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EdgeMax™ EM90 and EM180

In-Ceiling Loudspeakers

Application Guide

Contents

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About

This design guide covers topics related to EdgeMax™ loudspeakers, and their use in specific applications. Designed for in-ceiling mounting near wall-ceiling boundaries, EdgeMax loudspeakers provide improved audio quality and coverage, while reducing the number of required units, compared to conventional dome-tweeter ceiling speakers. EdgeMax loudspeakers feature proprietary Bose® PhaseGuide® technology that combines the room-filling coverage patterns typical of larger surface-mount speakers with the architect-preferred aesthetics of in-ceiling models.

EdgeMax Loudspeaker Overview

Comparison of In-Ceiling and Surface Mounted Loudspeaker Performance

Traditional in-ceiling loudspeaker designs are preferred in many cases as loudspeakers easily blend into the environment due to their mounting location and flush appearance. Because in-ceiling loudspeakers offer the best aesthetics they are the most common type of design for a variety of applications.

However, many in-ceiling loudspeakers utilize a single transducer and deliver a conical coverage pattern with a stated coverage angle, e.g. 120-degrees conical. This coverage angle, however, is not representative for the higher frequencies, which is narrower, resulting in a significant reduction in high frequency energy as you move off axis from the loudspeaker location.

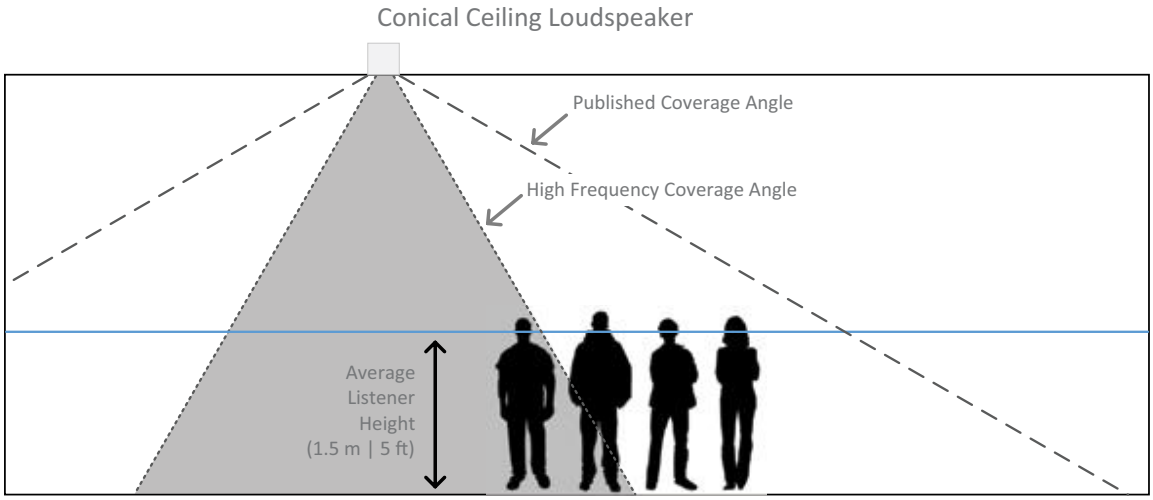


Figure 1. *Comparison between the published and typical high frequency coverage angles for an in-ceiling conical dispersion loudspeaker. Note that the shaded section represents the area where a balanced frequency response will be delivered.*

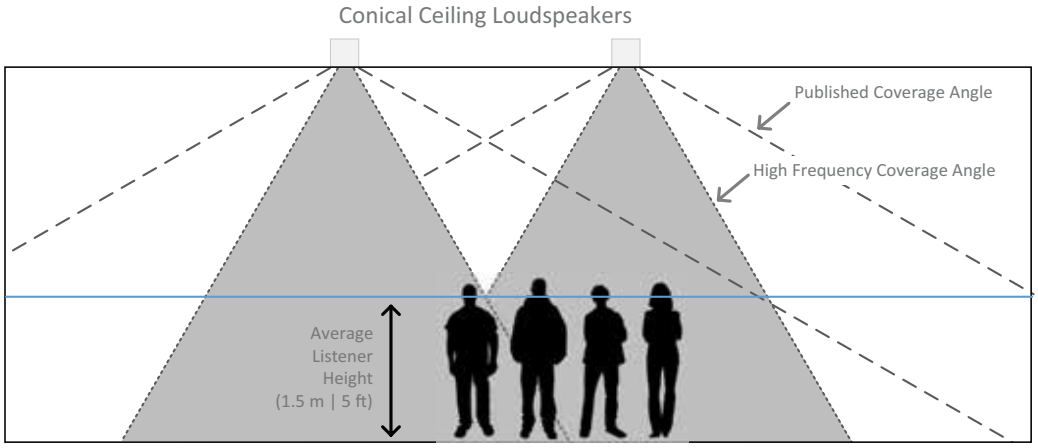


Figure 2. *To provide a consistent tonal balance across the coverage area in-ceiling loudspeakers must be closely spaced together.*

Surface-mounted loudspeakers do not offer the same aesthetic advantage, but are preferred when consistent tonal balance across the coverage area is the primary design objective. This is due to the physical nature of how surface-mounted loudspeakers project sound.

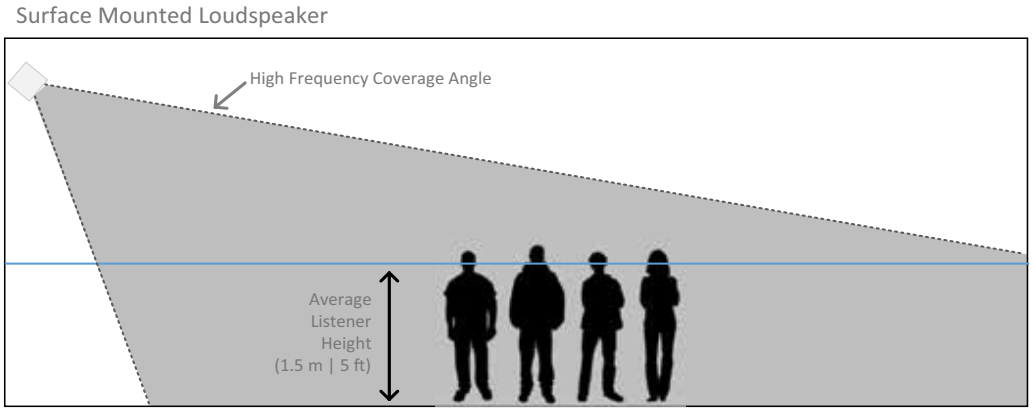


Figure 3. *Typical projection of a surface mounted loudspeaker vertical coverage into a room.*

Typically, the best performing types of surface-mounted loudspeakers are two-way products with a high-frequency section that delivers controlled coverage angles, and a ported enclosure for low-frequency reproduction. This arrangement results delivers more consistent high-frequency coverage and balanced frequency response to a larger area. In addition, surface mounted loudspeakers benefit from boundary loading, further improving the low frequency response of the system.

Despite these performance benefits, in-ceiling loudspeaker designs are still heavily preferred due to the aesthetic preference of architects and interior designers looking to minimize the appearance of loudspeakers.

EdgeMax Loudspeaker Performance

EdgeMax loudspeakers represent the best of both techniques in that they deliver the coverage of surface-mounted loudspeaker designs, but from a location in the ceiling. These unique products meet the visual requirements of architects and interior designers, while delivering the performance benefits of a high quality surface-mounted loudspeaker design.

EdgeMax loudspeakers utilize a two-way system comprised of a compression driver mounted to a proprietary Bose PhaseGuide structure, and an 8-inch driver mounted in a tuned, ported enclosure. Uniquely, EdgeMax loudspeakers have an 75-degree asymmetrical vertical coverage angle and are engineered to be installed in corners or along room perimeters.

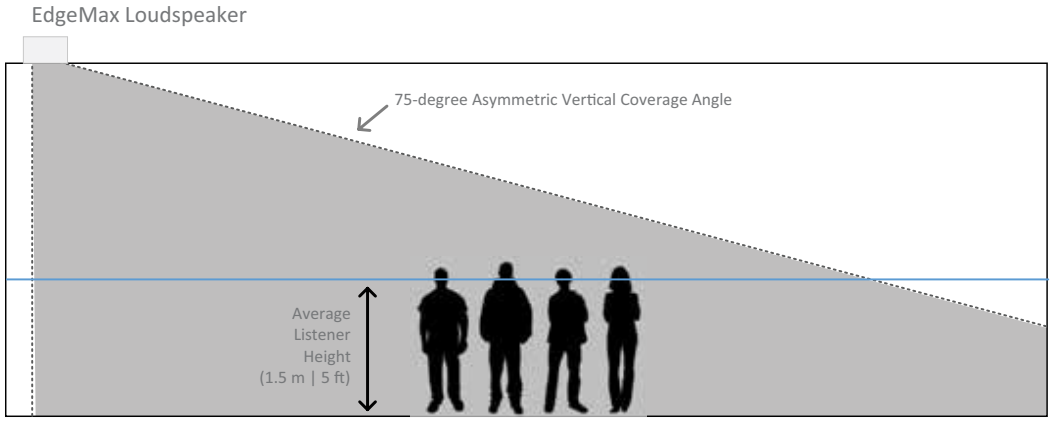


Figure 4. *The proprietary Bose PhaseGuide technology delivers controlled high frequency coverage like a surface-mount loudspeaker, from an in-ceiling location.*

Today, the EdgeMax family includes two horizontal coverage patterns. The EdgeMax EM90 offers 90-degree horizontal coverage and is intended for corner mounting, while the EM180 offers 180-degree horizontal coverage for mounting along the room perimeter.

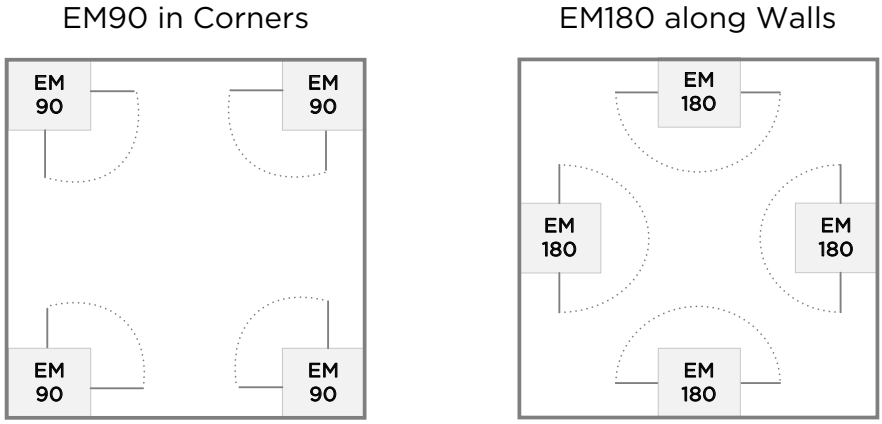


Figure 5. *EdgeMax EM90 and EM180 mounting locations.*

Since EdgeMax loudspeakers are specifically designed for mounting along corner and wall locations they benefit from boundary loading to deliver additional low frequency output as compared to traditional in-ceiling loudspeakers. Similar to surface-mount loudspeakers, the coverage pattern of EdgeMax will also allow stereo playback for some rooms, when the room dimensions allow sufficient overlap of coverage.

EdgeMax Design Considerations

Standard and Premium Coverage

The EdgeMax design guidelines offer two options for quality of coverage: Standard and Premium. When creating a design with Standard coverage, which should be suitable for most applications, EdgeMax loudspeakers are spaced such that the overlap between adjacent loudspeakers occurs at the -10 dB point. A design created with Premium coverage places the loudspeakers such that they overlap at the -6 dB point.

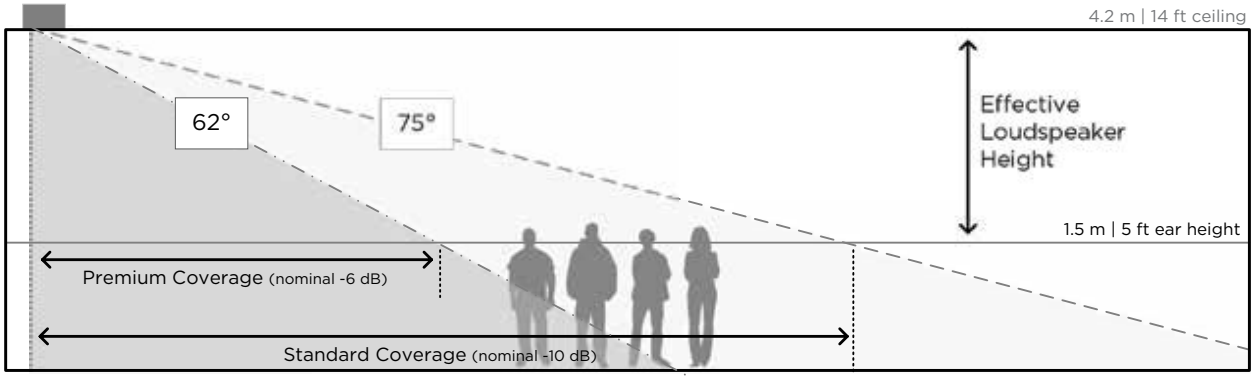


Figure 6. *Standard and Premium coverage comparison for EdgeMax loudspeakers.*

The quality of coverage for EdgeMax loudspeakers was derived using the vertical coverage angle, and confirmed using the Bose® Modeler® software.

