PROFESSIONAL

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Title: Basic PD5322 and PD5122 Array Applications

The Precision Directivity™ PD5000 family of products offered by JBL Professional is a versatile product line allowing a sound designer numerous ways to implement arrayed solutions for houses of worship, performing arts centers, and sports facilities. The compact design of the PD5000 models provides excellent array characteristics both acoustically and aesthetically. This application note specifically focuses on how two of the models, the PD5322 (three-way, full-range) and the PD5122 (dual 12" slot loaded low-frequency), can be used individually or in combination to create array solutions addressing common design requirements.

A sound designer's objective is to design a loudspeaker system that provides consistent horizontal and vertical pattern control through its usable frequency range. This achieves an even spectral balance throughout the seating area and excellent microphone gain before feedback. The diagram below (Fig 1.) describes how the levels of the loudspeaker system must be controlled in the vertical plane to achieve consistent direct levels in the seating area.

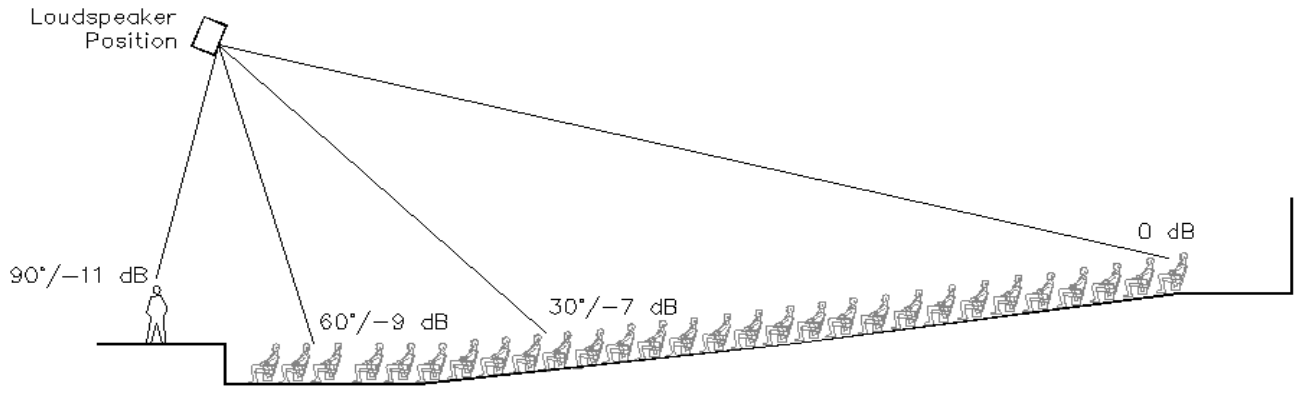


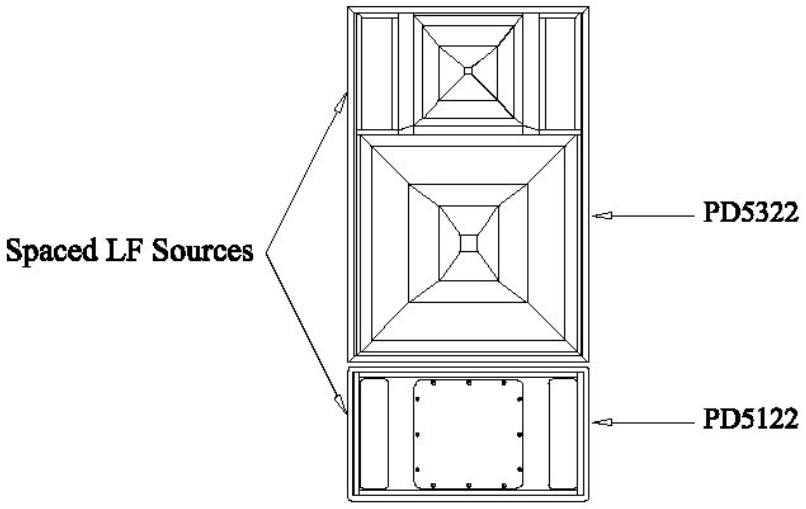
FIG. 1: SECTION

The following examples show how directivity can be maintained in the vertical plane by utilizing methods that create a smooth transition between the polar responses of the mid-frequency waveguides and the low-frequency devices.

