# BOSE

# EdgeMax™ EM90 and EM180
## In-Ceiling Loudspeakers

### Design 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

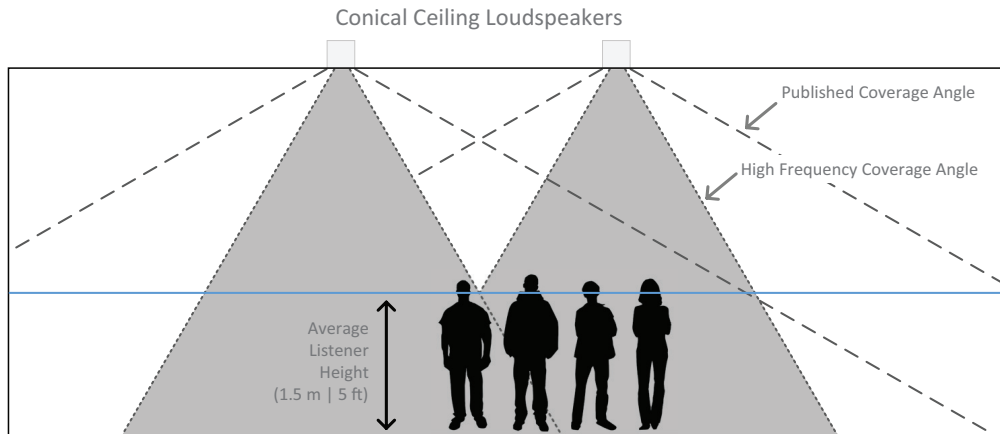## Comparison of In-Ceiling and Surface Mounted Loudspeaker Performance

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.
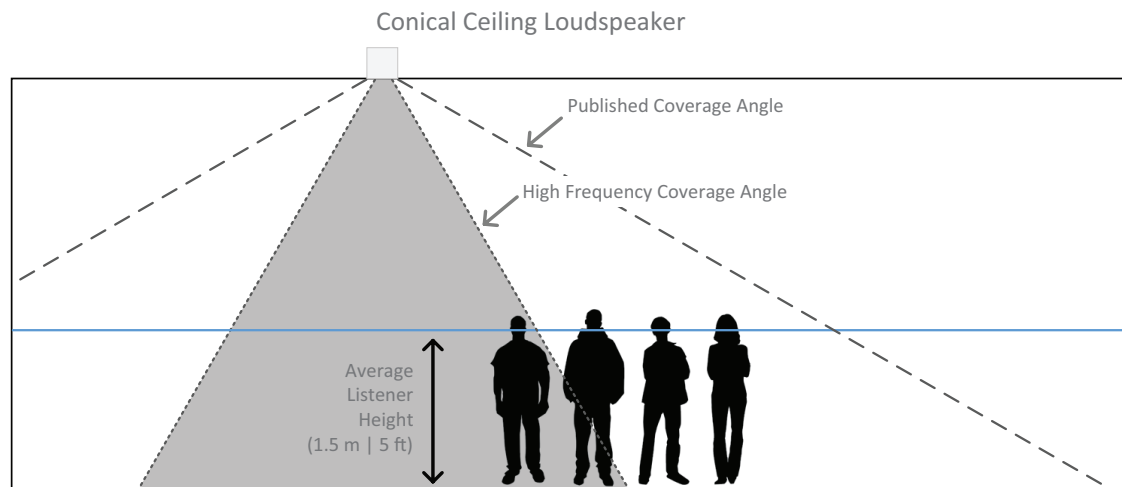


**Figure 1.** *Comparison between the published and typical high frequency coverage angles for an in-ceiling conical dispersion loudspeaker. Note that the shaded section represents the area where a balanced frequency response will be delivered.*

Conical Ceiling Loudspeakers

Published Coverage Angle

High Frequency Coverage Angle

Average Listener Height (1.5 m | 5 ft)

