SOUNDSPHERE®
LOUDSPEAKERS

Distributed System Quick Planning Guide

These pages contain information and tables to assist you in the design of effective public area distributed sound systems using Soundsphere® omnidirectional speakers.

Information provided herein is intended as a guide. Every application is different, there are times that considerations other than those addressed here must be taken into account. However, this guide should be very helpful for initial planning purposes. For assistance with specific applications, please call Soundsphere® direct at (203) 386-9200, or log on to www.soundsphere.com.

A well-designed distributed sound system will produce intelligible voice and full-range background or foreground music at any sound pressure level. This requires:

- A **S**ound **P**ressure **L**evel (SPL) of at least 10 dB higher than the nominal ambient (background) noise level throughout the designated coverage area. It is recommended that the ambient noise level be measured using an A weighted sound level meter for greatest accuracy.
- A target direct field SPL variation throughout the designated coverage area. An SPL variation of 3 to 4 dB (±1.5 to ±2 dB) is virtually indiscernible and therefore suggested. A variation of 5 to 6 dB (±2.5 to ±3 dB) is noticeable but may not be objectionable. Variations of more than 6 dB (±3 dB) are not recommended. Be aware, however, that some systems are proposed with SPL variations higher than 6(±3) dB to keep costs down. It is difficult to determine whether this practice creates unacceptable results because customers may not understand the significance of SPL variation with regard to system performance. In situations where fewer of another type of speaker are specified by a competing bidder, we suggest explaining the difference to the customer and leave the decision on performance to them. In most cases, fewer Soundsphere® speakers will be required.

Determining The System Requirements

The first step is to determine the system requirements. At a minimum, you must ascertain:

1. **The desired area of coverage**
   - The length, width and height of the area or areas to be covered.
2. **The expected ambient noise characteristics**
   - The conditions present when the sound system is operational, best determined by using an A weighted sound level meter readings taken at various points under actual conditions.
3. **The maximum acceptable SPL variation**

Other Important Factors To Keep In Mind

All Soundsphere® speaker models share the same omnidirectional sound radiation characteristics. The variation in direct field SPL with the use of each speaker model is the same. If the distance apart is the same, the SPL variation is the same. The differences between the speaker models relate to sensitivity, SPL capability, and quality of music reproduction.

Larger speakers can always be substituted for smaller speakers when higher SPL or the sound quality of larger speakers is preferred. Also, larger model Soundsphere® speakers produce a higher SPL per watt (that is, they have a higher sensitivity) than the smaller models. This may be important if you are using an existing amplifier that will not produce the required SPL in a system of smaller Soundsphere® models. In highly reverberant environments, Soundsphere® speakers should be mounted as low as feasible, as the greater the level of direct sound at the listener in relation to the reverberant sound level at the listener, the higher the speech intelligibility.

Speakers perform best when in line-of-sight to the listeners. Speakers should not be mounted adjacent to large beams or solid structures which would cast an acoustical shadow on the listening areas. Keep this in mind when selecting final mounting locations.

Soundsphere® shares in your objective to satisfy your customers' needs. Please call Soundsphere® direct at (203) 386-9200 or log on to www.soundsphere.com for further assistance.

Figuring Soundsphere® Speaker Requirements

There are three steps in the design procedure:

1) Determining the number of Soundsphere® speakers required
2) Determining the type of Soundsphere® speakers required
3) Determining the Soundsphere® speaker power requirements

The tables on page 4 of this guide will assist you in the system design procedure. Typical examples are presented for further clarification.

Determining the Number of Soundsphere® Speakers Required

Soundsphere® speakers produce full frequency sound in a 180° (vertical) by 360° (horizontal) coverage pattern. The main benefit of the broad dispersion pattern is that fewer Soundsphere® speakers are required compared to conventional speakers. Table 1 (on page 4), provides direct field SPL variation characteristics for all Soundsphere® speakers in distributed systems. An SPL variation of no more than 4 dB (±2 dB) is recommended.

Representative Examples

Example 1. A retail store with the following characteristics:

- Desired coverage area is 200' (width) x 300' (length)
- Ceiling height is 24'
- Floor to speaker mounting height is 22'
- Ambient noise is 70 dB SPL

It is recommended that an SPL variation of 4 dB (±2 dB) be used as a starting point in a typical system design. Greater or lesser variations may be considered as dictated by the particular situation.

