

A NEW MONITORING LOUDSPEAKER SYSTEM

MELCO SALES, INC.

A NEW MONITORING SPEAKER SYSTEM

Introduction

A new monitoring loudspeaker system that covers the entire audio frequency range has been developed by Consumer Products Research Lab., Mitsubishi Electric Corp.. The purpose of the development is to provide a top level high-fidelity loudspeaker system so that the new audio techniques such as direct-cutting or PCM recording system can offer their advantages sufficiently.

Through the development, two major goals have been aimed at. The first one concerns wide-range sound reproduction. It was decided that this system should cover the whole frequency range from 20 Hz (lowest audible frequency) up to 35 kHz. The second one is to reduce harmonic distortions until they go down to at least 50 dB (0.3 %) below the fundamental sound. In addition, phase characteristics that have a remarkable effect on sound quality and power handling capacity were taken to be the main problems to improve.

Characteristics

1. Wide-range sound reproduction (20 Hz~35 KHz)

The application of passive radiator phase inverter allows this system to reproduce low frequencies down to 20 Hz, providing comparatively high sound pressure level of 93 dB/w (at 1 meter) with a reasonable cabinet size (270 l). The sound reproduction is definitely confirmed by the pressure response characteristics shown in Fig. 1.

As for the high end of the frequency range, the dome-type supertweeter reproduces sound up to 35 kHz, that is far beyond 20 kHz (highest audible frequency). A special damper attached to the diaphragm reduces its modal vibration remarkably. That is why Fig. 2 shows a smooth response curve over the entire high frequency range.

2. Low distortion

(1) Honeycomb sandwich cone

A new cone was developed to reduce harmonic distortions. Fig. 3 shows its structure, which is made of aluminium honeycomb core and CFRP* skins. Fig. 4 shows the harmonic distortion characteristics of the woofer in the frequency range available for use. The range of "piston" motion can be found to be about three times wider than that of the traditional paper cone.

(2) Low current distortion magnetic circuit

Each magnetic circuit of the woofer and the squawker has two small permalloy rings that effectively reduce current distortion by their low hysteresis loss. As for the tweeter and the super-tweeter, the application of permendur to their magnetic circuits, as it is operated in its saturation region, reduces current distortion and offers a very high flux density (tweeter 21,000 gauss, super tweeter 23,000 gauss). Fig. 5 shows the harmonic distortion characteristics of this system. Each harmonic is kept at least 50 dB (0.3%) below the fundamental sound.

Transient intermodulation distortion is also shown in Fig. 6. It indicates that the transient intermodulation distortion of this new system is about 15 dB less than that of our present monitoring loudspeaker system.

3. Smoothness of phase characteristics

The dividing network of this system contains phase controllers. Fig. 7 shows their electrical circuits and phase characteristics. The phase of this controller varies with the frequency from 0° to -180° or from $+180^\circ$ to 0° , while its amplitude stays constant. Therefore, phase difference between loudspeaker units can be easily controlled by choosing the suitable network constants. The smooth characteristics are shown in Fig. 8. Sound quality was greatly improved by reducing the phase differences of speaker units.

4. Large power handling capacity

All voice coils of loudspeaker units are strengthened by a new epoxy-imide resin adhesive. This, as shown in Fig. 9, has the advantage of larger heat proofing than the ordinary epoxy resin adhesive. Moreover, it shows sufficient strength even at 300°C (572°F).

An extended life test also confirmed the strength of the loudspeaker units. They passed the test successfully, even though a 300 watt power amplifier was used to drive the loudspeaker system.

In addition, a protective circuit, installed in the dividing network, limits abnormally large power input.

Specifications

1. System configuration	4-way bass-reflex type (with a passive radiator)
2. Frequency response	20 Hz ~ 35 kHz
3. Efficiency	93 dB/w (at 1 meter from the front of the tweeter on its axial line)
4. Nominal impedance	8 Ohm
5. Power handling capacity	300 watts (peak)
6. Crossover frequency	400 Hz, 2 kHz, 7 kHz
7. Harmonic distortion	each of the harmonics is at least 50 dB (0.3 %) below the fundamental sound (1 watt, above 30 Hz)
8. Dimensions	660mm (W) x 1365mm (H) x 545mm (D) (26" x 53-3/4" x 21-1/2")
9. Weight	130 kg (286 lbs)

Construction Design

A Mitsubishi 300 watt power amplifier could be added to this system.