Maximum Room Dimension

Like a surface-mounted loudspeaker, the mounting height of an EdgeMax loudspeaker will determine its usable throw distance. The usable throw distance is the distance from the loudspeaker that we can expect to receive balanced frequency response and adequate loudness for a given application.

Usable Throw Distance, EdgeMax EM90 and EM180								
Mounting Height		**m**	2.7	3.0	3.7	4.3	4.9	5.5	6.1
		ft	**9**	**10**	**12**	**14**	**16**	**18**	**20**
Coverage Quality	**Premium**	**m**	2	2	3	4	5	6	7
		ft	**7**	**8**	**11**	**15**	**18**	**21**	**24**
	Standard	**m**	3	4	6	8	9	11	13
		ft	**11**	**14**	**19**	**25**	**30**	**35**	**40**

Figure 7. *Usable Throw Distance based on coverage quality for various ceiling heights. Assumes 1.5 m (5') ear height.*

The following are two examples of how the Maximum Room Dimension is applied in an EdgeMax design. The first is when EdgeMax loudspeakers are used along one side of the coverage area. The second is when they are installed along both sides of the coverage area.

When placing EdgeMax loudspeakers along one side of the coverage area, the Maximum Room Dimension should be less than or equal to the Usable Throw Distance.

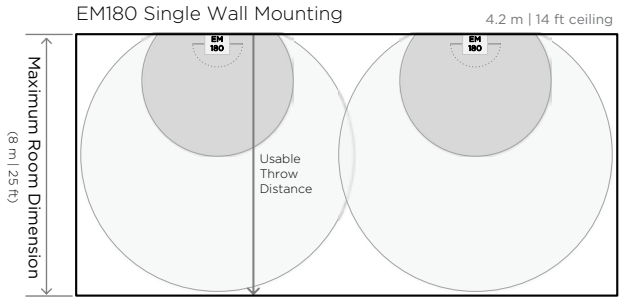


Figure 8. *The Maximum Room Dimension is less than or equal to the Usable Throw Distance when EdgeMax loudspeakers are placed along one edge of the area to be covered.*

In applications where EdgeMax loudspeakers will be mounted on two opposing sides of the room, the Maximum Room Dimension is twice the Usable Throw Distance for the planned ceiling height.

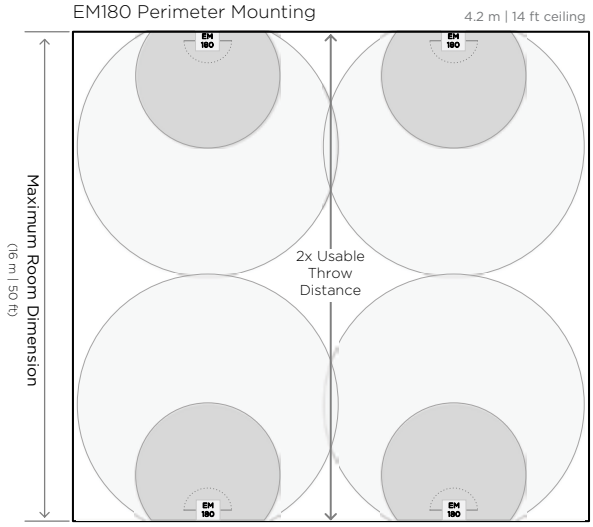


Figure 9. *The Maximum Room Dimension is equal to twice the Usable Throw Distance when EdgeMax loudspeakers are mounted on two opposing sides of the area to be covered.*

The Maximum Room Dimension is applied to EdgeMax designs to prevent the creation of a design which lacks sufficient coverage in the center of the room – particularly in the case of a square room where EM90 loudspeakers are used in the corners.

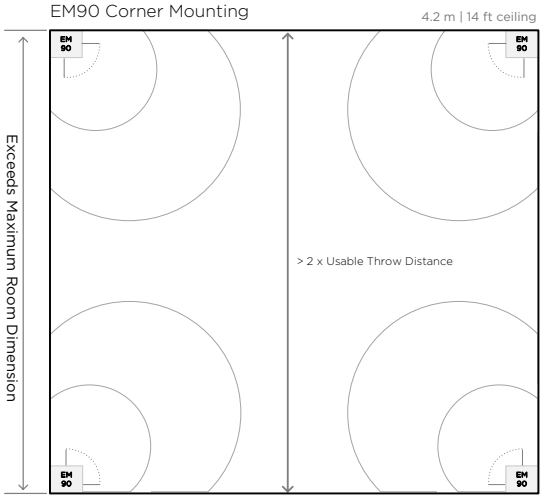


Figure 10. *In this example the Maximum Room Dimension has been exceeded, resulting in a coverage gap in the center of the room.*

EdgeMax Design Considerations

When working with rectangular-shaped coverage areas it is possible to exceed the Maximum Room Dimension in one dimension, either length or width, but not both. In this case the design is treated as any other surface-mounted system design by spacing the EdgeMax loudspeakers along the perimeter using a spacing constant based on the mounting height, and desired coverage quality.

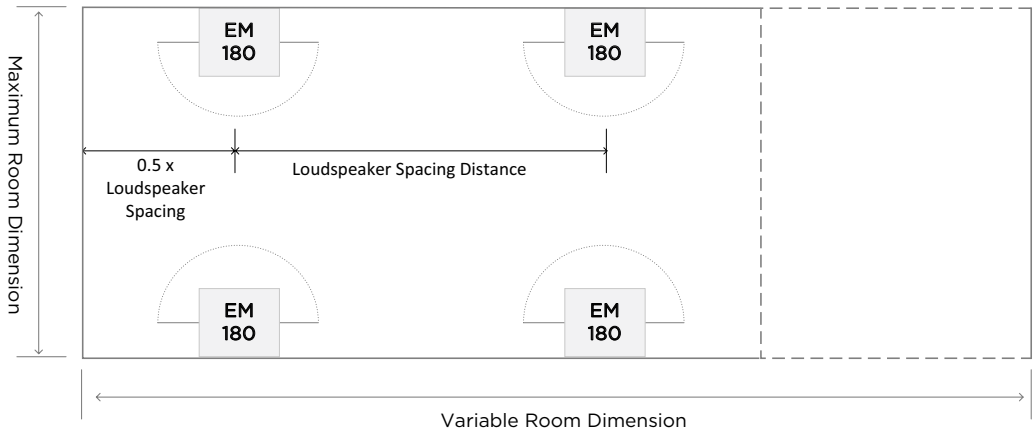


Figure 11. *The room size can exceed the Maximum Room Dimension in one dimension, length or width, to create a distributed design along the perimeter of the room.*

The spacing constant is the Loudspeaker Spacing Distance. This distance is based on the vertical coverage angle of the EdgeMax loudspeakers for both premium and standard coverage types, and is calculated based on the ceiling height where the loudspeakers will be installed.

Loudspeaker Spacing Distance, EdgeMax EM180								
Mounting Height	**m**	2.7	3.0	3.7	4.3	4.9	5.5	6.1
	ft	**9**	**10**	**12**	**14**	**16**	**18**	**20**
Coverage Quality — **Premium**	**m**	3	4	6	8	9	11	13
	ft	**11**	**15**	**20**	**25**	**30**	**35**	**40**
Coverage Quality — **Standard**	**m**	7	9	12	12	12	12	12
	ft	**20**	**30**	**40**	**40**	**40**	**40**	**40**

Figure 12. *Loudspeaker Spacing Distance table for various ceiling heights and coverage quality. Assumes 1.5 m (5') ear height.*

Balancing SPL In Mixed EM90 and EM180 Systems

EdgeMax loudspeakers are available in two horizontal coverage models, 90 and 180-degree (EM90 and EM180, respectfully). The difference in horizontal coverage results in a 3 dB sensitivity difference between the two devices, with the EM180 being 3 dB less sensitive than the EM90 model.

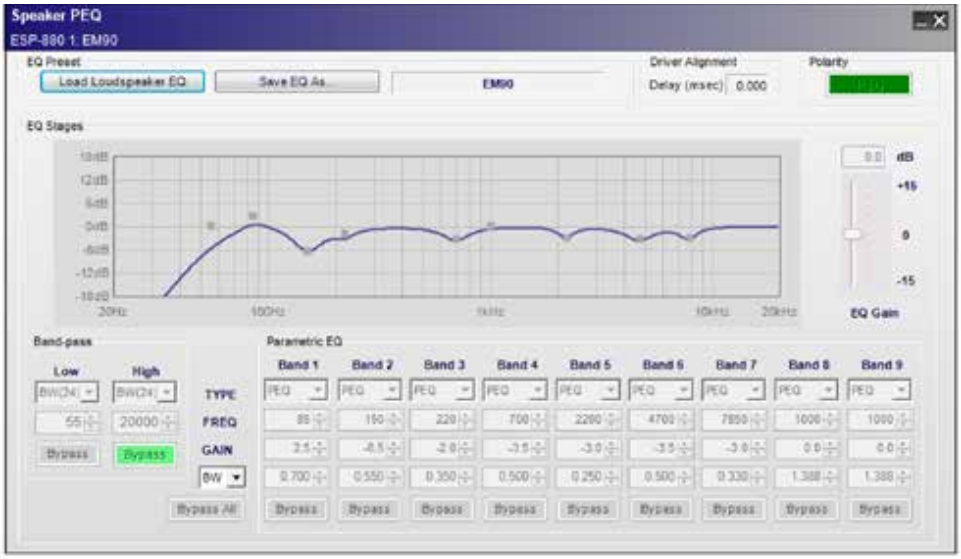
When designing a system that will mix both EdgeMax EM90 and EM180 loudspeakers, you will need to set the power level to the EM90 loudspeakers 3 dB less than the EM180 loudspeakers to achieve equivalent loudness. In 70/100V constant voltage applications, this can be easily achieved by setting your EM90 loudspeakers one tap setting lower then the EM180s in the same room.

EdgeMax Active Equalization

EdgeMax loudspeakers have an active equalization curve to deliver optimum performance when installed. Each EdgeMax loudspeaker model has a specific equalization curve that is available to apply via Bose ControlSpace® sound processors and PowerMatch® amplifiers using ControlSpace Designer™ software, or PowerShare amplifiers using PowerShare Editor software.

The following guidelines should be applied when choosing the correct equalization curve for your application:

EdgeMax EM90 loudspeaker EQ – Use when the system contains only EM90 loudspeakers, or when a mixed line EM180 and EM90 system will be installed.



EdgeMax EM180 loudspeaker EQ – Use when the system contains only EM180 loudspeakers.

Design Worksheet

EdgeMax EM180 & Mixed EM90/EM180 Systems

EM180	
	**Product Specifications** **Frequency Range:** 50 Hz – 18 kHz ± 3 dB **Long Term Power Handling:** 125 watts continuous **Sensitivity:** 93 dBSPL @ 1 W/1 m (pink noise) I**mpedance:** 70/100V or 8 Ω **Maximum Acoustic Output:** 114 dB-SPL @ 1 m (pink noise) **Dispersion:** 180° x 75° (H x V)

This design worksheet covers the basic steps for the creation of a system design comprised of EdgeMax EM180 in commercial audio/business music systems. EdgeMax EM180 loudspeakers are ideally suited for background/foreground music applications with mounting heights between 2.4 to 6.1 m (8 to 20').

EdgeMax loudspeakers utilize a two-way design comprised of a compression driver mounted in a proprietary PhaseGuide to deliver asymmetrical high frequency coverage, and an 8-inch driver mounted in a tuned, ported enclosure. EdgeMax loudspeakers are compatible with 70/100V and low-impedance amplifiers, and can deliver up to 98 dBSPL in a typical application with a 4.9 m (16') ceiling height.

