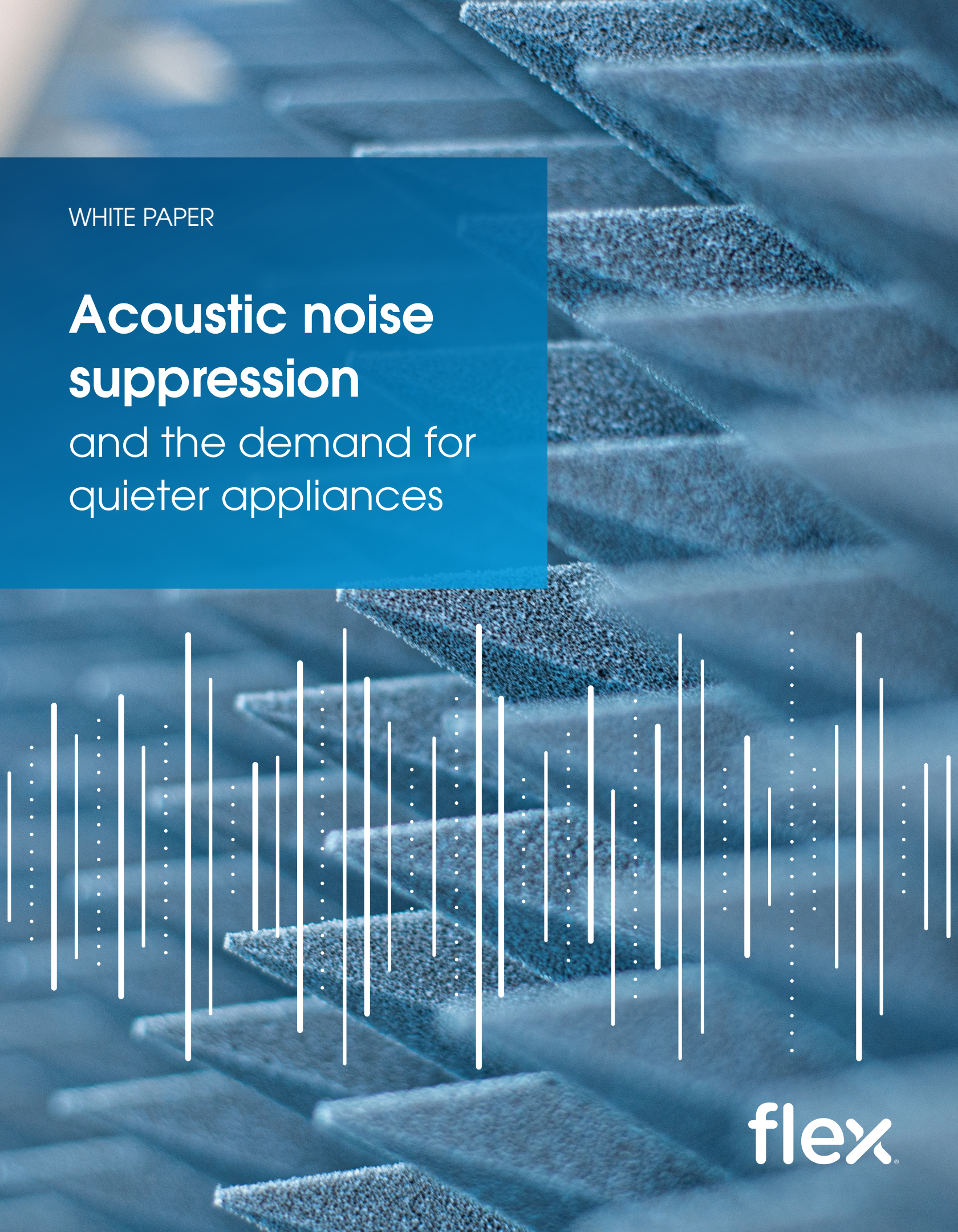

WHITE PAPER

Acoustic noise suppression

and the demand for quieter appliances

flex

Introduction

Impact on everyday human life

In today's world, noise is an unavoidable part of daily life, from the hum of household appliances to the bustle of urban environments. However, as people place greater value on comfort, wellness, and productivity, the demand for quieter spaces—both at home and in the workplace—is growing.

