

Plugging in your Dulcimer

Will Styler - Colorado Dulcimer Festival 2010

I. Why plug it in at all?

When you plug in your dulcimer for recording or amplification, you're converting acoustic energy (sound) to electrical signal (voltage) and then eventually, back to sound or into a digital representation to preserve it for later..

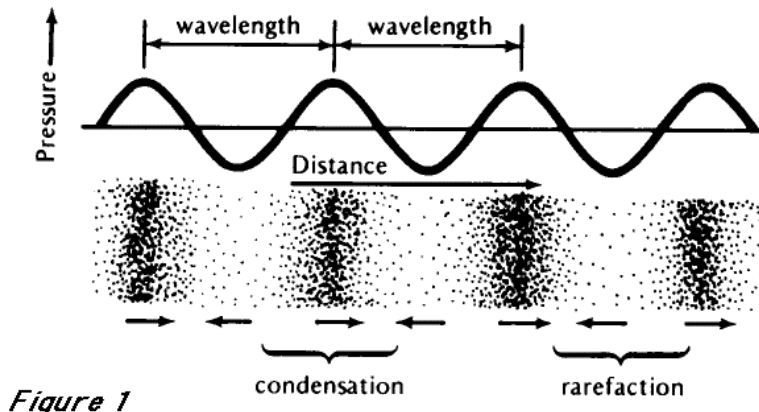


Figure 1

Courtesy: <http://www.neurophys.wisc.edu/~ychen/figs/fig1.gif>

Amplification: Sound ----> Voltage ----> Higher Voltage ----> Speaker ----> Sound

Recording: Sound ----> Voltage ----> Representation ----> Voltage ----> Amplification

II. Turning sound into Voltage

Microphones use a membrane attached to a moving magnet to change pressure into voltage. Several different types

Condenser Microphones have better **fidelity**, but are more fragile, usually need "phantom power". They're also more expensive.

Dynamic Microphones have better durability, no phantom power needed, higher gain. Can be found reasonably priced.

Different microphones pick up sound from different directions. **Cardioid** microphones pick up signal mostly from the front. **Omnidirectional** microphones pick up sound from everywhere. As such, Omni mics will pick up more noise.

Sometimes, you want to get the signal at the source. A **pickup** or **transducer** can be attached to an instrument's soundboard and change vibration directly into voltage. No background noise is picked up, and very good quality can be found, but a **pre-amplifier** is often required.

For recording either flavor of Dulcimer at home, a pickup is best, with a dynamic, cardioid microphone as a close second.

III. Pickup preamplifiers

If your pickup yields a very weak (but accurate) voltage, a **pickup preamplifier** amplifies that tiny signal very accurately so that the amplifier or recording device has more signal to work with. Many will allow you to adjust the **bass**, **treble**, and **gain**. Bass controls the lower frequencies, treble controls the higher frequency, and gain increases the amplification of the signal (but can add **distortion**).

If you've plugged everything in and the signal is just too quiet, even with the other settings at 3/4 of max, put a pickup preamp between the instrument and the next component.

If you're recording, you'll place your computer or external analog/digital converter after the microphone or pickup pre-amp.

IV. Mixers

If you have more than one input, microphone, or instrument that you want to record or amplify, you'll need to use a **mixer**. A mixer simply combines all the signals coming into it, and outputs a single stereo signal. You can usually adjust the level of each individual component in the final mix, to, for instance, make the mountain dulcimers sound louder than the hammered dulcimers. A mixer will often stand in for the pre-amplifier in pro-audio setups, and you'll need a mixer if you're hooking up more than one instrument to the same amplifier.

V. Preamplifiers

Preamplifiers allow you to adjust the volume of the signal going out to the amplifier, change the signal (with an **equalizer**, which lets you adjust the power of different parts of the signal), and switch between different inputs (microphone, instruments, etc). Most PA systems and home stereo systems use what are called **integrated amplifiers**, which have both a power amplifier and a preamplifier built in. Often, the Mixer will stand in for a preamplifier as well.