Refer to **Table 1**. Find the column for the desired SPL variation. Find the row for the speaker mounting height. At the intersection of the two, read the spacing between speakers. The spacing from the edge of the coverage area to the first speaker is one half the spacing between speakers.

From Table 1, we determine a spacing of 70 feet for a 4 (±2) dB variation. Then:
300 feet (length) ÷ 70 feet (spacing) = 4.29
200 feet (width) ÷ 70 feet (spacing) = 2.86
Since we cannot have .29 or .86 speakers, we should round up to the next whole number, therefore: this application would require 5 rows of 3 Soundsphere® speakers for a total of 15. Four rows of 3 speakers would lower the cost, but the SPL variation would be about 4.5 dB, which does not meet with our conservative design objectives.

Example 2. A busy transportation terminal:

- Desired coverage is 60' (width) x 100' (length)
- Ceiling height is 18'
- Floor to speaker mounting height is 14'
- Ambient noise is 80 dB SPL

From Table 1, we determine a spacing of 38 feet for a 4 (±2) dB variation. Then:
100 feet (length) ÷ 38 feet (spacing) = 2.63
60 feet (width) ÷ 38 feet (spacing) = 1.58
Since we cannot have .63 or .58 speakers, we should round up to the next whole number, therefore: this application would require 3 rows of 2 Soundsphere® speakers for a total of 6.

Example 3. A factory with a high ambient noise level

- Desired coverage area is 150' (width) x 600' (length)
- Ceiling height is 28'
- Floor to speaker height is 24'
- Ambient noise is 90 dB

From Table 1, we determine a spacing of 78 feet for a 4 (±2) dB variation. Then:
600 feet (length) ÷ 78 feet (spacing) = 7.69
150 feet (width) ÷ 78 feet (spacing) = 1.92
Since we cannot have .69 or .92 loudspeakers, we should round up to the next whole number, therefore: this application would require 8 rows of 2 Soundsphere® speakers for a total of 16.

Determining the Proper Soundsphere® Model and the Required Amplifier Power

Recall that the minimum SPL requirement is 10 dB over nominal ambient noise. This will require a speaker and adequate power to produce the ambient noise (dB SPL) plus SPL variation (dB SPL) plus 10 dB.

Example 1. Minimum SPL required = 70 (dB) ambient noise + 4 (dB) variation + 10 (dB) = 84 dB SPL
Floor to ceiling mounting height = 22'

Refer to Tables 2 through 5 for the Soundsphere® Models 110B, Q-6, Q-8, Q-12A and Q-15 respectively. In each table, find the floor to speaker height of 22 feet (left most column). Move across this row until you find a minimum of 84 dB SPL.

- ***For the Model 110B (Table 2), an SPL of 86.2 dB will be produced with an input power of 7.5 watts; powering each speaker with 7.5 watts or more will more than suffice.***
- ***For the Model Q-6 (Table 3), an SPL of 85.2 dB will be produced with an input of 15 watts.***
- ***For the Model Q-8 (Table 4), an SPL of 90.2 dB will be produced with an input power of 12.5 watts; powering each speaker with 12.5 watts or more will more than suffice.***

In this example, the 110B would be the obvious choice, but perhaps the sound quality of the Q-6 may be desired. Less power can be used in the case of the Q-8 to meet the SPL requirements. The benefits of a high-powered Q-12A in this store would probably not be worth the additional expense.

Example 2. Minimum SPL required = 80 (dB) ambient noise + 4 (dB) variation + 10 (dB) = 94 dB SPL
Floor to ceiling mounting height = 14'

- ***For the Model 110B (Table 2), an SPL of 94.3 dB will be produced with an input power of 15 watts.***
- ***The Model Q-6 (Table 3) at full power (30 Watts) will only produce 93.3 dB SPL, which is theoretically insufficient to meet our requirements. In reality, the Q-6 at full power could be used although the Model Q-8 would be a safer choice.***
- ***For the Model Q-8 (Table 4), an SPL of 95.3 dB will be produced with an input power of 12.5 watts.***
- ***The Model Q-12A is not recommended for ceiling heights lower than 16'.***

Either the 110B or Q-8 can more than meet the design requirements. The Q-8 requires less power to produce the equivalent SPL.