- | | |
|---------------------|--|
| 1. Passive radiator | dia., 40 cm (15-1/4")
cone type, 20 Hz ~ 50 Hz |
| 2. Woofer | dia., 40 cm (15-1/4")
cone type, 50 Hz ~ 400 Hz |
| 3. Squawker | dia., 18 cm (7")
cone type, 400 Hz ~ 2 kHz |
| 4. Tweeter | dia., 5 cm (2")
cone type, 2 kHz ~ 7 kHz |
| 5. Supertweeter | dia., 2.3 cm (9/10")
dome type, 7 kHz ~ 35 kHz |
| 6. Dividing network | ± 12 dB/oct. filters |
| 7. Cabinet | baffle board thickness, 42mm
(1-3/4") |

Postscript

Sound quality evaluation of a loudspeaker system depends more largely upon actual hearing tests than do other sound reproducing systems. For that reason, a large number of hearing tests have been performed throughout the development of this system. In addition, the performances of this system, such as wide-range sound reproduction and low distortion, were definitely confirmed by listening to the sound reproduced by the PCM recording system. Since this system covers the entire audio frequency range with very low distortion, it seems that this system is the fore runner of future sound reproducing systems.

* Carbon Fiber Reinforced Plastics



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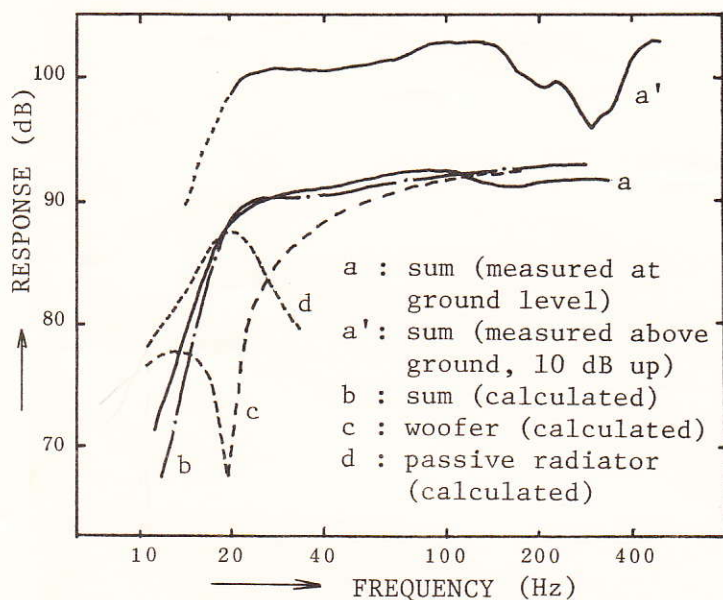


Fig. 1 Calculated and measured pressure response frequency characteristics of the new monitoring loudspeaker system. In the measurement, the system was mounted in the ground to make infinite baffle condition. Sum means total response of the woofer and the passive radiator.