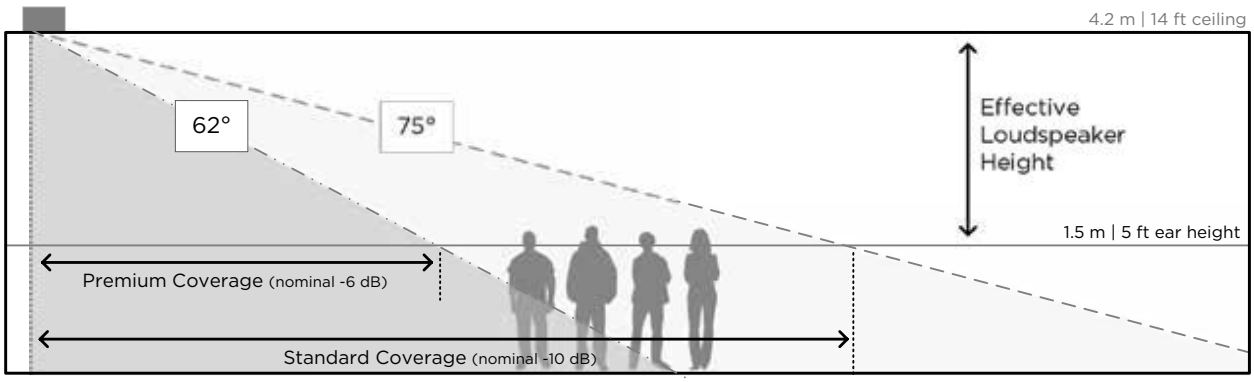
The design process described within this document uses three key requirements for the creation of the design, these are:

1. **Loudness:** What sound pressure level is required for this application?
2. **Coverage:** How consistent must the sound be across the entire coverage area?
3. **Response:** What bandwidth is required for the type of program material that will be used?

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 design guide, we will assume that you are familiar with the system requirements for typical business music systems and are ready to focus on the creation of a speaker layout using EdgeMax loudspeakers.

Design Guidelines

EdgeMax loudspeakers provide asymmetrical vertical coverage, and either 90 or 180-degree horizontal coverage. The design guidelines presented here offer two coverage quality options – Premium and Standard.



When creating a design that uses the EdgeMax loudspeakers you should consider the following:

- Recommended mounting height for EdgeMax loudspeakers is between 2.7 and 6.1 m (9 and 20')
- Maximum SPL for a typical application is between 95 and 110 dBSPL
- Always add 25% headroom to your amplifier to accommodate various types of program material.

Design Worksheet, EdgeMax EM180 & Mixed EM90/EM180 Systems

Design Worksheet

Use the following worksheet to create a design using EdgeMax loudspeakers.

Step 1: Confirm that the EdgeMax loudspeaker will meet your loudness requirement.

A. On the chart below, locate the loudspeaker mounting height for this design.

B. Draw a line down to the desired maximum SPL.

C. Draw a horizontal line across the chart at your desired SPL level.

D. Loudspeakers listed below the line will meet your loudness requirement.

Maximum Continuous Output Level											
Loudspeaker Mounting Height	**m**	**2.4**	**3.0**	**3.7**	**4.3**	**4.9**	**5.5**	**6.1**	**6.7**	**7.9**	**9.8**	
	ft	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**26**	**32**	
	DS 16F	99	96	93	91	89	88	87	86	84	82	dB_{SPL}
	DS 40F	106	103	100	98	96	95	94	93	91	89	
	DS 100F	108	107	104	102	100	99	98	97	95	93	
	EM90	111	109	106	104	102	100	99	98	96	95	
	EM180	108	106	103	101	99	97	96	95	93	92	

Step 2: Confirm that the EdgeMax loudspeaker will meet your response requirement.

Full Range	Extended Range
FreeSpace DS 16 FreeSpace DS 40 FreeSpace DS 100	EdgeMax EM90/EM180 FreeSpace 3 System

NOTE: *EdgeMax loudspeakers have a usable Frequency Response down to 50 Hz, so additional subwoofers may not be required. However, if designers find a need for additional bass, the MB210 compact subwoofer can be used.*

Step 3: Using the graph paper on the last page, create a sketch or drawing of the room.

Step 4: Using the chart below, determine the Usable Throw Distance for the loudspeaker mounting height that will be used with your design.

Usable Throw Distance, EdgeMax EM90 & EM180								
Mounting Height	**m**	2.7	3.0	3.7	4.3	4.9	5.5	6.1
	ft	**9**	**10**	**12**	**14**	**16**	**18**	**20**
Coverage Quality – **Premium**	**m**	2	2	3	4	5	6	7
	ft	**7**	**8**	**11**	**15**	**18**	**21**	**24**
Coverage Quality – **Standard**	**m**	3	4	6	8	9	11	13
	ft	**11**	**14**	**19**	**25**	**30**	**35**	**40**

1.) Locate the mounting height you will be using for the design.

2.) Determine the usable throw distance for the desired coverage requirement.

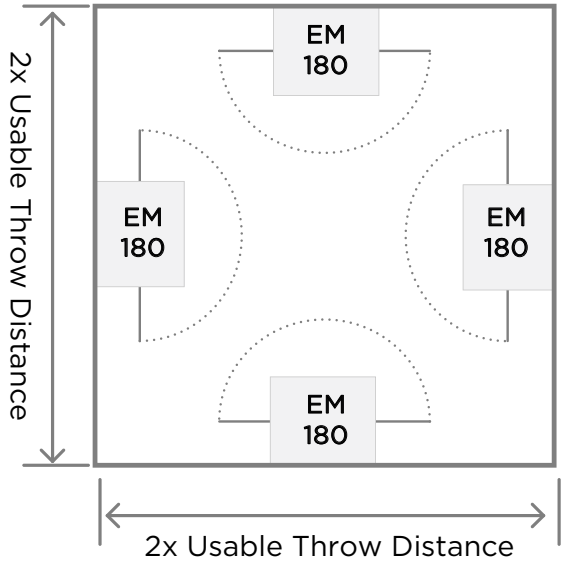
NOTE: For rectangular rooms, one dimension, (length or width), cannot exceed the maximum.

Step 5: Select the type of layout that will be used for your room's shape. Proceed to the design step noted.

Square Shaped Room / Coverage Area	Rectangular Shaped Room / Coverage Area
Proceed to Step 6	Proceed to Step 7

Step 6 (Square): Place the EdgeMax loudspeakers in corners or centered along walls. Proceed to step 8 when complete.

EM180 Square Room



Step 7 (Rectangle): Determine the Loudspeaker Spacing Distance for the mounting height and desired coverage quality.

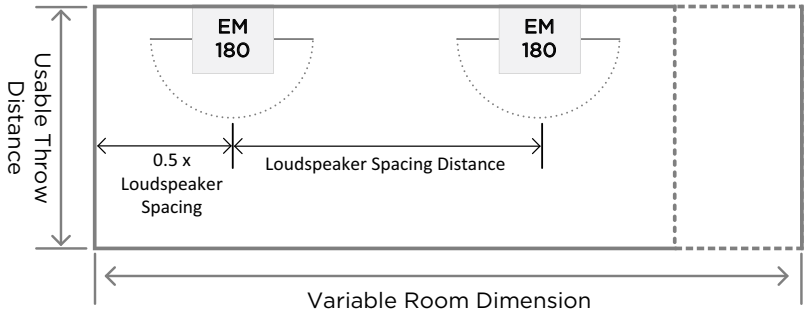
Loudspeaker Spacing Distance, EdgeMax EM180								
Mounting Height	**m**	2.7	3.0	3.7	4.3	4.9	5.5	6.1
	ft	**9**	**10**	**12**	**14**	**16**	**18**	**20**
Coverage Quality **Premium**	**m**	3	4	6	8	9	11	13
	ft	**11**	**15**	**20**	**25**	**30**	**35**	**40**
Standard	**m**	7	9	12	12	12	12	12
	ft	**20**	**30**	**40**	**40**	**40**	**40**	**40**

Design Worksheet, EdgeMax EM180 & Mixed EM90/EM180 Systems

Create a layout using one of the three layout options below.

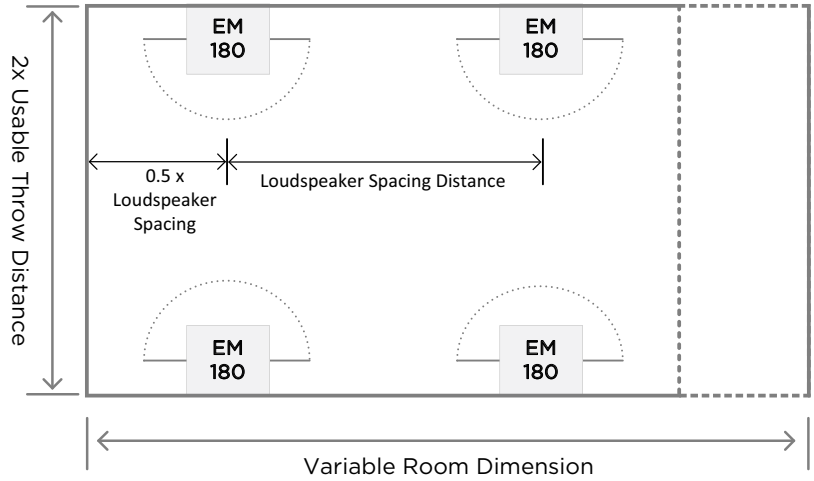
Single Edge Mounting – place the EdgeMax loudspeakers along a side wall using the spacing distance for the mounting height that will be used.

EM180 Single Edge Mounting



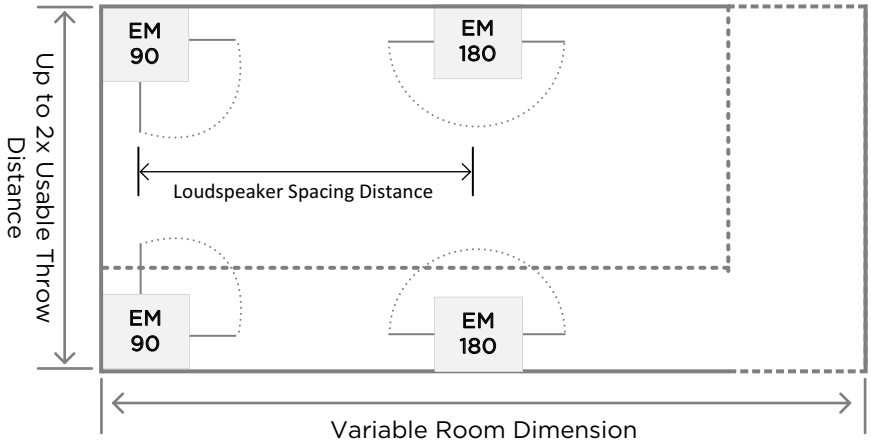
Perimeter Mounting – place the EdgeMax loudspeakers along side walls using the spacing distance for the mounting height that will be used.

EM180 Perimeter Mounting



Mixed (Recommended) – place the EdgeMax loudspeakers along side walls using the spacing distance for the mounting height that will be used. Follow the guidelines for Single Edge and Perimeter mountings.

EM90 & EM180 Mixed Mounting



Proceed to step 6.

Step 8 (Amplifier Size): Calculate the required amplifier size. Use the Tap Chart below to determine which loudspeaker tap is required for this design.

A. Locate the loudspeaker mounting height for this design.

B. Draw a line down to the desired maximum SPL.

C. Draw a horizontal line across the chart to read the required loudspeaker tap.

Continuous SPL Chart, EM180 & Mixed												
Mount Height	**m**	**2.7**	**3.0**	**3.7**	**4.3**	**4.9**	**5.5**	**6.1**	**6.7**	**7.9**	**9.1**	
	ft	**9**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**26**	**30**	
TAP	**2.5**	91	89	86	84	82	80	79	78	76		dB_{SPL}
	5	94	92	89	87	85	83	82	81	79	78	
	10	97	95	92	90	88	86	85	84	82	81	
	20	100	98	95	93	91	90	88	87	85	84	
	40	103	101	98	96	94	93	91	90	88	87	
	80	106	104	101	99	97	96	94	93	91	90	
	8 Ohm	108	106	103	101	99	97	96	95	93	92	

D. Calculate the required amplifier power:

_____	**x**	_____	**=**	_____
Number of Loudspeakers		Required Loudspeaker Tap		Power Required

E. Calculate the required amplifier size:

_____	**x**	1.25	**=**	_____
Power Required		Headroom		Amplifier Size

NOTE: When working with a mixed EM90 and EM180 system, the EM90 loudspeakers should be tapped 3 dB less than the EM180 loudspeakers to balance the overall SPL level.

