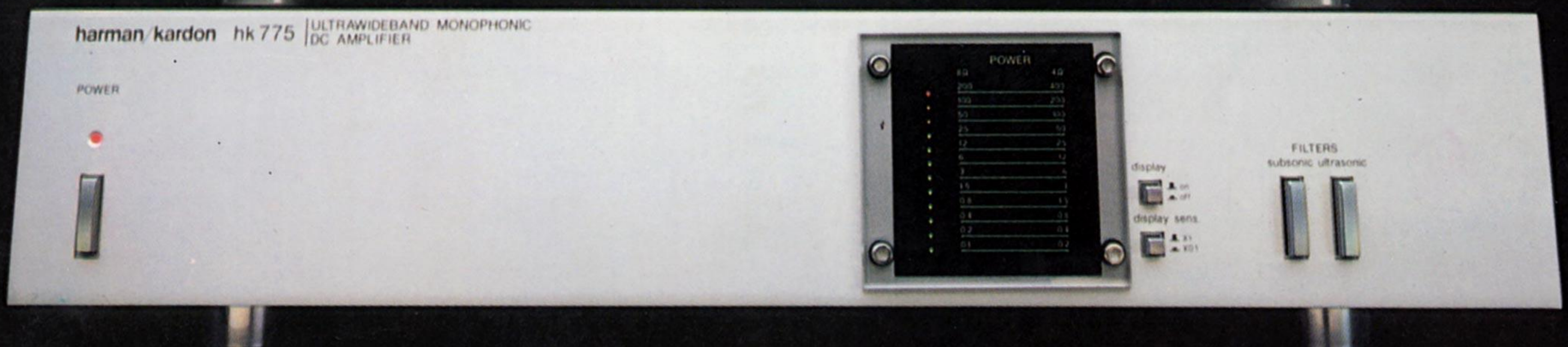
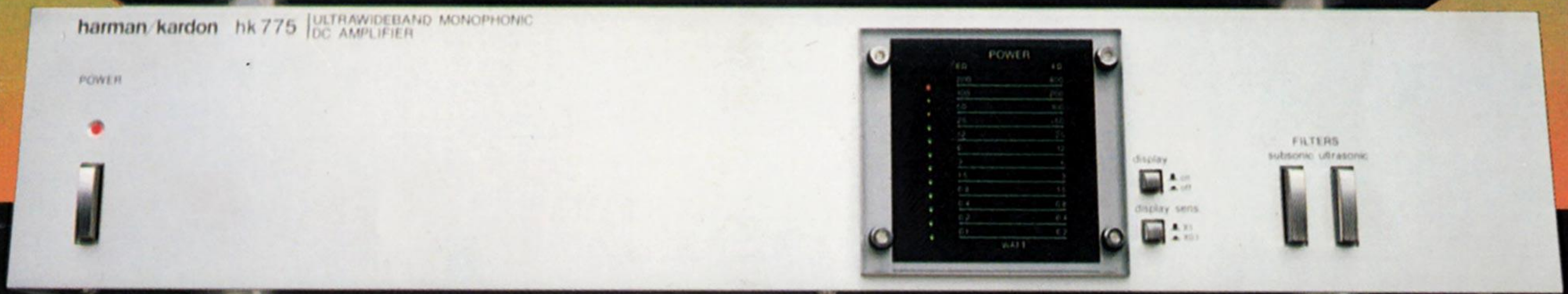
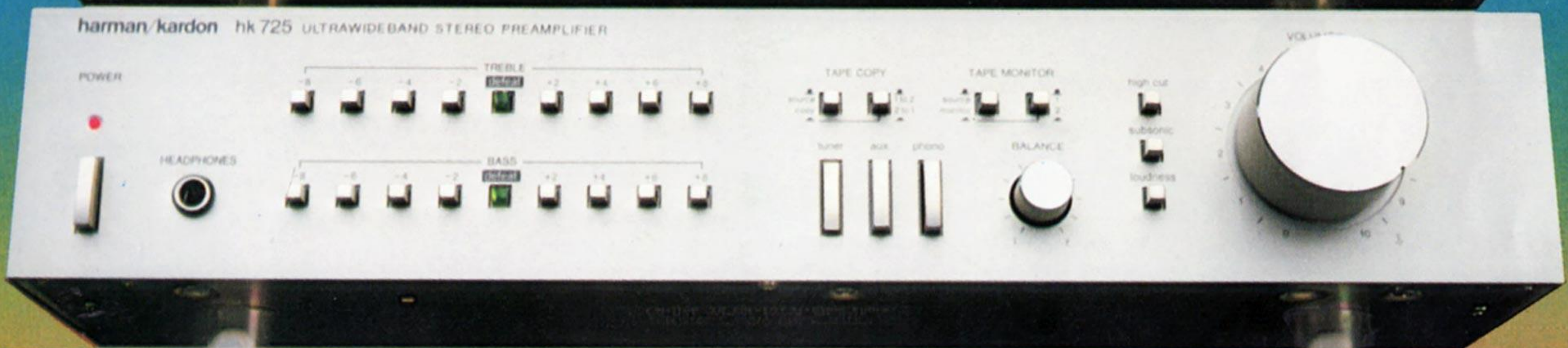
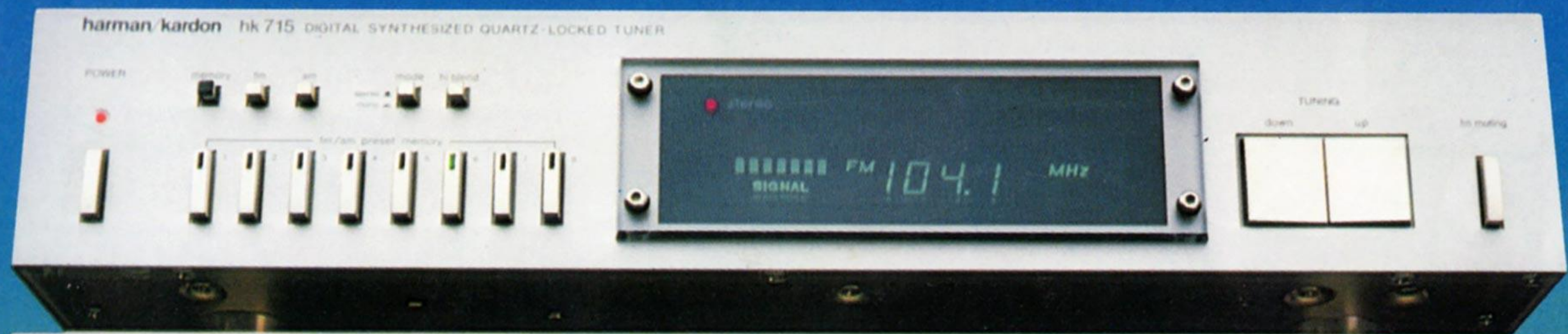


# The hk700 series high technology components



# An introduction to negative feedback.

Over the past few years, audio manufacturers have been promoting low Total Harmonic Distortion (THD) figures as a means of implying accuracy of their equipment. Their theory is simple. The lower the THD figures, the less distorted the reproduction. In the vast majority of equipment, low THD figures are not accomplished by careful attention to circuit design. Rather, they're accomplished by a heavy application of negative feedback, a universally used form of electronic compensation.

In addition to improving THD figures, negative feedback also allows the design engineer to compensate for design deficiencies in other areas.