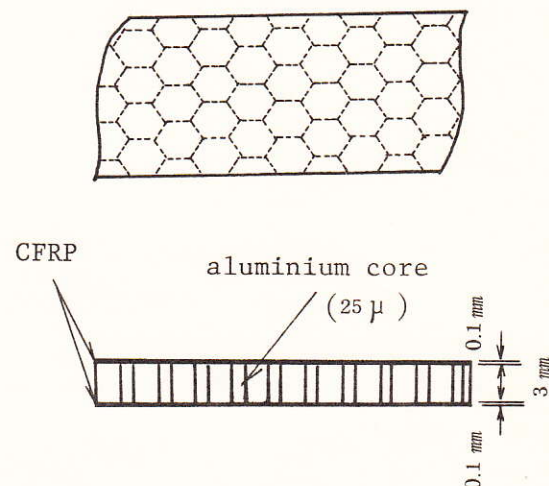


Fig. 3 Cross-sectional view of honeycomb sandwich cone

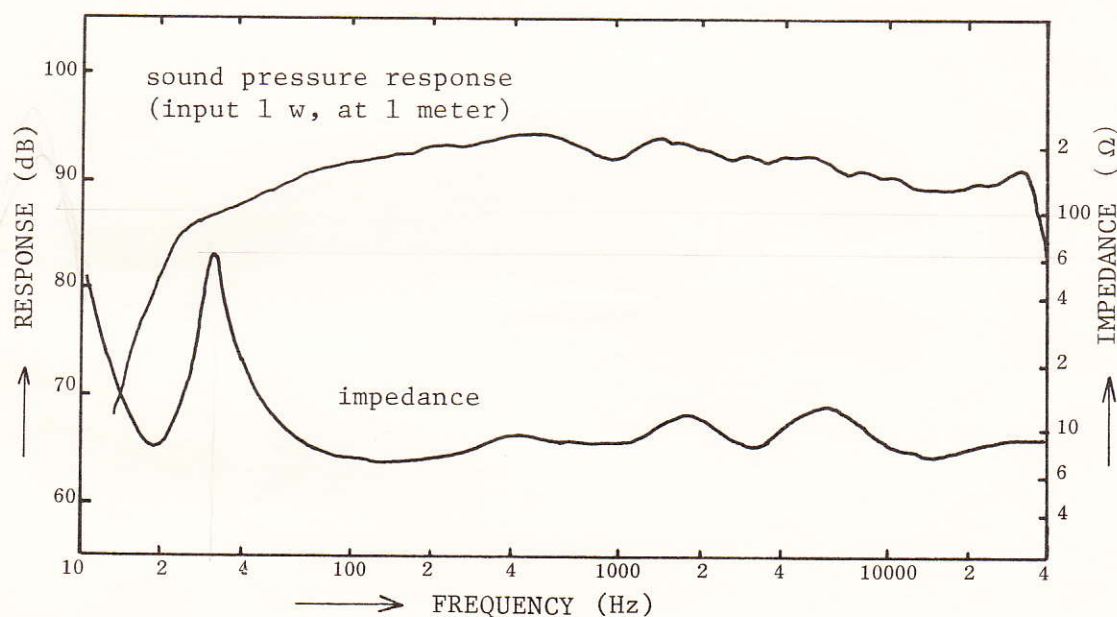


Fig. 2 Pressure response frequency characteristic and impedance frequency characteristic of the new monitoring loudspeaker system