Design Worksheet
EdgeMax EM90 Systems

EM90	
	**Product Specifications** **Frequency Range:** 50 Hz – 18 kHz ± 3 dB **Long Term Power Handling:** 125 watts continuous **Sensitivity:** 96 dBSPL @ 1 W/1 m (pink noise) **Impedance:** 70/100V or 8 Ω **Maximum Acoustic Output:** 117 dB-SPL @ 1 m (pink noise) **Dispersion:** 90° x 75° (H x V)

This design worksheet covers the basic steps for the creation of a system design comprised of EdgeMax EM90 in commercial audio/ business music systems. EdgeMax EM90 loudspeakers are ideally suited for background/foreground music applications with mounting heights between 2.4 to 6.1 m (8 and 20').

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Design Guidelines

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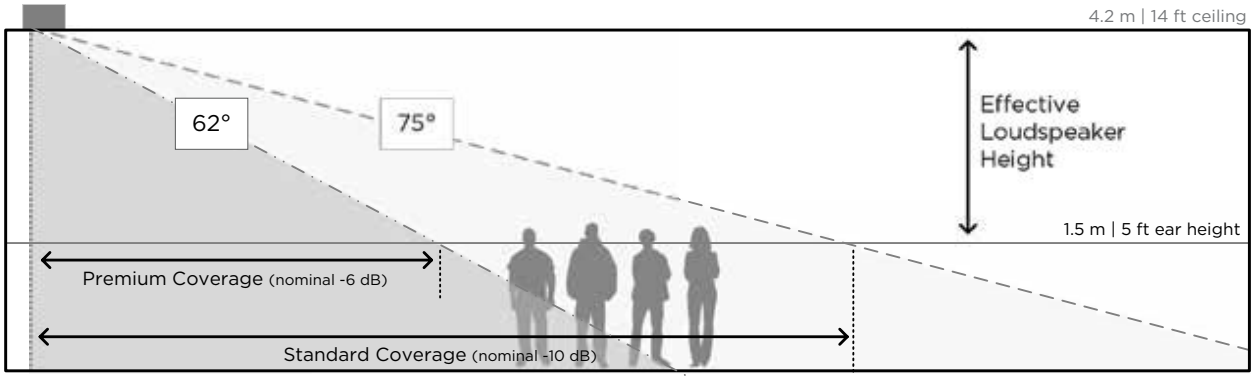


When creating a design that uses the EdgeMax loudspeakers you should consider the following:

- Recommended mounting height for EdgeMax loudspeakers is between 2.7 and 6.1 m (9 and 20')
- Maximum SPL for a typical application is between 95 and 110 dBSPL
- Always add 25% headroom to your amplifier to accommodate various types of program material.

Design Worksheet, EdgeMax EM90 Systems

Design Worksheet

Use the following worksheet to create a design using EdgeMax loudspeakers.

Step 1: Confirm that the EdgeMax loudspeaker will meet your loudness requirement.

A. On the chart below, locate the loudspeaker mounting height for this design.

B. Draw a line down to the desired maximum SPL.

C. Draw a horizontal line across the chart at your desired SPL level.

D. Loudspeakers listed below the line will meet your loudness requirement.

Maximum Continuous Output Level												
Loudspeaker Mounting Height	**m**	**2.4**	**3.0**	**3.7**	**4.3**	**4.9**	**5.5**	**6.1**	**6.7**	**7.9**	**9.8**	
	ft	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**26**	**32**	
	DS 16F	99	96	93	91	89	88	87	86	84	82	dB_{SPL}
	DS 40F	106	103	100	98	96	95	94	93	91	89	
	DS 100F	108	107	104	102	100	99	98	97	95	93	
	EM90	111	109	106	104	102	100	99	98	96	95	
	EM180	108	106	103	101	99	97	96	95	93	92	

Step 2: Confirm that the EdgeMax loudspeaker will meet your Response Requirement.

Full Range	Extended Range
FreeSpace DS 16 FreeSpace DS 40 FreeSpace DS 100	EdgeMax EM90/EM180 FreeSpace 3 System

NOTE: *EdgeMax loudspeakers have a usable Frequency Response down to 45 Hz, so additional subwoofers may not be required. However, if designers find a need for additional bass, the MB210 compact subwoofer can be used.*

Step 3: Using the graph paper on the last page, create a sketch or drawing of the room.

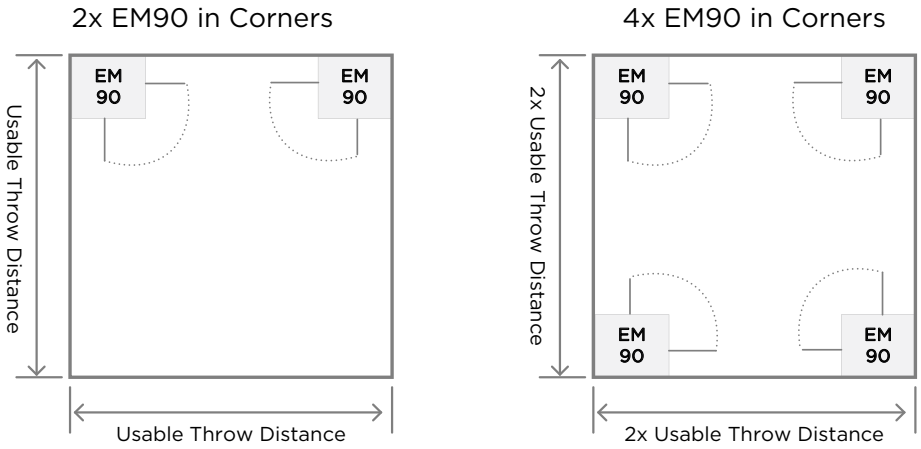
Step 4: Using the chart below, determine the Usable Throw Distance for the loudspeaker mounting height that will be used with your design.

Usable Throw Distance, EdgeMax EM90 and EM180								
Mounting Height	**m**	2.7	3.0	3.7	4.3	4.9	5.5	6.1
	ft	**9**	**10**	**12**	**14**	**16**	**18**	**20**
Coverage Quality **Premium**	**m**	2	2	3	4	5	6	7
	ft	**7**	**8**	**11**	**15**	**18**	**21**	**24**
Standard	**m**	3	4	6	8	9	11	13
	ft	**11**	**14**	**19**	**25**	**30**	**35**	**40**

1.) Locate the mounting height you will be using for the design.

2.) Determine the usable throw distance for the desired coverage requirement.

Step 5: Select the type of layout that will be used based on the Usable Throw Distance, and the dimensions of the room where the system will be installed.



NOTE: *For designs where bass is a primary consideration, square rooms with 4x EM90s will deliver more bass then 4x EM180s, due to the additional wall-boundary loading provided by the corner mounting.*

Step 6 (Amplifier Size): Calculate the required amplifier size. Use the Tap Chart below to determine which loudspeaker tap is required for this design.

A. Locate the loudspeaker mounting height for this design.

B. Draw a line down to the desired maximum SPL.

C. Draw a horizontal line across the chart to read the required loudspeaker tap.

Continuous SPL, EdgeMax EM90											
Mount Height	**m**	**2.7**	**3.0**	**3.7**	**4.3**	**4.9**	**5.5**	**6.1**	**6.7**	**7.9**	**9.1**	
	ft	**9**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**26**	**30**	
TAP	**2.5**	94	92	89	87	85	83	82	81	79	78	dB_{SPL}
	5	97	95	92	90	88	86	85	84	82	81	
	10	100	98	95	93	91	89	88	87	85	84	
	20	103	101	98	96	94	93	91	90	88	87	
	40	106	104	101	99	97	96	94	93	91	90	
	80	109	107	104	102	100	99	97	96	94	93	
	8 Ohm	111	109	106	104	102	100	99	98	96	95	

D. Calculate the required amplifier power:

_____	**x**	_____	**=**	_____
Number of Loudspeakers		Required Loudspeaker Tap		Power Required

E. Calculate the required amplifier size:

_____	**x**	1.25	**=**	_____
Power Required		Headroom		Amplifier Size

Sample EdgeMax Conference Room Applications

The unique coverage performance of EdgeMax loudspeakers makes them ideal solution in conference room applications, for both speech and music reproduction. Mounting an EM180 directly above a video screen provides excellent speech reproduction and localization for video conferencing applications, while the addition of EM180 loudspeakers along the side walls of larger rooms enhances both video and audio conferencing.

Small Conference Rooms

For smaller conference rooms with dimensions less than 3 x 4.5 m (10 x 15’), with a ceiling height of 2.7 – 3.7 m (9 - 12’), a single EM180 is sufficient above the main video screen location for both audio and video conferencing. If stereo playback of program material is desired two EM90s can be installed in the two corners to the left and right of the video screen location. Note that stereo playback can also be used in other applications, including background and foreground music, when room dimensions allow similar overlap.

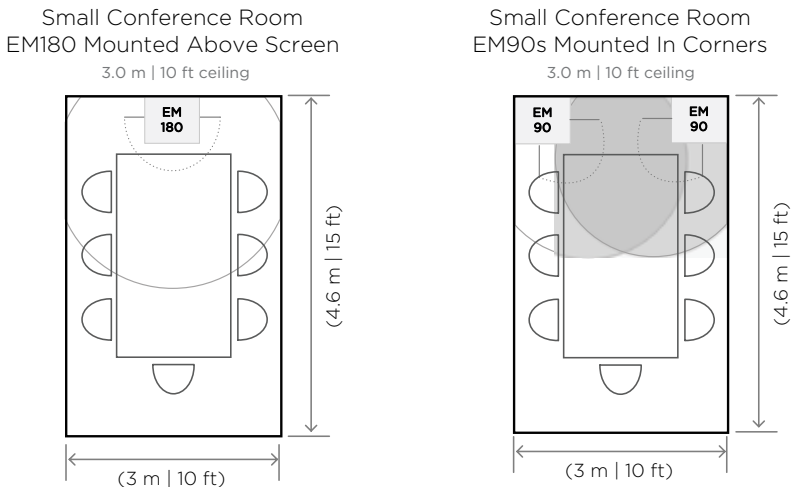


Figure 13. *In smaller conference rooms a single EM180 can be used above the screen location, or two EM90s in the corners can provide both speech and program material reinforcement.*

Medium Conference Rooms

For medium and large-sized conference rooms with dimensions greater than 3 x 4.5 m (10 x 15’), with a ceiling height of 2.7 – 3.7 m (9 - 12’), a single EM180 can be used above the main video screen location for both audio and video conferencing, and additional EM180s are placed behind the conferencing table using the recommended loudspeaker spacing dimensions for a room’s ceiling height.

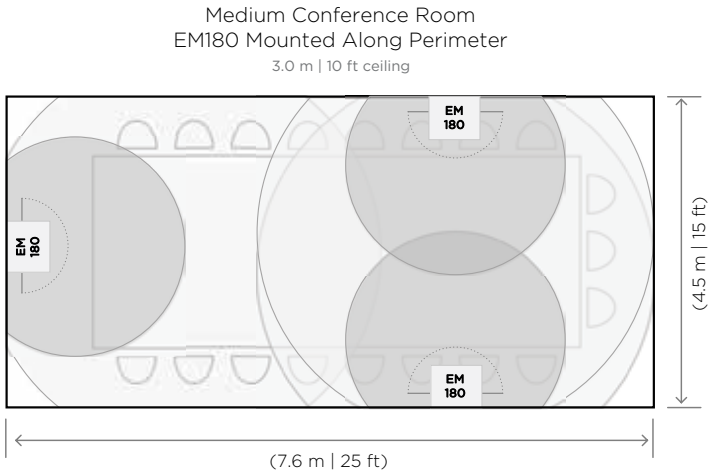


Figure 14. *In medium sized conference rooms a single EM180 is used above the screen location, and additional EM180s along the edges provide reinforcement for audio and video conferencing.*

In video conferencing applications where additional EdgeMax loudspeakers are utilized to cover the conference room, they should be reduced in level relative to the loudspeaker above the screen to provide adequate localization.

If stereo playback of program material is desired, two EM90s can be installed in the two corners to the left and right of the video screen location.

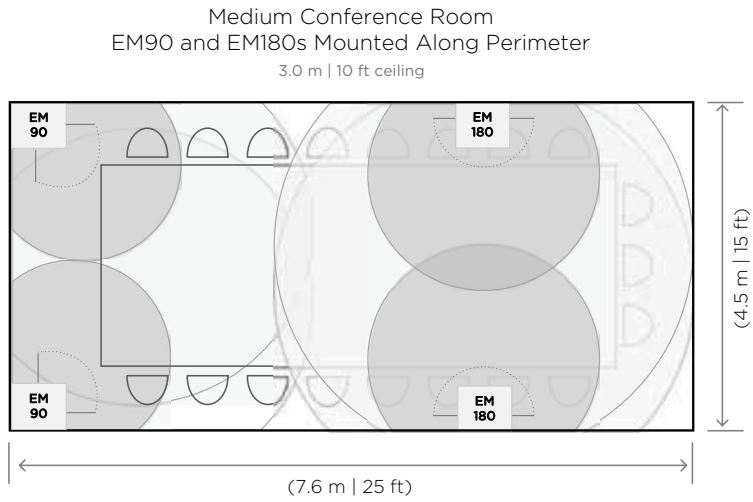


Figure 15. *In medium-sized conference rooms two EM90s can be mounted in the front of the room for stereo playback and conferencing, while additional EM180s can be installed along the side walls for conferencing reinforcement.*

Large Conference Rooms

For large (or divisible) conference rooms, similar guidelines are recommended. Place EdgeMax loudspeakers near the main video screen to provide adequate localization for video conferencing or playback, and other EdgeMax loudspeakers along the perimeter of the room using the spacing guidelines for the room's ceiling height and desired coverage quality.

