



DIY ACOUSTIC DIFFUSER DESIGNS

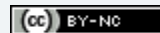
Fabrication Drawings for Optimized Stepped Diffuser A1-LF (The Leanfuser™)

ARQEN SONIC

A DIVISION OF WESTRIVER INDUSTRIAL INC.

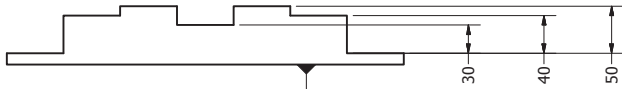
2012-2013

Prepared by: Tim Perry



Stepped Diffuser Designs in Chapter 7.3 of “The Lean Optimization of Acoustic Diffusers” by [Tim Perry](#) are licensed under a [Creative Commons Attribution-NonCommercial 3.0 Unported License](#). Consult [RPG Diffusor Systems Inc.](#) for restrictions on fractal diffusers. Background research draws from the works of [Trevor Cox, University of Salford](#); [Peter D’Antonio, RPG Diffusor Systems Inc.](#)

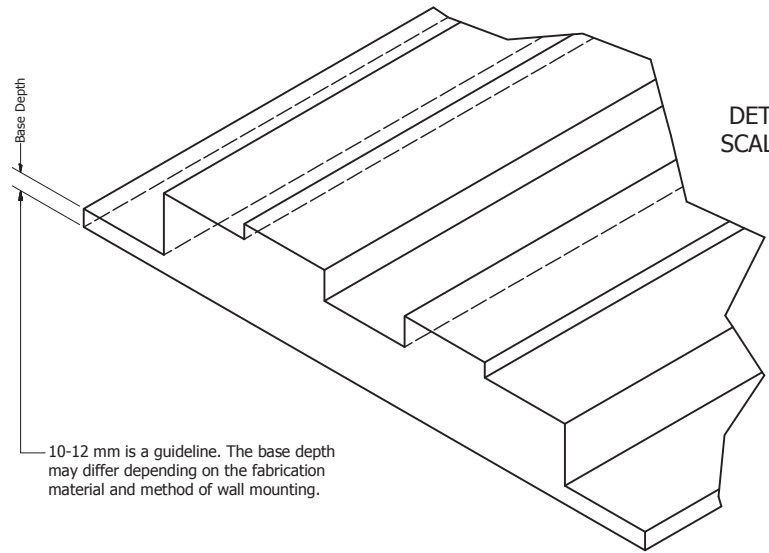
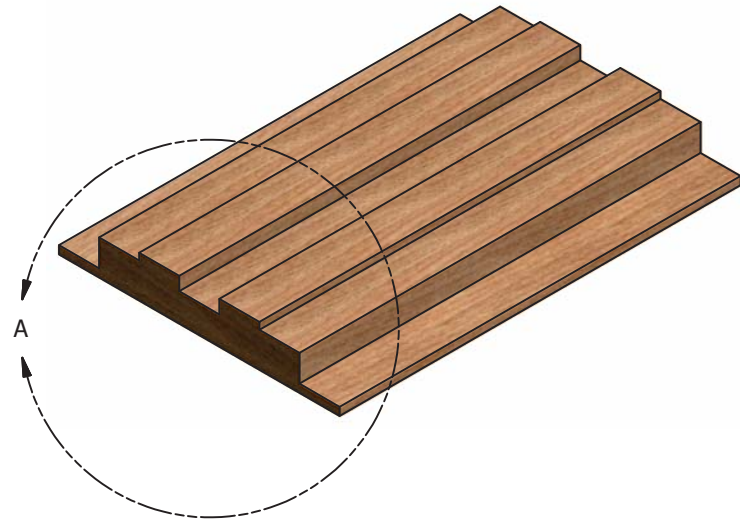
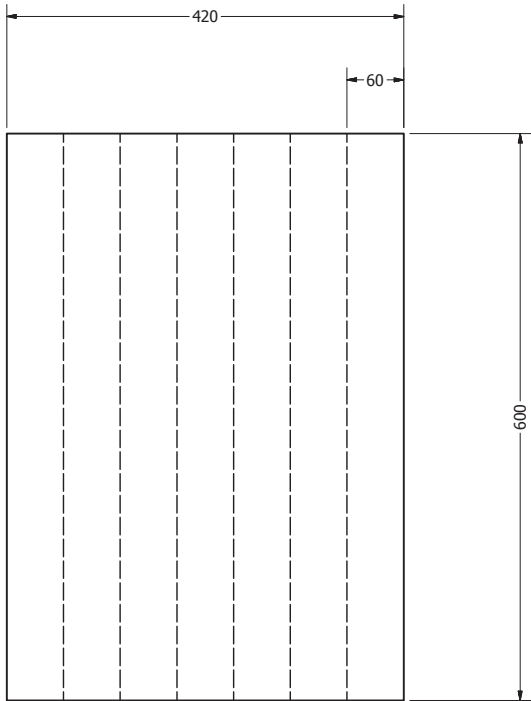
The latest version of these drawings can be downloaded for free at
<http://Arqen.com/acoustics/>



