Oasis Qt ™

sound masking system

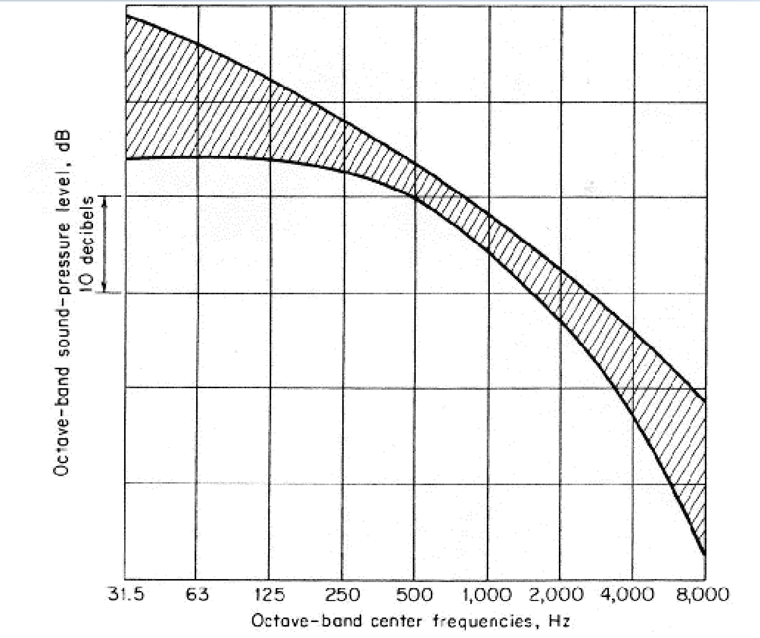
Frequently Asked Questions

What is sound masking?

Sound masking is the addition of a familiar sounding, air conditioning-like background sound to a target environment. This sound covers up or "masks" human speech, and helps to mitigate the distraction of other sounds, helping to make the environment more comfortable, making workers more productive and perhaps most importantly **creating speech privacy**.

What frequencies are important for effective sound masking?

Leo Beranek and the expert staff at Bolt, Beranek and Newman in the United States reported the range of spectra found in typical offices from HVAC systems and activity noise in combination with early sound masking systems, as illustrated below. **This spectrum has often mistakenly been taken as the optimal masking spectrum**, and has remained a reference standard for decades.



What is Articulation Index (AI) and why is it important in sound masking?

Articulation Index (AI) is defined in ANSI S3.5 [1] as a quantitative measure of the intelligibility of speech, i.e. the percentage of speech items correctly perceived and recorded. An articulation index of 100% means that all speech can be understood, 0% means that no speech can be understood.

Articulation Index is calculated from the 1/3 octave band levels between 200Hz and 6300Hz centre frequencies. It is important to note that each of the 1/3 octave dB(A) levels are weighted according to the following criteria:

1/3 Octave Centre Frequency Hz	AI Weighting
200	1.0
250	2.0
315	3.25
400	4.25
500	4.5
630	5.25
800	6.5
1000	7.25

1/3 Octave Centre Frequency Hz	AI Weighting
1250	8.5
1600	11.5
2000	11
2500	9.5
3150	9.0
4000	7.75
5000	6.25
6300	2.5

This weighting is used to define the Articulation Index (AI), the standard measure of acoustic privacy as defined in ASTM E1130 [2] and its corollary the Privacy Index (PI). AI is calculated using the weighted contributions of the signal (unwanted conversation) to noise (background sound) ratio in each octave band that contributes to speech intelligibility. Weights are determined by the contribution of each octave band to speech intelligibility.

AI	Target Workspace	Application
.00 – .05	Confidential speech privacy	Healthcare setting
.05 – .20	Normal privacy	Open office plan
.20 – .35	Marginal privacy	Team work areas
.50 – .65	Good communication	Cafeterias
.65 – 1.00	Excellent communication	Operating room or airplane cockpit

Thus it can be seen that the portions of the audio spectrum that contribute most to speech privacy are very well defined and understood. Frequencies below 250Hz and above 6300Hz contribute very little towards speech intelligibility. This can be demonstrated by playing voice recordings through single octave bandpass filters while listening to each octave band separately. The frequency bands that contribute to speech intelligibility and those that do not can be easily identified.