When you're setting up, make sure that there's a Volume (not gain) knob between your dulcimer and your speakers. That means that there's a preamp involved, and you can control the loudness of the signal, rather than making everybody in the room temporarily deaf.

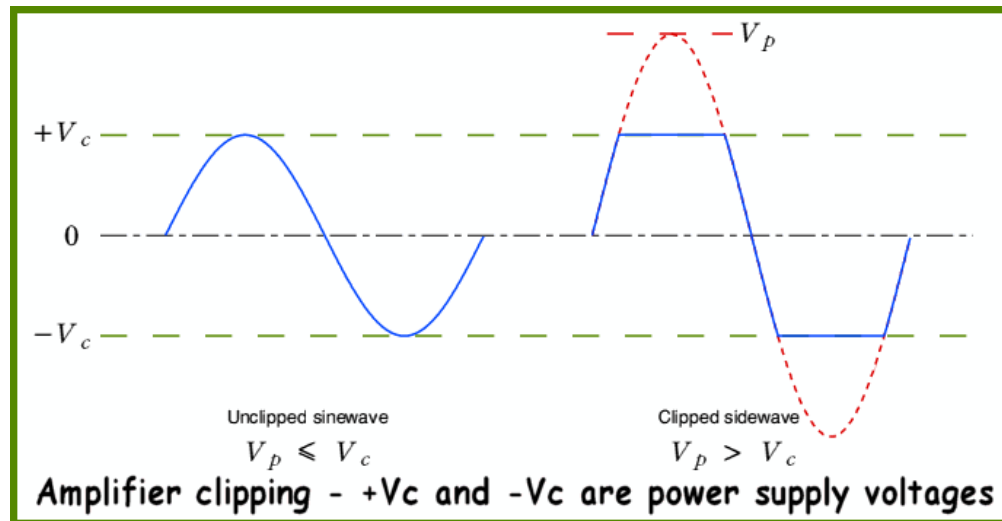
VI. Power Amplifiers

Power amplifiers, often just called "amplifiers" take a small, lower voltage signal and increase the voltage to be able to drive speakers. These are rated by wattage, and can go from 10w (for a car stereo or boombox) to 2000+ watts (for a movie theater or concert venue). The **wattage** of the amplifier indicates how much power it can put out without clipping and injuring the speakers and amplifier. Power amplifiers need a preamplifier to control the volume and prepare the signal. Remember, most amplifiers

you deal with will be integrated amplifiers, which have the preamp and power amp housed in the same chassis.

VII. Clipping

Signals want to be smooth lines, and they have peaks and valleys. If your amplifier (or recording device) doesn't have the range or power to hit the highest peaks and lowest valleys, it goes into **clipping**. Clipping is where you're missing the peaks in sound.



<http://www.drewdaniels.com/clip.gif>

If the amplifier starts clipping, you end up with a straight line where the amplifier is pushing as hard as it can for a larger period of time. In addition to really lowering sound and recording quality, **clipping can severely injure both speakers and amplifiers if allowed to occur for too long**. To spot clipping, watch the power meter on the front of the amplifier, or listen to a sharp drop in sound quality

If your amplifier is clipping to get the volume you want, you need a stronger amplifier.

If you're clipping while recording, reduce the input volume or remove the pickup preamp.

VI. Speakers

Speakers are pretty self-explanatory, and go after the power amplifier. Just make sure that you're not hooking a gigantic amplifier to a tiny pair of speakers and cranking the volume, or you're going to melt your speakers when they can't handle the power.

Also, make sure that the speaker **impedance** (usually listed on the speaker) matches that of the amplifier. If your speakers are $8\ \Omega$ (**ohm**), you need to hook them into the $8\ \Omega$ pegs on the amplifier. Connecting $2\ \Omega$ speakers to an amplifier meant for $8\ \Omega$ speakers is an easy way to melt your amplifier. Most speakers are $8\ \Omega$, though, and most amplifiers can deal with that.

