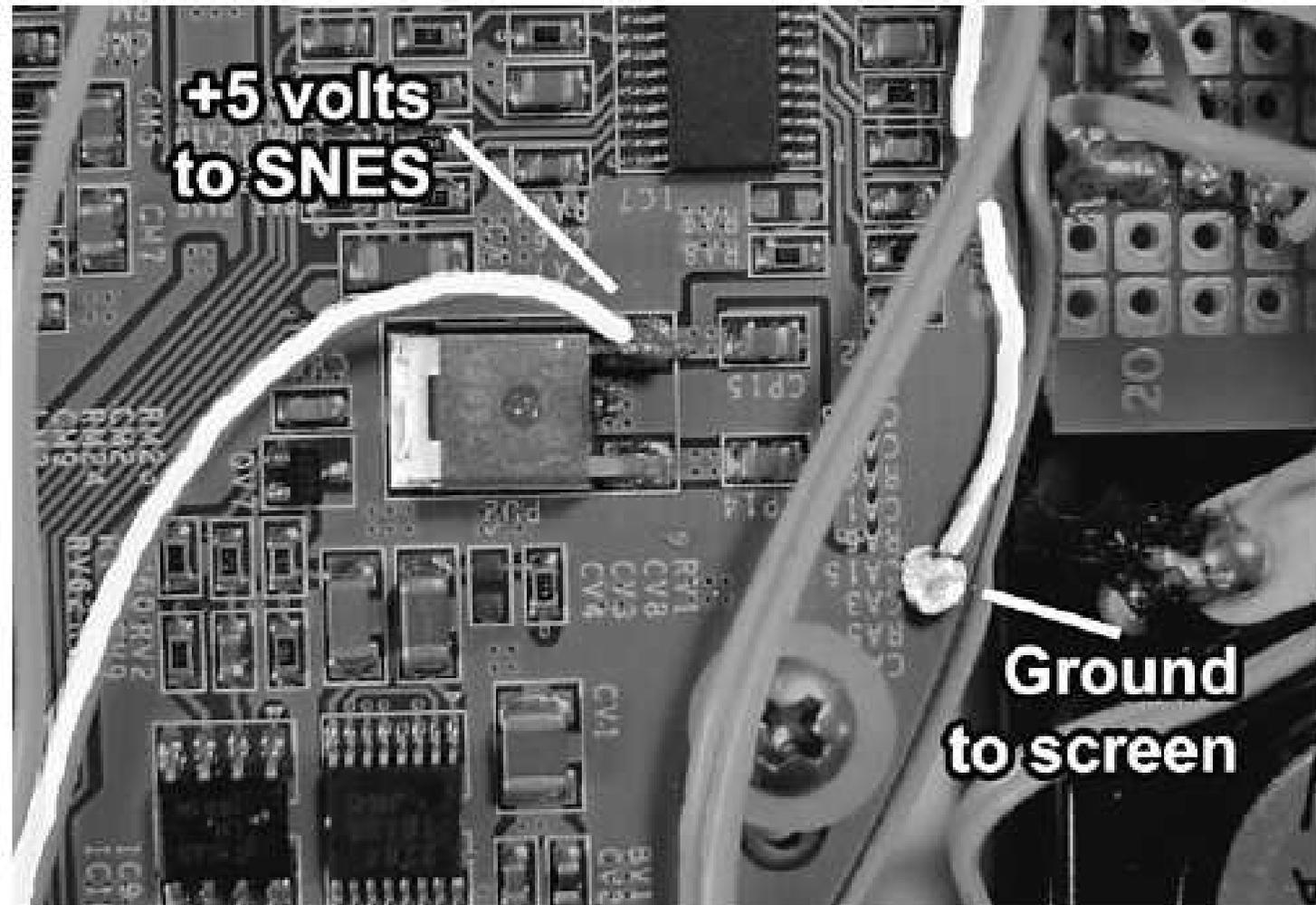
**FIGURE 10-35**

The ON/OFF switch installed, with wiring.



**FIGURE 10-36**

Connecting wires to the 7805A regulator on the PSOne screen.