It has the effect of increasing the frequency response of equipment with conventional narrowband circuit design. Using high amounts of negative feedback, a designer can "artificially" improve the inherent frequency response of the amplifier from the typical narrowband 20-20,000 Hz range to a new range as high as 150,000 Hz.

For these reasons, most manufacturers have come to regard negative feedback as a

design panacea. It's simple to improve THD and frequency response by adding more negative feedback. It's much more difficult to improve the basic circuit design.

## The price you pay for negative feedback.

In recent years, Dr. Matti Ojala, an internationally recognized authority in the audio field has discovered and isolated several new forms of distortion.

Dr. Ojala also traced the source of these new distortions, and found they were all caused – to some extent – by the excessive use of negative feedback.

One of the problems is Inter-face Intermodulation Distortion, or IIM, which makes lower frequencies boomy and muddy. IIM can occur any time a speaker cone is driven. As the cone moves, it creates its own signal which travels back through the speaker wire to the amplifier. The negative feedback loop then feeds these signals back through the amplifier circuit at the same time other music signals are passing through. The signals all interact with each other, causing IIM. So the higher the negative feedback, the higher the IIM distortion.

The fact is, when IIM is added to the existing static Inter-modulation Distortion (IM), the total audible distortion may actually be double the specified IM level.

As mentioned before, negative feedback can also reduce the THD specifications of any amplifier. In reality, audible distortion is not actually reduced. Instead, THD, a static form of distortion, is merely converted to a dynamic form of distortion pro-

ducing the Phase Modulation Effect. In its milder forms, the Phase Modulation Effect results in a loss of spatial imaging – music becomes hazy, colored and unclear.

As more negative feedback is applied, the distortion is transferred further, becoming TIM or Transient Intermodulation Distortion. TIM causes the music to become grating, smeared and irritating.

It was also discovered that TIM is much more audible than THD. While most people cannot detect THD at levels below .3%, TIM is ten times more audible and can be detected at levels of just .03%.

As you can see, the heavy application of negative feedback to reduce THD figures and compensate for other design deficiencies has its price – IIM, Phase Modulation Effect and TIM. These do far more to degrade the music than THD. And that's a very high price to pay.

## The Harman Kardon Philosophy: the less a signal is processed, the purer the sound.

At Harman Kardon, we believe that the less a signal is processed, the more faithful it will be to the original source. In essence, the simpler and more straightforward the circuit design, the better.

This philosophy is most readily seen in our approach to negative feedback.

While most manufacturers process the signal with 60 to 80 dB of negative feedback, we use less than 25 dB. We can minimize negative feedback for one

simple reason. We've optimized our designs in the open loop amplification circuitry of all our high technology electronics.

For instance, Harman Kardon amplifiers provide a typical frequency response of below 1 Hz to 100,000 Hz and THD figures of 0.08% without the aid of negative feedback. The minimal amount we use does improve the performance, but only nominally.

And while low negative feedback helps reduce IIM, we've taken other measures as well. We keep our amplifier output impedance low, which dissipates much of the signal returning from the speakers before it ever reaches the feedback loop. And we've provided our power supplies with high instantaneous current capabilities to accommodate those instances when amplifier output signals at very low dynamic impedances create extra high power demands from the amp.

So by doing our homework in original design, we can minimize the use of negative feedback, reducing Phase Modulation Effect, TIM and IIM to undetectable levels.

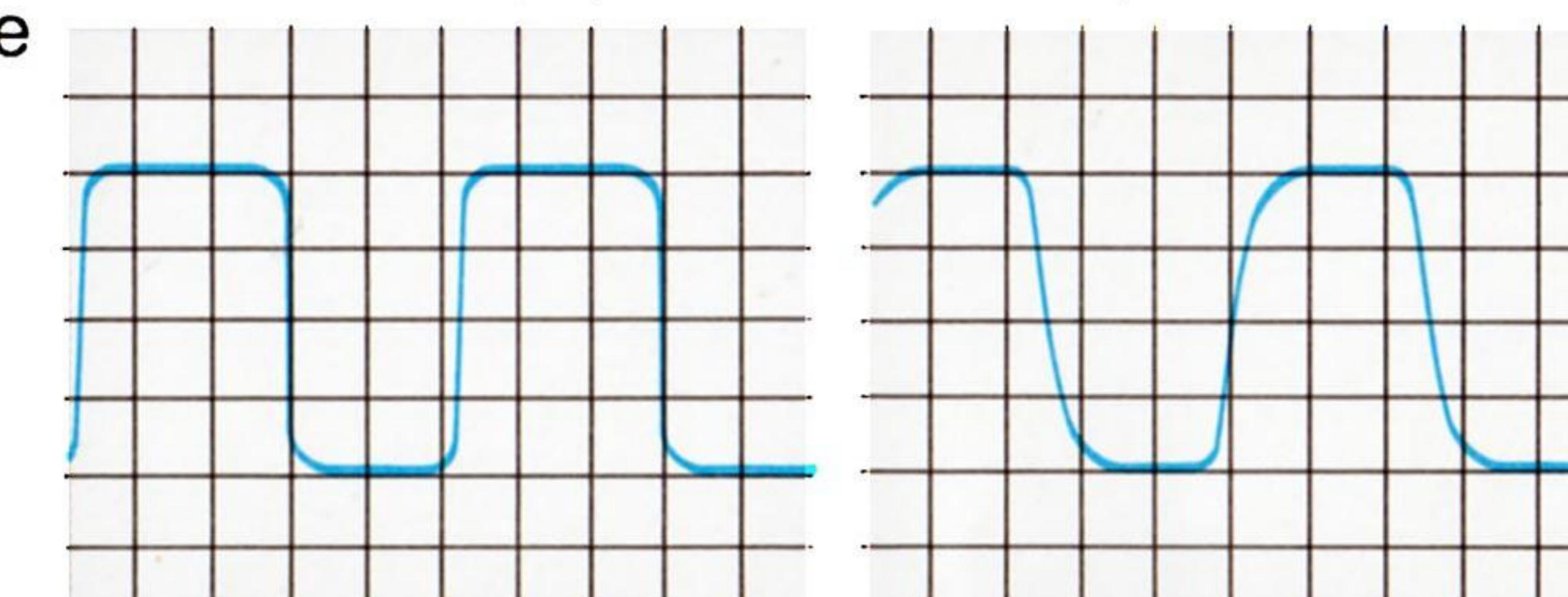
## Ultrawideband response and TIM.

The ultrawideband design of our preamplifiers, amplifiers and receivers provides frequency response from 1 Hz up to 150,000 Hz compared with the conventional narrowband design which typically provides response from 20 to 20,000 Hz.

While this range stretches well beyond the limits of human hearing, it delivers incredibly fast

transient response. Fast transient response is important because it means the vast complexity of fundamental tones and harmonics reaches the listener in exactly the same time relationship as on the recording.

Conventional narrowband equipment cannot reproduce fast



**Square wave response.** Accurate reproduction of a square wave, a result of ultrawideband design, is critical to maintain phase linearity. The Harman Kardon amplifier section on the left reproduces a square wave more accurately than conventional designs, producing a clearer, cleaner stereo image.

