NYQUIST™

Sound Masking System Design Guide

Sound Masking Design Goals

The primary goals of sound masking are to reduce distractions caused by unwanted sound and to provide conversational or speech privacy. Distractions are reduced by increasing the background noise while reducing the range of fluctuations in sound levels within a targeted area. Speech privacy is provided by increasing the background noise *surrounding* the target area, effectively distorting and muffling sounds and voices emanating from within.

Sound masking creates an evenly distributed and diffused sound field in which listeners are unable to detect the source. This "random" noise obfuscates most sounds within the environment—such as a conversation or typing—thereby reducing disturbances and providing a level of privacy, even within an open space.

Sound Masking Applications

Coverage and Planning

Sound masking can be useful in many environments such as:

- Commercial facilities, including both open and closed offices.
- Medical facilities, particularly to satisfy regulations that mandate protection of patient health information.
- Educational institutions, in administrative offices, consultation rooms, libraries, student centers, and areas where focused study is required.
- Secure facilities, such as legal offices, court rooms, accounting firms, and military facilities.

Areas where sound masking should not be utilized are:

- Training and audio/visual presentation rooms, where intelligibility is important.
- Bathrooms (for security purposes, unless requested by customer).
- Areas used by the hearing or sight impaired.

Sound masking is usually not applied in conference rooms and closed offices where clear and reliable communication is important. For these environments, privacy can be enhanced by applying sound masking to the *adjacent* hallway or open office/space, thereby providing improved privacy from people outside the "protected" area (*see Figure 1*).

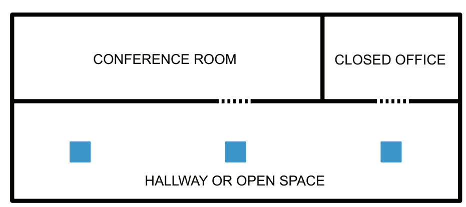

Figure 1: Typical sound masking application.

An exception when sound masking may be needed *within* a closed office is where the walls between it and the adjoining offices only extend up to the drop ceiling, not the structural ceiling, leaving the ceiling plenum (i.e., the space between the drop ceiling and the structural ceiling) open and acting as an air duct. This would allow sound to travel between each office through return air grilles, compromising privacy. Sound masking applied in a closed office would also prevent distractions from noise traveling outside open spaces into the closed office via the plenum space in the ceiling (*see Figure 2*).

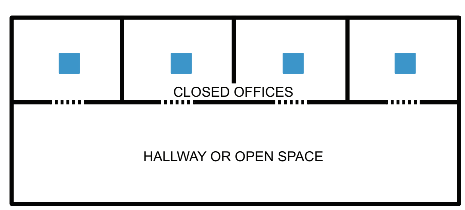

Figure 2: Closed offices application.

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Acoustics

A critical factor in the success of a sound masking system is first addressing the physical acoustics of the target area. The goal is to decrease the level of unwanted sound to which people are exposed, thereby decreasing the level of unwanted sound to mask (*see Figure 3 and Figure 4*).

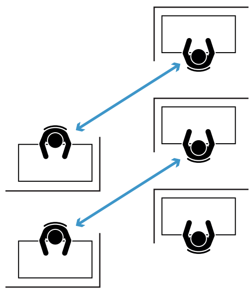

Figure 3: Poor design (line-of-sight between office workers)

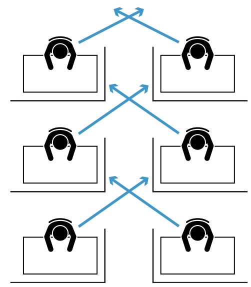

Figure 4: Good design (no line-of-sight between office workers)

Where possible, minimize *direct line-of-sight transmission* between workspaces/cubicles (*see Figures 5 and 6*) by adding or replacing partition walls, using the appropriate height and material.

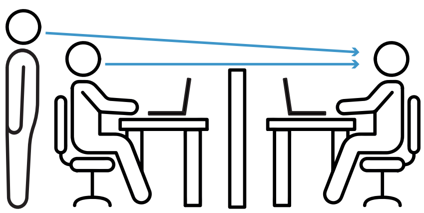

Figure 5: Low partitions offer no speech privacy.

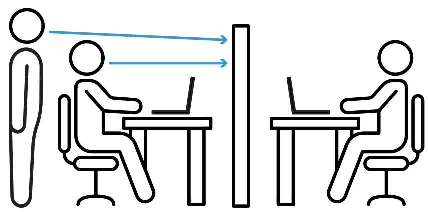

Figure 6: Minimum 66" partitions can block speech.

To minimize *voice and sound reflection* and reduce environmental sound in the target area (*see Figure 7 and Figure 8*):

- Change flooring material from hard surfaces such as hardwood or tiles to carpets.
- Replace standard flat-panel ceiling lights with parabolic recessed light fixtures.
- Use absorbent material in ceiling tiles and on cubical walls.