### Wiring the Two Halves Together

All the remaining connections involve wiring the two halves of the unit together. Yes, that's right—we're close to finishing it! To arrange the halves on your work space for the final wiring, place them as follows:

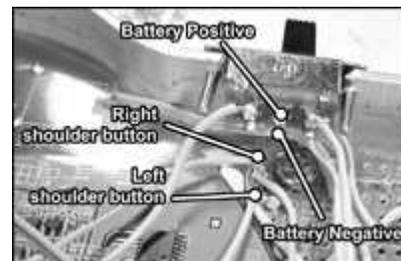
1. Lay the front half facedown and rotated 90 degrees on your work surface. The top of it should be going right, the bottom going left, and the power switch/left PC board going down/toward you. (These directions refer to your work space.)
2. Lay the rear of the case to the left of the front of the case. The bottoms of each of the halves should be touching so that you can "fold" the unit together, like closing a book. The blue capacitors should be going down/toward you.

You'll notice most of the wires you attach in this section will be too long. Cut them down as you make the connections so that they're only as long as they need to be. It's better to have them too long than too short!

With that positioning out of the way, let's get the wiring done, shall we?

1. We'll start by attaching the left and right shoulder button wires that are coming from the rear of the unit, under the SNES board. They connect to the left PC board just under the on/off switch, as shown in Figure 10-37.

FIGURE 10-37

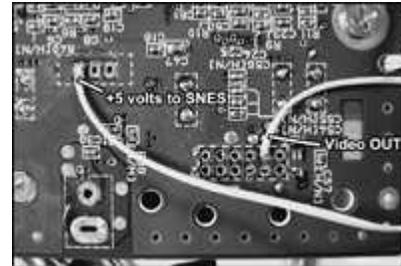


[\*click on image for full view\*](#)

2. With the shoulder button wires attached, you can then connect the positive and negative battery wires to the on/off switch, also shown in Figure 10-35. If you've forgotten which wire is which (or forgot to mark them), battery positive comes out near the blue capacitors, and negative emerges from under the center of the SNES board.

3. Now let's make the power and video connections to the SNES. At the lower right-hand corner of the SNES board, you'll see the area shown in Figure 10-38. Connect the +5 volts to SNES wire coming from the PSONe screen to the spot shown. Connect a 4" wire to the spot marked Video OUT.

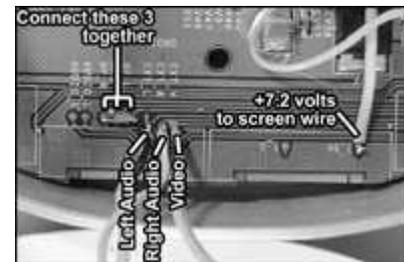
FIGURE 10-38



[click on image for full view](#)

Let's go to the PSONe screen now. Near the bottom of the main board, near where the cables were plugged in, you should see the following, as shown in Figure 10-39.

FIGURE 10-39



[click on image for full view](#)