A waveguide by itself is limited to how low in frequency it can control pattern based on the dimensions of the waveguide and the nominal coverage.[1] For pattern control below 800 Hz, the size of a single waveguide becomes too large to be practical in most cases. However, spaced-source low-frequency arrays provide effective and predictable polar responses that can be mated with the mid/high waveguides to produce integrated arrayed solutions that extend useful pattern control of the system to below 200 Hz.[2]

Example #1, PD5322+PD5122

A PD5322 consists of dual 12" VGC™ Vented Gap Cooled LF drivers, one on either side of the high-frequency waveguide and directly above the mid-frequency waveguide. A matching pair of LF devices in the form of a PD5122 placed directly below the PD5322 MF waveguide (Fig. 2) produces a spaced-source LF array effectively extending the height of the waveguide and correspondingly extending low-frequency pattern control through 160 Hz.



The PD5122 is simply the LF section of a PD5322. The similarity insures that the response of the LF sections will be identical. The acoustical crossover between the low and mid-frequency sections is 250 Hz. In the vertical polar plots (Fig. 3), note how well pattern control is maintained through the system crossover.

In a variation of this example, the same array configuration can be utilized to steer the main lobe of low-frequency energy down to provide smooth and controlled low frequency coverage closer to the stage. This result is achieved by offsetting the upper and lower low-frequency devices approximately 0.6 ms. (Fig. 4)