**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.

Surface Mounted Loudspeaker

High Frequency Coverage Angle

Average Listener Height (1.5 m | 5 ft)
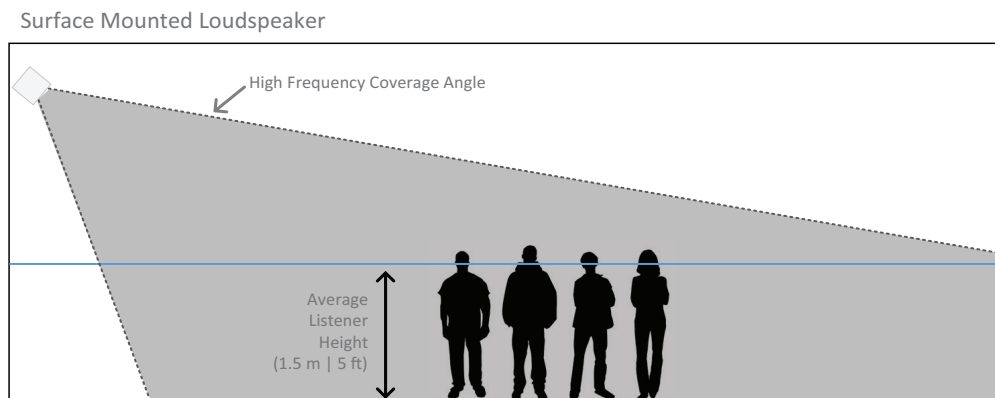
**Figure 3.** *Typical projection of a surface mounted loudspeaker vertical coverage into a room.*

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.

EdgeMax Loudspeaker

75-degree Asymmetric Vertical Coverage Angle

Average Listener Height (1.5 m | 5 ft)
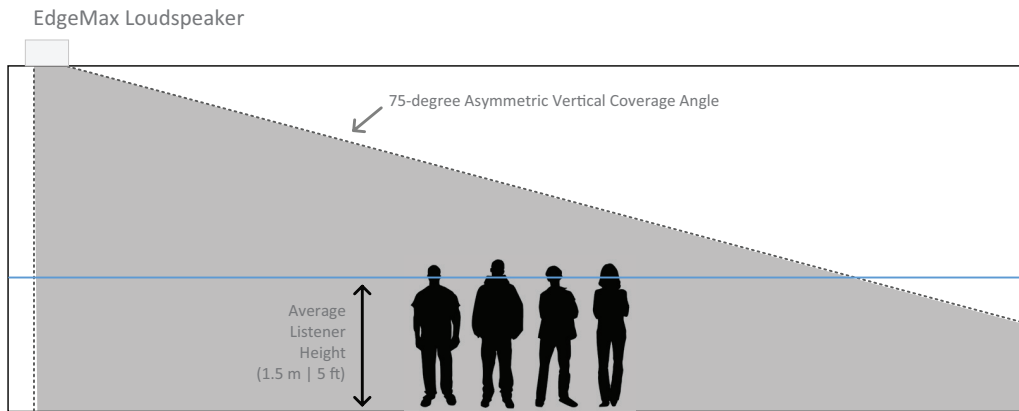
**Figure 4.** *The proprietary Bose PhaseGuide technology delivers controlled high frequency coverage like a surface-mount loudspeaker, from an in-ceiling location.*

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.

