



FreeSpace 360P Series II

Design Guide

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Overview

Introduction

This application note covers the basic concepts for the application of the FreeSpace 360P Series II loudspeaker in business music systems. The FreeSpace 360P Series II loudspeaker is ideally suited to background and foreground music in outdoor applications. The unique design of the FreeSpace 360P Series II delivers a full range response across a 360° area. The FreeSpace 360P Series II loudspeaker is compatible with 70V and 100V amplifiers, and is capable of delivering up to 90 dB-SPL in a typical application with a 15.0 ft (4.8m), speaker to listener distance.

Overview

All system designs begin with a set of requirements. The system requirements can be as simple as, “it has to sound great” or as detailed as, “it must play background-level music at 5 dB above the ambient noise level of the restaurant’s main dining room, which is 65 dB.” The challenge is to gather the right set of requirements, and then turn them into a set of criteria that you can use to create your design. It is important to remember that you are the designer and should use your own intuition and decision skills when planning a project in addition to calculations.

There are three key requirements that need to be identified to deliver the right system:

Loudness: What sound pressure level (SPL) is required for this application?

Response: What bandwidth is required for the type of program material that will be used?

Coverage: How consistent must the sound be across the entire coverage area?

Each of these requirements can be easily converted into a specification that we can use to create our system design. If we understand the customer’s needs in these four areas, we can deliver a design that will — at a minimum — meet their needs and — at best — exceed their expectations.

For the purposes of this design guide, we will assume that you are familiar with the system requirements for a commercial audio system and are ready to focus on loudspeaker selection, creation of a loudspeaker layout, and defining the necessary amplifier power needed to power the design.

Design Guidelines

When creating a design that uses the FreeSpace 360P Series II loudspeakers, you should consider the following:

The FreeSpace 360P Series II is designed for in-ground or above-ground installation.

Listeners should always be at least 1 m (3 ft) away from the nearest FreeSpace 360P Series II.

Maximum SPL for a typical application is between 85 and 90 dB-SPL.

Always add 25% headroom to your amplifier to accommodate various types of program material.

Design Worksheet

Use the following worksheet to create a design using FreeSpace 360P Series II loudspeakers.

Step 1: Room Layout

Using the graph paper on the last page, create a sketch layout of the room.

Step 2: Loudness

Maximum SPL Capability

Confirm that the FreeSpace 360P Series II loudspeaker will meet your loudness requirement. Find your listener distance and follow the column down to see the maximum continuous output level.

FreeSpace 360P Series II: Maximum Continuous Output Level									
Listener Distance	m	2.4	3	3.7	4.3	5	5.5	6	
	ft	8	10	12	14	16	18	20	
360P Series II		94	93	92	90	89	88	87	dB-SPL

Step 3: Response

Confirm that the FreeSpace 360P Series II loudspeaker will meet your response requirement. If the loudspeaker that meets your response and loudness requirement does not meet your mounting needs, select one that provides more bandwidth and also meets your mounting needs.

FreeSpace 360P Series II (full-range):

Frequency response (-10 dB): 60 Hz – 15 kHz

Step 4: Coverage

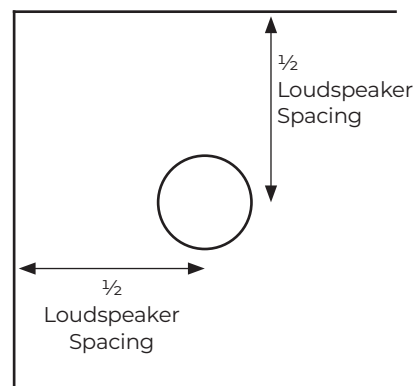
Determining Loudspeaker Quantity and Spacing

The goal is to fill a rectangle-shaped room with coverage circles at your desired density.

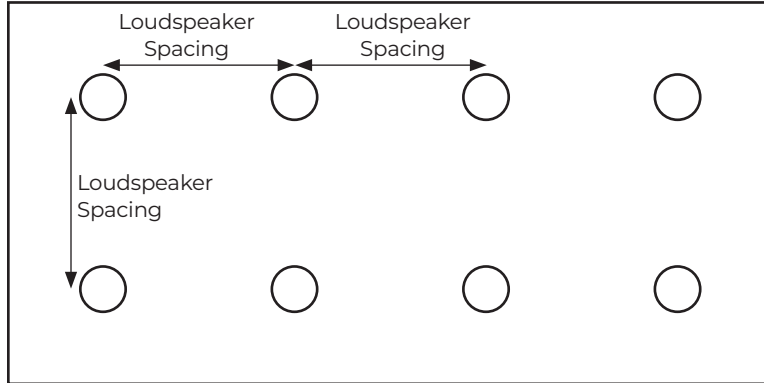
- A. Using your sketch of the room, create a loudspeaker layout using a **Loudspeaker Spacing Distance (LSD)** from the table below that meets your coverage requirement.

Coverage	Loudspeaker Spacing Distance (LSD)
Premium	10 ft (3 m)
Standard	20 ft (6 m)
Minimum	30 ft (9 m)

- B. Place the first loudspeaker at $\frac{1}{2}$ LSD from any corner of the room.



- C. The remaining loudspeakers are arranged on a square grid pattern using the LSD. If a loudspeaker would be placed on or beyond the perimeter of the room, delete that row/column of loudspeakers.



- D. After the last loudspeaker is placed, center the loudspeakers in that row to create new offset distances out from each wall, which may be unique from 1/2 LSD.

Step 5: Calculate Required Amplifier Size

Use the Tap Charts to determine which loudspeaker tap is required for this design

- Locate the loudspeaker tap chart and find the column for listener distance for this design.
- Follow the column to the desired maximum SPL.
- Follow the row across the chart to determine the required loudspeaker tap.
- Calculate the required amplifier power:

$$\frac{\text{Number of Loudspeakers Required}}{\text{Number of Loudspeakers Required}} \times \frac{\text{Required Loudspeaker Tap}}{\text{Required Loudspeaker Tap}} = \frac{\text{Power Required}}{\text{Power Required}}$$

- E. Calculate the required amplifier size:

$$\frac{\text{Power Required}}{\text{Power Required}} \times \frac{1.25}{\text{Headroom}} = \frac{\text{Amplifier Size}}{\text{Amplifier Size}}$$

SmartBass: Application of SmartBass processing

If your design is using a PowerSpace+ amplifier; or your design utilizes a dedicated Bose Professional DSP, such as the Commercial Sound Processor CSP models; or any of the ControlSpace ESP or EX models; you have the option of applying SmartBass to your loudspeaker output channel. This uses Bose Professional EQ presets, dynamic EQ, and excursion limiting tuned to each model and room calibration. This will prevent lower background-level music from sounding thin, but also ensures the sound is consistent at various SPL levels. At louder levels, SmartBass also allows for more musical limiting than traditional voltage limiters.

Tap Charts

Individual Loudspeaker Continuous Output Level

Note: Room reverberation could add as much as 4 dB system gain, which is not factored into the measurements. Designing without room gain will ensure you don't under-plan your design, and amp attenuation is possible at the job site if you exceed the average room SPL target during measurement. Values below 70 dB are omitted—select a higher tap.

360P Series II

360P Series II (standing listener height)						
Listener Distance		m	3	4.5	6	
		ft	10	15	20	
TAP	10 W	88	85	82	dB-SPL	
	20 W	91	88	85		
	40 W	94	91	88		
	80 W	97	94	91		

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Graph Paper

