ALTEC ENGINEERING NOTES

TECHNICAL LETTER 255

COVERAGE OF ALTEC LANSING LOUDSPEAKERS
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INTRODUCTION

All loudspeaking horns radiate sound in all directions, into full space. This technical letter presents latitude-and-longitude displays of the main lobe of radiation from Altec Lansing high frequency horns suitable for the determination of their suitability in real-world, three-dimensional architecture.

MAPPING LOUDSPEAKER RADIATION

Consider the sphere of radiation coming from a high frequency horn. Such a sphere is shown in Figure 1. Erect a cylinder around the sphere whose circumference is the same as that of the sphere, and whose height is one-half the circumference of the sphere. Map the lines of latitude and longitude at equal intervals around the cylinder, and equal heights along it, as shown in Figure 2.

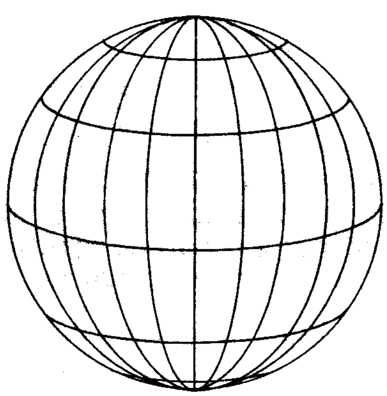

Figure 1. Sphere of Radiation Coming from a High Frequency Horn.

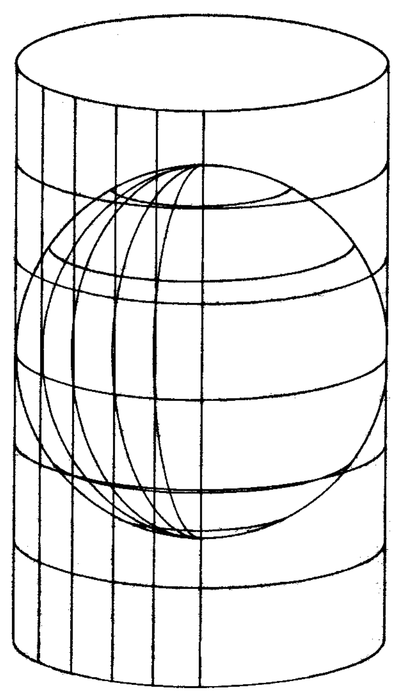

Figure 2. Spherical Latitudes and Longitudes Mapped at Equal Intervals on a Cylinder.

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Obviously mapping distortions will take place near the poles; here, points on the sphere have been transformed into circles at the top and bottom of the cylinder. Longitude lines, which converge at the poles of the sphere, are parallel on the cylinder; any geography mapped onto the cylinder would suffer an anamorphic distortion on the cylinder, being stretched out horizontally more and more as the poles are approached. There are several reasons why these distortions are inconsequential, primarily because we will only look at sound radiation near the axis of the horn, which we will place at the point where the Greenwich meridian crosses the equator. The last step in our mapping procedure is to cut the cylinder along a line of longitude and unroll it into a plane — so that we can print it and distribute it to you as a Technical Letter. See Figure 3.

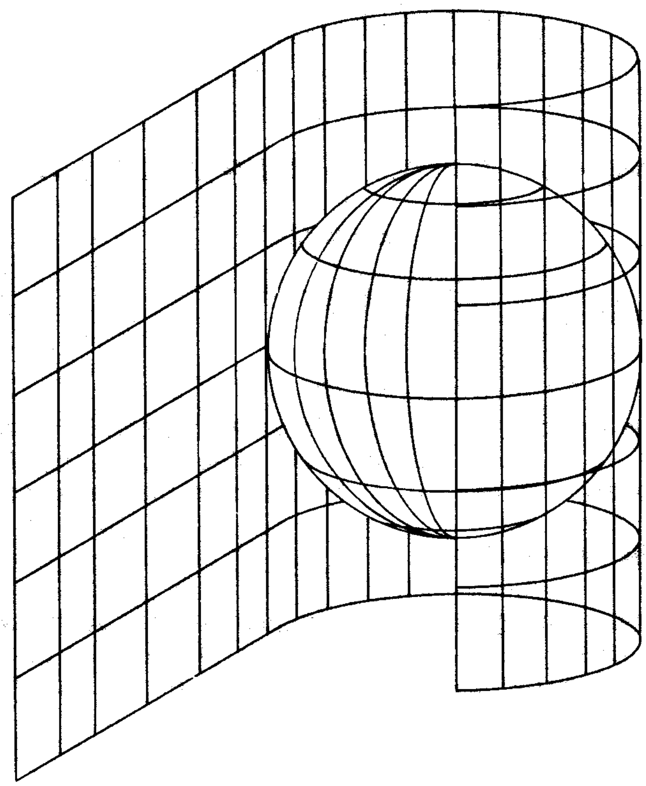

Figure 3. The Cylinder is Cut and Unrolled into a Plane.

