

Figure 1 AR-3a in oiled walnut

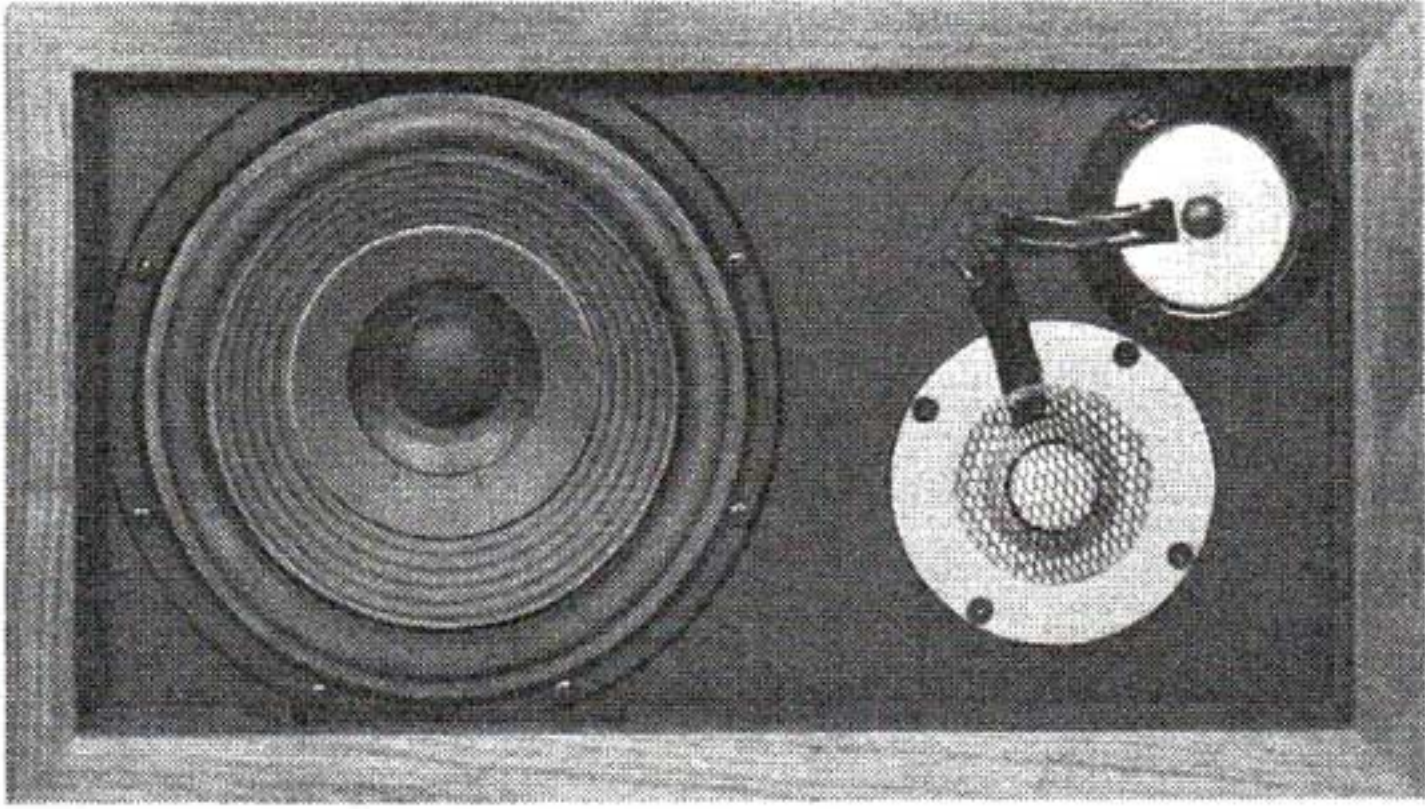