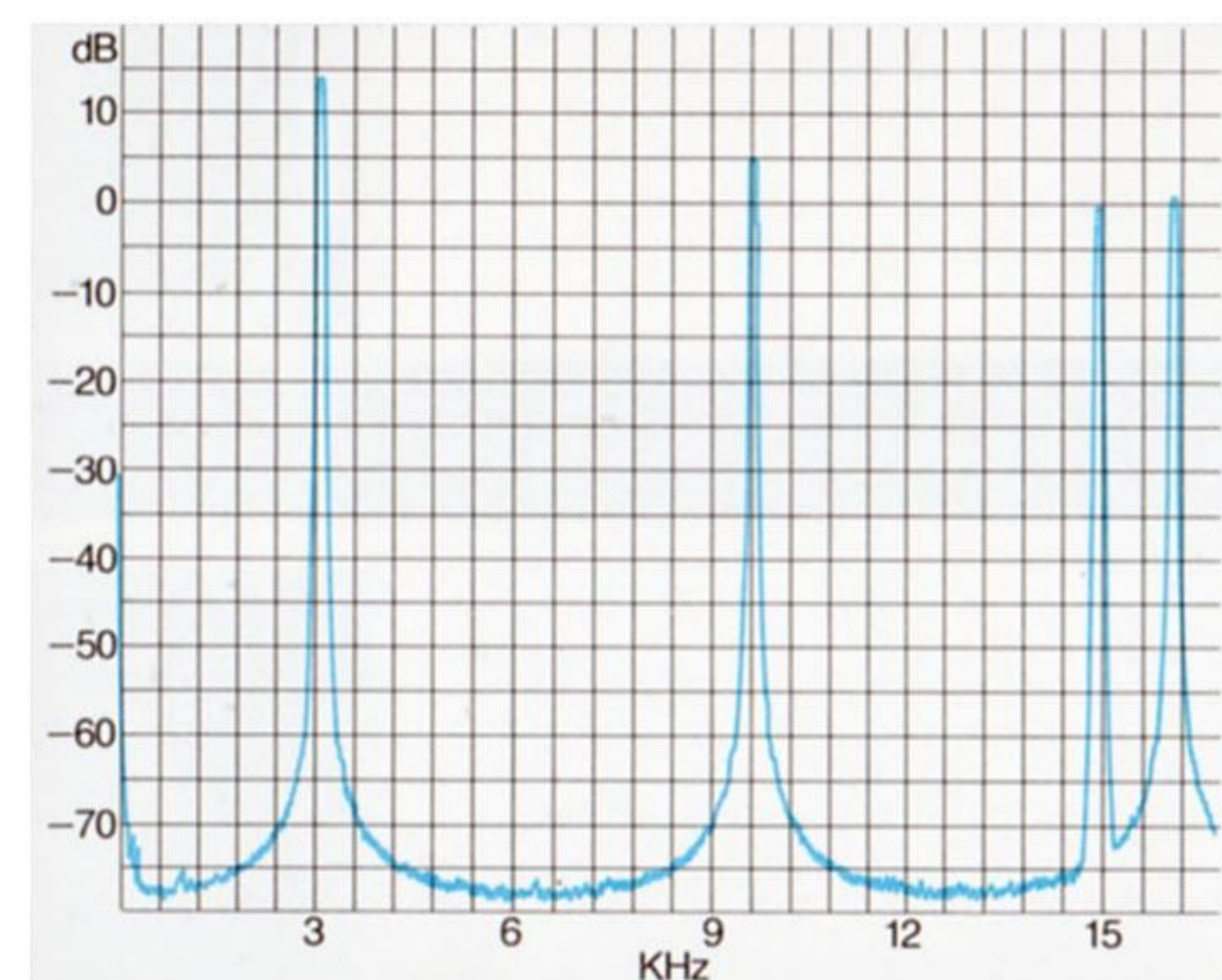
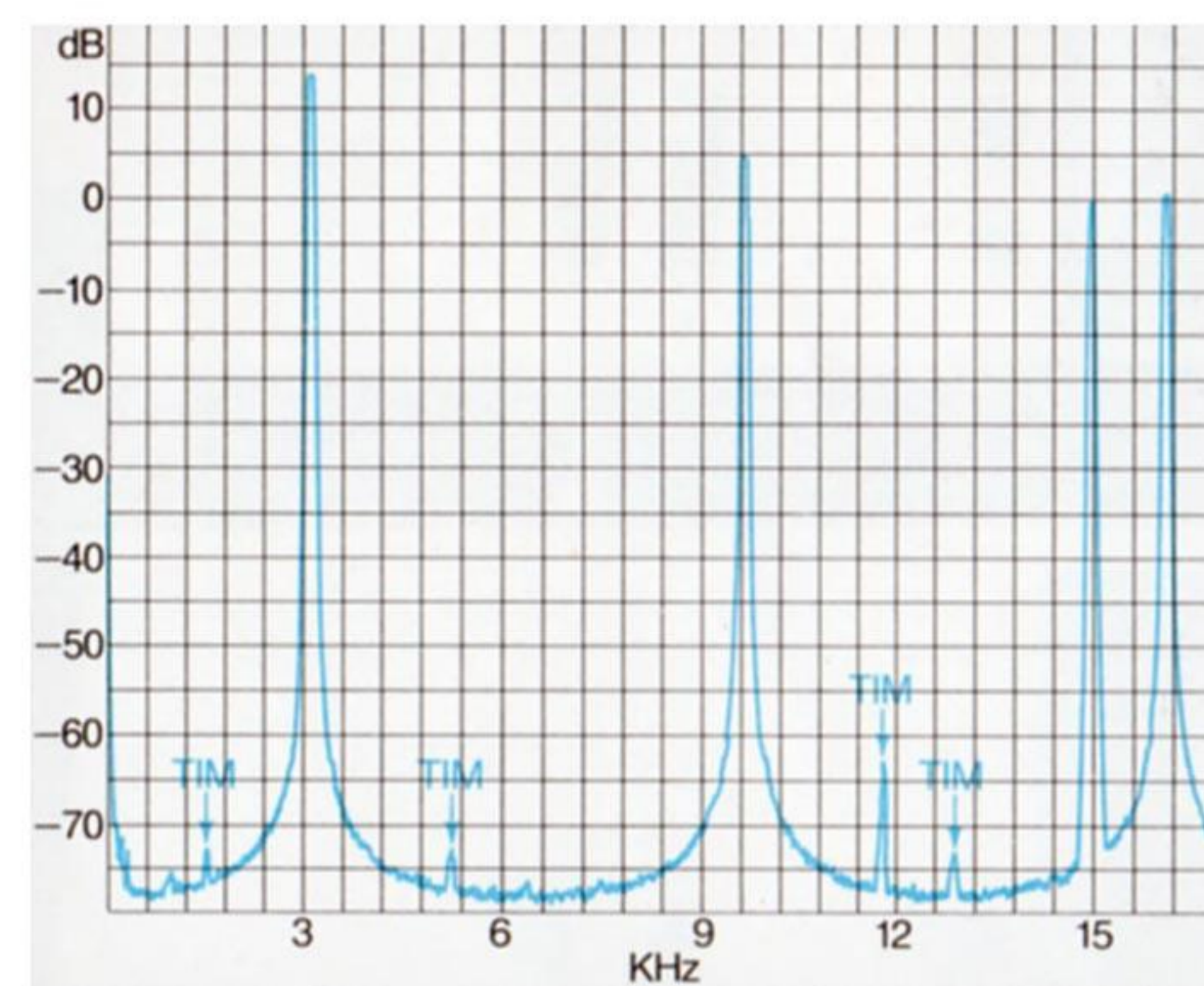
transients accurately, causing TIM. The music sounds harsh and metallic. And the spatial relationships of the various instruments becomes unclear and vague, which degrades stereo image.

