

September 18, 2020

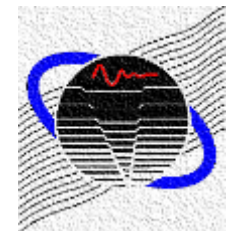
# Micro-Perforated Panel Placement Study

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Caoyang LI  
University of Kentucky

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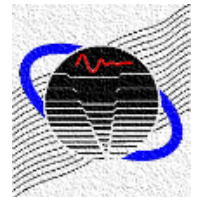
**Vibro-Acoustics Consortium**



# Objectives


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To investigate effect of positioning of MPP in a treatment lay-up on transmission loss and sound absorption.





# Glossary of Elements


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Glass Fiber  
( $t = 2.5$  cm, Flow Resistivity 15,000 Rayls)  GFR

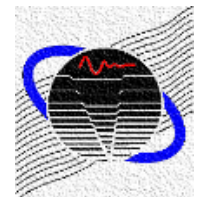
Air Pocket  
( $t = 2.5$  cm, Flow Resistivity 0 Rayls)  AIR

Micro Perforated Panel  
( $d_h = 0.2$  mm,  $\sigma = 0.04$ ,  $t = 1$  mm)  MPP

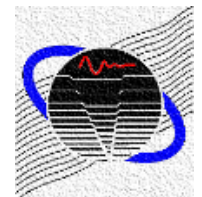
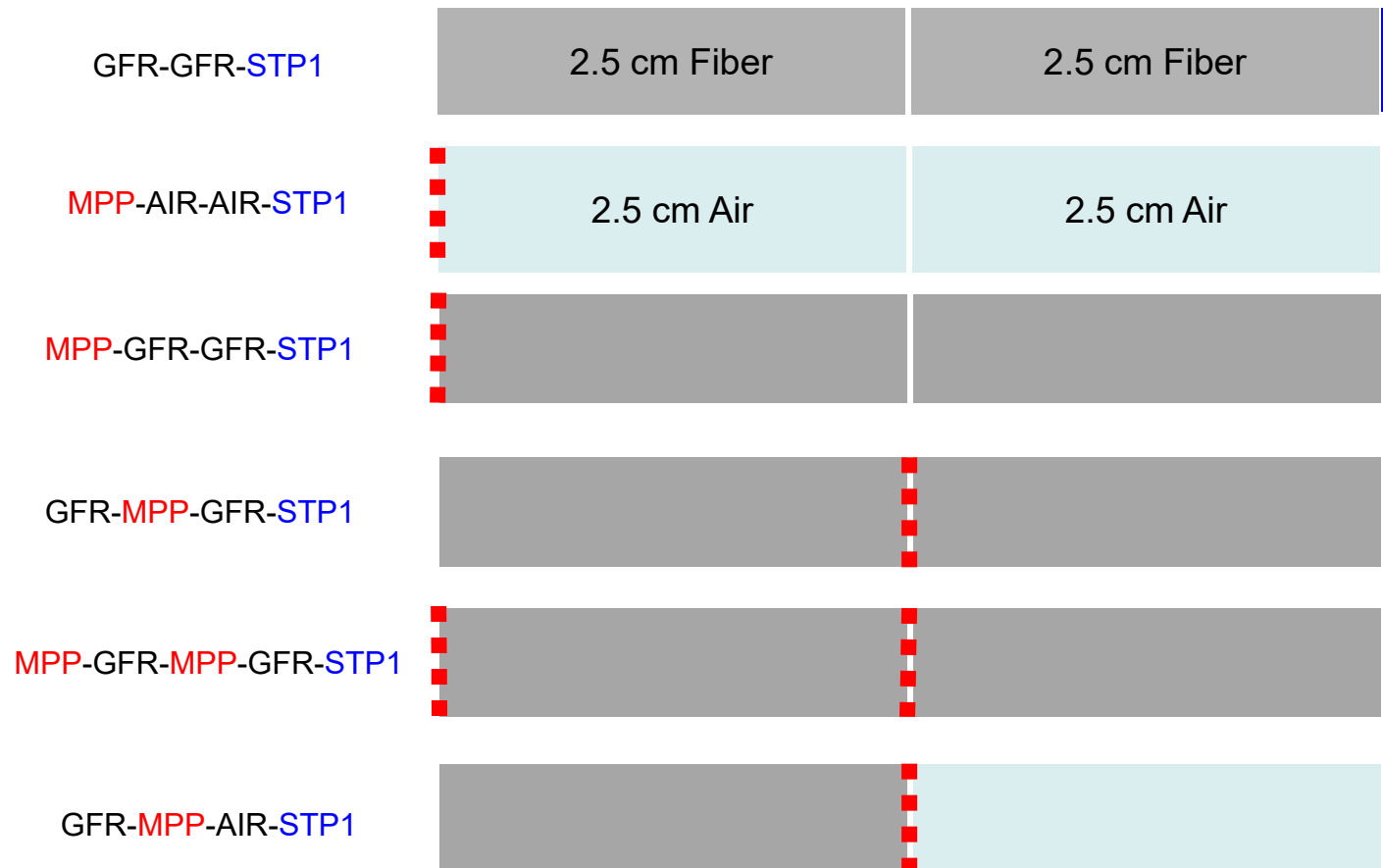
Ultra-Thin Micro Perforated Panel  
( $d_h = 0.2$  mm,  $\sigma = 0.08$ ,  $t = .65$  mm)  UTMPP

