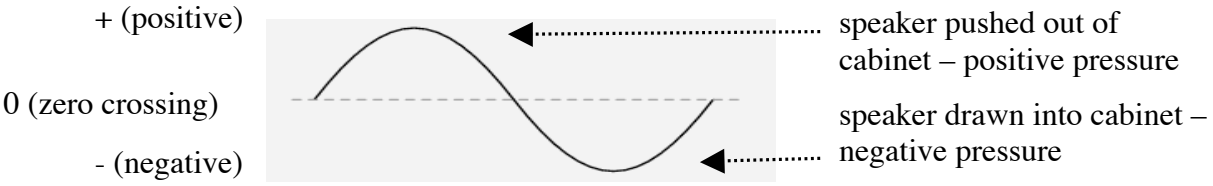
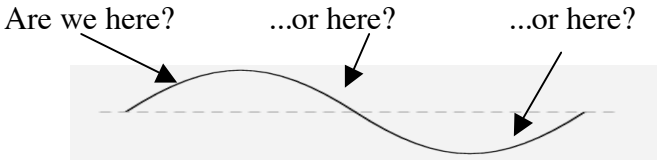
Polarity and Phase

It's important to notice the ***polarity*** of a waveform. Polarity is the positive or negative quality of the waveform as it crosses above and below the center. The center is called the **zero-crossing**.

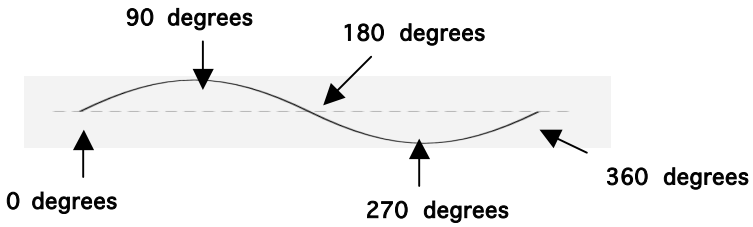


Positive is when the speaker is pushing out into the room – ***negative*** is when the speaker is drawn back into the speaker cabinet. It is the back and forth motion that causes the air vibrations that we hear as sound.

Phase is related to polarity, but it's a little more complex. Phase means how far have we traveled through ONE cycle of the waveform?

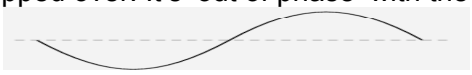


Phase is measured in degrees, kind of like a stretched out circle. One complete waveform cycle has 360 degrees. Every half cycle of the waveform has 180 degrees.

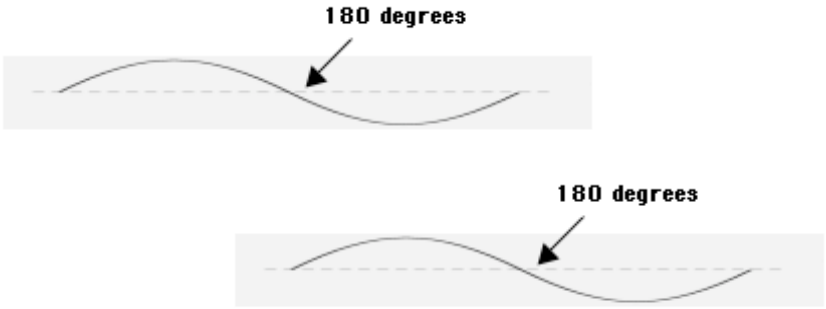


Here's a single cycle of a sine wave:

Here's the same sine wave, flipped over. It's 'out of phase' with the one above.