EM90 in Corners

EM 90    EM 90

EM 90    EM 90

EM180 along Walls

EM 180

EM 180    EM 180
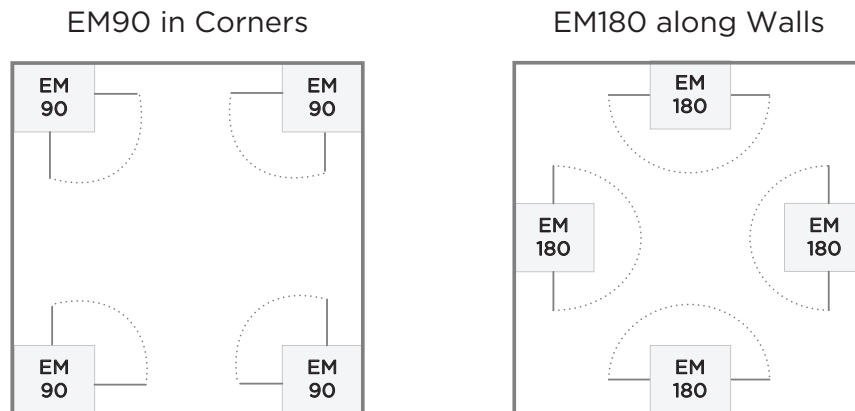
EM 180

**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.
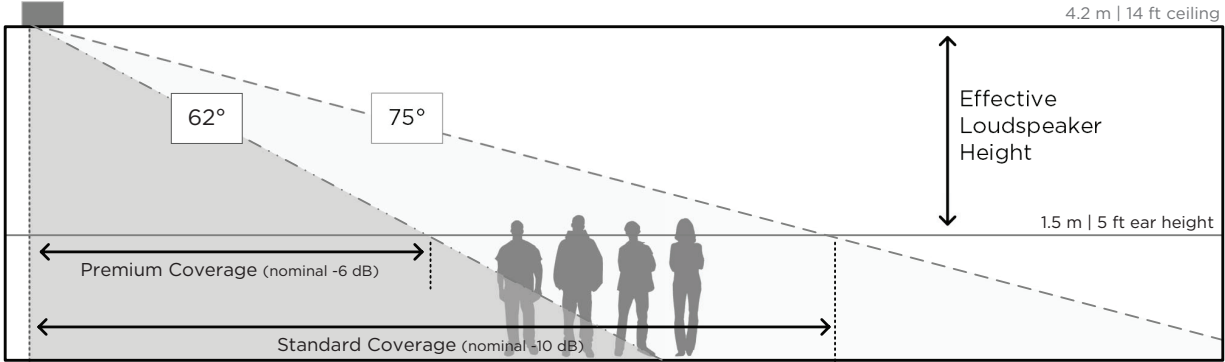


**Figure 6.** *Standard and Premium coverage comparison for EdgeMax loudspeakers.*

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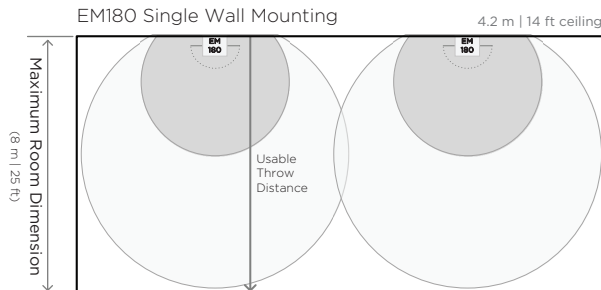
## Maximum Room Dimension

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.
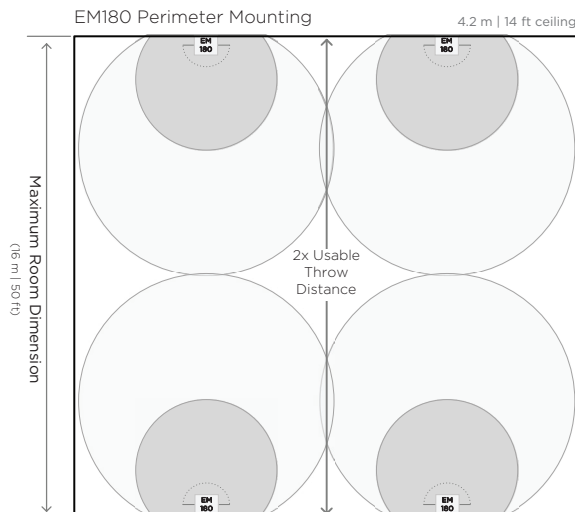


**Figure 9.** *The Maximum Room Dimension is equal to twice the Usable Throw Distance when EdgeMax loudspeakers are mounted on two opposing sides of the area to be covered.*

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.
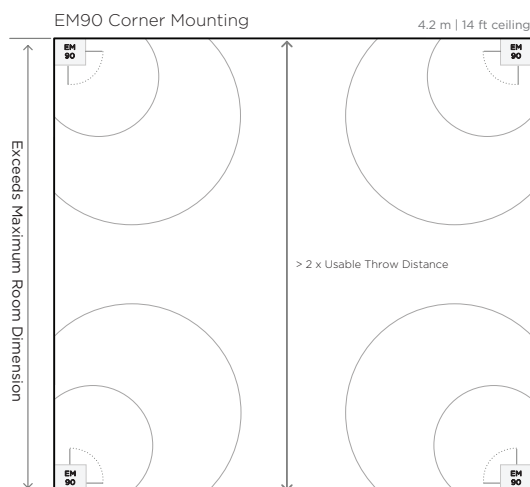


