

BOSE

PROFESSIONAL



EdgeMax EM90 & EM180

in-ceiling loudspeakers

Design Guide
English

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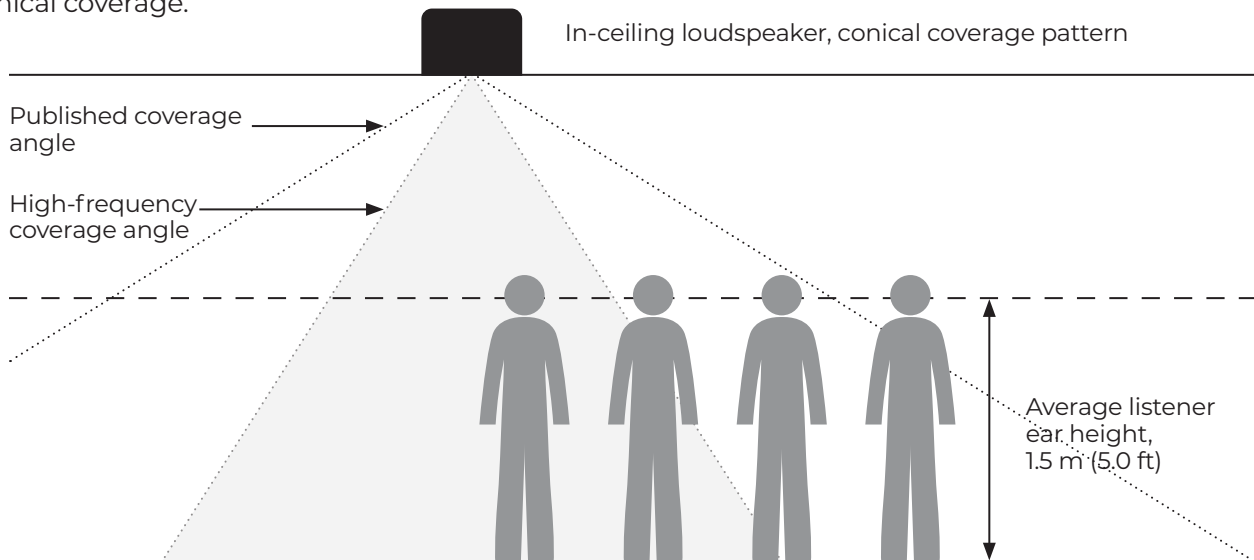
Overview

This guide covers topics related to system design with Bose Professional 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.

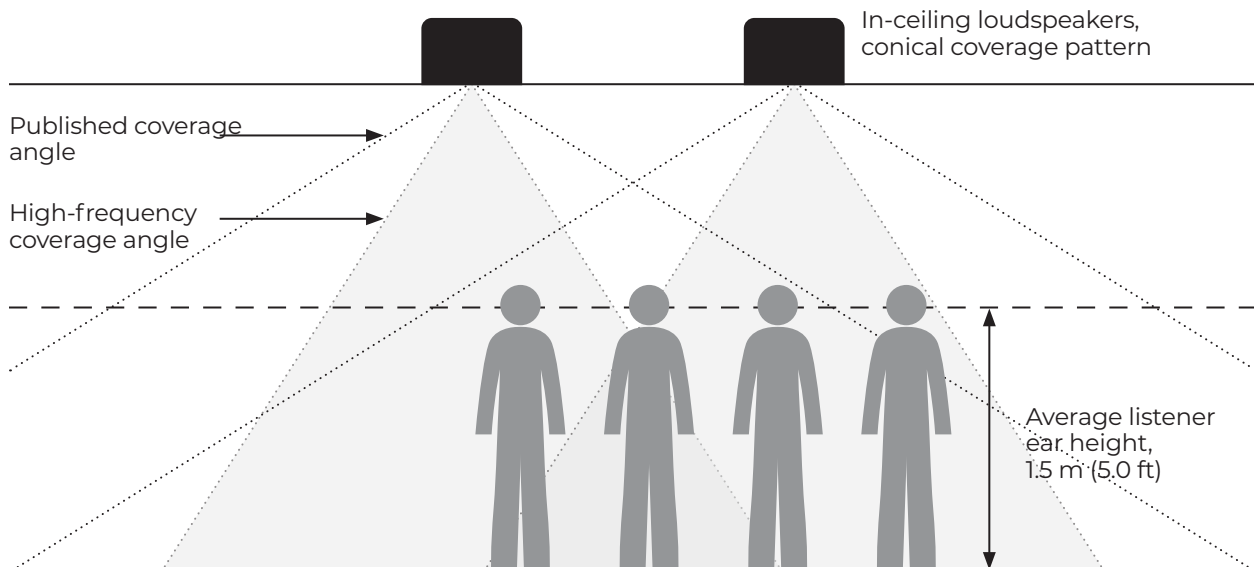
Loudspeaker Performance Comparison

In-Ceiling

Conventional in-ceiling loudspeakers are often preferred because they blend easily into the environment, but they often use a single transducer and deliver a conical coverage pattern with a stated coverage angle (e.g., 120° conical). That coverage angle does not accurately represent the higher-frequency band, though, which is narrower, resulting in significantly less high-frequency energy the further away the listener is from the axis of the conical coverage.



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

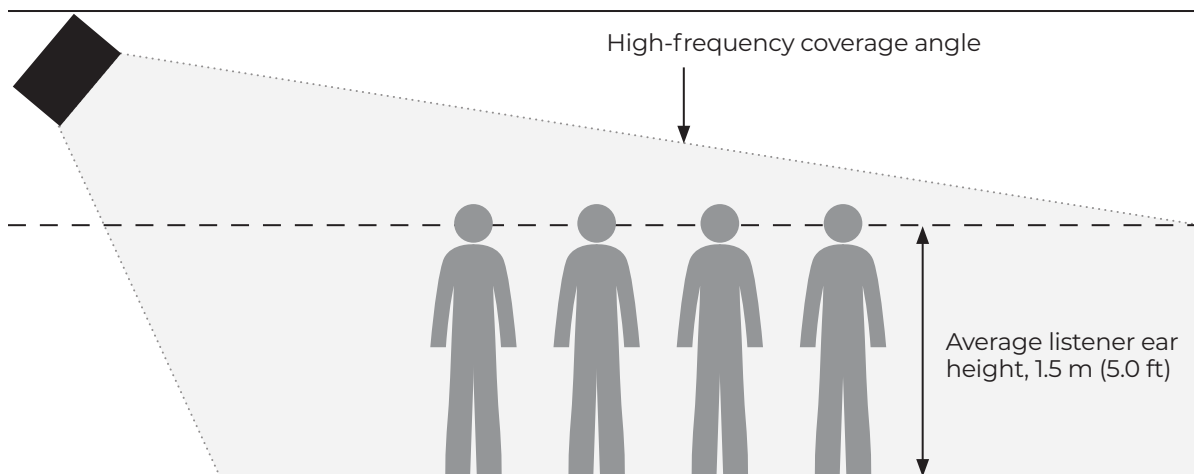


To provide a consistent tonal balance across the coverage area, in-ceiling loudspeakers must be closely spaced together.

Surface-mounted

Surface-mounted loudspeakers project sound differently than in-ceiling loudspeakers, so they are preferred when the primary concern of the design is consistent tonal balance across the coverage area. However, these loudspeakers do not offer the same aesthetic advantages as in-ceiling loudspeakers.

Surface-mounted loudspeaker



High-performance surface-mounted systems are usually two-way loudspeakers with a high-frequency section that delivers controlled coverage angles and a ported enclosure for low-frequency reproduction. Boundary-loading improves the low-frequency response of the system. This results in more consistent, balanced frequency response across a larger area.

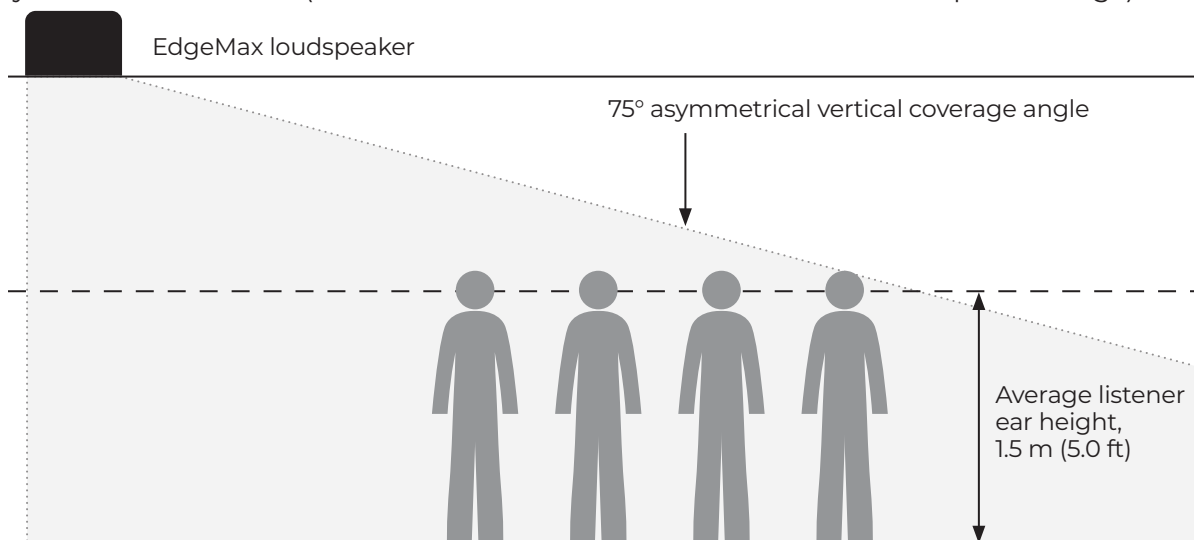
Despite the performance benefits of surface-mount loudspeakers, in-ceiling loudspeaker designs are still heavily preferred due to the aesthetic preference of architects and interior designers.