The measurements of the sphere of radiation around a high frequency horn were made as shown in Figure 4. The horn was rotated around its horizontal apparent apex, while the microphone was positioned at a distance d on the horizontal plane of rotation. Then, the latitude at angle θ was measured by raising by microphone d sin θ and advancing it toward the horn by the amount d (1-cos θ) (this is the horizontal component only). d was measured to the vertical apparent apex.

For Altec Lansing's measurements, d was six feet, except in the case of the MR42 Mantaray horn, for which d was ten feet. The latitudes were cut at five degree intervals, and a vertical polar plot was usually run to generate additional data points. The test signal used was a band of pink noise running between 1 kHz and 2 kHz, which we believe most suitable to indicate intelligibility performance with running speech.

While traditionally (but without very much justification) the "coverage" of a loudspeaking horn is considered to be the solid angle within the −6 dB contour (relative to axial level), an analysis of auditorium architecture conducted recently at Altec Lansing shows inverse-square variations in direct sound pressure levels from the front row to the rear row to be most often in the 8-10 dB range. Of course, total sound pressure levels vary less than this owing to the contribution of reverberant sound, but concomitant with wide changes in direct sound pressure level are wide changes in intelligibility. In order to offer the alternative of designing coverage for evenness of direct sound, we show nested −3 dB, −6 dB, and −9 dB contours surrounding the geometric axis of the horn.

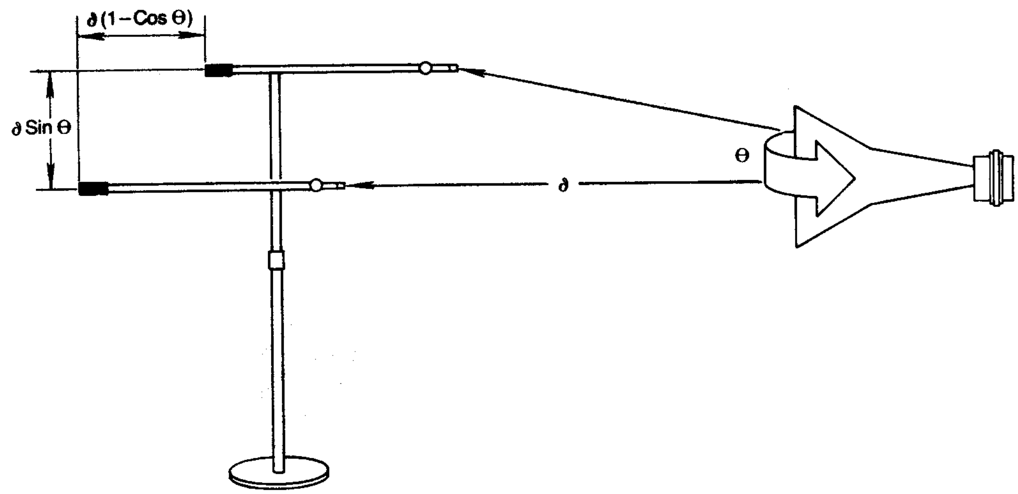

Figure 4. The Horn is Rotated Again and Again as the Microphone is Raised and Advanced to Cut Different Lines of Latitude, Always from the Same Measurement Distance.

THE CONTOURS

Here follow the angular contours for the Altec Lansing MR42, MR64, MR94, and MR94-8 Mantaray horns; the 311-90, 311-60, and 511B sectoral horns; and the 203B, 805B, 1005B, and 1505B multicellular horns.

IN CONCLUSION

The sound system designer need design only for the "magic seat" (at the axis of the horn) no longer; with these radiation contours and the design aids that have been developed at Altec Lansing, he can predict direct sound, direct plus reverberant sound, and intelligibility throughout a bank of seats in an auditorium, church, or anywhere else that people gather to hear and understand.