The negative impact of excess, unwanted noise (often referred to as "noise pollution") extends beyond simple annoyance and can be associated with several health conditions, including higher stress levels, sleep disturbances, and even cardiovascular disorders. A 2019 review[1] of existing studies found that prolonged exposure to noise pollution is linked to faster cognitive decline, emphasizing the need for better noise management in everyday environments. This awareness became more pronounced in 2020, when global lockdowns led to a more than 50% reduction in man-made noise in many countries. During this time, people experienced—and came to appreciate—the benefits of a quieter world.

A quieter world

As a result of a newfound appreciation for quieter environments and an increased focus on wellness, consumers are increasingly prioritizing low-noise options when purchasing what would traditionally be seen as "louder" products, like appliances. In response, manufacturers are integrating noise reduction into product design, creating appliances that deliver high performance without unnecessary and disrupting noise pollution.

This brief explores the role of noise in everyday life, the rise in consumer demand for quieter appliances, and the strategies used to develop products that align with these expectations.

[1] The Effect of Noise Exposure on Cognitive Performance and Brain Activity Patterns
https://pmc.ncbi.nlm.nih.gov/articles/PMC6901841/

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Quieter appliances

Quiet in the home

Quiet appliances can help reduce the noise pollution in homes and offices by creating a more peaceful, relaxing, and comfortable environment, which can improve quality of life in the home and workplace. For example, a quiet coffee machine, ceiling fan or washing machine can be run at any time of day or night without disturbing the occupants of the building.

This is particularly beneficial for remote workers, parents with young children who nap during the day, and those who simply value a more serene living space.

Consumer preferences for low-noise appliances

Consumer demand for quieter appliances continues to grow, as seen in a recent survey[2] by Quiet Mark which revealed that:

- 82% of UK consumers would like to make appliances in their homes quieter.
- 63% (age 18-34), 51% (age 35-54), 30% (age 55+) are willing to pay more for quieter appliances.
- 70% are more likely to buy an appliance labeled as "quiet" over a comparable product without noise specifications.
- 79% consider noise level an important factor when buying appliances, with this number expected to increase as awareness of noise-related health impact grows.

[2] Quiet Mark reports half of adults want quieter home
https://www.quietmark.com/news/quiet-mark-reports-half-of-adults-want-a-quieter-home

Noise characteristics

Noise is undesired sound that disrupts normal activities and can negatively affect well-being. It encompasses bothersome or disturbing sounds emitted by various sources, such as machinery, appliances, and environmental factors. Noise can interfere with communication, relaxation, and overall comfort.

Noise however, is more than just loudness; it is a combination of several characteristics, including:

Loudness
The perceived volume of sound.

Tonality
The presence of distinct tones or pitches.

Sharpness
High-frequency elements that make a sound more harsh or "piercing."

Roughness
Variations in the noise signal that can make a sound more irritating to the listener.

These factors influence the responses that a listener has to any particular sound, potentially impacting stress levels and overall comfort. Understanding these noise characteristics is essential for designing quieter products and, ultimately, calmer environments.

Common sources of appliance noise

Appliances can produce noise from a variety of sources depending on product design and applications. The most common noise sources in appliances come from:

Motors

Many appliances, such as washing machines, vacuum cleaners, and air conditioners, use electric motors to power their operation. These motors can generate noise as they spin, particularly if they are not properly balanced or lubricated.

Fans

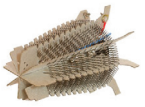
Appliances such as refrigerators, air purifiers, and computer towers often use fans to circulate air and cool internal components. These fans can generate a whirring or humming noise as they spin.

Compressors

Refrigerators, freezers, and air conditioners use compressors to cool or compress gases. These compressors can generate a loud humming or buzzing noise as they operate.

Heating elements

Appliances such as ovens, toasters, and hair dryers use heating elements to generate heat. These elements can sometimes produce a buzzing or hissing sound as they heat up.

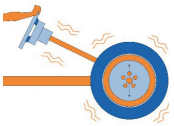


Moving parts

Some appliances, such as dishwashers and garbage disposals, have moving parts that can generate noise as they operate. These noises can include clanking, grinding, or rattling.

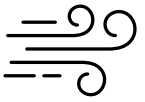
Vibration

Appliances that operate at high speeds or with unbalanced components can generate vibration, which can in turn produce noise as the appliance vibrates against surfaces or components.