**Figure 10.** *In this example the Maximum Room Dimension has been exceeded, resulting in a coverage gap in the center of the room.*

## 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.
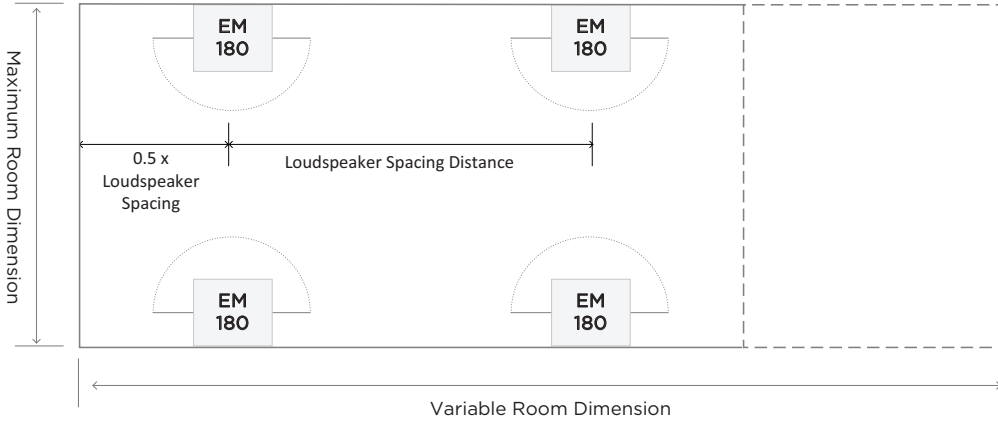


**Figure 11.** *The room size can exceed the Maximum Room Dimension in one dimension, length or width, to create a distributed design along the perimeter of the room.*

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 |
| | **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.
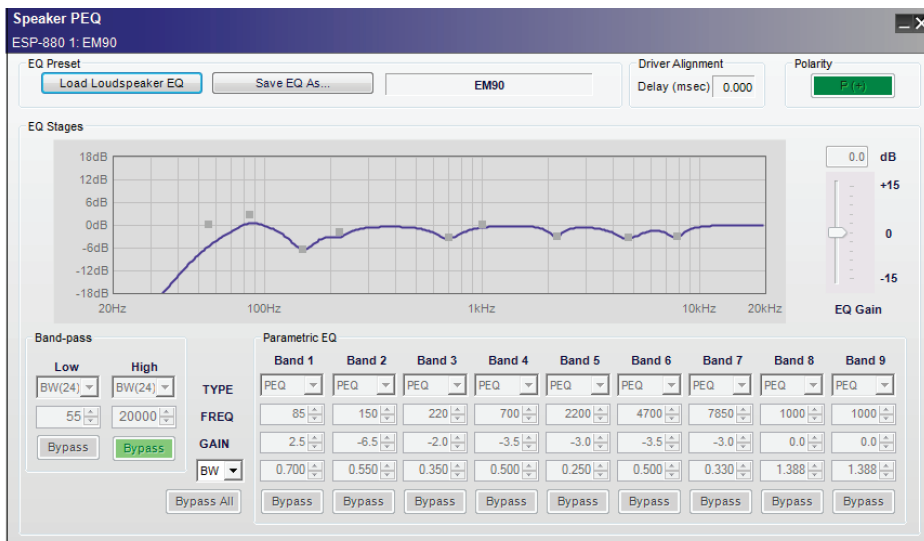


**EdgeMax EM180 loudspeaker EQ** – Use when the system contains only EM180 loudspeakers.

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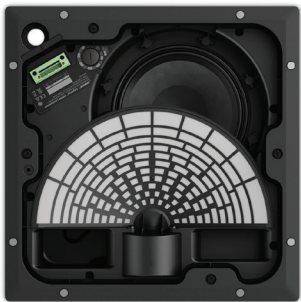
This design worksheet covers the basic steps for the creation of a system design comprised of EdgeMax EM180 in commercial audio/business music systems. EdgeMax EM180 loudspeakers are ideally suited for background/foreground music applications with mounting heights between 2.4 to 6.1 m (8 to 20').

