

Tactile Transducer Setup Guide



By Jeremy Paterson

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Introduction

A tactile transducer is a relatively cheap (<\$100) way to add a sense of motion to your sim rig without having to spend thousands of dollars on a full-motion system. The idea is that you will feel the vibrations and bumps that you would feel in a real car.

To accomplish this you take data from the simulator, convert it into a low-frequency sound signal and output it to a device mounted on the bottom of your seat. Because the frequency is so low and the device does not have a speaker cone, you sense the vibration in your body instead of your ears which gives you the sensation of driving on a real road. Not only does this increase immersion, but it can give you a better sense of how your car is interacting with the road.

There are many possible configurations and setups for adding a tactile transducer to your sim rig. I will go over the method that I used, which I believe to be the easiest and cheapest method, and I'll also include other useful information and configurations for setting up your system.

What You Will Need:

- One or more tactile transducers
- A sound card that's not needed for anything else
- Speaker wire, cables, and connectors
- An amplifier
- Crossover filter (optional... I'll explain later)
- Mounting hardware
- X-Sim software with profile for using the transducer in iRacing (optional... I'll explain later)

You will probably spend \$45 to \$150 depending on how much of this equipment you already have and the type of configuration you go with.

Tactile Transducer

There are a few options available. As of the time of this writing, the two that seem most reasonable are the **Aura AST-2B-4 Pro Bass Shaker**, and the **Dayton Audio TT25-16 PUCK Mini Bass Shaker 4-pack**.

Here is a comparison chart:

Product	Aura AST-2B-4 Pro Bass Shaker	Dayton Audio TT25-16 PUCK Mini Bass Shaker 4-pack
Photo (Relative sizes are approximated)		
Price	~\$40 each	\$30 for 4 transducers
Wattage	50w RMS / 100w Max	15w RMS / 30w Max each 60w/120w total
Impedance	4 Ohms	16 Ohms each
Usable Frequency Response	20-80 Hz	20-80 Hz
Peak Force	30 lbs/foot	30 lbs/foot total (all 4 combined)
Dimensions	6.2" Diameter, 2.5" High	3.4" Diameter, 1" High each

A big plus to the Dayton Minis is that they are a lot more configurable (impedance, wattage, placement, etc.) due to the fact that you have 4 transducers instead of one. However, there is more wiring involved compared to a single Aura Bass Shaker.

Sound Card

You will need to have a sound card that can be dedicated to the transducer. This can be your motherboard's sound device, a PCI sound card, or an external USB sound device. If you don't already have a sound device that you can dedicate to the transducer, you will need to buy and install one. Most sound cards will work with X-Sim; however avoid the cheap USB thumb-style sound cards as they may not be compatible with the software. PCI sound cards are easy to find for <\$10 and if you know somebody who works with PCs a lot, they probably have a bunch of old ones lying around and would be willing to give you one. It doesn't need to be anything fancy.

Speaker Wire, Cables, and Connectors

Standard, 2-conductor speaker wire (or even lamp cord) is all you need to connect the transducer. I recommend using 12 or 14 gauge wire to eliminate the risk of overheating the wires from too much power draw.

You will need various cables, connectors, splitters, etc. for connecting components. If you're using a splitter, be sure all 3 connectors are stereo. Headphone splitters like the ones pictured here should work fine and can be purchased for only a few dollars.



Amplifier

The signal coming out of your sound card will not be strong enough to drive the transducer, so you will need a way to amplify the signal.

The two most important things when deciding on an amplifier is the wattage, and the impedance. The amplifier must have enough power to handle the number of transducers you plan to run, and it must also be set up for the correct impedance (ohms.) If you don't understand how to get the right impedance, see the section on "Designing Your System."

You can buy a new 70w Subwoofer Amplifier for around \$60 - \$70. A cheaper solution might be to search for a used Home Theater subwoofer, disconnect the speaker, and just use the amplifier to drive the transducer. The amplifier does not *have* to be a subwoofer amplifier as long as the wattage and impedance is correct. However, depending on your application, you may or may not need to add a crossover filter if you go this route. See below for more information.

Crossover Filter

A crossover filter takes a full-range sound signal and filters out unwanted frequencies. In the case of a tactile transducer, you only want to use lower frequencies (typically <100Hz).