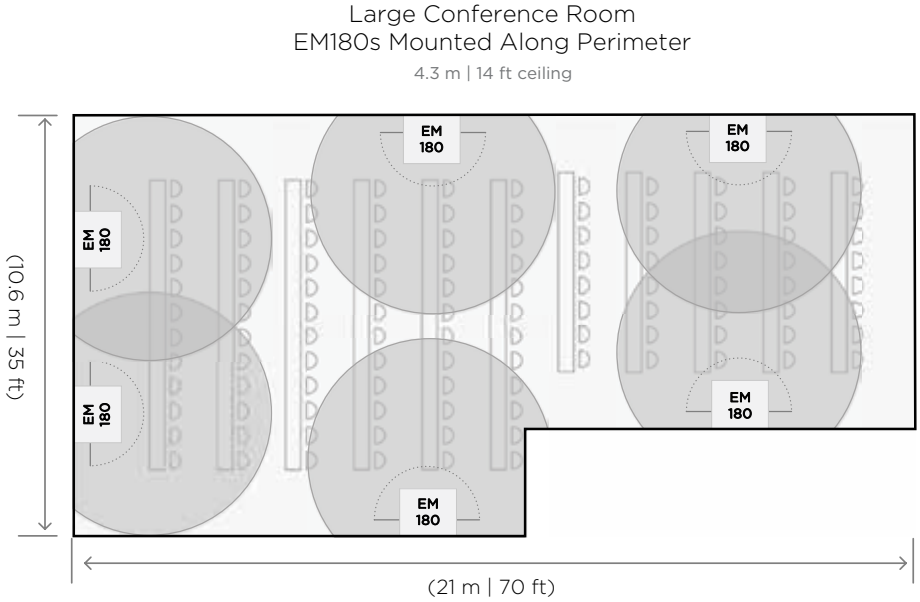


Figure 16. *A large conference room with two EM180s mounted near the video screen location, and additional units spaced along room sides using the recommended loudspeaker spacing for the room's ceiling height.*

BOSE
PROFESSIONAL

EdgeMax EM90 & EM180

In-ceiling Loudspeakers

Installation Guide

Please read and keep all safety and use instructions.

This product is intended for installation by professional installers only! This document is intended to provide professional installers with basic installation and safety guidelines for this product in typical fixed-installation systems. Please read this document and all safety warnings before attempting installation.

Do not attempt to service this product yourself. Refer all servicing to authorized service centers, installers, technicians, dealers or distributors. To contact Bose Professional or to find a dealer or distributor near you, visit **PRO.BOSE.COM**.

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Clean only with a dry cloth.
7. Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produces heat.
9. Only use attachments/accessories specified by the manufacturer.

WARNINGS/CAUTIONS

This product contains magnetic material. Consult your physician on whether this might affect your implantable medical device.

- All Bose products must be installed in accordance with local, state, federal and industry regulations. It is the installer's responsibility to ensure installation of the loudspeakers and mounting system is performed in accordance with all applicable codes, including local building codes and regulations. Consult the local authority having jurisdiction before installing this product.
- Unsafe mounting or overhead suspension of any heavy load can result in serious injury or death, and property damage. It is the installer's responsibility to evaluate the reliability of any mounting method used for their application. Only professional installers with the knowledge of proper hardware and safe mounting techniques should attempt to install any loudspeaker overhead.
- Do not mount the product in locations where condensation may occur.
- This product is not intended for installation or use in indoor water facility areas (including, without limitation, indoor pools, indoor water parks, hot tub rooms, saunas, steam rooms and indoor skating rinks).
- Do not mount on surfaces that are not sturdy, or that have hazards concealed behind them, such as electrical wiring or plumbing. If you are not sure about installing the bracket, contact a qualified professional installer. Ensure the bracket is installed according to local building codes.
- Use only the hardware and accessories included or specified by Bose for use with EdgeMax EM90 & EM180 loudspeakers. For information on compatible accessories, see the product's technical data sheet at **PRO.BOSE.COM**.
- Do not make unauthorized alterations to this product.
- Do not use hydrocarbon based solvents, lubricants or cleaning agents of any type on or around this loudspeaker and associated mounting hardware during installation. Exposure to such substances can lead to degradation of the plastic material, resulting in cracking and creating a falling hazard.
- Clean speakers using only a dry cloth. Do not expose loudspeaker to soap, detergent, mineral oil, alcohol or other cleaning agents or chemicals.
- The grille is equipped with a safety lanyard pin designed for a single use.

Product Ratings:

Input Voltage: 70V/100V

Impedance: 8 Ω, 125 W

Current or Power: (70V): 2.5W, 5W, 10W, 20W, 40W, 80W; (100V): 5W, 10W, 20W, 40W, 80W

Regulatory Information

This product conforms to all applicable EU directive requirements. The complete declaration of conformity can be found at: **www.Bose.com/compliance**.

This symbol means the product must not be discarded as household waste, and should be delivered to an appropriate collection facility for recycling. Proper disposal and recycling helps protect natural resources, human health and the environment. For more information on disposal and recycling of this product, contact your local municipality, disposal service, or the shop where you bought this product.

China Restriction of Hazardous Substances Table

Names and Contents of Toxic or Hazardous Substances or Elements						
	Toxic or Hazardous Substances and Elements					
Part Name	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent (CR(VI))	Polybrominated Biphenyl (PBB)	Polybrominated diphenylether (PBDE)
PCBs	X	O	O	O	O	O
Metal Parts	X	O	O	O	O	O
Plastic Parts	O	O	O	O	O	O
Speakers	X	O	O	O	O	O
Cables	X	O	O	O	O	O
This table is prepared in accordance with the provisions of S.J/T 11364. O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572. X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.						

Taiwan Restriction of Hazardous Substances Table

Equipment name: EdgeMax EM90 & EM180, Type designation: 778844, 777189						
	Restricted substances and its chemical symbols					
Unit	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr+6)	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
PCBs	-	○	○	○	○	○
Metal Parts	-	○	○	○	○	○
Plastic Parts	○	○	○	○	○	○
Speakers	-	○	○	○	○	○
Cables	-	○	○	○	○	○
Note 1: "○" indicates that the percentage content of the restricted substance does not exceed the percentage of reference value of presence. **Note 2:** The "–" indicates that the restricted substance corresponds to the exemption.						

Date of Manufacture: The eighth digit in the serial number indicates the year of manufacture; "7" is 2007 or 2017.

China Importer: Bose Electronics (Shanghai) Company Limited, Part C, Plant 9, No. 353 North Riying Road, China (Shanghai) Pilot Free Trade Zone

EU Importer: Bose Products B.V., Gorslaan 60, 1441 RG Purmerend, The Netherlands

Mexico Importer: Bose de México, S. de R.L. de C.V. , Paseo de las Palmas 405-204, Lomas de Chapultepec, 11000 México, D.F. For importer & service information: +5255 (5202) 3545

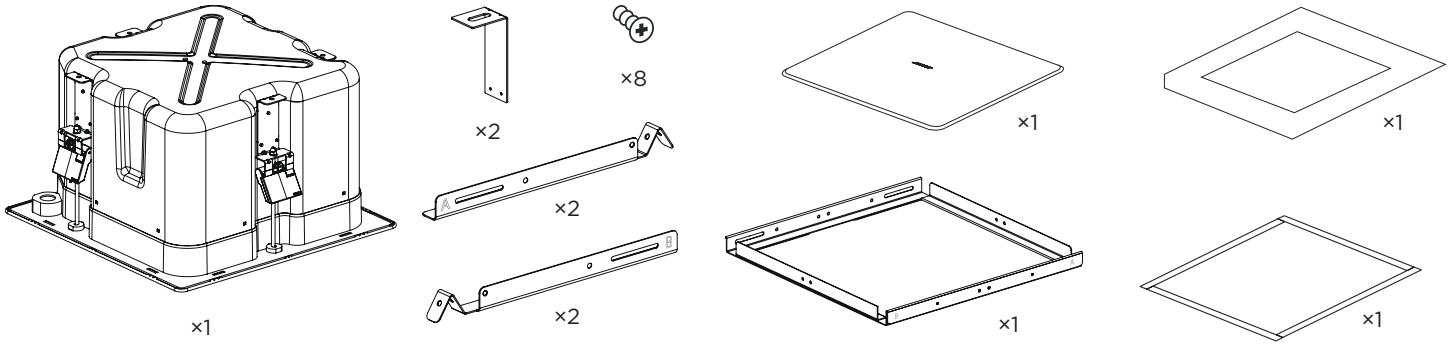
Taiwan Importer: Bose Taiwan Branch, 9F-A1, No. 10, Section 3, Minsheng East Road, Taipei City 104, Taiwan. Phone Number: +886-2-2514 7676

Bose Corporation Headquarters: 1-877-230-5639

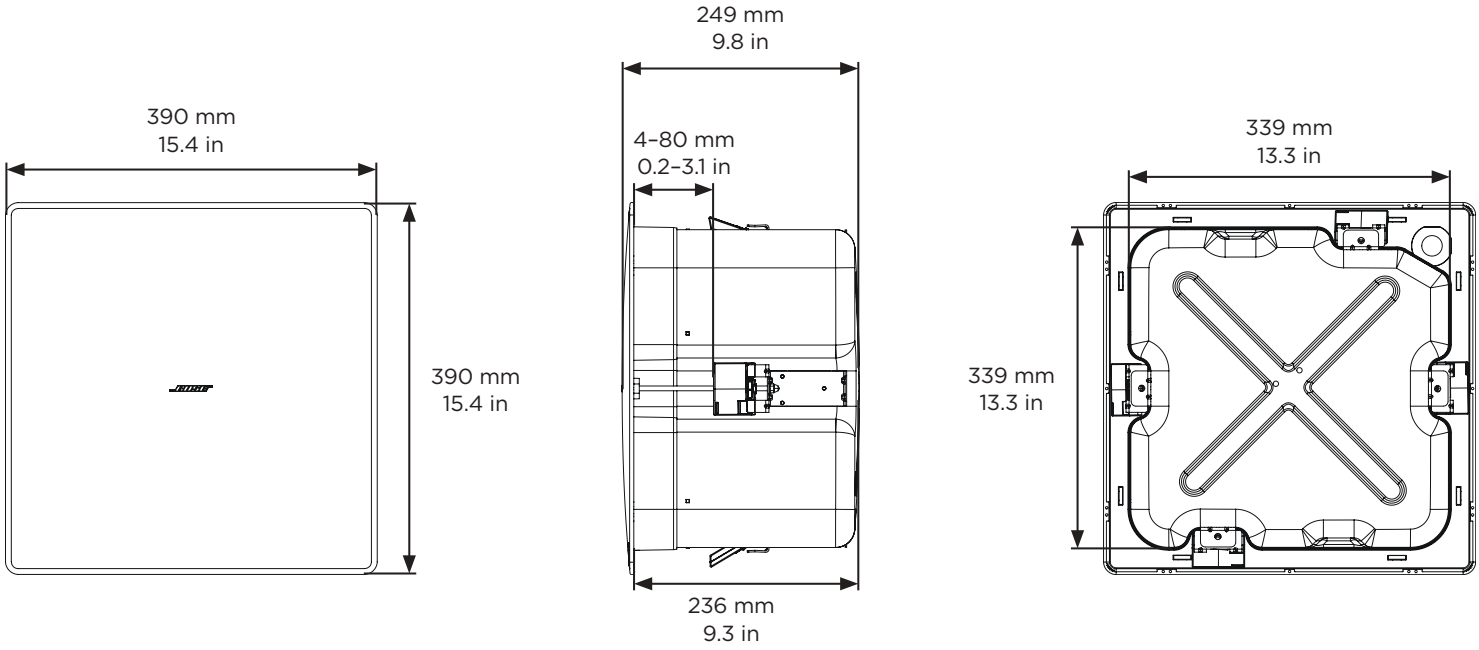
Warranty Information

This product is covered by a limited warranty.
For warranty details, visit **PRO.BOSE.COM**.

