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Is Absolute Polarity Absolute?

Considerations from an Engineering Perspective

BY KEITH HERRON

The Summer 2000 issue of Ultimate Audio featured a thought-provoking piece by Lars Fredell on the absolute polarity of recordings. In this issue, noted electronics designer Keith Herron weighs in on the question of maintaining the absolute phase of recordings from mike to speakers—adding some not-so-well-known provisos. —MBA

Is absolute polarity audible? Absolutely! But what are you really hearing when you flip that polarity switch—or reverse those speaker wires? The answer may not be so absolute. Absolute polarity can be lost (via 180 degree phase shifts) and again restored in many places in the recording and playback chain—from the microphones, transformers, microphone preamplifiers, mixer, tape machines and cutter amplifiers on the recording end to the CD player, turntable, preamplifier, power amplifier, *etc* on the playback end. One never can know for certain (unless you did the recording and measured the phase accuracy of all of the equipment in the chain) whether the absolute phase is maintained from the microphones (actually the source) to the output of the speakers. On the surface, it seems that listening to a recording should be the easiest way to determine the correct absolute polarity (because it "sounds" better). However, there is some potential contamination in the path that just might mislead our ears into preferring the incorrect orientation on occasion.

The most obvious contaminant is found in many speaker systems where phase inversion is used on one or more (but not all) of the drivers in order to maintain optimum response through the crossover regions. This is common practice in many second (12 dB/octave) and some third-order (18 dB/octave) designs. Here, absolute polarity cannot be maintained through the entire audio spectrum, and reversing the system's polarity interchanges the parts of the spectrum in absolute polarity and some parts that are not. One way may sound better to the listener than the other—but real full-frequency absolute phase correctness can never be accomplished with such an arrangement. Phase shifts of more or less than 180 degrees that are common in speaker systems (and a lot of audio electronics) also prevent correct in-phase reproduction of the original event.

Another less commonly understood phenomenon when it comes to hearing the effects of absolute polarity are the summations and cancellations of various products of asymmetric distortion traceable to the components in the audio chain. We demonstrated with two identical unity gain amplifiers (designed to have 1% distortion due to non-linear gain) that two in series (the output of one connected to the input of the other) produced 2% measurable distortion. Inserting a unity gain phase inverter between these two amplifiers resulted in cancellation of the distortion which now measured essentially zero.

Did adding the phase inverter change the sound? You bet, but it also changed the measurable distortion products. Were we hearing the effects of absolute phase, the effects of the distortion—or a combination of the two? The summed effects of asymmetric distortion may well be a factor that alters the perceived sound quality upon the introduction or removal of a phase inversion in the audio chain. Although such distortions are typically found to be much less than in our experiment, the ear is nevertheless incredibly sensitive to such perturbations.

These effects will also probably vary depending on where in the chain the phase inversion is inserted. Speakers may produce different distortion products relative to waveforms found in music depending on the polarity of the signal fed to them. In other words: Will the speaker cone go in exactly the same way it goes out?

One might wonder, considering the sensitivity of our ears to millibel variations in frequency response, if the absolute polarity switches found on many electronic products have exactly the same colorations (or lack thereof) in both the non-inverting and inverting configurations? It would also be fair to ask if the gain is precisely the same in both the inverting and non-inverting positions. Considering the effect of just a piece of wire on the sound, the additional phase inversion circuit could be a likely source for added coloration in one mode or the other.

At this point one might ask, "If perceived polarity differences could be influenced by distortion products, why do I prefer some recordings played back in one polarity and others with the signal inverted?" It just might be that distortion products in the recording process cancel or add differently with those in the playback process. Is there anything absolute about this? Absolutely not! ◉