

“Linear-Drive”--a New Concept in Headphone Listening



and linear phase response are supplemented by acoustical compensation to make up for the “unnatural” listening environment inherent in headphone listening.

Waveform Fidelity and Linear Drive

Even if an audio system exhibited “perfect” waveform fidelity, from program source to speaker output, its sound would still be influenced by such things as room acoustics, speaker placement, the listening position, and the listener’s head and ears. These factors are all part of a “natural” listening environment.

When headphones are worn, practically all these influences are removed or changed. To discover exactly what changes occur, Technics engineers conducted tests represented in figure 1.

They used a Technics SB-7000A speaker system, which has excellent waveform fidelity, sets up in a free-field listening environment. A “dummy head” apparatus, which simulates the characteristics of the human head, was placed at a 30° angle from speaker. Inside the head, microphone was placed where the eardrum would be, and response curves were made with this microphone to show any change in the sound as it traveled from the speaker to the “eardrum.”

Although the speaker itself has essentially “flat” frequency response and linear phase response (two requirements for waveform fidelity), the response at the dummy head showed two peaks in the frequency response curve, along with some phase shift. Further investigation revealed that the first peak was caused by resonances in the ear canal, while the second peak was due to diffractions from the head and external ear.

What happened when headphones were substituted for speakers? The first peak, caused by the auditory canal, remained largely unaffected. But the second peak disappeared, because the head and external ear were now “bypassed” in the listening environment. It was clear that if headphones were to exhibit waveform fidelity in terms of “response at the eardrum,” they must compensate for natural diffractions that are lost in headphone listening.

Three Conditions for Linear-Drive Headphones

In order to achieve the desired response, the Linear-Drive headphones had to have the frequency and phase characteristics of the reference speakers, and further had to recreate the amplitude peak and requisite phase alterations caused by the head and external ear. Three conditions were necessary to achieve this:

1. The headphone driver units had to be constructed with a lightweight vibration system capable of producing frequency extension and phase linearity equal to that of the reference speaker system.
 2. Low distortion and high power-handling capacity were required in the drivers.
 3. Special acoustic design was needed to reproduce the second amplitude peak and correct phase response.
- These design requirements were fulfilled as follows:

What is “Linear-Drive?”

At Technics, we emphasize “waveform fidelity” in our amplifiers, tuners, and speakers. This means that the input sound waveform is processed and transmitted by the component with as little change as possible.

“Linear-Drive” extends the concept of waveform fidelity to headphone design. But with one important difference. The normal requirements of wide, flat frequency response