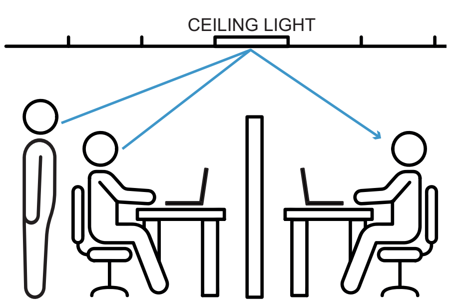

Figure 7: Sound bounces off light fixtures with hard, reflective surface.

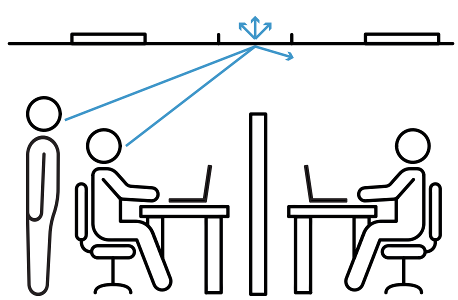

Figure 8: Sound is reduced by absorbent ceiling tiles.

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Sound Masking System Design

Speaker Options

NQ-SMS1810-SCG: Nyquist Suspended Ceiling Grid Sound Masking Speaker

The NQ-SMS1810-SCG includes a ceiling grid mount and a sound masking speaker assembly, which consists of an 8″ dual-cone loudspeaker with a 10-ounce magnet and a 25V/70V, 4W max., rotary tap selector. A seismic safety cable is supplied to secure the speaker to a solid object in the plenum space.

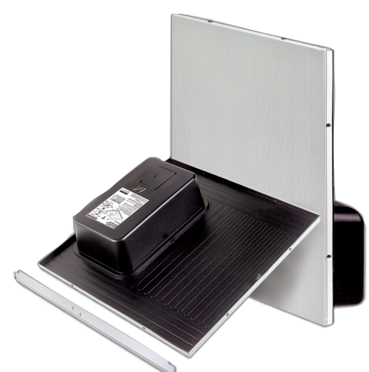
Installation: Place upward-facing on top of a 24″-wide ceiling tile on a conventional suspended ceiling grid.

NQ-SMS1810-VF: Nyquist Variable Firing Sound Masking Speaker

The assembly for the NQ-SMS1810-VF comes with an 8″ dual-cone loudspeaker with a 10-ounce magnet and a 25V/70V, 4W max., rotary tap selector. It includes two multi-position hangers for multiple mounting configurations and also comes with a chain kit.

Installation: Connect the two multi-position hangers to the structural ceiling to hang above the suspended ceiling deck. It can face upwards, downwards, or sideways.

CSD2X2 and CSD1X2: Drop-In Ceiling Speaker



The CSD2X2 or CSD1X2 replaces a conventional ceiling tile and faces downward.

Installation: Mount the CSD2X2 or CSD1X2 parallel to the floor plane in a 24″-wide suspended ceiling tile grid facing downward.

Refer to Table 1 for additional devices that work in conjunction with the above speakers.

Nyquist 2-Channel Audio Power Amplifiers	Nyquist 4-Channel Audio Power Amplifiers	Volume control wall unit (for closed offices and conference rooms)
• NQ-A2060-G2	• NQ-A4060-G2	• AT10A 10W Attenuator
• NQ-A2120-G2	• NQ-A4120-G2	• AT35A 35W Attenuator
• NQ-A2300-G2	• NQ-A4300-G2	
Note: 15–20% headroom is recommended for the masking amplifiers. Note: Any Bogen high-impedance downward-facing ceiling speaker can be used for sound masking applications.		

Table 1: Other available devices

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Speaker Selection and Layout

Buildings with Suspended Ceilings

The ceiling plenum is the most common location to install sound-masking speakers. The specific type of speaker to use depends on the plenum's depth and available space.

A typical office has a height of 9' from the floor to the visible face of drop-ceiling tiles. The plenum extends upwards from the top of the drop ceiling to the structural ceiling (hard deck) above. In this kind of construction, either install NQ-SMS1810-SCG on top of the ceiling tile grid to avoid a cluttered plenum (*see Figure 9)* or, using the chain kit, hang NQ-SMS1810-VF upward-facing from the structural ceiling, with the bottom of each speaker about 6" to 8" above the suspended ceiling grid (*see Figure 10*).

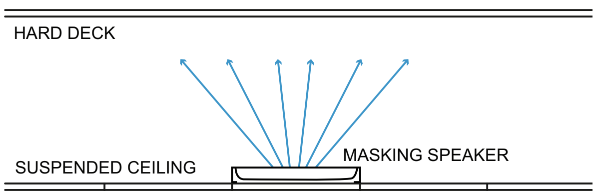


Figure 9: NQ-SMS1810-SCG placement with a typical plenum height.

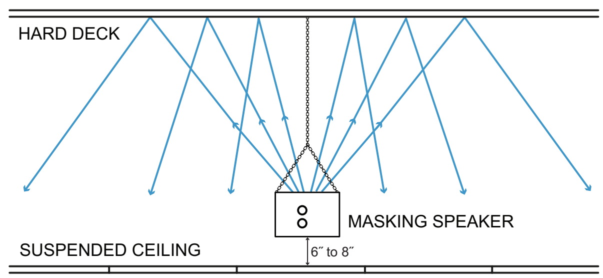


Figure 10: NQ-S1810SM-VF placement with a higher plenum height.

