Panaray® MA12EX
Modular Line Array Loudspeaker

DESIGN GUIDE

Introduction

The Panaray® MA12EX Modular Line Array Loudspeaker is ideal for a wide variety of indoor and outdoor applications where voice and full range music performance without bass augmentation are the main requirements. The MA12EX is well suited for indoor and outdoor: houses of worship, recreation, multi-purpose spaces, retail, restaurants, hospitality, auditoriums, transportation, atriums, malls, and gymnasiums.

In this guide we will discuss recommended design practices for Panaray MA12EX installations by exploring the following concepts:

- Recommended loudspeaker array height.
- Best location for loudspeaker arrays.
- Total number of loudspeaker modules required.
- Calculating loudspeaker array pitch.

Getting Started

When designing Panaray MA12EX loudspeaker systems, the following rules of thumb should be considered:

- An ***array*** is an assembly of one or more MA12EX loudspeakers at one location.
- The ***height*** of an array should between the seated and standing listener ear height; measured from the center of the loudspeaker module.
- The ***spacing*** between adjacent arrays in a facility should be 40 feet (12m) at maximum.
- Usable ***throw distance*** for arrays is:
  30′ (10m) for a single MA12EX array,
  75′ (23m) for double MA12EX arrays,
  120′ (35m) for triple MA12EX arrays.

System Performance (Single Module)	
Frequency Response (-3dB) [1]	75 Hz - 13 kHz
Frequency Range (-10dB)	58 Hz - 16 kHz
Calculated Maximum SPL @ 1m [2]	109 dB
Input Power Rating (continuous/peak) [3]	150W/600W
Axial Sensitivity (SPL/1W@1m) [4]	87 dB
Nominal Horizontal Coverage (-6dB)	160°
Nominal Vertical Coverage (-6dB) [5]	20°
Nominal Impedance (transformer bypass)	8Ω
Dimensions	38.8″ x 4.1″ x 5.5″ (986mm x 104mm x 140mm)
Weight	20.8lbs (9.43kg)

Notes:

[1–5] See "How our Loudspeakers are Measured" on page 4.

Design Checklist

A typical Panaray MA12EX loudspeaker design uses a Decentralized Array approach, comprised of left and right main arrays near the front of the venue's primary stage platform. This design guide focuses on this approach in a traditional house of worship of 400+ seats.

The first step in this systematic approach, is to determine the estimated throw distance from the loudspeaker location to the most distant listener.

1. Record Throw Distance (D) to the most distant listener. D = _____

Design Checklist (Continued)

The next step is to determine the number of loudspeaker modules required for each array. For flat seating areas, use the chart in Figure 1, and draw a vertical line corresponding to the throw distance recorded in step 1. Then draw a horizontal line corresponding to the estimated mid-band reverberation time of the room in seconds. Note the number of MA12EX modules indicated by the shaded area, where the two lines intersect.

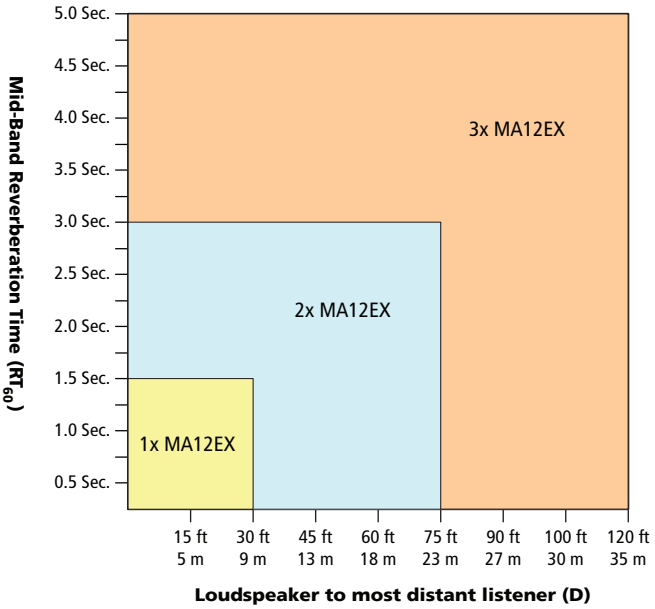

Figure 1: Loudspeaker Module Quantity Matrix

2a. Record MA12EX loudspeakers required per array = _____

For raked seating areas (seats mounted on a sloped floor), refer to visual elements shown in Figure 2 to determine the number of loudspeaker modules required to provide appropriate vertical coverage to the listeners.