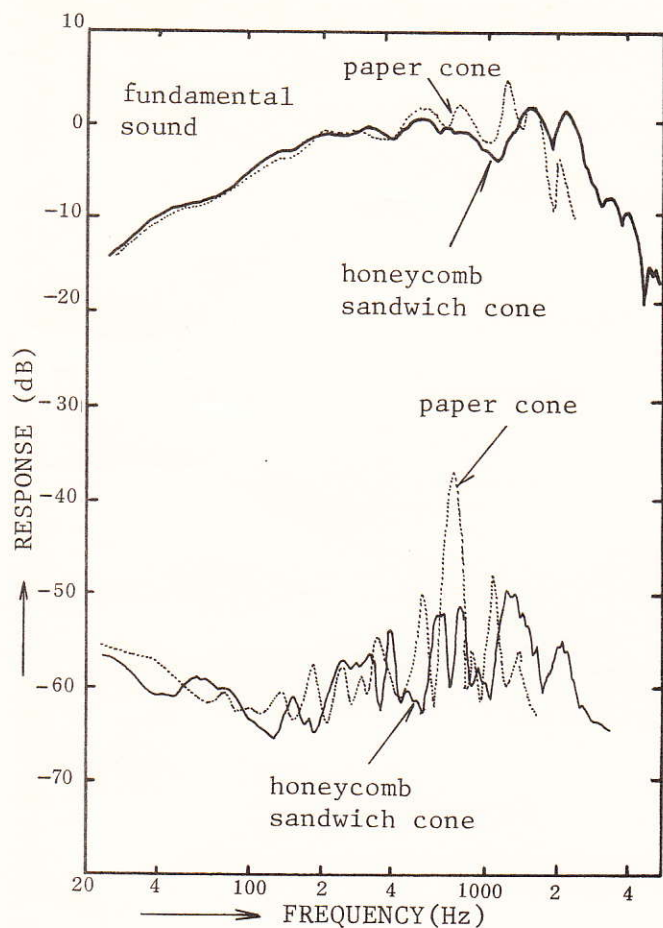


Fig. 4 Harmonic distortion characteristics of the woofers

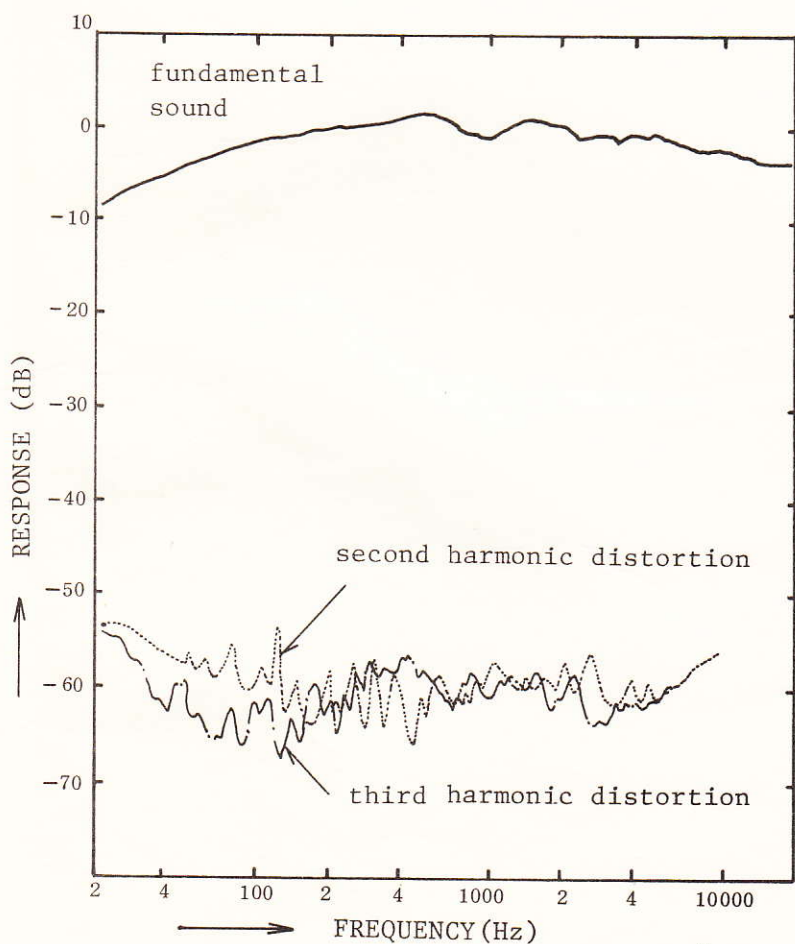


Fig. 5 Harmonic distortion characteristics of the new monitoring loudspeaker system

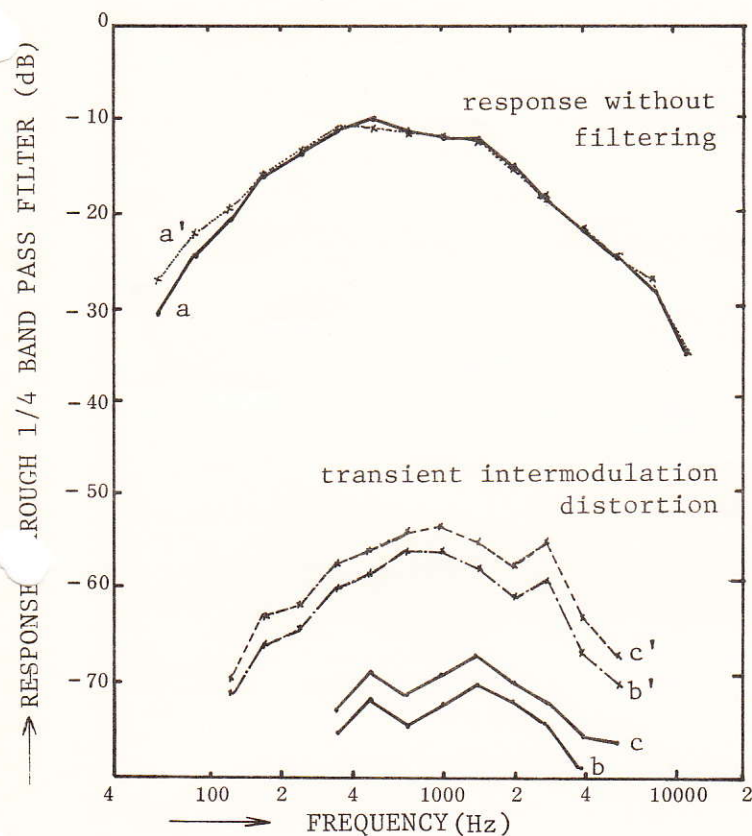


Fig. 6

Transient intermodulation distortion characteristics comparing the new monitoring loudspeaker system with our present monitoring loudspeaker system