Steel Panel (24 gage 0.64 mm thick)  STP1

Steel Panel (14 gage 1.90 mm thick)  STP2



# Examples Nomenclature



# Transfer Matrix Approach



$$[T] = \begin{bmatrix} T_{11} & T_{12} \\ T_{21} & T_{22} \end{bmatrix} = [T_{MPP}][T_{GFR}][T_{STP}]$$

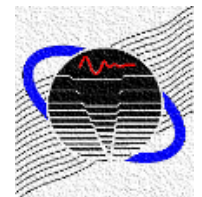
Sound Absorption Coefficient (Rigid Termination)

$$R = \frac{T_{11} - T_{21} \frac{\rho c}{S_c}}{T_{11} + T_{21} \frac{\rho c}{S_c}}$$

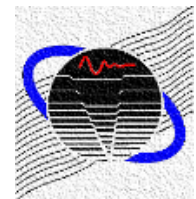
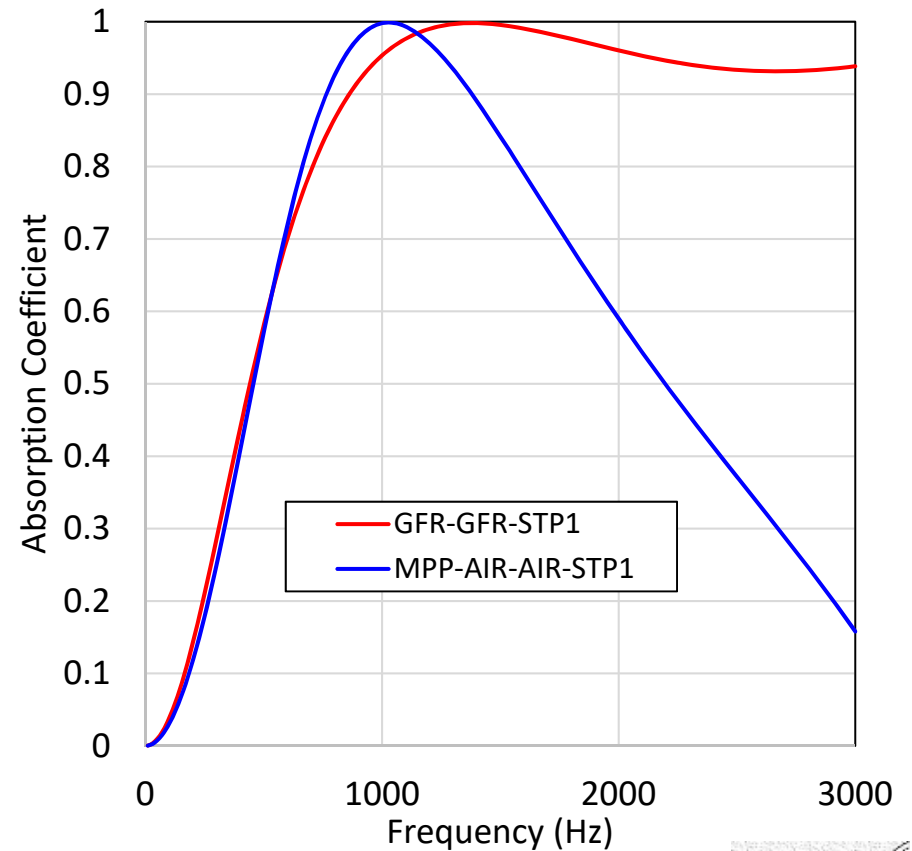
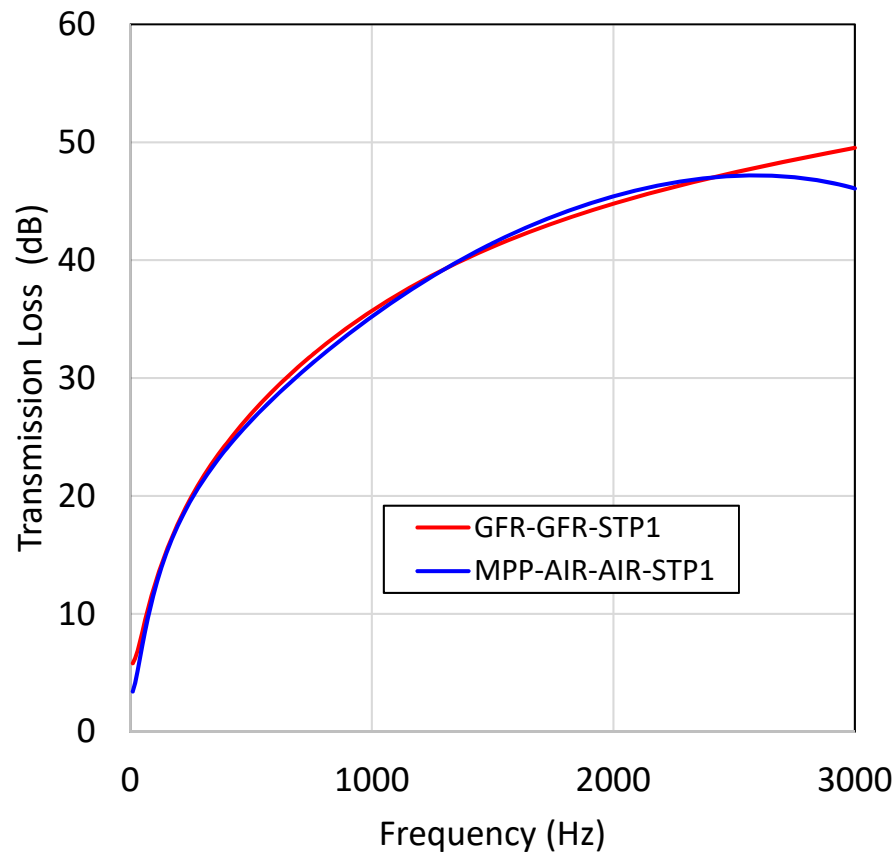
$$\alpha = 1 - |R|^2$$

