

# COMPUTER INTERCONNECTIONS III

Early PC sounds were limited to beeps and boops, which made for some pretty boring games, and if you wanted to listen to music, you had a separate cassette deck to play your tapes. Now even laptop computers can play CD music in stereo, games come in surround sound and we do our music recording, organizing and playback on our computers. Here are some tips on how to connect all those pieces of a computer audio system together to get clear and satisfying sound.

## 1. Basic Sound Card Wiring



The basic computer sound system starts with a sound card, either a real pluggable card or one integrated into the motherboard. The traditional sound card has four stereo 3.5 millimeter jacks for inputs and outputs. One jack is a direct microphone input and one can drive a pair of speakers or headphones. Two other jacks are for Line In and Line Out. We will discuss these two a bit later. You can use the microphone and speaker jacks to hook up a headset for Internet VOIP phone calls or gaming.

If gaming is your thing, you can step up to a surround sound card that can drive several speakers. Speaker configurations are known by a numbering system where 2.0 stands for simple stereo with a left and a right channel speaker. Systems that are 2.1 add a subwoofer for better low frequency response. True surround sound systems start with 5.1 - these have a front left and right, rear left and right (satellites) and a center channel plus the subwoofer. That is a lot of speaker wires coming out the back of your computer!

## 2. Powered Speakers

Internal sound cards have to run off the 12 Volt computer power supply. This limits the power available to a little over 2 Watts RMS (Root Mean Square) before the onset of overload distortion (we will get into that later). To get around this limitation, most high quality computer speakersystems bypass the internal power amplifier on the sound card and incorporate a higher-powered amplifier either in a stand-alone box or right inside the speaker enclosure. A separate line operated power supply gives the juice to the powered speakers. Having at least 10 Watts RMS for each speaker makes a lot of difference



in the quality of the sound even if you are not blasting rock and roll. Beware of PMPO (Peak Music Power Output) ratings because they are pretty meaningless, whereas RMS is a real measure of the ability of an amplifier to drive a speaker.

Powered speakers are driven by an analog signal from one of the 3.5 mm jacks on your sound card. You could plug it into the Speaker/Headphone jack, but the quality would stink. This is where the Line Out jack comes into play. The line level signal bypasses the speaker amplifier on the sound card to give you a cleaner signal. The Line In jack bypasses the microphone amplifier for higher quality recording, but we will have to get into that in a future Tech-Tips.

### 3. Subwoofer



I already mentioned subwoofers as the x.1 part of a speaker array. A subwoofer is a special speaker that does a better job of producing the deep bass that makes music sound full and battlestar explosions more real. You can have a simple stereo speaker set, but to get the bass, the speakers on your desk would have to be large. I don't know about you, but my desk doesn't have room for large speakers. Instead, the speakers on your desk can be small to produce just the high frequencies that you want to hear directly. The subwoofer can be larger and placed under your computer desk and you will still hear and feel the bass just fine. Just remember that the speakers have to be wired up so that only low frequencies go to the subwoofer and only high frequencies go to the small speakers. It is best to purchase a complete speaker system with the proper crossover (frequency splitting circuit) and interconnect cabling included.

### 4. External USB

An alternative to the traditional sound card is the USB speaker system that moves all the audio circuitry outside your computer. The only connection to the computer is the digital USB cable. The debugging headaches outlined below apply to sound systems connected with analog signals. With a digital interface, the noisy computer case is completely separated from the sensitive audio circuits. USB connected sound systems are especially good for laptop computers that may have only a headphone sound output that is not up to par for decent sound.



### 5. Sound System Debugging

Since computers were not originally designed to be part of a hi-fi sound system, it's no wonder that

we run into many problems like distortion, noise, and hum when we go for top quality audio. Here are some tips for cleaning up those problems so you can have a sweet-sounding music or gaming system.

## 6. Distortion

Audio signals are prone to all sorts of distortion that can be introduced by everything from a dirty plug to a faulty audio CODEC (Compression/



Decompression algorithm). Since we are talking about

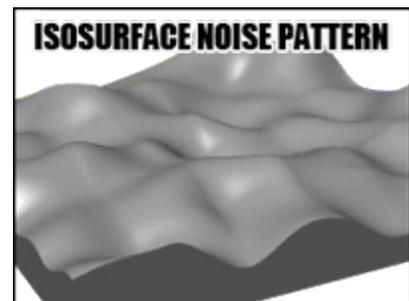
computer interconnects here, we will limit our distortion discussion to only two causes:

One type I mentioned is dirty or loose plugs. Make sure your computer audio signals are protected by tight, clean connections. Corroded contacts can do all sorts of nasty things to sound. Clean your plugs with a dry rag, or maybe a tiny bit of contact cleaner that you can buy at Radio Shack. If this doesn't result in nice shiny connectors, replace your cables. They are too cheap to have them degrade your sound.