4. The left and right audio and the video wires all come from the SNES board. Solder them to the PSONe board as shown.

5. The +7.2 volts to screen wire comes from the on/off switch. Connect it as shown.

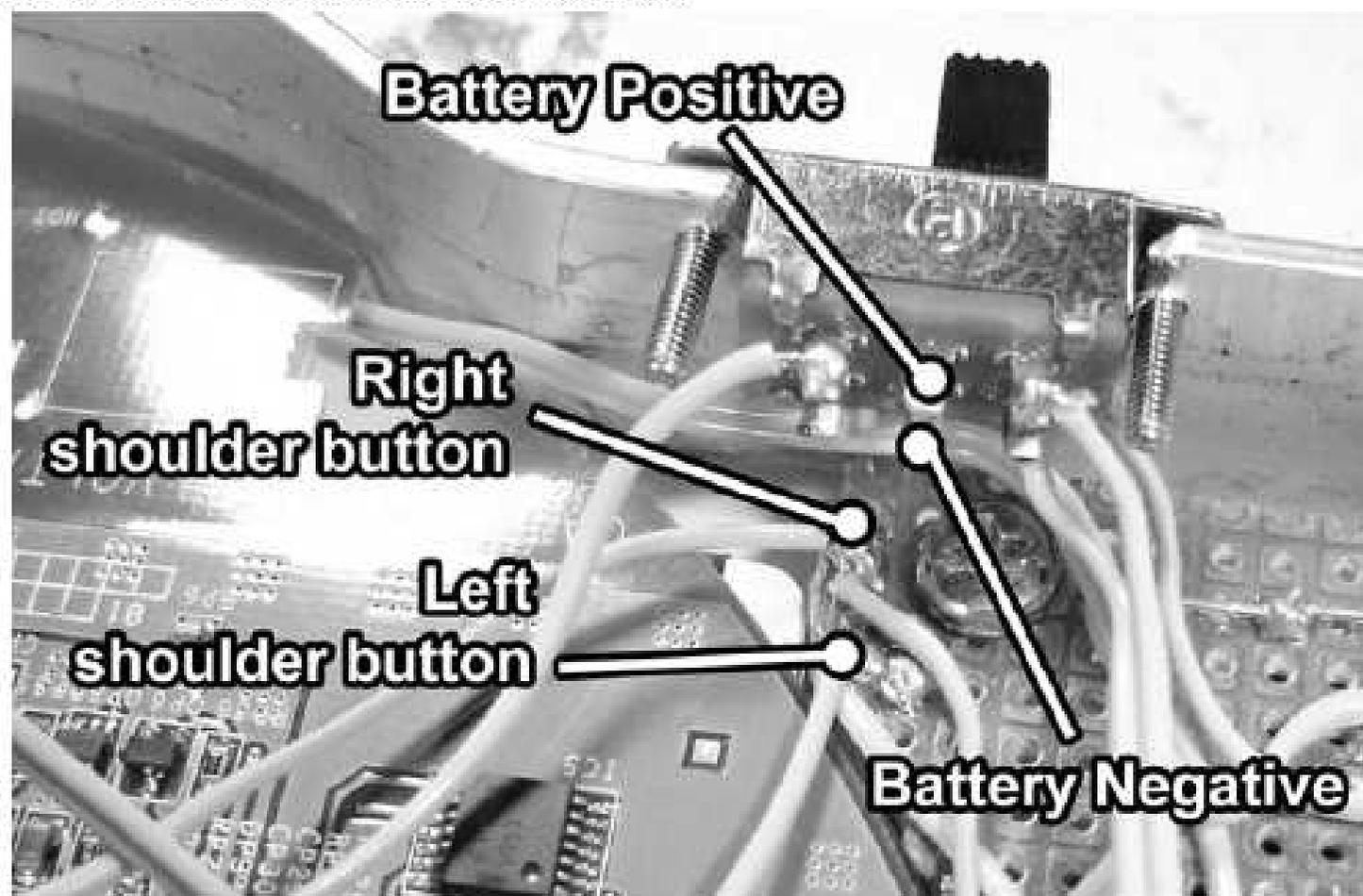
6. You'll see three spots on the PSONe board, marked HPxR, HPS, and HPxL. Solder all three of these together to enable the PSONe speakers to work.

There's not much solder spot on the board to connect wires to, so be

sure that they are firmly attached. Before closing up the unit, you may want to lay a bead of hot glue over these connections to protect them.