Transmission Loss

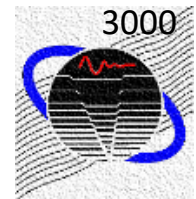
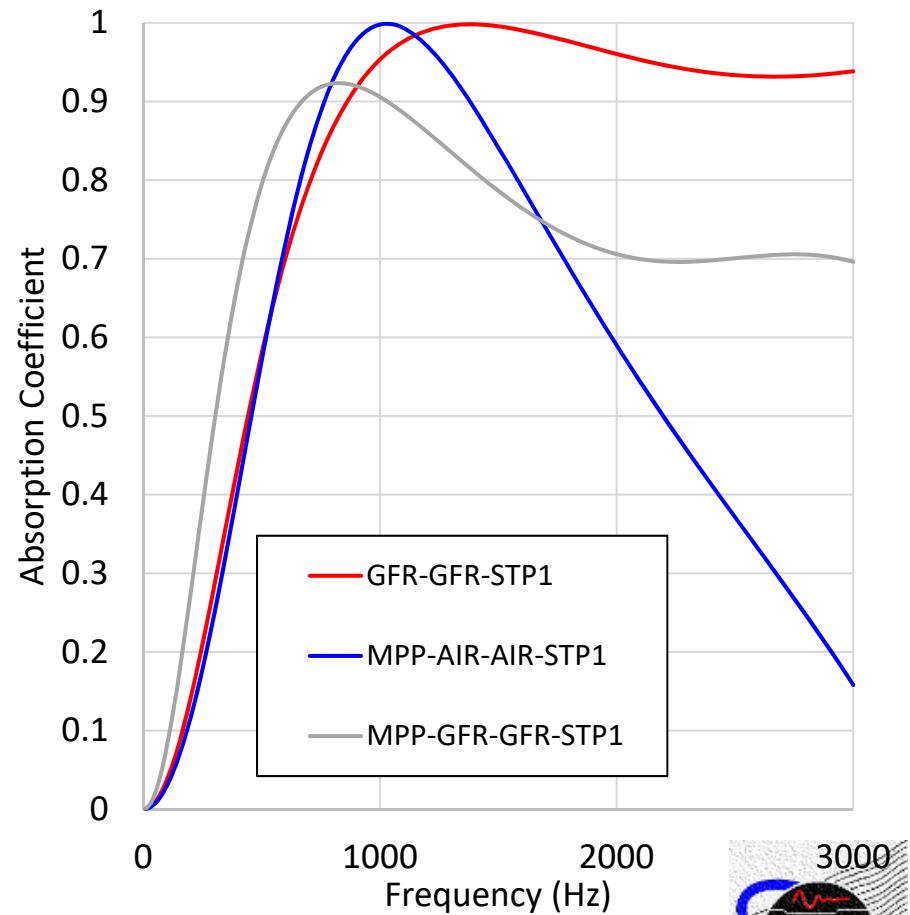
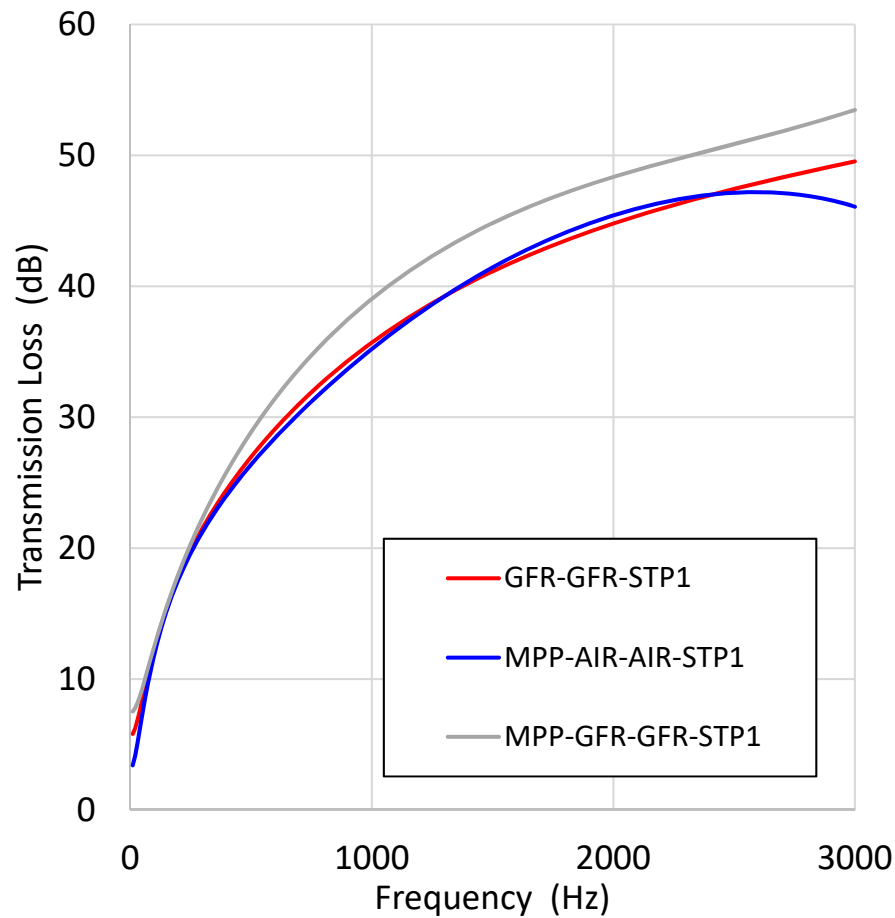
$$TL = 20 \log_{10} \left\{ \frac{1}{2} \left| T_{11} + T_{12} \frac{S_c}{\rho c} + T_{21} \frac{\rho c}{S_c} + T_{22} \right| \right\}$$