EdgeMax

EdgeMax loudspeakers represent the best aspects of both loudspeaker types — the coverage and performance of surface-mounted loudspeakers and the aesthetic benefits of in-ceiling loudspeakers.

EdgeMax loudspeakers use a two-way system comprised of a compression driver mounted to a PhaseGuide structure and an 8-inch (203-millimeter) driver mounted in a tuned, ported enclosure. The asymmetrical 75° vertical coverage angle enables EdgeMax loudspeakers to be installed in corners or along room perimeters.

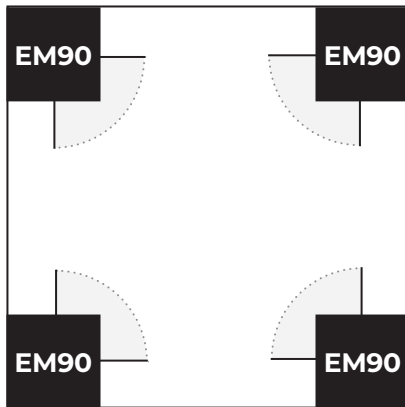
EdgeMax loudspeakers benefit from boundary-loading to deliver more low-frequency output than conventional in-ceiling loudspeakers. Similar to surface-mount loudspeakers, the coverage pattern of EdgeMax will also allow stereo playback for some rooms (when the room dimensions allow sufficient overlap of coverage).



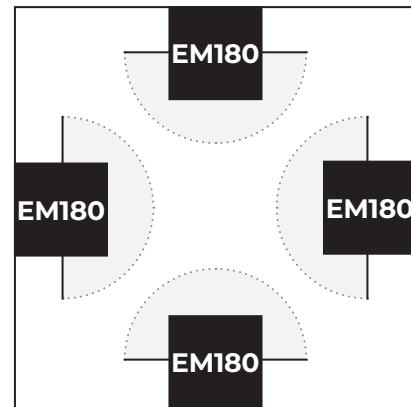
EdgeMax loudspeakers deliver controlled, vertically asymmetrical high-frequency coverage from a wall-ceiling boundary.

The EdgeMax family includes two horizontal coverage patterns:

EM90 offers 90° horizontal coverage for mounting in room corners.



EM180 offers 180° horizontal coverage for mounting along the room perimeter.



Technical Specifications



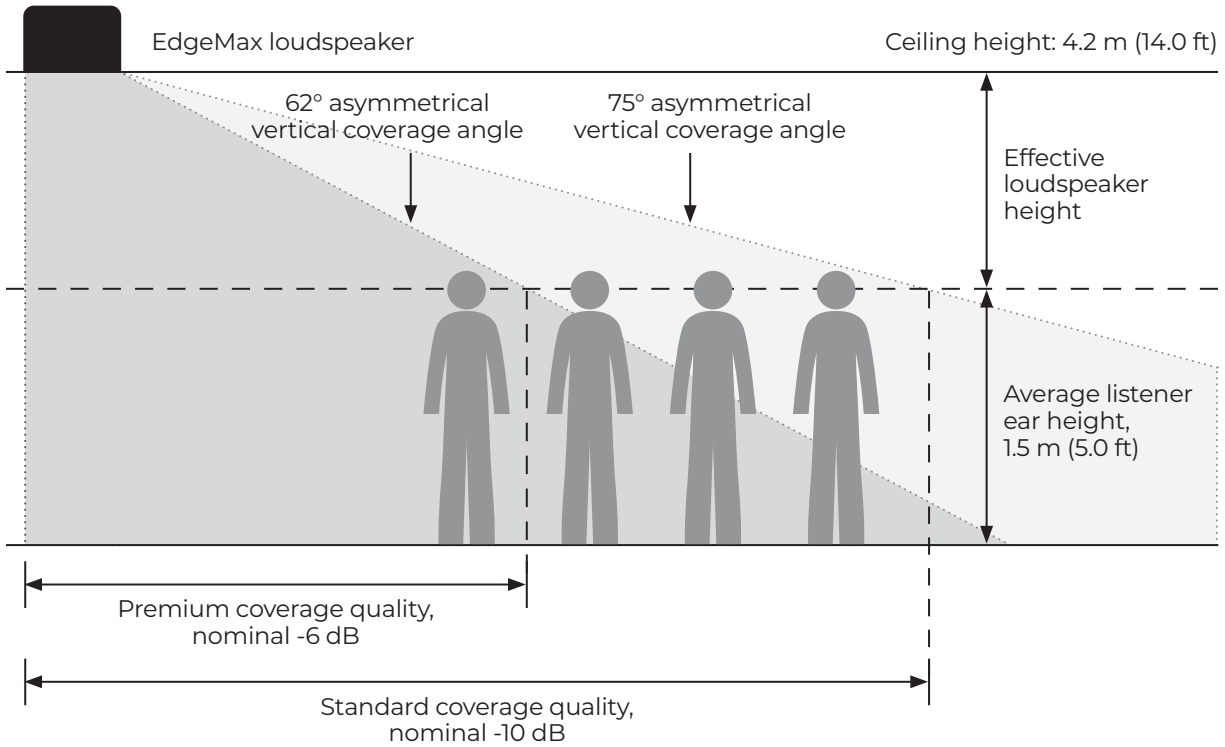
	EM90	EM180
Frequency range (-10 dB) ¹	45 Hz – 20,000 Hz	45 Hz – 20,000 Hz
Long-term power handling, continuous ²	125 W	125 W
Sensitivity (SPL @ 1 W/1 m, pink noise) ³	96 dB	93 dB
Impedance	70/100V or 8 Ω (bypass)	70/100V or 8 Ω (bypass)
Maximum SPL @ 1 m ⁴	117 dB	114 dB
Nominal coverage pattern (horizontal × vertical)	90° × 75° asymmetrical	180° × 75° asymmetrical

1. Frequency response and range measured on-axis in one-eighth-space (corner-loaded) environment with recommended active EQ.
2. Extended-lifecycle test using pink noise filtered to meet IEC268-5, 6-dB crest factor, 500-hour duration.
3. Sensitivity measured on-axis in one-eighth-space (corner-loaded) environment with recommended active EQ.
4. Maximum SPL calculated from sensitivity and power handling specifications exclusive of power compression.

Design Considerations

Standard & Premium Coverage

The design guidelines for EdgeMax loudspeakers offer two options for the quality of coverage: **standard** and **premium**. In a standard coverage design, which should be suitable for most applications, EdgeMax loudspeakers are spaced such that the overlap between adjacent loudspeakers occurs at the -10 dB point. In a premium coverage design, that overlap occurs at the -6 dB point. (The quality of coverage for EdgeMax loudspeakers was derived using the vertical coverage angle and confirmed using Modeler software.)



Standard and premium coverage comparison.

Maximum Room Dimension

Like a surface-mounted loudspeaker, the mounting height of an EdgeMax loudspeaker determines its **usable throw distance**, the greatest distance from the loudspeaker where the listener receives a balanced frequency response and adequate loudness.

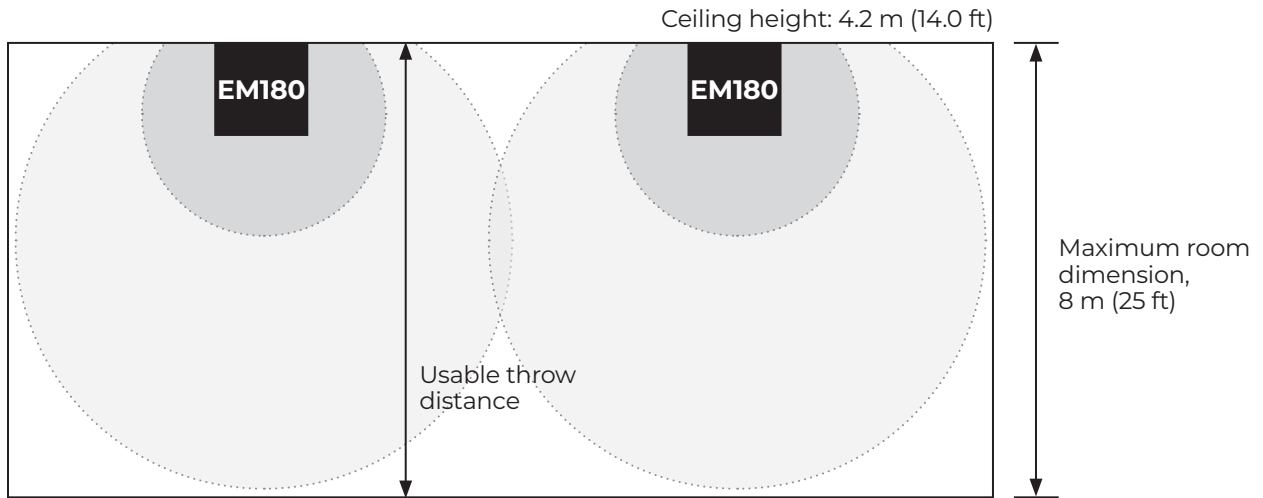
Usable throw distance, EM90 & EM180

Loudspeaker 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	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

Usable throw distance based on coverage quality at various heights. Assumes 1.5 m (5 ft) ear height.