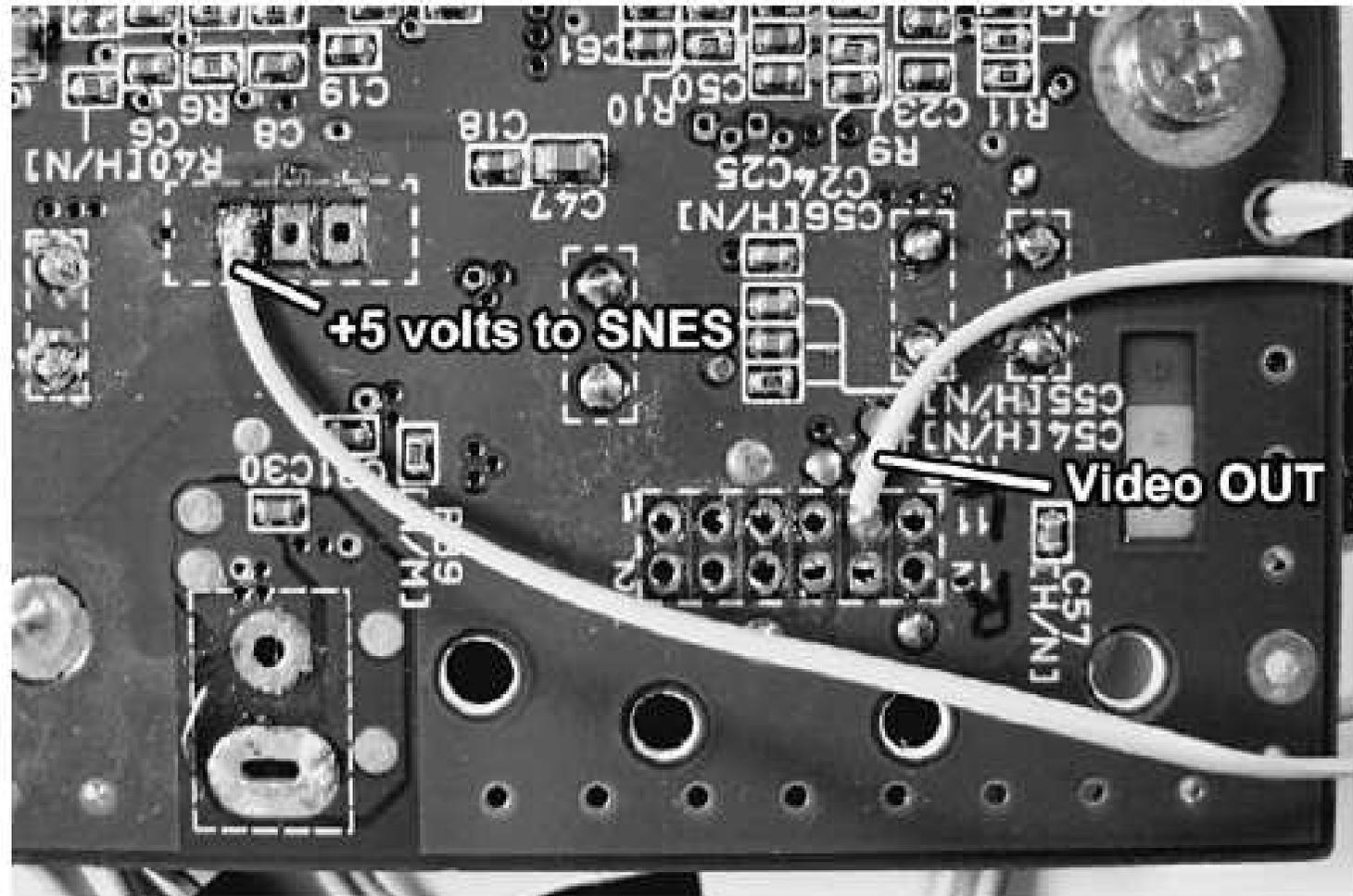
**FIGURE 10-37**

Connecting the right and left shoulder buttons to the PC board.



