

# Barco AuroMax: room design guidelines

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# Table of content

<b>Introduction</b>	<b>3</b>
<b>AuroMax system design</b>	<b>4</b>
Three-layer approach	4
Objects and beds	4
<b>AuroMax room design</b>	<b>5</b>
Widescreen speakers	5
Full-range surrounds	5
<b>Default AuroMax configurations</b>	<b>6</b>
AuroMax 26.1	6
AuroMax 20.1	7
AuroMax 22.1	8
Overview	9
<b>System design</b>	<b>10</b>

## Introduction

The Barco immersive audio solution, through its APX AuroMax spatial audio processor, delivers the most realistic representation of standardized immersive audio compatible with the SMPTE 2098-2 immersive audio standard. It is the only immersive audio solution that utilizes both three-layer zones and a balanced mixture of channel and object-based technology.

By leveraging Barco's spatial sound rendering technology, AuroMax delivers the most realistic immersive audio cinema experience. It adds additional zones to the room, allowing for better placement of specific objects in the mix, regardless of the size of the room.

Leveraging Barco's signature surround layer and screen channel configuration, Barco's optimized immersive audio solution offers a large variety of speaker configurations up to 26.1, also supporting Auro 11.1, classic 5.1. or 7.1 and anything in between.

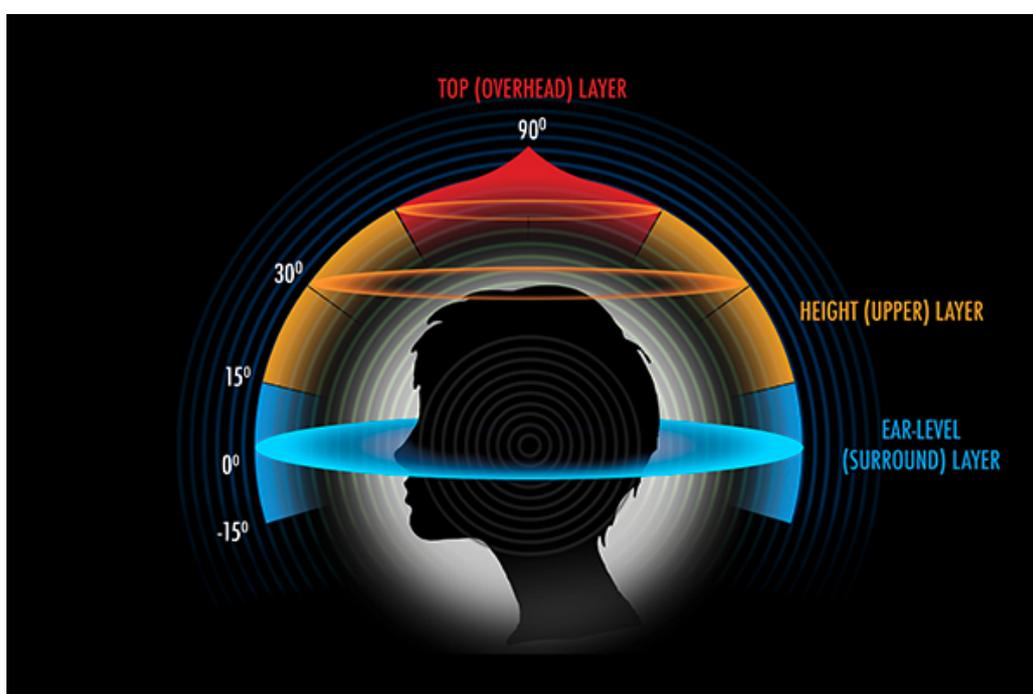
In this whitepaper we will introduce the concepts behind the technology that drive the room design; as well as give guidelines on how to do a proper room design and speaker layout for AuroMax. This whitepaper was based on the 2016 whitepaper by Barco and Auro Technologies on AuroMax

## AuroMax system design

### Three-layer approach

The unique 3-layered system allows for more precision in the localization of sounds on the vertical axis than systems using only object-based technology represented over 2 layers. This is because our hearing system is horizontally oriented and cannot experience sounds as phantom sources on the vertical axis between 2 speakers in the same way as on the horizontal axis.

