

SpeakerFinder™ Technology: ***Automated Home Theater Speaker*** ***Configuration and Setup***

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This paper describes the features and benefits of the SpeakerFinder technology included in the FS848 HD Wireless Audio Integrated Circuit (IC) designed for audio Home Theater applications.

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Overview

The FS848 Wireless Audio IC is a premium audio solution designed specifically for Home Theater audio systems. The FS848 was designed to solve Home Theater audio setup and distribution difficulties by delivering innovative features and capabilities in three key areas:

- **High Quality Audio:** Extracts the highest audio fidelity possible from the speaker drivers and cabinets through programmable filters and crossovers tuneable to each speaker's characteristics.
- **Ease of Setup:** Automatic Home Theater audio setup and single button audio sweet spot location programming.
- **Robust Wireless Network:** Provides a noise free, interference resistant wireless network between the master and up to eight speakers, with 2 ms latency.

This white paper focuses on the SpeakerFinder™ technology integrated into the FS848, which is one of several features enabled by Focus Enhancements that greatly simplify the setup process of a Home Theater system. Please refer to the complete set of white papers about the FS848 HD Wireless Audio IC solution.

Technical Challenge

Once a consumer brings home their newly purchased Home Theater audio system, they are faced with a daunting, time consuming challenge – properly connecting and configuring their speakers. Some consumers put off upgrading their audio to surround capability solely because of the complexity of routing wiring across three or more walls to six or more speakers. Others grossly under estimate the effort required to wire the speakers in an inconspicuous manner and then calibrate the system to optimal performance. For the average consumer, a surround system install can take most of a day to install it properly, or can add hundreds of dollars to have it installed professionally. When faced with the realities of a self-install, some customers resign to re-boxing the system and returning it to the retailer.

Wiring Challenge

Running wire to each of the speakers is the most time consuming and complicated of all the steps. Consumers typically run the wires under the carpet, or tack them to the baseboard as these methods are the only practical approach given their skills, time and patience. With either approach it is difficult to completely conceal the wires - particularly with higher powered speakers, which require a thicker speaker wire. When speaker wires are placed under the carpet, the consumer runs the risk of shorts or opens developing over time or as people repeatedly step on the (covered) cables. New homes with open floor plans and hard surfaced flooring further complicate this approach, as there might not be carpet to cover the wires, or walls to run the wires along. See Figure 1.



Figure 1: Modern Minimalist Décor Presents Wiring Challenges

Speaker Assignment and Polarity

Once the speaker's wire is run out to the speakers, the user must connect each wire (16 with a 7.1 system!) to the correct output on the Audio Video Receiver (AVR) or amplifier (see Figure 2). If the wires weren't properly labelled, it can be a challenge knowing which wire corresponds to which speaker channel. A common mistake is to swap polarity on one or more speakers. Incorrectly connecting speakers or reversing polarity, noticeably impacts audio performance, but unfortunately, not always so dramatically that the user can immediately identify and resolve the problem.



Figure 2: Typical AVR Back Panel

Sound Field Calibration

The final challenge faced by the consumer is adjusting the relative volume and phase delay from each speaker to calibrate an audio sweetspot. The volume and phase calibration is especially important for room layouts that prevent speaker placement in the recommended 5.1 or 7.1 arrangements speaker placement. Figure 1 shows an example where the room layout and windows greatly constrain speaker and TV location. More often than not, consumers are forced by architecture and furniture to arrange the TV surround system speakers in a manner that greatly deviates from manufacturer suggestions.

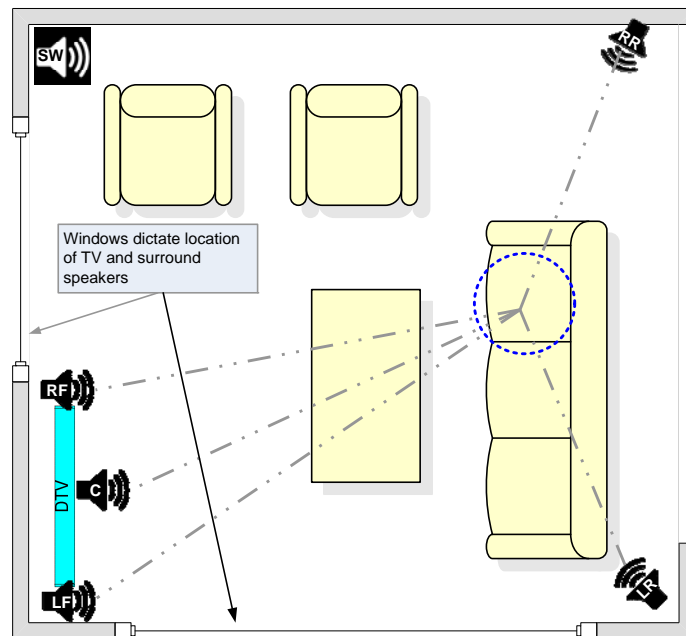


Figure 3; Audio Surround System Constrained by Room Layout

In Figure 3, the distance from the desired listening location to the left-front speaker is longer than the distance to the right-front speaker. This arrangement causes the right channel audio to arrive out of phase and louder than the left channel. In this example, it is especially important that the surround field be calibrated to the listening position, for acceptable audio performance.