If you only plan on using the transducer with the X-Sim software, a crossover filter will not be necessary because the software will only put out the low frequencies. However, if you plan on using a program's sound to drive the transducer, then you will need a crossover filter or you will not only feel bumps in the road (low frequency), but you will also feel people chatting (high frequency) in your butt... probably not very pleasant! A limited number of games and simulators are supported by X-Sim, so if you think you'll want to use the transducer with all of your other games and movies, then a crossover will be necessary.

The nice thing about subwoofer amplifiers is that they usually have a crossover built right in. You can also buy an amp and crossover separately if the amp doesn't have one built in.

There are 3 types of crossovers: Active, Passive, and Software. Here is a comparison table:

Type	Active	Passive	Software
Installation	<ul style="list-style-type: none"> Between sound card and amplifier 	<ul style="list-style-type: none"> Between amplifier and transducer 	<ul style="list-style-type: none"> Operating System
Pros	<ul style="list-style-type: none"> Usually adjustable Filters out unwanted frequencies before the amp, reducing amp's workload 	<ul style="list-style-type: none"> Smaller and simpler No power supply needed 	<ul style="list-style-type: none"> No extra hardware and wiring to deal with Freeware available
Cons	<ul style="list-style-type: none"> Needs a power supply More hardware and wiring to deal with 	<ul style="list-style-type: none"> Not adjustable More hardware and wiring to deal with Filters out unwanted frequencies <i>after</i> they've been amplified, causing unnecessary load on the amp 	<ul style="list-style-type: none"> More software running on system One more program to launch before starting simulator
Price	\$20-\$100's, depending on features	~\$20-\$30 and up	Free (payware solutions available too)

Mounting Hardware

It's best to mount the transducer to something solid. If they're mounted sideways they won't transmit as much energy to your body, so ideally you'd have them firmly mounted on something like a cross-beam on your seat's support. This will transmit as much energy as possible directly up into your body. You also want to have as much of the surface of the transducer as possible touching that cross-beam.

Obviously, the exact mounting hardware you'll need will be based on your arrangement.

You will also want to try to isolate your chair or sim rig from the floor using rubber pads or feet for best results.

X-Sim Software

X-Sim is a free program designed for motion rig simulators, however it also works very well for use with a tactile transducer. It takes Telemetry data straight from iRacing and converts it into a low-frequency sound wave proportional to the bumps and vibration the driver should be feeling. The software is very complex, but fortunately through the use of profiles it is relatively easy to set up for using a tactile transducer in iRacing. See the "Setting Up X-Sim" section for instructions.

The software is available at www.x-simulator.de

Using X-Sim is optional. If you'd prefer to get the transducer's signal from the sound alone instead of telemetry, then X-Sim is not necessary.

Designing Your System

So, now that you know what components you need it's time to design your system. The most important thing here is to match your amplifier with your transducers. There is an unlimited number of ways to set up the system. I'll describe the ones that are simplest and easiest.

Goals

How you design your system will depend on a couple factors. These are some good questions to answer before getting started:

- Do I want to use sound or telemetry for the vibration data?
- Do I plan to use it for other games or movies?
- What equipment do I already own that I can design my system around to minimize cost?
- How many transducers do I want?
- How much am I willing to spend?

My goal was to spend as little as possible utilizing equipment I already had. I had an old subwoofer laying around so I decided to use it, eliminating the need to buy an amplifier or a crossover filter. Your situation may lead you in a different direction with your design.

Sound, Telemetry, or Both?

Method	Telemetry Only	Sound Only	Sound + Telemetry
Pros	<ul style="list-style-type: none"> You get more “true to life” feedback because the data is coming directly from Telemetry No need for a crossover filter You can adjust the X-Sim profile to your liking 	<ul style="list-style-type: none"> Can be used with movies and games that aren’t supported by X-Sim No extra software to deal with Gives you feedback on some things that telemetry can’t (like rumble strips) 	<ul style="list-style-type: none"> Some feedback can only come from telemetry, and other feedback can only come from sound. Using both together gives you all of the feedback Can be used with movies and games that aren’t supported by X-Sim
Cons	<ul style="list-style-type: none"> X-Sim software can be tricky to setup. (Step-by-step instructions are included in this guide) Can’t feel some things like rumble strips X-Sim software may conflict with other Force Feedback devices. Fanatec wheel owners have reported a temporary loss of FFB when using X-Sim. 	<ul style="list-style-type: none"> If you use a USB headset, you will have to use software to send sound to two different devices You will need to have a crossover filter somewhere in your signal path Can’t customize the feedback for different events 	<ul style="list-style-type: none"> Have to run X-Sim software If you use a USB headset, you will have to use software to send sound to two different devices You will need to have a crossover filter somewhere in your signal path

