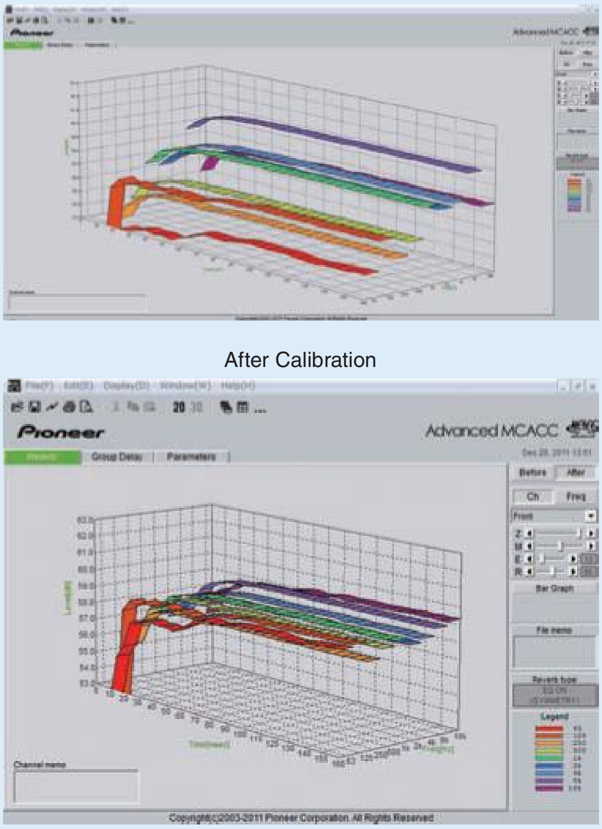
3D Time-Axis Compensation

As shown on the 3D graphs on right, the frequency characteristics change with the passing of time. So if compensation is made on the same point of the time-axis, there will be some difference due to reverberation. To solve this problem, Advanced MCACC adopts the 3D Time-Axis Compensation which takes into account this change along the time-axis. You can measure the listening environment before correcting the sound field, and make compensations matched to the condition. The adjustment can be done in 0 to 160 msec range including the direct sound area, allowing compensation with emphasis on direct sound. The adjustment point can be controlled manually for minute adjustments suited to the listening environment. The measured results can be displayed in a rotatable 3D graph on your personal computer or iPad via the AVNavigator or iControlAV5 app. Anyone can easily use the professional features such as display before/after calibration comparison, or check if each frequency characteristic is aligned at the setup point on the time-axis.

Before Calibration

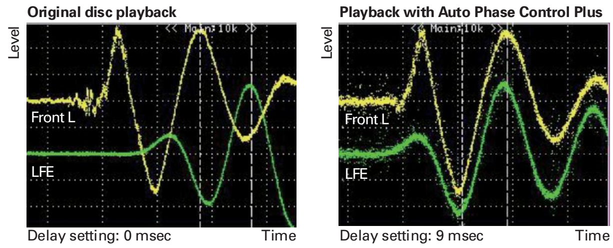


Advanced MCACC Reverberation Measurement Result

Auto Phase Control Plus

Multi-channel sounds on Blu-ray Discs, DVDs, or 5.1ch WAV/FLAC are sometimes recorded with LFE channel delay (about max. 16 msec) caused by the LPF (low-pass filter) when the discrete sounds are packaged. This delay in the low frequencies affects not only the bass, but also the main channel playback, dulling the rhythm and sound. During playback, Phase Control Plus technology automatically adjusts and compensates the phase lag (group delay) included in the sound source, from 0 to 16 msec in 1 msec increments. In addition to solving the phase lag (group delay) in audio devices such as AV receivers and speakers, the phase shift sometimes included in discs or broadcasts can also be adjusted, allowing precise control of every phase, from audio source to output. With the synergy effect of the original Phase Control compensation, all sounds are aligned, providing better balance for the overall reproduced sound, exceptionally powerful and dynamic bass, and clear high frequencies.

Effect of Auto Phase Control Plus (data comparison)

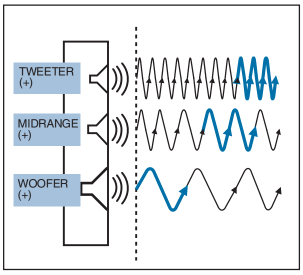


Superior sound provided by compensating the lag in the subwoofer channel on the disc.

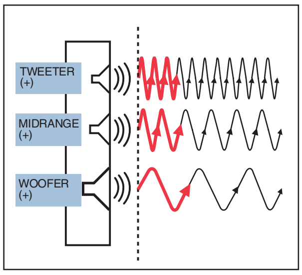
Full Band Phase Control

While Phase Control's bass management technology controls the LFE channel timing and phase within the AV receiver, the Full Band Phase Control's technology has further evolved to control the phase of all the units of the multi-way speaker system. With a normal multi-way speaker system, the audio signals are separated with the network filter inside the speaker and routed to each unit. However, group delay occurs between the units due to this processing through the network filter. Using a microphone, Full Band Phase Control automatically measures and analyzes the group delay that occurs across the whole frequency range, then compensates only the phase characteristics without affecting the frequency characteristics, by adjusting with a FIR filter. As a result, multi-way speakers sound coherent like full-range speakers, while retaining their advantage of the wide frequency range—a significant advancement in sound quality.

