

## Absolute Phase

A topic addressed in *HFN/RR*'s interview with Peter Walker was whether or not reversing a signal's polarity, its so-called "absolute phase," would be audible or not on music. Though JGH is pretty much convinced that some people can detect polarity differences, he admits in this month's review of the Infinity IRS Beta that he himself cannot; in his review of the Mobile Fidelity CD of *Dark Side of the Moon*, Kevin Conklin finds that having the absolute phase correct has a significant effect on the music. Which brings me to a book by the aforementioned Clark Johnsen that should be on every stereophile's reading list. Entitled *The Wood Effect*, it is a thorough examination of the history of Absolute Phase audibility, expanding into a more general exposition on some of the wrong turns taken during the development of sound reproduction, one such being the abandonment of the 78 (footnote 5).

Clark (footnote 6) makes absolutely clear his position on the importance of absolute polarity reversal: "Whoever cannot recognize Absolute Polarity, shall be deemed SUPERFLUOUS," which seems a little *too* absolute, considering that JGH is one the least superfluous audio commentators around. But why should polarity matter? If an acoustic compression at the original event is reproduced as an acoustic rarefaction when the recording is played back, electrically there should be no difference at all. Additionally, the eminent acoustician Helmholtz stated in 1862 (footnote 7) that "the quality of the musical portion of a compound tone depends solely on the number and relative strength of its partial simple tones and in no respect of their differences of phase," and many people feel that Helmholtz said all that needed to be said on the subject. However, as documented by Johnsen in *The Wood Effect* (and also in an article I wrote for *HFN/RR* in 1980, footnote 8), nearly all the academic work performed since Helmholtz suggests that the human ear *can* detect acoustic polarity differences, although all research indicates that the effect is sometimes subtle. (The book's title comes from work carried out in 1957 by Charles L. Wood of the Defense Research Laboratory, who found that a sinewave, clipped on one side of the time axis only to render it asymmetrical, took on a different timbre when its polarity was reversed.) Work by Stanley Lipshitz in the late '70s (footnote 9), using carefully organized double-blind testing, confirmed that a reversal of absolute signal polarity will be subtly audible on music *to a 99% confidence limit!* (footnote 10) (Indeed, it is one of the few things that *can* be reliably detected with double-blind testing.)

There is even a mechanism agreed upon as to why the ear should be able to detect the supposedly undetectable. The nerves attached to the frequency-discriminating hair-cells in the inner ear only fire on the positive-going parts of the waveform, indicating that the ear acts as a half-wave rectifier. It will thus produce a different output to the brain *on asymmetric signals* if the absolute polarity is reversed. A music signal, unlike a sinewave, is *not* symmetrical about the time axis, other than that over the long term there are equal amounts of energy on either side, and it would be expected that if an original compression was reproduced as a rarefaction, you would be able to hear it.

What does it sound like? "Wrong polarity is the muffling distortion," writes Johnsen, and it seems generally agreed that to listen to a recording with the wrong polarity is to suffer from a lack of realism, a lack of body to instrumental tone, a lack of integration within the soundfield, and less natural-sounding applause. Unfortunately, as there is no necessity for engineers to preserve absolute polarity during the production of a recording, a recording has a 50% chance of being wrong. In fact, as reported in *The Wood Effect*, which includes considerable documentation of the subject, Japanese-pressed LPs even have alternate tracks in opposite polarity!

The aspect of Clark's book that I found fascinating, and one which ties in with the general theme running through this essay, is that despite the evidence for its existence, despite there being almost no opposing evidence, the engineering establishment seems to dismiss the matter of the ear's sensitivity to absolute signal polarity. (One would almost think that we were talking about amplifier differences here.) *The Wood Effect* contains a thorough examination of the apparent philosophy of the Audio Engineering Society, as expressed through the choice of papers to reprint in its *Journal*. Johnsen implies strongly that only the results of research work which conforms to orthodoxy will benefit from a wide dissemination in the *JAES*, and that that orthodoxy sticks strictly to Helmholtzian theory in denying the importance of phase effects at all. There is, of course, the notable exception of the published work by Stanley Lipshitz *et al* referred to in footnote 9—Stanley's formidable mind brooks very little obstruction in its chosen path—but I don't think it coincidental that Douglas Self behaves as expected in his *E&WW* article in attempting to cast doubt on the Lipshitz findings on the audibility of phase errors. Once the door is opened a crack, then it could be pushed open even further, and—heavens!—amplifiers might be found to be audibly different after all! Better to dismiss the whole subject altogether, and if that means dismissing something such as absolute signal polarity that has without question a real effect on the quality of reproduced sound, then so be it.

Thus is the thrust of Clark Johnsen's *tour de force*, and if you feel that the reality of the matter is not so, then let me conclude with a quotation from the *BAS Speaker* by David Moran, once of dbx and President of the Boston Audio Society, which also concludes *The Wood Effect*. It neatly illustrates, in my opinion, exactly how

"technical orthodoxy" is more concerned with preserving establishment attitudes than with improving the quality of music in the home:

"These are interesting times in audio. The smoke that is blown is now being couched in the language of science, and no longer in the language of marketing. Waveforms of oboes, discussions of room acoustics, etc., with footnotes to the *JAES et al.*, will be given, along with contentions that clarinets will suck instead of blow if speakers are not properly phased—all couched in terms of, 'You've heard hype before: this is science.' "

*The Wood Effect*, by R.C. Johnsen, cost \$7.95 when it was first published and could be obtained at The Modern Audio Association, 23 Stillings Street, Boston, MA 02210. It is out of print in 2006 but copies might still be obtainable from the author.

Footnote 5: Absolute Phase should not be confused with relative phase, when the speakers are out of phase with each other. Johnsen here appears to confuse the two on p.15 of *The Wood Effect*, where it seems obvious that in the passage quoted from Jens Blauert's *Spatial Hearing* (MIT Press 1982), Blauert is talking about speakers being out of *relative*, not absolute, phase.

Footnote 6: The author is a Harvard Physics graduate, with published academic work in the fields of image processing and the measurement of sight objects. He has worked on holography, surveillance satellites, the Mars Lander camera, and the Orbiting Space Telescope. He now runs "The Listening Studio" in Boston and recently founded The Modern Audio Association to advance the state of music reproduction art "without commercial gain or pressure."

Footnote 7: *On the sensations of tone*, H.L.F. Helmholtz; Dover, 1954.

Footnote 8: "Listening Tests and Absolute Phase," *HFN/RR*, November 1980.

Footnote 9: "A little understood factor in A/B testing," *The BAS Speaker*, March 1979, followed by "On the Audibility of Midrange Phase Distortion in Audio Systems" (with John Vanderkooy and Mark Pocock), *JAES*, Vol.30 No.9, September 1982.

Footnote 10: It subsequently emerged that the 99% confidence limit applied to test results using both music and asymmetrical test tones, not music alone.—**John Atkinson**