The second type of distortion involves overload, basically turning the sound up so loud that the circuit cannot amplify it properly so the peaks of the signal are clipped off (hence the name "clipping distortion or peaking"). This creates all sorts of harmonic distortion. If you are recording rock guitar, harmonic distortion is part of your sound. For playing back music on your computer, it sounds horrible. I will go into how overload distortion interacts with how you have your computer sound system connected up in the next section on noise.

## 7. Noise

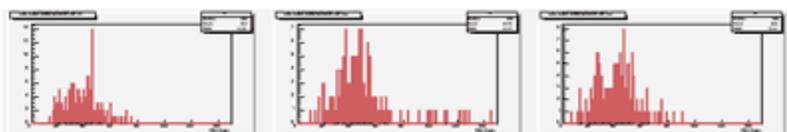
All audio systems suffer from noise at some level. It is just natural by-product of amplifying sound signals, but we can minimize it to the point that we do not hear it anymore. By noise, I mean the constant hiss you hear when you crank the volume way up. We will cover power line hum noise in a moment.



I am going to introduce a concept that even many engineers do not seem to grasp, but it is really simple: gain distribution. You want to have the least amount of gain between the source of the sound signal and your ears as you can have. Gain is a measure of amplification and you can have too much of it.

Here is a concrete example that you can demonstrate yourself and maybe even improve your computer sound. Suppose you have a set of powered speakers that are fed an analog signal from your sound card. Play some music, say, a CD in the CD drive. Go to the full audio mixer control panel, usually double clicking on the speaker icon at the lower right of your screen.

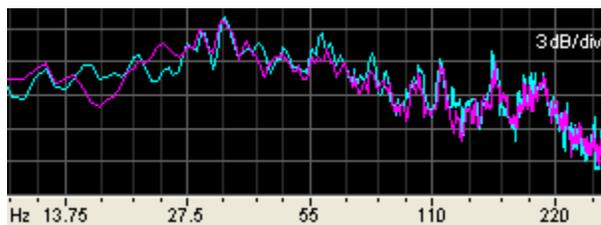
Push the mixer slider for the CD Player all the way to the bottom. Push the Master control all the way to the top and turn the volume control on your powered speakers all the way up. You are probably listening to a lot of hiss noise with no music right now because you have maximum gain going in your powered speaker and your sound card. Move the CD Player slider up very carefully and you will find that you get maximum volume very quickly, but all that hiss is still there.



Now, reverse the process and start with the powered speaker turned all the way down and the mixer controls all the way up. Turn up the powered speaker only to a comfortable level. Back down the mixer controls only as needed to get rid of overload distortion. You can quickly find a setting that gives all the volume you want, low distortion and minimum hiss. This is the ideal gain distribution between the elements of your sound system.

## 8. Hum

Getting rid of hum in your computer sound system can really be frustrating. Hum is caused by our power lines that run at 60 Hertz (which we used to call 60 cycles per second) and it can leak in from anywhere. Sixty Hz is a pretty low frequency that many speaker systems do not reproduce very well, but often the harmonics (multiples) of the power line frequency (120 Hz, 180 Hz, 240 Hz and so on) are what we hear, and they can be really annoying.



The first step to get rid of hum is the optimum gain distribution as described above. Hum gets louder with more amplification, so get the gain down. The next step is to get rid of the source of the hum if you can.

One source of hum can be the use of an unshielded cable between the Line Out of the sound card

and the input of the powered speaker system. You can get cables with 3.5 mm plugs that are designed to hook up speakers and these cables generally have no shield to protect the signal from hum induced by nearby power cords. Make sure all the cables between your sound card and your speaker system have a shield. Your best bet is to use the cables that came with the speaker system in the positions where the instruction tell you to use them. do not swap cables around. The unshielded speaker cable will work fine between the amplifier and a speaker, but not on the input of the speaker amplifier.

Another culprit can be the power supply in your powered speakers. Leave the volume control where you usually listen when you like it loud and unplug the power supply. Now unplug the sound signal cable (the 3.5 mm plug), and make sure the plug is not touching anything. It is not dangerous, but it will pick up hum if it is in contact with something. Plug the power supply back in. If you still have hum, it is coming from the power supply in the powered speaker, so you might think about getting it repaired or upgraded.

Still another cause of hum is a ground loop. When you have the power cords of two pieces of equipment plugged into separate receptacles, there could be a long path between the two receptacles. Also, the position of the audio cables relative to the power cords can have your sound system humming. One way to avoid ground loops between equipment is to connect the power cords of the two pieces of equipment with a Y-Cable that ensures they are plugged into the same branch circuit. If the Y-Cable still has your computer humming a few bars, try repositioning the audio cables. Try to keep the audio cables, including speaker wires, bundled together with a cable organizer kit. Keep some separation between the audio cables and the power cords, but sometimes too much separation contributes to a ground loop. It really ends up being a trial-and-error solution.

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