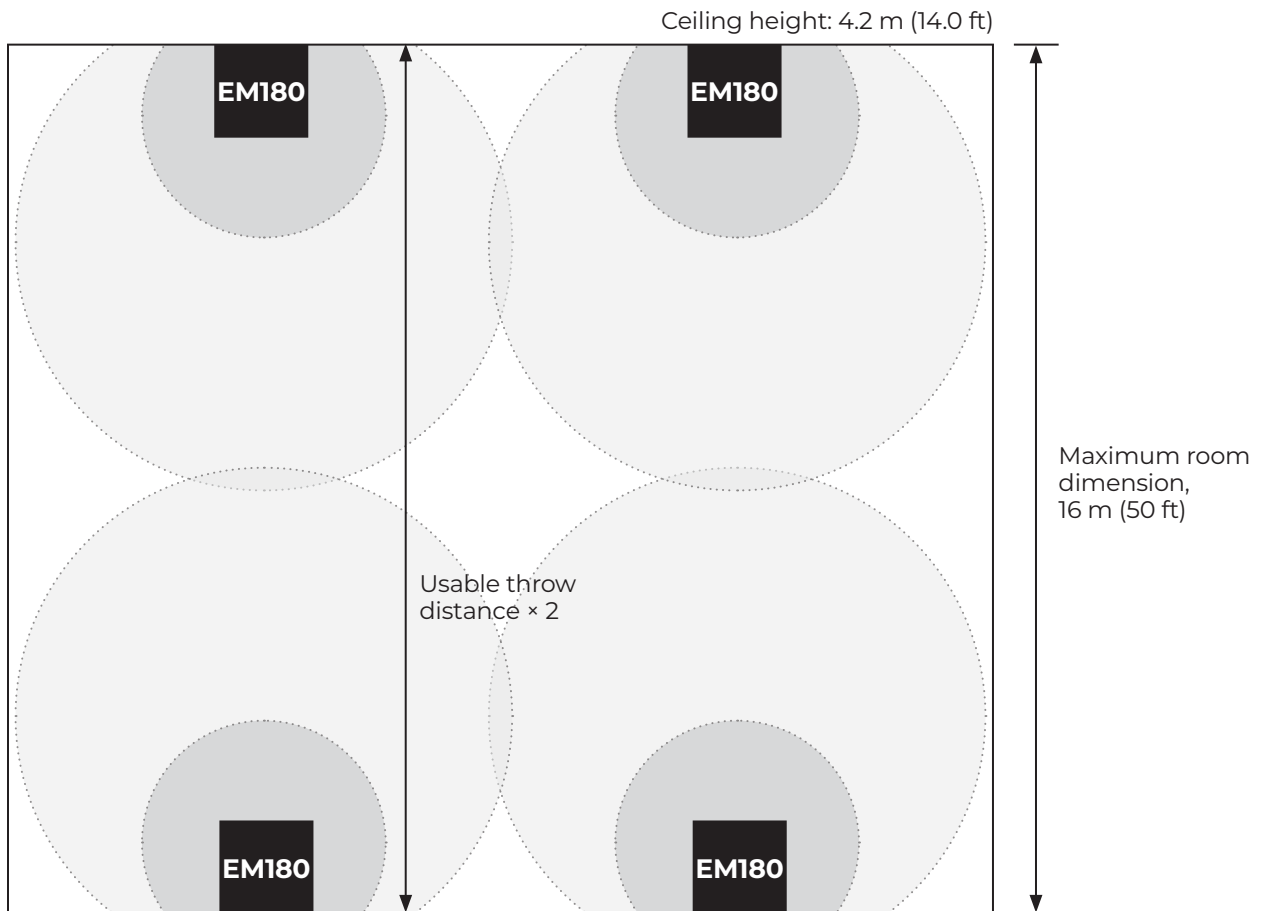
Here are two examples of how the maximum room dimension applies to an EdgeMax design.

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.



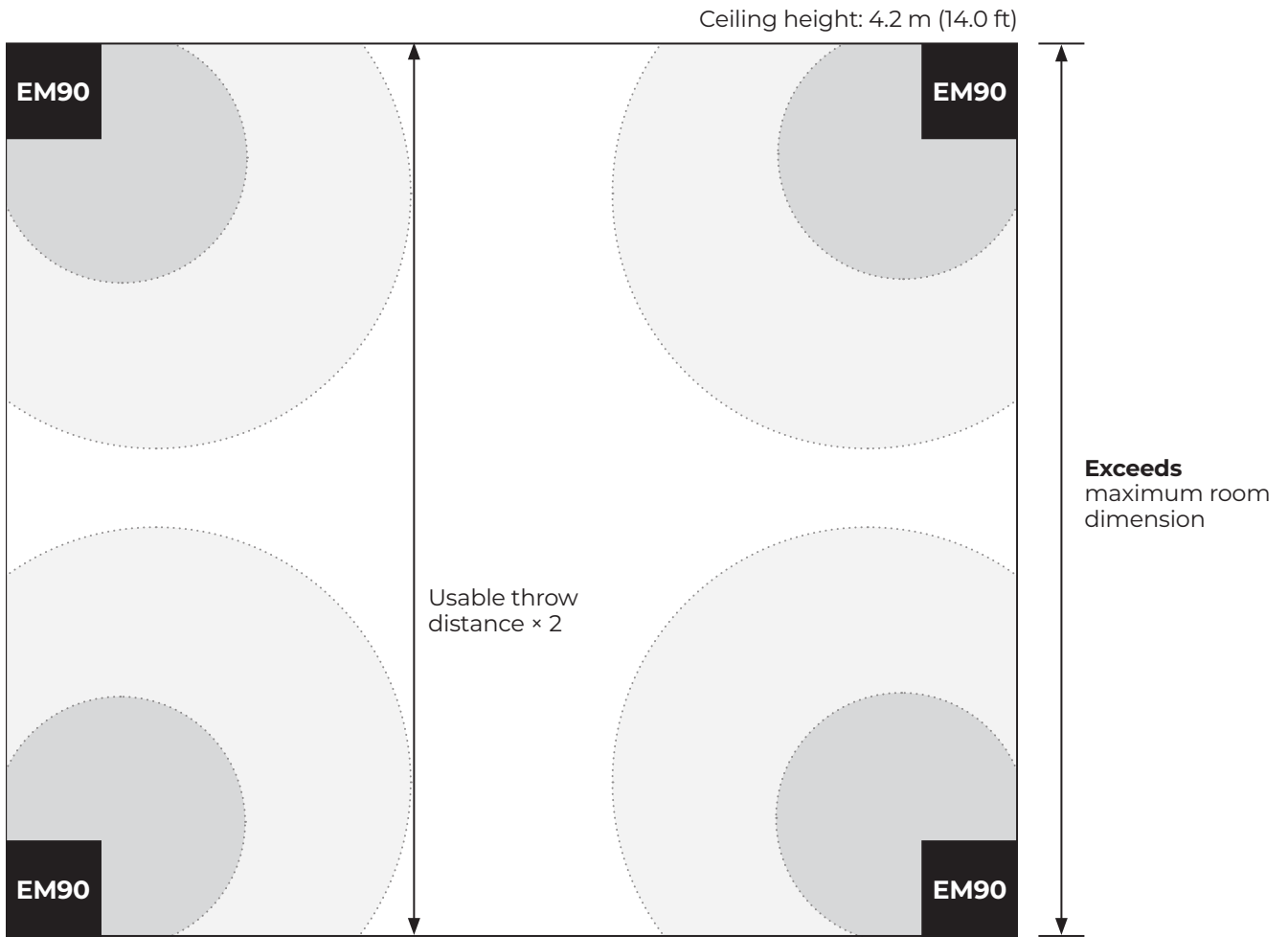
The maximum room dimension is less than or equal to the usable throw distance when EdgeMax loudspeakers are placed along one edge of the area.

When placing EdgeMax loudspeakers along two opposite sides of the coverage area, the maximum room dimension should be twice the usable throw distance for the planned ceiling height.



The maximum room dimension is equal to twice the usable throw distance when EdgeMax loudspeakers are mounted on two opposing sides of the area.