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 | |
| | **DS 40F** | 106 | 103 | 100 | 98 | 96 | 95 | 94 | 93 | 91 | 89 | |
| | **DS 100F** | 108 | 107 | 104 | 102 | 100 | 99 | 98 | 97 | 95 | 93 | $dB_{SPL}$ |
| | **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<br>FreeSpace DS 40<br>FreeSpace DS 100 | EdgeMax EM90/EM180<br>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 |
| | **Premium** ft | 7 | 8 | 11 | 15 | 18 | 21 | 24 |
| | **Standard** m | 3 | 4 | 6 | 8 | 9 | 11 | 13 |
| | **Standard** 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.

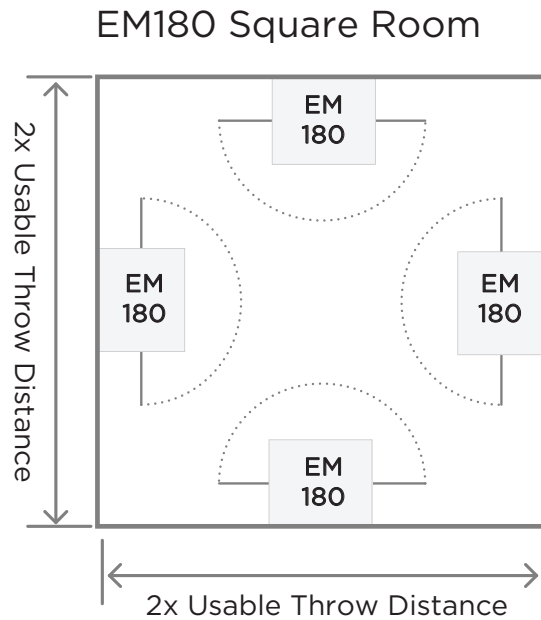| | |
|---|---|
| Square Shaped Room / Coverage Area<br><br>Proceed to Step 6 | Rectangular Shaped Room / Coverage Area<br><br>Proceed to Step 7 |

**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
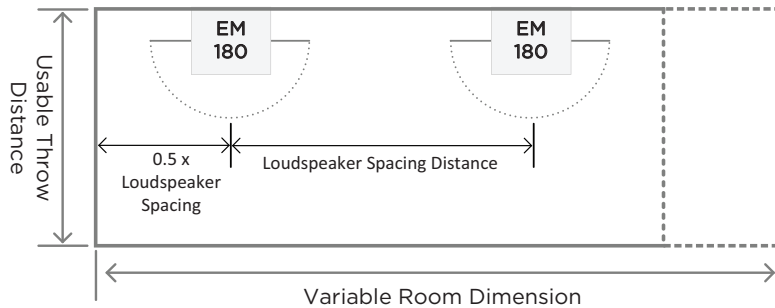


**Perimeter Mounting** – place the EdgeMax loudspeakers along side walls using the spacing distance for the mounting height that will be used.