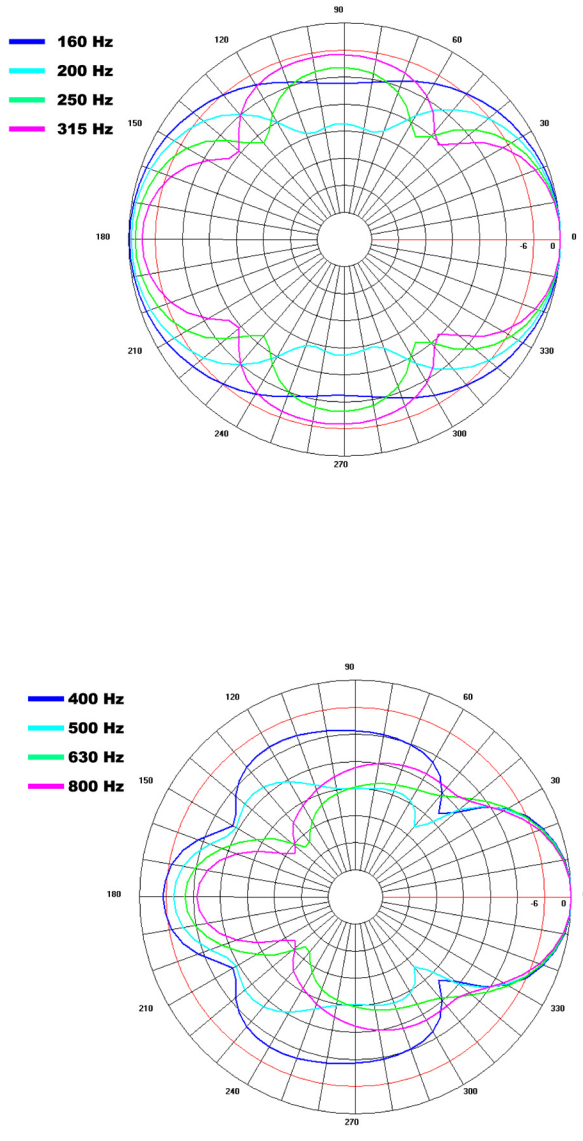


Fig. 3: PD5322 + PD5122 - modeled vertical polar response

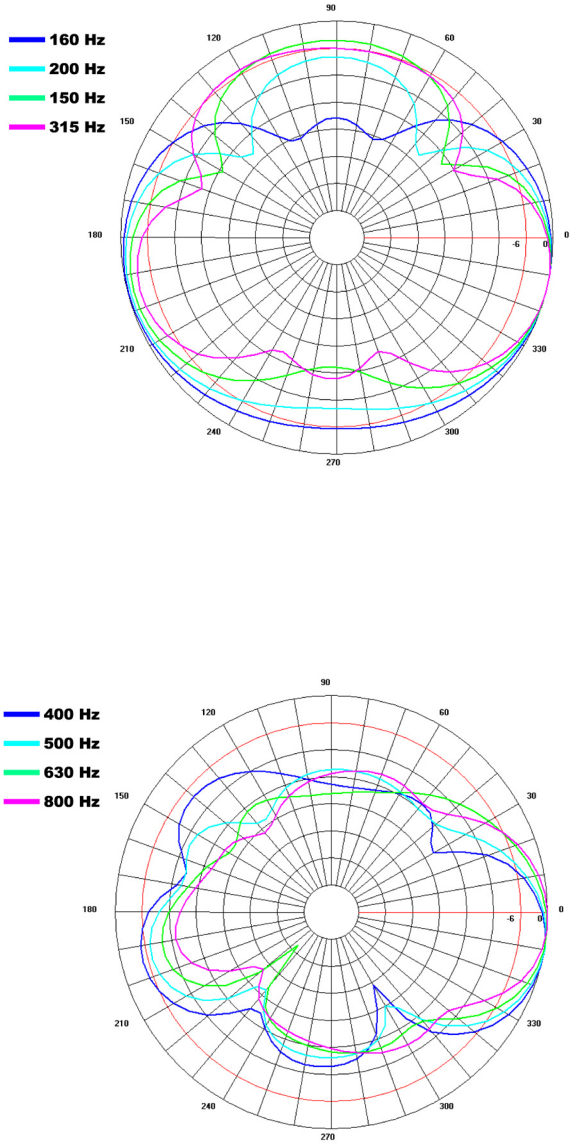


Fig. 4: Steered PD5322 + PD5122 - modeled vertical polar response

A downfill box such as an Application Engineered™ AM6200/95 may be appropriate to maintain matching mid and high frequency energy below the main coverage pattern of the PD5322.

Example #2, Vertically configured PD5322 pair

In another variation, the same acoustic principle can be realized by using a second PD5322 as a downfill device (Fig. 5), with the LF section on top of each of the two vertically oriented boxes. When the bottom box is splayed down at 30 degrees, as may be typical, the LF sections provide a spaced-source pair that extends the pattern control of the system similar to the previous examples (Fig.6). In this example it is recommended to low pass the lower pair of LF drivers at 125 Hz. This bandpass change is necessary because the LF pairs are spaced farther apart than in the previous example described.