Package Contents



Product Dimensions



Technical Specifications

For additional specifications, see the EdgeMax EM90 & EM180 technical data sheet at **PRO.BOSE.COM**.

Physical	
Product Dimensions	Grille: 390 mm × 390 mm (15.4 in × 15.4 in)
	Enclosure: 339 mm × 339 mm (13.3 in × 13.3 in)
	Backcan depth: 236 mm (9.3 in)
Hole cutout	345 mm × 345 mm (13.6 in × 13.6 in)
Maximum Ceiling Thickness	80 mm (3.1 in)
Net Weight, Loudspeaker with grille	10.1 kg (22.2 lb)
Net Weight, Tile Bridge	1.4 kg (3.1 lb)
Shipping Weight	12.5 kg (27.6) lb)

Important Installation Information

It is the installer's responsibility to ensure installation of the loudspeakers and mounting system is performed in accordance with all applicable codes, including local building codes and regulations. Consult the local authority having jurisdiction before installing this product.

It is the responsibility of the installer to ensure the safety of the loudspeaker installation. Failure to properly install the loudspeaker could result in damage, injury, or death.

Do not mount the product in locations where condensation may occur.

This product is not intended for installation or use in indoor water facility areas (including, without limitation, indoor pools, indoor water parks, hot tub rooms, saunas, steam rooms and indoor skating rinks).

Do not mount on surfaces that are not sturdy, or that have hazards concealed behind them, such as electrical wiring or plumbing. If you are not sure about installing the bracket, contact a qualified professional installer. Ensure the bracket is installed according to local building codes.

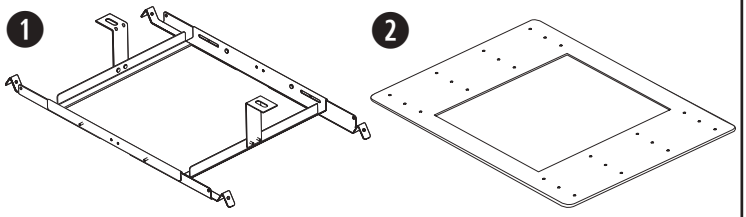
Do not use hydrocarbon based solvents, lubricants or cleaning agents of any type on or around this loudspeaker and associated mounting hardware during installation. Exposure to such substances can lead to degradation of the plastic material, resulting in cracking and creating a falling hazard.

Installation Options

Installation Options and Accessories

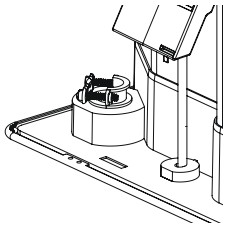
❶ Adjustable Tile Bridge (included)

❷ Rough-in Pan (optional)

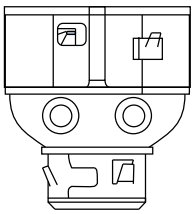


Conduit Fitting

If using a flexible metal conduit, use with a ⅜-inch conduit fitting or a ⅜-inch dual (duplex) connector.
Note: *Conduit fittings are not provided.*



⅜-inch single in



⅜-inch duplex in/loop

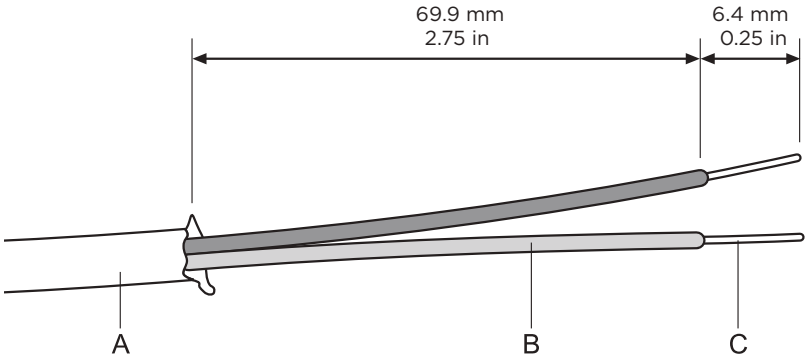
Wiring the Loudspeaker

With Use of Direct Input Terminals

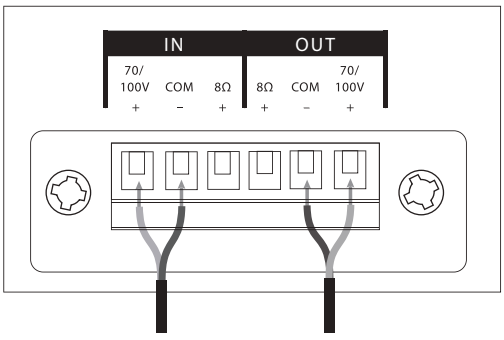
Wire gauge requirements from loudspeaker line wiring to loudspeaker terminals: Use 18 AWG (0.8 mm²) to 14 AWG (2.5 mm²) size wire only.

Preparing the Wire

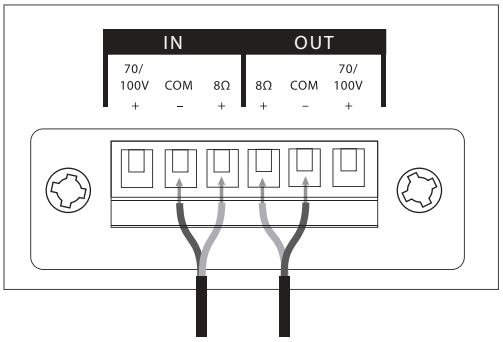
Trim back the outer jacket (A) and some of the wire insulation (B) to expose enough bare wire (C) to attach to the terminals.



Connection Diagrams

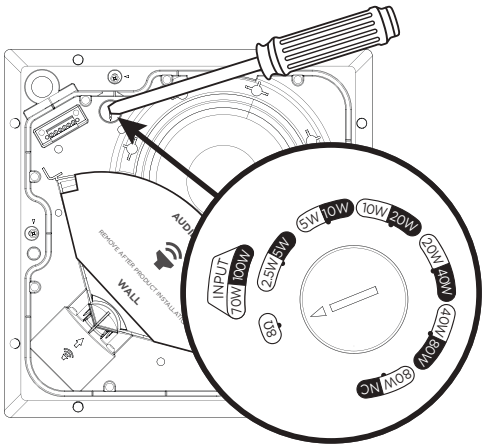


70V/100V



8Ω

Loudspeaker Settings



70V						
2.5W*	5W	10W	20W	40W	80W	8Ω
5W*	10W	20W	40W	80W	NC**	
100V						

* Factory default

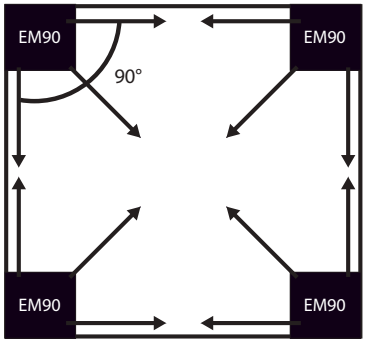
** NC: No Connection (do not use)

Transformer Tap Setting

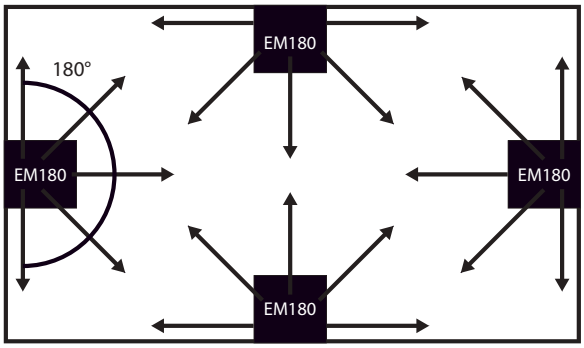
Set tap by turning. Use a flat head screwdriver.

Preparing the Installation

Install the EM90 in a corner. See below for the room placement top view.



Install the EM180 along a wall. See below for the room placement top view.



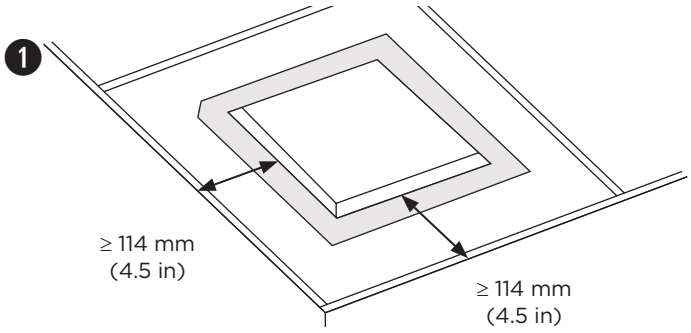
Note: *Keep the phase guide protector in place until installation is complete.*

Loudspeaker Placement

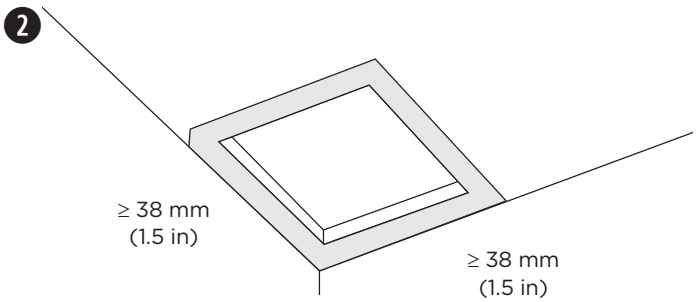
When installing the loudspeaker near a wall-ceiling interface, allow sufficient space for the grille overhang. The grille must be flush with the ceiling surface so the magnets can fully engage.

Use the enclosed template to ensure appropriate dimensions for the loudspeaker cutout and placement.

1. For EM90 or EM180 in ceiling tile: Place the loudspeaker opening at least 114 millimeters (4.5 inches) from each wall to allow space for the tile bridge.



2. For EM90 or EM180 in hard ceiling: Place the cardboard template flush with the corner (EM90) or wall (EM180). This leaves at least 38 millimeters (1.5 inches) from each wall to accommodate the grille.



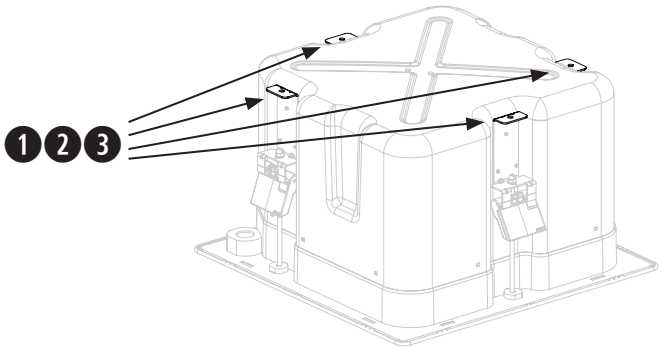
Note: *Installation in close proximity to cooking surfaces where the loudspeaker may be directly exposed to cooking oils, steam, vapor, or high heat such as in commercial cooking environments may decrease the performance or reliability of the loudspeaker.*

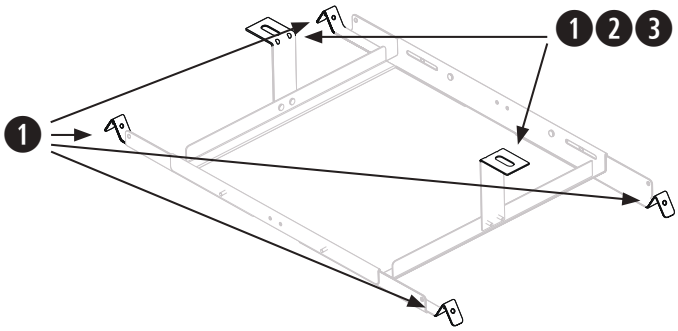
Using a Safety Cable

Some regional construction codes require the use of a secondary method of securing loudspeakers to support structures to provide additional safety. Choose a mounting position, method, and hardware consistent with local building codes and regulations.

Bose recommends using (1) a safety wire, (2) a safety cable, or (3) a threaded rod as a secondary securing mechanism. See the diagrams below for safety attachment points.

Follow the manufacturer's instructions for any secondary securing mechanism implemented.