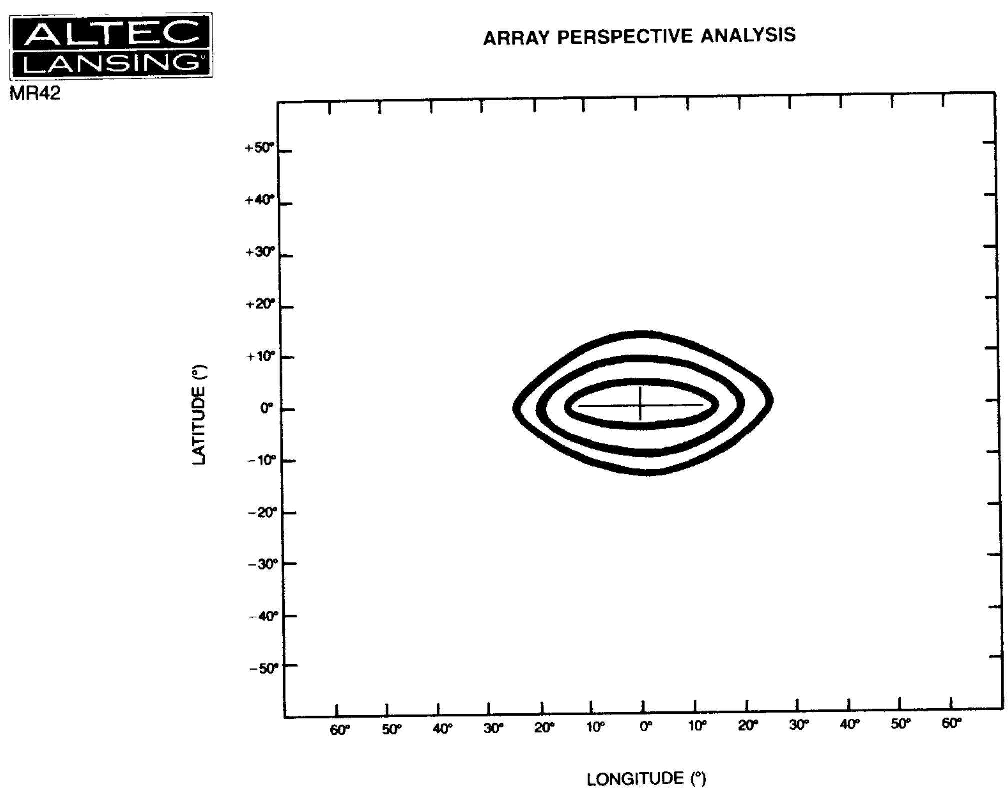

Figure 5. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing MR42 Mantaray Horn. The Cross Hairs Locate the Axis.

ALTEC LANSING
MR64

ARRAY PERSPECTIVE ANALYSIS

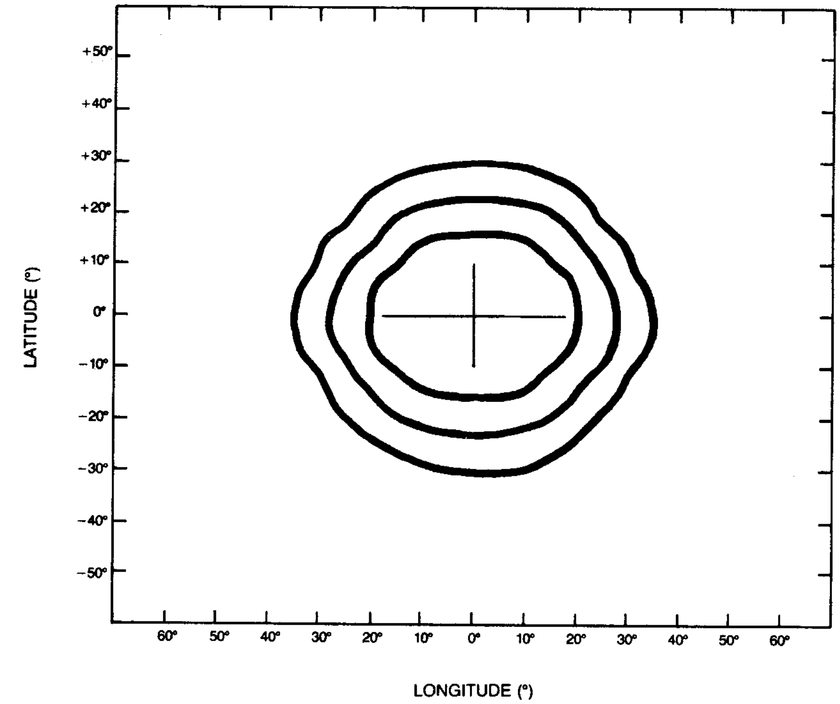

Figure 6. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing MR64 Mantaray Horn.