Seven 60 mm wide strips, or "steps".

Step heights measured from the top of the base are {0, 40, 50, 30, 50, 40, 0} mm.

Fabricate from acoustically reflective material such as wood or bamboo

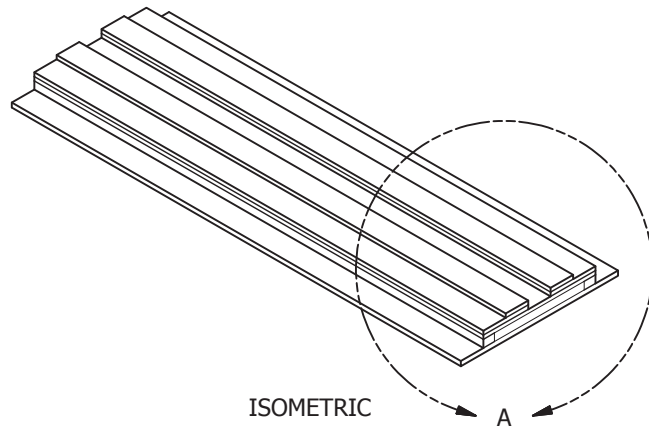


DETAIL A
SCALE 1 / 2

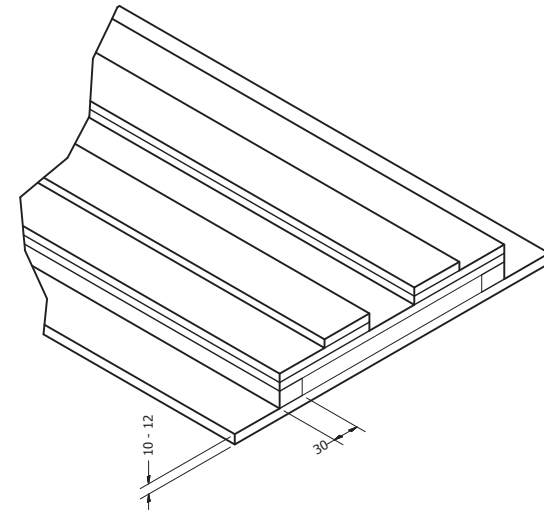
Base Depth

10-12 mm is a guideline. The base depth may differ depending on the fabrication material and method of wall mounting.