## Instantaneous current capability.

Although the majority of speakers carry nominal impedance ratings of 4 or 8 ohms, the actual impedance of a speaker can vary tremendously, depending on the music played.

As impedance levels decrease, the current required to drive the speakers must increase enormously, otherwise various forms of distortion will occur. High level transients, such as a thundering tympany or a fortissimo piano attack, make similarly heavy current, or power, demands.

At Harman Kardon, we've developed new circuit designs that allow our amplifier sections



**Transient Intermodulation Distortion (TIM).** When too much negative feedback (60-80 dB) is used, as in the conventional amplifier in the left graph, TIM is at a highly audible .1% level. By reducing negative feedback to 17 dB in the Harman Kardon amplifier on the right, TIM is reduced to an inaudible .007%.

to deliver huge amounts of power during those brief moments when extra power is required. Our 65 watt per channel hk770 power amp, for instance, delivers significantly more current under demanding loads than any conventional design, giving unprecedented control over the loudspeaker.

The fact is, all our amplifier sections, under peak power demand conditions, will outperform conventional equipment rated at anywhere near the power.

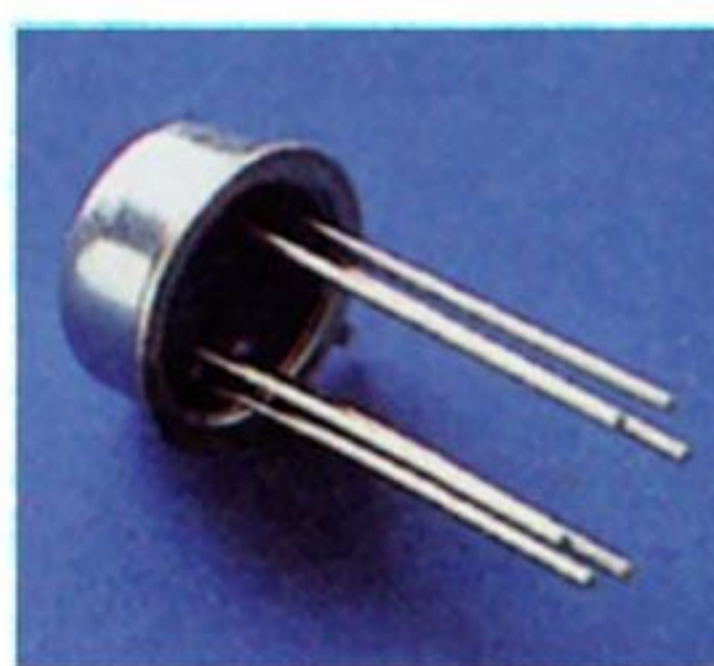
### Power supplies. The heart of an amplifier.

Because the power supplies of a receiver or amplifier can mean the difference between good performance and great performance, even our least expensive components incorporate power supplies that are much more rugged than they have to be.

And every amplifier section in our 700 series uses toroidal transformers, which eliminate stray magnetic fields entirely, keeping internal hum unusually low.

### Discrete components vs. integrated circuits.

Conventional equipment also contains components that affect the sound quality. Integrated circuits, or ICs.



They're used to save space and money – a single, inexpensive IC contains hundreds of circuits on a chip just 1/4" square.

Unfortunately, ICs present compromises.

First, they're not made to the same high standards as the

discrete components we use.

And the circuit density creates a problem, too. With so many circuits in such a small area, each one is affected by its neighbors as the IC heats up. The result is Thermal Distortion, another recent discovery.

Rather than compromise the sound of Harman Kardon equipment, we design our audio circuitry with discrete components rather than ICs. They cost more. But sound noticeably better.

### DC coupling. One more way we avoid distortion.

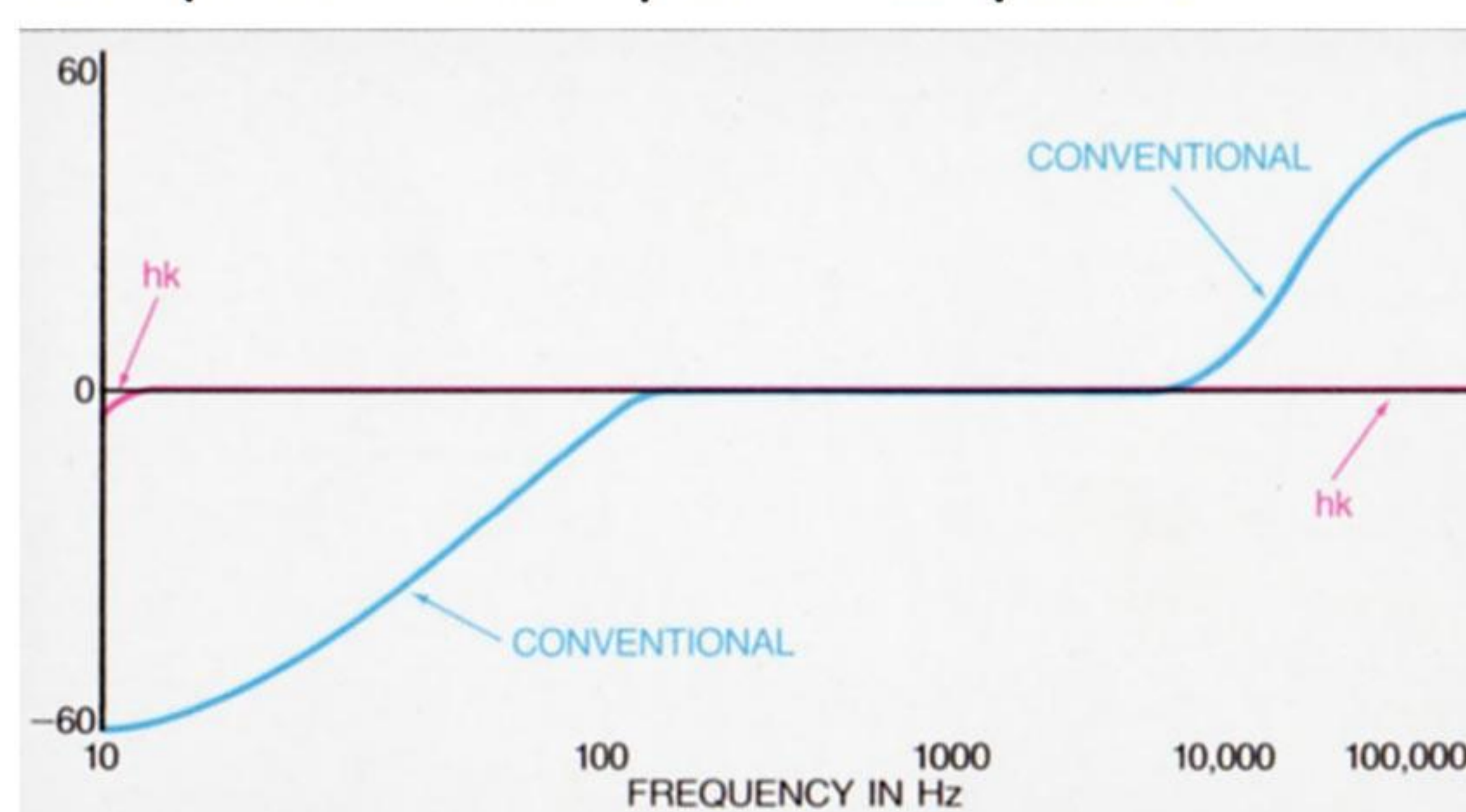
Harman Kardon amplifier sections are also DC coupled. Basically, DC coupling eliminates coupling capacitors between the amplifier and loudspeakers.