VII. Recording

In order to play your music back later, you need to store it. **Analog** recording is the saving of the exact pattern of pressure/voltage into some medium, whether it be wax, vinyl, or magnetic tape. **Digital** recording is transforming that **waveform** into a series of discrete points, storing the **amplitude** (power) at an amazingly large number of points in the signal. Some digital recording vocabulary:

To do this, you'll need an **Analog/Digital Converter** or **Sound Card**. 99% of modern computers have them built in, and usually the little ring surrounding the microphone input is pink and fits a stereo miniplug adapter. If you plug your microphone or pickup preamp into that port and use a recording program, you should be able to record your music without too much difficulty.

You can buy an **external Analog/Digital Converter** which does a better job of digitizing sound, and allows you to adjust the input volume and use 1/4" phono and XLR cables as input. Most external Analog/Digital Converters will connect to your computer using a **USB** cable, and will be visible to your recording program without too much fighting.

Audacity is a free program which you can (and should) use to do your recording on your computer. Versions are available for Apple, Windows and Linux computers, and it's very well made. There are many tutorials available online which tell you how to record using audacity.

Download Audacity from:

<http://audacity.sourceforge.net>

Audacity Recording Tutorials:

<http://audacity.sourceforge.net/manual-1.2/tutorials.html>

http://www.gwu.edu/~slavic/gw_itunes/#recording

<http://www.youtube.com/watch?v=lrPGMjZORCM>

<http://www.youtube.com/watch?v=6txQRfptawE>

There are a variety of vocabulary words you'll need to know when dealing with digital recordings.

Sampling Frequency - The number of times per second that amplitude is measured. *Higher sampling frequency means higher quality*, and is measured in **Hertz (Hz)**, number of samples per second.

The highest sampling frequency you're likely to want is 44,100 Hz, which can capture all sounds the human ear is capable of picking up.

Lossless audio files - If you save your recordings as .aiff or .wav files, you're saving all the information that you recorded, nothing is lost. These are big files, but higher quality.

Lossy audio files - If you save your recordings as .mp3 or .wma files, you're saving all the information that you recorded, nothing is lost. These are small files, easy to email or send to people, but they don't sound as nice.

mp3 files - An mp3 file is a file format where the recording is simplified a little bit to save space. Audacity can save mp3 files, and they're pretty universal, nearly everybody can open them.

Bitrate - The amount of information stored for every second of the recording in a lossy audio file.

Less storage space = less sound quality. If you're saving as an MP3, make sure you save with a bitrate above 128 kilobytes per second (kbps) if you want it to sound decent.

V. Types of cables and cable endings

RCA Cables - These are the sorts of white and red cables that you see on most home electronics, and most preamps have RCA inputs. CD players are likely to have RCA out. It's easy to find RCA ---> Stereo Miniplug adapters, so this may be the best way to connect your computer to a stereo system. *With RCA, right is red.*

Stereo Miniplug - Most computers and personal music players use stereo miniplug cables to connect. It carries two channels (**stereo**) in a smaller insert. This can be converted to 1/4" phono easily with an adapter.

1/4" Phono (or "Phono") - This is a much larger plug, common on instruments and pickups, which can either be mono or stereo. Most preamps (especially for professional audio) have 1/4" jacks. This can be converted to stereo miniplug easily with an adapter.

XLR - This is a balanced, more shielded sort of cable which is often used to go between pro-audio components and also to connect microphones to everything else.



