A Half Century of Loudspeaker Engineering Brings a Significant Breakthrough.

With the Technics introduction of its nodal-driven honeycomb disc, diaphragm driver, the science of loudspeaker engineering takes a giant step forward. For over half a century familiar cone-shaped drivers have represented the standard design, even with many inherent faults being apparent. The flat-diaphragm driver has long been considered an ideal design concept, but hasn't been found in many practical applications. Without the "cavity effect" that affects every cone shaped driver and disturbs its frequency response, the flat Technics honeycomb driver delivers extremely wide, smooth frequency response. To build it, however, required a material of very high rigidity and low mass, a special combination that was not readily available. But the development of the Technics "axially symmetric honeycomb sandwich diaphragm" has made it possible to combine all the desirable characteristics without being forced into compromises or trade-offs.

The Technics speaker is "nodal-driven" by a large-diameter voice coil that permits the flat honeycomb diaphragm to operate with accurate pistonic motion, without break-up or partial vibrations caused by "vibration modes" (a major source of distortion).

A honeycomb disc woofer, a honeycomb disc midrange driver, and a Technics leaf tweeter together form a compact speaker system that offers:

1. Extremely low inherent distortion of all drivers
2. Smooth, wide frequency response
3. Linear phase response in the Technics tradition
4. Solid, reinforced enclosure construction preventing enclosure rattle and resonances.

Why Flat Is Better

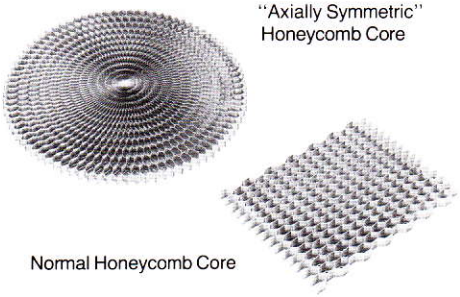
The familiar cone shape of practically all dynamic drivers was not adopted by choice by speaker designers, but was the only shape with which they could obtain sufficient rigidity and something resembling piston-like movement with a basically soft and pliant material—paper. A cone, partially enclosing a cavity, suffers from the "cavity effect," which causes dislocations (peaks and dips) in the frequency response curve towards the upper end of the driver's assigned frequency range. Also, the cone-shaped driver does not possess a distinct and stable "acoustic center" (the point from which the sound waves seem to emanate), but has a rather blurred acoustic center somewhere at or near the dust cap. This complicates the task of the enclosure designer, forcing them to vertically stagger the drivers in order to align their acoustic centers in one plane for linear phase response.

A flat diaphragm, on the other hand, does not suffer from a cavity effect; its frequency response remains linear and smooth up into a much higher range. This automatically means that its inherent phase response is smoother, too, as frequency linearity and phase linearity are two closely related phenomena.

Also, the flat diaphragm has a clearly defined, stable acoustic center, so staggering of drivers becomes unnecessary in a linear phase speaker system.

The Technics Axially Symmetric Honeycomb Diaphragm

Honeycomb-type materials, such as the type used in aircraft construction, possess very high bending rigidity despite their low mass. In the usual honeycomb structures, however, this rigidity is not the same in all directions; the honeycomb is easier to bend lengthwise than across. Technics uses a special "axially symmetric" honeycomb with the same high rigidity in all directions.



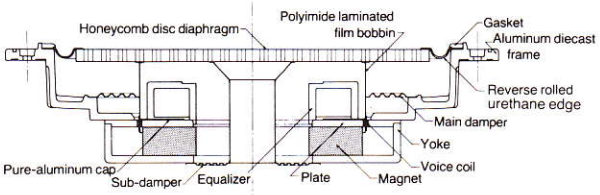
"Axially Symmetric" Honeycomb Core

Normal Honeycomb Core

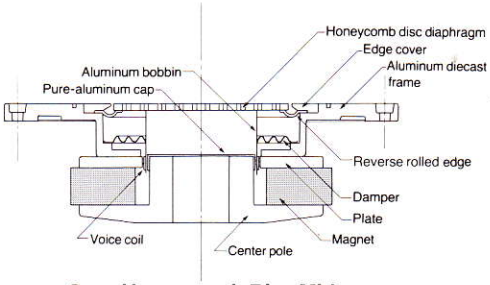
We Considered the Sound Then Shaped It Round

A honeycomb disc or a sheet of any other material, will exhibit a number of "vibration modes" when made to vibrate at certain frequencies. At such a vibration mode, the diaphragm vibrates in a pattern with some areas flexing in one direction, others in the opposite direction.