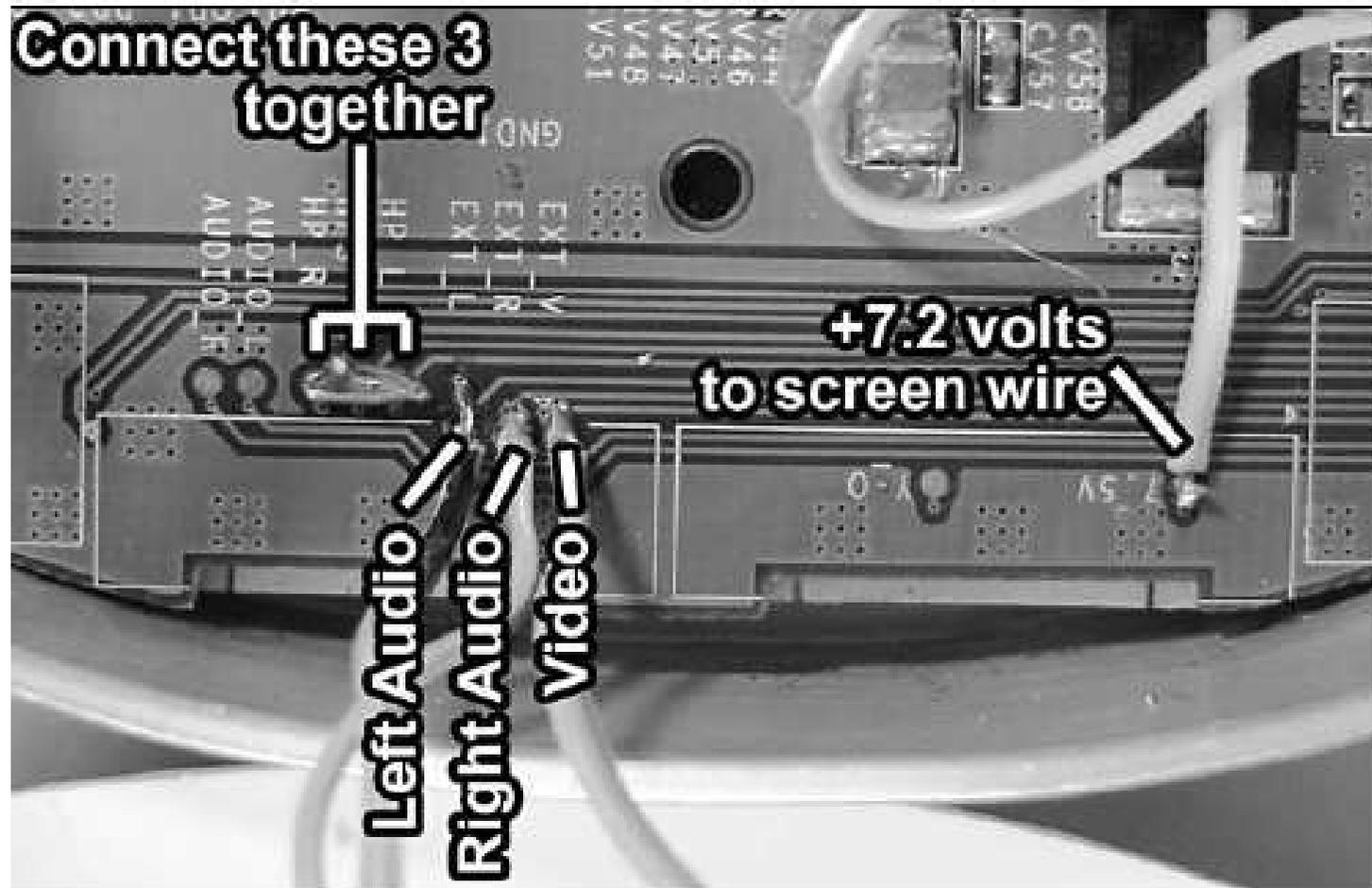
**FIGURE 10-38**

Connecting the power and the video wire to the SNES board.



**FIGURE 10-39**

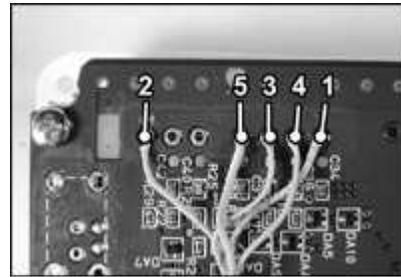
Connections to be made at the base of the PSOne screen.



### Final Controller Connections to the SNES Board

There should now be only five unconnected wires: the ones coming from the left PC board. These were labeled 1-5 when we attached them to the PC board, and wire #1 should have a black mark on it for reference. Connect them to the Player 1 control spots on the SNES as shown in Figure 10-40.

FIGURE 10-40



*[click on image for full view](#)*

The SNES portable is now completely wired! You can insert six AA rechargeable batteries, flip the on switch, and see what happens. We'll take a step-by-step troubleshooting walk-through in the next section to address any problems you may find.

### Modifying the battery charger

The 7.2/9.6-volt battery charger will need a new plug so that it can connect to the SNES portable.

1. Cut off the existing white plug and connect the wires to the 1/8" phono plug (Radio Shack catalog #274-287), as shown in Figure 10-41.
2. The wire with the white stripe goes to the longer outer lead (negative), and the plain black wire goes to the shorter inner lead (positive).

