



FreeSpace® DS 16F Loudspeaker



Product Specifications

Frequency Range	90 Hz – 16 kHz ± 3dB
Long Term Power Handling	16 watts continuous
Sensitivity	84 dB-SPL @ 1W/1m (pink noise)
Impedance	70 / 100V or 8 Ohm
Maximum Acoustic Output	96 dB-SPL @ 1m (pink noise) 102 dB-SPL peak @ 1m (pink noise)
Dispersion	140° Conical

Overview

This application note covers the basic concepts for the application of the FreeSpace DS 16F loudspeakers in business music systems.

The FreeSpace DS 16F loudspeaker is ideally suited to background music and paging applications with mounting heights between 8 and 20ft (2.4 to 6.1m). The system incorporates a single 2.25 inch full range driver in a ported enclosure which can be pendant mounted or installed flush in either a drop tile or solid ceiling. The FreeSpace DS 16F loudspeaker is compatible with 70V, 100V and low impedance amplifiers, and is capable of delivering up to 91 dB_{SPL} in a typical application with a 14ft (4.3m) mounting height.

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 have an output level of 100 dB_{SPL}.” In either case the challenge is to gather the right set of requirements, and then turn them into a set of design criteria that you can use to create your design.

The three key requirements that you need to identify in order to deliver the right business music sound system are:

LOUDNESS What sound pressure level 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 three 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 application note, we will assume that you are familiar with the system requirements for a business music system and are ready to focus on the creation of a speaker layout using the FreeSpace DS 16F loudspeaker. To learn more about the system requirements for business music systems, see the Bose FreeSpace systems design application note.

Design Guidelines

When creating a design that uses the FreeSpace DS 16F loudspeakers, you should consider the following:

- The FreeSpace DS 16F loudspeaker is ideally suited to background music and paging applications. If your customer’s requirement is for a foreground music system, consider the FreeSpace DS 100F loudspeakers.
- Recommended mounting height for the FreeSpace DS 16F is between 8 and 20ft (2.4 and 6.1m).
- Maximum SPL for a typical application is between 87 and 99 dB_{SPL}.
- Always add 25% headroom to your amplifier to accommodate various types of program material.

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Design Worksheet

Use the following worksheet to create a design using the FreeSpace DS 16F loudspeaker.

STEP 1 Using the graph paper on the last page, create a sketch or drawing of the room.

STEP 2 Confirm that the FreeSpace DS 16F loudspeaker will meet your loudness requirement.

- On the chart below, locate the loudspeaker mounting height for this design.
- Draw a line down to the desired maximum SPL.
- Draw a horizontal line across the chart at your desired SPL level.
- All of the loudspeakers listed below the line will meet your loudness requirement.

		Maximum Continuous Output Level												
Loudspeaker Mounting Height	m	2.4	3.0	3.6	4.2	4.8	5.5	6.1	6.7	7.3	8.0	10.0		
	ft	8	10	12	14	16	18	20	22	24	26	32		
LOUDSPEAKER	DS 16S / SE	90	89	89	88	87	86	85						
	360P-II	94	93	92	90	89	88	87						
	FreeSpace 3	96	95	95	94	93								
	Model 32SE	96	96	95	94	93	92	91	90					
	DS 100SE	98	97	97	96	95	94	93	92	92	91	89		
	FreeSpace 203	98	97	97	96	95								
	DS 16F	99	97	94	91	90	88	87						
	102F	105	100	98	95	94	92	91	90	89	88			
	DS 100F	107	103	102	99	98	96	95	94	93	92	89		
	Model 32	107	103	100	97	96	94	93	92	91	90			

STEP 3 Confirm that the FreeSpace DS 16F loudspeaker will meet your Response Requirement.

