

Basic Design Guide

Basic system design is pretty simple. You need to know some key information in order to come up with a good design. The dimensions of the room, ceiling height, where sound is needed, how loud the system needs to play, etc.

Step by Step

1. First you need to figure out what kind of speakers you need and how many are necessary. There is a simple formula to follow that will help you get an accurate speaker count.
2. You then need to know how much power will be necessary. There is a simple process for that, too.
3. You'll also need to decide how many volume controls will be needed and whether paging is necessary.

What kind of speakers do I need?

In the following cases we'll use a basic retail store or restaurant to make our calculations. The kind of speaker depends a good deal on the ceiling type or mounting situation.

Flush mounted speakers	Surface mounted speakers
<ul style="list-style-type: none">• Drop tile ceilings under 25 feet• New construction sheetrock ceilings	<ul style="list-style-type: none">• Existing building sheetrock ceiling• Excessively low ceilings (under 8')• Column mounted situations• Outdoor wall mounted situations

How many speakers do I need?

In a drop tile ceiling (most common) for **premium speakers** use this simple formula: For simple purposes this formula should be used for all Bose and JBL ceiling speakers, plus any ceiling speakers that are four to five inches in diameter.

Subtract the ear height from the ceiling height and multiply that number by three. Square the result and then divide it into the square footage. It may be easier to understand as an equation:

$$\text{Speakers} = \text{square footage} / [(\text{ceiling height} - \text{ear height}) 3]^2$$

- Ear height for a seated audience (restaurant) is **3.5 feet**
- Ear height for a standing listeners (retail and others) is **5 feet**

Example:

A retail show floor that was 40 x 90 with a 12 foot ceiling would go like this:

- ∇ Subtract the ear height (5) from the ceiling height (12) to get 7.
- ∇ Multiply 7 x 3 to get 21.
- ∇ Multiply 21 x 21 to get 441.
- ∇ Divide that number into the square footage (3600/441) to get 8.1 speakers.
- ∇ Round it down to eight and you've got your speaker count.

Flush mounted speakers are also recommended for new construction hard ceilings provided the system can be pre-wired and roughed in prior to sheetrock installation.

For economy 8 inch speakers use spacing rules:

- If the system will be playing music, space the speakers at 1.5 times the ceiling height
- If the system will be for paging only, and understanding every word is not critical, space the speakers at 2 times the ceiling height

To calculate the number of loudspeakers required, divide the spacing number into the length and width of the room, round to the nearest whole number, and multiply the two numbers together.

NOTE: If economy is the main driver of the purchase, you can use the paging formula for music. However, the customer must understand that they are sacrificing coverage by using fewer loudspeakers.

Example:

- ∇ Same retail store at 40 x 90 with a 12 foot ceiling. They system will be playing music.
- ∇ The spacing should be 1.5 x the ceiling height = 18.
- ∇ Divide 18 into the length of the room: $90/18 = 5$ speakers.
- ∇ Divide 18 into the width of the room: $40/18 = 2.2$ (=2 rounded down)
- ∇ Multiply the two together: $2 \times 5 = 10$ speakers.

The Global Speaker Solution

In the DMX MUSIC line of loudspeakers, we have a self-branded value loudspeaker to offer. This loudspeaker is manufactured by Posh specifically for our company. The benefits of the speaker are:

- **Aesthetically pleasing.**
- **Dispersion** of a 5½ inch driver, which is much wider than that of an 8-inch loudspeaker.
- **Low Cost** – it is more economical than a conventional coaxial loudspeaker.

Design systems with the Global Speaker using the same formula as the premium loudspeaker.

Surface-Mount Loudspeakers

In an existing sheetrock ceiling, or other hard surface, or a very low ceiling, use perimeter and column mounted surface speakers. The simple formula to remember for surface mounts is:

Each speaker will cover a circle with a diameter of 25 feet.

A speaker mounted on a wall firing directly into a room would cover 12.5 feet on either side of it and 25 feet out into the room. Some larger speakers like the JBL Control 28 will throw a little farther.

Example:

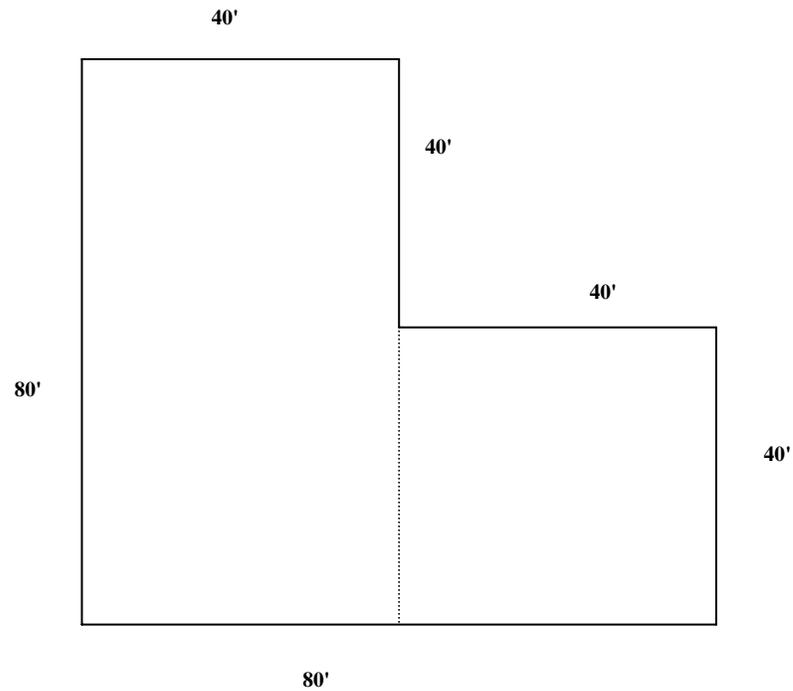
Same retail store at 40 x 90 with a 12 foot ceiling. They system will be playing music.