Wattage

Speakers and transducers have watt ratings. The watt rating tells you how much power it needs for optimal performance. Speakers and transducers will still work if they’re under or over-powered, but not optimally. If they’re underpowered, you’re not able to get the full effect. If they’re over-powered you risk damaging them. You want to make sure that your amplifier has enough power for all of the transducers you intend to use but not so much that you will damage them. For instance, if you’re going to use 2 Aura Bass Shakers, you’ll want to limit your power to 100w to prevent possible damage. You can usually overpower speakers somewhat with no detriment, but for the purposes of this guide keep within the correct power ranges unless you really know what you’re doing. You can safely under-power them though. You can run 2 Aura Bass Shakers off of one 70w amp; you just might not get as strong of an effect.

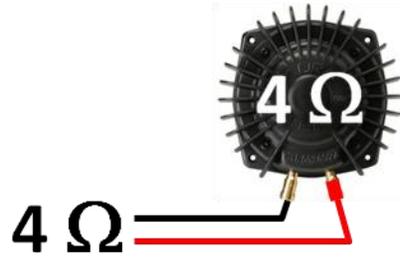
NOTE: Amplifiers typically have two watt ratings. They are “Watts RMS” and “Peak Watts.” Watts RMS is the rating you want to use. Think of RMS as the average ocean level, and Peak Watts at the height of the highest wave (it’s a little more complicated than that, but the explanation is beyond the scope of this guide.)

Impedance

All speakers and tactile transducers have an “ohm” rating to tell you their impedance (or resistance to changes in current.) The amplifier output also has an impedance rating. It is important that the amplifier sees the correct amount of impedance. **If you do not match up your amplifier’s impedance rating to the total load, you could damage the amplifier, the transducers, or both.**

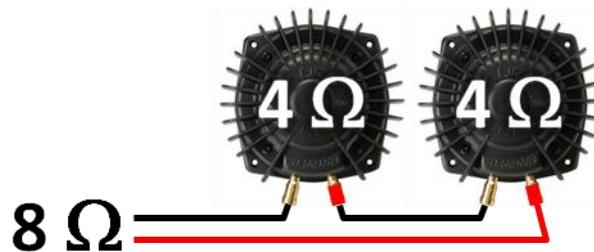
If you're only using one transducer, this is very easy. For instance, you could hook up one Aura Bass Shaker (4-ohm) to a 4 ohm amplifier and you're all set.

SINGLE:



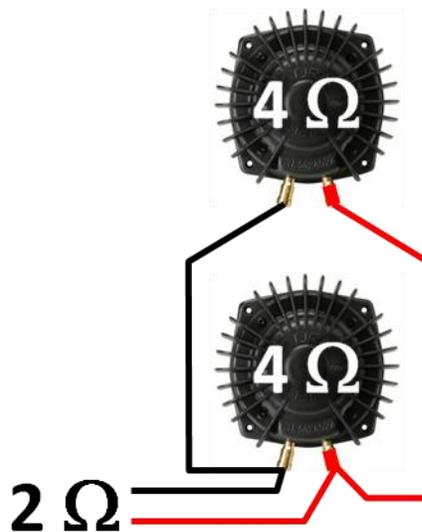
If the transducers are wired in **series**, as shown below, then you add their impedances to get the total impedance. In this example, you have a 4-ohm transducer in series with another 4-ohm transducer, giving you a total impedance of 8 ohms ($4+4=8$)

SERIES:



If transducers **of equal impedance** are wired in **parallel**, then you divide the impedance of ONE transducer by the total number of transducers*. In this example, you have two 4-ohm transducers in parallel, giving you a total impedance of 2 ohms ($4/2=2$)

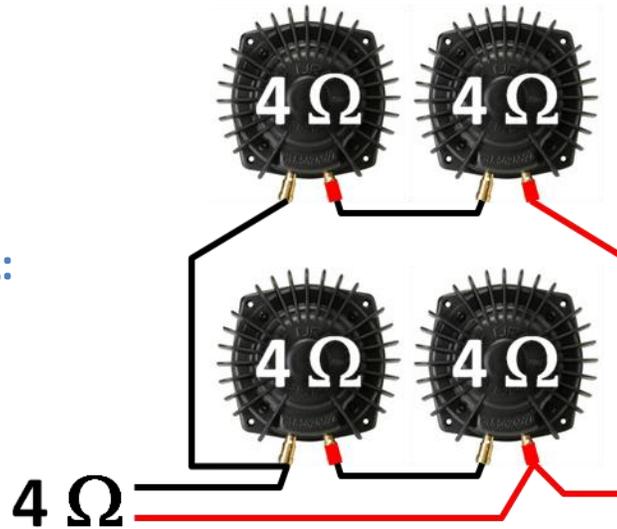
PARALLEL:



* All transducers in the parallel circuit must be of equal impedance for this method of calculation to work.