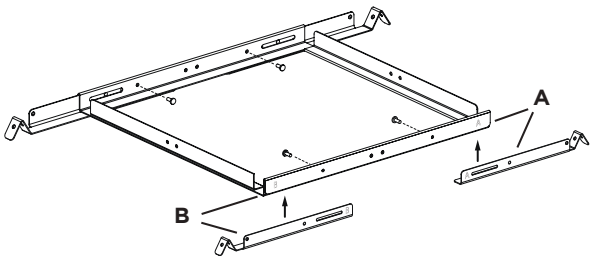




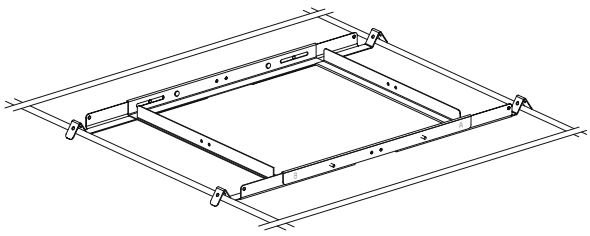
Assemble the Tile Bridge

1. Attach the four rails to the center frame using four of the included screws. Insert the screws from the inside of the tile bridge. The rails and center frame are labeled A and B to identify the correct attachment points.
2. Adjust the length of the tile bridge rails so the rails rest securely on the ceiling grid or furring.
   Note: *The tile bridge supports 56 to 66 centimeters (22 to 26 inches) spacing.*
3. Tighten the four screws securing the tile bridge rails to the center frame.
4. Optional: Attach the L-brackets to the tile bridge to create an additional connection point for a safety wire, safety cable, or threaded rod. For more information, see **Using a Safety Cable** on page 5.
   Note: *Place the L-brackets in a position that does not prevent the anchors on the loudspeaker from fully engaging on the tile bridge.*

1



2



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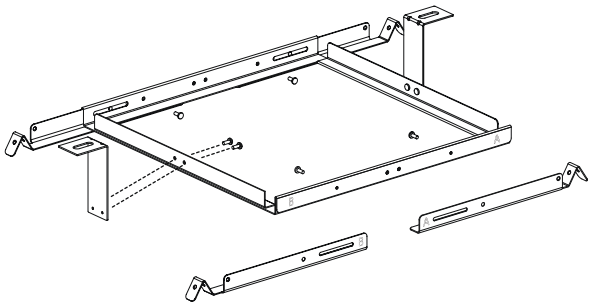

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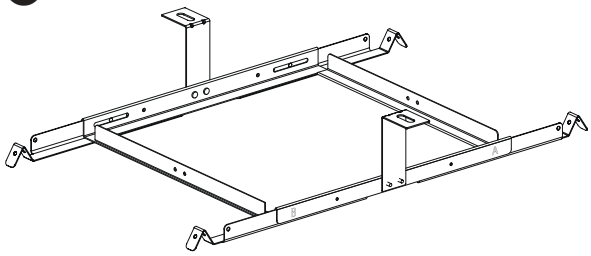
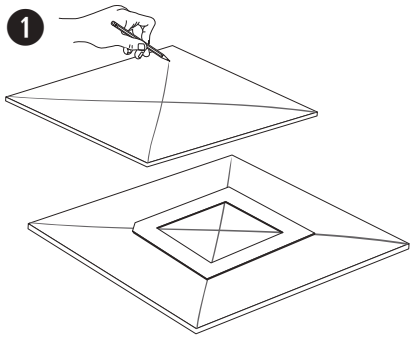


Preparing Acoustic Ceiling Tile

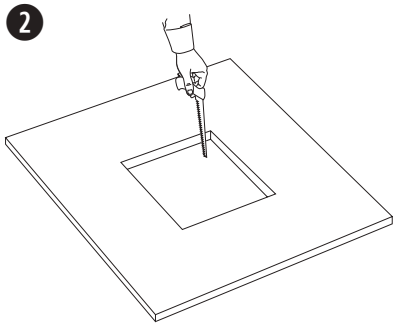
Cutting the Ceiling Tile

1. Remove the tile and use the template to trace a loudspeaker hole onto the tile. To center the template on the tile, draw an X by connecting the corners diagonally and center the template using the crossing point.
2. Cut a hole into the tile.

1



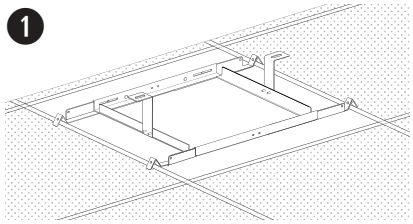
2



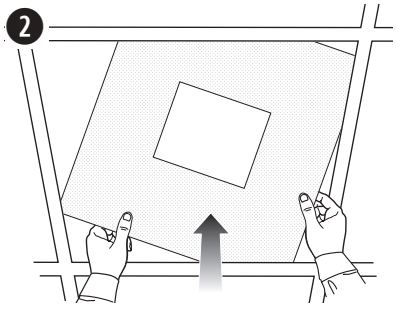
Installing the Tile Bridge

1. Place the assembled tile bridge across the ceiling grid. If necessary, adjust the tile bridge so the rails rest on the ceiling grid.
2. Replace the tile in the ceiling.

1



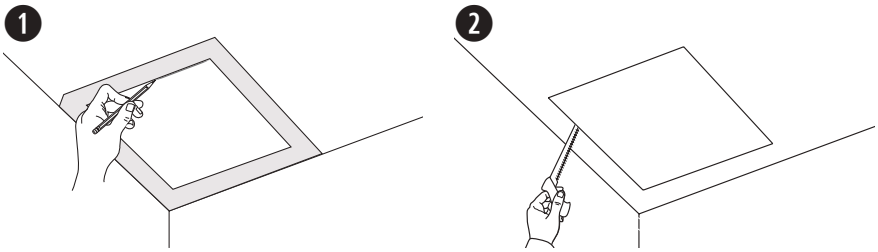
2



Preparing Hard Ceiling (Existing Construction)

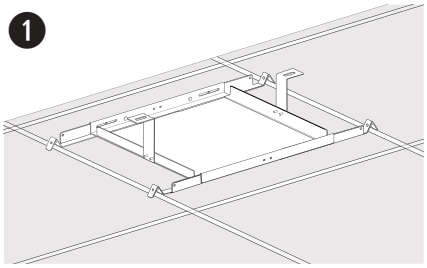
Cutting the Ceiling

1. Use the template to trace a hole onto the ceiling.
2. Cut a hole into the ceiling.



Installing the Tile Bridge

1. Insert the assembled tile bridge through the hole and place the tile bridge across the ceiling grid or ceiling furring. If necessary, adjust the tile bridge so the rails rest on the ceiling grid or ceiling furring.

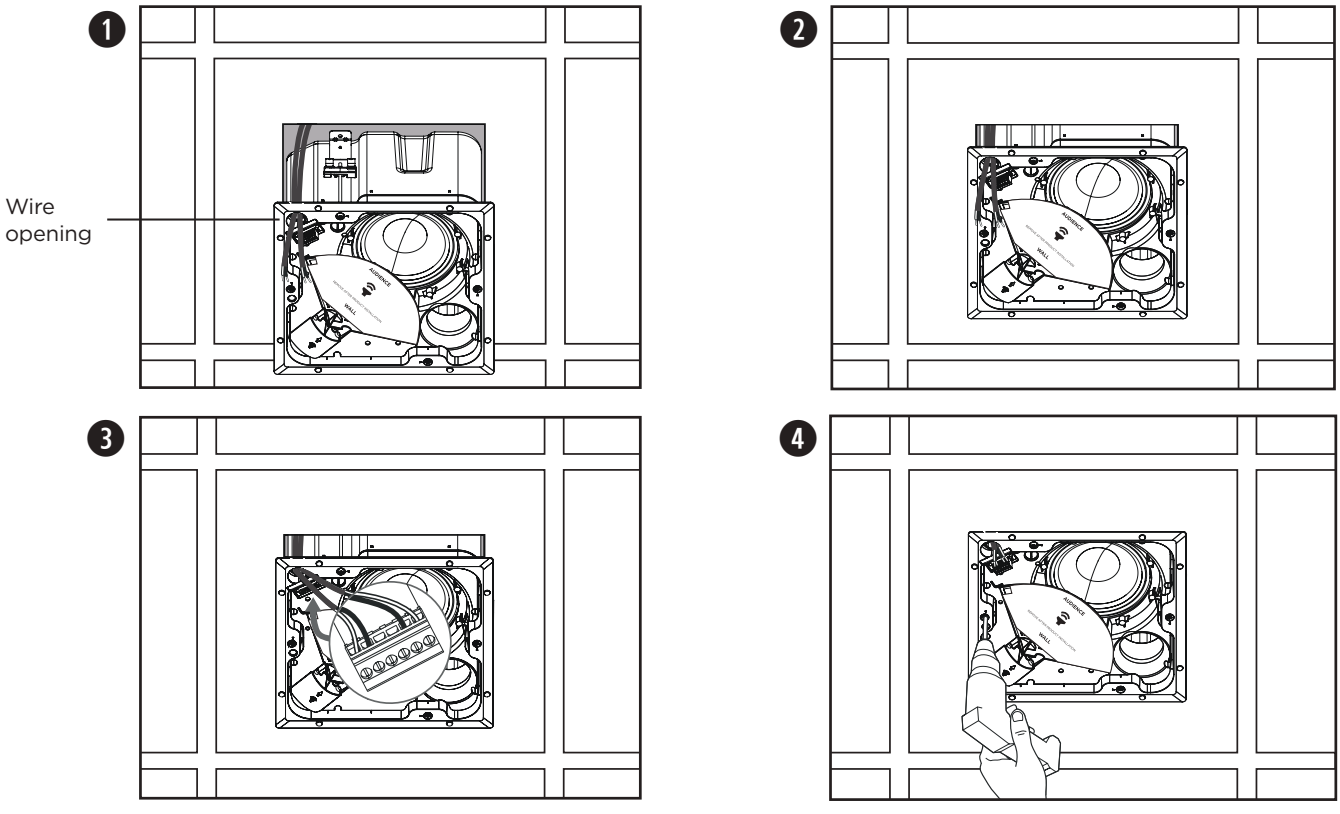


Mounting the Loudspeaker

1. Pass the audio wire through the wire opening (next to wiring terminal).
2. Insert the loudspeaker through the hole and into the tile bridge. Make sure the anchors engage on the tile bridge before loosening your grip on the loudspeaker.
3. Remove the connector, wire the connector, and reinsert the connector into the loudspeaker. For wiring information, see **Wiring the Loudspeaker** on page 4.
4. Tighten the anchor arm screws to secure the loudspeaker. If using a power drill, set to a low torque setting.

   WARNING: *Over-tightening the screws may result in damage to the anchor attachment point or the ceiling, which could lead to a falling hazard.*

5. Discard the phase guide protector.

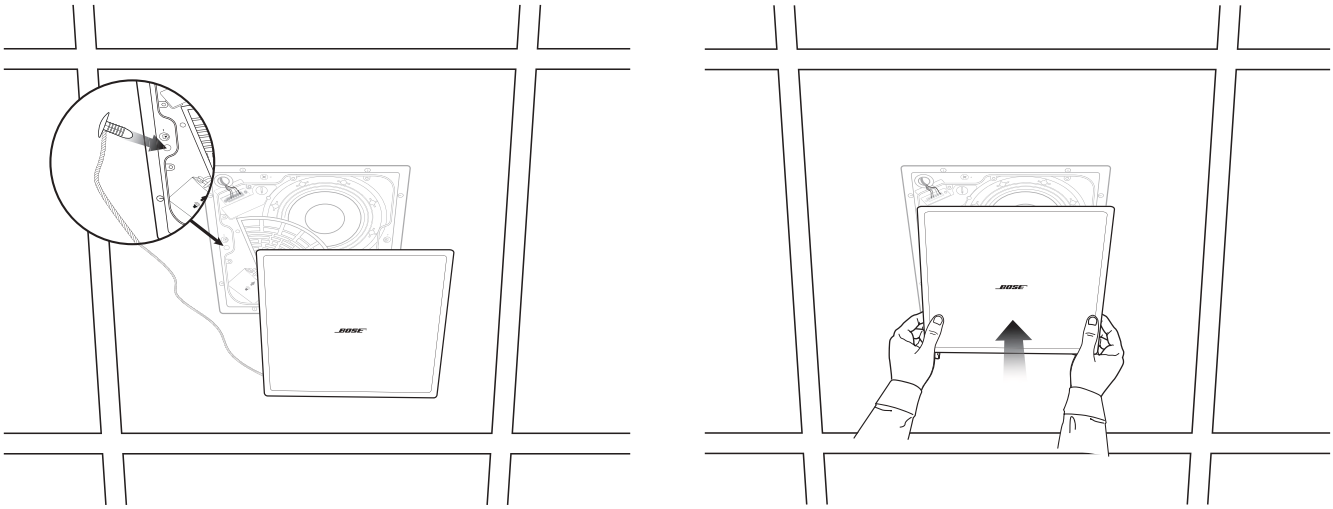


Installing in Hard Ceiling Using a Rough-in Pan (New Construction)

For information on installing a rough-in pan, see the EdgeMax Rough-in Pan installation guide at **PRO.BOSE.COM**. Once the rough-in pan is installed, see **Mounting the Loudspeaker** on page 7.