ALTEC LANSING
MR94

ARRAY PERSPECTIVE ANALYSIS

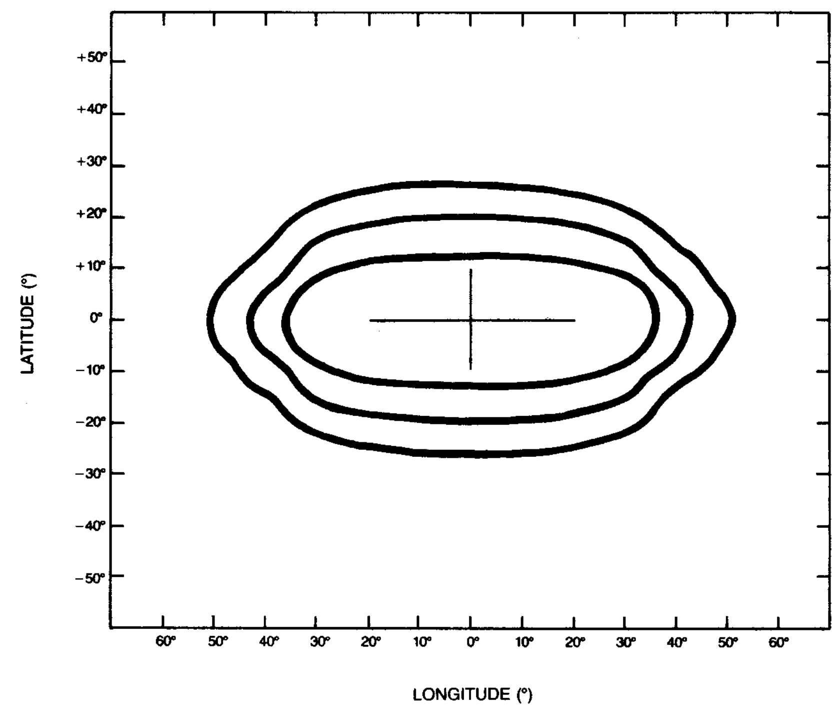

Figure 7. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing MR94 Mantaray Horn.

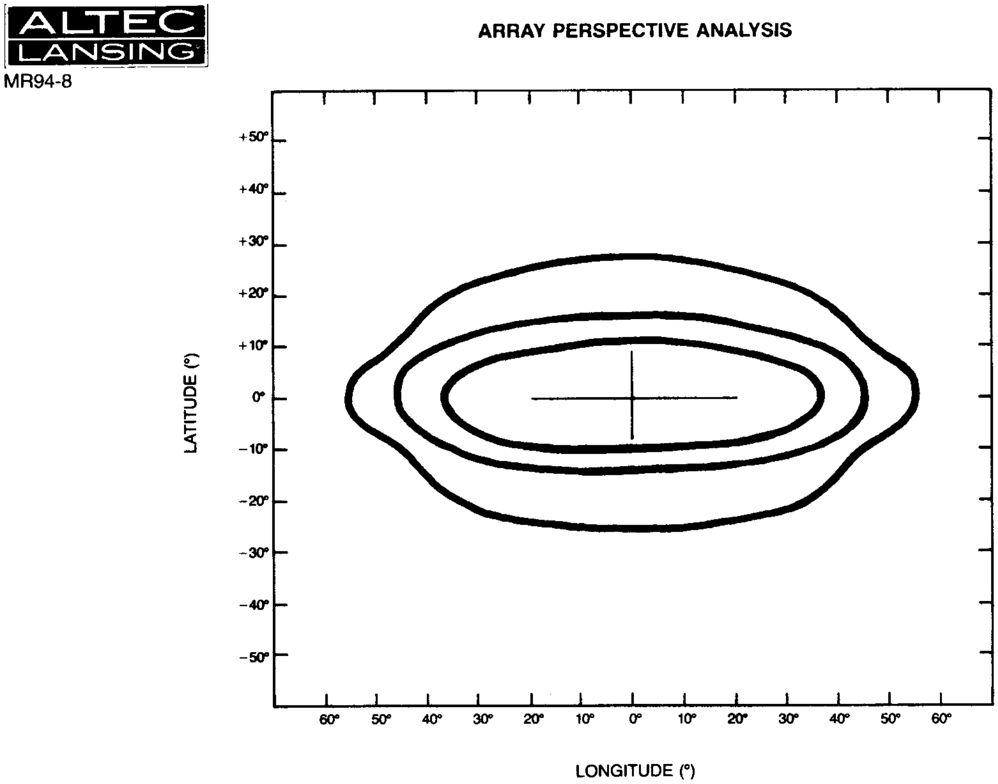

Figure 8. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing MR94-8 Mantaray Horn.