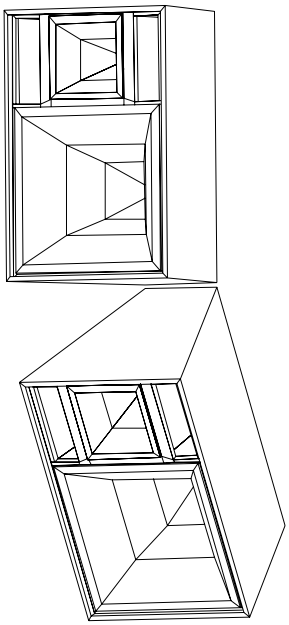


Fig. 5: Vertically configured PD5322s

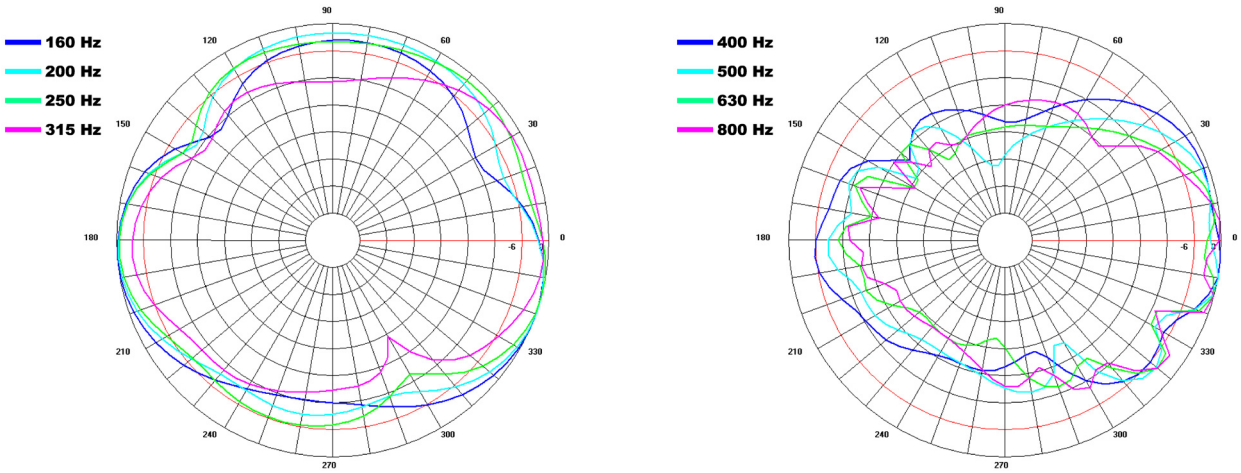


Fig. 6: Vertically configured PD5322 - modeled vertical polar response

Example #3, Horizontally configured PD5322 pair

For the same “long-throw/down-fill” combination, two PD5322s may instead be stacked horizontally (Fig. 7). As a result, the four 12” low-frequency devices are placed on top of each other, making a short LF speaker column. This column exhibits desirable directivity and matches the mid-frequency directivity at crossover. The coverage maintains the target directivity down to 250 Hz and remains useful through 160 Hz. (Fig. 8)

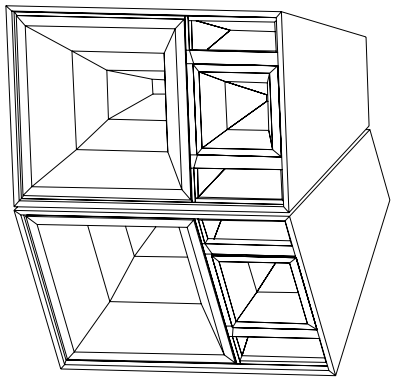


Fig. 7: Horizontally Configured PD5322s

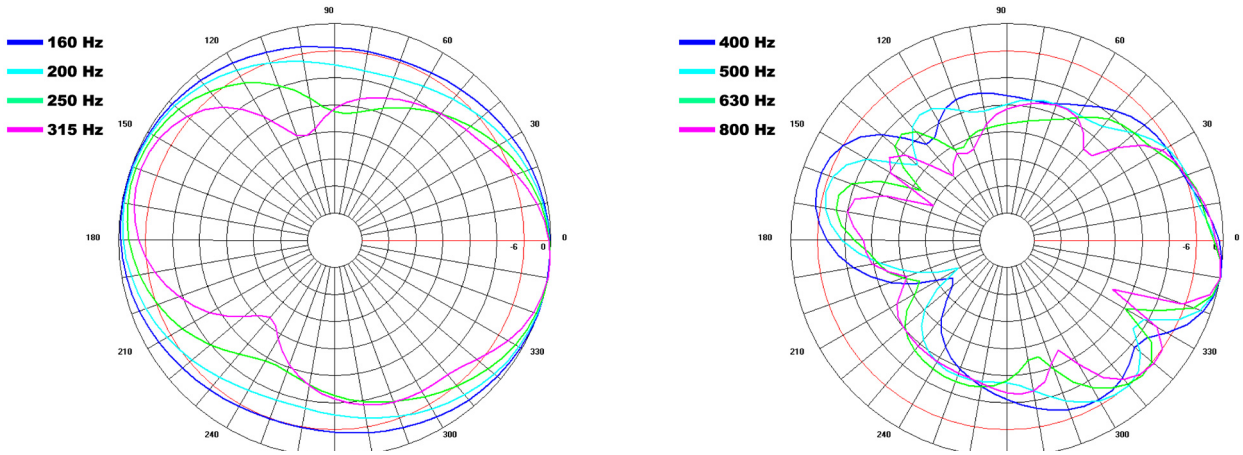


Fig. 8: Horizontally configured PD5322 - modeled vertical polar response

Example #4, PD5122 shaded arrays:

A simple 4-element shaded array may be constructed with four PD5122s. (Fig. 9) Here, the two outer boxes are crossed over to the two center boxes at 140 Hz to create an array that matches the requirements of a typical space described above, and extends useful directivity past 125 Hz. (Fig 10) The shaded LF array could be part of a cluster consisting of PD700, PD5000, and AE mid-high loudspeakers.