The AuroMax speaker layouts are based on the existing 5.1 surround layouts, maintaining the largest possible sweet spot and providing the same experience as intended by the creators to almost every seat in the theater, for all kinds of content.



### Objects and beds

The use of Object-Based Audio (OBA) theoretically provides a 'format-agnostic' mix that should work with any speaker layout. In practice this has proven to have some limitations. One element is that the number of individually driven speakers required to take advantage of the spatial resolution of the OBA essence is higher than before.

The use of more individually driven speakers in combination with Object-Based Audio also potentially leads to a smaller sweet spot, due to a combination of speaker positioning, directivity and power handling. In some cases, a single speaker now needs to project a single sound into the whole theater, whereas in the past, speaker arrays were used to evenly spread the energy of this same sound throughout the whole theater. Depending on the size of the theater, this can lead to more unwanted variations in level and timbre.

The AuroMax system provides the best of both worlds, maximizing the sweet spot while enabling the use of Object-Based Audio and the reproduction of regular 5.1 and 7.1 content as defined by existing standards.

To provide the best listening experience while guaranteeing almost every spectator the same mix as intended by the creators, multiple AuroMax playback configurations have been defined. These make use of 'zones', dividing the traditional surround speaker arrays in the room into smaller groups of speakers. These individually addressable zones provide the increased resolution for Object-Based Audio, while not requiring the level of investment often associated with these systems to make each speaker its own channel. It also allows existing Auro 11.1 systems to be easily converted into AuroMax systems, by simply rewiring the speakers and installing a few additional amplifiers, when necessary.

## **AuroMax room design**

### **Widescreen speakers**

The use of the widescreen or 'proscenium' speakers is recommended for AuroMax designs. These allow a smooth transition from the screen to the front-most zone of surround speakers. In cinema theaters, the front-most surround speakers are installed near the first row of seats, which creates a gap between the left or right screen channel and the first surround speakers. This effect can especially be noticed when sounds are moving from the screen into the front-most surround zones. In order to fill that gap, it is recommended to optionally add 4 more speakers: one on each side wall in the lower layer and in the height layer. The 4 widescreen speakers will only be used for the objects and can be directed towards the middle of the theater in order to have a good spread of sound over the whole room without any influence on the channel-based sounds of the beds.

### **Full-range surrounds**

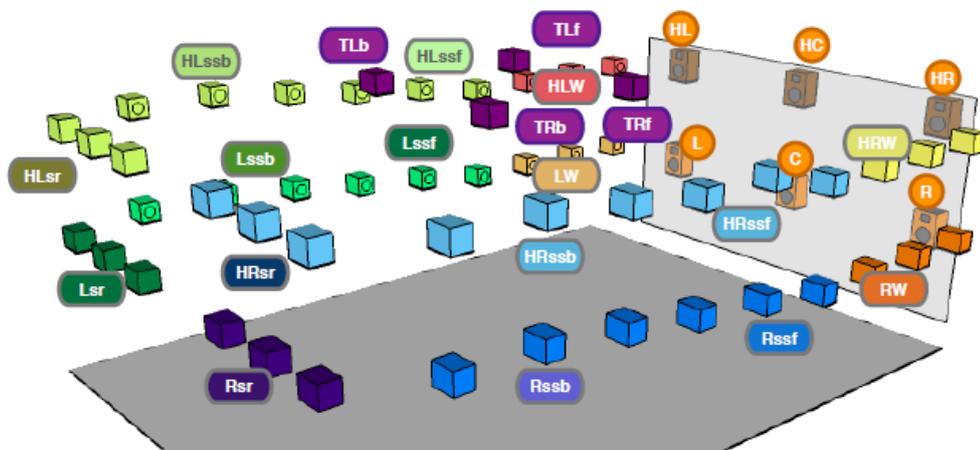
With the advent of immersive sound in cinema, full-range surrounds capable of reproducing the full sound spectrum have become a much-welcomed possibility as well, bringing the sound quality of all output channels to the same level as the screen channels. This can be achieved using full-range speakers or, more practically, by adding subwoofers in the room and applying bass management. Bass management is strongly recommended in the surround and top channels. Adding bass management to the surround system typically involves installing a subwoofer at each side of the theater, either on the side walls or on the back wall.