FIGURE 10-41



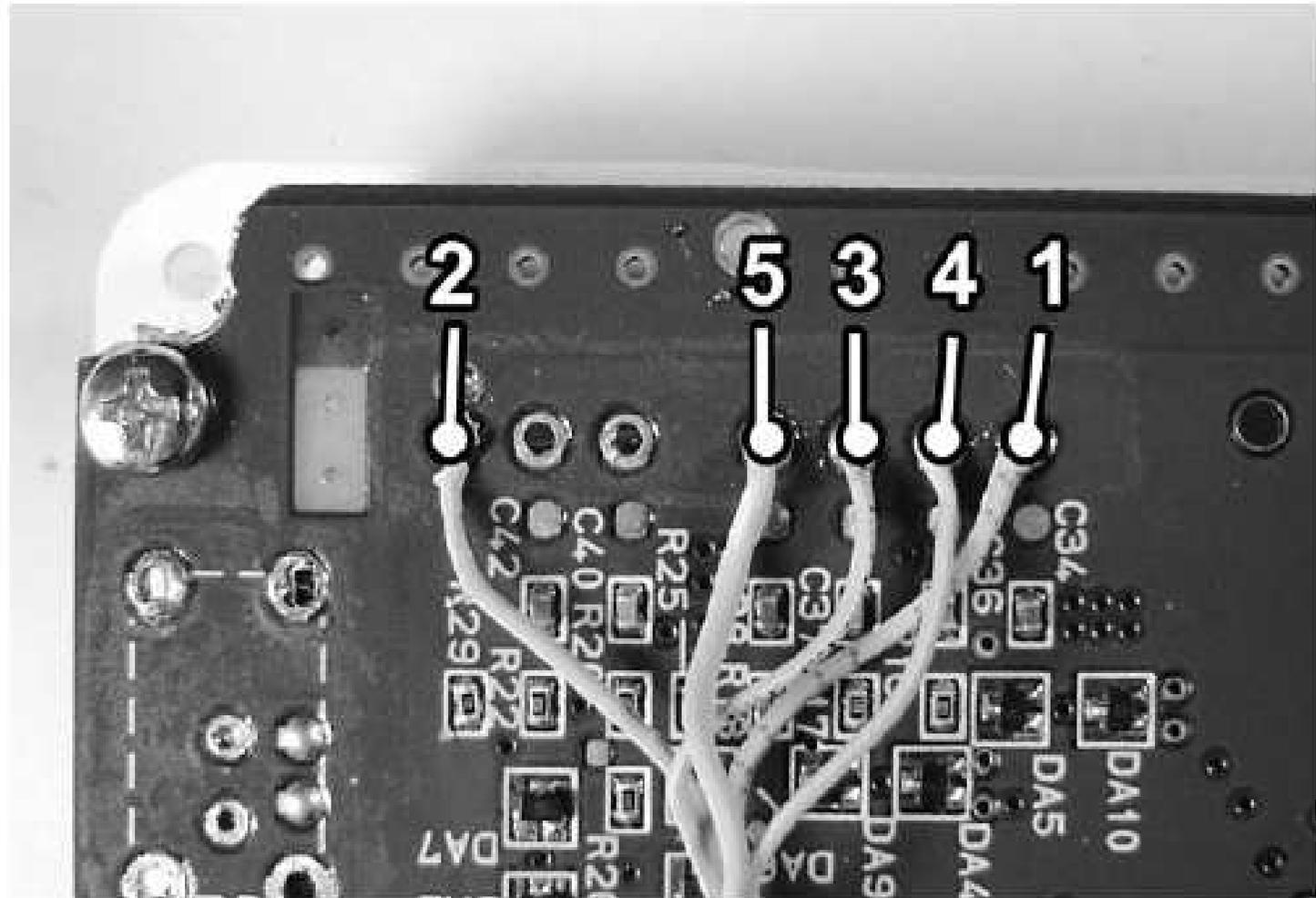


*[click on image for full view](#)*

You can now plug it into your SNES to charge up the batteries. An indicator should light up on the charger to show that it's, well, charging. Be sure it's switched to the kind of batteries you have (Ni-Cd or Ni-MH).

**FIGURE 10-40**

Connecting the built-in Player 1 controls to the SNES board.



**FIGURE 10-41**

Attaching a new plug on the end of the battery charger.



## Testing and Troubleshooting

Chances are you're doing one of two things right now: Gleefully playing SNES games, or holding your head in despair, gazing at an unfunctional portable.

If you're in the latter category, then this is the section for you! We'll start with the biggest problems and solutions, and then go on to the minor ones. The solutions in this section for the most part tell you what to check, so be prepared to look back through the book.