The equation for determining this is as follows:

$$H_a = (D \times \sin\alpha) + (L + (8" \text{ or } 20cm))$$

2b. Record MA12EX loudspeakers required per array = _____

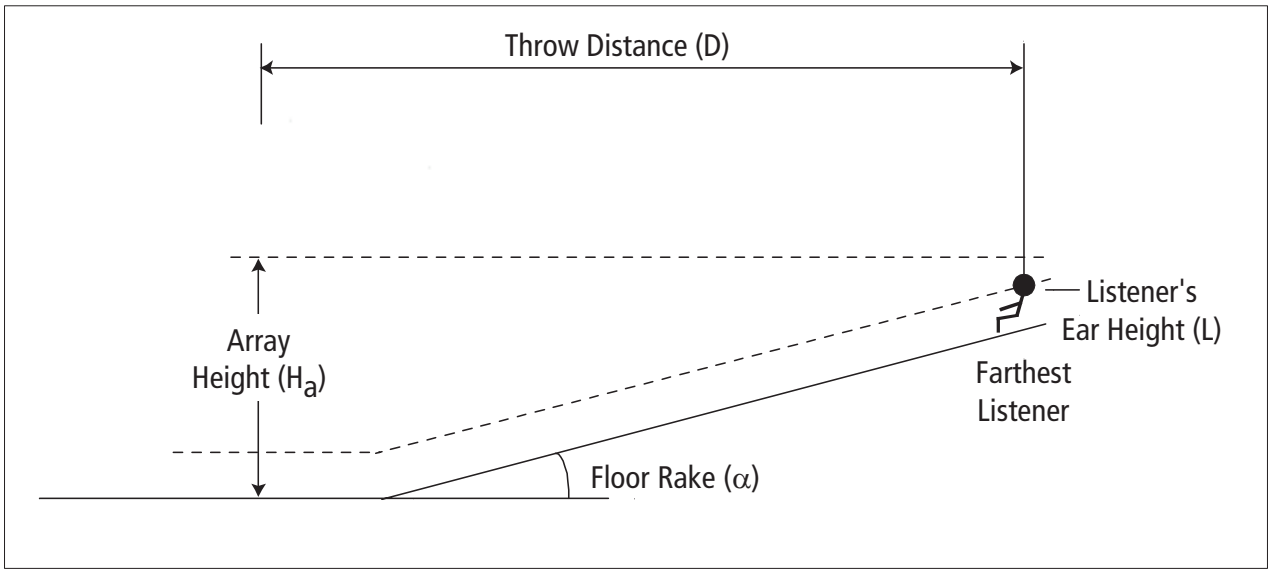

Figure 2: Raked Seating Factors

Design Checklist (Continued)

Once the number of loudspeaker modules per array is established, the next step is to determine the total number of loudspeaker modules required for the entire project. This quantity is derived by multiplying the number of loudspeaker modules per array, by the number of arrays required for the project.

In this sample design, we are using two array locations by referencing our spacing rule of thumb to maintain 30' (10m) between adjacent array locations. These locations are indicated in Figure 3 as circles at the front edge of the stage and the direction of array aiming is indicated by blue arrows.