For optimal masking with either layout, speakers should be placed in a grid pattern (*see Figure 13*). Since sound mixes well in the open plenum space, this will give an even coverage of sound masking. The taller the plenum space, the further apart the speakers should be and the higher the wattage should be set for the transformer taps. The shorter the plenum space, the closer the speakers should be to one another.

If the plenum depth exceeds 6', hang upward-facing NQ-SMS1810-VF speakers 2' to 4' from the structural ceiling (hard deck).

When there is acoustic absorption material or thermal insulation on the structural ceiling, hang downward-facing NQ-SMS1810-VF speakers 2' to 4' from the structural ceiling (*see Figure 11*). Adjacent speakers must be incoherent[1] (i.e., different) and therefore a two-channel system is required (*see Two-Channel Wiring*).

CSD2X2 speakers can be used when the plenum is shallow (less than 1' in height) and/or contains obstructions which would prevent an even coverage of sound masking and cause difficulty in installation (*see Figure 12*). Adjacent speakers must be incoherent and therefore a two-channel system is required (see *Two-Channel Wiring*).

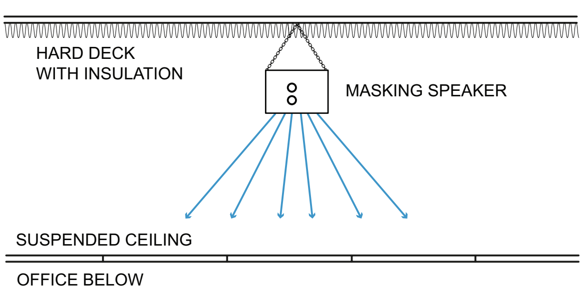


Figure 11: NQ-S1810SM-VF installed in plenum space with insulation.

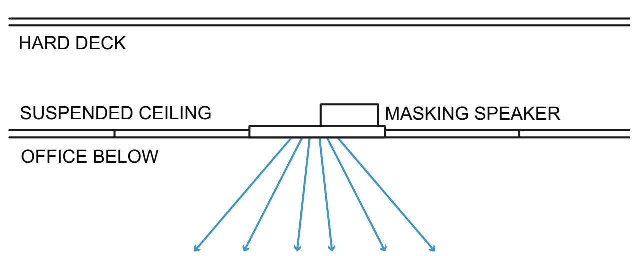


Figure 12: CSD2X2 speaker installed within a suspended ceiling.

1 Coherent signals have the exact same frequency and a definite phase relationship, whereas incoherent signals do not. Sound masking signals from the same generator are coherent to each other; signals from different generators are incoherent.

Buildings with Open Ceilings

With an open-plenum ceiling, hang the NQ-SMS1810-VF facing upward 2’ to 4’ away from the structural ceiling.

When there is acoustic absorption material or thermal insulation on the structural ceiling, hang downward-facing NQ-SMS1810-VF speakers 2’ to 4’ from the structural ceiling. Adjacent speakers must be incoherent and, therefore, a two-channel system is required (*see Two-Channel Wiring*).

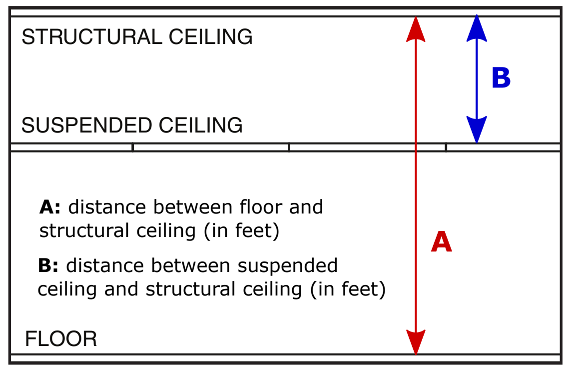
In the rare case of an interior with a sloped ceiling, hang NQ-SMS1810-VF facing sideways into the sloped ceiling.

If an obstacle prevents the installation of a speaker, the speaker can be moved to an appropriate space but the speakers on either side should be spaced out accordingly to maintain optimum sound masking. For example, if a speaker needs to be moved three feet away from its intended installation point, then the next speaker moves two feet away from its original position, and the next speaker one foot away from its original position.

Important: Masking speakers should not be installed within three feet of a rectangular metal air duct.

Determining Speaker Placement

Recommended speaker placement is determined by the speaker position, orientation, and the *calculated acoustic path* (P), which is the distance the sound travels from the speaker to the floor.



The formula used to calculate the acoustic path (P) is determined by the presence of a drop ceiling, the speaker orientation, the speaker type, and the plenum height, as shown in the following table. The variables A and B correspond to the distances between the floor and structural ceiling (A) and between the suspended ceiling and structural ceiling (B).

