

- Press Release -

Tohoku Pioneer Corporation (Yamagata, Japan) developed and introduced world's first HVT speaker, which drastically reduced the thickness of speakers (with more than 30 patent applications).

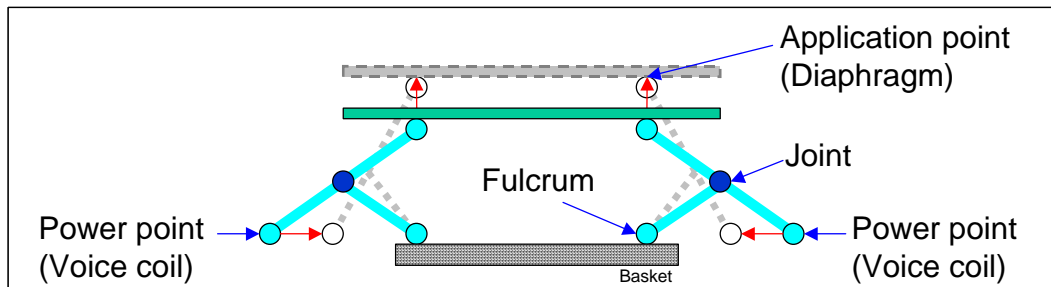
The HVT mechanism is a brand-new idea to employ linkage mechanisms inside a speaker unit which transform the horizontal movement of a voice coil to the vertical movement of a diaphragm and reduce the thickness and unwanted vibration compared with conventional speakers.

Movement of HVT mechanism

What is HVT?

Abbreviation of **H**orizontal-**V**ertical **T**ransforming

A speaker which transforms the horizontal movement to the vertical movement



Employed are “Scott-Russell Linkages” to the speaker, which enabled to transform the vibration direction.

*Scott-Russell linkage

John Scott Russell (GB) 1808-1882

A linkage which transforms the horizontal movement to the vertical movement.

Patent pending as a speaker with a Scott-Russell or pantograph linkage (31 applications).

The height of a conventional speaker is the sum of (i) cone depth, (ii) clearance under the spider, (iii) voice coil height, (iv) clearance under the voice coil, and (v) thickness of the back plate (magnetic circuit).

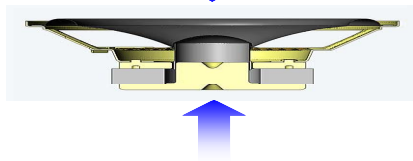
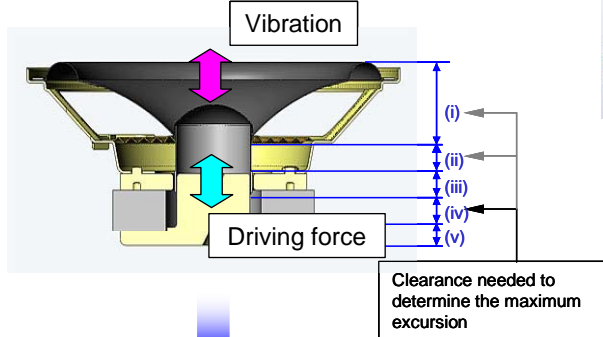
Shallow speakers with conventional structures often suffer from the bump of the spider or voice coil due to the insufficient clearance (ii) and (iv) and the acoustic distortion because of the excursion limitation by the spider and surround. Thus, they are not likely to reproduce rich bass.

The motor systems (magnets and voice coils) of HVT speakers do not need to be disposed in the backside of the diaphragm.

The motor system disposed in the side vibrates the diaphragm via the linkage mechanism, which achieved the higher sound quality from the thinner speaker design that no one had ever accomplished.