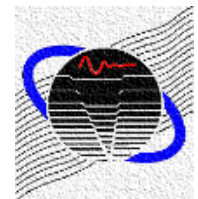
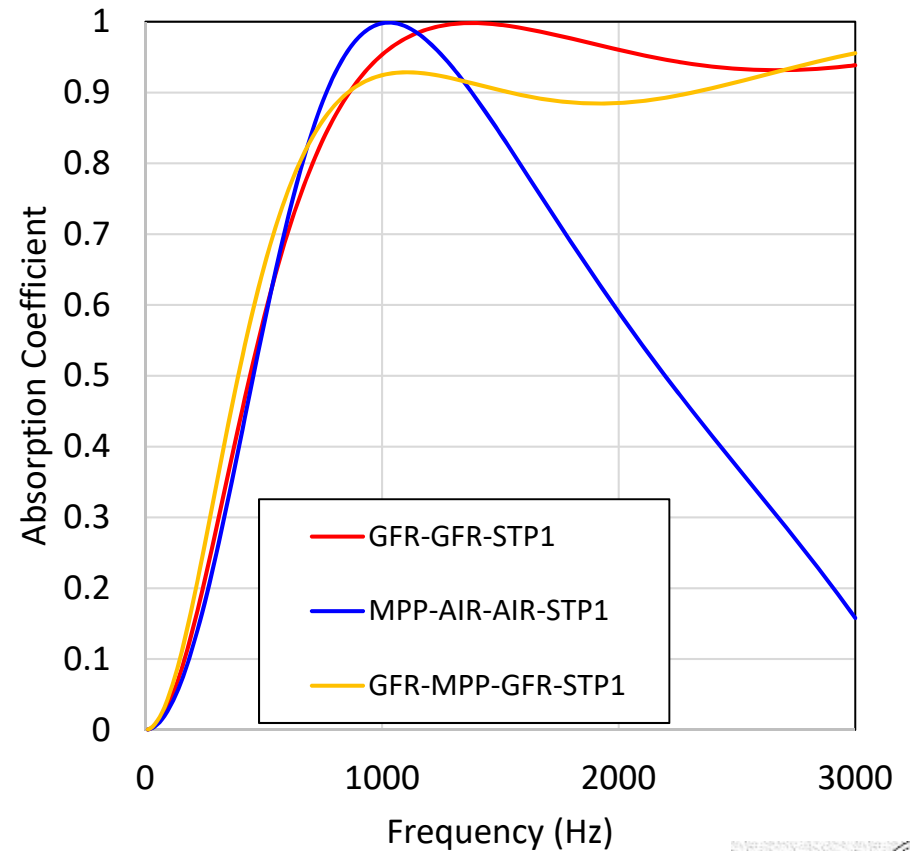
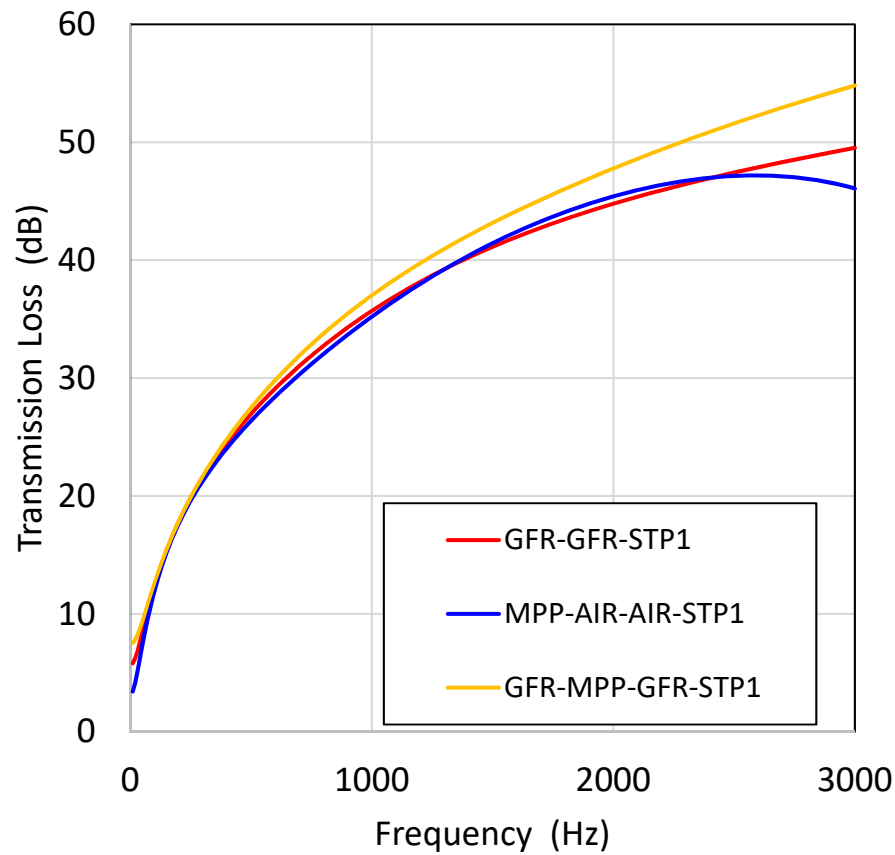
# Comparison Baseline Cases