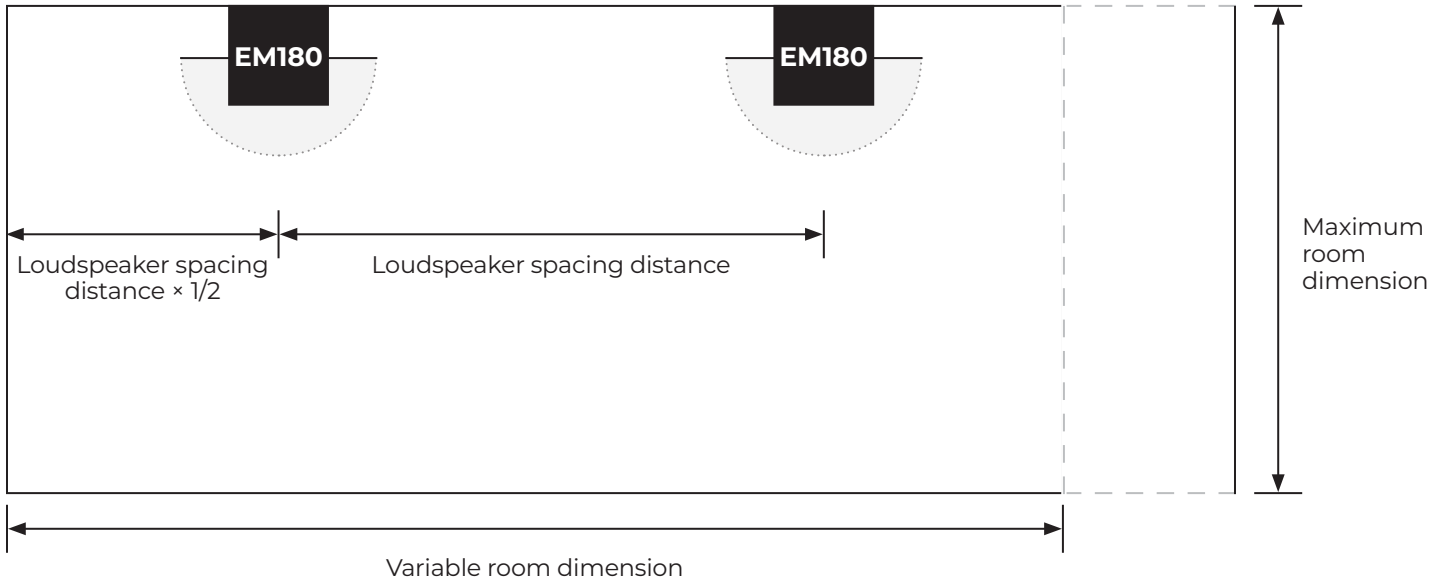
Planning a design around the maximum room dimension ensures the coverage reaches the center of the room —particularly in the case of a square room where EM90 loudspeakers are used in the corners.



The maximum room dimension has been exceeded here, resulting in a coverage gap in the center of the room.

When working with rectangular coverage areas, only one dimension — the length or the width — may exceed the maximum room dimension. In this case, treat the design like any other system design with surface-mount loudspeakers: space the EdgeMax loudspeakers along the perimeter using a constant value called the **loudspeaker spacing distance**, which is based on the mounting height and desired coverage quality.

The loudspeaker spacing distance is based on the ceiling height and on the vertical coverage angle of the EdgeMax loudspeakers for both premium and standard coverage types.



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. coverage quality.

Loudspeaker spacing distance, EM180

Loudspeaker 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

Loudspeaker spacing distance based on coverage quality at various heights. Assumes 1.5 m (5 ft) ear height.

Balancing SPL in “Mixed” EM90-EM180 Systems

The sensitivity of the EM180 is 3 dB less than that of the EM90 due to the difference in horizontal coverage between the EdgeMax EM90 (90°) and EM180 (180°). To achieve equivalent loudness when designing a “mixed” EM90-EM180 system, set the power level of each EM90 so it is 3 dB lower than the EM180. In 70/100V constant-voltage applications, do this by setting each EM90 one tap setting lower than the EM180.

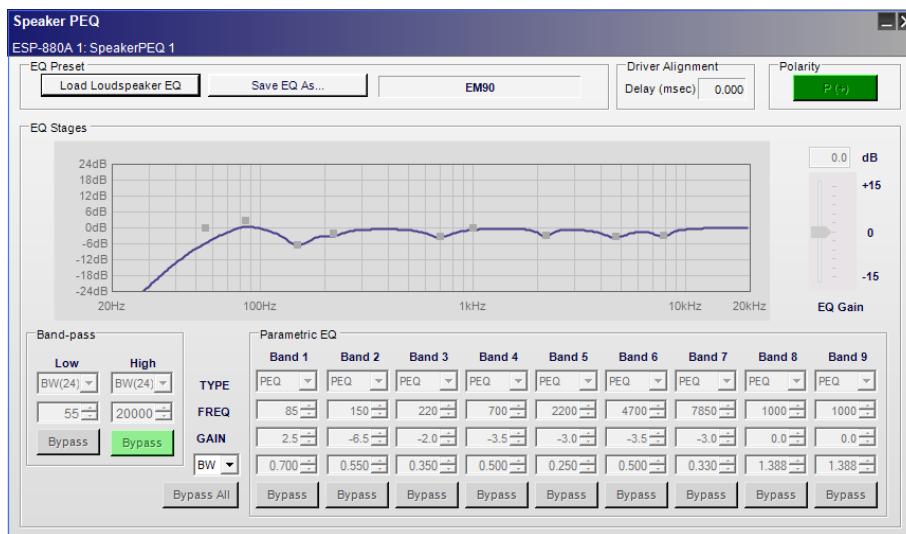
Active Equalization

Each EdgeMax model uses an active equalization curve to deliver optimum performance. Apply this active EQ via one of these options:

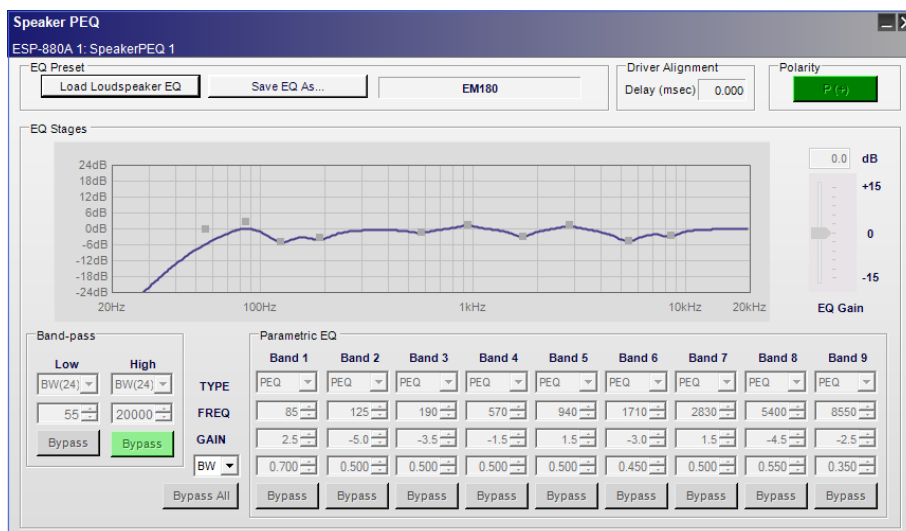
ControlSpace Designer software with PowerMatch amplifiers and ControlSpace processors

PowerShare Editor software with PowerShare amplifiers

Use the EdgeMax EM90 loudspeaker EQ when the system contains EM90 models only or contains both EM90 and EM180 models.



Use the EdgeMax EM180 loudspeaker EQ when the system contains EM180 models only.



Design Process

EM180 Systems & “Mixed” EM90-EM180 Systems

This section covers the basic steps to create a system design comprised of EdgeMax EM180 loudspeakers in commercial audio/business music systems. EM180 loudspeakers are ideal for background/foreground music applications with mounting heights of 2.4–6.1 meters (8–20 feet).

EdgeMax loudspeakers are compatible with 70/100V and low-impedance amplifiers and can deliver up to 98 dB SPL in a typical application with a ceiling height of 4.9 meters (16 feet).