The following table shows the qualitative and quantitative analysis of such a test:

Octave Band	What you can hear	Contribution to Deciphering Speech
200 Hz and below	A few low "booms", but cannot decipher that the sound is speech	0%
250 Hz		7.2%
500 Hz		14.4%
1000 Hz	Intelligibility would be fairly good but sound "fuzzy"	22.2%
2000 Hz		32.7%
4000 Hz	Intelligibility would be fairly good but sound "fuzzy"	23.4%
8000 Hz	Hear a few S's and T's but won't understand words	0%

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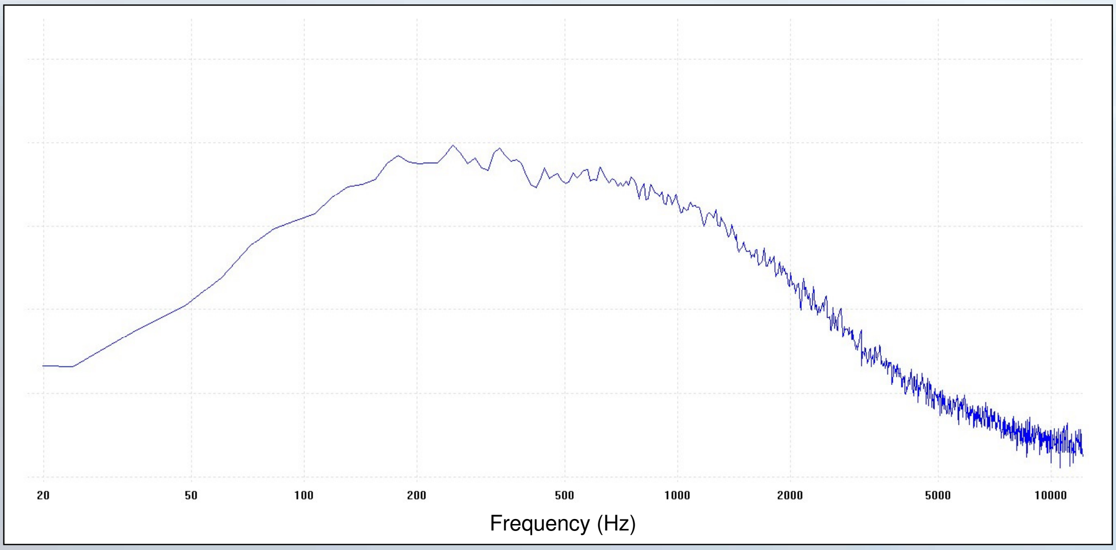
What is the ideal masking sound and what sound is used in our system?

The ideal masking sound is always pleasant, unobtrusive and completely uniform within the target space. Additionally it should be as quiet as possible to meet the acoustic goals of the application.

In our system, the frequencies of the masking sound that create privacy are those naturally found in human speech. Other frequency bands are still masked, but at lower levels, allowing the overall masking level to be quieter than typical "white noise" systems. In fact the patented spectrum employed in our system has been found to achieve speech privacy with sound levels up to 3dBA lower than competing systems. To make the sound pleasant we have removed all tonality, "hissing," and very low frequencies, creating a spectrum shape that is the most pleasing to the most people. We simultaneously generate masking sound within the speech frequencies of the Beranek spectrum to guarantee the most speech privacy at the quietest possible masking level. A typical snapshot of the frequency spectrum applied to one emitter is shown below.



What is the best type of sound masking system?

The best sound masking systems are undoubtedly "direct field" systems. Compared to previous generations, they are far simpler and less expensive to install, they provide more uniform and unobtrusive sound in the targeted space and don't overflow into adjacent spaces or offices.

Our patented Q*t Quiet technology™* based systems are direct field, and a generation ahead of the competing alternative. In a standard office environment, miniature emitters are installed in the ceiling tiles and deliver a pleasant, diffused, non-distracting, air conditioning-like sound into the targeted space. If your ceiling isn't "standard," the emitters can be mounted to exposed beams or even embedded in furniture or other fixtures.

Why are Direct Field systems better than in-Plenum systems?

Introduced in the late 1990's direct field sound masking systems project the sound from the masking speakers (emitters) directly to listeners within the room, without interfacing with any other reflecting or transmitting features (within the plenum for example). Direct field systems are in widespread use and are designed to be installed in both suspended ceilings and in areas without any absorptive ceiling systems. When installed in suspended ceilings, emitters are mounted directly in to the ceiling tile. For spaces that don't have a suspended ceiling, emitters are mounted in brackets placed on any available structure. In each case the emitters face downwards sending the masking noise directly into the target space.

Emitters are spaced appropriately for the working area, providing a masking sound that is **evenly distributed**. Because they are direct field emitters, any issues of spatial non-uniformity due to in-plenum conditions are eliminated, as the plenum, ceiling materials, and other plenum mounted items are not involved in the acoustic path. Consequently, individual speakers do not have to be adjusted to counteract plenum conditions and no spectral tuning is usually required, so system complexity and hence cost is minimised.