Attaching the Grille

Insert the safety lanyard pin into the hole in the loudspeaker. Using both hands, position the grille against the loudspeaker. The grille secures to the loudspeaker magnetically.



Safety and Regulatory Compliance

The Bose EdgeMax EM90 and EM180 loudspeakers have passed testing and comply with the following specifications and uses:

Listed to ANSI/UL 1480A-2016, Speakers for Commercial & Safety Professional Use

General-Purpose Use - UL Category UEAY, File Number S 5591 Control Number 3N89

Suitable for use indoors in damp locations under UL 1480A, but see warnings and cautions on page 2 of this installation guide for important installation restrictions.

UL-2043, 2013, Fire Test and Visible Smoke Release for Discrete Products and their Accessories Installed in Air Handling Spaces. Suitable for use in air handling (plenum) spaces.

Suitable for installation using Class 1, Class 2, or Class 3 wiring methods in accordance with NFPA 70, *National Electric Code*, 2017, Article 640

NFPA 70, National Electric Code, 2017, Article 300-22(c).

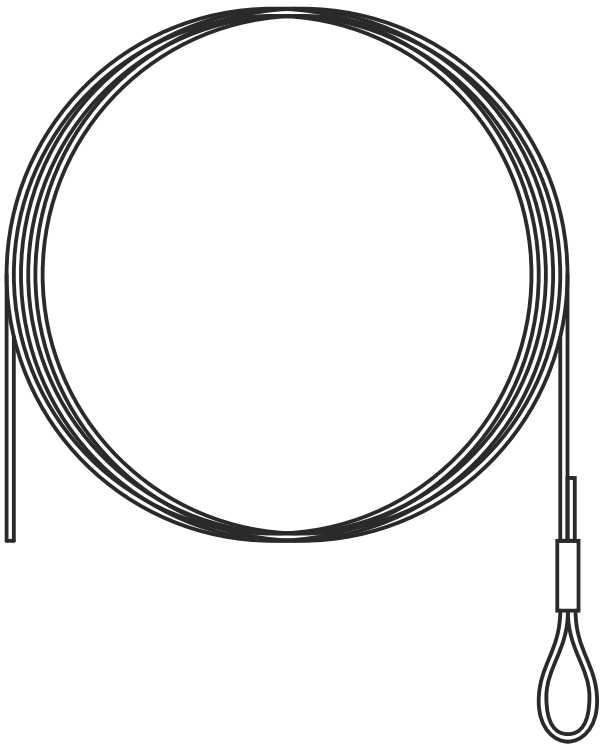
NFPA 90-A, 2015, Installation of Air Conditioning and Ventilation Systems, Paragraph 4.3.11.2.6.5

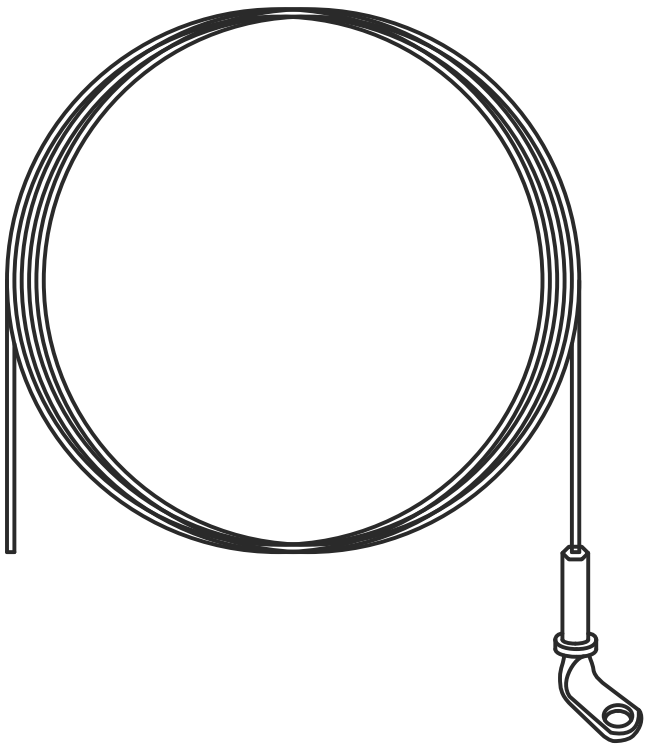
The EdgeMax EM90 and EM180 loudspeakers have been designed to the requirements defined in the following European regulatory specification for combination systems:

Tested to IEC 60268-5, 2007

Wire Gauge

The EdgeMax EM90 and EM180 loudspeakers are designed to work with 18 AWG (0.8 mm^2) to 14 AWG (2.5 mm^2) size wire only.





Safety Cable

Design Guide Supplement

Before attempting installation, please read all instructions & warnings in the installation guides for the product & the safety cable.

Introduction

This document provides important information to system designers about the use of safety cables with certain Bose loudspeakers in commercial cooking environments.

Bose has discovered that the mounting components on some of our loudspeakers can degrade and break when exposed to certain substances. If the mounting components break, the loudspeaker could fall and result in personal injury or property damage. Lubricants and cooking oil are the only substances to which the affected loudspeakers are likely to be exposed at levels high enough to degrade their mounting components. Therefore, lubricants should never be used during installation and loudspeakers that will be exposed to cooking oils must be installed with a safety cable.

Affected Products

All variants of the products listed here as well as mounting accessories (such as pendant-mount kits) are affected.

Flush-mount (In-ceiling) Models:

EdgeMax EM90
EdgeMax EM180
FreeSpace DS 16F
FreeSpace DS 40F
FreeSpace DS 100F
FreeSpace 3 Flush-Mount Satellites
FreeSpace 3 Series II Acoustimass module

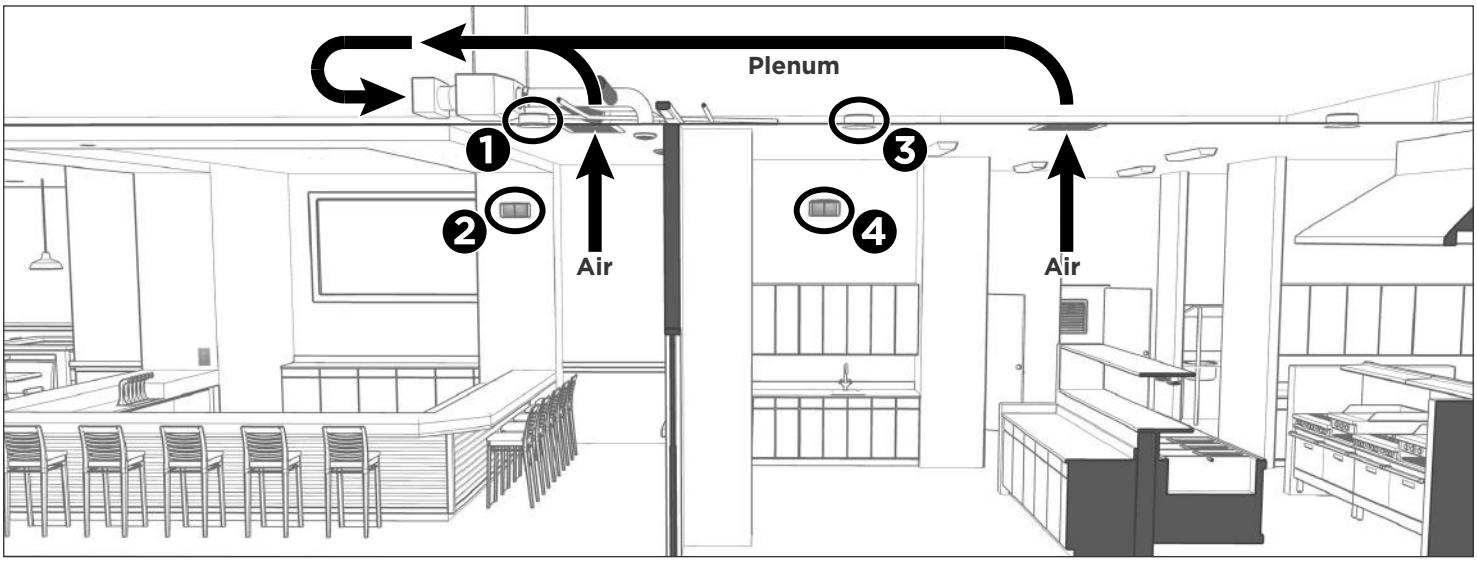
Surface-mount Models:

FreeSpace DS 16S / 16SE
FreeSpace DS 40SE
FreeSpace DS 100SE

Applications

The loudspeaker requires a safety cable if it meets either of these conditions:

- **A** It is installed in the same room as a cooking surface. This means that the loudspeaker and cooking surface are not separated by **(1)** full-height walls, **(2)** full-height doors, or **(3)** wall openings that are normally closed.
- **B** It is a flush-mount (in-ceiling) loudspeaker and is exposed to air from a room with a cooking surface via an HVAC system with an above-ceiling plenum return. An **HVAC system** provides heating and cooling services to a building. An **above-ceiling plenum return** is a separate space between the structural ceiling and a drop-down ceiling that allows for air circulation for the HVAC system.



In the diagram above, the installed Bose loudspeakers are circled and numbered:

- **1** The flush-mount loudspeaker in this dining area requires a safety cable.
- **2** The surface-mount in this dining area does **not** require a safety cable.
- **3** The flush-mount loudspeaker in this kitchen requires a safety cable.
- **4** The surface-mount loudspeaker in this kitchen requires a safety cable.

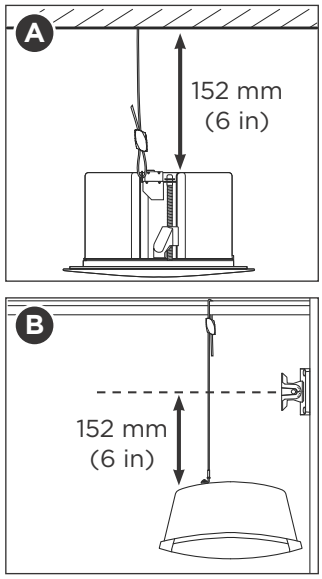
Design Requirements When Using the Safety Cable

If the loudspeaker requires a safety cable, please note the following information to aid your design process:

The safety cable must be wrapped securely around a building support structure. For surface-mount loudspeakers, you may wrap the safety cable securely around a structural attachment point, such as an eye screw above the loudspeaker, as an alternative.

After attaching the safety cable to both the loudspeaker and building support structure (or attachment point), you must remove enough slack from the safety cable such that, in the event of a fall, the top (rear) of the loudspeaker will drop to a distance of no more than **152 millimeters (6 inches)** below the ceiling (if it is a flush-mount loudspeaker, Fig. A) or from its mounted location (if it is a surface-mount loudspeaker, Fig. B) before it is retained by the safety cable.

Refer to the safety cable installation guide for detailed instructions and important safety warnings when installing the safety cable.



Safety Cable Ordering & Specifications

When you purchase any of the affected products from Bose, a safety cable will be provided for each loudspeaker. To obtain safety cables for loudspeakers that are already installed, visit **BoseBMSSafety.com**.

Bose can provide these two types of safety cable kits for free:

Kit	Compatible Products	Part Number	Specifications
Flush-mount safety cable kit	EdgeMax EM90 EdgeMax EM180 FreeSpace DS 16F FreeSpace DS 40F FreeSpace DS 100F FreeSpace 3 Flush-Mount Satellites	839760-0010	**Length:** 6.1 m (20.0 ft) **Ends:** 1 closed-loop end, 1 open end with fastener
Surface-mount safety cable kit	FreeSpace DS 16S / 16SE FreeSpace DS 40SE FreeSpace DS 100SE FreeSpace 3 Series II Acoustimass module*	839761-0010	**Length:** 1.5 m (5.0 ft) **Ends:** 1 end with 90° eyelet, 1 open end with fastener

* The FreeSpace 3 Series II Acoustimass module requires the surface-mount safety cable kit as this model does not have attachment points for the flush-mount safety cable.

If the safety cable provided by Bose is too short, you may substitute a longer safety cable only if it meets the specifications listed below. Failure to meet these requirements could cause the loudspeaker to fall and result in personal injury or property damage.

Material: Galvanized high-tensile steel to EN12385

Cable Diameter: 2 mm (5/64 in)

Strand Configuration: 7 × 7

If you are unable to install the Bose-provided cable **or** a longer substitute that meets the requirements that Bose has provided, do not install the loudspeaker and return it to Bose for a refund. (This applies only to loudspeakers installed in commercial cooking environments.)

Support & Contact Information

If you have any questions, contact your Bose Professional sales representative. Visit **bosepro.link/contact** to find your local sales office.

Framingham, MA 01701-9168 USA
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