## Default AuroMax configurations

### AuroMax 26.1

The ideal configuration using the 'zones' approach, adds the so-called "proscenium" speakers between the screen channels and the front-most surround speakers. These allow for smoother movements of sounds from the screen into the room and are often used to bring the music slightly into the room, away from the screen. The surround speaker arrays are divided into two zones for each wall, while the top layer (overhead) consists of four zones, arranged in a square.

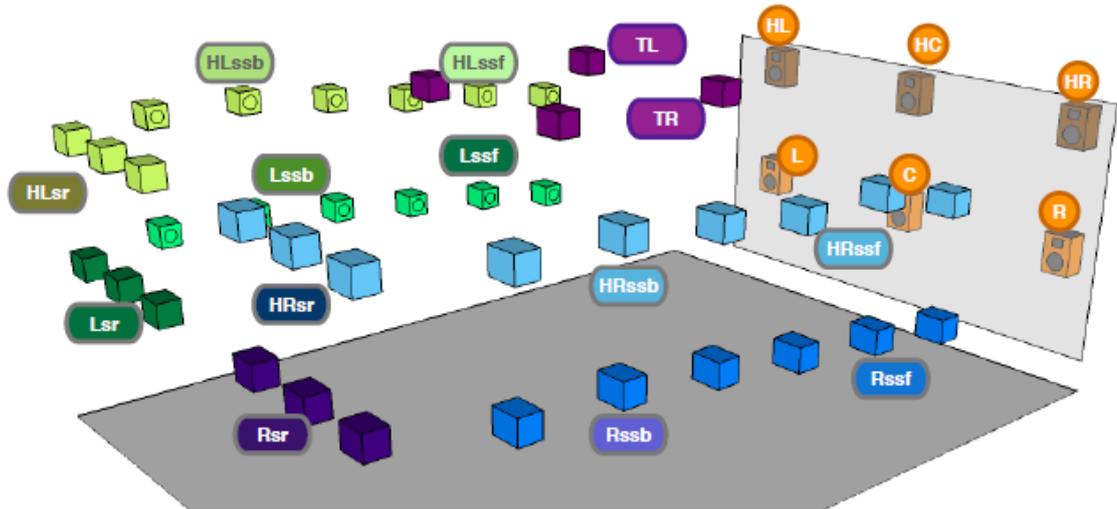
This configuration is the recommended configuration for most rooms and provides the best immersive sound experience with the highest compatibility and a large sweet spot.



<b>L</b> Left	<b>LW</b> Left Wide	<b>Lssf</b> Left Side Surround Front	<b>Lsr</b> Left Surround Rear	<b>TLf</b> Top Left Front
<b>C</b> Center	<b>RW</b> Right Wide	<b>Lssb</b> Left Side Surround Back	<b>Rsr</b> Right Surround Rear	<b>TRf</b> Top Right Front
<b>R</b> Right		<b>Rssf</b> Right Side Surround Front		<b>TLb</b> Top Left Back
		<b>Rssb</b> Right Side Surround Back		<b>TRb</b> Top Right Back
<b>HL</b> Height Left	<b>HLW</b> Height Left Wide	<b>HLssf</b> Height Left Side Surround Front	<b>HLsr</b> Height Left Surround Rear	
<b>HC</b> Height Center	<b>HRW</b> Height Right Wide	<b>HLssb</b> Height Left Side Surround Back	<b>HRsr</b> Height Right Surround Rear	
<b>HR</b> Height Right		<b>HRssf</b> Height Right Side Surround Front		
		<b>HRssb</b> Height Right Side Surround Back		