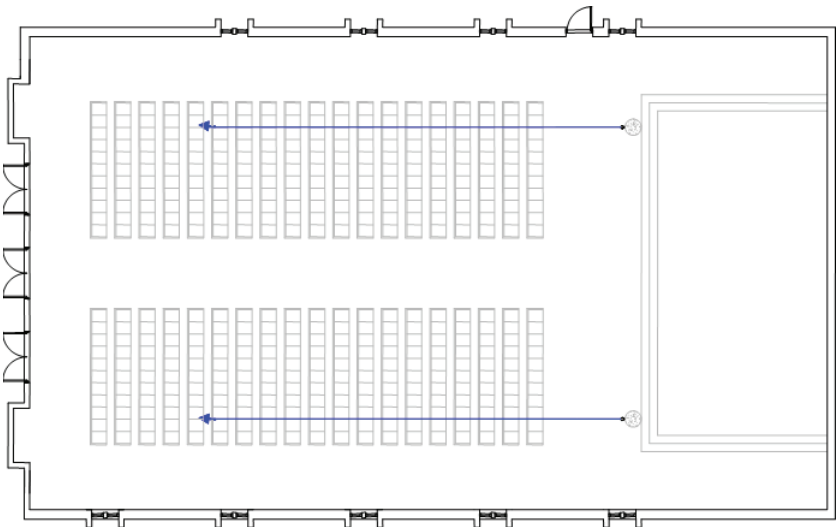

Figure 3: Distributed Array Locations

3. Record the total MA12EX loudspeakers required _____

The final step in this design process is to determine if any pitch is required for each of the arrays.

In many cases pitch is unnecessary, but two unique situations warrant the use of pitch:

- To prevent a ***late-arriving reflection*** at the front of the seating area off of a reflective rear wall.
- To ensure unobstructed ***line-of-sight*** coverage to all listeners.

Pitching Rule: An MA12EX loudspeaker should be mounted and pitched so the nearest seated listener's ears and the most distant standing listener's ears, are within the vertical coverage pattern of the array. See Figure 4 for an illustration of this effect.

1 to 5 degrees is the typical maximum pitch necessary to compensate for the effects mentioned above. Once a array is pitched, coverage at the rear of the seating area should be verified by listening tests, to ensure that all listener's are within the array's vertical coverage pattern.

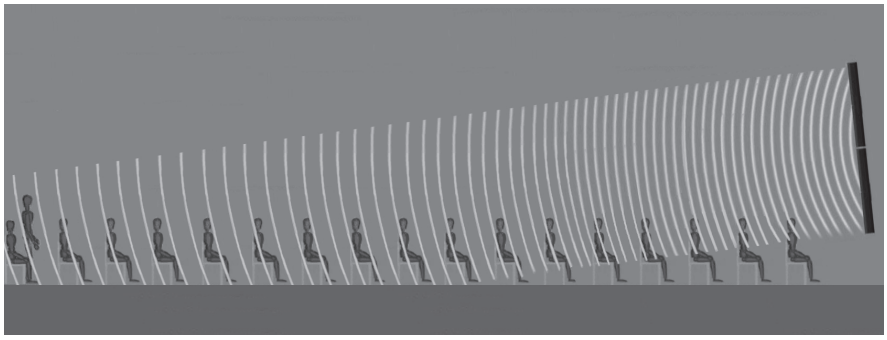

Figure 4: Array Pitch Example

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Rigging

MA12EX loudspeakers can be mounted as a single element, or stacked in multiples, to achieve line array performance. Bose® MA12EX loudspeaker mounting brackets are available and tested for use with single-, double-, and triple-stack MA12EX loudspeaker installations. For installations of four or more MA12EX loudspeakers, obtain your mounting system from a reputable manufacturer. Select a system design that works for your loudspeaker of choice and its intended use. Always have a licensed professional engineer review the design and fabrication for structural integrity and safety in the intended application.

How our Loudspeakers are Measured

1. Frequency Response and Range

Data is the average response in the typical coverage area with the recommended equalization applied.

2. Calculated Max SPL

Calculated based on input sensitivity with recommended equalization applied, and maximum input power rating exclusive of power compression.

3. Input Power Rating

Pink noise with a 6 dB crest factor is bandpass limited to the operating range of the loudspeaker and applied for 100 hours.

4. Axial Sensitivity

Full-bandwidth pink noise with recommended equalization amplified to a level of 1 watt and applied to the loudspeaker in an anechoic environment.

5. Nominal Vertical Coverage

Vertical coverage varies by number of modules vertically arrayed and distance from line-source boundary. Use Bose® Modeler® sound system software for the best prediction.

More Information

Technical literature and other materials are available at pro.Bose.com.

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