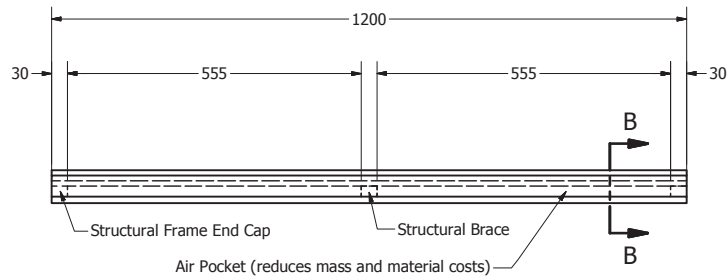
DRAWN Tim Perry	31/03/2012	Arqen		
CHECKED		TITLE		
QA		Lean Optimized Acoustic Diffuser Module A1-LF		
MFG				
APPROVED		SIZE C	DWG NO DiffuserA1-LF-Fab	REV
		SCALE	SHEET 1 OF 1	



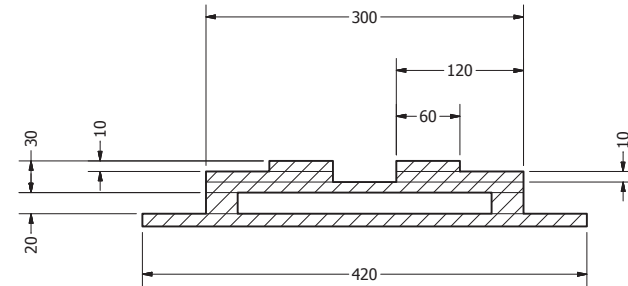
ISOMETRIC



DETAIL A
SCALE 0.28 : 1

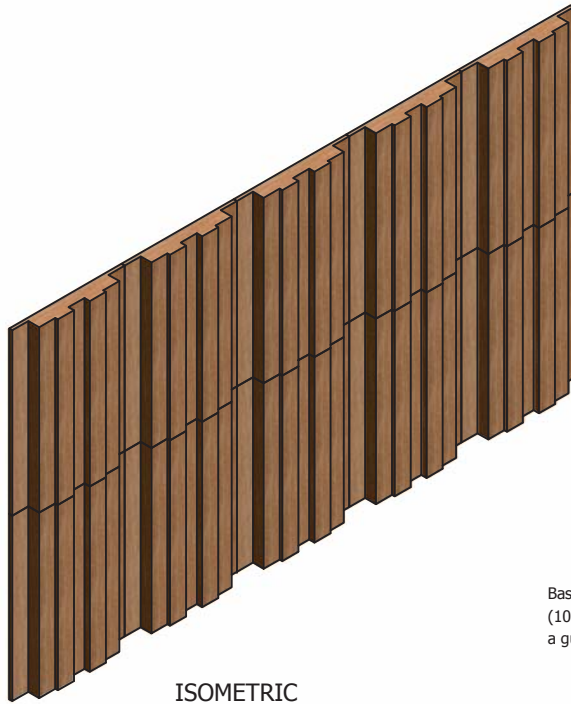


SIDE



SECTION B-B
SCALE 0.28:1

DRAWN Tim Perry	02/09/2012	Arqen	
CHECKED		TITLE	
QA		Optimized Acoustic Diffuser Module A1-LF Assembly (full height module)	
MFG			
APPROVED		SIZE C	DWG NO DiffuserA1-LF-Fab-2-Tall
		SCALE	REV
		SHEET 1 OF 1	



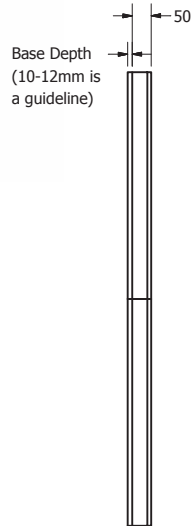
WALL-MOUNTING NOTES

Array assembly may vary depending on the height of each module*.

Modules may be heavy, depending on the construction material. Mount appropriately to support the weight of each module (Use a stud finder to choose locations for drilling into the wall).

To mount the array on a wall, attach modules to the wall one at a time. The simplest way to mount each unit is to pre-drill at the wall anchor points, then attach using wood screws.