Full Band Phase Control Off



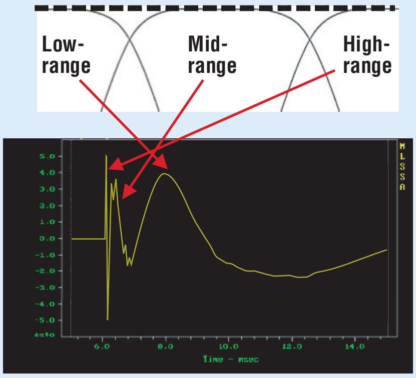
Full Band Phase Control On



Adjusts group delay for each unit

When the frequency range is separated via the network filter on a multi-way speaker, although the total frequency characteristic is designed to be flat, the phase and group delay characteristics are not flat. As shown on right, Full Band Phase Control solves this in three steps by using the MCACC microphone and DSP to measure, analyze, and make compensations.

Frequency Characteristic and Impulse Response of a General 3-Way Speaker



Because of group delay due to the network filter, the sound output order is: high-range, mid-range, low-range.

The phase and group delay adjustment of Full Band Phase Control is applied not only to each speaker unit—simultaneous analysis and compensation is also made between all connected speakers. So even on a setup consisting of speakers from various brands or series with completely different characteristics, you can enjoy a natural and seamless performance as if delivered all from the same speakers. With accurate sound reproduction for the full bandwidth in all channels, Full Band Phase Control creates the ideal sound field for multi-channel reproduction with unprecedentedly clear audio localization and a tremendous surrounding sound.

Three-Step Processing within the AV Receiver

Measurement Step 1

Special sweep signal output from each speaker

↓

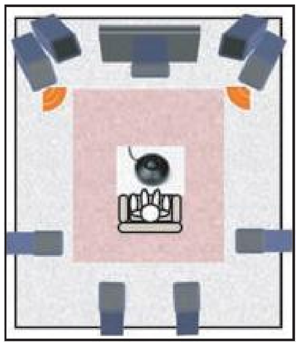
Signals measured with dedicated mic

↓

Digital Signal Processing (DSP) of measured signals

↓

Impulse response gained from each speaker



Measurement Step 2

Calculate phase characteristics from impulse response

↓

Extract the optimal model from the approx. 5,500 phase models
(99 % of the commercially available speakers)

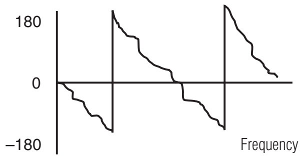
- Less influence from room environment
- Avoiding overcompensation allows adjustment without deteriorating sound quality

↓

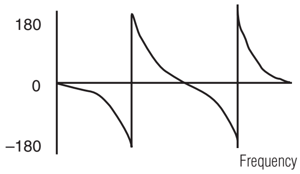
Calculate the inverse filter factor for adjusting the selected phase model

- Allows compensation for only the phase component by creating an all-pass FIR filter

<Measured Phase Characteristics>



<Estimated Phase Characteristics>



Measurement Step 3

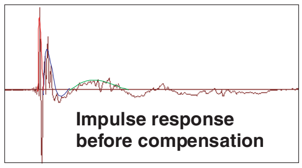
Apply FIR filter with the calculated filter factor to each channel

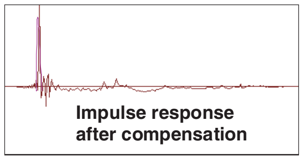
↓

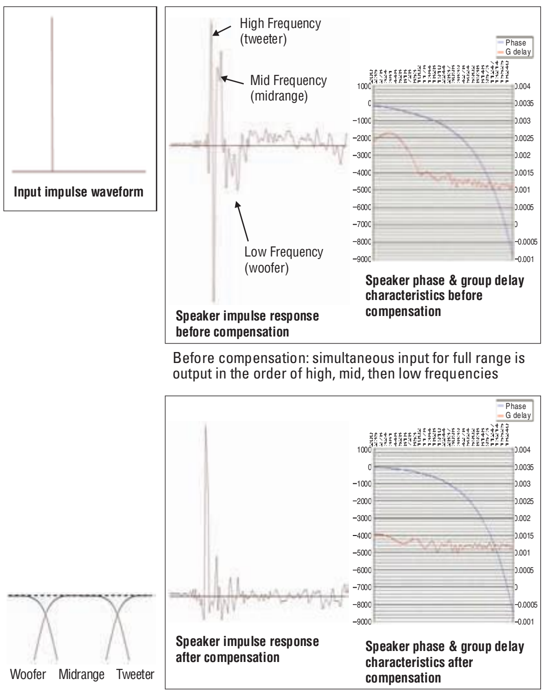
Phase and group delay for each speaker is adjusted to have the ideal characteristics of a full-range speaker

↓

Sound field with matched phase and group delay characteristics for all speakers achieved







Before compensation: simultaneous input for full range is output in the order of high, mid, then low frequencies

After compensation: simultaneous input for full range results in simultaneous output for all frequencies

Group Delay Compensation Effect