1. Insert six fully rechargeable AA batteries, and switch the unit to off/charge. Plug the charger into the charge jack on the unit—it should light up indicating charging activity.

If not, do the following:

- ◆ Check the wiring of the charge plug.
- ◆ Double-check how you wired the power on/off switch. If even one wire is wrong, the unit won't run or charge correctly.
- ◆ Check how you wired the battery terminals. If it doesn't match the photo earlier in this chapter, the batteries may not be in the correct series, thus breaking the circuit.

Once the charger indicates it's charging, you can move on.

2. Insert a game cartridge and switch the unit on. If nothing happens (i.e., there is no screen light or sound), do the following:

- ◆ Make sure the batteries have been charged. Even charging them for a moment "refreshes" them and gives them enough power for a short test.
- ◆ Check that the wires going between the battery terminals are placed correctly.
- ◆ Check the polarity of the wires coming off the battery to see if they're reversed. Use your multimeter to check the power going into the main switch from the battery. If it reads a negative voltage, then it's reversed, and you need to switch the power wires around.

3. If the screen turns on, but the SNES doesn't, do the following:

- ◆ Press the brightness and volume buttons to see if the indicators for them appear on the screen. This lets you know whether the screen is working properly. If you don't see the indicators on-screen:

- ◆ Check that the LCD ribbon cable is fully reinserted into its jack. (See Chapter 4.)
- ◆ Check that +5 volts is going to the SNES at the spot where the SNES's regulator used to be.
- ◆ Check that the SNES's power switch has been "jumped" with a bit of wire, switching it to be "always on." (See Chapter 9.)
- ◆ Check the five wires that connect the built-in controller to the SNES. The SNES gets its ground from these, so that if they are wired incorrectly, the whole SNES won't work, not just the controller.

4. If the screen and SNES turn on, but there's no sound, do the following:

- ◆ In the section Wiring the two halves together, the audio and video were connected to some small spots near the bottom of the PSOne board. Make sure these haven't come loose.
- ◆ In that same area there were three spots on the PSOne board that were to be soldered together: HPxR, HPS, and HPxL. Check that they are; if not, no sound will come out of the speakers.
- ◆ Check the left and right audio connections to the small surface-mount IC on the SNES board; they may have come loose. Once you have picture and sound going, press Start, and try playing the game using the built-in controllers.

5. If the built-in controller doesn't work correctly, or at all, do the following:

- ◆ The five wires going from the left PC board to the SNES board may not be in the correct order—double-check them.
- ◆ Make sure that the two 16-pin ICs are positioned correctly. There's a small dent on the end of them; check that it matches the orientation of the ICs in the photos. If not, you've got some desoldering to do!
- ◆ Check that every tact switch has these three things going to it: Ground connection, 10K-ohm resistor, Connection to IC (on same pin as 10K-ohm resistor).
- ◆ Each 10K-ohm resistor should have +5 volts going into it. Use your multimeter to check for this. If you find one that doesn't, find +5 volts on the PC board and connect it to the resistor.

- 
- ◆ Space can get tight on those PC boards, especially the left one. Make sure no connections are shorting each other out. If the controller works, but acts flaky, this is probably the reason.

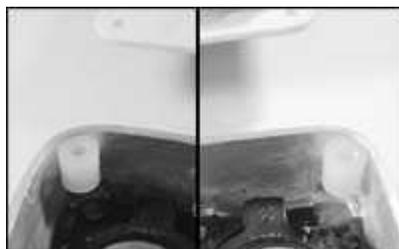
Once the picture, sound, and controls are all working correctly, your SNES portable is officially completely wired, and ready for final assembly!

### Final Assembly

Now that the SNES is working, we can do the final assembly. This involves adding a couple more screw posts (believe it or not!), arranging the wires inside the SNES so they'll all fit, and screwing both halves together. You're probably pretty anxious to get this thing done, so let's get started!

1. Take two 1/4"-high nylon spacers (make sure they've been threaded well), and glue them into the corners near each speaker as shown in Figure 10-42. Be sure to use epoxy on them as well, so that they don't snap loose when screwed into.
2. Flip the rear half of the case over onto the front plate to check how well the spacers line up to the screw holes, and adjust (before the epoxy dries) if necessary. Even if you use quick epoxy, I'd strongly suggest letting these cure overnight to allow maximum strength.