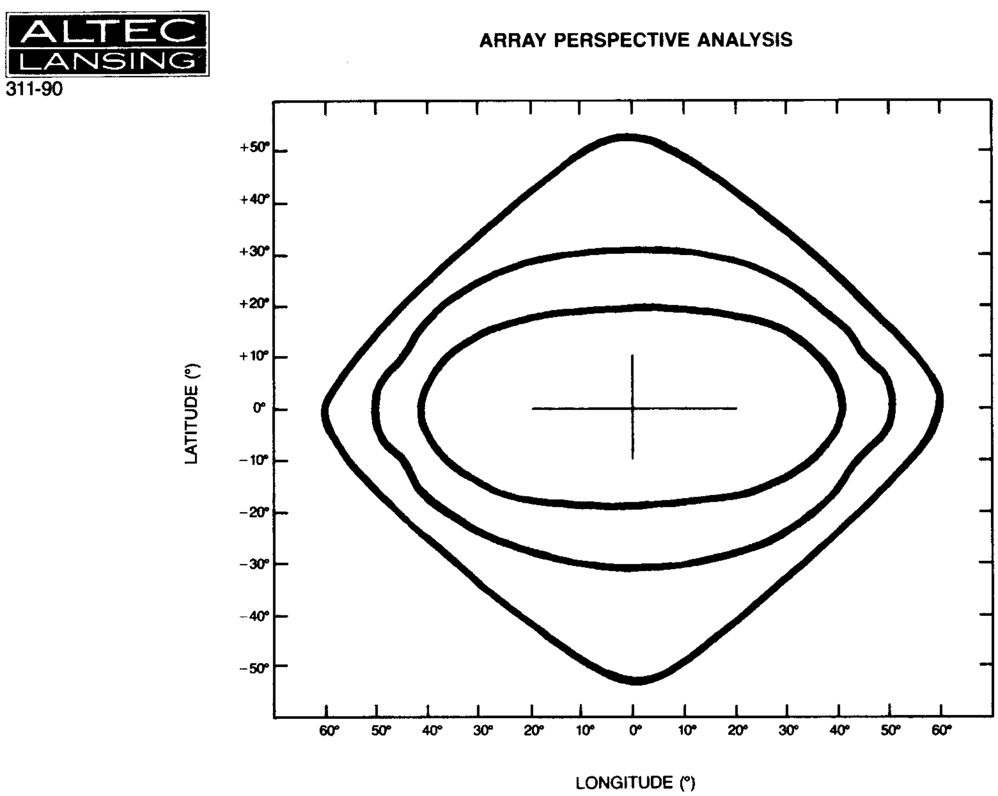

Figure 9. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing 311-90 Sectoral Horn.

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311-60

ARRAY PERSPECTIVE ANALYSIS

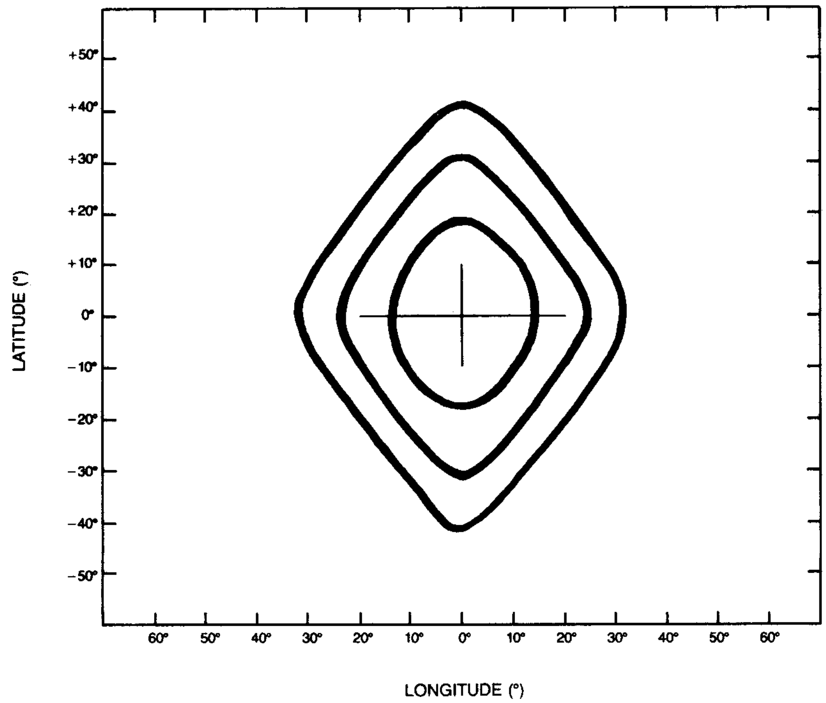

Figure 10. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing 311-60 Sectoral Horn. At the Test Frequencies Used, This Horn has a Greater Vertical than Horizontal Angle. For More Information on Coverage vs. Frequency for this Horn, See Altec Lansing Technical Letter No. 221.