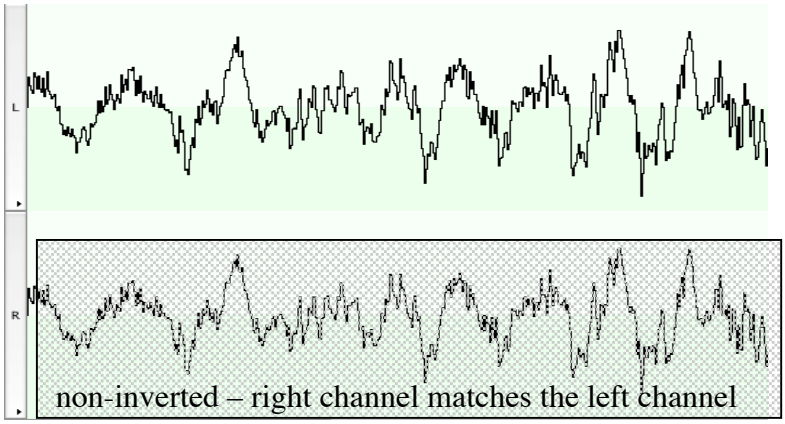


Flipping the waveform is called *inverting* the waveform. The two sine waves in the previous example are *out of phase* by *180 degrees.* The wave on the bottom starts its positive cycle halfway through the wave on the top, just as the top one goes negative. This is called ***cancellation***.



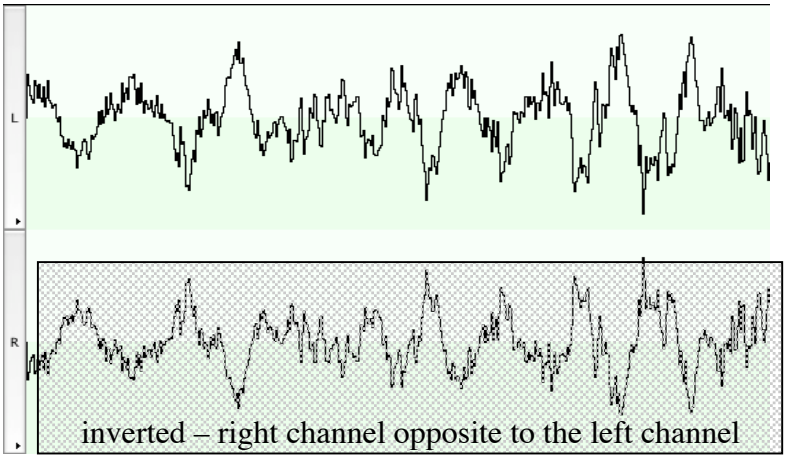
Let's look at a stereo mix. Normally, the two signals (L & R) will match each other closely (example 1). They'll both go positive or negative at about the same time. They're in phase with each other.

example 1



Now let's *invert* the bottom waveform (R) (example 2).

example 2



You can see that the upper waveform (left channel) goes positive at the same time that the lower waveform (right channel) goes negative. This is a big problem!

If the two waveforms are in phase, both channels produce a positive push. or a negative pull, *at the same time*. This is a good thing. The positive and negative energies reinforce each other. The total energy of the sound mix is kept good and strong.

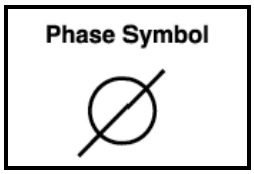
But if the waveforms are out of phase, one speaker creates air pressure while the other speaker creates a vacuum. This is a bad thing! The positive and negative energies cancel each other out. The total energy of the sound mix is weakened. Sometimes you'll hear a tilted stereo image, a thinner than expected sound, or a hollow ringing quality. It can hard to 'locate' a sound in the stereo image, meaning to identify exactly where from left to right the sound is positioned.

Check for Phase Problems!

The best way to check if two signals are in phase with each other is to listen to them both at the same time, but panned to the center. Some mixing consoles have a stereo/mono switch. Or you can manually pan each of the L and R channels to the center.

It's important to do this little stereo/mono check every so often if you're recording or mixing a track. For example, if you've double-miked an action scene (one mic to the left, the other to the right), you have to check that the two mics are in phase. You can locate the mics on your mixer, pan both to the center, and listen to the effect. If the sound tends to get weaker, you might have a phase problem. If you're mixing, you'll hear the sounds that were panned center get weak or disappear. Sounds such as bass, kick drum, vocals, and solo instruments fit into this category.

You may be able to correct phase problems with a phase switch on the mixer channel. Many good mixers have phase switches on the input channels. Check any mixer you use to see if there's a phase inversion option. It might have this universal phase symbol:



Or the switch might be labeled **INV** (short for Invert) or **180** (degrees).

Phase problems of more or less than 180 degrees happen, but this one is the worst – 180 degrees causes ***total cancellation***.