

Amplifier Transfer Functions: A Strange Audio Controversy

LARRY KLEIN

My IEEE dictionary defines transfer function as "a mathematical, graphic, or tabular statement of the influence that a system or element has on a signal or action compared at input and output terminals..." The somewhat stilted language refers essentially to whatever differences occur between the input and output signals of a circuit. It may seem strange that an innocuous technical term like "transfer function" could in another guise excite such passions in the audiophile community. It all began, as have several other audio controversies in the past decade, with the work of Bob Carver, former president of Phase Linear, and presently the president and chief engineer of the Carver Corporation.

The Carver Corporation

When Carver founded the company that bears his name, he produced two products that both excited audio consumers and rattled a few cages. The first to hit the market was a "sonic holography" preamplifier that provided an enormous extension of the sonic sound stage far beyond normal speaker spacing. In fact, on certain program material, the effect is as though two invisible side-wall speakers have been switched in. The holographic illusion is achieved by electronically nullifying the interaural crosstalk that occurs with conventional speaker setups. Normally, the sound from the right speaker reaches your left ear and the sound from the left reaches your right ear; the Carver circuit injects some out-of-phase left signal into the right channel and vice versa, thus electronically canceling, when you are properly located, the acoustic "leakage" between both channels.

Carver's sonic holograph prompted a host of "me-too" products, and variations on the idea are still found in the products of some companies. Not surprisingly, purist audiophiles

complained in letters to audio magazines that Carver was illegitimately monkeying with the integrity of the audio signal, that the effects achieved were far from realistic, and that the recommended listener position was unduly restrictive. However, buyers of the Carver sonic-holograph preamp simply enjoyed its effect, untroubled by the objections of the purists.

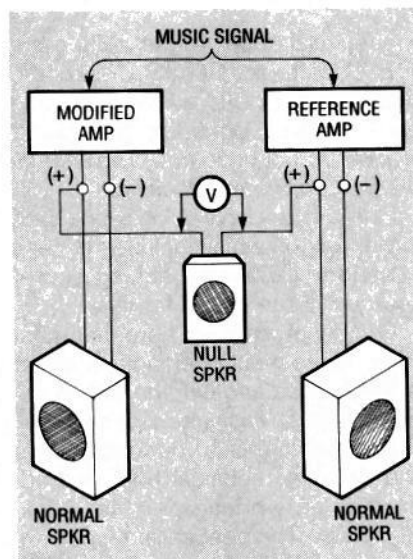


Fig. 1. CONNECTION FOR COMPARING one channel of a reference amplifier to one channel of the modified amp. The normal speakers, whose purpose is to provide a typical load, are placed out of earshot. The null speaker plays only the difference between the two channels. Theoretically, two identical channels will produce no sound from the null speaker. A meter connected across the null speaker has revealed nulls as low as -70 dB.

The Carver challenge

Bob Carver's next project was the M-400 "magnetic-field" amplifier. Truly a revolutionary product, it was a 200-watt-per-channel amplifier embodied in a 7-inch cube weighing a mere 10 pounds. Once again, audiophiles who tended to judge an amplifier's quality by its cost—and the severity of the hernia you got trying to lift it—were outraged. Obviously, there had to be something wrong with

the M-400's sound that did not show up in conventional testing, yet was surely audible to anyone with ears golden enough to hear it.

Bob Carver told me several times during that period how distressed he was by the self-selected audio esthetes who felt that he was, at best, a designer of mid-fi equipment. Carver set out to prove them wrong. He devised and demonstrated a nullification circuit (not unlike the Hafler circuit discussed in these pages several years ago) that would null out all similarities in the signal between any two amplifier channels leaving only whatever differences might exist in phase shift, frequency response, distortion, and/or noise to be heard.

I attended at least two of Carver's demonstrations and came away convinced that his amplifier was essentially perfect in respect to absence of any audible problems. In truth, I was not terribly surprised by Carver's test results since I believe that almost any well-designed amplifier when operated with a reasonable speaker load and within its power rating will sound like any other amplifier also operated under the same conditions. (That is also Carver's view, but he hesitates to propagate it for fear of further alienating the irrational self-appointed audio elite.) In any case, Carver made his point among those willing to be convinced. But Carver's test convinced none of the audio fundamentalists whose ultimate faith resides in what they think they hear under their own essentially uncontrolled listening conditions.