### EM180 Perimeter Mounting



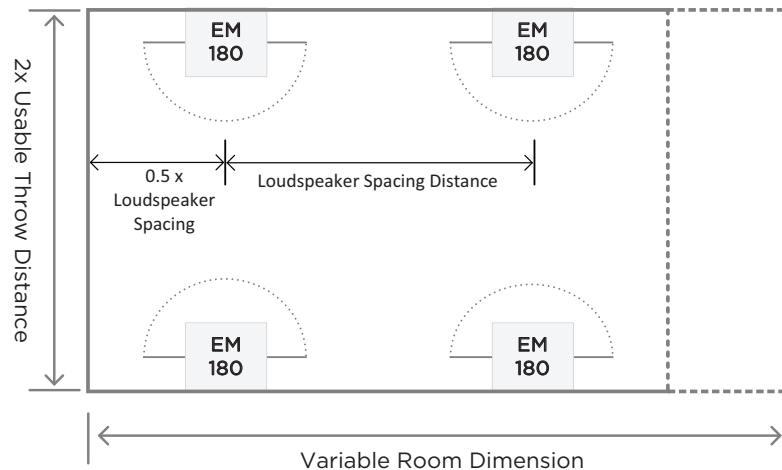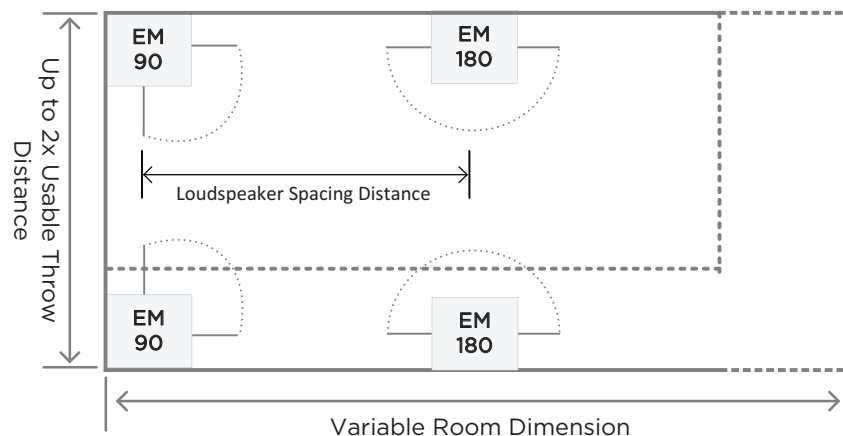**Mixed (Recommended)** – place the EdgeMax loudspeakers along side walls using the spacing distance for the mounting height that will be used.  Follow the guidelines for Single Edge and Perimeter mountings.

### 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** | |
| | **2.5** | 91 | 89 | 86 | 84 | 82 | 80 | 79 | 78 | 76 | | |
| | **5** | 94 | 92 | 89 | 87 | 85 | 83 | 82 | 81 | 79 | 78 | |
| | **10** | 97 | 95 | 92 | 90 | 88 | 86 | 85 | 84 | 82 | 81 | |
| **TAP** | **20** | 100 | 98 | 95 | 93 | 91 | 90 | 88 | 87 | 85 | 84 | dB$_{SPL}$ |
| | **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:

$$\underline{\hspace{3cm}} \quad \mathbf{X} \quad \underline{\hspace{3cm}} \quad \mathbf{=} \quad \underline{\hspace{3cm}}$$

   Number of            Required              Power
   Loudspeakers    Loudspeaker Tap      Required

   **E.** Calculate the required amplifier size:

$$\underline{\hspace{3cm}} \quad \mathbf{X} \quad 1.25 \quad \mathbf{=} \quad \underline{\hspace{3cm}}$$

   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').

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:
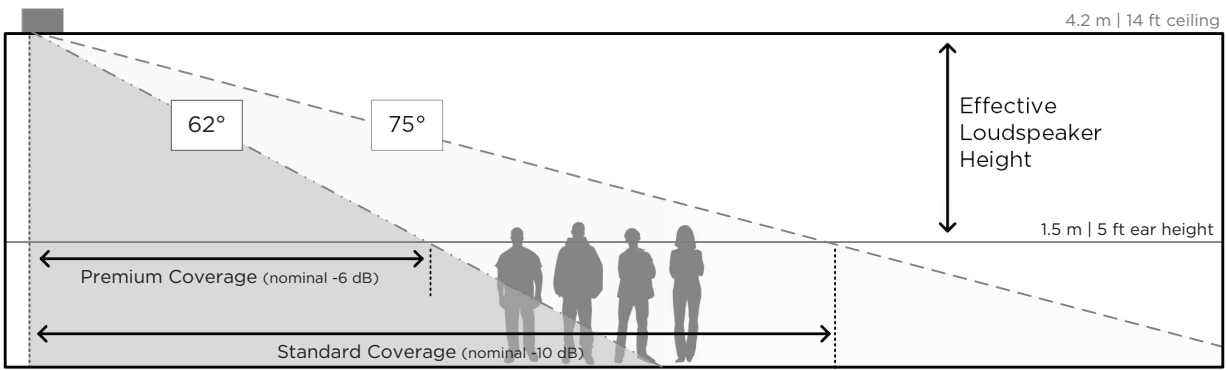
1. **Loudness:** What sound pressure level is required for this application?

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 a business music system and are ready to focus on the creation of a speaker layout using EdgeMax loudspeakers.

