

## Speaker coverage calculation

## Quick guide

# Speaker coverage calculation

## Introduction

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### Introduction

This document describes how to estimate the number of speakers you need at a site. The method works for both indoor and outdoor environments. For more information about the fundamentals of audio and acoustics, see the document *Introduction to audio – Acoustics, speakers and audio terminology*.

# Speaker coverage calculation

## Products covered by this document

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### Products covered by this document

The information in this document is valid for the following Axis network speakers:

- - AXIS C1310-E Network Horn Speaker
- - AXIS C1210-E Network Ceiling Speaker
- - AXIS C1211-E Network Ceiling Speaker
- - AXIS C1410 Network Mini Speaker
- - AXIS C1510 Network Pendant Speaker
- - AXIS C1511 Network Pendant Speaker
- - AXIS C1610-VE Network Sound Projector
- - AXIS C1110-E Network Cabinet Speaker
- - AXIS C1111-E Network Cabinet Speaker



# Speaker coverage calculation

## Different demands on even sound levels

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### Different demands on even sound levels

Axis recommends two different solutions depending on the customer requirements of the evenness of the audio level:

<b>Basic</b>	<p>The basic setup will give you the minimum number of speakers needed to cover a certain area. Going below this number of speakers is never recommended, since the evenness of audio levels would vary too much within the area.</p> 
<b>Premium</b>	<p>The premium setup will give you twice the number of speakers compared to a basic solution. A more even audio level will be created throughout the area.</p> 

For announcements, a basic solution will be enough in most situations. If the ambient audio level is very high (like a noisy manufacturing site), then a premium solution is recommended. For background music in retail (like a grocery or DIY store) a basic solution will be enough. A retail business choosing a premium solution could be a high-end fashion store where the customer experience is critical.

A certain installation might also require a combination of basic and premium. This could be a larger project with many different types of areas, such as a school campus, shopping mall or manufacturing site.

# Speaker coverage calculation

## Indoor placement

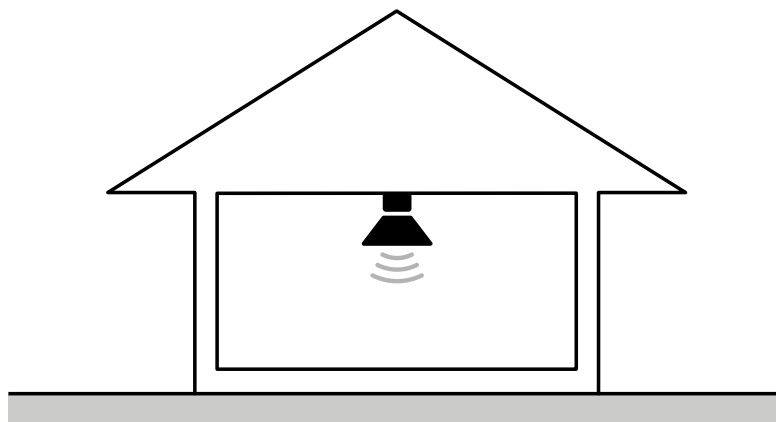
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### Indoor placement

Speakers can be mounted in a ceiling or on a wall when used indoor.

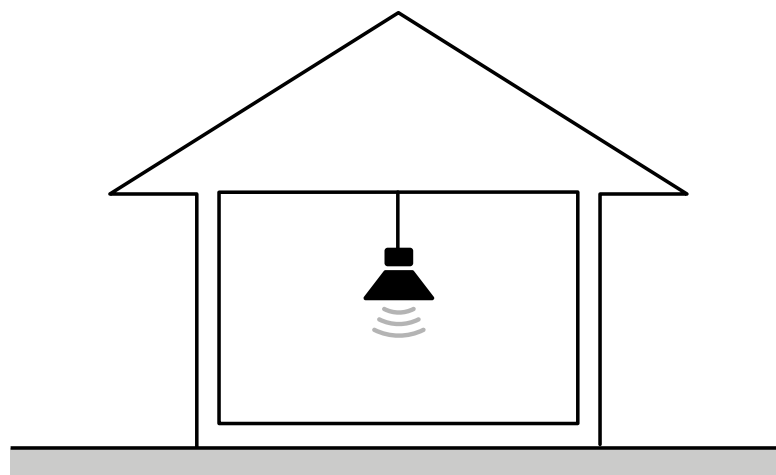
#### Ceiling mount

All Axis network speakers can be mounted in the ceiling, which means that the sound is going from ceiling to floor. The preferred way to get the most even coverage of audio levels is a ceiling-mounted solution. This means that if you play a message it can be clearly heard at any position. However, sometimes a ceiling mounted solution is not possible due to a very solid material of the ceiling, height of the ceiling or obstacles between the ceiling and the floor.



#### Pendant mount

In the event that the height of the ceiling is the limiting factor for a ceiling mount installation, pendant mount speakers can be used instead. These speakers are intended to be mounted on a wire in a high ceiling in order to provide the same level of coverage as a ceiling mounted speaker.



