YOU ASKED FOR IT !

In recent months I have had an increasing number of requests for information relative to the directional characteristics or polar response of microphones.

Because of the extent of this subject and its complexities, the next several issues of Microphone Facts will be devoted to polar response. In this first part, I will start with an explanation of axial and polar response, the effects of case design on polar response, and the running of such a curve for non-directional or pressure microphones. (Microphones actuated by sound pressure are "pressure microphones". All so-called nondirectional mikes fall into this category; I say "so-called" because all microphones are directional at some frequencies.)

AXIAL RESPONSE

Microphone response, as one usually thinks of it, is the frontal response represented by the horizontal line response curve or chart generally found on microphone specification sheets. This curve is run with the microphone in a fixed position facing the sound source; the resultant curve is known as the axial response.

This curve tells what response to expect when standing directly in front of the microphone at the distance at which it was calibrated. This is fine as far as it goes, but another curve of equal importance is the polar, or angular response of that microphone.

POLAR RESPONSE

Generally, it is simple enough to determine by a listening test whether the axial response is adequate for a given job. But it is another thing to analize polar response by the same method. It takes much more time-consuming "cut-and-try" and, at best, the results are rather inconclusive. However, when polar curves of your various microphones are consulted, it is comparatively simple to make the right choice without having to resort to a listening comparison.

EFFECT OF CASE SIZE AND SHAPE ON RESPONSE

In charts 4, 5 and 6 are shown polar curves of the Model 635, 655C and 649A. In looking over the curves you find little resemblance one for another, and yet the microphones are all of the same type. Here is why they differ. Sound waves resist being bent or flowing around an object. This resistance to bending increases as frequency rises. Thus, there will be a greater loss of level at 5 kc than at 1 kc, when these frequencies must bend around a microphone to arrive at the diaphragm. We also find that, as the case diameter of the microphone increases, the loss in off-axis sound increases as frequency rises. Therefore, the size and shape of a pressure microphone controls its polar response. The area seen when looking at a pressure microphone on axis has the greatest effect. This is known as the baffle area, and causes what is known as "baffle effect". Chart 3 shows the baffle diameters of the 635, 655C and 649A. Now compare the baffles with the polar response. Comparing chart 3 with charts 4, 5, and 6, you will note that as the baffle is reduced in size, the microphone becomes less directional.

POLAR RESPONSE CALIBRATION

The following will explain the equipment used and the procedure followed in running a polar curve.

An anechoic sound chamber or echo-free room is required for all calibrating activities. This type room is used to be sure that there is no reverberation or ambient noise present to distort the polar pattern. Only under these conditions can we be certain we are reproducing the true performance of the microphone.

Diagram 1 shows the arrangement used in the sound room; diagram 2, the associated audio equipment. To run the curve the microphone is attached to the stand and very carefully aimed at the center of the speaker. The door is now closed and the balance of the operation controlled from outside.

The oscillator is set at 10 kc and a level is established with microphone positioned on axis in relation to speaker. Since the level at all other positions will be less, the axis position is noted as zero on the polar chart.

Now we are ready for the circular polar curve paper on which the curve will be plotted. Refer to the 635 polar curve in chart 4. To prepare the chart, zero degrees and zero db will have to be located. Below zero on each concentric ring will be written in order -5, -10, -15 and -20 db. Due to the small size of this chart the 1 db steps are not shown.

To calibrate the 635, we rotate the microphone. At about 30°, level has dropped to -5 db; at 45° to -8-1/2 db, at about 80° to -15 db, at 90° to -17-1/2 db and 180° to -20 db. As rotation is continued beyond 180°, the curve repeats itself as shown on the chart. With each succeeding frequency this process is repeated until a picture of the polar response is complete. In the process of analysis we run many more frequencies than are shown, but we have included on this chart only those frequencies where a significant change has taken place.

So far we have considered polar pattern in one plane only. What happens to the curve when the 635 is rotated around on its axis?

If the axis position remains unchanged, curves run at any position around the axis will remain practically unchanged. Because the case of the 635 is symmetrical, the polar response will remain unchanged (this will be true of any pressure microphone of symmetrical shape).

That is the how and why of polar response. Next we'll take up how it applies to your everyday needs, selection of the microphone for the job, and other practical application information.

Meantime, if there are any questions, let's hear from you.