### Design Guidelines

EdgeMax loudspeakers provide an 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

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 | |
| | **DS 40F** | 106 | 103 | 100 | 98 | 96 | 95 | 94 | 93 | 91 | 89 | |
| | **DS 100F** | 108 | 107 | 104 | 102 | 100 | 99 | 98 | 97 | 95 | 93 | $dB_{SPL}$ |
| | **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<br>FreeSpace DS 40<br>FreeSpace DS 100 | EdgeMax EM90/EM180<br>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.



2x EM90 in Corners



4x EM90 in Corners
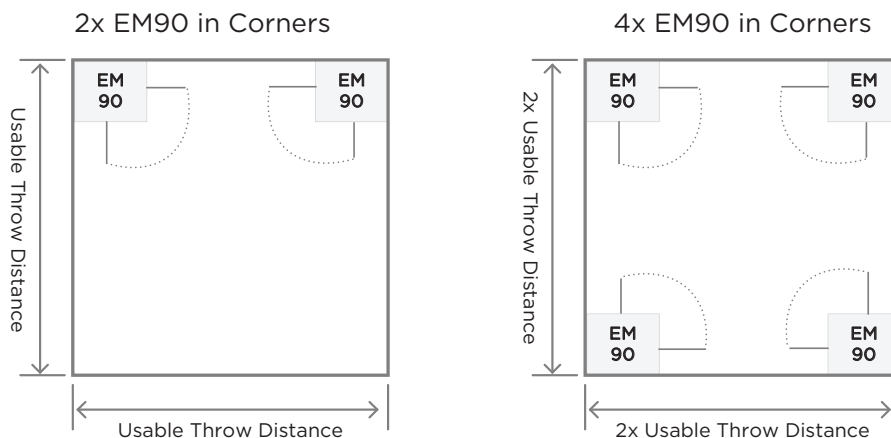
**NOTE:** *For designs where bass is a primary consideration, square rooms with 4x EM90s will deliver more bass then 4x EM180s, due to the additional wall-boundary loading provided by the corner mounting.*

**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:

$$\underline{\hspace{2cm}} \quad X \quad \underline{\hspace{2cm}} \quad = \quad \underline{\hspace{2cm}}$$

Number of Loudspeakers     Required Loudspeaker Tap     Power Required

**E.** Calculate the required amplifier size:

$$\underline{\hspace{2cm}} \quad X \quad 1.25 \quad = \quad \underline{\hspace{2cm}}$$

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.
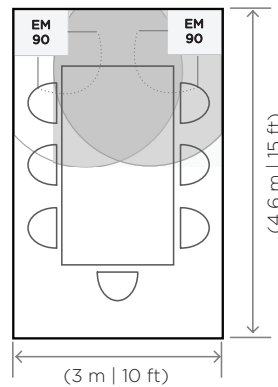
## Small Conference Rooms

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.

Small Conference Room
EM180 Mounted Above Screen
3.0 m | 10 ft ceiling
(4.6 m | 15 ft)
(3 m | 10 ft)
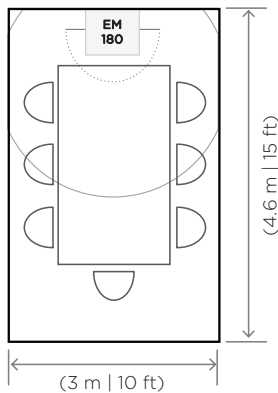
Small Conference Room
EM90s Mounted In Corners
3.0 m | 10 ft ceiling
(4.6 m | 15 ft)
(3 m | 10 ft)

**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.

Medium Conference Room
EM180 Mounted Along Perimeter
3.0 m | 10 ft ceiling
(4.5 m | 15 ft)
(7.6 m | 25 ft)
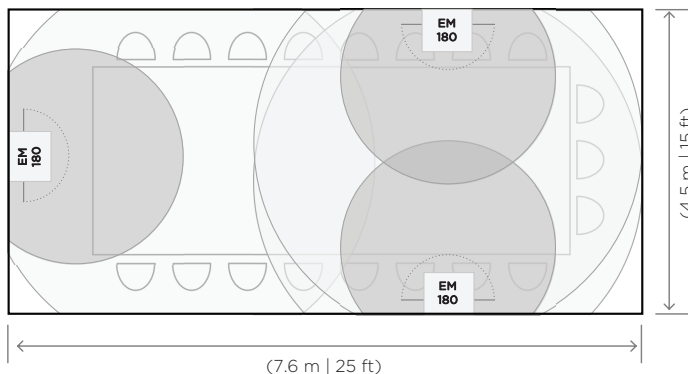
**Figure 14.** *In medium sized conference rooms a single EM180 is used above the screen location, and additional EM180s along the edges provide reinforcement for audio and video conferencing.*

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.