Example 3. Minimum SPL required = 90 (dB) ambient noise + 4 (dB) variation + 10 (dB) = 104 dB SPL
Floor to ceiling mounting height = 24'

- ***Only the Q-12A or Q-15 (Table 5) with 250 watts of power (105.3 dB) meet the requirement.***

In the above examples, required speaker power is determined by the SPL requirement. We suggest using as much power per speaker (up to the rated power of the selected speaker model) as is economically feasible.

Selecting Amplifiers for Transformer Based Constant Voltage Systems

Soundsphere® transformers have an insertion loss of 1 dB maximum. To overcome this loss and arrive at the figures in the power charts, 1.26 times the transformer power tap rating will be required from the amplifier per unit, as shown below.

Insertion Loss Compensation for Soundsphere Transformers

Example: 20 Model 110B with TX30 tapped at 7.5 watts each: Amplifier Power Required = 20 x 9.5 watts = 190 watts

Transformer	Tap	Amplifier Power Required
Q-CA	15 watts	18.9 watts
	7.5 watts	9.5 watts
	3.7 watts	4.7 watts
	2.0 watts	2.5 watts
	1.0 watts	1.3 watts
	0.5 watts	0.6 watts

Transformer	Tap	Amplifier Power Required
TX-30	30 watts	37.8 watts
	15 watts	18.9 watts
	7.5 watts	9.5 watts
	3.8 watts	4.8 watts
	1.9 watts	2.4 watts
	1.0 watts	1.3 watts

Transformer	Tap	Amplifier Power Required
TX-100	100 watts	126 watts
	50 watts	63 watts
	25 watts	31.5 watts
	12.5 watts	15.8 watts
TX-250	250 watts	315 watts
	125 watts	157.5 watts
	67.5 watts	85.1 watts

Wire Size Selection

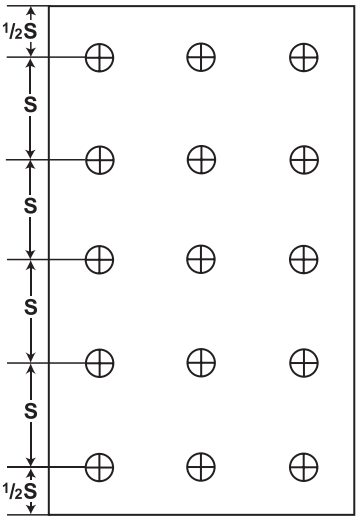
18AWG wire is the minimum recommended for distributed systems of Soundsphere® speakers using transformers. Significant power loss can occur in systems with long wire runs, especially in high power systems. As an example, a 70V system with a 200 Watt power requirement and a wire run of 75' will produce good results using 18AWG wire. If the wire run in this system were 200', there would be significant power loss and noticeable degradation of sound quality with 18AWG wire. In this case, the minimum wire size would be 14AWG. Be sure to select a wire size appropriate for the length of the wire run and the system power requirements. Always try to locate the amplifier as close to the loudspeakers as possible. If unsure, contact our engineering department for assistance.

Distributed System Quick Planning Guide Tables

Table 1. Spacing (S) for Soundsphere® Speakers

(Multiple Speaker / Distributed Systems)

Floor-to-Speaker Height in Feet	Direct Field SPL Variation in dB			
	3dB (±1.5)	4dB (±2.0)	5dB (±2.5)	6dB (±3.0)
8'	14'	**16'**	18'	21'
10'	21'	**24'**	27.5'	32'
12'	27'	**32'**	36'	42'
14'	33'	**38'**	45'	52'
16'	39'	**44'**	54'	62'
18'	46'	**54'**	63'	72'
20'	52'	**62'**	72'	82'
22'	60'	**70'**	81'	92'
24'	66'	**78'**	90'	102'
26'	72'	**86'**	100'	115'
28'	78'	**94'**	110'	125'
30'	84'	**100'**	119'	136'
32'	90'	**112'**	128'	146'
34'	96'	**120'**	137'	157'
36'	100'	**128'**	146'	167'