Cordially yours,

ELECTRO-VOICE, INC

Lou Burroughs

L.R. Burroughs
Vice President
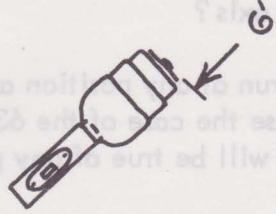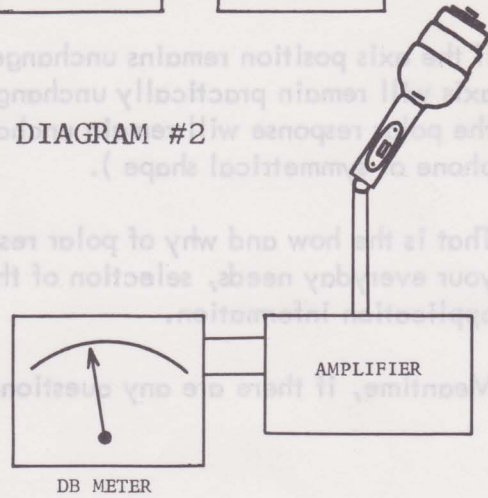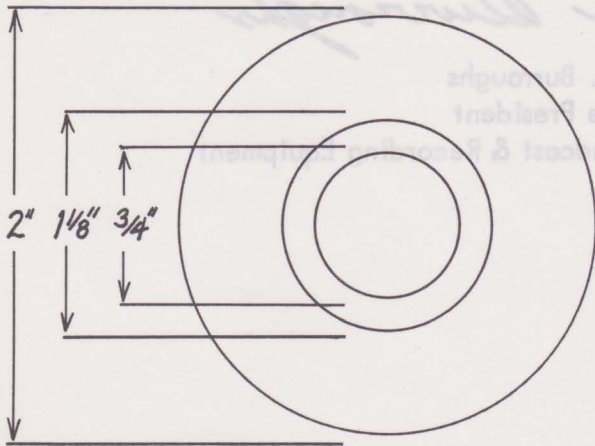Broadcast & Recording Equipment

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DIAGRAM #1

DIAGRAM #2

AUDIO OSCILLATOR

AUDIO AMPLIFIER

AMPLIFIER

DB METER

CHART #3

2" 1⅛" ¾"

CHART #4

SCALE: 5 DECIBELS PER DIVISION
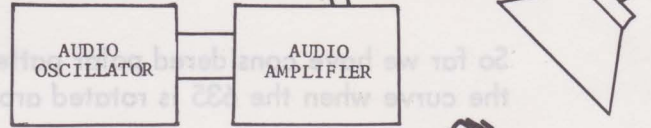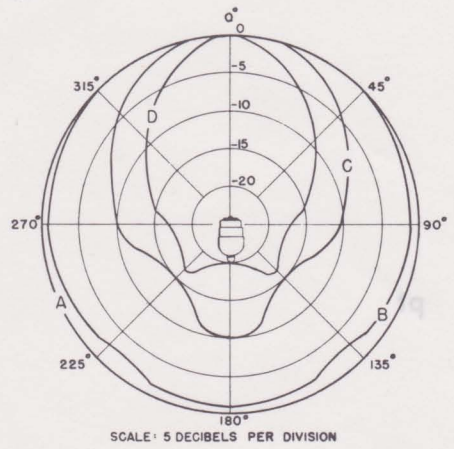
POLAR RESPONSE
OF 635

CHART #5

SCALE: 5 DECIBELS PER DIVISION
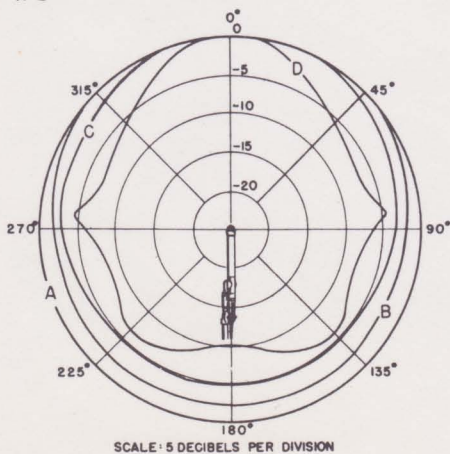
POLAR RESPONSE
OF 655C

CHART #6

SCALE: 5 DECIBELS PER DIVISION

POLAR RESPONSE
OF 649A