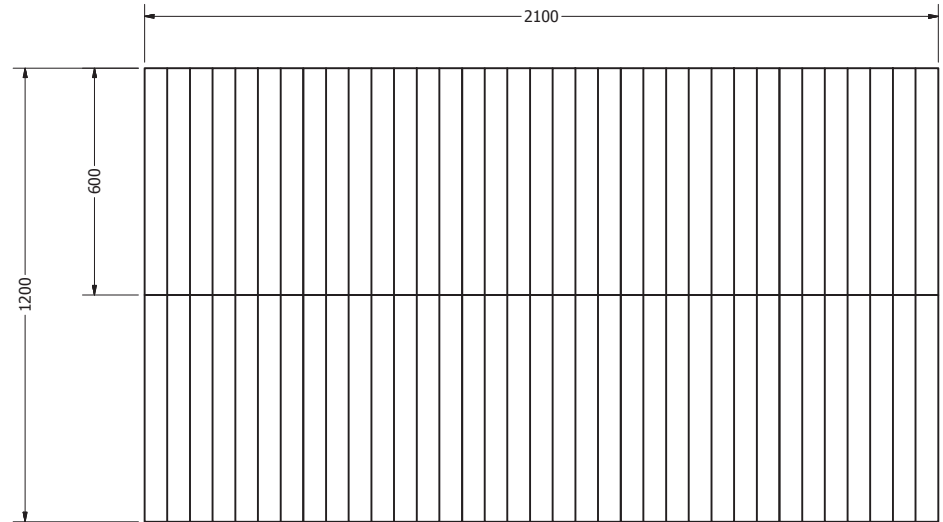
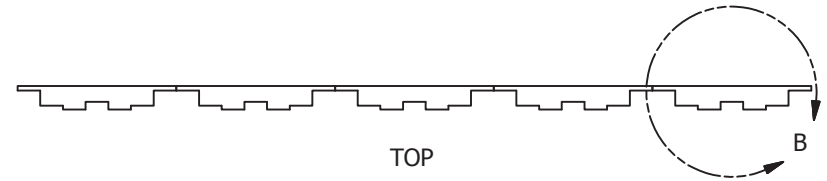
If wall stud spacing does not allow convenient mounting, attach a mount board to the wall studs (large enough to support the entire array). Then, attach the modules to the mount board.



SIDE



DETAIL B
SCALE 1 / 5



FRONT

*ARRAY ASSEMBLY OPTION 1:

Create array by assembling 5 full-height diffuser modules. Each module is 1200 mm (4') high.

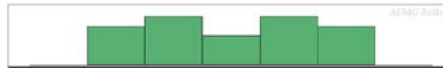
*ARRAY ASSEMBLY OPTION 2 (Shown):

Create array by assembling 10 half-height diffuser modules. Each module is 600 mm (2') high.