You can also make a combination of series and parallel transducers to get a different value. In the example below, you have a pair of transducers in series with each other, and in parallel with another pair of transducers. You can consider the ones in series to be a single transducer whose impedance is equal to the sum of the two. So this would be like having two 8-ohm transducers in parallel with each other, giving you a total impedance of 4 ohms ($8/2=4$)

SERIES/PARALLEL:



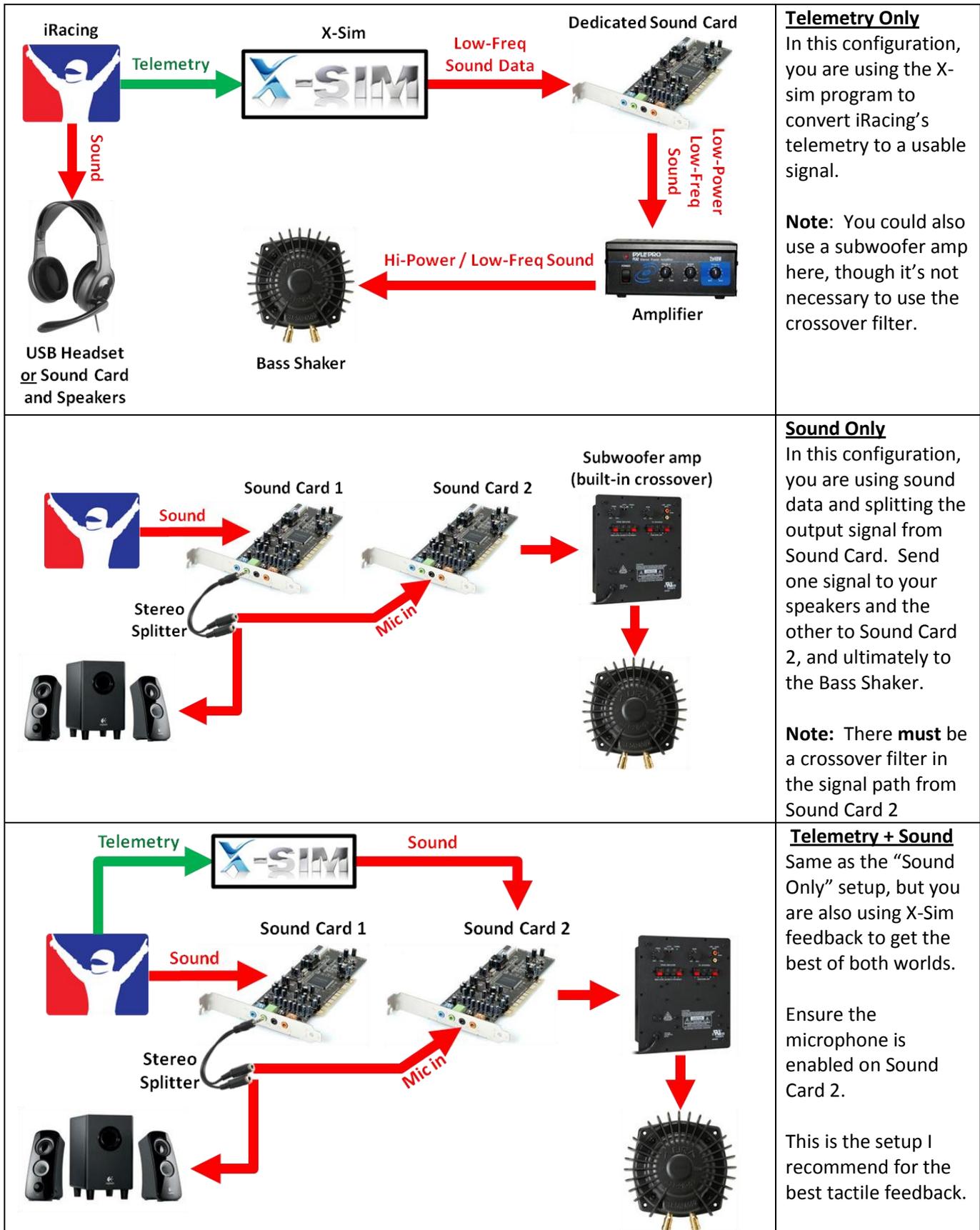
In the case of the Dayton Mini Bass Shakers (16 ohms each), you could wire all 4 in parallel for a 4-ohm load, or 2 in parallel for an 8-ohm load. If you have a 2-channel amp at 8-ohms, you could put 2 Mini Shakers on one channel in parallel with each other and the other pair on the other channel in parallel with each other for two separate 8-ohm loads. There are many, many possible configurations. The more transducers you have, the more options you have for impedance.