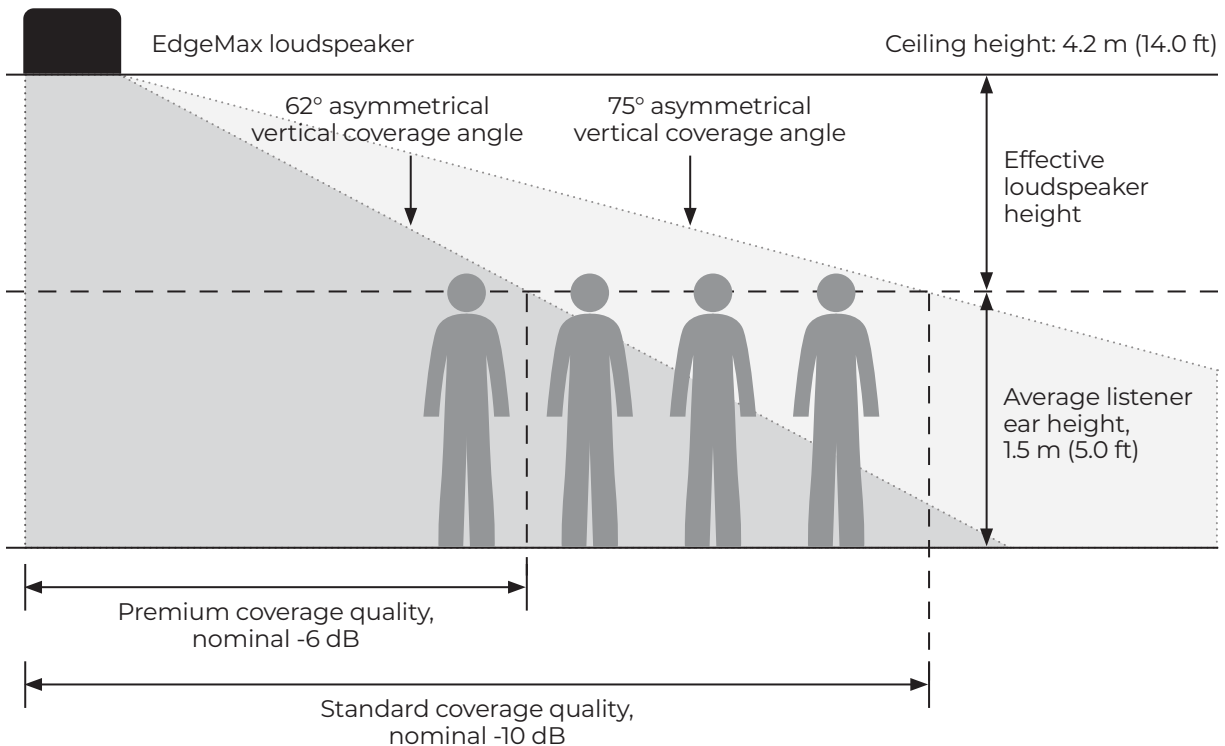
The design process described here uses three main requirements:

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 sound that will be used?

Each of these requirements can be easily converted into a specification to create our system design. If we understand the customer’s needs in these three areas, we can deliver a design that will meet or exceed their expectations. For the purposes of this design guide, we assume you are familiar with the system requirements for typical business music systems.

Design Guidelines

EdgeMax loudspeakers provide asymmetrical vertical coverage, and either 90° (EM90) or 180° (EM180) horizontal coverage. The design guidelines presented here offer two coverage quality options — **premium** and **standard**.



Keep these considerations in mind:

The recommended mounting height for EdgeMax loudspeakers is 2.7–6.1 meters (9–20 feet).

The maximum SPL for a typical application is 95–110 dB SPL.

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

Design Worksheet

Follow the steps below to create a design with EdgeMax loudspeakers.

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

- I. In the chart below, locate the loudspeaker mounting height for your design.
- II. Draw a line down to the desired maximum SPL.
- III. Draw a horizontal line across the chart at your desired SPL level. 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	
FreeSpace FS4CE (40 W)			105	100	97	95	93	92	91	90	88	86	dB SPL
DesignMax DM5C (50 W)			105	100	97	95	93	92	91	90	88	86	
DesignMax DM6C (80 W)			108	103	100	98	96	95	94	93	91	89	
DesignMax DM8C (80 W)			111	106	103	101	99	98	97	96	94	92	
EdgeMax EM90			111	109	106	104	102	100	99	98	96	95	
EdgeMax EM180			108	106	103	101	99	97	96	95	93	92	

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

Full Range	Extended Range
FreeSpace FS4CE	EdgeMax EM90
DesignMax DM5C	EdgeMax EM180
DesignMax DM6C	FreeSpace 3 system
DesignMax DM8C	

Note: EdgeMax loudspeakers have a usable frequency range down to 45 Hz, so additional subwoofers may not be required. However, if the design needs additional bass, the MB210-WR compact subwoofer can be used.

3. Use the graph paper on the last page to create a drawing of the room.

4. Use the chart below to determine the usable throw distance for your design.

Usable throw distance, EM90 & EM180

Loudspeaker 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

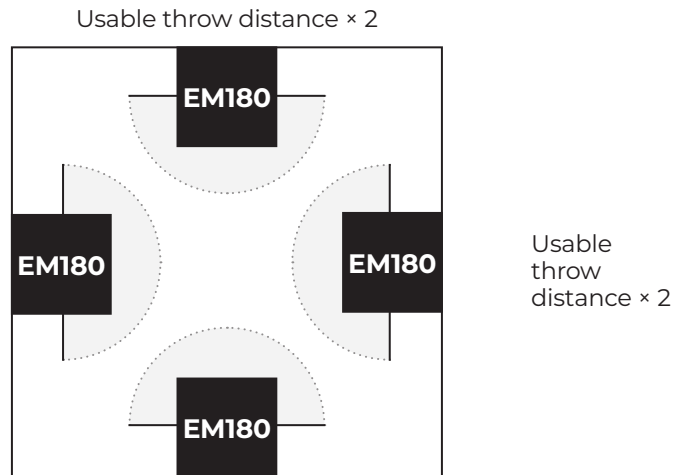
- I. Locate the mounting height you will use for the design.
- II. Determine the usable throw distance for the required coverage quality.

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

5. If the room/coverage area is shaped like a square, proceed to Step 6.

If the room/coverage area is shaped like a rectangle, proceed to Step 7.

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



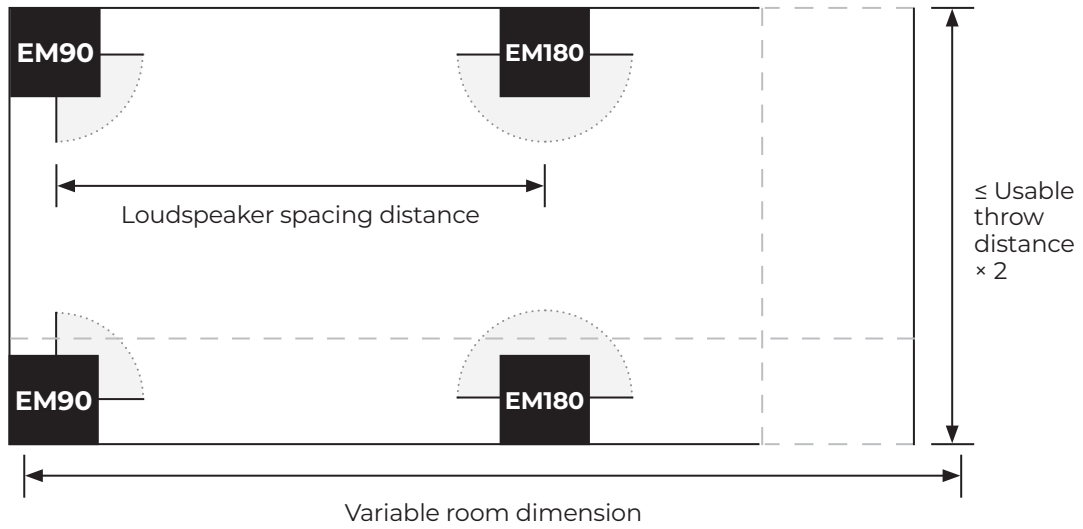
7. **Rectangle:** Determine the loudspeaker spacing distance for the mounting height and required coverage quality.

Loudspeaker spacing distance, EM180

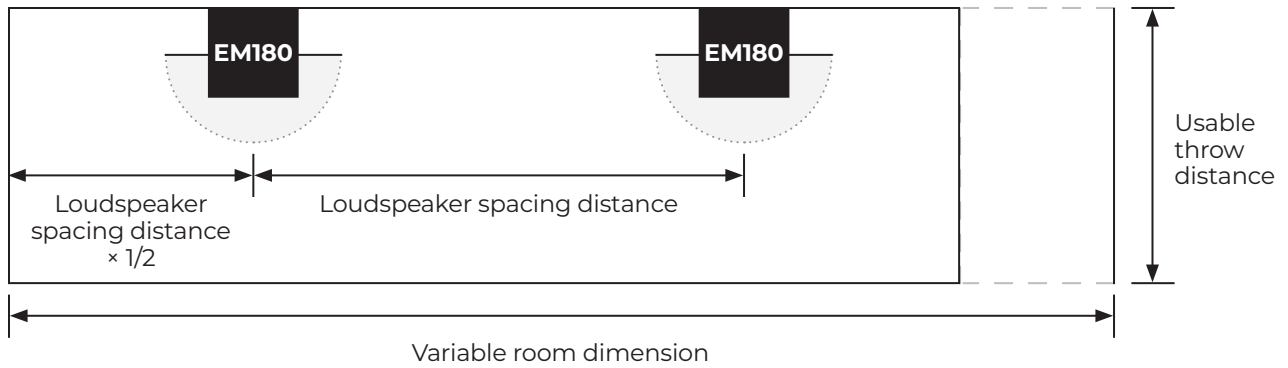
Loudspeaker mounting height	m	2.7	3.0	3.7	4.3	4.9	5.5	6.1	
	ft	9	10	12	14	16	18	20	
Coverage quality	Premium	m	3	4	6	8	9	11	13
		ft	11	15	20	25	30	35	40
	Standard	m	7	9	12	12	12	12	12
		ft	20	30	40	40	40	40	40