FIGURE 10-42



*[click on image for full view](#)*

Whenever I design a portable, my main thought is, "It must be thin!" The hand-built SNES portable is no exception, and because of this, the insides are very tight and cramped for space! True, you can mash the halves together and get it to fit but you may also short out connections by doing that. It's best to prevent this by placing electric tape over the following areas:

1. A double-layer of tape over both rows of the SNES's cartridge connector leads.
2. A small piece over the two screws holding down the SNES board near the cartridge connector.
3. A small piece over the +5 volt into SNES spot (where the 7805 regulator was).
4. A small piece over the 7805A regulator on the PSONe screen that powers the white LEDs.

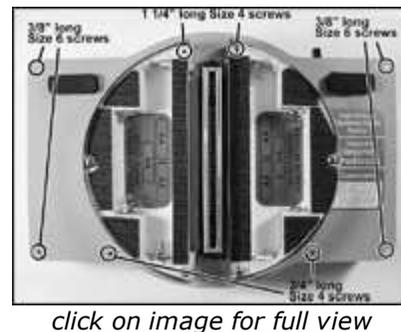
5. A small piece over the 7805A regulator on the PSOne screen that powers the SNES.
6. A big piece to cover the exposed leads of the power on/off switch.

### Putting It Together

Once you've placed electric tape in the indicated positions, you can press the two halves together. As you do, you'll find what wires and ribbon cables are getting in the way—press them aside or flatten them until both halves of the unit can meet. The shifting around and tucking away of various ribbon cables is vital to closing up the unit. Remember the extra-long ribbon cable between the left and right PC boards? You can tuck that under the top of the PSOne screen's board (if you haven't already) so that it stays out of the way of the SNES board. Since it's the biggest cable (eight strands), this really saves space. With the ribbon cables in place you can now screw the halves together as follows:

1. Insert the final screws through the back of the rear plate to secure the unit, as shown in Figure 10-43.

FIGURE 10-43



2. Fold the two halves together, like closing a book or making a sandwich. Then drive the screws from the rear half into the front to close it all up.

A few things may keep the sides from connecting properly, depending on how precisely the unit was built. Since it was done by hand, errors such as these can appear or not appear at random, and it's mostly a matter of luck.

**The top two 1-1/4" screws that go through the balsa in the battery compartments may not line up to the top two nuts on the front plate.** To work around this problem, use your soldering iron to widen the two holes on the inside of the rear plate, as shown in Figure 10-44. Stick the iron into the holes and tilt it left and right. This melts the plastic and makes a groove, so that when you insert a screw, you can tilt it left and right and have a better aim when

connecting it to the nuts on the front plate.

FIGURE 10-44



*[click on image for full view](#)*

**The right-hand speaker may bump against the SNES board, keeping the case from closing completely.** You can solve this problem by sanding down the front and back of the speaker. This will require you to remove the speaker from the case. Simply desolder the wires on the speaker itself, and pull it free of the glue. Fine-grit sandpaper will work, but a coarser grit will make it go faster.

1. Lay the sandpaper on something flat and scrape the speaker across it. A good minute of sanding on each side should get the speaker thinned enough to fit. You can remove some from the front of the speaker and a lot from the back.

2. Once the front is level with the center cone and all the text that was on the back is scraped away, you should be ready. You're actually sanding away some of the magnet, so particles of it will stick back onto it. To remove them, take the speaker outside and blow on it; they'll fly right off.

Don't sand the magnet anywhere near your portable. The magnet shards can short out circuits if they get into the case.

Note that when placing the speaker back down, you should keep it slightly away from the sides of the case. There's epoxy along that seam, and if you put the speaker on it, it may not lay as flat as possible.

**The SNES board hits the ON/OFF switch.** Again, this depends on where you placed the switch. Regardless, only a small portion of one corner of the SNES board will hit the switch, so you can just snip that corner of the board off with your cutters. The sides of the board are

just ground, and you can go up to 3/8" in from the sides with the cutting and still be safe.

Once you've made these corrections, you should be able to connect the two halves together. Congratulations, your hand-built portable Super Nintendo Entertainment System is finished! Enjoy your portable Final Fantasies and Chrono Triggering!