## AuroMax 20.1

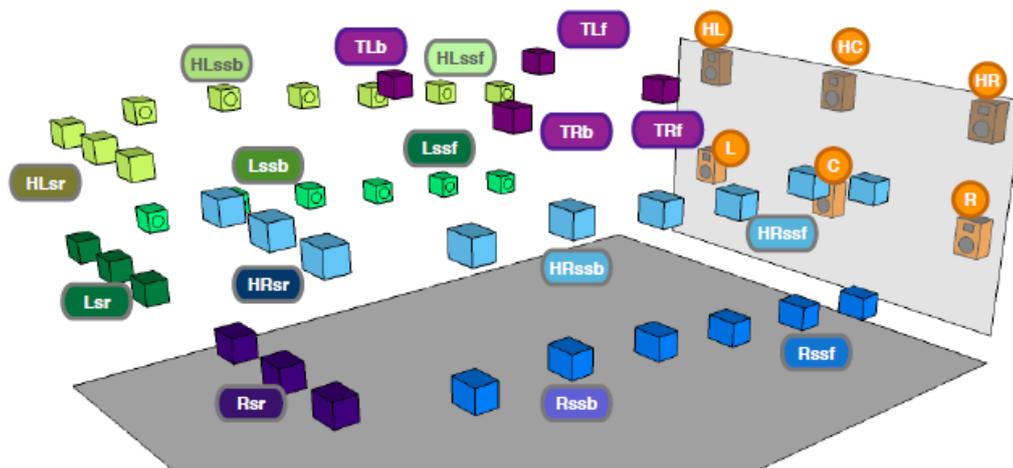
The smallest default configuration for AuroMax splits the surround and top speaker arrays into two zones for each wall.



- |                         |   |  |                     |
|-------------------------|---|--|---------------------|
| <b>L</b> Left           | <b>Lssf</b> Left Side Surround Front          | <b>Lsr</b> Left Surround Rear          | <b>TL</b> Top Left  |
| <b>C</b> Center         | <b>Lssb</b> Left Side Surround Back           | <b>Rsr</b> Right Surround Rear         | <b>TR</b> Top Right |
| <b>R</b> Right          | <b>Rssf</b> Right Side Surround Front         |  |                     |
|                         | <b>Rssb</b> Right Side Surround Back          |  |                     |
| <b>HL</b> Height Left   | <b>HLssf</b> Height Left Side Surround Front  | <b>HLsr</b> Height Left Surround Rear  |                     |
| <b>HC</b> Height Center | <b>HLssb</b> Height Left Side Surround Back   | <b>HRsr</b> Height Right Surround Rear |                     |
| <b>HR</b> Height Right  | <b>HRssf</b> Height Right Side Surround Front |  |                     |
|                         | <b>HRssb</b> Height Right Side Surround Back  |  |                     |

## AuroMax 22.1

In a second configuration the Top layer is further divided into 4 distinct zones.



- |                         |   |  |                            |
|-------------------------|---|--|----------------------------|
| <b>L</b> Left           | <b>Lssf</b> Left Side Surround Front          | <b>Lsr</b> Left Surround Rear          | <b>TLf</b> Top Left Front  |
| <b>C</b> Center         | <b>Lssb</b> Left Side Surround Back           | <b>Rsr</b> Right Surround Rear         | <b>TRf</b> Top Right Front |
| <b>R</b> Right          | <b>Rssf</b> Right Side Surround Front         |  | <b>TLb</b> Top Left Back   |
|                         | <b>Rssb</b> Right Side Surround Back          |  | <b>TRb</b> Top Right Back  |
| <b>HL</b> Height Left   | <b>HLssf</b> Height Left Side Surround Front  | <b>HLsr</b> Height Left Surround Rear  |                            |
| <b>HC</b> Height Center | <b>HLssb</b> Height Left Side Surround Back   | <b>HRsr</b> Height Right Surround Rear |                            |
| <b>HR</b> Height Right  | <b>HRssf</b> Height Right Side Surround Front |  |                            |
|                         | <b>HRssb</b> Height Right Side Surround Back  |  |                            |

## Overview

The table below gives an overview of the reproduction channels of the different zone-based AuroMax playback configurations.