This eliminates phase problems which mask low frequencies. So low frequency response is tighter, more articulate.

### Specially designed phono stage.

One purpose of a preamplifier section is to present signals of uniform level to the power amplifier.

Since turntables provide much weaker signals than tuners, tape decks and other program sources, preamplifiers consist of two separate amplifier stages. The phono stage, which boosts turntable signals to the same level as the other sources. And the high-level stage, which then boosts all signals to a level acceptable to the power amplifier.



RIAA equalization showing phase error in degrees.

Additionally, the phono stage performs another function. It equalizes the phono signal to match the RIAA curve used in the record making process.

While other manufacturers roll this curve off below 20 Hz and above 20,000 Hz, we follow the RIAA curve faithfully even beyond the audible frequency range. By equalizing in this way, Harman Kardon pre-amplifier sections produce cleaner, tighter bass. And more transparent highs.

### Protection begins with the right components.

Harman Kardon believes the best way to protect the components of an amplifier section is to design them to handle more load than they're ever likely to see. Which is why we use only extra heavy duty output devices and massive heat sinks. Together, they provide Safe Operating Areas well above average.

Of course, to be absolutely safe under the most adverse conditions, we've also incorporated protection circuitry. But in a different place than in most amplifiers.

Conventional designs place their protection circuitry within the feedback loop, which is part of the audio chain. We don't. Because every extra bit of circuitry a signal must pass through introduces more distortion.

Also, protection circuitry within the feedback loop can be fooled by your speakers, cutting power and creating distortion even at low output levels.



**Digital quartz-locked tuning locks into the strongest signal. Every time.**

Digital quartz-locked tuning is the most recent, most accurate, state-of-the-art tuning design, and it's found on our digital tuner, the hk715. With this system, the tuner automatically locks in to the exact dead center of any broadcast signal. This is accomplished by a combination of digital control systems and a highly accurate quartz reference crystal. The digital control system automatically locks into the center of the assigned frequency of any broadcast. And the quartz crystal continuously provides a precise reference frequency. By comparing the reference frequency against the broadcast frequency 3000 times every minute the tuner remains locked in to the channel center at all times. Regardless of temperature and humidity changes that affect conventional tuners. The result is not just automatic channel centering, but drift-free reception as well.

**Defeatable tone controls for accurate critical listening.**

Tone controls are important because they allow you to adjust bass and treble frequency response to your particular listening environment.

But a tone control defeat is equally important, especially for very critical listening. If your room provides good acoustics,

bass and treble adjustments are both unnecessary and unwanted.

The tone controls on most conventional units, even when turned to their neutral position, force the audio signal to pass through the extra tone control circuitry, which can cause distorted sound.

Our hk725 preamplifier and hk750 integrated amplifier provide a tone defeat control that allows you to bypass the tone control circuitry altogether. This assures you of the clearest, cleanest, least distorted sound possible.





## The hk715 high technology digital tuner.

The hk715 represents the state-of-the-art in tuners today. Digital quartz-locked tuning is by far the most accurate tuning system available. Because the digital control system automatically locks in to the dead center of the broadcast frequency every time. There's no guessing, no fine tuning.

The hk715 also lets you store up to 8 of your favorite stations either AM or FM in memory. Once a station has been stored, you simply touch the appropriate preset memory button to recall it at any time. Without the need to scan in either direction.

The hk715 also shares many of the same features that make our hk710 such an outstanding tuner. Like a precise balance between sensitivity and selectivity. And an MPX null circuit, which cancels the 19 kHz subcarrier signal with less distortion than filters.

For convenience and performance, the hk715 is hard to beat.

## The hk725 high technology preamplifier.

Many of the critics from the most widely recognized audiophile publications consider the hk725 one of the best preamplifiers on the market.

As with all our components, the hk725 was designed with careful attention to even the finest details. Instead of the typical 4-stage phono section, we used 8 stages. And we used FET front ends on both our low and high level stages. These provide higher signal-to-noise ratio than other designs.

Instead of conventional rotary tone controls, we used fixed resistor push-buttons because they provide lower distortion. The hk725 also allows you to defeat the tone controls altogether, giving you the clearest, cleanest sound possible.

Even our volume control is unique. With twelve wipers instead of the usual four. This extra bit of engineering not only provides a smoother acting, longer lasting control, but also helps lower distortion as well.

And we didn't forget convenience. You get facilities for two tape decks, with 2 way tape copy that allows you to monitor any source you like while copying from one deck to another. Plus loudness, subsonic and high cut filters to help you contour your system to your listening environment.

All this in the cleanest preamplifier around.

## The hk770 high technology power amplifier.

The hk770 is certainly one of the most sophisticated stereo power amps you can buy. With 65 watts per channel, and plenty of extra headroom, the hk770 can easily handle the most demanding of transients.

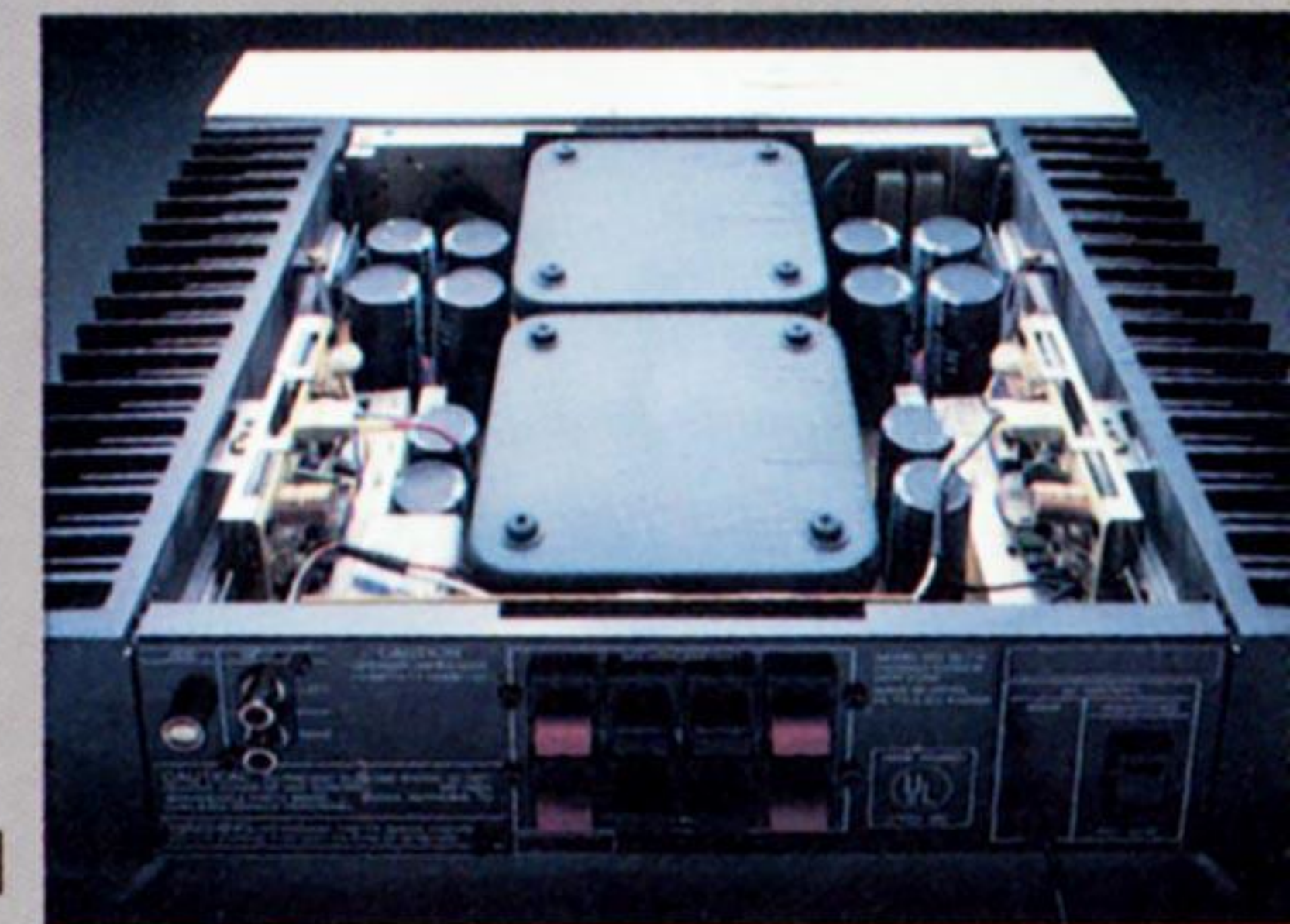
Unlike most conventional amplifiers, negative feedback levels in the hk770 are kept below 20 dB, reducing TIM distortion to inaudible levels.

