A PROVEN SOLUTION TO PROTECT MEMS MICROPHONES

Rigorous testing shows how GORE® MEMS Protective Vents Style 200 reliably prevents particle contamination and pressure build-ups in MEMS microphones, and enables higher manufacturing yields and in-process acoustic testing in high-volume PCB (Printed Circuit Board) assembly operations.

Proven Effective Protection

Acoustic testing before and after Gore's Dust Test proves the performance effectiveness of integrating a Style 200 vent into a MEMS package: particle contamination is minimized, while acoustic quality can be maintained for the life of the device.

Test Protocol

Gore performed accelerated IP5X dust-chamber testing based on the IEC60529 standard. Three types of MEMS microphone systems (one protected by Gore's Style 200 vent; the other two unprotected by any vent) were exposed to fine JIS test powder (Class 9/~50% particle distribution at 5 µm) for 30 minutes. Each MEMS system underwent acoustic testing and microscopy inspection before and after the dust challenge.

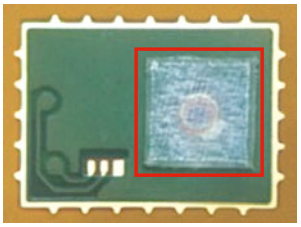
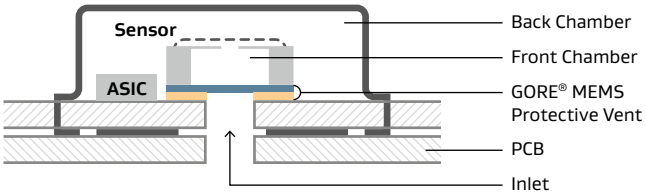


Figure 1: Typical placement of Style 200 on a MEMS PCB

MEMS Microphone Packages Evaluated

Part No./Type of MEMS System/Protection
083*/Single diaphragm/Style 200
SDMS/Single diaphragm/Unprotected
DDMS/Dual diaphragm/Unprotected

* Goertek Part SD18OB371-083 with integrated GORE® MEMS Protective Vent Style 200



Integrating a GORE® Vent can enhance production output in high-volume PCB assembly.

Acoustic Testing After IP5X Challenge

Frequency Response (FR) Test

			Sensitivity at 1 kHZ (dB re 1V/Pa)			Outside of Spec.
PN	Style 200	Qty.	Mean	Std.	Range	Observed %
083	Yes	96	-36.48	0.15	0.87	0
SDMS	No	96	-41.18	3.8	15.12	77.1
DDMS	No	93	-37.29	0.55	3.35	5.4

Table 1: MEMS Performance and Sensitivity Comparison

As seen in Table 1, only PN 083 (protected by the GORE® MEMS Protective Vent Style 200) was able to perform to the manufacturer's specification after dust exposure. In PN DDMS, dust exposure caused a failure rate of 5.4%. This equates to a failure rate of 54,000 parts per million, an unacceptable rate for high-volume devices.

Total Harmonic Distortion (THD) Test

THD helps determine output quality, as microphones or loudspeakers with high distortion suffer from reduced audio clarity. Figure 2 compares the THD differences as a function of drive level to capture the impact before and after dust exposure. Results show significant differences in the standard deviation for the post-exposure conditions of the two unprotected MEMS microphones. Only PN 083, protected by the GORE® MEMS Protective Vent Style 200, experienced minimal THD after the dust challenge.

THD vs. Drive Level: All MEMS Pre- vs. Post-Dust

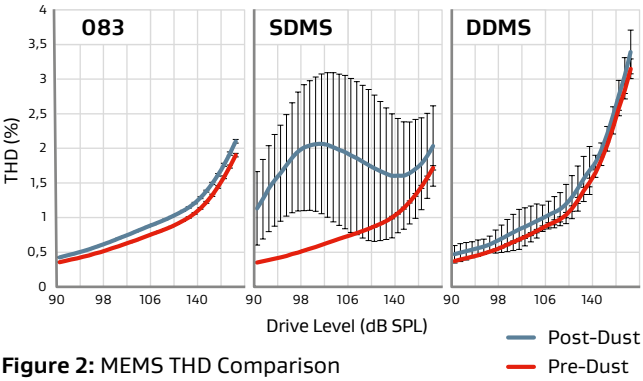
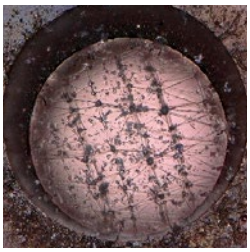


Figure 2: MEMS THD Comparison

Microscopy Evaluation

Each MEMS microphone was inspected using a Keyence VHX-5000 Microscope both before and after dust exposure.

PN 083 – Gore-Protected MEMS (Single Diaphragm)

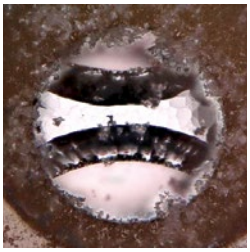


The GORE® MEMS Protective Vent Style 200 integrated in this MEMS package was able to capture dust particles on or within the membrane microstructure. No adverse acoustic performance or reliability concerns were evident on the MEMS microphone after exposure to dust particles.

PN SDMS – Unprotected MEMS (Single Diaphragm)

No vent was integrated in this MEMS package, which allowed dust particles to collect directly onto the back plate of the MEMS die. The back plate features nominal aperture holes of 8 µm. As more than 75% of the dust used in the test was smaller than 8 µm in diameter, test particles likely migrated into the space between the back plate and the diaphragm, causing the adverse results.

PN DDMS – Unprotected MEMS (Dual Diaphragm)



No vent was integrated in this MEMS package, which allowed significant collection of dust particles on the die separator bar and the exposed diaphragm area. Although only the non-porous diaphragm was exposed, as these dust particles progressively accumulate they can limit the vibration of the diaphragm, degrading the acoustic performance and overall reliability of the MEMS.

Conclusions

Following the IP5X dust exposure challenge, MEMS microphones with the GORE® MEMS Protective Vent Style 200 significantly outperformed the unprotected MEMS devices. The microphone sensitivity (Frequency Response) and THD tests clearly demonstrate that dust exposure degraded the acoustic quality and performance of the unprotected devices.

These tests demonstrate conclusively that MEMS microphones equipped with GORE® MEMS Protective Vent Style 200 can consistently meet manufacturers' acoustic sensitivity specifications after dust testing and provide reliable, life-of-device protection for MEMS microphones.

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