For this group, only prolonged listening to one amplifier and then the other will allow proper evaluations to be made. Anyone who has attempted to make scientific subjective assessments in any product area knows of the pitfalls of such a procedure, but nevertheless, that is the preferred audiophile evaluation technique.

Okay, thought Carver, let's approach the problem from a different

direction. He issued a challenge to the editors of *Stereophile* magazine: You pick out an esteemed high-end power amplifier—tube or transistor—and I will duplicate its sound by minor modifications of one of my current \$700 magnetic-field amplifiers. Carver flew out to *Stereophile*'s Santa Fe, NM, offices and set up his equipment in a nearby motel, and *Stereophile* brought over a massive \$5,000 tube amplifier to serve as the reference. Several days later, Bob emerged from his instrument- and parts-cluttered motel room with the modified Carver amplifier whose sound he claimed exactly matched that of *Stereophile*'s audiophile tube amplifier.

Here comes the surprising part: After hours of comparison listening, the flabbergasted editors of *Stereophile* reluctantly agreed that Carver had accomplished just what he claimed he would. The sound of the two amplifiers was *indistinguishable* even with the "best available" associated equipment and speakers! The implications of what Carver had done was not lost on those who had participated in the event. How could Carver's amplifier duplicate the sound of the reference, without the use of gold-plated connectors and circuit boards, oxygen-free copper wire, capacitors with special dielectrics, and metal-film resistors, and all the other magical elements—including tubes—that are found in audiophile amplifiers? Could it be, as Carver claimed, that the only thing necessary was to get the proper transfer function?

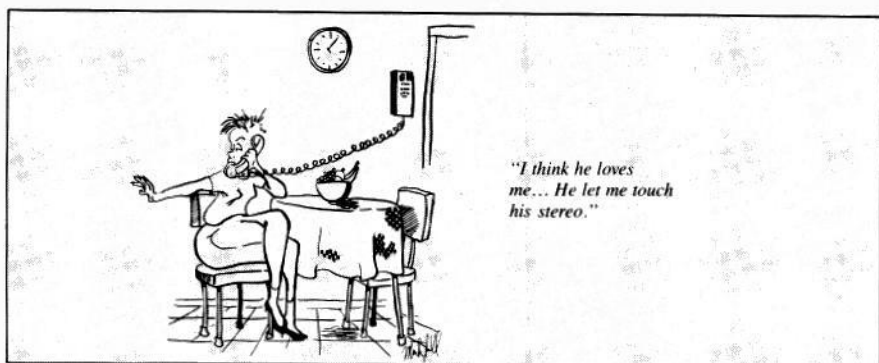
Now for the unsurprising part. Upon reflection, reconsideration, and relistening to the original modified Carver amp plus other samples that Carver had modified similarly, *Stereophile*'s staff decided that the amplifiers really didn't sound alike after all. How could they, when the basic premise of the magazine (and high-end audio) suggests the existence of subtle, mysterious audible differences that differentiate audiophile equipment from that produced by the "mass merchandisers" such as Carver. You wipe out those differences and you obviously wipe out the justification for overpriced and over-designed high-end audio equipment.

I asked Bob exactly what he does to match the sound of two amplifiers. Essentially, he said, the differences

he's eliminating are all in the spectral domain. However, that involves more than simply matching the frequency-response characteristics of two amplifiers. Every amplifier has a characteristic complex input and output impedance that causes small frequency response variations when driving various speakers and when being driven by various input components. Matching the sound of two amplifiers consists essentially of matching those impedance characteristics. It isn't necessary to work out the reasons for the impedance characteristics of the reference amp, only to duplicate them.

Postscript

I thought that Carver's approach to amplifier matching would make an interesting story and I offered it to *Audio* magazine. The editor, whom I've known for years, turned me down flat. Why? His belief system, like those of the editors of *Stereophile*, would not permit him to accept that Carver's feat was possible. And a final note: Since *Stereophile* recanted, they have, in Carver's view, constantly attacked his products in editorial comments and reviews. That has led indirectly to a series of legal claims and counterclaims, which, are now being worked out in court. **R-E**



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