Also unlike conventional power amps, the brawn behind the hk770 comes from a pair of independent power supplies. We use two discrete rectifier circuits. Two sets of electrolytic capacitors. And two massive toroidal transformers, which eliminate the stray magnetic fields that cause hum.

Our twin power supply design provides you with two distinct benefits. First, it eliminates the possibility of channel-to-channel interference. It also prevents one channel from draining the power available to the other. Each power supply is further divided into high and low level stages. This ensures that the power requirements of the high level stages do not drain current at the expense of the low level stages.

Unlike most power amps, the hk770 gives you accommodations for two pairs of speakers with independent speaker switching. Plus a power display that allows you to monitor performance. And for more accurate power readings at low listening levels, display sensitivity can be increased by a factor of 10.

The hk770 packs a lot of power and a lot of technology into a surprisingly compact amplifier.



## The hk775x2 dual amp system.

For the absolute in sonic accuracy, true audiophiles prefer individual, high powered amplifiers for left and right channels. Which is precisely why we designed the hk775x2 dual amp system, with 130 watts on each side.

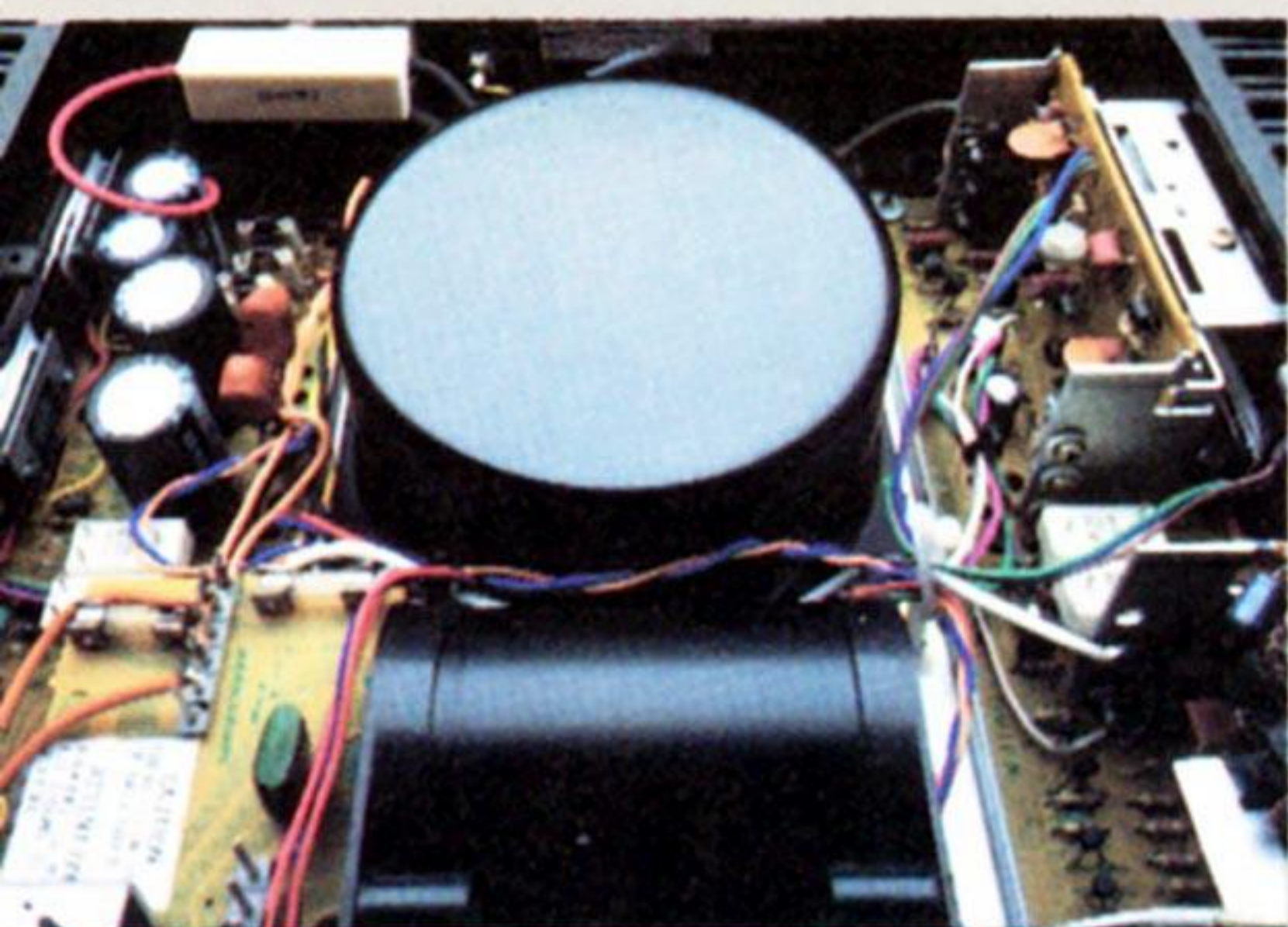
The hk775x2 dual amp system is based on a circuit design developed by Dr. Matti Ojala, the engineer who discovered TIM distortion and its relation to excess negative feedback.

One unique feature is the amplifier's total symmetry. Many conventional amps are symmetrical only at the final output stage. But Dr. Ojala's design is perfectly symmetrical from the first transistor in the input stage to the final transistor in the output stage. Such a design keeps even order harmonic distortions well below audible levels.

Like all Harman Kardon equipment, the hk775x2 dual amp system features ultrawideband response – the result of a quad differential cascode design – which radically reduces the possibility of phase shifts and also reduces distortion of all kinds. In fact, the amount of TIM and IIM distortion is not only inaudible, but virtually unmeasurable as well.