	Zone	Auro-Max 20.1			Auro-Max 22.1			Auro-Max 26.1		
		Obj	Chan 11.1	Chan 13.1	Obj	Chan 11.1	Chan 13.1	Obj	Chan 11.1	Chan 13.1
1	L	L	L	L	L	L	L	L	L	L
2	C	C	C	C	C	C	C	C	C	C
3	R	R	R	R	R	R	R	R	R	R
4	Lw	-	-	-	-	-	-	Lw	-	-
5	Rw	-	-	-	-	-	-	Rw	-	-
6	Leef	Leef	Le	Lee	Leef	Le	Lee	Leef	Le	Lee
7	Reef	Reef	Re	Res	Reef	Re	Res	Reef	Re	Res
8	Leeb	Leeb	Le	Lee	Leeb	Le	Lee	Leeb	Le	Lee
9	Reeb	Reeb	Re	Res	Reeb	Re	Res	Reeb	Re	Res
10	Lre	Lre	Le	Lre	Lre	Le	Lre	Lre	Le	Lre
11	Rre	Rre	Re	Rre	Rre	Re	Rre	Rre	Re	Rre
12	HL	HL	HL	HL	HL	HL	HL	HL	HL	HL
13	HC	HC	HC	HC	HC	HC	HC	HC	HC	HC
14	HR	HR	HR	HR	HR	HR	HR	HR	HR	HR
15	HLw	-	-	-	-	-	-	HLw	-	-
16	HRw	-	-	-	-	-	-	HRw	-	-
17	HLeef	HLeef	HLe	HLe	HLeef	HLe	HLe	HLeef	HLe	HLe
18	HReef	HReef	HRe	HRe	HReef	HRe	HRe	HReef	HRe	HRe
19	HLeeb	HLeeb	HLe	HLe	HLeeb	HLe	HLe	HLeeb	HLe	HLe
20	HReeb	HReeb	HRe	HRe	HReeb	HRe	HRe	HReeb	HRe	HRe
21	HLre	HLre	HLe	HLe	HLre	HLe	HLe	HLre	HLe	HLe
22	HRre	HRre	HRe	HRe	HRre	HRe	HRe	HRre	HRe	HRe
23	TLf	TL	T	T	TLf	T	T	TLf	T	T
24	TRf	TR	T	T	TRf	T	T	TRf	T	T
25	TLb	TL	T	T	TLb	T	T	TLb	T	T
26	TRb	TR	T	T	TRb	T	T	TRb	T	T
27	LFE	-	LFE	LFE	-	LFE	LFE	-	LFE	LFE

## System design

### AuroMax System Designer

Available through [my.barco.com](http://my.barco.com), we have created the AuroMax System Designer. This tool translates detailed physical room dimensions into accurate speaker positions.



System Designer v1.0.0

**User Guide:**

- Start working through the Tool by entering the dimensions of your Room in the **Room Dimensions** sheet.
- The first section consists of all parameters required for calculating the speaker positions of an APX system.
- There is an optional section (labeled) with parameters enabling you to customize some automatically calculated values. Leaving them empty restores the calculation.
- You get a notification for invalid inputs for most parameters which you need to resolve before the system gets calculated.
- Not every invalid input prevents the tool from calculating (e.g. having a screen width wider than the room itself). Use the visualizations of the room to find invalid parameters.

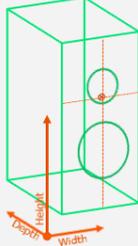
- The sheet called **Speaker Dimensions** contains an interface for entering the physical dimensions of the speaker groups. The values *Height*, *Width* and *Depth* correspond to the actual dimension of the speaker.
- The tool uses the *acoustic center* (ac) of a speaker to determine its position. With the **AC factor** you can define the ac position within the speaker. Their values are relative weights between 0 and 1 for each speaker dimension.
- The origin of coordinates is in the front most left bottom corner (see picture 1).
- For example an ac at two thirds height, center width and the face of the speaker can be achieved with the values 0.66/0.5/0.0 (see red indicator in picture 1)

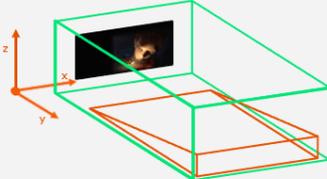
- The Sheet **Speaker List** lists the coordinates for all calculated speaker positions.
- The xyz-coordinates correspond to the *acoustic center* of a speaker.
- x stands for the width, y for the length and z for the height within the room (see picture 2).
- The origin of coordinates is in the left bottom corner at the front wall.

- The sheets **Front View**, **Side View**, **Rear View** and **Ceiling view** visualize the results graphically for different viewing points and can be shared with your installation partner/team.



Picture 1: Speaker dimension system



Picture 2: Room coordinates

For questions on how to use this tool or on how to work with the default configurations of your specific project, don't hesitate to reach out to the AuroMax team at Barco.