- ▽ Divide the length of the room by 25, which equals 3.6. Round that up to 4 speakers.
- ▽ Since the speaker throw 25' each for a total of 50' of coverage if they were on facing walls, you would put 4 speakers down the length of each 90' wall for a total of 8 speakers. Each speaker would be placed evenly along the longer wall.

Calculating square footage

The easiest method for this is counting ceiling tiles.

- Square tiles are 2 feet by 2 feet
- Rectangular tiles are 2 feet by 4 feet



To calculate the square footage, multiply the length times the width. In "L" shaped rooms, split the space into two rectangles.

Calculating ceiling height

A ballpark method is to visualize how many grown adult males (6 feet tall) stacked up it would take to reach the ceiling. Ask the business owner, or if it's new construction, get a copy of the reflected ceiling plan. Get as accurate a height as possible. Two feet can make a difference.

Note: When dealing with retail, business owners will be very keen on what their square footages are as that is how they calculate their rent, sales per square foot, etc... If you're having trouble figuring out dimensions, ask the owner.

New Construction

New construction can be easier to design because there will be blueprints for the project. Prints are generally many pages and encompass all levels of construction on the job. The pages you need for a quality system design are:

Reflected Ceiling Plan: Locations of lights, HVAC ducts, ceiling types, etc...

Floor Plan: Locations of furniture, fixtures, walls, doors

Elevations Plan: Heights of ceilings, soffits, and other architectural details.

Timing on these jobs is critical. The system will need to be pre-wired while all of the other electrical system components are being wired. It will also need to be roughed in before any hard ceiling is finally installed. The last step is to install the speakers and make final connections to the amplifier.

How much Power will I need?

This depends on how many speakers you have and what the system will be used for.

- Higher ceilings and loud venues like Bars and young retail require more power per speaker. Loud venues that want business foreground music will need the system to play between 80-85 dB.
- Offices, hotels, non-youth oriented retail, and quieter restaurants require less power per speaker. Venues who want only background music will need the system to play at 55-70 dB.

Headroom

Refer to your tapping guidelines elsewhere in this manual to figure how much power per speaker, then simply add them all for your total power needs. Make sure to have at least 20 percent headroom in your amplifier. Your amplifier needs a little extra room, just like your car does. You may only drive your car 70 miles per hour, but it can go 85 miles per hour if you need it to. The same goes for amplifiers. Sometimes there are peaks in the music that the amplifier needs to handle. Allowing for headroom will make sure the system will always sound good.

Also, leave extra room if you can for future expansion of the system. The customer may want to add a few speakers here or there in the future. Leaving extra room will insure that there will be enough power.

Zoning

Very often you will have to zone your sound system. A zone is any part of a system that needs to be controlled separately from the rest of the system. Zones fall into three categories:

- **Music Zones**
- **Paging Zones**
- **Volume Zones**

A **music zone** is exactly how it sounds. It's an area that has it's own style of music playing. If you need to have different music in the Bar from the Restaurant, you'll need a two-zone system. Also, each music zone requires it's own amplifier and music source. A two-zone music system would require two DR500's and two amplifiers.

A **paging zone** is similar to a music zone in that it also requires it's own amplifier. The standard hospitality page zoning has paging in the lounge and waiting area but not in the dining area. This would require two amplifiers, one with paging capabilities, with a paging microphone.

The other common paging scenario is in retail or grocery stores. The retail paging system is typically one zone, whereas the grocery paging can be multiple zones. Both of these systems would use the telephone system as the paging source.

A **volume zone** is a different concept. A volume zone doesn't require a separate amplifier. It's simply a group of speakers that need to have the volume adjusted, such as different zones in a restaurant. A restaurant may only be one zone of music with no paging but may have six volume zones:

Bar	Dining area
Ladies Room	Men's Room
Waiting area	Outdoor seating

Each of these zones would have its own volume control located either in the zone itself or mounted in the system rack. Other areas in a restaurant that may use volume controls could include different dining areas within the same room, private function rooms or the kitchen area.

What about Wire?

Wiring is very important. It's what gets the sound to the speakers. Thankfully, your installers are excellent at figuring out how to get wire from one place to another. There are three basic scenarios for wiring:

- **New construction**
- **Wire Molding**
- **"Hide the Wire"**

In **New Construction** a pre-wire is necessary. This is a phase of the construction when all of the wiring for all of the systems (electrical, computer, POS, audio, telephone, network, etc...) takes place. At this point the walls and or ceiling are still open and the workers can run wire easily. When dealing with a new construction job, ask the superintendent what the pre-wire date is.

In **Existing Construction** using surface mount speakers, you may need to use **Wire Molding** to hide the wire. This is just a metal or plastic channel with a cover over it that is stuck to the wall. It makes for a more aesthetically pleasing installation.

In other **Existing Construction**, the installer will simply **"hide the wire"** behind beams, moldings or other architectural details of the building.

Do I need an equipment rack or shelf?

A rack is a metal or wooden cabinet mounted on the wall or the floor that holds the "head end" of the system or all of the amplifier and mixers. Some racks have locking doors on the front and back, others are open on the front. A rack is not always necessary on a job, but should be considered when there are more than two or three components in the system or when making the system tamperproof is a concern.

- Simple jobs with 10 speakers, and amp and a DMX music source can sit on an existing shelf, or a simple shelf can be included in the installation.
- Multi zone systems with three amplifiers, two DMX music sources, a mixer and a power strip will require a rack. Consult with your engineer on jobs like this.