Vocal Range	Full Range	Extended Range
DS 16S & SE	203	FreeSpace 3
DS 16F	360P-II	
Model 32	DS 100SE	Any vocal range loudspeaker combined with a FreeSpace 3 bass module.
Model 32SE	DS 100F	
102F		

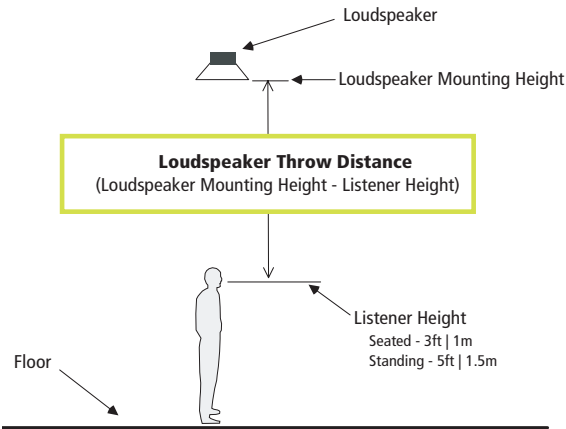
NOTE: If the loudspeaker that meets your response and loudness requirement does not meet your mounting needs, select one that provides more bandwidth, and also meets your mounting needs.

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STEP 4 Using your sketch of the room, follow the steps below to create a layout with the Loudspeaker Spacing that meets your Coverage Requirement.

A. Calculate the Loudspeaker Throw.



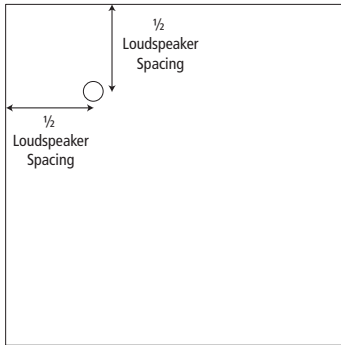
B. Calculate the Loudspeaker Spacing distance by multiplying the Loudspeaker Throw Distance by the desired Coverage Multiplier.

Coverage	Multiplier
Premium	2.0
Standard	2.5
Minimum	3.0

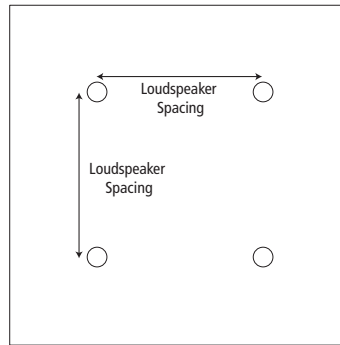
Loudspeaker Throw Distance x Coverage Multiplier = Loudspeaker Spacing

$$\frac{\text{Loudspeaker Throw Distance}}{\text{(Loudspeaker Throw Distance)}} \times \frac{\text{Coverage Multiplier}}{\text{(Coverage Multiplier)}} = \frac{\text{Loudspeaker Spacing}}{\text{(Loudspeaker Spacing)}}$$

C. Place the first loudspeaker at ½ the Loudspeaker Spacing distance from any corner of the room.



D. Remaining loudspeakers are arranged on a square grid pattern using the Loudspeaker Spacing distance.



STEP 5 Calculate the required amplifier size.

Use the Tap Chart at right to determine which loudspeaker tap is required for this design.

- Locate the loudspeaker mounting height for this design.
- Draw a line down to the desired maximum SPL.
- Draw a horizontal line across the chart to read the required loudspeaker tap.
- Calculate the required amplifier power:

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

Mount Height	m	2.4	3.0	3.6	4.2	4.8	5.5	6.1	dB _{SPL}
		ft	8	10	12	14	16	18	
TAP	1	87	84	82	79	78	76	75	
	2	90	87	85	82	81	79	78	
	4	93	90	88	85	84	82	81	
	8	96	94	91	88	87	85	84	
	16	99	97	94	91	90	88	87	