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511B

ARRAY PERSPECTIVE ANALYSIS

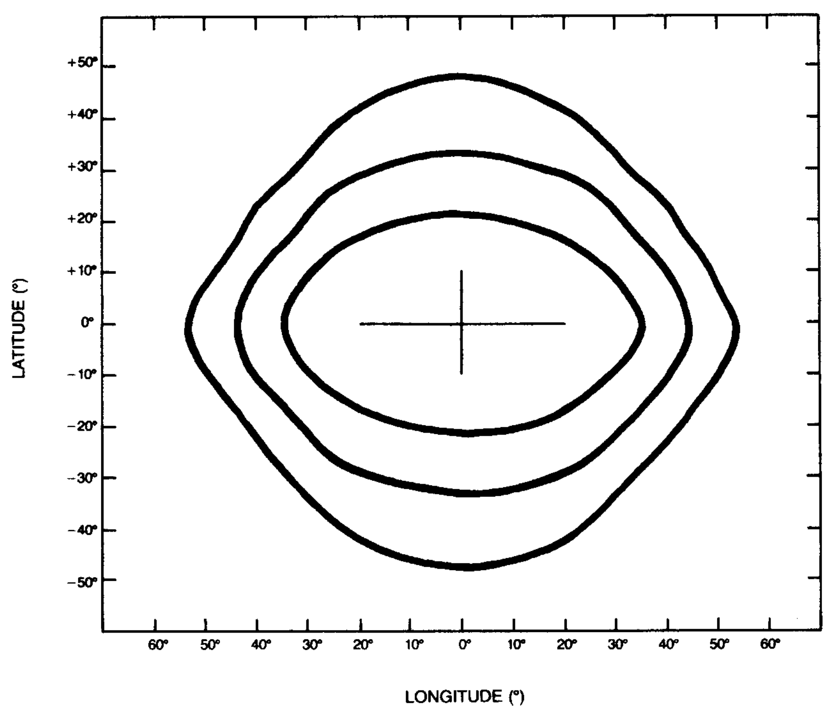

Figure 11. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing 511B Sectoral Horn.