# Comparison MPP-GFR-GFR-STP1

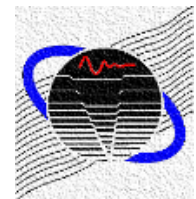
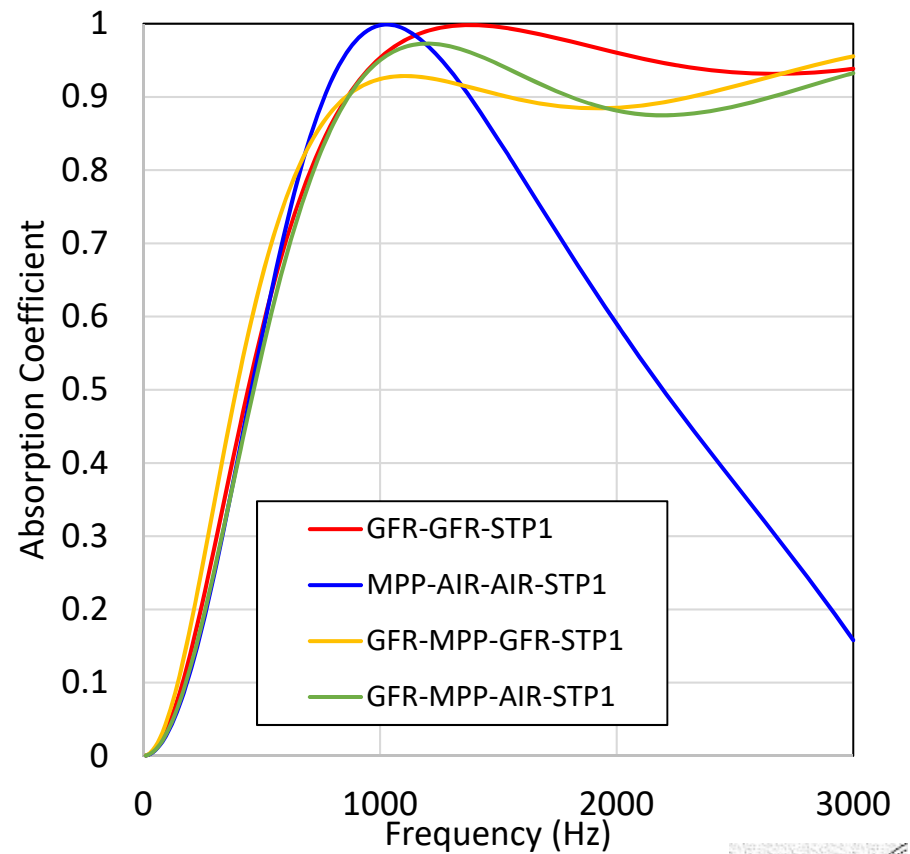
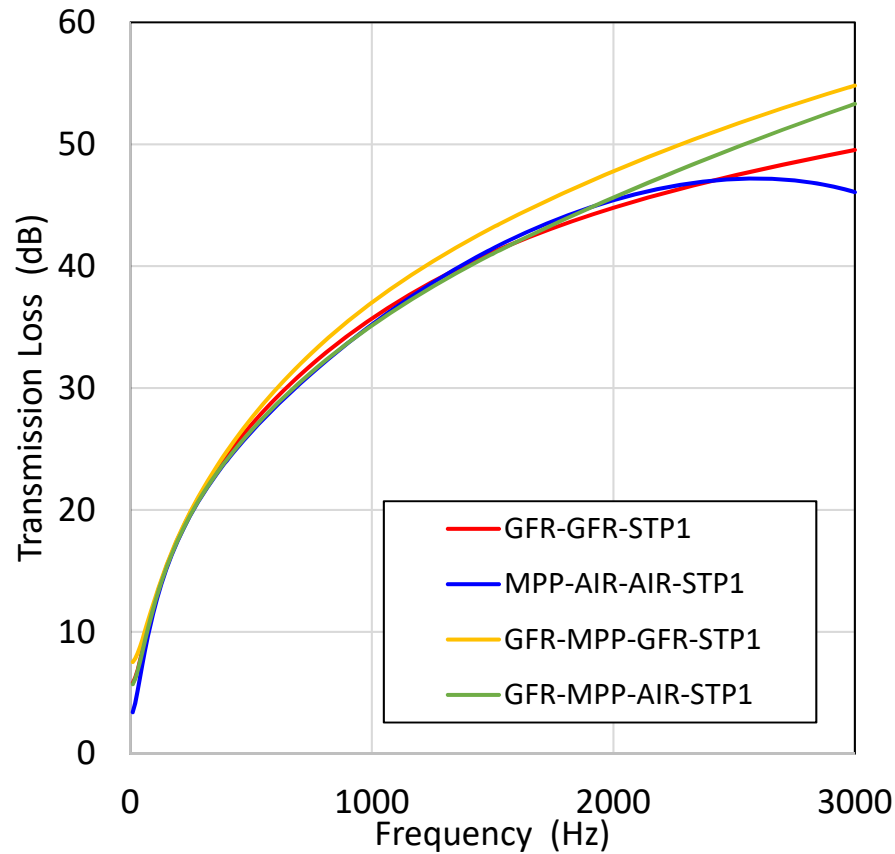