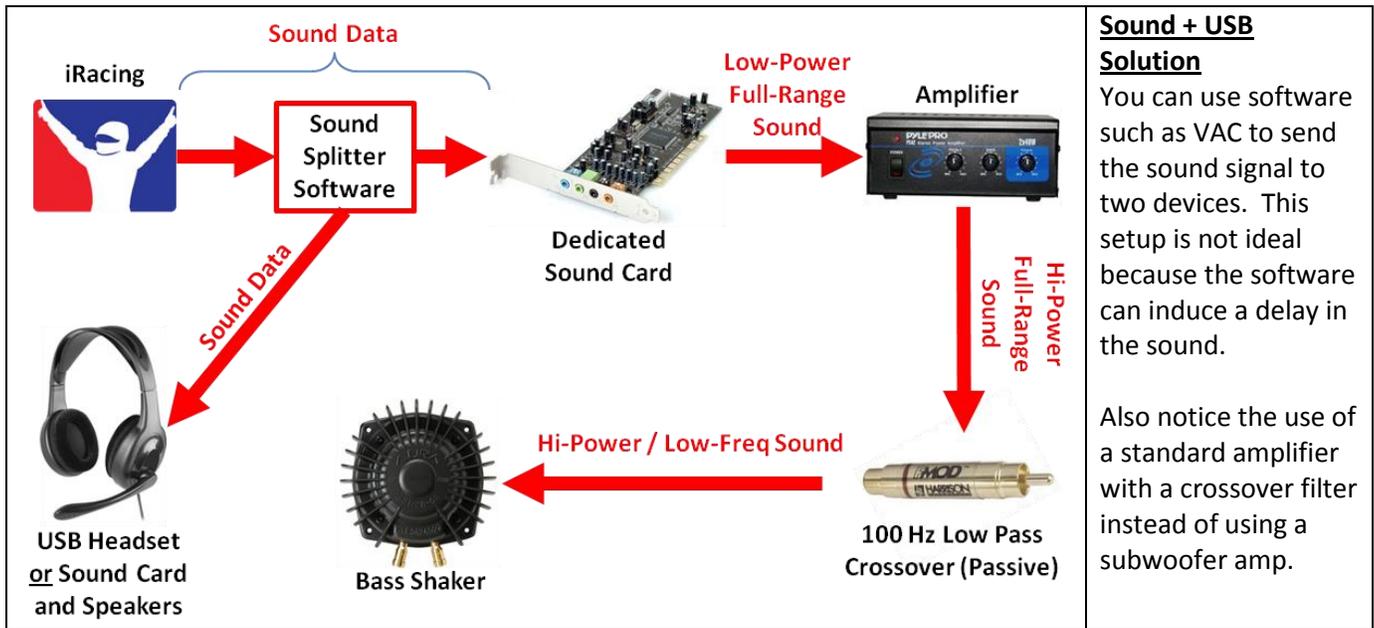
Do not try adding resistors to the circuit to get the speaker load to the right impedance. It's not that simple and you could damage components or even start a fire!

Signal Path

Here are some block diagrams of the signal path for a few possible configurations.

NOTE: On the configurations that use Sound Data from iRacing, a stereo splitter is used to send sound to both the speakers, and to the secondary sound card so you can hear the sim and feel it too. However, if you are using a USB device then a stereo splitter is not an option. The only solution is to split the sound signal using software. There are programs available to do this and I've included a link to one at the end of this guide. I do not recommend this type of setup because the splitter software can induce a noticeable delay in the sound due to the time it takes to process the signal. Because of this limitation, if you plan to use a USB device to hear the in-car sounds, I recommend using a "Telemetry Only" setup to drive the transducers.