Air turbulence noise

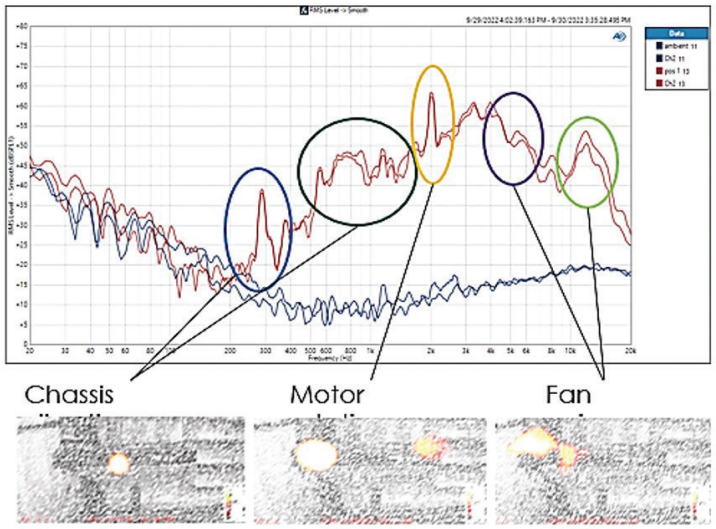
The air turbulence noise or "air leak noise" generated when high speed air flow from an enclosure leaks out from a tight opening or tiny hole that generates a hissing sound.



Designing quieter appliances

Creating quieter appliances requires careful engineering and design considerations, and one of the most effective ways that Flex can help reduce appliance noise is to eliminate or minimize noise sources.

This process includes understanding the noise spectrum to help isolate and identify the most dominant and irritating peaks within that spectrum, which allows Flex to work to reduce or suppress the noise being created by the appliance.



Noise reduction strategies

Minimizing noise sources:

Using more efficient fans and motors, reducing the number of moving parts, and incorporating noise-dampening materials such as insulated covers.

Optimizing airflow:

Designing fan blades and airflow paths to reduce turbulence and lower noise levels.

Testing and refinement:

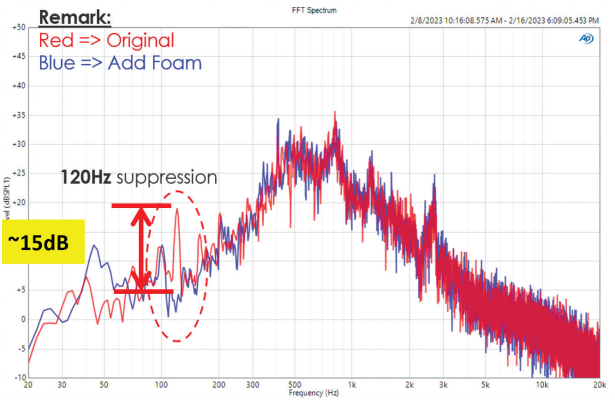
Identifying and eliminating noise sources through acoustic testing and performance analysis, as well as making iterative design changes to reduce noise levels.

Eliminating noise sources

One of the most effective ways to reduce appliance noise is to eliminate or minimize noise sources. This can be achieved by using more efficient motors and fans, reducing the number of moving parts, and incorporating noise-reducing components such as sound-insulating covers or dampeners.

For appliances that rely on fans and air circulation, the design can be optimized by carefully designing fan blades and airflow paths to reduce turbulence and minimize noise.

Designing quieter appliances often involves a process of testing and refinement to identify and eliminate noise sources. This can involve using acoustic testing equipment to measure noise levels and identify the sources of noise, as well as making iterative design changes to reduce noise levels.



Anechoic chamber measurement

- Measurement of noise in anechoic chamber using free field microphone and advanced noise data acquisition system
- Spectrum analyzer app to analyze noise signal

Sound camera

- Break down the sound and visualize the noise source
- Greatly ease pinpointing of noise source
- Can be utilized to localize acoustics defects such as buzz and air leak in audio products

The demand for quieter appliances is growing as consumers recognize the benefits of reduced noise pollution in their daily lives. Designing these low-noise appliances requires a combination of innovative engineering, strategic material selection, and rigorous testing and analysis.

By focusing on minimizing noise sources and leveraging advanced measurement techniques, Flex can work with you to develop products that enhance comfort and well-being without compromising function.

All this is made possible with our state-of-the-art acoustic facility in Flextronics Technologies Penang (FTP).

For more information, visit **flex.com/connect**

Flex (Reg. No. 199002645H) is the manufacturing partner of choice that helps a diverse customer base design and build product that improve the world. Through the collective strength of a global workforce across 30 countries and responsible, sustainable operations, Flex delivers technology innovation, supply chain, and manufacturing solutions to various industries and end markets.