# Comparison GFR-MPP-GFR-STP1

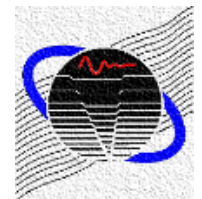
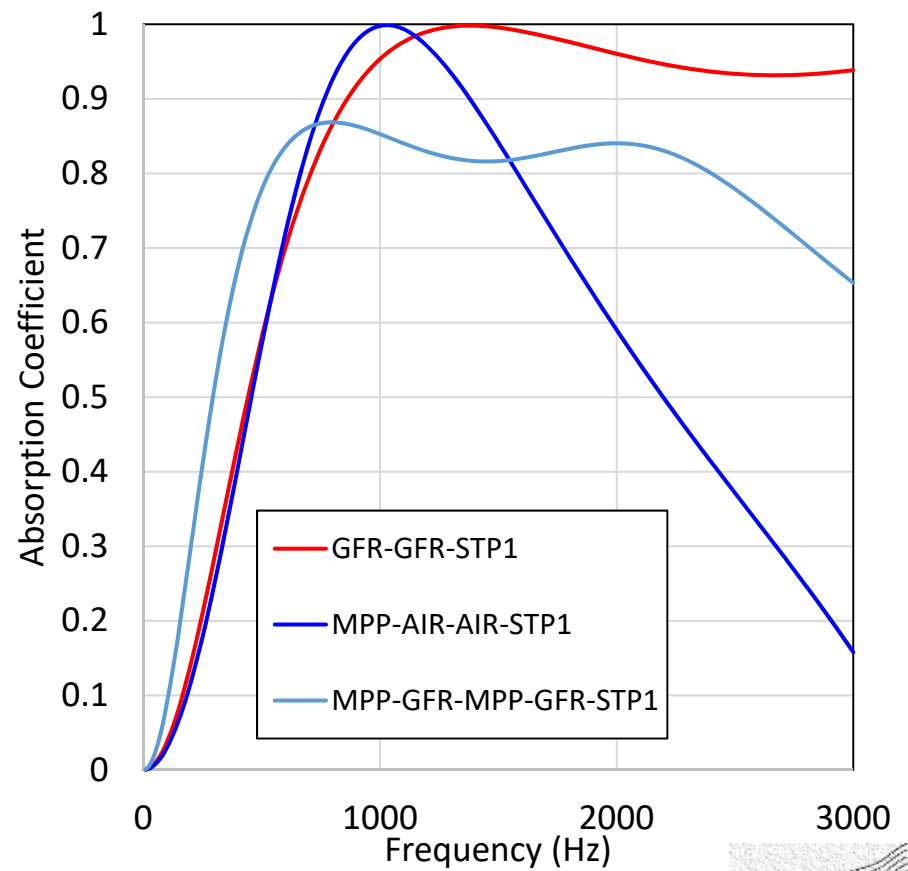
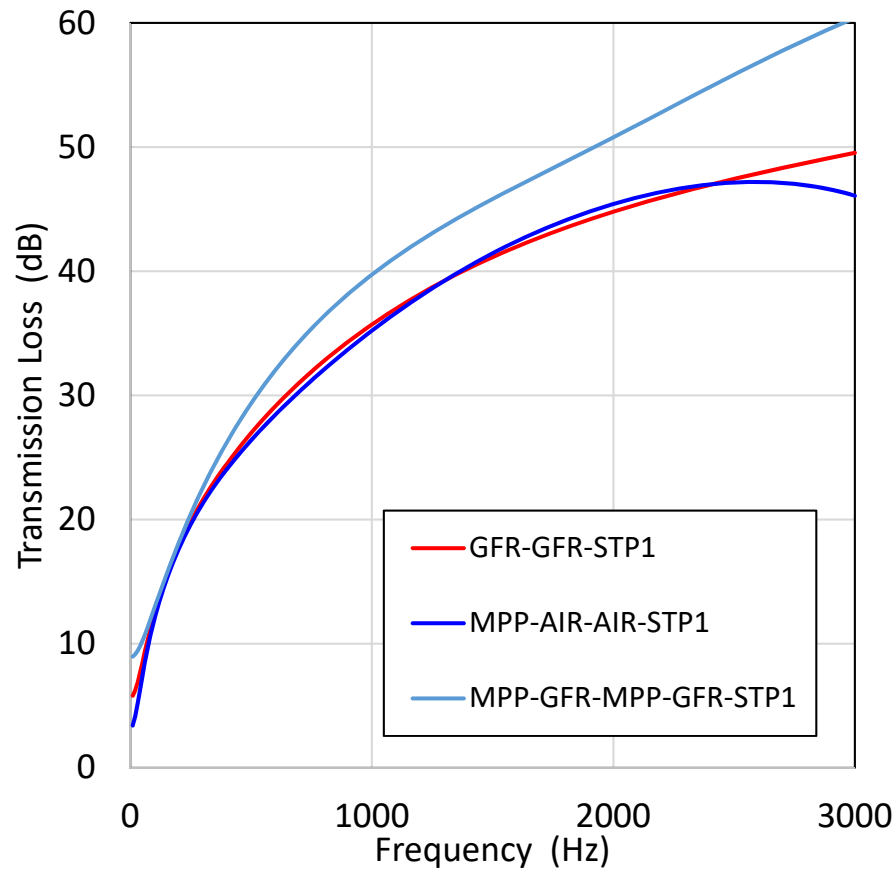