Each amp in our dual amp system is driven by a massive toroidal power supply, with more than 30,000 microfarads capacitance compared to less than 12,000 microfarads for any comparable amp. That's more than twice the reserve power available. To handle the most demanding dynamics you're likely to find. And to keep bass tight and clean.

A system powered by our hk775x2 dual amp system is quite simply, the cleanest, most advanced system available.

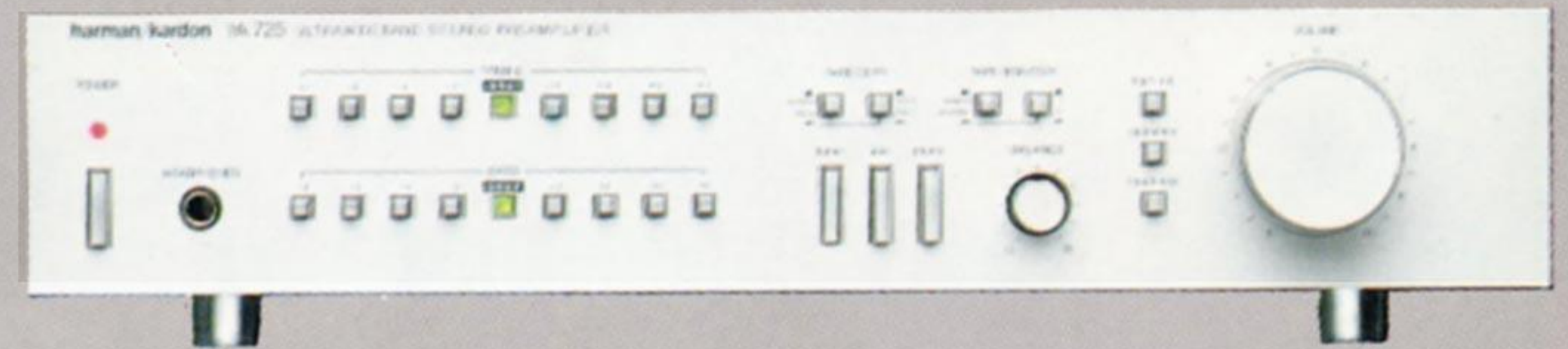


## hk715 digital tuner



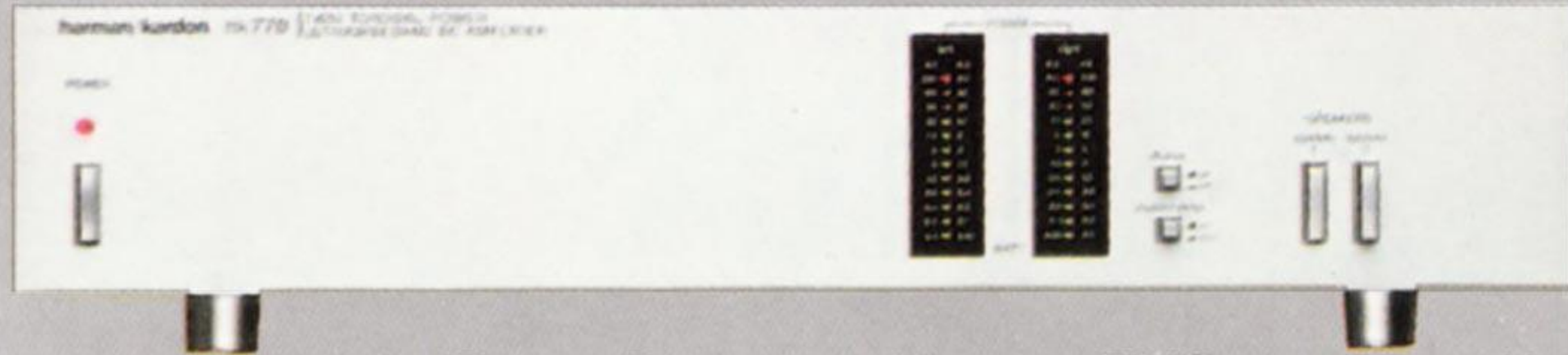
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|--|--|
| <b>Usable Sensitivity:</b>               | 1.7 $\mu$ V (IHF)                        |
| <b>50 dB Quieting (mono):</b>            | 3.0 $\mu$ V                              |
| <b>(stereo):</b>                         | 34 $\mu$ V                               |
| <b>Signal-to-Noise Ratio:</b>            | -77 dB (stereo)                          |
|  | -79 dB (mono)                            |
| <b>Total Harmonic Distortion:</b>        | 0.07% (mono at 1 kHz, 100% modulation)   |
|  | 0.09% (stereo at 1 kHz, 100% modulation) |
| <b>Capture Ratio:</b>                    | 1.0 dB                                   |
| <b>Alternate Channel Selectivity:</b>    | 70 dB                                    |
| <b>Image Rejection:</b>                  | 80 dB                                    |
| <b>IF Rejection:</b>                     | 105 dB                                   |
| <b>Spurious Response Rejection:</b>      | 105 dB                                   |
| <b>AM Rejection:</b>                     | 65 dB                                    |
| <b>Stereo Separation:</b>                | 50 dB at 1 kHz                           |
| <b>Output Level/Impedance:</b>           | 780 mV/2 k ohms                          |
| <b>AM Usable Sensitivity:</b>            | 200 $\mu$ V/meter                        |
| <b>AM Signal-to-Noise Ratio:</b>         | -60 dB                                   |
| <b>AM Selectivity:</b>                   | 40 dB                                    |
| <b>AM Alternate Channel Selectivity:</b> | 37 dB                                    |
| <b>AM Image Rejection:</b>               | 50 dB                                    |
| <b>AM IF Rejection:</b>                  | 45 dB                                    |
| <b>Dimensions:</b>                       | 385 mm/15.2" Width                       |
|  | 72.5 mm/2.9" Height                      |
|  | 320 mm/12.6" Depth                       |
| <b>Weight:</b>                           | 4.2 kg/9.25 lbs.                         |