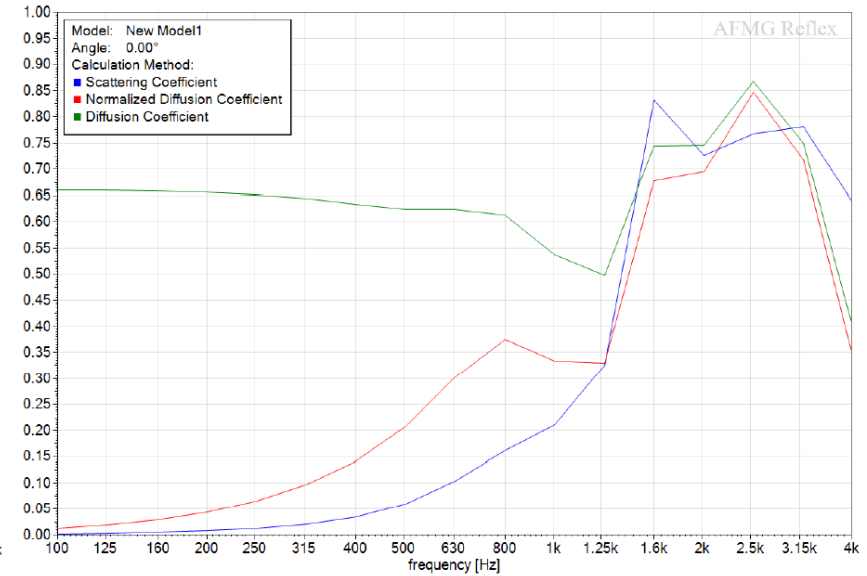
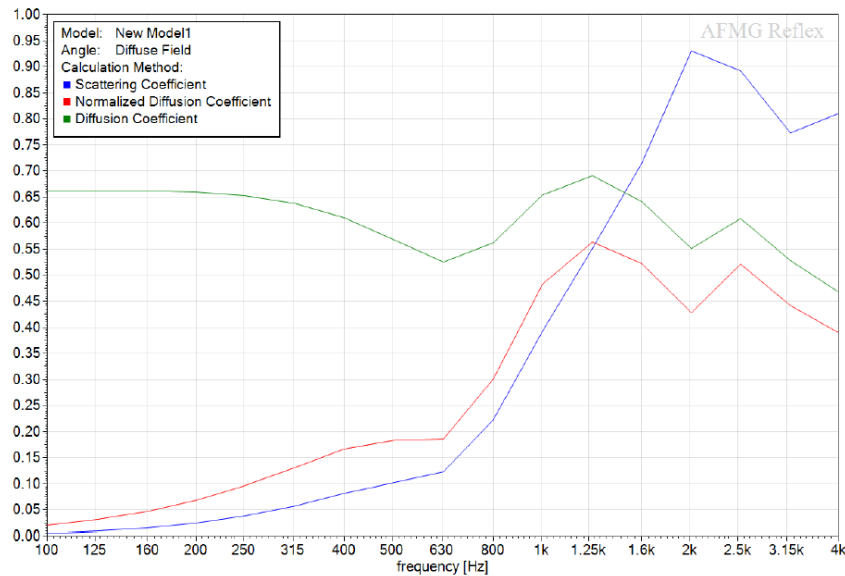
DRAWN Tim Perry	30/08/2012	Arqen		
CHECKED		TITLE		
QA		Modular Stepped Diffuser A1-LF Assembly (Array of Modules)		
MFG				
APPROVED		SIZE C	DWG NO DiffuserA1-LF-Fab-Array	REV
		SCALE	SHEET 1 OF 1	

Performance Coefficients for Single Module

Depth Profile of Diffuser Module (Simulation View in AFMG Reflex)