Based on nominal ear height of 4 feet

Soundsphere Models SPL (dB) vs. Power and Mounting Height

Based on nominal ear height of 4 feet

Table 2. Model 110B

Floor-to-Speaker Height in Feet	Power per Speaker in Watts			
	30	15	7.5	3.8
12'	99.3dB	96.3dB	93.3dB	90.3dB
14'	97.3dB	94.3dB	91.3dB	88.3dB
16'	95.7dB	92.7dB	89.7dB	86.7dB
18'	94.4dB	91.4dB	88.4dB	85.4dB
20'	93.2dB	90.2dB	87.2dB	84.2dB
22'	92.2dB	89.2dB	86.2dB	83.2dB
24'	91.3dB	88.3dB	85.3dB	82.3dB
26'	90.5dB	87.5dB	84.5dB	81.5dB
28'	89.7dB	86.7dB	83.7dB	80.7dB
30'	89.0dB	86.0dB	83.0dB	80.0dB
32'	88.4dB	85.4dB	82.4dB	79.4dB
34'	87.8dB	84.8dB	81.8dB	78.8dB
36'	87.2dB	84.2dB	81.2dB	78.2dB
	dB SPL			

Table 3. Model Q-6

Floor-to-Speaker Height in Feet	Power per Speaker in Watts			
	30	15	7.5	3.8
12'	95.3dB	92.3dB	89.3dB	86.3dB
14'	93.3dB	90.3dB	87.3dB	84.3dB
16'	91.7dB	88.7dB	85.7dB	82.7dB
18'	90.4dB	87.4dB	84.4dB	81.4dB
20'	89.2dB	86.2dB	83.2dB	80.2dB
22'	88.2dB	85.2dB	82.2dB	79.2dB
24'	87.3dB	84.3dB	81.3dB	78.3dB
26'	86.5dB	83.5dB	80.5dB	77.5dB
28'	85.7dB	82.7dB	79.7dB	76.7dB
30'	85dB	82dB	79dB	76dB
32'	84.4dB	81.4dB	78.4dB	75.4dB
34'	83.8dB	80.8dB	77.8dB	74.8dB
36'	83.2dB	80.2dB	72.2dB	74.2dB
	dB SPL			

Table 4. Model Q-8

Floor-to-Speaker Height in Feet	Power per Speaker in Watts			
	100	50	25	12.5
12'	106.3dB	103.3dB	100.3dB	97.3dB
14'	104.3dB	101.3dB	98.3dB	95.3dB
16'	102.7dB	99.7dB	96.7dB	93.7dB
18'	101.4dB	98.4dB	95.4dB	92.4dB
20'	100.2dB	97.2dB	94.2dB	91.2dB
22'	99.2dB	96.2dB	93.2dB	90.2dB
24'	98.3dB	95.3dB	92.3dB	89.3dB
26'	97.5dB	94.5dB	91.5dB	88.5dB
28'	96.7dB	93.7dB	90.7dB	87.7dB
30'	96.0dB	93.0dB	90.0dB	87.0dB
32'	95.4dB	92.4dB	89.4dB	86.4dB
34'	94.8dB	91.8dB	88.8dB	85.8dB
36'	94.2dB	91.2dB	88.2dB	85.2dB
	dB SPL			

Table 5. Models Q-12A, Q-15

Floor-to-Speaker Height in Feet	Power per Speaker in Watts		
	250	125	62.5
16'	109.7dB	106.7dB	103.7dB
18'	108.4dB	105.4dB	102.4dB
20'	107.2dB	104.2dB	101.2dB
22'	106.2dB	103.2dB	100.2dB
24'	105.3dB	102.3dB	99.3dB
26'	104.5dB	101.5dB	98.5dB
28'	103.7dB	100.7dB	97.7dB
30'	103.0dB	100.0dB	97.0dB
32'	102.4dB	99.4dB	96.4dB
34'	101.8dB	98.8dB	95.8dB
36'	101.2dB	98.2dB	95.2dB
	dB SPL		

Table 6. Model Q-CA

Floor-to-Speaker Height in Feet	Power per Speaker in Watts						
	30*	15	7.5	3.8	2	1	.5
8'	100dB	97dB	94dB	91dB	88dB	85dB	82dB
10'	96.5dB	93.5dB	90.5dB	87.5dB	84.5dB	81.5dB	79dB
12'	94dB	91dB	88dB	85dB	82dB	79dB	76dB
14'	92dB	89dB	86dB	83dB	80dB	77dB	74dB
	dB SPL						

*30 Watts at 100V only

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