a, a': Response without filtering

a : the new monitoring system

a': our present monitoring system

b, c : Transient intermodulation distortion of the new monitoring system

b : pressure response 90 dB at 1 meter

c : pressure response 95 dB at 1 meter

b', c': Transient intermodulation distortion of our present monitoring system

b': pressure response 90 dB at 1 meter

c': pressure response 95 dB at 1 meter

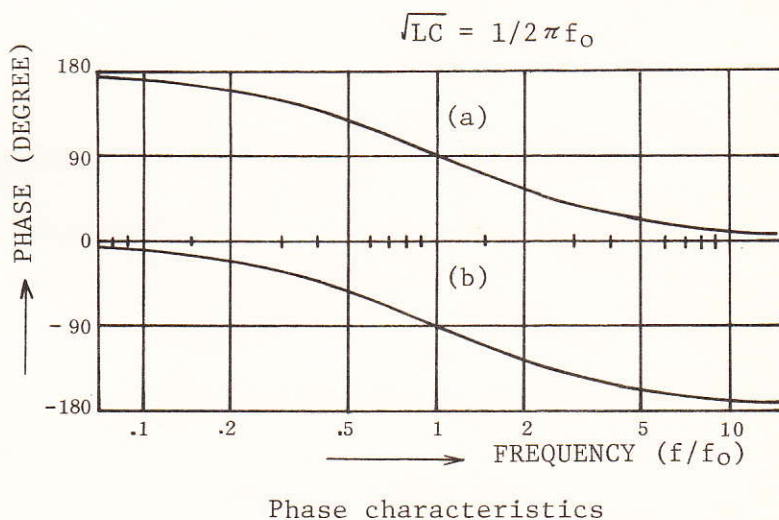
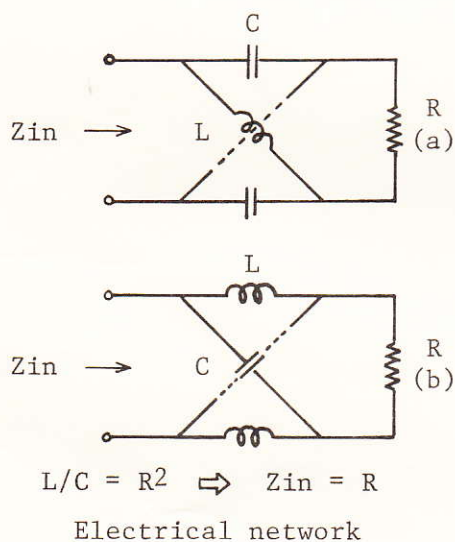


Fig. 7 Electrical network and phase characteristics of the phase controller

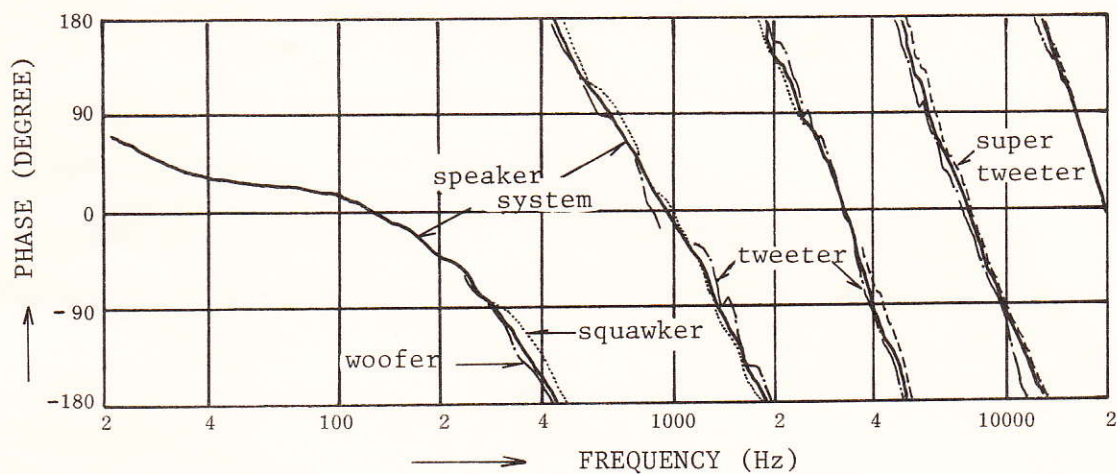


Fig. 8 Phase characteristics of the new monitoring loudspeaker system and speaker units