Drop ceiling	Speaker type	Speaker orientation	Plenum depth	Calculated Acoustic Path (P)
No	NQ-SMS1810-VF	Upward	–	P = A + 4
No	NQ-SMS1810-VF	Downward	–	P = A – 2
Yes	NQ-SMS1810-VF	Upward Bottom of speaker 6” above ceiling grid	2’ to 6’	P = A + B – 1
Yes	NQ-SMS1810-VF	Upward Speaker 4’ below structural ceiling	> 6’	P = A + 4
Yes	NQ-SMS1810-VF	Downward	–	P = A – 2
Yes	NQ-SMS1810-SCG	Upward	–	P = A + B
Yes	CSD	Downward	–	P = A – B

Table 2: Acoustic path calculation formulas

Once the acoustic path (P) has been calculated, use the following table to determine the correct spacing distance (*d*) to leave between speakers.

Calculated acoustic path (P)	Speaker spacing for VF and SCG (±1′)	Speaker spacing for CSD (±2′)
8′–10′	9′	8′
10′–12′	10′	10′
12′–14′	11′	12′
14′–16′	12′	
16′–18′	13′	
18′–20′	14′	
20′–22′	15′	
22′–24′	16′	
24′–26′	17′	
> 26′	see comments below	

Table 3: Speaker spacing based on calculated acoustic path and speaker type

If P exceeds 26′, consider changing the speaker orientation and/or type and using the relevant formulas to obtain a smaller value for P. If P is still greater than 26′ after trying all other options, use CSD speakers or install VF speakers facing downward at 18′ to 20′ from the floor at a spacing distance (*d*) of 14′.

For example, if upward-facing SCG speakers result in P = A + B = 27′, we may get a smaller P value using upward-facing VF speakers (P = A + 4, assuming B > 4), downward-facing VF speakers (P = A − 2), or even CSD speakers (P = A − B, assuming a drop ceiling).

Once the speaker spacing distance *d*′ has been determined, the speaker layout is relatively simple. Layout starts in one corner of the room. The first speaker should be installed *c*′ from the corner of the room—where *c* is between 2′ and one half the spacing distance (*d*)—with each additional speaker in the first row installed *d*′ from the previous one. Move down *d*′ and install the next row of speakers, with speakers again installed in increments of *d*′ from the first. Each additional row will continue the same pattern until the whole area is covered (see Figure 13).

Enclosed offices and most small enclosed spaces follow the same placement rule except when using CSD speakers. Even in spaces of less than 200 sq. ft., use a minimum of two CSDs, located diagonally from each other, to prevent hot spots.

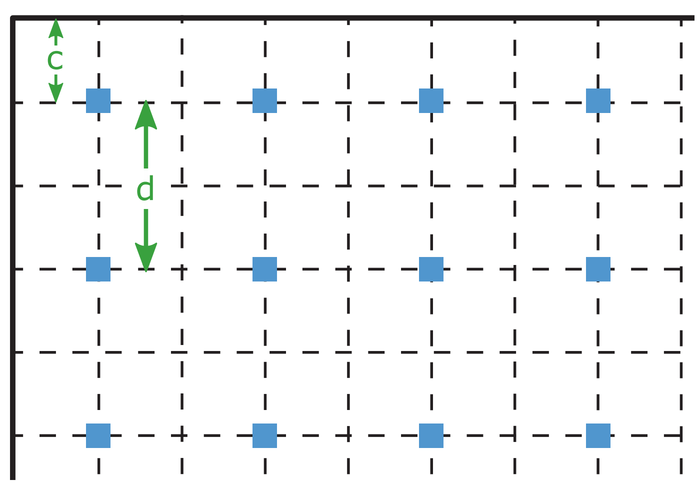


Figure 13: The distance between each speaker ■ and its adjacent speakers is d′ (±1′ or ±2′, depending on speaker type). The distance between outer speakers and the wall is c′, a value between 2′ and ½d′.

Determining Speaker Power Tap

CSD speakers should be tapped at 1W when the drop ceiling is less than 14′ tall and 2W when it is 14′ or taller. VF and SCG speakers should be tapped at 2W for speakers spaced less than 14′ apart and 4W for speakers spaced more than 14′ apart.

Wiring for 25- or 70-Volt Systems/Schematics

Multiple-Wire Runs

When more than 10 speakers are required, multiple runs can be wired in parallel, with no more than 10 speakers per run (*see Figure 14*). This reduces the overall resistance, allowing the amplifier more head room, increasing the number of speakers the amplifier can handle, and providing coverage for both small and large areas.

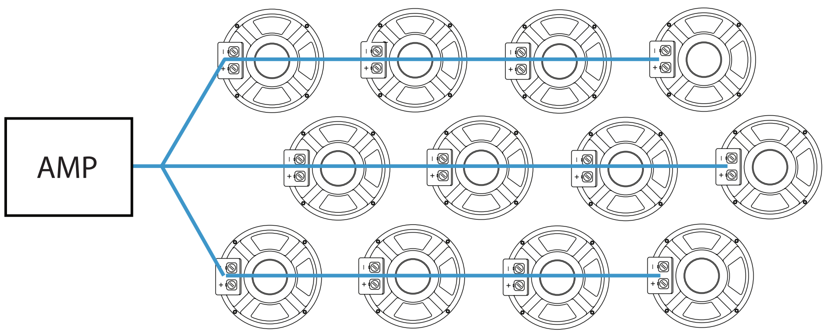


Figure 14: Installation with multiple wire runs is recommended for more than ten speakers.