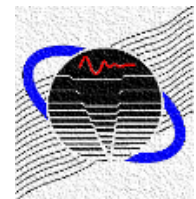
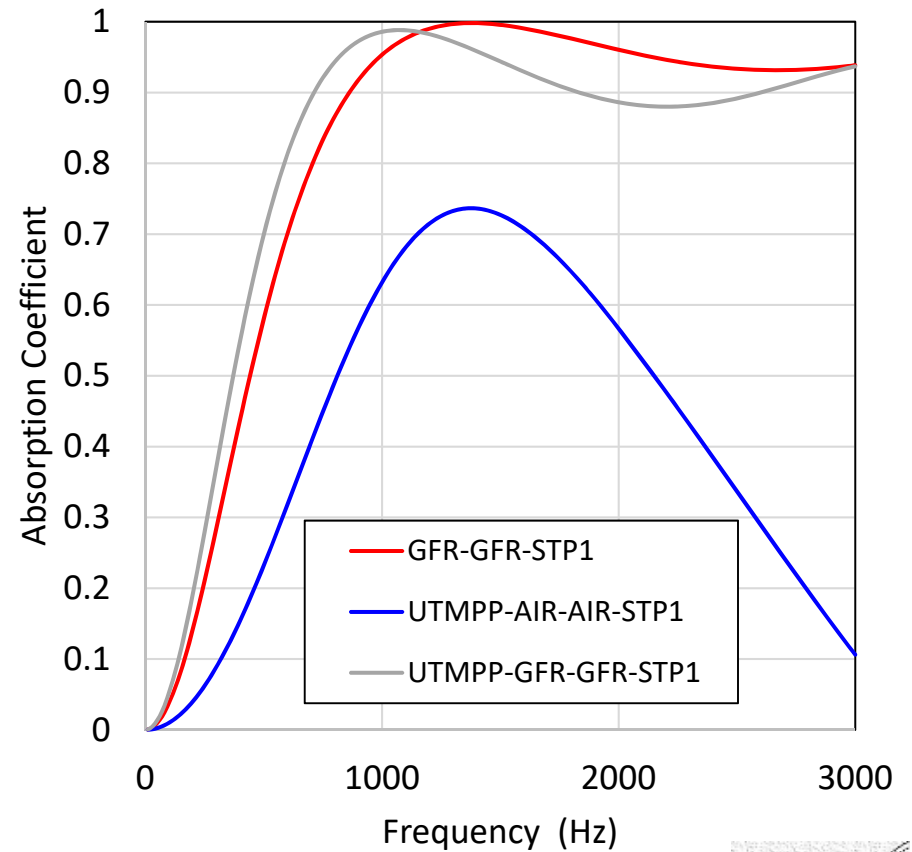
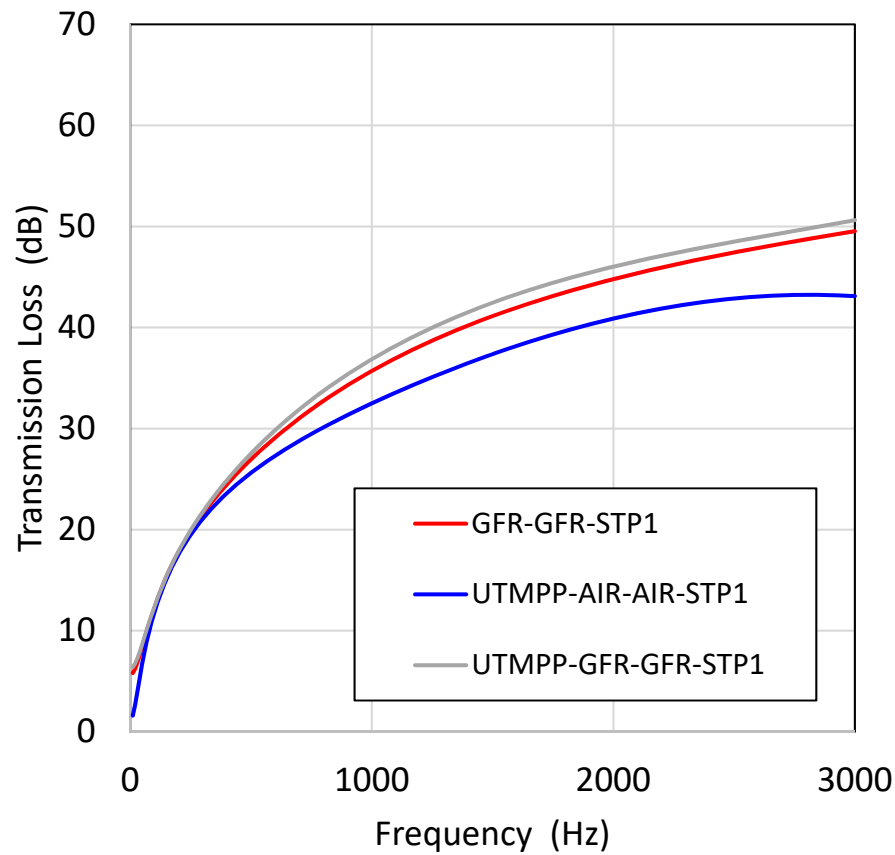
# Comparison GFR-MPP-AIR-STP1



