

Product Specifications and Their Relationship to KOI Human PsychoAcoustic[®] Technology

KOI's unique approach to audio design—in concert with KOI's patented technologies—has produced speaker systems of extraordinary performance. KOI speaker systems have consistently delivered audio reproduction of the highest quality with system components of unusually small size and deceptive external simplicity.

The very uniqueness of KOI design philosophy, however, is the source of potential confusion and consternation among KOI technology clients and consumers. Much of the misunderstanding occurs when conventional performance criteria and measurement methodologies are applied in attempts to quantify perceived differences.

KOI hopes, with this document, to prevent such misunderstanding and provide a view of the technical and philosophical foundations that underlie the KOI design process.

Power Specifications

The Evolution of Power Ratings

The convention for rating such devices as loudspeakers and amplifiers was established at least five decades ago for high-quality audio products. That convention was based on the practice at the time, where amplifiers and loudspeakers were sold as independent products. To this day, this remains the most common configuration for high-quality audio equipment.

To make it possible for consumers to make reasonable decisions—and also as a competitive matter—amplifier manufacturers rated their amplifiers for a particular power output. Since all loudspeakers are distinctly different from each other, these power ratings were based upon the use of dummy load resistors. Resistors are not loudspeakers, but they provide the advantage of being repeatable. In turn, loudspeaker manufacturers rated their loudspeakers for both 'impedance' and power. Such 'impedance' and power specifications were neither particularly accurate nor rigorous, but they would allow for an appropriate selection of an amplifier (and, during the time of vacuum tubes, which 'impedance' connection, or output transformer tap, was the best choice.)

Eventually, the "power ratings" became associated in the public's mind with "quality" (which it most assuredly was not), and this led some manufacturers to abuse the power ratings so as to obtain competitive advantage... or, often as not, so as to "keep up" with competitors who had first abused the power ratings.

In the U.S., the Federal Trade Commission stepped in and required manufacturers to provide 'honest' ratings based upon standardized procedures.

This well-intended action had two consequences. First, it "froze" technology at the level of the ratings—new design approaches that dealt with the reproduction of sound, and not with the legal requirements of behavior with "dummy load resistors" were discouraged. More seriously, the legislation itself lent credibility to power ratings as a measure of quality. In at least one instance, a major U.S. manufacturer degraded a product's performance because, by making the product operate less well, it became possible to advertise "100 watts" rather than "80 watts." The difference between a three-digit and two-digit power rating was considered to be more important than how the product actually performed.

KOI does not make such compromises for the purposes of achieving numbers that consumers can misinterpret as "quality."

The KOI Human PsychoAcoustic® Design Approach

KOI system designs—i.e., those where the system includes both amplifier and loudspeakers—aim for the maximization of perceived sound quality, regardless of what ‘numbers’ might be determined for intermediate stages in the system.

As one example, the amplifiers are always connected to loudspeakers, never to dummy load resistors; the behavior of those amplifiers when connected to dummy load resistors is irrelevant. Therefore, KOI designs do not make compromises in audible characteristics so as to ‘improve’ the behavior when driving dummy load resistors. As another example, KOI system designs use the amplifier characteristics to achieve ‘flatness’ of system frequency response; KOI designs do not compromise the behavior of the sound by achieving ‘flatness’ of the loudspeaker driver itself through the use of multiple high-frequency resonances.

One particularly clear-cut example of KOI’s Human PsychoAcoustic design approach is the choice of efficiency for the loudspeaker elements. It is possible, on paper, to design two loudspeakers that are nearly identical, but that have different efficiencies (e.g., the difference between a relatively weak magnet and the rare-earth magnets used in the KOI HQ driver.) To achieve the “same” performance, it would seem sufficient to simply use an amplifier with higher power output to drive the lower-efficiency driver. However, such an amplifier would “heat up” the voice coil of the lower-efficiency driver, increasing its electrical resistance, and “compressing” the sound, even when the heating is not enough to actually destroy the driver. This “compressed” sound (sometimes called a “loss of dynamics”) does not have the impact or clarity that is possible when a high-efficiency driver is used. This is an exact example of a situation where the power ‘numbers’ that consumers have been trained to associate with ‘quality’ are an indication of a *loss* of rather than an improvement in quality.

It is precisely by paying attention to such details, including details that run contrary to what consumers have been taught to expect, that leads to a level of performance described by Michael Fremer in the March 2001 issue of *Stereophile*:

I’ve heard dozens of systems like this, and was quite prepared for the usual vague, wimpy sound... But what poured forth was what I would have to call high-end audio... [The product under review] had an absolutely stunning, detailed, and believable midband, and delivered a soundstage that was large, and freed from the constraints of the tiny boxes. The system had genuine dynamics...

There are other design factors (outside of the scope of this paper) that can also intrude upon “standard power rating methods.” In all cases, KOI follows the policy that it is the reproduced sound that reaches the ears of the listeners that takes precedence over “standard power rating methods.” In the final analysis, it is the behavior of the entire system, *including the listener*—not any set of numbers that can be printed on the outside of a box—that yields the perceived sound quality.

Publication of Power Ratings

KOI strongly recommends against the publication of any power specifications for several reasons. The most obvious is that such specifications can only mislead the consumer. It need not have been so, but we all live in the environment that exists, and the reality is that the “numbers game” has led consumers—and even some so-called ‘experts’—to believe that the power numbers are an indication of quality when such is demonstrably not the case.