Two-Channel Wiring

A two-channel, acoustically incoherent wiring design (*see Figure 15*) is required for direct radiating speakers (e.g., CSD or NQ-SMS1810-VF when installed facing downward). Adjacent speakers receive signals from different sound masking sources, thereby avoiding *comb filtering* (i.e., acoustic interference). It is critical to make sure that the sound masking from each channel has the same spectrum preset and level.

Ideally, the two channels should come from two different amplifiers, ensuring the signals will be different. When it is not practical to have multiple amplifiers, add phase shift to one of the channels to achieve the same result (see *Viewing Station Configuration Settings* in the *Nyquist System Administrator Guide* and refer to the **Add Phase Shift** station setting).

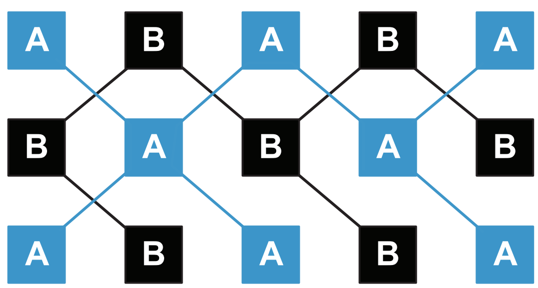


Figure 15: A two-channel wiring design.

Wire-Related Losses

Wire is an important but often ignored component of a sound masking system. Because all wire has resistance, some of the voltage at the source is lost or dropped in the wire before it reaches the target destination. The voltage lost in the wires is affected by the resistance and gauge of the wire and the electrical current flowing through the wire. This is classic Ohm's law in action. If the voltage lost in the cables is not anticipated, the final volume level at the passive speaker may not meet the requirement.

The sound masking system can be run as 25V or 70V. A 70V system can use significantly longer cables, but requires twice the number of amplifiers due to bridging. There are separate charts for 25V and 70V transformer distribution systems that specify the maximum cable lengths that should be allowed. Attempt to keep the system power lost in the wires below 10%; however, less power at the speaker is the only negative effect that larger losses have on the system. Clarity, intelligibility, and frequency response are unaffected by larger losses in the wiring of transformer distribution systems.

Once the number of speakers to be wired together in a run has been decided, estimate how long the wire run will be from the first to the last speaker in each run. Include the lead-in wire length from the amplifier to the first speaker in each run in the overall run length. For each run, sum up the speaker power and cable lengths. Using that information, refer to the Wire Loss Chart to ensure that the wire gauge is sufficient to support the power and cable length for the run. It may be necessary to increase the wire gauge, split the speaker loads, or shorten the wire run lengths if they exceed the chart maximums.

	70V – Load Power Per Wire Run (Watts)						
Wire Gauge	**5**	**10**	**15**	**30**	**50**	**100**	**200**
16	10,000	7,000	4,600	2,300	1,400	700	350
18	9,000	4,500	2,800	1,400	830	415	205
20	5,500	2,700	1,800	900	540	270	135
22	3,400	1,700	1,100	550	330	115	60
24	2,100	1,000	700	350	350	105	50
	Maximum Wire Run Cable Length (ft.) (10% of power lost in wire) Shielded Pair, Stranded Cable						

Figure 16: 70V Wire Loss Chart

	25V – Load Power Per Wire Run (Watts)						
Wire Gauge	**5**	**10**	**15**	**30**	**50**	**100**	**200**
16	1,280	640	425	215	125	60	30
18	800	400	265	130	80	40	20
20	505	250	165	80	50	25	12
22	315	155	105	50	30	15	7
24	200	100	65	30	20	10	5
	Maximum Wire Run Cable Length (ft.) (10% of power lost in wire) Shielded Pair, Stranded Cable						

Figure 17: 25V Wire Loss Chart

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Sound Masking Zoning Choices

There are a number of factors that must be considered in mapping out the sound masking zones for each physical location. Their acoustic attributes and administrative functions, as well as the available speaker types, are all factors that must be considered.

Areas with different structural and acoustical features should be assigned to distinct sound masking zones. For example, closed vs. open offices, areas with alternating suspended ceilings, and open offices with extreme panel height differences. Areas with different administrative functions should also be assigned to different sound masking zones, such as cafeterias, open offices, reception areas, closed offices, and conference rooms. It is usually best to also separate areas using different types of speakers, such as upward-facing vs. downward-facing speakers, into distinct masking zones.

Sound Masking Levels

Introducing a New Sound Masking System

It is advisable to introduce a sound masking system slowly. Turn the system on at 10 dB below the final target level and bring it up to its final level over a period of 20 to 30 days, allowing time for office staff to adjust to the extra ambient sound (see *Sound Masking Zones* in the *Nyquist System Administrator Guide*, particularly the **Slow Ramp Days** setting).