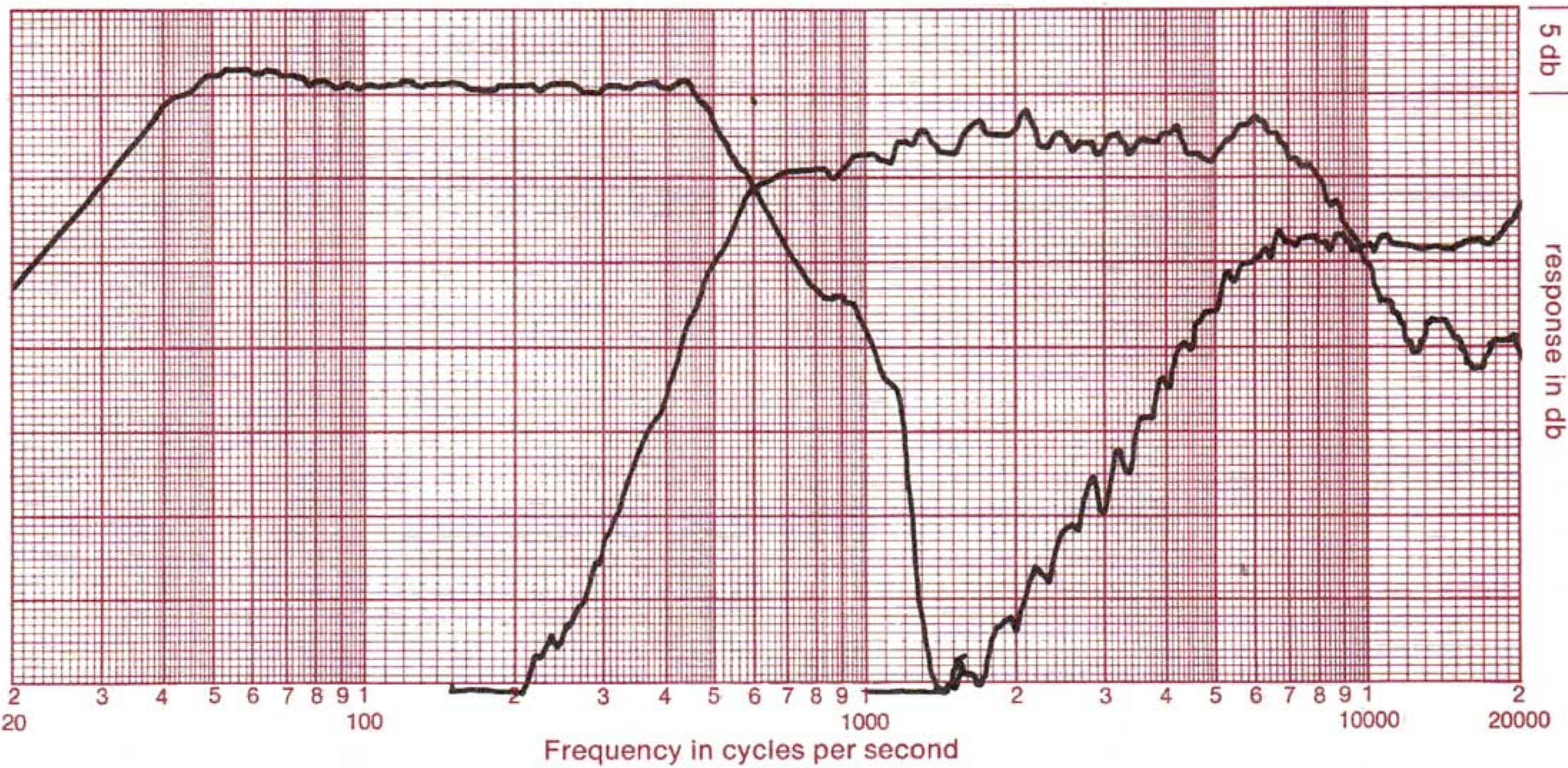