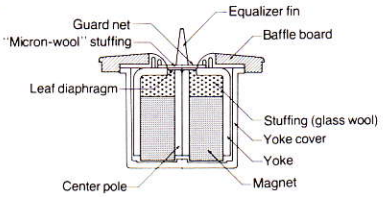
Those points and lines that seem to be at a standstill in such a vibration mode are called "nodes." Vibration modes are undesirable because they are caused by the diaphragm itself and are unrelated to the music signal—and



32 cm Honeycomb Disc Woofer



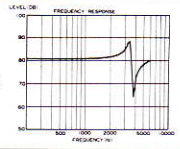
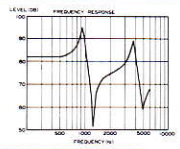
8 cm Honeycomb Disc Midrange



Leaf Tweeter

cause a specific kind of resonance. It has been found, though, that the formation of such vibration patterns can be prevented by driving the diaphragm at the corresponding nodes or at a line that intersects with these nodes.
In a square diaphragm, the node patterns appear in so many complex ways that no single voice coil can drive the diaphragm at all these nodes. Some unwanted vibration modes thus become inevitable. In the Technics round honeycomb disc diaphragm, however, vibration modes can be effectively prevented because the nodes appear at clearly defined, predictable places which can all be covered by a "nodal drive" using a large-diameter voice coil. The result: great "round" sound; the Technics honeycomb disc speaker sounds clean and brilliant because its nodal drive prevents vibration modes and partial vibrations. The purity you hear is the purity of accurate, purely pistonic motion.

Extension of Pistonic Motion Range by Nodal Drive (32 cm Honeycomb Disc Diaphragm)

	Nodal Drive	Center Drive
Freq. Response		
f10 (920Hz)		
f20 (4000Hz)		

Phase Linearity in the Technics Tradition

Together with amplitude-versus-frequency linearity, a speaker system also needs phase-versus-frequency linearity in order to give a faithful rendition of the original waveform. Technics has long insisted on waveform fidelity, and consequently on phase linearity. In the new honeycomb disc speaker, this is achieved quite easily, because the flat woofer and midrange driver diaphragms are aligned in one plane in the baffleboard, and the Technics leaf tweeter—also a flat diaphragm design—has its acoustic center in the same plane, too. Oscilloscope traces reveal the very high degree of accuracy that is achieved in reproducing even the most complex musical waveforms. Technics phase linearity means waveform fidelity, and that simply means that you hear what is in the music.

The Drivers You Actually Hear in Model SB-10

The Woofer

Model SB-10 is equipped with a 32 cm Technics Honeycomb Disc Woofer unit nodally driven by an extremely large 16 cm voice coil—bobbin assembly. This woofer provides excellent, low distortion sonic quality in the low range, but could, if required, reach up as high as 3.3 kHz. In the SB-10, however, only its area of optimum linearity is actually utilized.

The Midrange Driver

The 8 cm midrange driver is built upon the same principle of Honeycomb Disc Diaphragm and is nodal-driven by an extremely large sized voice coil and bobbin (here 50.5 mm in diameter). As in the woofer, reversely rolled edge construction prevents spurious sonic radiation from the edge. An aluminum cap on the center pole reduces 3rd harmonic distortion. A sturdy frame of precision machined aluminum diecast provides strong support.

The Technics Leaf Tweeter

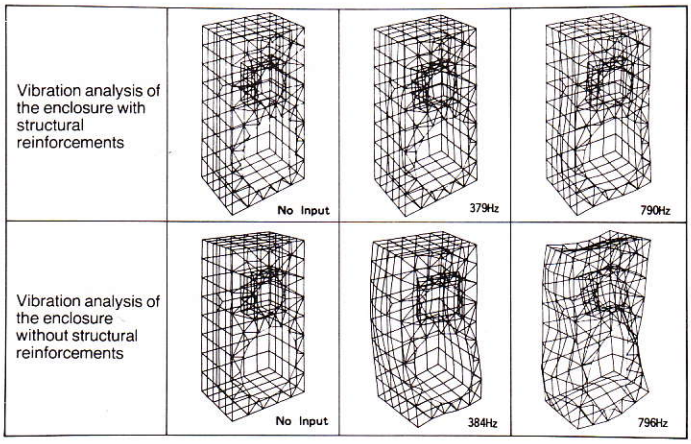
With a moving mass of only one twentieth of that of a conventional metal dome tweeter, the Technics Leaf Tweeter achieves a frequency response that extends up to an almost unbelievable 125 kHz. Driven across most of its surface, the flat leaf diaphragm has a well-defined acoustic center and thus provides a good match with the honeycomb disc diaphragm drivers for the low and mid ranges. While a ribbon tweeter generally uses aluminum foil for the diaphragm and voice coil and can suffer from diaphragm damage due to high current driving, the Technics leaf tweeter features high power handling ability of 20 watts r.m.s. (continuous sine wave) for heavy duty use thanks to its heat-resistant voice-coil-patterned polyimide film diaphragm.
A ribbon tweeter may also need a matching transformer because of its low impedance. Our leaf tweeter, with its frequency-independent 8 ohm impedance, requires no matching transformer and thereby avoids problems of transient response and phasing associated with such transformers. For a wide sound dispersion angle, a precision machined, diecast equalizer has been provided. A cross-sectional drawing of this unit is shown above.