Finding the Right Balance

In general, louder sound masking levels provide more speech privacy. However, in the real world of an open office space, there is a limit to how much speech privacy one can have. If the masking sound is set higher than a reasonable level, issues may arise. Office workers will talk louder and any speech privacy gained will be lost. A comfortable sound pressure level (SPL) range for sound masking in a relatively quiet office area is 46 dB_A to 52 dB_A. Using 47 dB_A as a starting point, raise or lower the masking level based on the existing background noise level.

It is critical to avoid sudden sound level changes throughout the facility. Keep sound levels balanced between different zones, as well as masked and unmasked areas. If there is an unmasked open area nearby, the adjacent corridor or space should have speakers that gradually reduce the masking level. A cost-efficient way is to adjust the speaker power tap setting to create a spatial gradient of masking levels as one enters the open area.

Adjust overall zone output levels using the masking zone's Output Gain to obtain uniform levels throughout masked areas. If there are multiple stations within a zone (a station, in this context, represents an amplifier output channel), adjust the output level of each station via the Output Power field of the Edit Station view, which allows adjustments of ±6 dB (see *Editing Station Configuration Settings* in the Nyquist System Administrator Guide). Do not rely on the amplifier's DSP output levels to make adjustments to the channel.

Measuring Sound Levels

Masking sound levels should be measured using a sound pressure level meter with A-weighting in each open area and in each closed room where a sound masking speaker is installed. Measure SPL at a height off the floor of 4.0' to 4.7' (i.e., approximately ear height when seated). Measurements should be made across several locations in larger areas. Adjust the masking sound levels to within ±3 dB of the target level.

Emergency Muting

If applying sound masking to an area with an existing paging system, the sound masking should not interfere with the paging system. To compensate for the masking noise, the normal paging system level should be increased by +3 dB.

The masking noise will immediately be muted by the Nyquist system whenever an Alarm tone, Disable-Audio command, or an Emergency or Emergency-All-Call announcement occurs. Once the announcement or alarm has completed, the masking sound will be automatically ramped back up to its previous level over a period of five (5) minutes (known as *fast ramping*). This also occurs whenever the masking zone signal has been disabled and re-enabled, as well as after a system reboot, power outage, or system maintenance.

Note: Sound masking is not muted for an Emergency announcement or Alarm that is being played to a specific zone.

Sound Masking Spectrum

In addition to the sound masking level, the sound masking spectrum is also very important. Because sound masking is intended primarily for speech privacy, it is only the frequency range of speech that is critical, so the masking sound is adjusted using high- and low-pass filters to minimize sounds outside that range.

High-frequency sound is considered "hissy" and uncomfortable, but high frequency sound is also more effective at providing speech privacy. This results in a tradeoff between performance and acceptability. Using a sound spectrum that rolls off approximately 5 dB per octave provides a good balance between effectiveness and comfort. A well-designed HVAC (i.e., air conditioning) system generates a significant level of low-frequency sound. To avoid adding an unwanted rumbling sound, the masking sound covers the higher, speech-like frequencies but reduces frequencies below 160 Hz.

The ideal sound masking level and spectrum are strongly affected by the acoustic conditions of the room, such as the panel height, ceiling tile material, furniture, flooring, etc. Bogen provides a number of spectrum preset options corresponding to these various conditions, applications, and preferences.

The following is a list of available spectrum preset options:

Closed-plan space	Recommended for private office or small conference room with some reflective surfaces, absorptive ceiling, and furnishings.
Ideal open-plan space	Suitable for open offices with 5-foot or higher cubical panels, absorptive ceilings and furnishings, and proper layout.
Good open-plan space	Suitable for open office with 4- to 5-foot high cubical panels, some reflective surfaces, and moderate furniture absorption.
Non-ideal open plan space	Recommended for open office with no cubical panels or with cubical panels under 4-foot high, reflective surfaces, and moderate furniture absorption.
NCB contour	Noise Criterion Balanced (NCB) Contour may be used to evaluate the acceptability of masking sound in various non-industrial environments.
NRC Canada Contour	A cost-effective open-plan environment masking spectrum published by the National Research Council, Canada.
NC40 Contour	Noise Criterion (NC) 40 Contour may be used to evaluate the acceptability of masking sound in an open office environment.

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Sound Masking System Design Example

Here is a scenario where a sound masking system installation is requested for an office complex.

Assume the following conditions:

- The building has two large open offices, several closed offices, and a few conference rooms.
- The building has suspended ceilings.
- Some areas have sound absorption materials in the ceiling plenum.
- The suspended ceiling height is lower than 12 feet.
- The plenum depth is between one and three feet.

The final sound masking design is shown (*see Figure 18*) to make it easier to visualize as each area is analyzed and an optimal design determined.