Medium Conference Room
EM90 and EM180s Mounted Along Perimeter
3.0 m | 10 ft ceiling
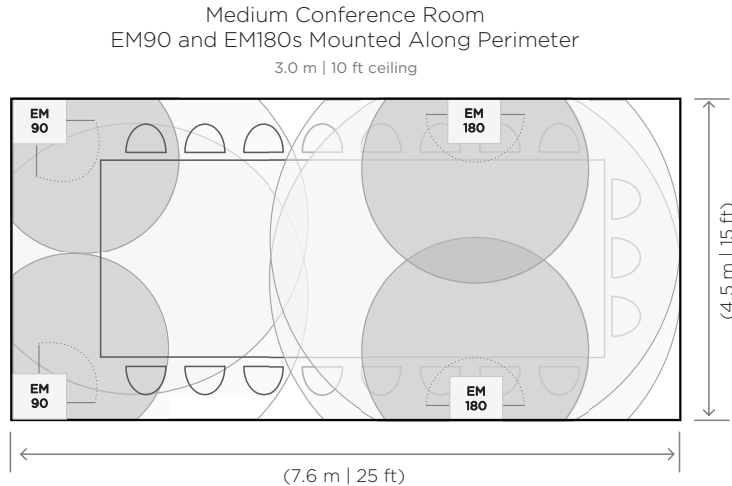
**Figure 15.** *In medium-sized conference rooms two EM90s can be mounted in the front of the room for stereo playback and conferencing, while additional EM180s can be installed along the side walls for conferencing reinforcement.*

## 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.

Large Conference Room
EM180s Mounted Along Perimeter
4.3 m | 14 ft ceiling
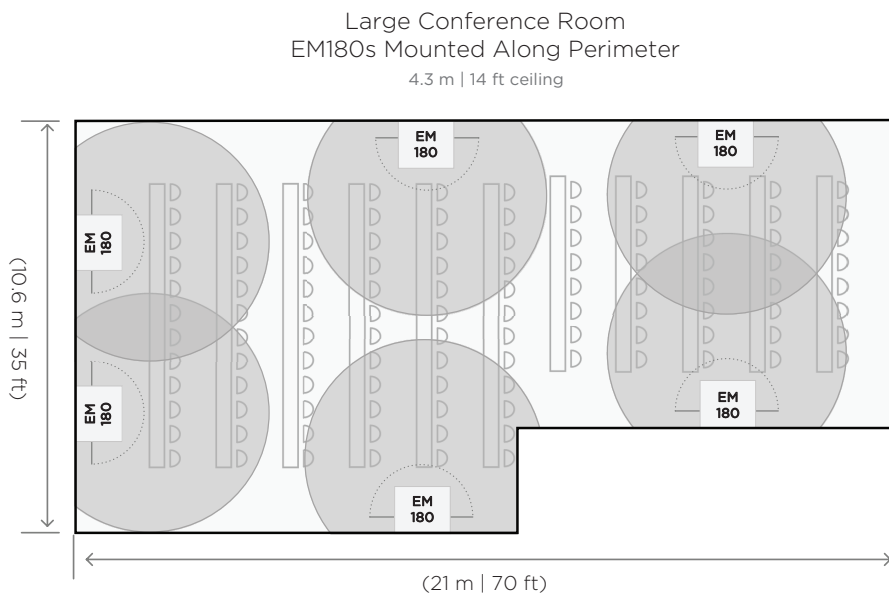
**Figure 16.** *A large conference room with two EM180s mounted near the video screen location, and additional units spaced along room sides using the recommended loudspeaker spacing for the room's ceiling height.*

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