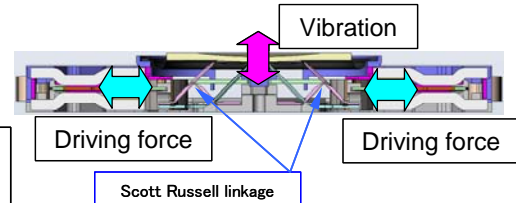
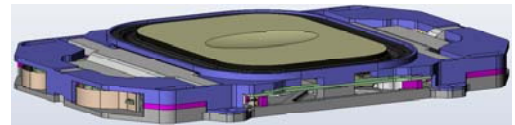
Advantage of the HVT speakers

Conventional dynamic speaker



The excursion of a thin speaker with a conventional structure is limited, which causes acoustic distortion.

HVT speaker



Employing the linkage mechanism enables to:

1. **drastically reduce the thickness.**
2. employ soft suspensions without strict limitation of excursion, which also lowers the F_0 and improves bass reproduction,
3. dispose strong motor systems (magnetic circuits and voice coils),
→ 2 and 3 realize **richer bass reproduction with a smaller enclosure.**
4. **less unwanted vibration** because of the perpendicular movement of the motor system and diaphragm, and
5. use a flat diaphragm because of multi-point drive with the linkage.

HVT speakers do not need strict limitation of excursion according to the thickness reduction.

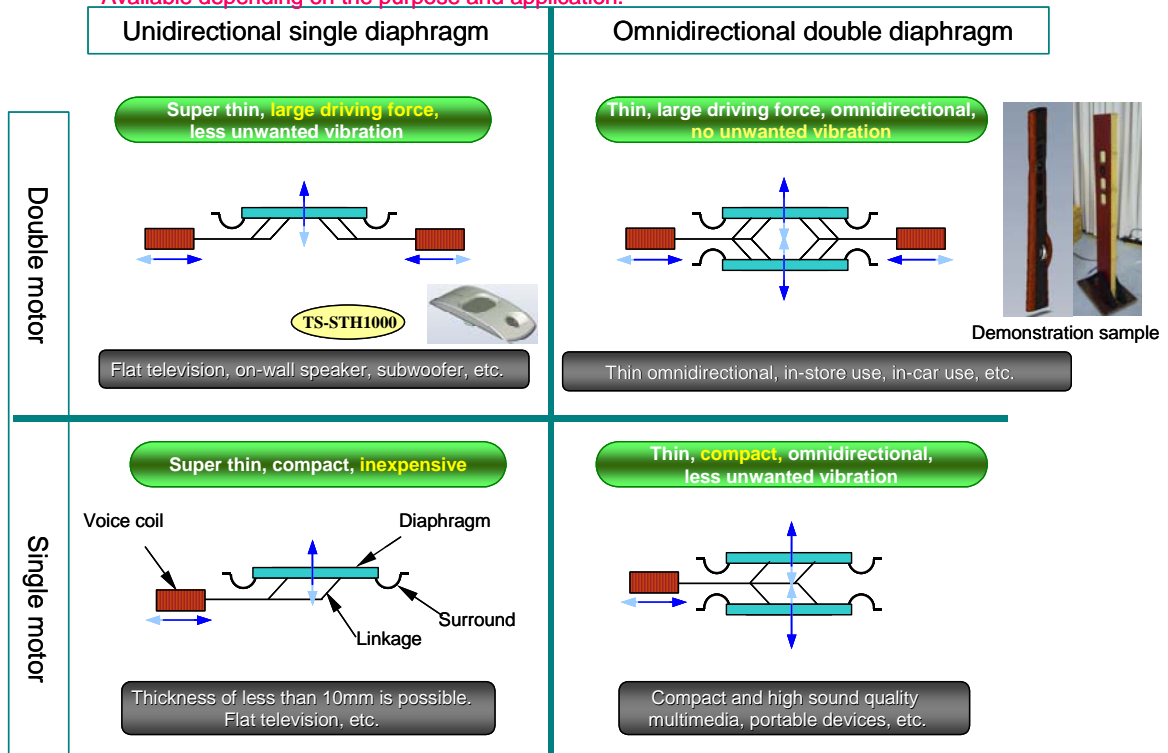
Therefore, it is possible to design thin speakers with the lower resonance frequencies (F_0).