A secondary (but still very real) consideration is that certain members of—and, indeed, entire departments within—KOI client organizations may share the misunderstandings of the general public. This can lead to serious confusion and a loss of communication between KOI and its clients. For example, it is possible that an advertising group may be accustomed to playing “the numbers game.” KOI will not engage in that game for it inevitably leads to a loss in product quality... which is, in the final analysis, the *only* thing that KOI has to offer. This could lead to the perception that KOI is “being uncooperative,” when, in fact, nothing could be further from the truth. It is nothing more than KOI working very hard to develop products that will enhance the client’s reputation in the world of audio.

While KOI strongly discourages the publication of misleading power specifications, KOI also recognizes the necessity of internal specifications for quality assurance purposes. The “power ratings” are of no relevance for comparisons between different products that integrate amplifier and loudspeaker, but they are of genuine relevance in guaranteeing that initial performance levels are not degraded over the lifetime of the product. KOI provides such quality-assurance data to its clients.

Power Consumption

“Power Consumption” is an entirely different matter from “rated power output.” Power consumption provides the consumer with information regarding the “load” his various components and devices place on each circuit. Thus, power consumption becomes a matter of consumer safety.

Indeed, most (if not all) safety rating organizations require that power consumption be specified for any product which is connected to home wiring. KOI provides data regarding the power consumption of its devices and specifies the smallest power consumption value that may be published. (The client may choose to specify a higher value since a higher value leads to a “more conservative” use of home wiring.) KOI cannot and does not discourage the publication of “power consumption” values for its products.

Human PsychoAcoustic® Technology

While KOI discourages the use of conventional specifications in product descriptions, it strongly encourages an emphasis on design approaches that take into account the interaction between the sound reproduction system (amplifier *plus* speaker driver *plus* speaker enclosure), the listener, and, most especially, the activity of the listener’s brain.

“High Fidelity” has long been associated with “wide frequency range.” A high-fidelity system (regardless of whether it is a two-speaker “stereo” or a six-speaker “surround-sound” system) must cover a wide frequency range, from powerful deep bass to the delicate nuances of the very highest audible frequencies. This requirement, though, must not be met at the expense of the most important range of frequencies—the range of the human voice. The reason for this is quite straightforward: A particular person may attend a few live concerts in a year—maybe more—but hears human voice *every day*. Voice communication has evolved as a matter of survival in the human species, and so the human ability to distinguish even tiny variations in sound character of a voice has become “hard wired” into our brains. Human beings are more sensitive than the most sensitive measurement instruments in this regard.

For a sound reproduction system to sound “natural,” it must be “natural” when reproducing the human voice.

Tom Miiller in *The Absolute Sound*, February/March 2002:

This modest system with immodest sound is a legitimate high-end product in that it remains faithful to the absolute sound... Whatever the patented technology might be, it doesn't do only the imaging thing, it's even better at tonality... It sculpts the sound of a human voice with realism.

Miiller’s comments are not a matter of coincidence but the reflection of the overriding concern of KOI when it comes to psychoacoustics.

The small size of the KOI HQ driver is not accidental; it is comparable to the size of a human mouth when open so as to speak. The shape of the enclosures of KOI loudspeakers is not a matter of what some industrial designer would consider “modern” or “striking” or “suitable for some home décor.” The shape is designed to avoid the “box shape” that does not occur in nature, and is inevitably detected by the highly attuned brain of the human as “sound coming from a box.”

KOI systems do not have crossover frequencies inside the range of the human voice because human beings do not have crossover frequencies when they speak. KOI loudspeakers are designed to minimize heating (high efficiency coupled with patented heat-exchange voice coil cooling) and the attendant loss of dynamics because the human voice does not have any comparable loss of dynamics.

The human brain has evolved to “hear” in a particular manner, and KOI system designs are specifically engineered so as to respect the manner in which the human brain operates.

This does not mean that the KOI systems are limited to voice reproduction. They are as “wide frequency range” as any other high-fidelity system. It *does* mean that KOI does not design “sound reproduction systems” but, rather, “human interactive systems”—where the loud-speaker system is not an “isolated design” but, rather, an integrated part of the whole... “the whole” including the listener and the listener’s highly-evolved brain. While the human brain evolved so as to maximize communication, in the process it has also become a supreme instrument for listening to music. Because KOI designs are designed to be the best possible instruments for interacting with the human brain, they have inevitably become supreme instruments for the reproduction of music.

There are, however, some expected consequences to the KOI Human PsychoAcoustic® (i.e., “natural”) design approach. Just as human beings do not have the ability to “fill an auditorium” with their voices, KOI designs for home use are not suitable for large spaces. To deal with large spaces, it is first necessary to make the sound “loud enough.” Theater speakers “give up” naturalness in sound reproduction so as to meet their first requirement: being “loud enough.” KOI’s highly compact speakers are “loud enough” for home listening rooms; this includes KOI home theater products, which, in typical living spaces, will reproduce film sound tracks at loudness levels that are comparable to those in actual cinemas. However, they will probably not satisfy those who seek the literally deafening loudness levels that can be achieved with large speakers driven by large amplifiers in small rooms.

Conclusion

It is hoped that the foregoing has provided sufficient information regarding the KOI approach to system design as to allow those who would use KOI designs to develop appropriate performance expectations. It is also hoped that this paper serves as a central guide for those who would advertise and specify KOI designs, allowing them to more clearly differentiate KOI from conventional designs. It is our strong belief that such differentiation is the pathway to both consumer satisfaction and commercial success for these products.