

ALTEC ENGINEERING NOTES

TECHNICAL LETTER NO. 221

DIRECTIVITY OF ALTEC LOUDSPEAKERS

By

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Previous technical letters relating to the directivity of Altec loudspeakers have dealt with the subjects of directivity factor (Q) and angular coverage as though they were interchangeable. Recent investigations, however, have disclosed that Q and useful coverage angle are independent of one another in most loudspeakers.

Determination of Directivity

Apparent horizontal and vertical Q information for each loudspeaker was derived from graphical evaluation of horizontal and vertical polar data. The graphical evaluation method considers the total relative radiated energy of a loudspeaker by measuring the relative output at 10° intervals through the full 360° excursion around the principal horizontal and vertical axes. In arriving at a directivity factor, the total relative on-axis output is then compared to the total relative energy radiated. This method provides accurate on-axis directivity information, but additional data is required to determine the angular coverage of a loudspeaker.

Six polar response charts are shown in Figure 1. Each chart depicts a loudspeaker that has a useful coverage angle (included angle within the -6 dB points) of 100°. The apparent Q, however, varies from 3.50 to 13.43.

Similarly, loudspeakers or loudspeaker arrays having the same Q may have different useful coverage angles. Figure 2 shows three polar plots depicting this behavior.

The determination of acoustic attenuation with distance in reverberant spaces requires that the apparent horizontal and vertical Q data be reduced to an expression of the overall directivity of the device. Use the following equation to calculate the Mean Q of a loudspeaker:

$$\text{Mean } Q = \sqrt{Q_H \cdot Q_V}$$

Where: Mean Q is the mean directivity factor,

Q_H is the apparent horizontal directivity factor,

Q_V is the apparent vertical directivity factor.

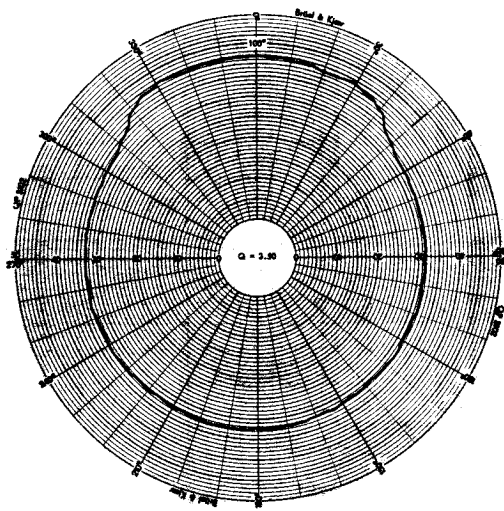
Separate graphical displays are provided for Mean Q and for horizontal and vertical coverage angles. Where horizontal and vertical coverage angles are identical, such as in the 616-8A, a single curve is depicted.

Test Procedure

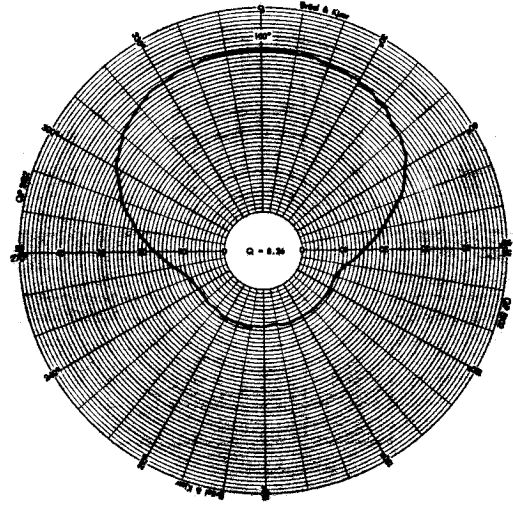
Horizontal and vertical polar response charts for the various loudspeakers were obtained at several frequency intervals. The test signal source was a General Radio 1382 Random Noise Generator filtered into appropriate one-third octave bands by a General Radio 1564A Analyzer. An Altec 9477A Amplifier provided final amplification for the loudspeaker under test. Tests were performed in the large Altec anechoic chamber and recorded by a Bruel and Kjaer 2305 Level Recorder, operated in synchronization with a Bruel and Kjaer 3921 Turntable which rotated the device under test. A Bruel and Kjaer 4133 Calibrated Microphone was located 10 feet from the test loudspeaker and provided signal for the level recorder.

Summary

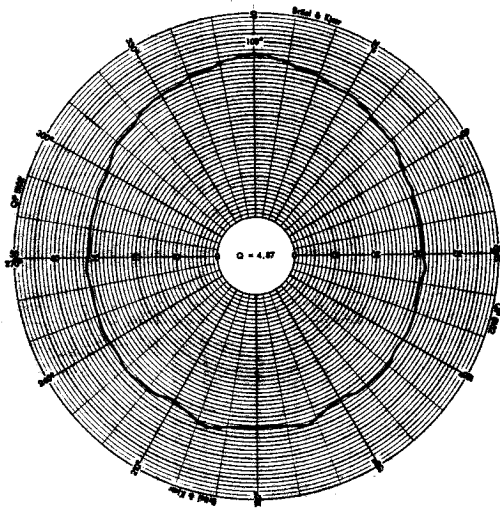
Two sets of charts are included for each loudspeaker measured. Q data was separated from angular coverage data to avoid misinterpretation. Sound system designers should employ the Mean Q data in determining attenuation with distance in reverberant rooms. The angular coverage data should be used in determining loudspeaker distribution angles.