It is also possible to dispose strong motor systems (magnetic circuits and voice coils). Thus, richer bass reproduction with a smaller enclosure than conventional speakers has been achieved.

HVT speakers have wide variety of their structural application with the different number of the motor system and diaphragm. It is possible to design many types of HVT speakers depending on the purpose and application.

Four variations of HVT speakers

Four variations of HVT speakers with the motor system and diaphragm design:
Available depending on the purpose and application.

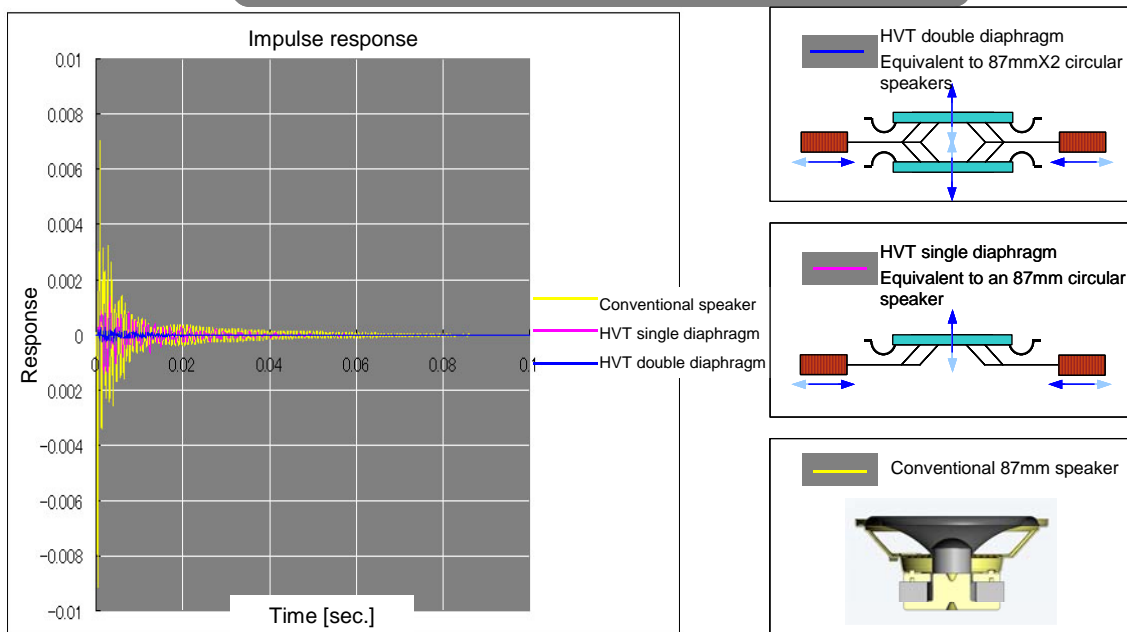


HVT speakers have the advantage of "less unwanted vibration from the speaker".

The feature of less unwanted vibration achieved the superior acoustic response with clearer bass and less vibration transmission to the downstairs and neighbors.

(See next page)

Comparison of unwanted vibration with different unit types



Less unwanted vibration from HVT speakers:
especially the double-motor double-diaphragm type is almost unwanted-vibration free.

Omnidirectional speakers with conventional dynamic speakers have such problems as the acoustic characteristic dependence on the listening positions and the tricky frequency response of reflected sound due to the arrival time intervals caused by the distance among the diaphragms.

Conventional thin speakers such as electrostatic loudspeakers and ribbon speakers with a printed voice coil radiate out-of-phase sound to the front and back. Therefore, it has been difficult to realize omnidirectional speakers.