By contrast, **in-plenum systems**, first developed in the 1960's, employ a network of larger loud speakers each mounted within the plenum (the plenum is the void between the suspended ceiling and the deck above it). Each speaker points upwards to reflect sound off the deck in order to broaden the footprint of the masking sound entering the working space below. The actual pattern of acoustic energy entering the workspace is complicated by many factors, all of which cause some **spatial variation** in the distribution of sound within the target area. Some of these factors are listed below:

1. Since loud speakers radiate in all directions, some low frequency energy is radiated directly downwards. This causes some **sound variability** in the area immediately below the speakers.

2. Suspended ceilings exhibit a wide range of acoustic transmission loss. Some of the common lightweight office tiles have a high degree of acoustic transparency (how easily sound is transferred to the space below), which increases the sound variability in the area below the speakers.

3. The space within the plenum is acoustically complicated due to the presence of structural beams, heating and ventilation ducts and so on. All of these act to compartmentalise the masking sound, causing it to be scattered and reflected. This can also add to the spatial variability in the target space below.

4. When less acoustically transparent ceiling tiles are used, such as mineral fibre tiles, a reverberrent acoustic build-up can occur within the plenum. This can cause a significant overflow of masking noise in to spaces where it might not be wanted, needed or desireable.

5. In many workplaces, internal walls only extend from the floor to the suspended ceiling (and not in to the plenum and up to the deck above). In these cases it may be impossible to contain the masking sound from an in-plenum system in the desired area only, and overspill in to adjacent spaces is likely to be unavoidable.

6. For installations that might require different masking volume levels for different areas, e.g. an installation consisting of an open-plan office, some enclosed cellular offices, and perhaps a reception / circulation area, the ability to generate the different masking levels required may necessitate additional costly electronics. Also, containment of the desired levels within their respective target areas may also be severely compromised by in-plenum conditions.

7. If the plenum is used as the air-return for an HVAC system, the ceiling will contain vents or open-air returns. Should these returns be untreated, they will act is direct transmitters of the masking sound from the plenum to the target space, thus adding further to the variability of the masking sound in the working area. Treating such open-air returns is straightforward, but inevitably adds cost to the installation.

Properly tuned and adjusted in-plenum systems, when installed in conjunction with treated open-air returns, can provide uniformity within many target sound masked spaces. However, this uniformity is likely to require careful adjustment of the volume and output spectra of individual or small groups of speakers, which requires additional electronics for individual speakers (or groups of speakers), thus further adding to installations costs.

Does each emitter / speaker need to be tuned individually in our system?

Since our system is direct field, no individual emitter tuning is necessary. All of our systems are pre-programmed with the optimum masking sound. Our QT Pro controller systems allow for automatic sound ramping to accommodate gradual user acclimatisation, facilitate optional different day / night levels with user programmable switching times and ramping rates, together with graphic equalisation adjustment for individual zones to satisfy the most demanding areas.

With previous generation in-plenum systems, adjustments (both spectral and level) are required for each speaker, because of the variety of discontinuities between the loudspeaker and the target area in typical working environments. Acoustic obstacles in the plenum, e.g. air ducts, suspended ceiling discontinuities such as open-air return vents, and structural considerations such as walls that do or do not extend to the deck – each require specific attention with an in-plenum system. Since our systems are direct field (installed to interface directly with the target area and not the space above it) there are no acoustic discontinuities between the emitters and the target area. Additionally, direct field systems do not spill into unwanted areas such as private offices with walls that extend only to the suspended ceiling, as in-plenum systems do.

Is a sound masking system expensive to run?

The amount of energy consumed by any sound masking system is, of course, dependant on the size of the installation. However, our QT Pro 1500 connected to 1800 emitters servicing an area of 16,700m^2 (for example) will consume only around 60W in total, i.e. just 33mW per emitter. This is because our direct field emitters do not have to interact with the plenum and the ceiling tiles. When this is compared to in-plenum systems, which may require several Watts per emitter, we believe that our Oasis and QT Pro systems are amongst the most energy efficient systems available today, being up to 100 times more energy efficient than comparable in-plenum systems, and so reducing running costs accordingly.

References

[1] American National Standards Institute, “Methods for calculation of the speech intelligibility index”, ANSI S3.5, 1986.

[2] ASTM International, “Standard test method for objective measurement of speech privacy in open plan spaces using Articulation Index”, E 1130 - 08

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