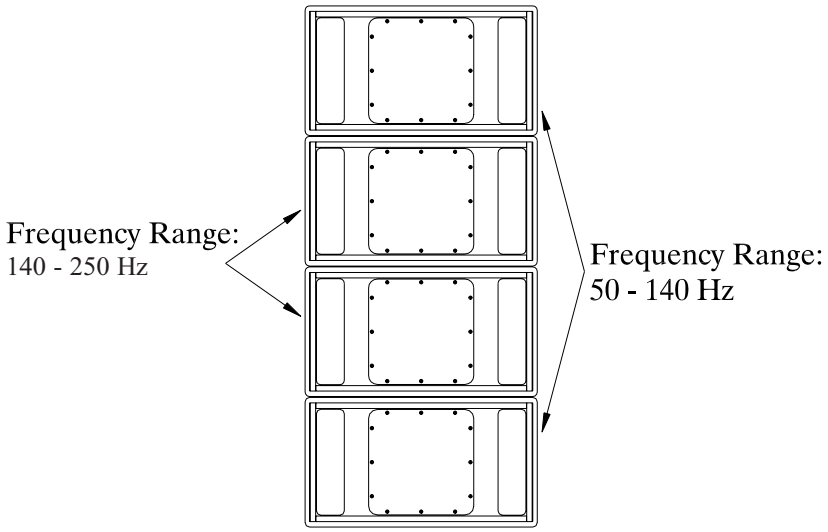


Fig. 9: Four-element PD5122 shaded array

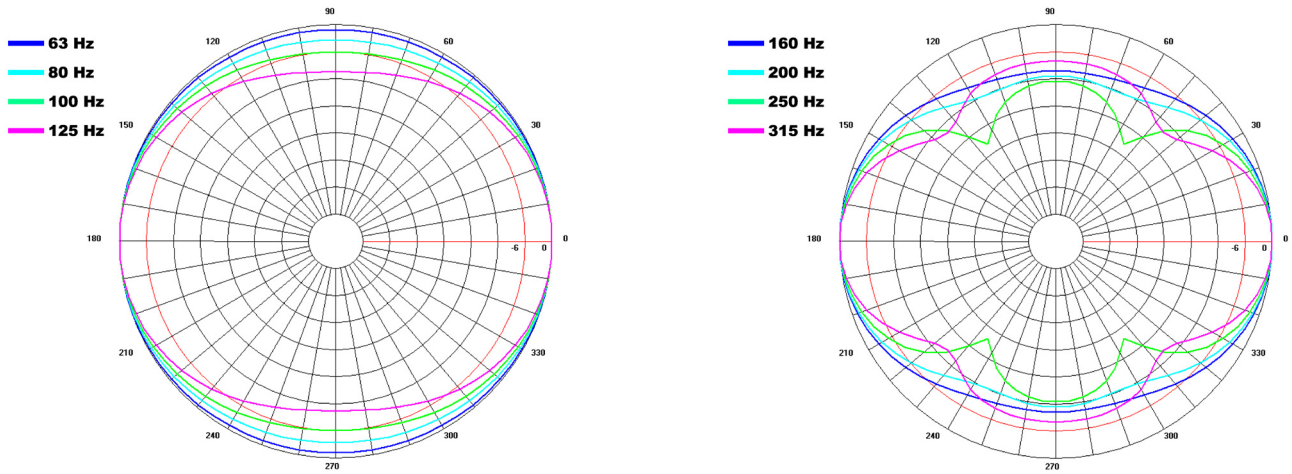


Fig. 10: PD5122 shaded array - modeled vertical polar response

Summary:

The PD5000 family provides elements to create effective arrays that are well behaved acoustically, maintaining pattern control into the low-frequency band. These types of arrays are useful for maintaining broadband evenness of coverage, especially in the vertical plane, with the added benefit of excellent microphone gain before feedback.

REFERENCES

1. "The Manta Ray Horns", Clifford A. Hendrickson and Mark S. Ureda, JAES, 1978 September.
2. Filtered Array Technology: A look at controlling an array's low frequency radiation pattern using digital signal processing, JBL Professional
   Tech Note: Volume 1, # 28 Controlling Low Frequency Coverage via FSA Forward Steered Bass Arrays, JBL Professional

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