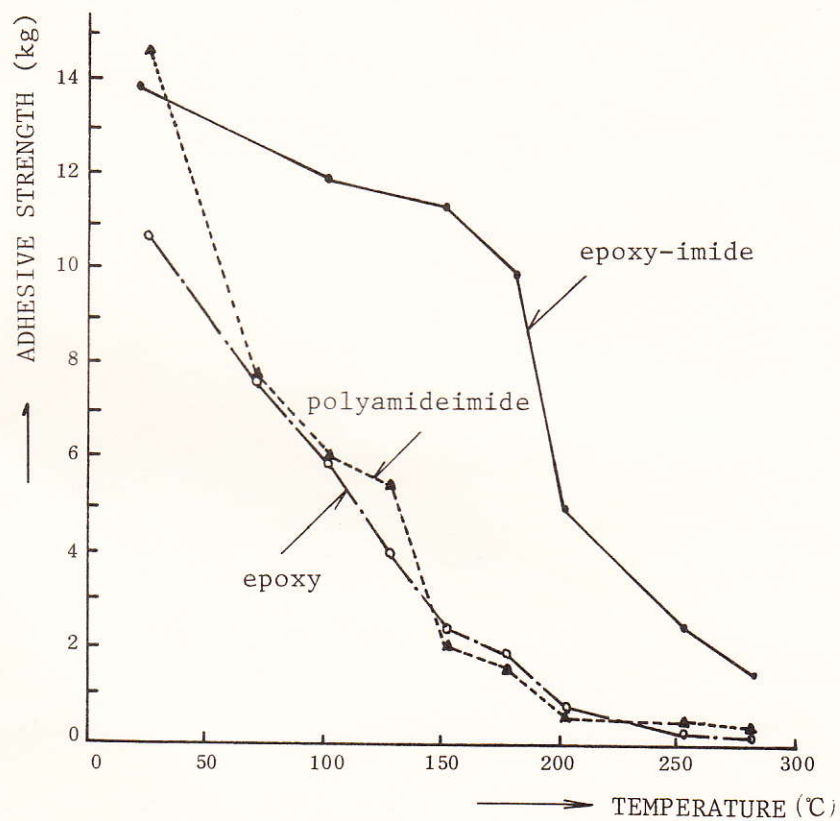
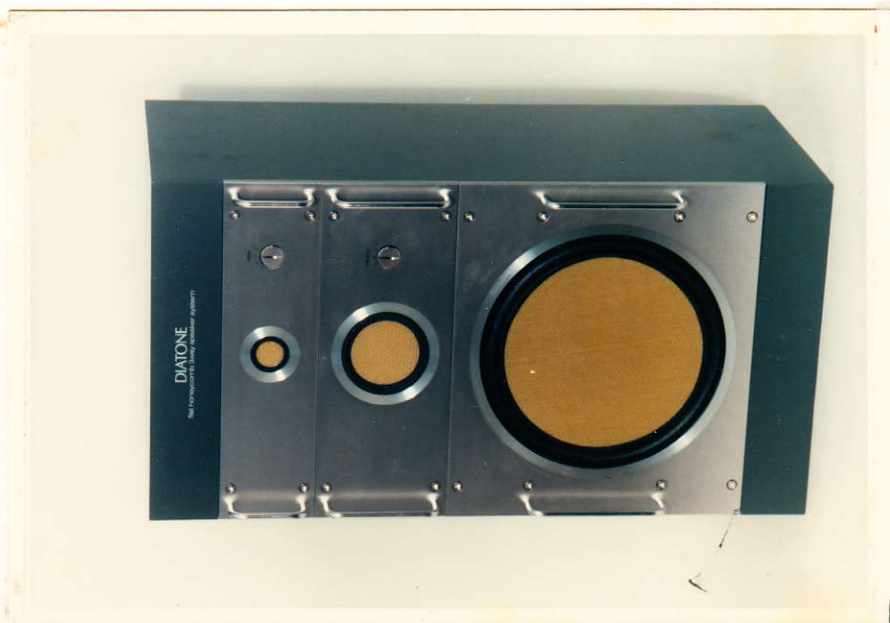


Fig. 9 Temperature characteristics of adhesives



3 WAY



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