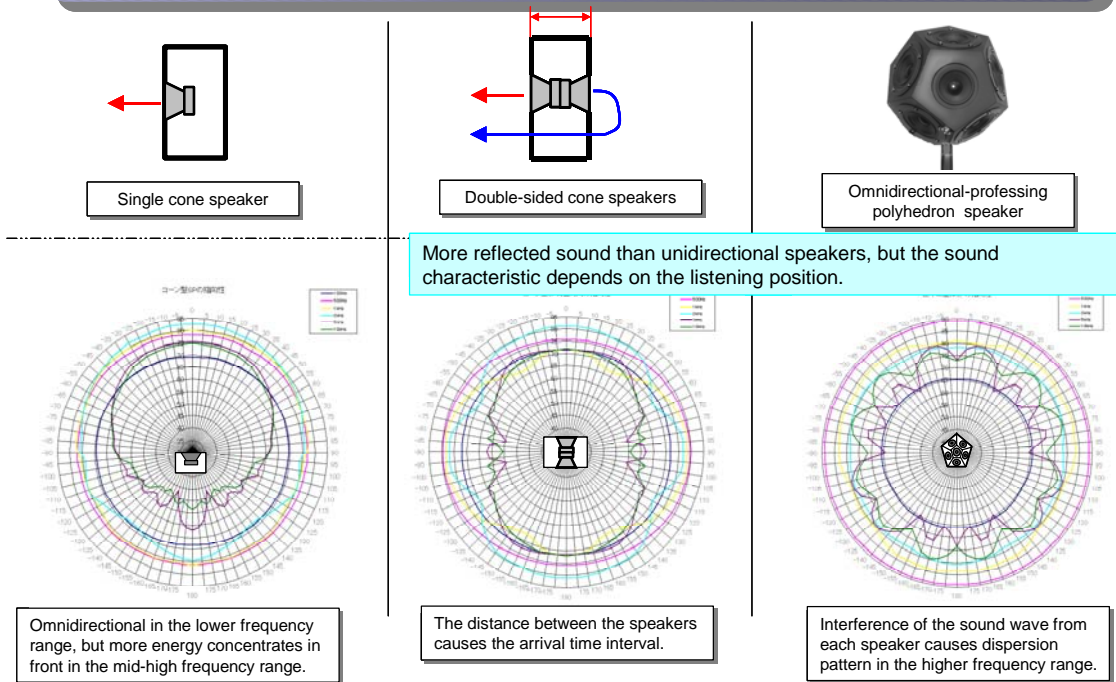
The front and back diaphragms of a double-diaphragm HVT speaker are disposed close with each other and vibrate in-phase. This is a simple design solution to realize an omnidirectional speaker with an ideal dispersion pattern, which had ever been impossible.

This is also a great benefit of **the thin HVT speaker.**

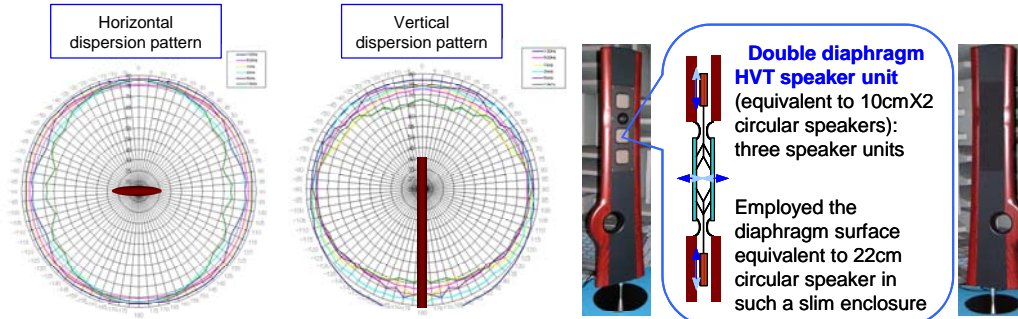
The advantages of omnidirectional speakers are well known as "more natural sound field" and "three-dimensional sound image localization". Other effects are "stable stereo balance even when a person walks in front of the speakers" and "comfortable loudness near and distant from the speakers".