Notice that in every configuration, the ultimate goal is to get a High-Power / Low Frequency sound signal to the transducer. You could make many configurations that are different than these examples, but these examples should illustrate the concept well enough to get you started.

Using X-Sim

This guide was written using X-Sim White Workshop Edition version 2.0.8.9

The X-Sim software converts telemetry data from iRacing into low-frequency sound data to be used for the tactile transducer. This portion of the guide is written for setting up X-Sim with iRacing and a tactile transducer. It doesn't encompass the whole program.

Initial Setup

- Download the software at <http://www.x-simulator.de>. There are two versions for downloading. They are the "White Workshop Edition" and the "Black Community Edition." The Black edition has internet connection abilities and the White edition does not. The White edition is faster and less RAM intensive.
- Download a profile for iRacing Bass Shaker use. This can be found in the X-Sim forums under [Forums > Motion Profiles > iRacing > X-Sim² profiles](#)
- Run the downloaded installer. It will install a few programs, but the only ones you will need are "Force Sender" and "Force-Profiler 2."
- After installation it will also ask you if you want to install pneumatic/hydraulic USB interface drivers. You do not need to install them.
- Once installed, open Force-Profiler. The first thing you will notice is a voice and a "Wizard" window. Click "Do not show intro again." The voice is activated every time you start and stop the Profiler. If you want to turn that off, click "My Simulator" on the top toolbar and uncheck "enable speech output."
- On the left menu, click "Interface Settings."
- Then, in the right-hand box, uncheck everything except BassShaker.

- Double-Click on the word “BassShaker” and you will get the Plugin Settings menu. In the dropdown box, select the soundcard that you’re using for your transducer.
- You will get a popup box saying that a hardware rescan is needed. Click OK.
- On the bottom right, click “Start HW Rescan.”
- After the scan, you should see “BassShaker Frequency” and “BassShaker Volume” added to the “All outputs of found interfaces” box.
- Double-Click on “BassShaker” again in the right box.
- Verify the correct soundcard is still selected.
- You can adjust minimum and maximum frequency here. This acts as a crossover filter, which is why you don’t need one attached before or after your amplifier.
- There are other options on this page too, including test signals and volume controls.
- After you have it all set, click “Close Dialog.”
- On the top menu, click “File menu” from the top menu, then “load.” Select the iRacing BassShaker profile that you previously downloaded.
- In the “Load Dialog” menu that pops up, just leave everything checked and hit “Accept.”
- Next, start up the Force-Sender software.
- On the Force-Sender software, select “Choose official developer plugin” from the top menu and select “iRacing.” Everything else on this screen can be left blank.

This completes the setup. You will not have to load profiles every time you launch the program, it will automatically load the last-used settings.

Using X-Sim after initial setup

- Launch the Force Sender
- Launch the Force Profiler
- In the Force Sender, click the “Try send data” button
- You can now minimize the programs and run iRacing like normal

Using a 2nd PC to run the Profiler

X-Sim can cause a performance hit in the simulator due to the extra CPU load. To alleviate this, the Profiler can be run on a secondary PC that’s networked with your iRacing PC. This will still work with the “white” edition of X-Sim (Thanks to Brent Bundy for these instructions.)

Signal: iRacing Telemetry > Force Sender > LAN > Force Profiler on 2nd PC > Sound Card > Amplifier > Transducer

- Hook up your transducers and amplifier to your 2nd PC's soundcard.
- Set up the X-Sim **Profiler** on the **2nd PC** using the instructions above.
- Run X-sim Force **Sender** to your **iRacing machine**
- Open the Force Sender and click on the "Edit Cluster List" button
- Enter your 2nd PC's IP address
(to find your IP address in Windows: Start > Run > CMD. Type *ipconfig* in the prompt)
- Click the "Try Send Data" button and run everything as you normally would on one machine

Now the only extra load on the iRacing PC is the Force Sender (very small load) which sends the telemetry data to the 2nd PC. The 2nd PC is now handling the extra CPU workload of converting the telemetry into sound data and driving the Bass Shakers, minimizing the load on your iRacing PC.

Useful links:

<http://www.x-simulator.de> - X-Sim website

<http://www.parts-express.com/> - Parts Express sells tactile transducers and amplifiers

<http://software.muzychenko.net/eng/vac.htm> - Virtual Audio Cable software that allows a program to send sound data to more than one sound device. Useful if you're using sound data instead of Telemetry.

http://www.amplifiedparts.com/tech_corner/speaker_impedance_power_handling_and_wiring - Explanation of speaker impedances.