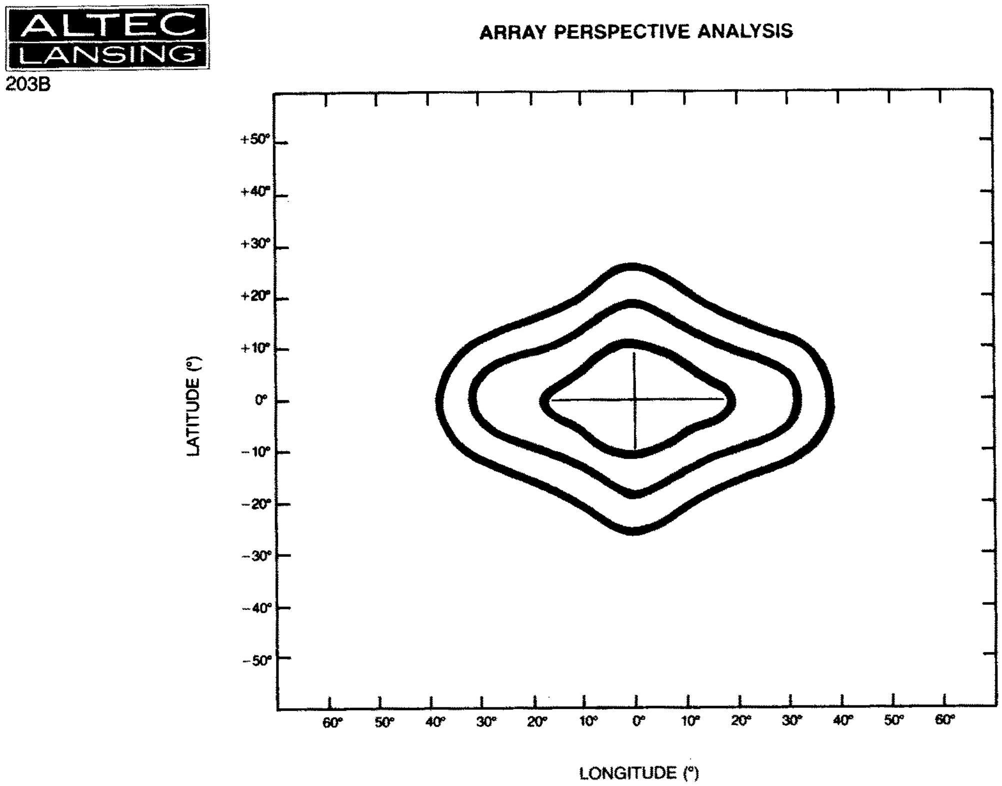

Figure 12. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing 203B Multicellular Horn.

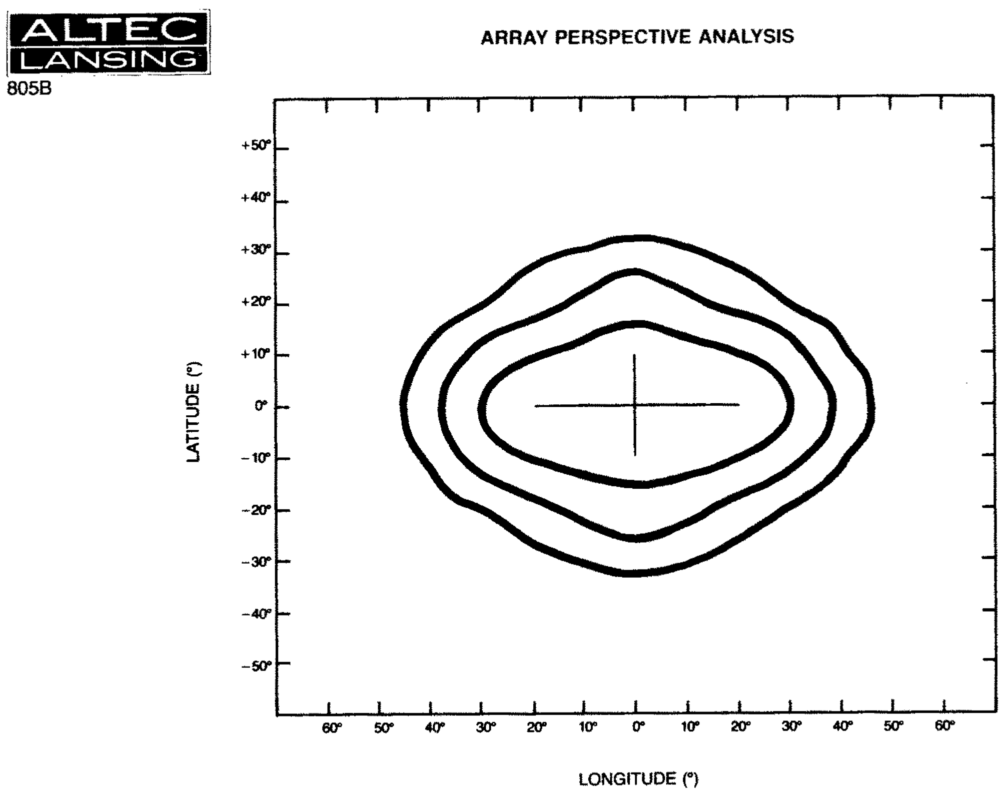

Figure 13. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing 805B Multicellular Horn.