RCA



Stereo Miniplug



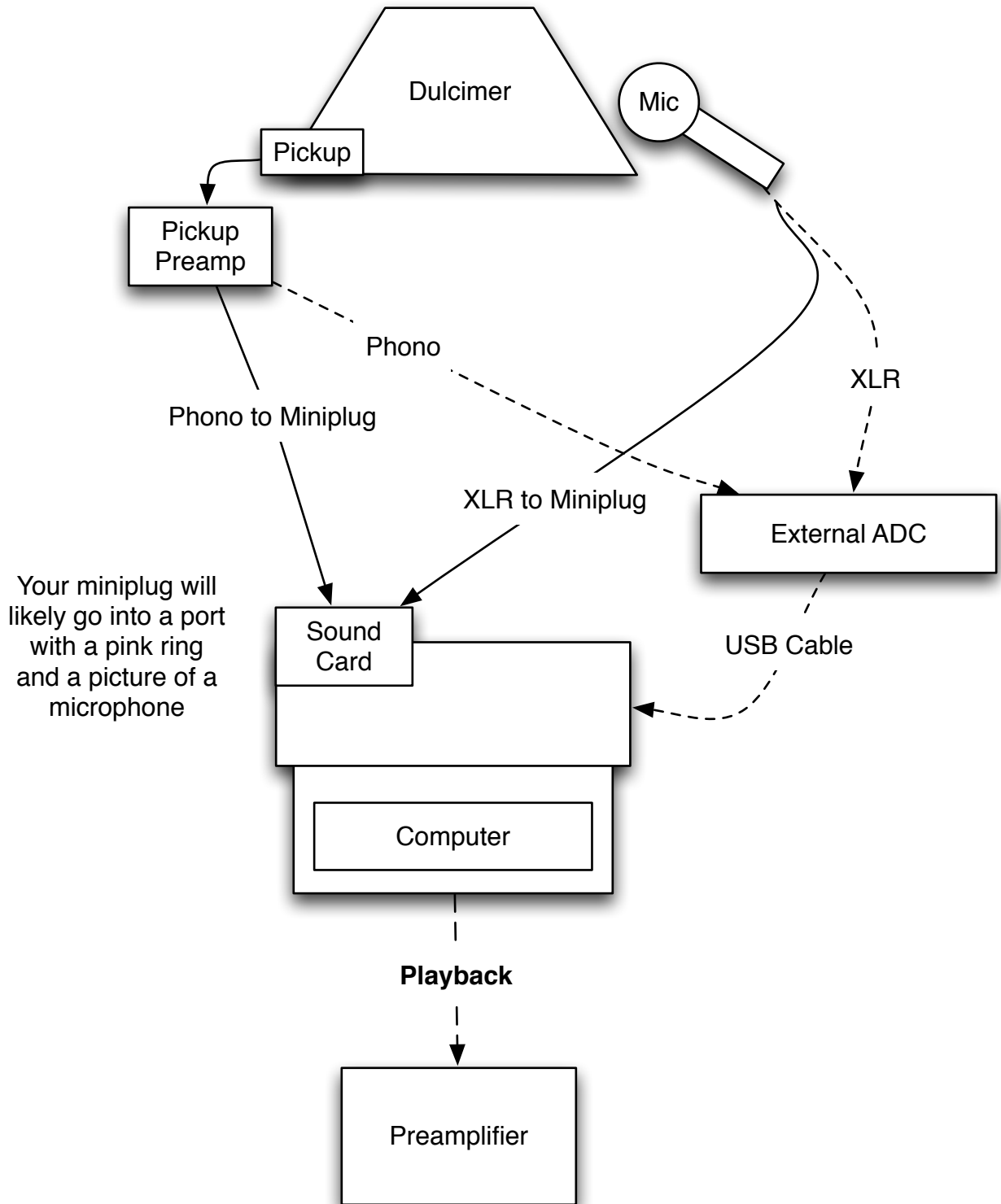
1/4" Phono



XLR

Wiring up your Dulcimer for digital recording

Use the dotted lines if you have an external analog/digital converter.
Use either a mic or a pickup, but not both.



Wiring up your Dulcimer for amplification

Use the dotted lines if you've only got a mixer, if you're wanting both a mic and a pickup to go through the system, or if you're playing with other people.