## hk725 preamplifier



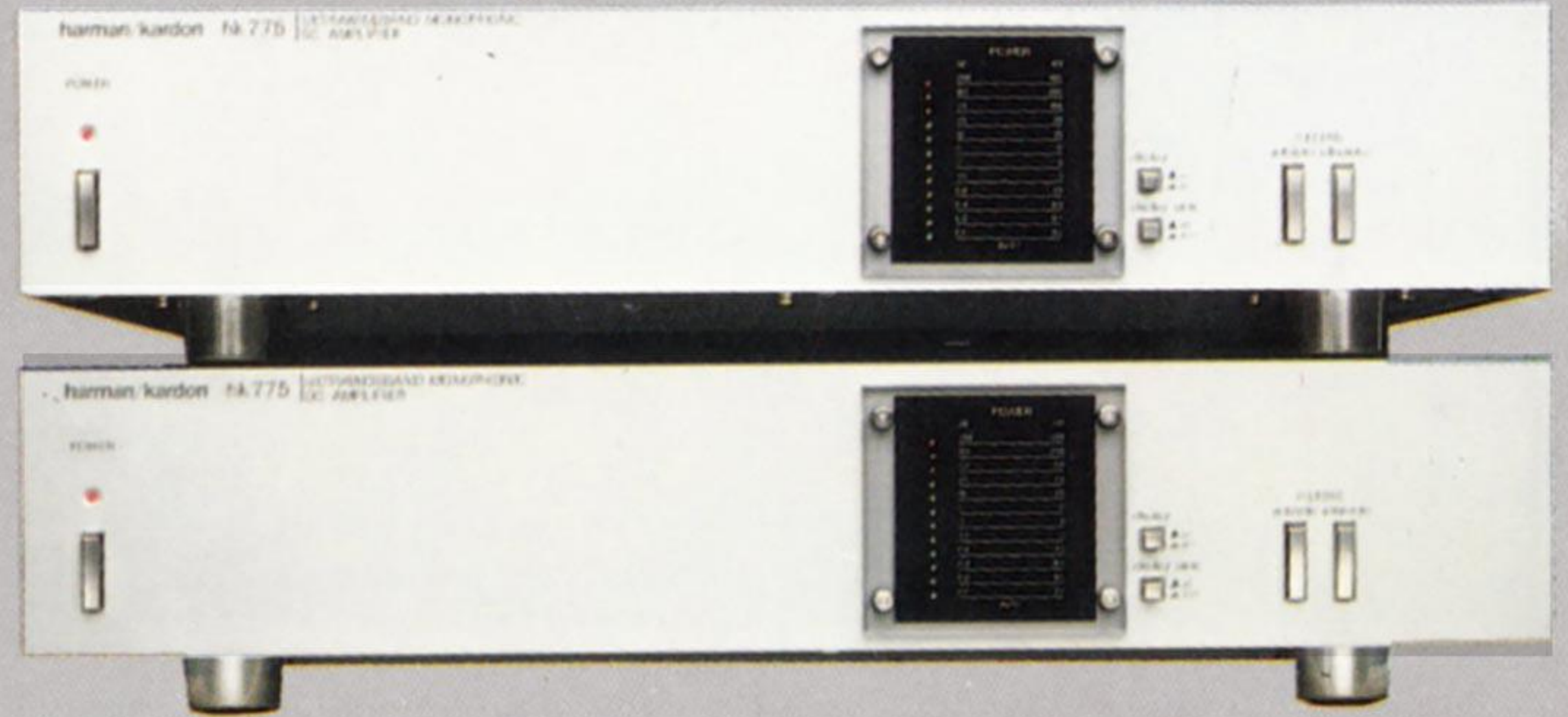
|                                    |   |
|------------------------------------|---|
| <b>Input Sensitivity:</b>          | Phono: 2.3 mV/47 k ohms                                       |
|                                    | High Level: 145 mV/23 k ohms                                  |
| <b>Frequency Response:</b>         | Less than 1 Hz to beyond 150 kHz +0, -1 dB                    |
| <b>RIAA Equalization:</b>          | $\pm$ .2 dB (20-20 kHz)                                       |
| <b>Signal-to-Noise Ratio:</b>      | Phono: 90 dB (IHF-A)  |
|                                    | High Level: 106 dB (IHF-A)                                    |
| <b>Phono Overload:</b>             | 250 mV at 1 kHz   |
| <b>Total Harmonic Distortion:</b>  | Phono: 0.009%   |
|                                    | High Level: .005%   |
| <b>Intermodulation Distortion:</b> | 0.009% at 2 volts output                                      |
| <b>Slew Rate:</b>                  | Greater than 200 volts/ $\mu$ sec to output with IHF standard |
| <b>Dimensions:</b>                 | 385 mm/15.2" Width  |
|                                    | 72.5 mm/2.9" Height   |
|                                    | 320 mm/12.6" Depth  |
| <b>Weight:</b>                     | 4.2 kg/9.25 lbs.  |

## hk770 power amplifier



|  |  |
|--|--|
| <b>Power Output:</b>                     | 65 watts, RMS, per channel into 8 ohms, both channels driven simultaneously from 20-20kHz with less than 0.03% THD             |
| <b>Power Bandwidth:</b>                  | Less than 8 Hz to 100 kHz at 32.5 watts per channel with less than 0.03% THD   |
| <b>Total Harmonic Distortion (1kHz):</b> | 0.006% at rated output   |
| <b>Intermodulation Distortion:</b>       | Less than 0.01% at rated output. Both channels driven at different operating frequencies                                       |
| <b>Frequency Response:</b>               | Below 1Hz to beyond 250 kHz +0, -3 dB  |
| <b>Damping Factor:</b>                   | Greater than 50  |
| <b>Slew Rate:</b>                        | 150 V/ $\mu$ sec into 8 ohms at rated power output, both channels driven   |
| <b>Square Wave Rise Time (20kHz):</b>    | 1.5 $\mu$ sec into 8 ohms at rated power output, both channels driven  |
| <b>Square Wave Tilt:</b>                 | Less than 2% at 20Hz   |
| <b>Total TIM Distortion:</b>             | Less than 0.007% at rated output   |
| <b>Total Interface I.M. Distortion:</b>  | Less than 0.007%   |
| <b>Power Supply Crosstalk:</b>           | Greater than 100 dB (20Hz to 20kHz) unused channel shorted input   |
| <b>Amplifier Configuration:</b>          | Twin toroidal transformers with positive and negative supplies plus high and low voltage supplies for output and driver stages |
| <b>Signal-to-Noise Ratio:</b>            | 123 dB (IHF-A)   |
| <b>Input Impedance:</b>                  | 35 k ohms  |
| <b>Sensitivity:</b>                      | 1.2 volts for rated output   |
| <b>Dimensions:</b>                       | 385 mm/15.2" Width<br>72.5 mm/2.9" Height<br>320 mm/12.6" Depth  |
| <b>Weight:</b>                           | 10.1 kg/22.2 lbs.  |

## hk775x2 power amplifier



|  |  |
|--|--|
| <b>Power Output:</b>                     | 130 watts, RMS, into 8 ohms, from 20-20kHz with less than 0.03% THD  |
| <b>Power Bandwidth:</b>                  | Less than 8Hz to 100kHz at 65 watts per channel with less than 0.03% THD   |
| <b>Total Harmonic Distortion (1kHz):</b> | 0.006% at rated output   |
| <b>Intermodulation Distortion:</b>       | Less than 0.02% at rated output (60Hz and 7kHz)  |
| <b>Frequency Response:</b>               | Below 1Hz to beyond 300kHz +0, -3 dB   |
| <b>Damping Factor:</b>                   | Greater than 100   |
| <b>Slew Rate:</b>                        | 150 V/ $\mu$ sec into 8 ohms at rated power output   |
| <b>Square Wave Rise Time (20kHz):</b>    | 1.2 $\mu$ sec into 8 ohms at rated power output  |
| <b>Square Wave Tilt:</b>                 | Less than 2% at 20Hz   |
| <b>Total TIM Distortion:</b>             | Less than 0.007% at rated output   |
| <b>Total Interface I.M. Distortion:</b>  | Less than 0.007%   |
| <b>Power Supply Crosstalk:</b>           | 0  |
| <b>Amplifier Configuration:</b>          | Each amplifier uses one toroidal power transformer with positive and negative supplies plus high and low voltage supplies for output and driver stages |
| <b>Signal-to-Noise Ratio:</b>            | 123 dB (IHF-A)   |
| <b>Input Impedance:</b>                  | 24 k ohms  |
| <b>Sensitivity:</b>                      | 1.2 volts for rated output   |
| <b>Dimensions for each amp:</b>          | 385 mm/15.2" Width<br>72.5 mm/2.9" Height<br>320 mm/12.6" Depth  |
| <b>Weight for each amp:</b>              | 10.1 kg/22.2 lbs.  |



**harman/kardon**

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