Since the balance of reflected sound with omnidirectional speakers compared with direct sound is relatively larger than standard speakers. The acoustic characteristic can be applied and contribute to exhibition spaces in such as stores and museums where many people walk around.

Dispersion pattern comparison: currently difficult to realize omnidirectional speakers



Features of the demonstration sample with HVT speaker units



Three dimensional sound field

The diaphragms of double diaphragm HVT speaker units are disposed close with each other, and the systems can be considered to be a point source. Thus, they have 360 degree uniform dispersion pattern in both horizontal and vertical direction.

They can create the sound field more like three dimensional, which is the most important feature of omnidirectional speakers.

Rich bass reproduction

It is one of the features of HVT speakers to reproduce "richer bass from a smaller enclosure".

Thanks to the double-sided diaphragms, rich bass can be reproduced independent of the baffle width (independence of the baffle effect and higher degree of design freedom).

Two pair voice coils and diaphragms cancel the vibration, therefore, less wobble on the time domain and clear bass reproduction have been achieved.

Environmental advantages

Speakers without unwanted vibration do not require large mass for the enclosures or speaker stands, which enables resource-saving design.

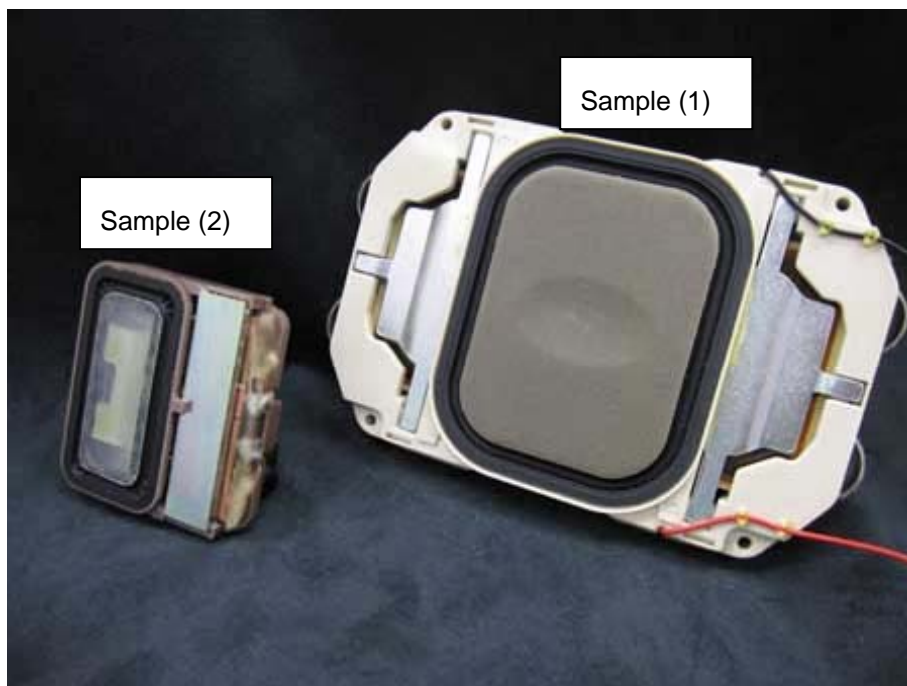
Also, less vibration transmission to the floor and wall will not annoy the downstairs and neighboring people.

A wider listening area delivers comfortable loudness both near and distant from the speakers.

Stable stereo balance will not be disturbed even when a person walks in front of the speakers because the sufficient reflected sound fills the listening room with uniform acoustic energy.



We will contribute in various areas such as in-car use, home use and environmental-friendly speakers utilizing the advantages of space-saving, super thin, unwanted-vibration free, omnidirectional speakers.



(1) 75X57 mm (equivalent to 87 mm circular) single diaphragm HVT speaker unit

(2) 49X22 mm double diaphragm (equivalent to 53 mm circular) omnidirectional HVT speaker unit