Office Areas

There are four distinct areas in which sound masking is to be incorporated:

Zone 1: Open Office Area X

Open Office Area X is approximately 8600 sq. ft., therefore requiring 50 upward-facing NQ-SMS1810-VF speakers installed in the plenum area 13' apart across the length of the room and 14' apart across the width of the room.

The NQ-A4120-G2 amplifier can provide 120W per channel when operating at 25V. Allowing 20% headroom, each channel should not exceed 96W. At 2W per 25V speaker, this allows for a maximum of 48 speakers per channel. Since a single channel cannot support all 50 speakers, two channels (A and B) are used, assigning 25 speakers to each channel.

Channels A and B of an NQ-A4120-G2 amplifier are assigned to Sound Masking Zone 1.

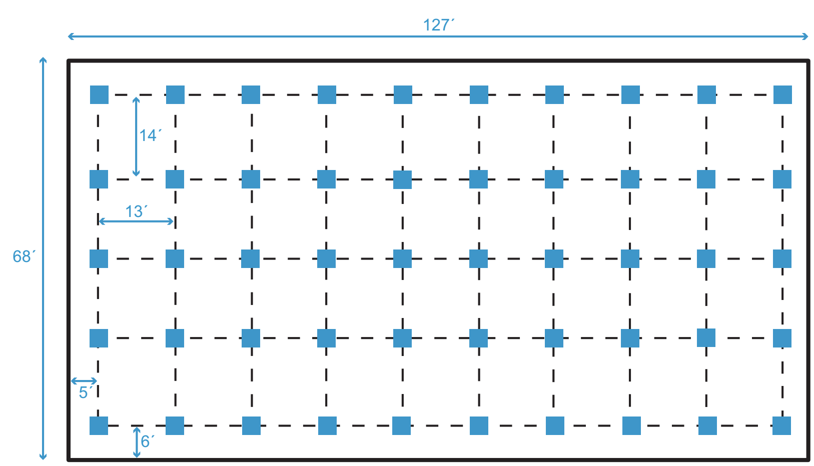

Figure 18: 8600 sq. ft. open office area with 50 NQ-SMS1810-VF speakers in place.

Zone 2: Closed Offices

There are several private closed offices ranging in size from 90 to 200 sq. ft. One upward-facing NQ-SMS1810-VF speaker tapped to 2W is used in addition to an optional wall-mount volume control for each office.

Channel C of the NQ-A4120-G2 amplifier is assigned to Sound Masking Zone 2.

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Zone 3: Open Office Area Y

Due to acoustic material above the drop ceiling tile (e.g., a layer of fiberglass sheet), CSD2X2s are the only option for Open Office Area Y. At approximately 1200 sq. ft., 16 speakers are installed within the drop ceiling (*see Figure 19*). Two-channel wiring is also mandated. Speakers are installed 8' apart from each other and tapped to 1W. Alternate speakers will receive signals from two channels from two separate amplifiers, as shown in Figure 20.

Channel D of NQ-A4120-G2 and Channel A of a separate NQ-A2120-G2 are assigned to Sound Masking Zone 3.

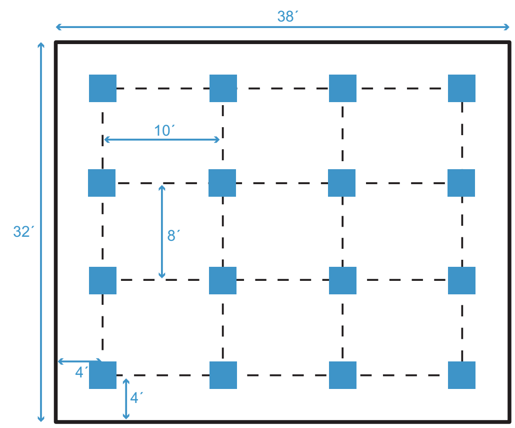

Figure 19: 1200 sq. ft. open space area with 16 CSD2X2 speakers.

Zone 4: Hallway Outside Conference Room

To provide speech privacy during meetings, three NQ-SMS1810-SCG speakers tapped to 2W are installed 12' apart in the plenum of the hallway ceiling. The speakers are placed 4' away from the conference room wall. A wall-mounted AT10A attenuator is also installed inside the conference room to adjust the masking sound level. Sound masking will be turned on during meetings and off at other times.

Channel B of the NQ-A2120-G2 is assigned to Sound Masking Zone 4.

The final layout is shown in Figure 20.