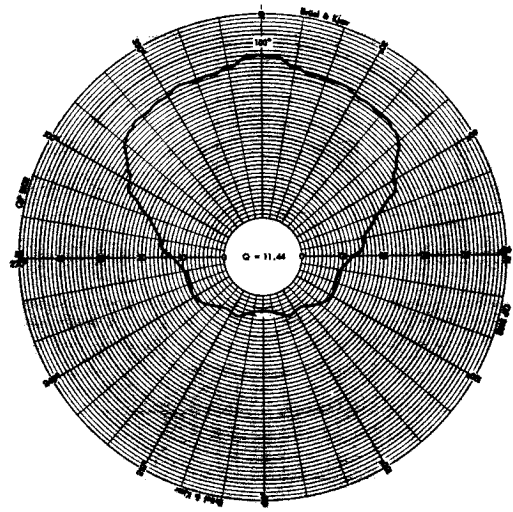
1A



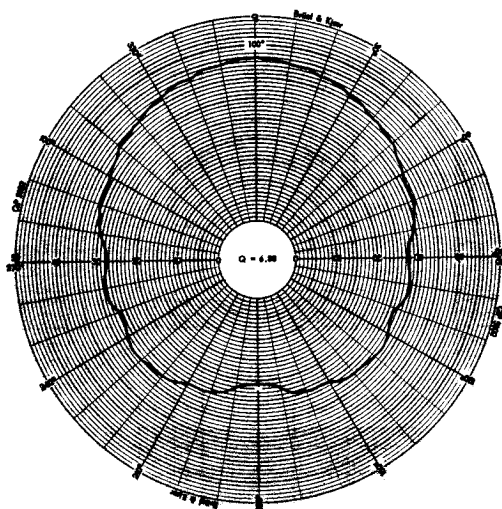
1D



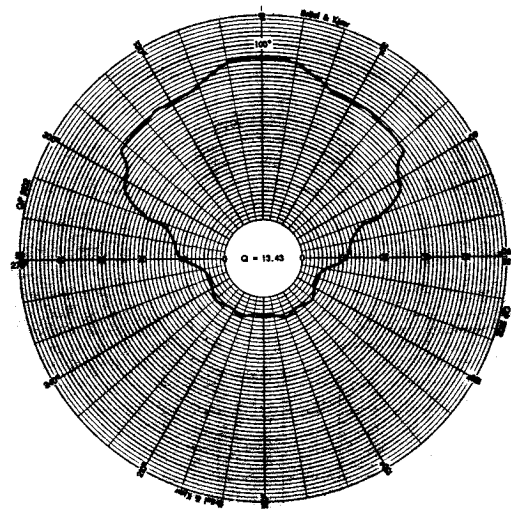
1B



1E

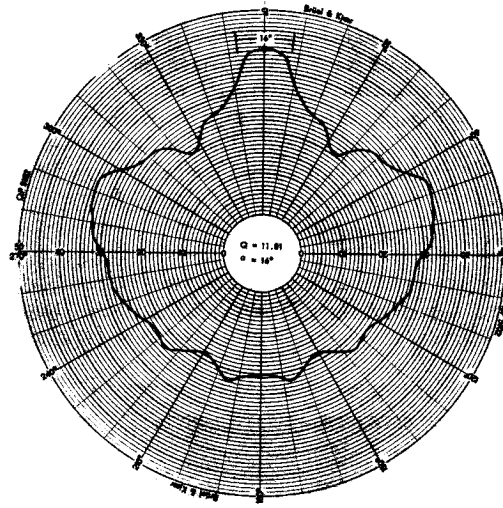


1C

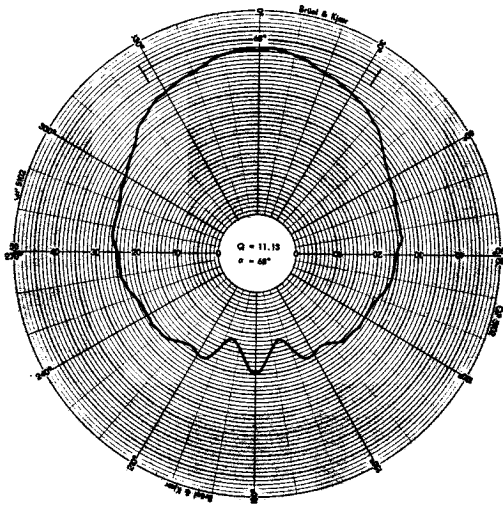


1F

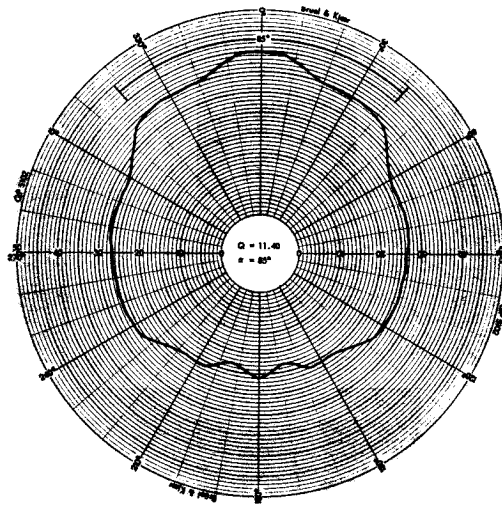
Figure 1. Polar Response Charts of Loudspeakers with Differing Q and Useful Coverage Angle of 100 Degrees



2A



2B



2C

Figure 2. Polar Response Charts of Loudspeakers with Similar Q and Differing Useful Coverage Angles