Figure 2 AR-3a with grill cloth removed

Technical Data

AR-3a Speaker System

Figure 3 Individual drivers

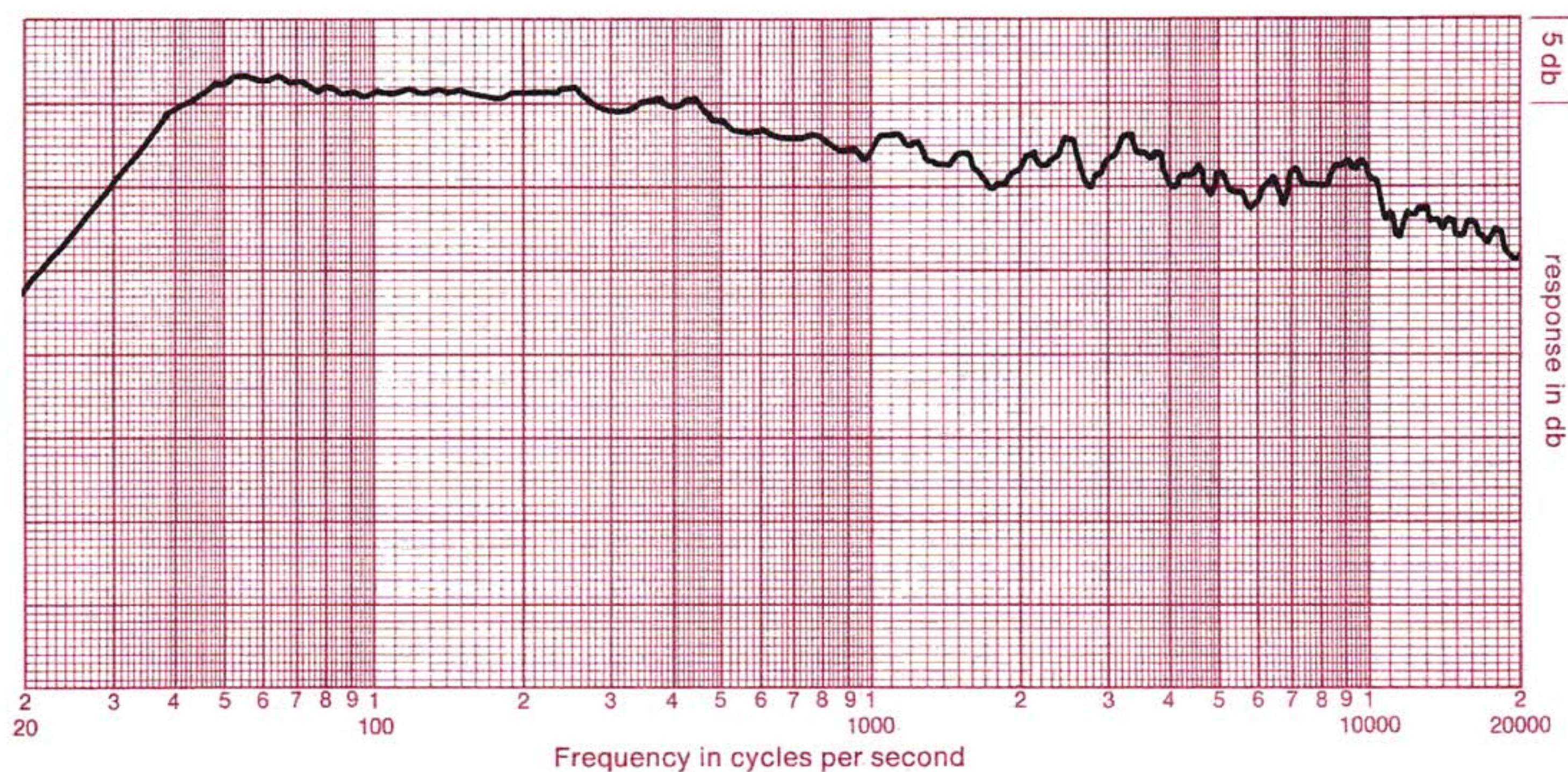


The AR-3a is the most recent of a series of speaker systems derived from the original acoustic suspension design introduced by Acoustic Research in 1954. Three drivers are used in the AR-3a: a 12-inch bass unit, in a 0.283 m³ (1.7 ft³) sealed enclosure filled with loosely packed glass wool; a hemispherical mid-frequency radiator 38 mm (1½ in.) in diameter; and a 19 mm (¾ in.) hemispherical radiator which serves for high frequencies. The output levels of the two smaller radiators are independently adjustable by controls on the rear panel of the enclosure.

The frequency response of each of the three drivers is shown in Figure 3. All have been measured radiating into a 360° solid angle (a hemisphere), with the AR-3a grill cloth and decorative molding removed. The bass driver was measured outdoors. As may be seen, response is quite uniform at both high and low frequencies, while the high efficiency of the smaller radiators permits excellent overall flatness of system response. The curves were obtained with uniform input voltages for all drivers.

Acoustic suspension systems are less efficient than some other designs, so that amplifiers with adequate power must be used to obtain the advantages provided by the AR-3a. A minimum capability of 25 watts per channel r.m.s. is recommended. The AR-3a will tolerate a sustained input of 11 watts r.m.s. at any frequency for an indefinite period, 23 watts r.m.s. for at least 30 seconds, and overloads of 400 watts for 2 seconds, with a Fusetron FNM 1¼ fuse in series with the system.