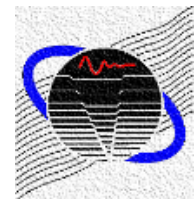
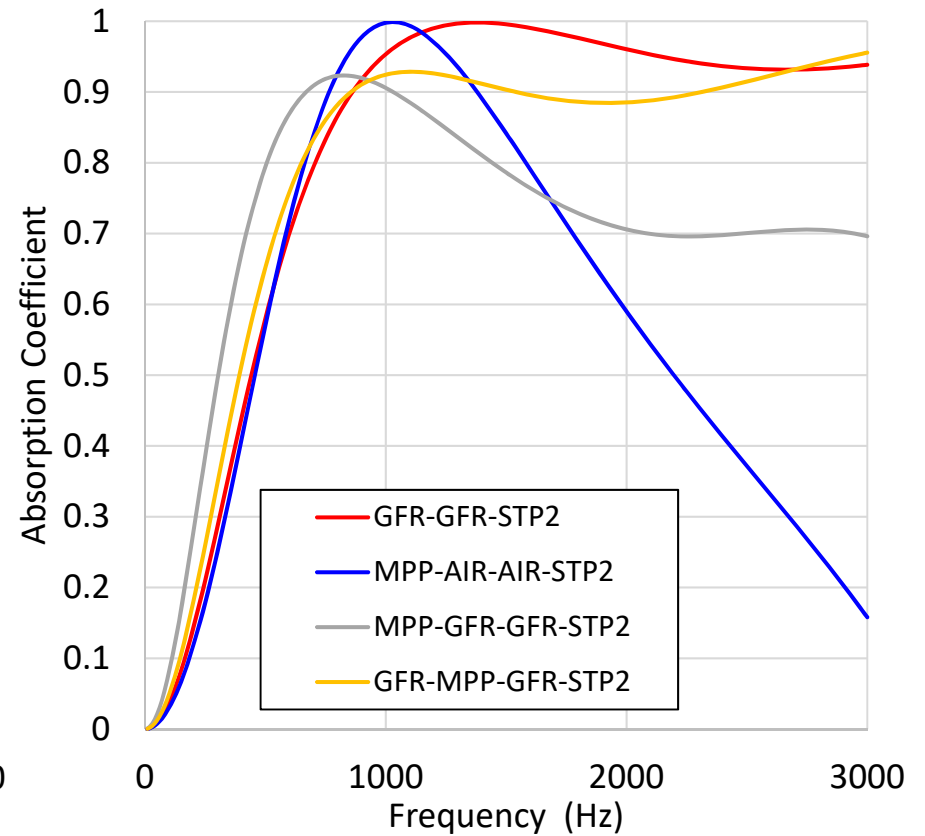
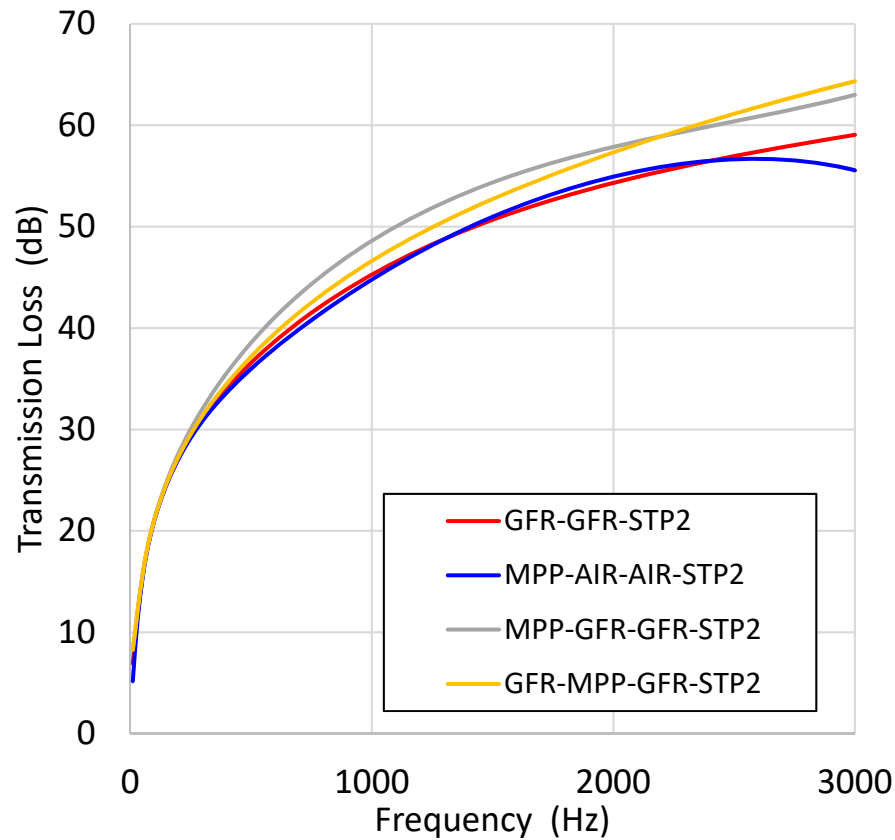
# Comparison MPP-GFR-MPP-GFR-STP1



# Comparison Ultra-Thin MPP



# Comparison Thicker Steel Panel



# Summary

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- Placement of an MPP in front of fiber improves low frequency sound absorption and transmission loss.
- Placement of an MPP in the middle of an absorber lay-up slightly improves both low frequency sound absorption and transmission loss.
- Acoustic performance alone will not drive use of MPP absorbers.