Performance Coefficients for Diffuser Module



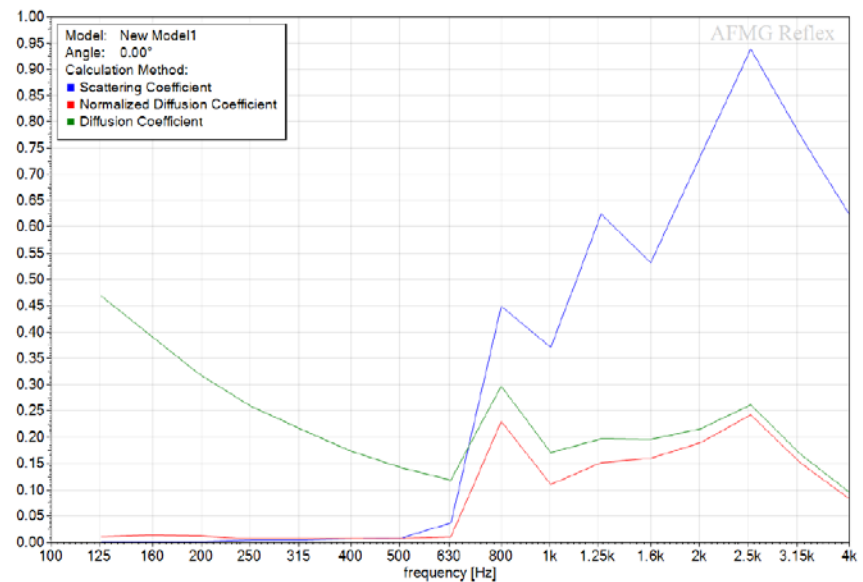
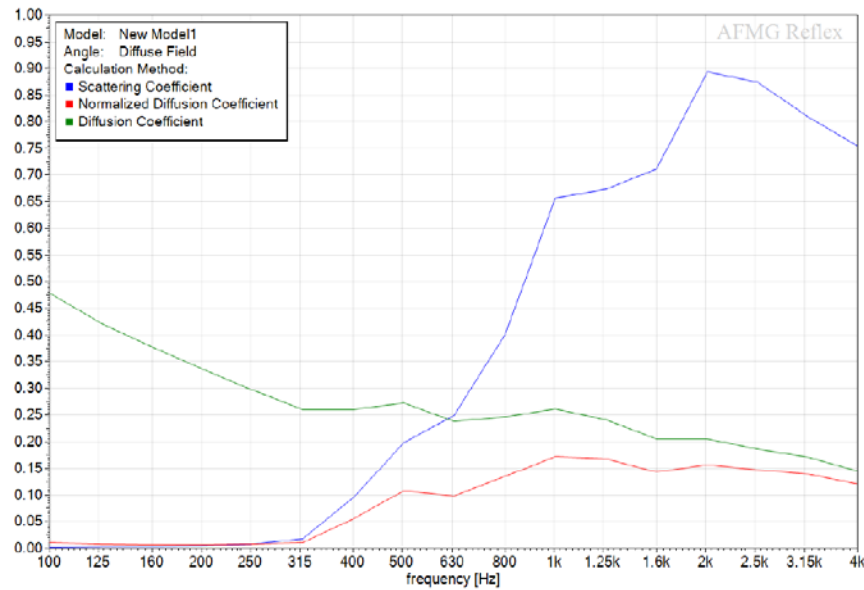
Visit <http://Argen.com/acoustics/> for updates and more designs.

Performance Coefficients for Periodic Array of 5 Modules

Depth Profile of Diffuser Array with No Profiled Modulation 1 (Simulation View in AFMG Reflex)



Performance Coefficients for Periodic Array of 5 Modules



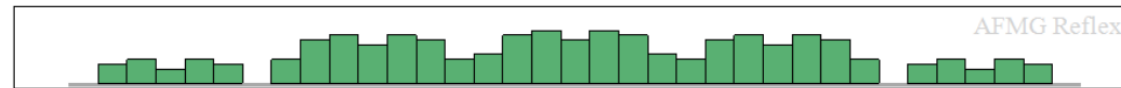
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Profiled Modulation 1: Mounting Modules to Prevent Periodicity

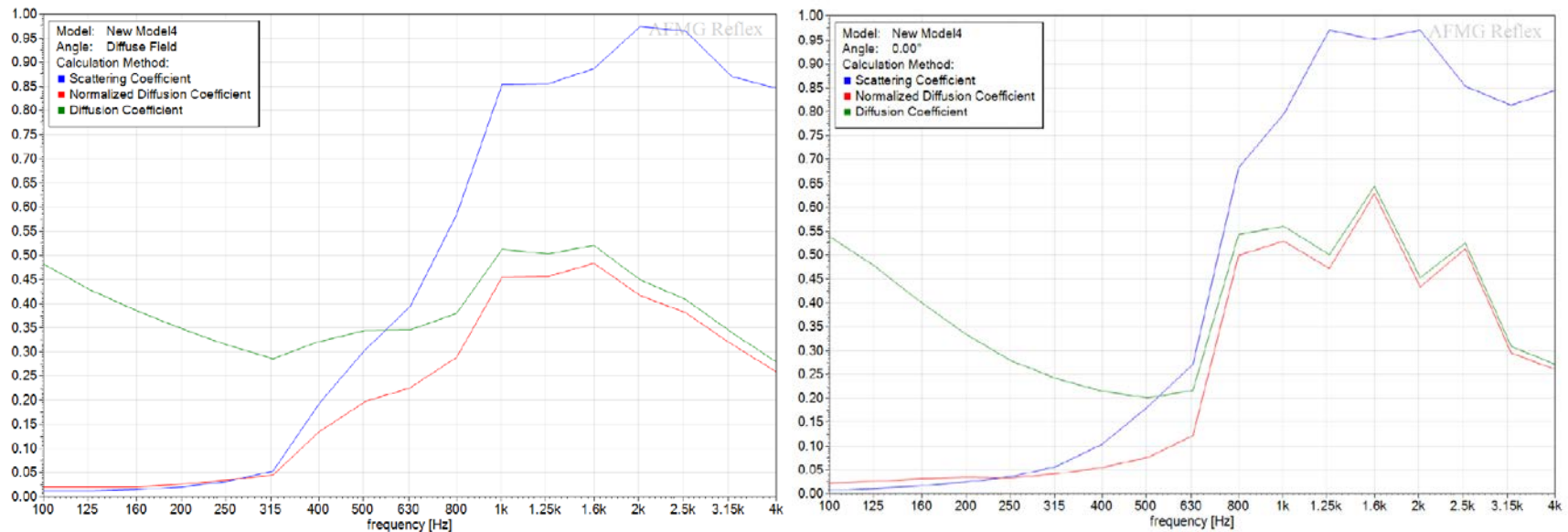
To reduce the effects of periodicity in the array, mount modules with varying depths as follows:

[0 cm, 5 cm, 6 cm, 5 cm, 0 cm]

Depth Profile of Diffuser Array with Profiled Modulation 1 (Simulation View in AFMG Reflex)



Performance Coefficients for Profiled Modulation 1



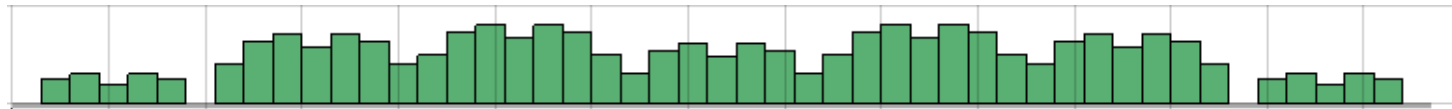
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Profiled Modulation 2: Mounting 7 Modules to Prevent Periodicity (*Fractal Modulation*)

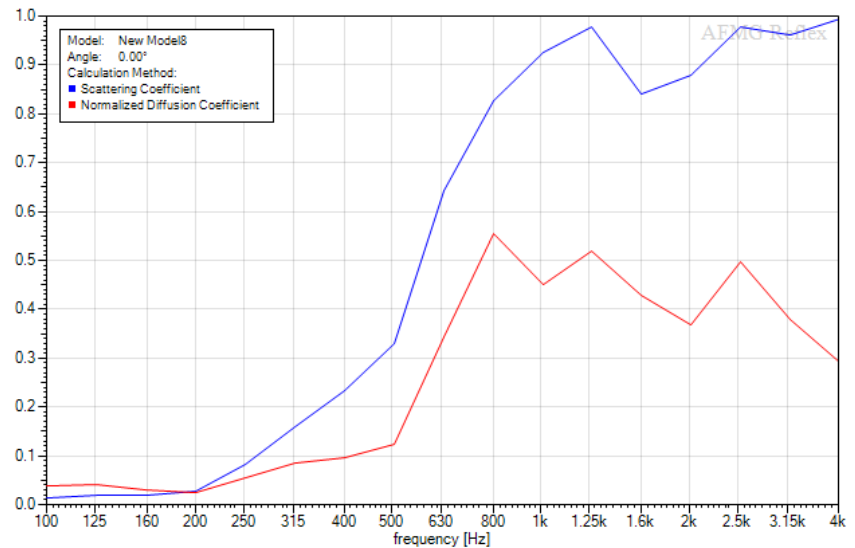
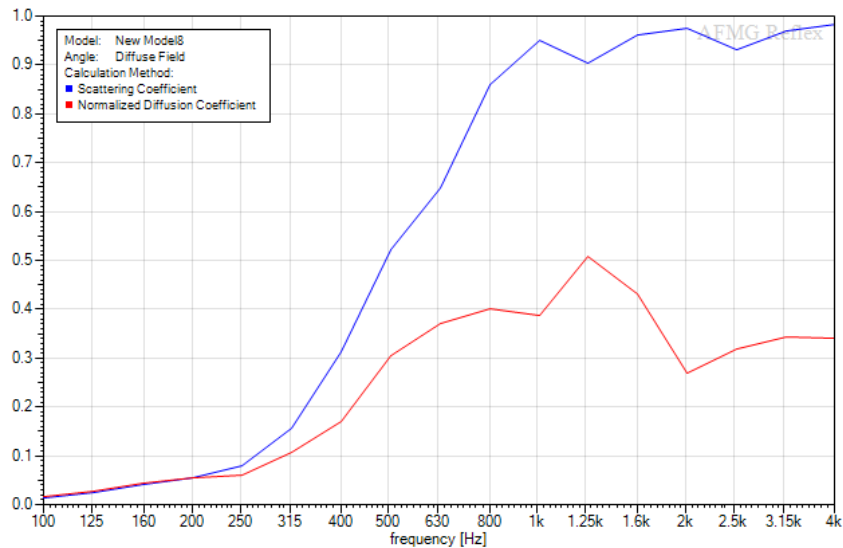
To reduce the effects of periodicity in the array, mount 7 modules with varying depths as follows:

[0 cm, 8 cm, 10 cm, 6 cm, 10 cm, 8 cm, 0 cm]

Depth Profile of Diffuser Array with Profiled Modulation 2 (Simulation View in AFMG Reflex)



Performance Coefficients for Profiled Modulation 2



Visit <http://Argen.com/acoustics/> for updates.

More about Fractal Modulations

Profiled Modulation 2

Profiled Modulation 2 uses seven A1-LF (Leanfuser™) modules mounted at different depths based on fractal self-symmetry. The seven mounting depths are derived from the depth sequence of the Leanfuser™. The resulting diffuser has basic fractal geometry; therefore, you can call this a *fractal modulation*. And if you applied this modulation to A1-frac (the fractal version of the A1-LF module, which is detailed in Chapter 8 of the diffuser design thesis), you'd have a 3rd order nested fractal!

The mounting sequence [0, 8, 10, 6, 10, 8, 0] cm is based on the depth sequence of the Leanfuser™ multiplied by 2:

$$2 \times [0, 4, 5, 3, 5, 4, 0] \text{ cm} = [0, 8, 10, 6, 10, 8, 0] \text{ cm}$$

I chose the scaling factor of 2 because it creates a shallow profiled diffuser that offers good performance with minimal depth. The scaling factor was determined experimentally by simulating various profiled modulations using [AMFG Reflex](#).

Feel free to test the performance of your own fractal design variations by choosing a scaling factor, applying it to the Leanfuser™ depth sequence, and simulating the resulting modulation using AMFG reflex. If you find a design that performs well that you want to share, please email me (tim@argen.com), or better yet, share it with the community in the [DIY diffusers forum thread](#).

Deep Fractal Modulation

If you don't mind a thick diffuser, you could take the fractal self-symmetry concept more literally. For example, you could create a low frequency fractal stage with the proportions equal to the stepped diffuser proportions (i.e., keeping the same width:depth ratio). For the Leanfuser™, the width:depth ratio = 42 cm / 5 cm = 8.4. Therefore, for an array of 7 diffuser modules (294 cm wide), the deepest step of the profiled modulation would be 294 cm / 8.4 = 35 cm. Since the deepest step of the Leanfuser™ is 5 cm, you would scale all the depths by 35 cm / 5 cm = 7.

This would give you a profiled modulation of $7 \times [0, 4, 5, 3, 5, 4, 0] \text{ cm} = [0, 28, 35, 21, 35, 28, 0] \text{ cm}$. The resulting diffuser would have an operational depth of 40 cm, which is a much deeper design than the one we started with!

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