Create a layout using one of these three options:

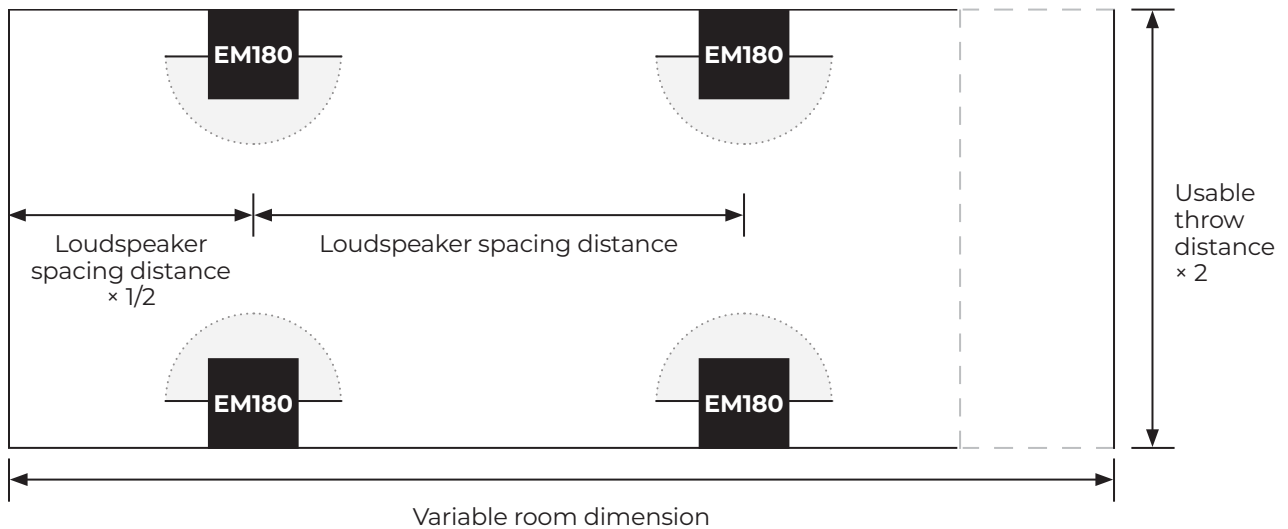
“Mixed” (recommended):



Single-edge mounting:



Perimeter mounting:



8. Calculate the required amplifier power based on the tap setting and number of loudspeakers.

- I. In the chart below, locate the loudspeaker mounting height for your design.
- II. Draw a line down to the desired maximum SPL.
- III. Draw a horizontal line across the chart to the required loudspeaker tap.

Continuous SPL, EM180 & Mixed EM90-EM180

Loudspeaker mounting height	m	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.9	9.1	dB SPL
	ft	9	10	12	14	16	18	20	22	26	30	
Tap setting	2.5 W	91	89	86	84	82	80	79	78	76	—	
	5 W	94	92	89	87	85	83	82	81	79	78	
	10 W	97	95	92	90	88	86	85	84	82	81	
	20 W	100	98	95	93	91	90	88	87	85	84	
	40 W	103	101	98	96	94	93	91	90	88	87	
	80 W	106	104	101	99	97	96	94	93	91	90	
	8 Ω	108	106	103	101	99	97	96	95	93	92	

IV. Calculate the required amplifier power:

$$\frac{\text{Number of loudspeakers}}{\text{Number of loudspeakers}} \times \frac{\text{Required loudspeaker tap setting}}{\text{Required loudspeaker tap setting}} = \frac{\text{Required power}}{\text{Required power}}$$

V. Calculate the required amplifier size:

$$\frac{\text{Required power}}{\text{Required power}} \times \frac{1.25}{\text{Headroom}} = \frac{\text{Required amplifier power}}{\text{Required amplifier power}}$$

Note: To achieve equivalent loudness when designing a “mixed” EM90-EM180 system, set the power level of each EM90 so it is 3 dB lower than the EM180. In 70/100V constant-voltage applications, do this by setting each EM90 one tap setting lower than the EM180.

EM90 Systems

This section covers the basic steps to create a system design comprised of EdgeMax EM90 loudspeakers in commercial audio/business music systems. EM90 loudspeakers are ideal for background/foreground music applications with mounting heights of 2.4–6.1 meters (8–20 feet).

EdgeMax loudspeakers are compatible with 70/100V and low-impedance amplifiers and can deliver up to 98 dB SPL in a typical application with a ceiling height of 4.9 meters (16 feet).

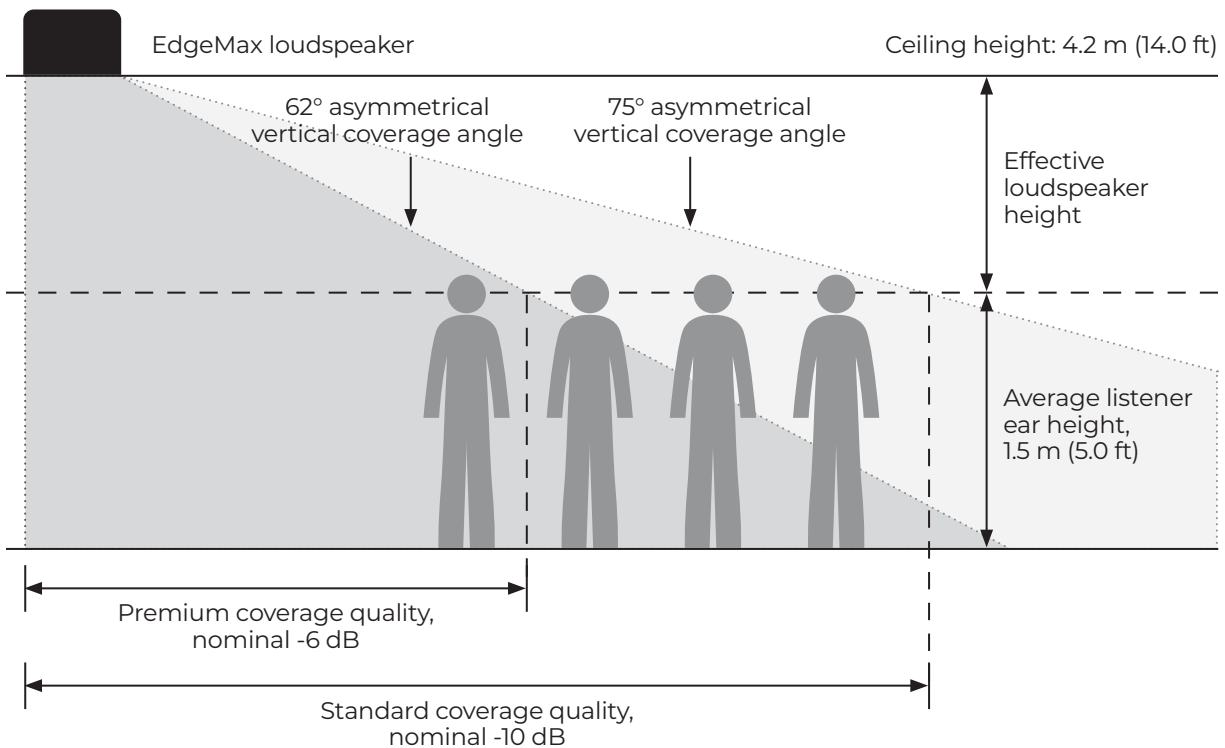
The design process described here uses three main requirements:

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 sound that will be used?

Each of these requirements can be easily converted into a specification to create our system design. If we understand the customer's needs in these three areas, we can deliver a design that will meet or exceed their expectations. For the purposes of this design guide, we assume you are familiar with the system requirements for typical business music systems.

Design Guidelines

EdgeMax loudspeakers provide asymmetrical vertical coverage, and either 90° (EM90) or 180° (EM180) horizontal coverage. The design guidelines presented here offer two coverage quality options — **premium** and **standard**.



Keep these considerations in mind:

The recommended mounting height for EdgeMax loudspeakers is 2.7–6.1 meters (9–20 feet).

The maximum SPL for a typical application is 95–110 dB SPL.

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

Design Worksheet

Follow the steps below to create a design with EdgeMax loudspeakers.

1. Confirm the EdgeMax loudspeaker will meet your loudness requirement:
 - I. In the chart below, locate the loudspeaker mounting height for your design.
 - II. Draw a line down to the desired maximum SPL.
 - III. Draw a horizontal line across the chart at your desired SPL level. 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	dB SPL
	ft	8	10	12	14	16	18	20	22	26	32	
FreeSpace FS4CE (40 W)		105	100	97	95	93	92	91	90	88	86	
DesignMax DM5C (50 W)		105	100	97	95	93	92	91	90	88	86	
DesignMax DM6C (80 W)		108	103	100	98	96	95	94	93	91	89	
DesignMax DM8C (80 W)		111	106	103	101	99	98	97	96	94	92	
EdgeMax EM90		111	109	106	104	102	100	99	98	96	95	
EdgeMax EM180		108	106	103	101	99	97	96	95	93	92	

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

Full Range	Extended Range
FreeSpace FS4CE	EdgeMax EM90
DesignMax DM5C	EdgeMax EM180
DesignMax DM6C	FreeSpace 3 system
DesignMax DM8C	

Note: EdgeMax loudspeakers have a usable frequency range down to 45 Hz, so additional subwoofers may not be required. However, if the design needs additional bass, the MB210-WR compact subwoofer can be used.