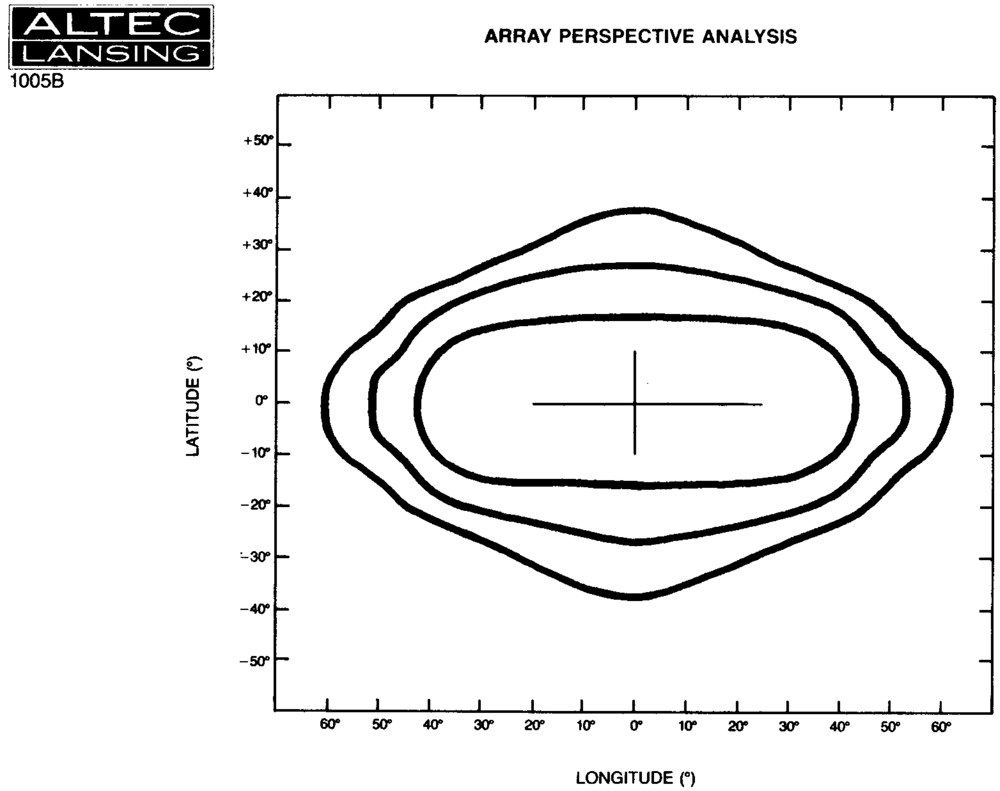

Figure 14. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing 1005B Multicellular Horn.

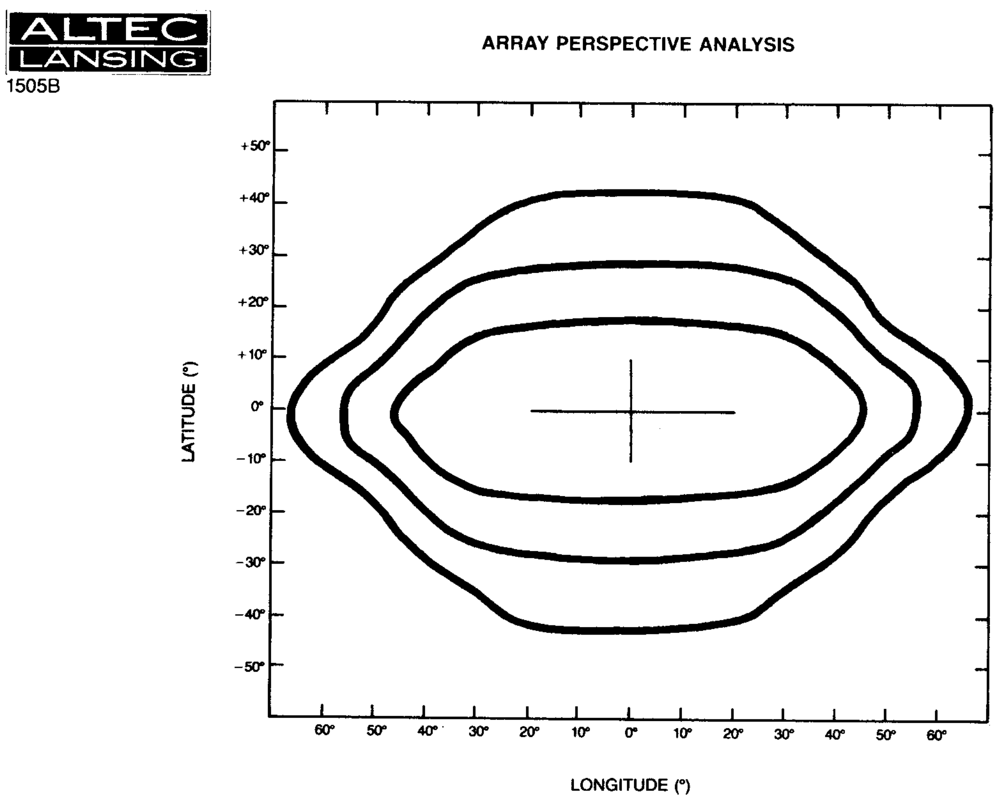

Figure 15. Nested −3 dB, −6 dB, and −9 dB Angular Contours for the Altec Lansing 1505B Multicellular Horn.