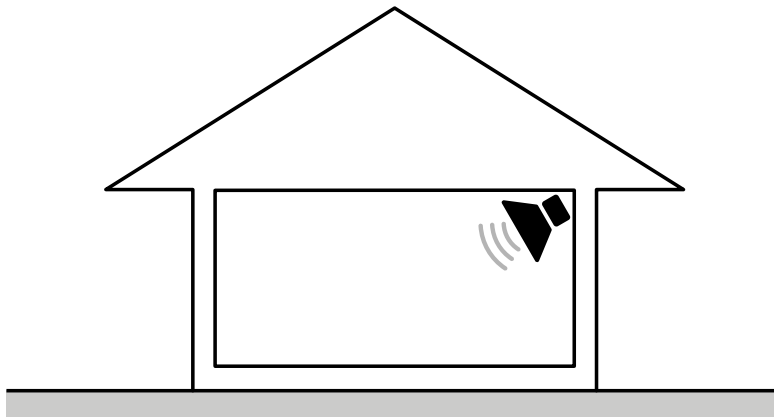
# Speaker coverage calculation

## Indoor placement

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### Wall mount

With wall-mounted speakers the direction of the audio is going from the speaker and straight out in the room. A wall-mounted solution is more cost-efficient than a ceiling-mounted solution, due to the fewer number of speakers required. However, when considering a wall-mounted solution we need to account for the distance the speaker can reach into the room. For a large room, the audio levels in the center of the room might be too low if messages are to be clearly heard at any position.



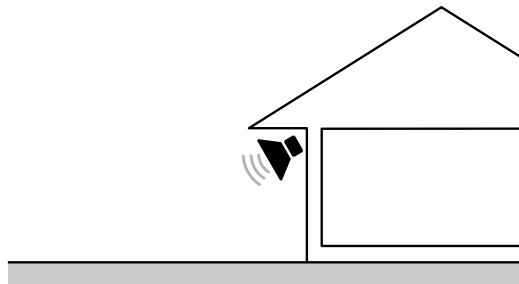
# Speaker coverage calculation

## Outdoor placement

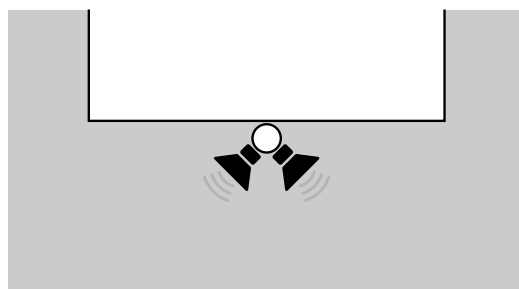
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### Outdoor placement

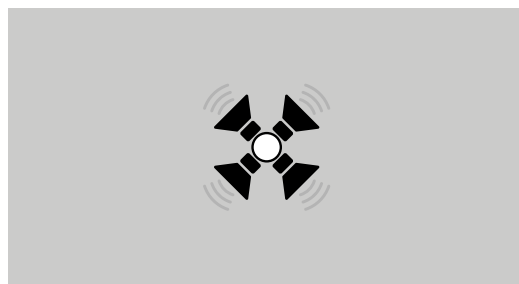
Speakers can be mounted on a wall or pole when used outdoor. In an outdoor solution the spread of audio is better due to less reflections and can often use a fewer number of speakers than an indoor solution.



*Outdoor wall placement*



*Outdoor pole placement with two speakers*



*Outdoor pole placement with four speakers*

# Speaker coverage calculation

## Calculate how many speakers you need

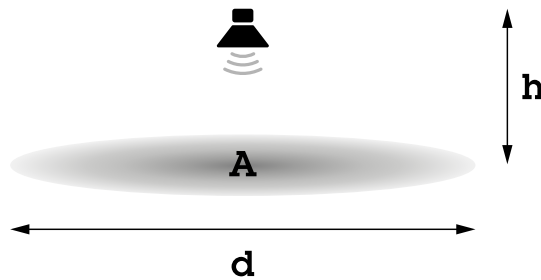
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### Calculate how many speakers you need

The calculations in this document are for basic solutions. A premium solution contains twice as many speakers as a basic solution.

#### Indoor ceiling mount (including the horn speaker)

A higher mounting height makes a speaker cover a larger floor area.



- h* Mounting height
- A* The area that a single speaker covers on the floor
- d* The diameter of *A*

1. Calculate the diameter of the area that a single speaker covers on the floor:

For C1110-E, C1111-E, C1310-E, C1210-E, C1211-E, C1510, C1511 and C1610-VE:  $d = h \times 3$

For C1410:  $d = h \times 4$

2. Calculate the cover area for a single speaker:

$$A = 3.14 \times (d / 2)^2$$

3. Calculate the number of speakers needed:

$$\text{Number of speakers} = \text{Total floor area of the room} / A$$

*Example: An office with a ceiling height of 2.5m (8ft) makes one speaker cover an area with a 7.5m diameter (3 x 2.5m), which makes the cover area 44m<sup>2</sup> (3.14 x (7.5/2)<sup>2</sup>). If the total floor area of the room is 700 m<sup>2</sup>, then you need sixteen (700/44) speakers.*

#### Wall mount (indoor and outdoor)

This calculation works for all speakers outdoor. For horn speakers it works for both indoor and outdoor.

1. Calculate the distance you need between the speakers:

$$\text{Speaker distance} = 6 \times (\text{Mounting height} - 1)$$

2. Calculate the number of speakers needed:

$$\text{Number of speakers} = \text{Length of wall} / \text{Speaker distance}$$

*Example: An office with a mounting height of 2.5m (8ft) requires the distance between the speakers to be 9m (6 x (2.5 - 1)). If the wall is 45m long you need five speakers (45 / 9).*



# Speaker coverage calculation

## Calculate how many speakers you need

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### Horn speaker (outdoor)

An Axis network horn speaker can be mounted outdoor on a wall or pole. In any case, we recommend using a parallel spacing of 140m (230ft).