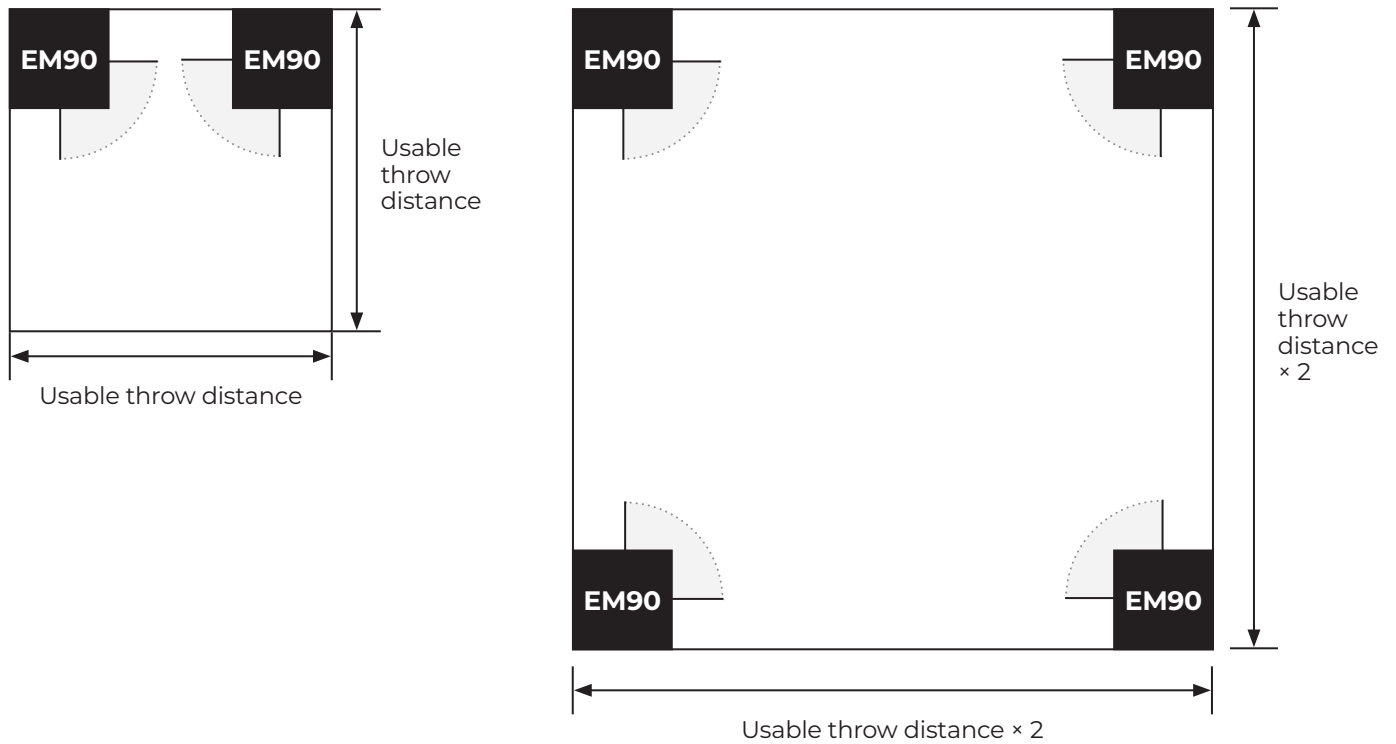
3. Use the graph paper on the last page to create a drawing of the room.
4. Use the chart below to determine the usable throw distance for your design.

Usable throw distance, EM90 & EM180

Loudspeaker 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	

- I. Locate the mounting height you will use for the design.
- II. Determine the usable throw distance for the required coverage quality.

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 4 EM90s will deliver more bass than 4 EM180s, due to the additional wall-boundary loading provided by the corner mounting.

6. Calculate the required amplifier power based on the tap setting and number of loudspeakers.

I. In the chart below, locate the loudspeaker mounting height for your design.

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

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

Continuous SPL, EM90

Loudspeaker mounting height	m	2.7	3.0	3.7	4.3	4.9	5.5	6.1	6.7	7.9	9.1	dB SPL
	ft	9	10	12	14	16	18	20	22	26	30	
Tap setting	2.5 W	94	92	89	87	85	83	82	81	79	78	
	5 W	97	95	92	90	88	86	85	84	82	81	
	10 W	100	98	95	93	91	89	88	87	85	84	
	20 W	103	101	98	96	94	93	91	90	88	87	
	40 W	106	104	101	99	97	96	94	93	91	90	
	80 W	109	107	104	102	100	99	97	96	94	93	
	8 Ω	111	109	106	104	102	100	99	98	96	95	

IV. Calculate the required amplifier power:

$$\frac{\text{Number of loudspeakers}}{\text{Number of loudspeakers}} \times \frac{\text{Required loudspeaker tap setting}}{\text{Required loudspeaker tap setting}} = \frac{\text{Required power}}{\text{Required power}}$$

V. Calculate the required amplifier size:

$$\frac{\text{Required power}}{\text{Required power}} \times \frac{1.25}{\text{Headroom}} = \frac{\text{Required amplifier power}}{\text{Required amplifier power}}$$

Design Examples

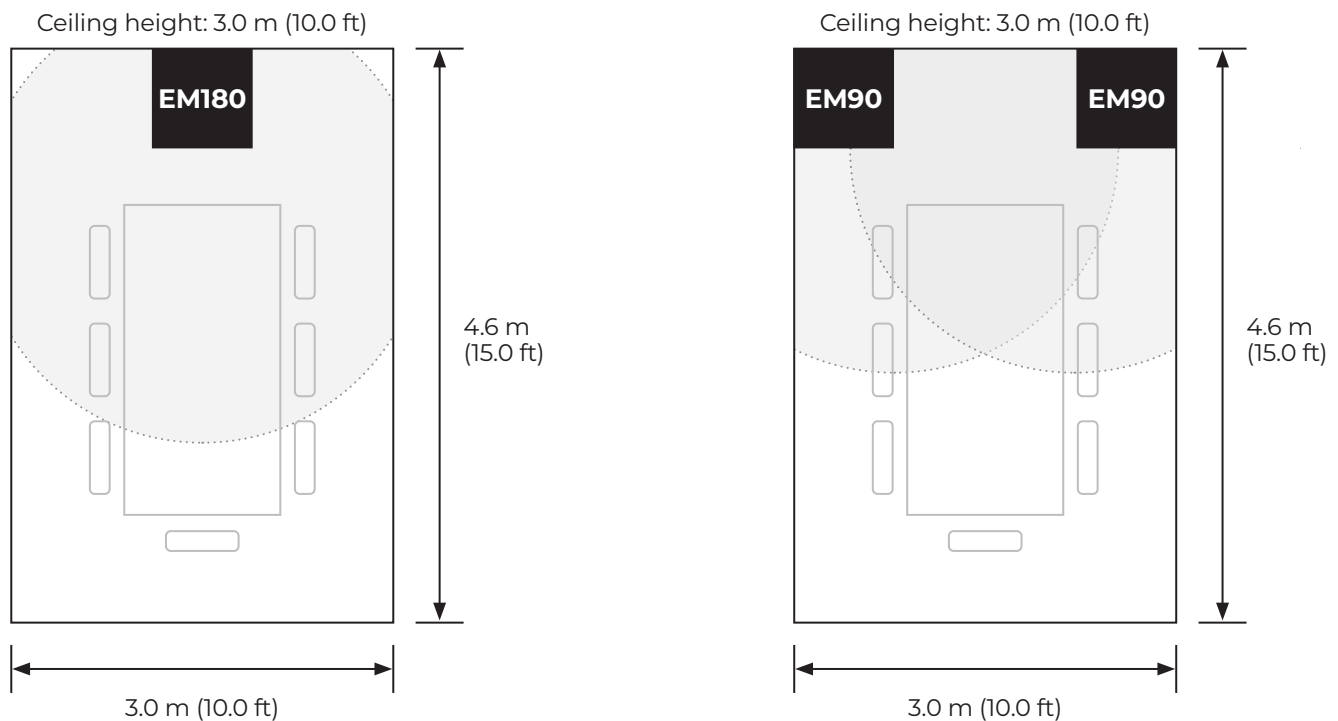
The unique coverage and performance of EdgeMax loudspeakers make them ideal for conference room applications for both speech and music reproduction. An EM180 mounted directly above a display screen provides excellent speech reproduction for video conferencing, while the addition of more EdgeMax loudspeakers along the side walls of larger rooms enhances the experience.