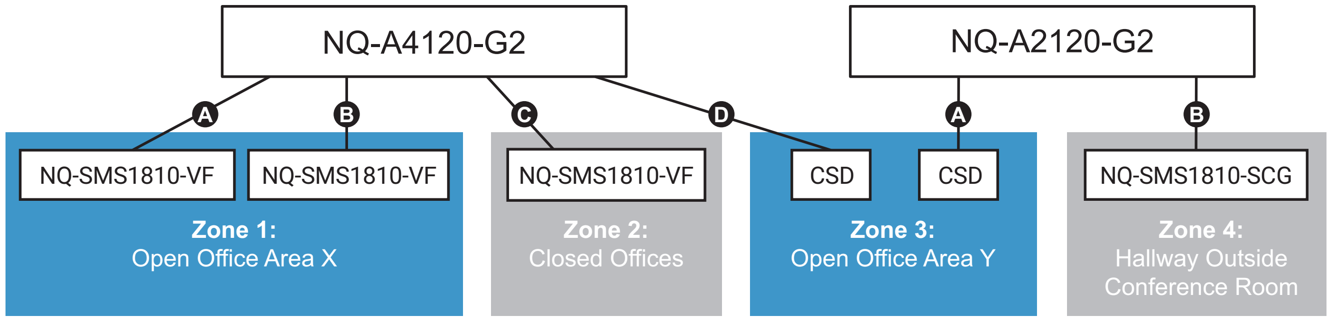

Figure 20: Sound masking design for a 4-zone office space.

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Configuring the Nyquist System for Sound Masking

Once the speakers in the design example are installed and connected to the appropriate amplifier channels, there are several tasks that must be performed on the Nyquist System to configure the system.

1. Configure six sound masking stations for two amplifiers:
   - Four stations for the NQ-A4120-G2
   - Two stations for the NQ-A2120-G2
2. Define and configure four masking zones, assigning sound masking stations to each zone:
   - Open Office Area X
   - Closed Offices
   - Open Office Area Y
   - Hallway Outside Conference Room
3. Initiate sound masking and adjust levels

Add and Configure Amplifiers on the Nyquist System Controller

After the NQ-A4120-G2 and NQ-A2120-G2 amplifiers are connected to the network, they must be added to the Nyquist system and stations must be created for them of type Sound Masking via the Station Management view of each amplifier. It may be helpful to review the *Adding Amplifier and Gateway Devices* and *Adding and Editing a Sound Masking Zone* sections in the Nyquist System Administrator Guide for detailed instructions.

Note: For this example, ensure that all Amplifier Mode switches on the amplifiers are set to 25V/4Ω (not bridged), allowing the use of every channel on each amplifier.

Add the amplifiers to the Nyquist system and configure each channel, as specified in Table 4.

Device Type	NQ-A4120-G2				NQ-A2120-G2	
Channel	A	B	C	D	A	B
Name	A4120-A	A4120-B	A4120-C	A4120-D	A2120-A	A2120-B
Load Impedance	High (all speakers will be wired at 25V)					
Output Power	0 dB (may eventually be adjusted)					
Add Phase Shift	No	No	No	No	No	No

Table 4: Amplifier Station Management channel configurations Station Management channel configurations

Although channels A and B of the NQ-A4120-G2 are connected to the same zone and are from the same amplifier, two-channel wiring is not needed and **Add Phase Shift** is set to **No** because the NQ-SMS1810-VF speakers on both channels are upward-facing, which do not need to be phase shifted (as the sound waves are significantly randomized by reflecting off the structural ceiling). All other channels can also be **No** because they do not include more than one channel from the same amplifier, so there are no phasing issues.

Configure Sound Masking Zones

Now that the amplifiers have been configured for sound masking, the sound masking zones can be created.

It may be helpful to review the *Sound Masking Zones* section of the Nyquist System Administrator Guide, which provides details on how to add and edit sound masking zones, as well as an overview of sound masking zones in general.

For this example, the properties of the four sound masking zones will be configured as specified in Table 5.

	Zone 1	Zone 2	Zone 3	Zone 4
Enabled	No	No	No	No
Number	1	2	3	4
Name	Open Office Area X	Closed Offices	Open Office Area Y	Hallway Outside Conference Room
Stations	A4120-A A4120-B	A4120-C	A4120-D A2120-A	A2120-B
Speaker Orientation	Up	Up	Down	Up
Spectrum Preset	Good open-plan space	Closed-plan space	Good open-plan space	Non-ideal open-plan space
Output Gain	-35 dB	-35 dB	-35 dB	-35 dB
Slow Ramp Days	30	30	30	30

Table 5: Sound masking zone configurations

Initiate Sound Masking and Adjust Levels

Once all sound masking zones are configured, return to the Sound Masking Zones page and enable each zone to determine if the sound masking volume satisfies the sound masking needs. It may be necessary to adjust the sound masking levels to ensure an even sound distribution, wherein the direction of the sound source is undetectable and the volume appears consistent. The levels can be adjusted by modifying the Output Gain for each masking zone.

Once the levels are satisfactory, select **Start Ramping**. Sound Masking is now in effect and will reach the specified level in 30 days.

Assuming that there is an existing paging system in one or more of the sound masking areas, at some point during those 30 days (e.g., approximately 15 days), the paging and audio distribution cut levels (and optionally the system-wide All-Call cut level) should be increased by +3 dB to compensate for the increased noise level. This can be performed manually via the Nyquist web interface (Zones configuration) or by creating a routine that includes Change-Volume actions for each audio type (i.e., Audio Distribution, Zone Paging, and optionally All-Call) and for any zone that overlaps a sound masking zone, specifying a cut level +3 dB above the zone's current level, and scheduling the routine to occur at the desired time (e.g., approximately 15 days into the ramping process).