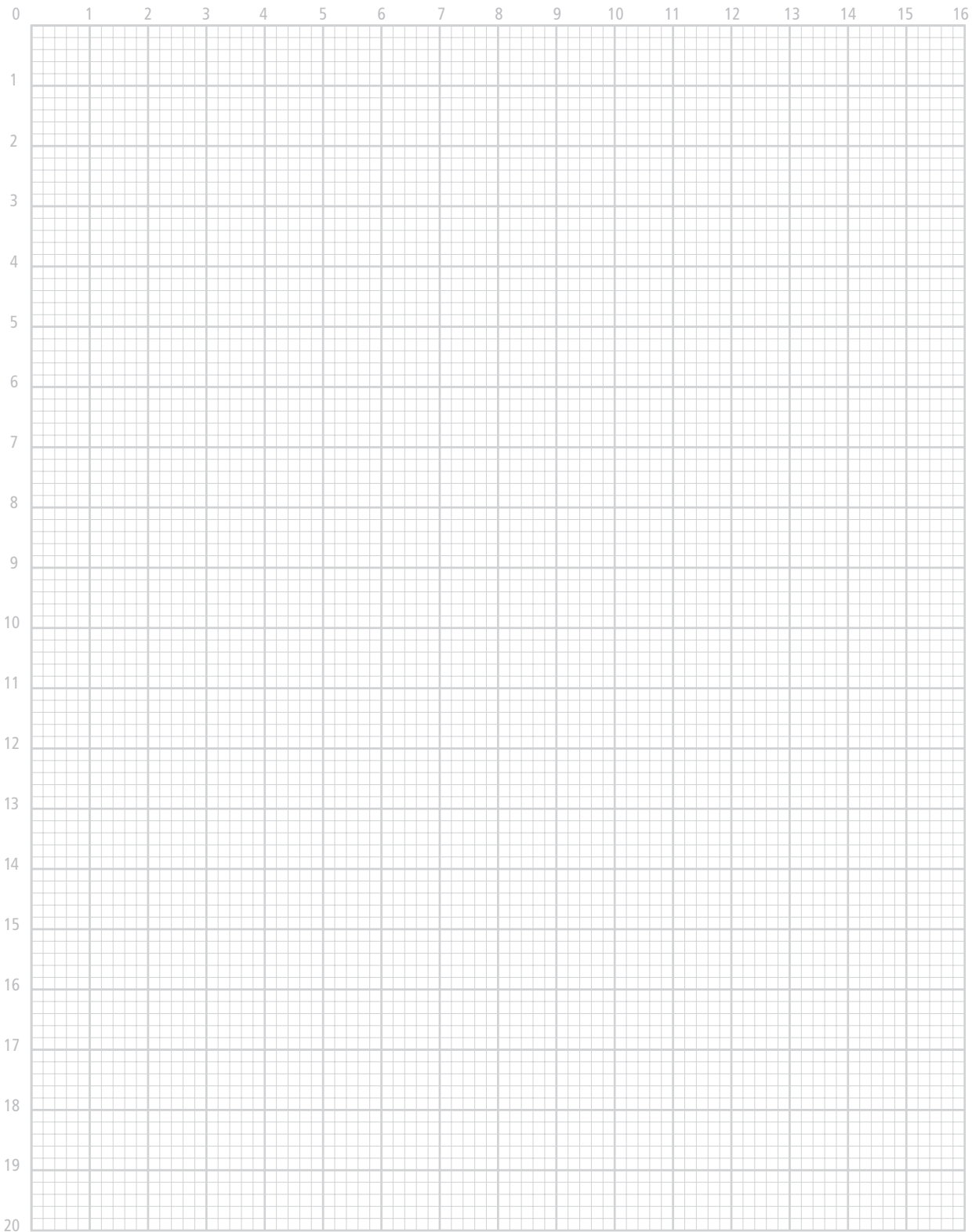
Note: 1 Watt tap is not available for 100V operation.

E. Calculate the required amplifier size:

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

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DESIGN GUIDE



Project Name: _____

Contact: _____ Date: _____



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