Cross Sectional View of the SB-10

Anti-Resonant Design, Reinforced Enclosure

While working on the subject of vibration modes, Technics engineers also found that audible enclosure resonances can be the result of a weak speaker enclosure flexing and bending. In the Technics honeycomb disc speaker system, the enclosure is built very sturdily and reinforced with additional bracings to prevent vibration and resonances. What you hear is the music, not the box.

Analysis of the Enclosure's Vibration by the Finite Element Method



System Design

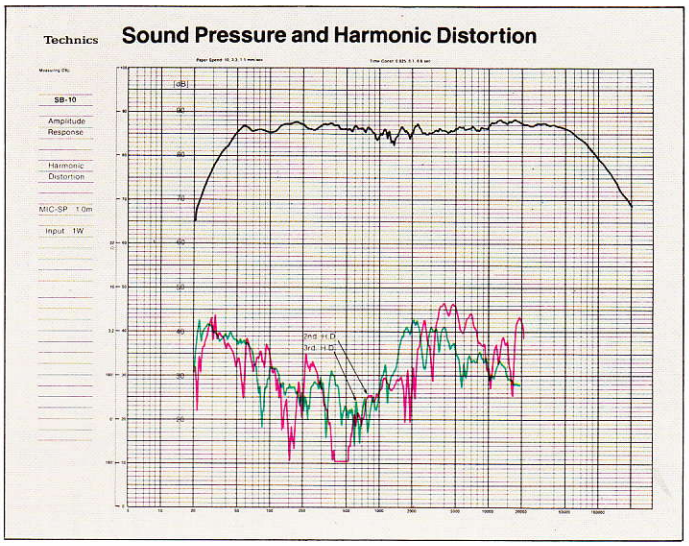
Computer simulations played an important role in designing this speaker system. These included:

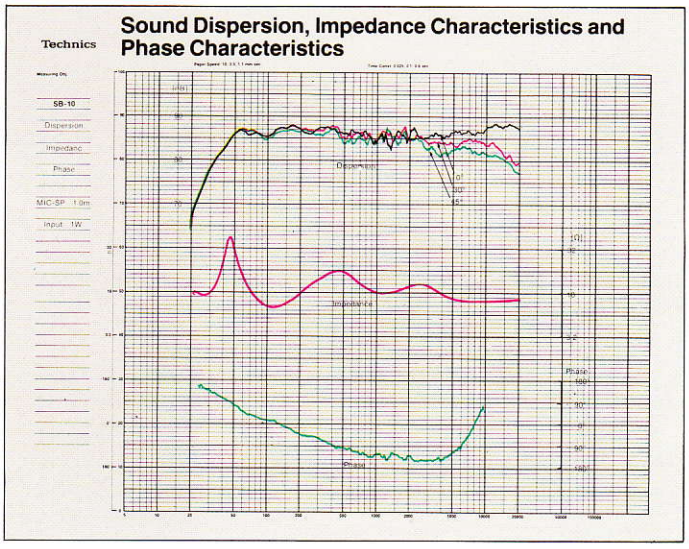
- Crossover simulation by computer, including phase information
- Enclosure construction
- Multi-channel acoustic measurement system
  Technics utilized a "Multi-Channel Acoustic Measurement System" which permits simultaneous evaluation of as many as 12 different factors including frequency response, harmonic distortion, horizontal and vertical sound dispersion, etc., that can all be measured at the same time. By evaluating this total information, the Technics speaker designer can easily establish the complex relationships that determine the final sonic quality.
- Live vs. speaker direct comparison test for fine tuning.

Multi-Channel Acoustic Measurement System

Technical Specifications

Configuration	3-way, 3-speaker
Speaker units	Woofer: 32 cm honeycomb disc Midrange: 8 cm honeycomb disc Tweeter: Leaf tweeter
Impedance	8 ohms
Input power	150 W, music 100 W, DIN
Output level	87 dB/W (1.0 m)
Frequency range	28 Hz~125 kHz (at 10 dB below average level)
Crossover frequencies	400 Hz, 4,000 Hz
Dimensions (H×W×D)	71.1 cm×40.2 cm×31.8 cm (28"×15-7/8"×12-1/2")
Weight	32 kg (70.5 lbs) (including grille)





Technics
R&B series

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