Small Conference Rooms

For rooms smaller than 3 × 4.5 meters (10 × 15 feet) with a ceiling height of 2.7–3.7 meters (9–12 feet), place one EM180 above the display screen.

Alternatively, if stereo playback of program material is required, two EM90s can be installed in the corners on either side of the display.

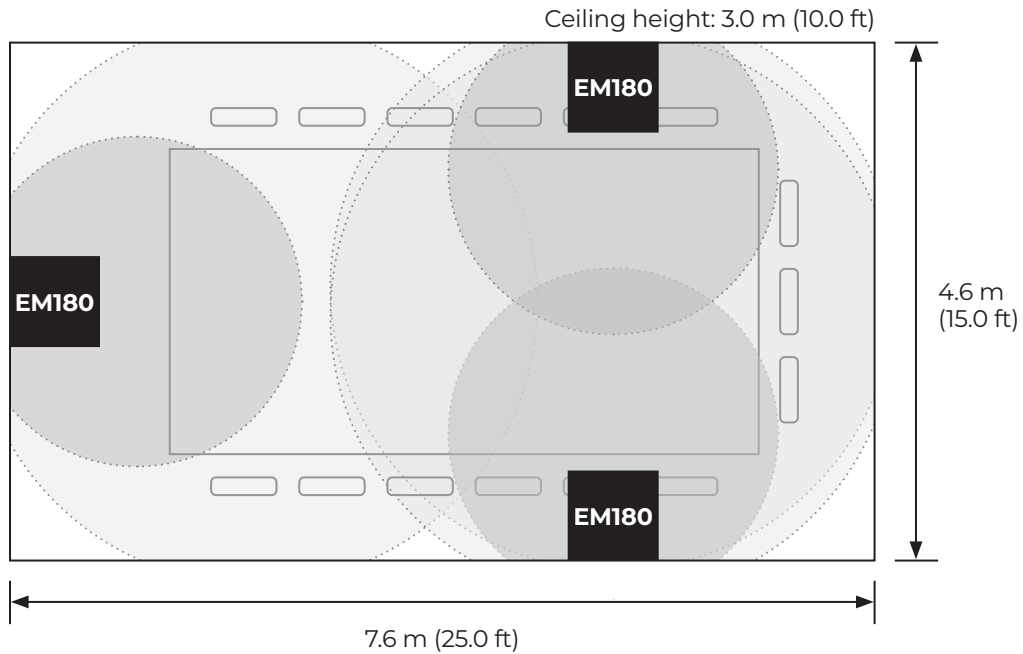
Note: This dual-EM90 configuration can be used for other stereo playback applications (background or foreground music) if the room dimensions allow similar overlapping coverage.



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

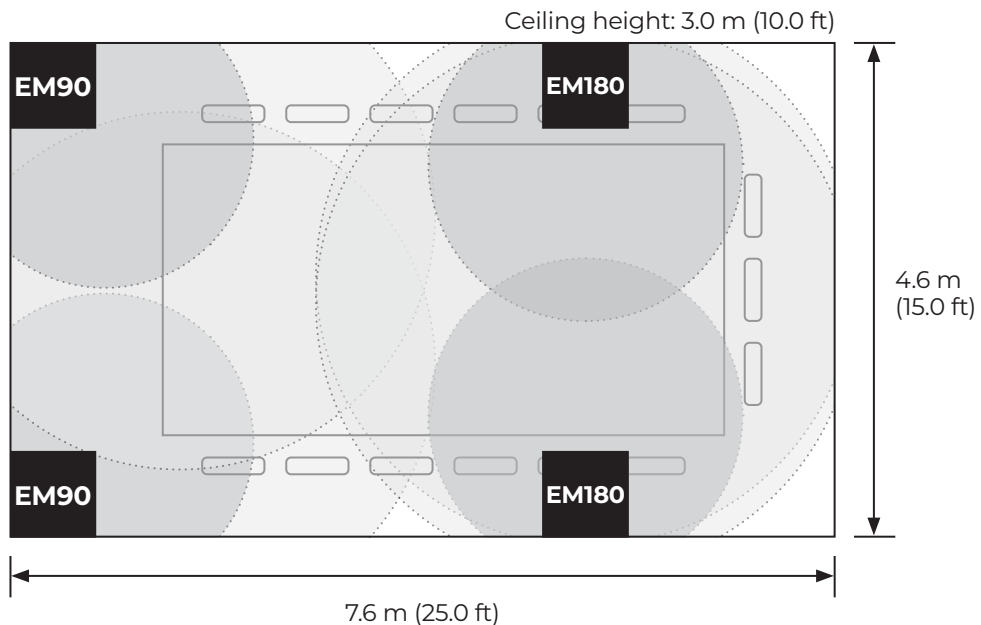
For rooms larger than 3 × 4.5 meters (10 × 15 feet) with a ceiling height of 2.7–3.7 meters (9–12 feet), place one EM180 above the display screen, and place additional EM180s behind the conferencing table using the recommended loudspeaker spacing distance for the ceiling height.



One EM180 above the display screen and additional EM180s along the perimeter to provide reinforcement for audio and video conferencing.

Ensure the EdgeMax loudspeakers that cover the rest of the room use a lower output level than the loudspeaker above the display screen to provide adequate localization.

Alternatively, if stereo playback of program material is required, two EM90s can be installed in the corners on either side of the display.

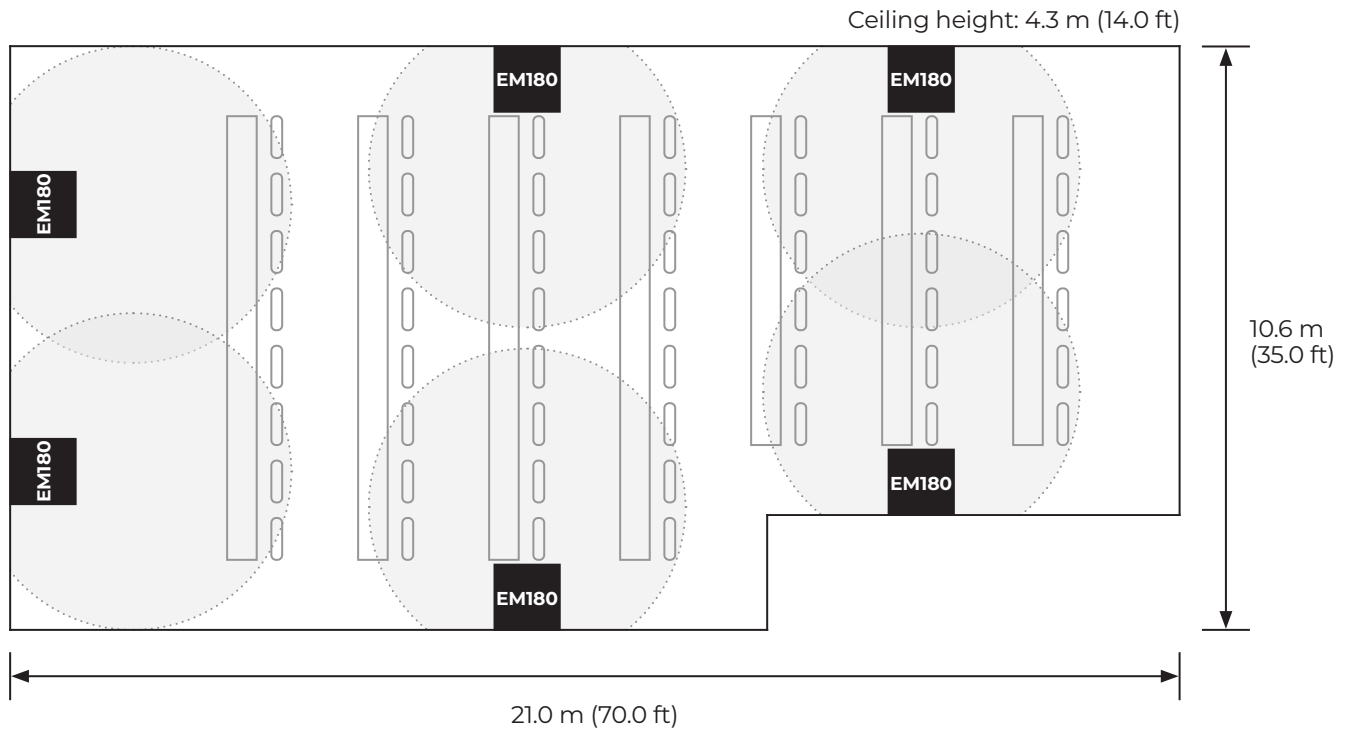


Two EM90s in the front of the room for stereo playback and conferencing and EM180s along the perimeter to provide reinforcement for audio and video conferencing.

Large Conference Rooms

For even larger or divisible rooms, place EdgeMax loudspeakers along the wall of the main display screen and around the perimeter of the room using the recommended loudspeaker spacing distance for the ceiling height.

Ensure the EdgeMax loudspeakers that cover the rest of the room use a lower output level than the loudspeakers above the display screen to provide adequate localization.



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.

Graph Paper