With typical surround systems, volume calibration requires the use of a hand-held sound meter or microphone to measure the relative volume over frequency and then adjusting the volume level of speaker channel. Phase delay requires measuring the distance from the listening location to each of the speakers and then calculating the delay in milliseconds required for each channel. This is a complicated, time consuming process for a majority of consumers.

Moving Furniture

Once a room has been wired for and setup for a surround sound system, changing the room layout, or even moving a few pieces of furniture, can require rewiring one or possibly all the speakers.

FS848 Solution

The FS848 Wireless Audio IC is a premium audio solution designed specifically for Home Theater audio systems. One of the key challenges FS848 was designed to solve was the Home Theater installation and setup challenge faced by consumers.

All Wireless Home Theater audio solutions, including the FS848 and competitive solutions, address many of the wiring and installation challenges faced by consumers. With wireless speakers, consumers no longer have to struggle to hide speaker wires behind baseboards or underneath the carpet, they have the freedom to place the speakers wherever they want, not just the locations to which they can easily run wiring to.

SpeakerFinder Technology

Unlike the competing wireless audio solutions, Focus Enhancements has taken wireless technology one step further with SpeakerFinder technology. With the SpeakerFinder, the consumer only needs to place the speakers in the desired location, and SpeakerFinder does the rest.

Ultrasonic Transducer

SpeakerFinder uses 40 KHz ultrasonic transducers integrated in the speakers to automatically map the location of each SpeakerFinder-enabled speaker within the room. At power up (or with a host processor command), the master module requests each speaker to sequentially “chirp” its ultrasonic transducer in a round-robin fashion. When one speaker chirps, the others listen, determine exactly when they heard the chirp, and wirelessly report the information back to the master system. In turn, each of the remaining speakers chirp, and the master builds a cube of data that has the time-of-flight information between all of the speakers. Through mathematical algorithms, the FS848 calculates the angle and distance between all of the speakers to within ± 1 cm accuracy.



Figure 4: Ultrasonic Transducer

Automatic Speaker Discovery

Using speaker location coordinates; the master can automatically assign each speaker to the correct audio channel: Left, Right, Center, Subwoofer, Left Side, Right Side, Left Rear, and Right Rear at power up. Each of the speakers, with the exception of the Center and SubWoofer are identical, and can be placed in any location. This eliminates the possibility of not associating the correct speaker to the correct audio channel. Even if speaker locations are switched, the system automatically detects the change, and at the next power up, correctly reassigns the audio channels.

Other wireless solutions typically associate a particular speaker with a particular speaker location, requiring the consumer to correctly place each speaker in its assigned location.

Volume and Phase Delay Calibration

In addition to automatic channel assignment, these speaker coordinates can be used to adjust audio delay, volume and phase per channel to compensate for location and distance of the speakers relative to the listener and to each other. If desired, the audio delay (up to 30 ms delay) can be handled internally in each of the slave modules to program a sweetspot directly in between the two surround speakers as shown in Figure 3. Alternatively, the coordinates can be sent from the FS848 master to a Home Theater decoder DSP that can adjust the audio delay and phasing based on the precise speaker placement information provided by SpeakerFinder.

SpeakerFinder functionality takes less than a second to complete, and is automatically initiated each time the FS848 system is powered up. This has the added advantage that if the speakers are moved after the initial setup, speaker channels are automatically assigned based on the new speaker location and the volume and phase delay are automatically re-compensated.

Summary

The FS848 Wireless Audio IC is a premium audio solution designed specifically for Home Theater Audio systems to enable an auditory experience exceeding that of comparable wired systems, as well as set a new standard for “ease-of-use” in Home Theater audio.

SpeakerFinder is an innovative new technology that removes any obstacles or challenges consumers typically have setting up their Home Theater audio systems. With a wireless audio solution based on the FS848 and SpeakerFinder, install, setup and audio sweetspot optimization of a Home Theater Audio solution is reduced from an all day process down to as little as 30 minutes, dramatically improving the customer’s overall audio experience.

FS848 – “Superior Surround Made Simple”

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