Figure 4 System response on axis



The overall frequency response curve shown above is a composite, in which the section below 200 Hz is the response of the bass driver outdoors radiating into a 360° solid angle, while the remainder was obtained with a single B&K 4133 microphone on axis. Both of the system level controls were set for maximum output. The most significant feature of the curve is

the smoothness of response over the entire range of frequencies available from voice or musical instruments. In practice, it is usually necessary to attenuate middle and high frequencies by means of the level controls on the AR-3a to achieve natural reproduction from most disc recordings. This is due partly to undamped resonances in pickup cartridges, which often produce

peaks of 6 db or more in the 10,000 Hz region, and partly to equalization and microphone placement techniques which are now common. In any event, since the curve was made under anechoic conditions, it does display the response characteristics of the "first arrival" acoustic signal from an AR-3a, before room reflections or other interference have changed its subjective quality.

Polar response curves

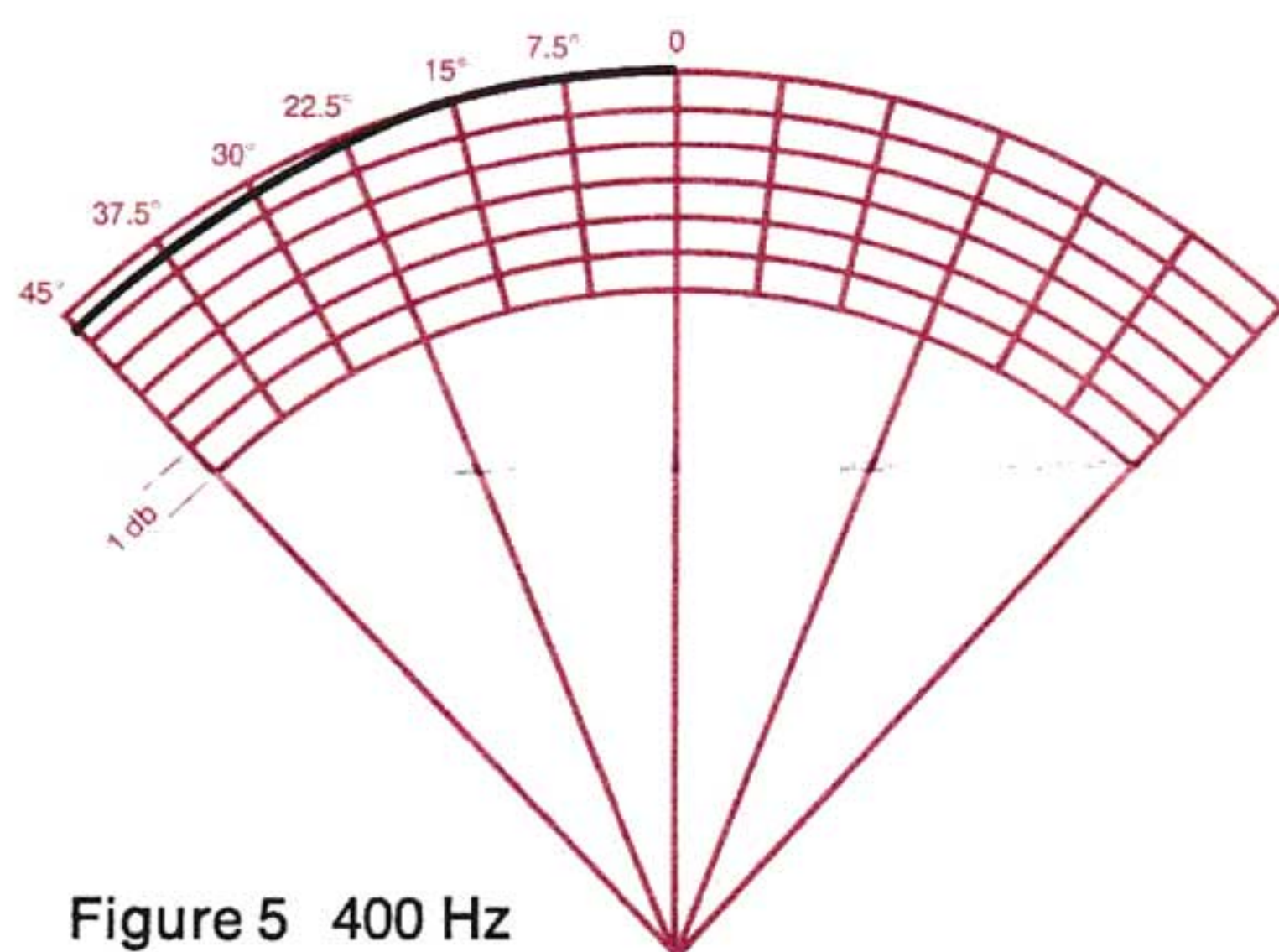


Figure 5 400 Hz

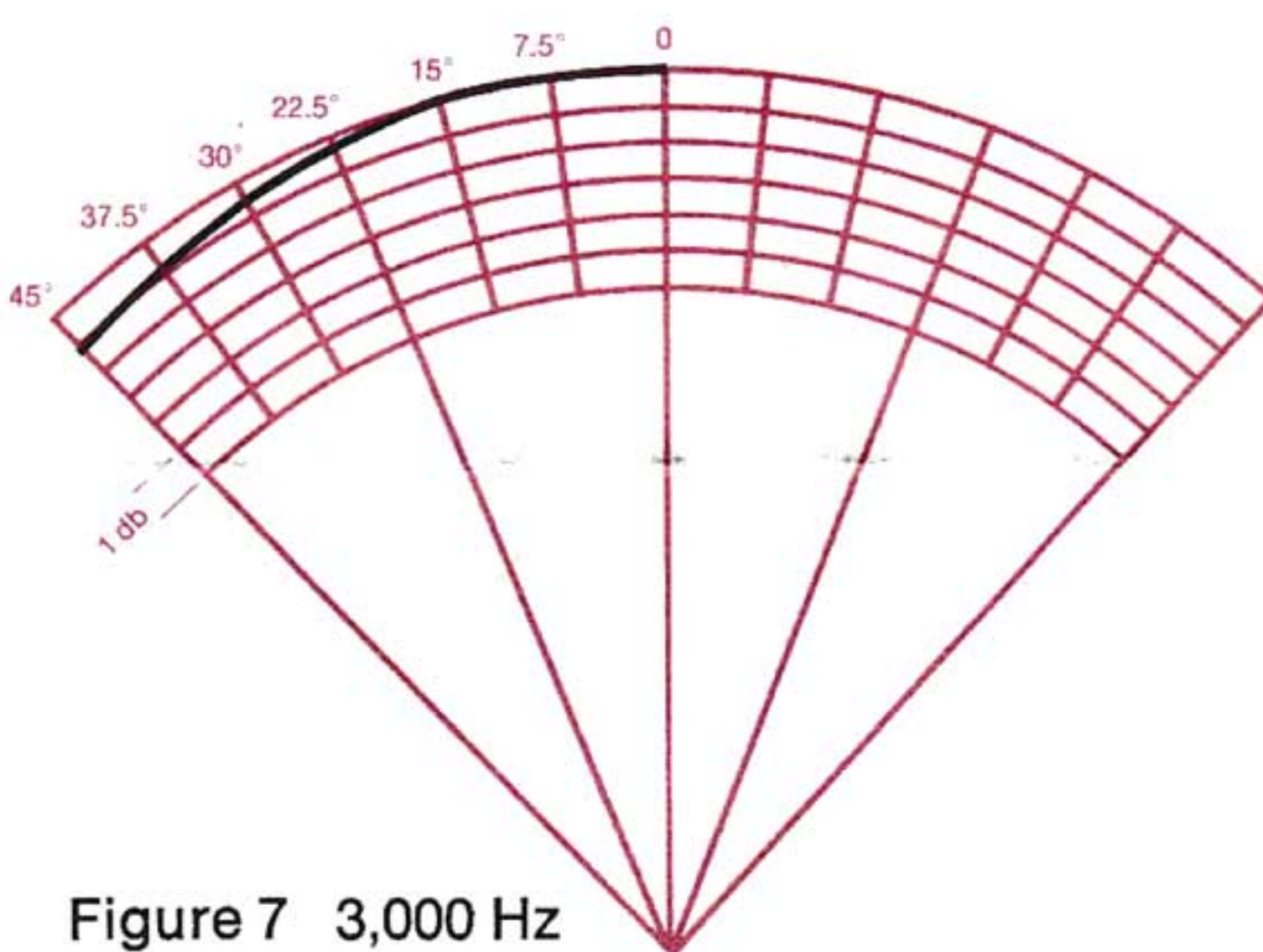


Figure 7 3,000 Hz

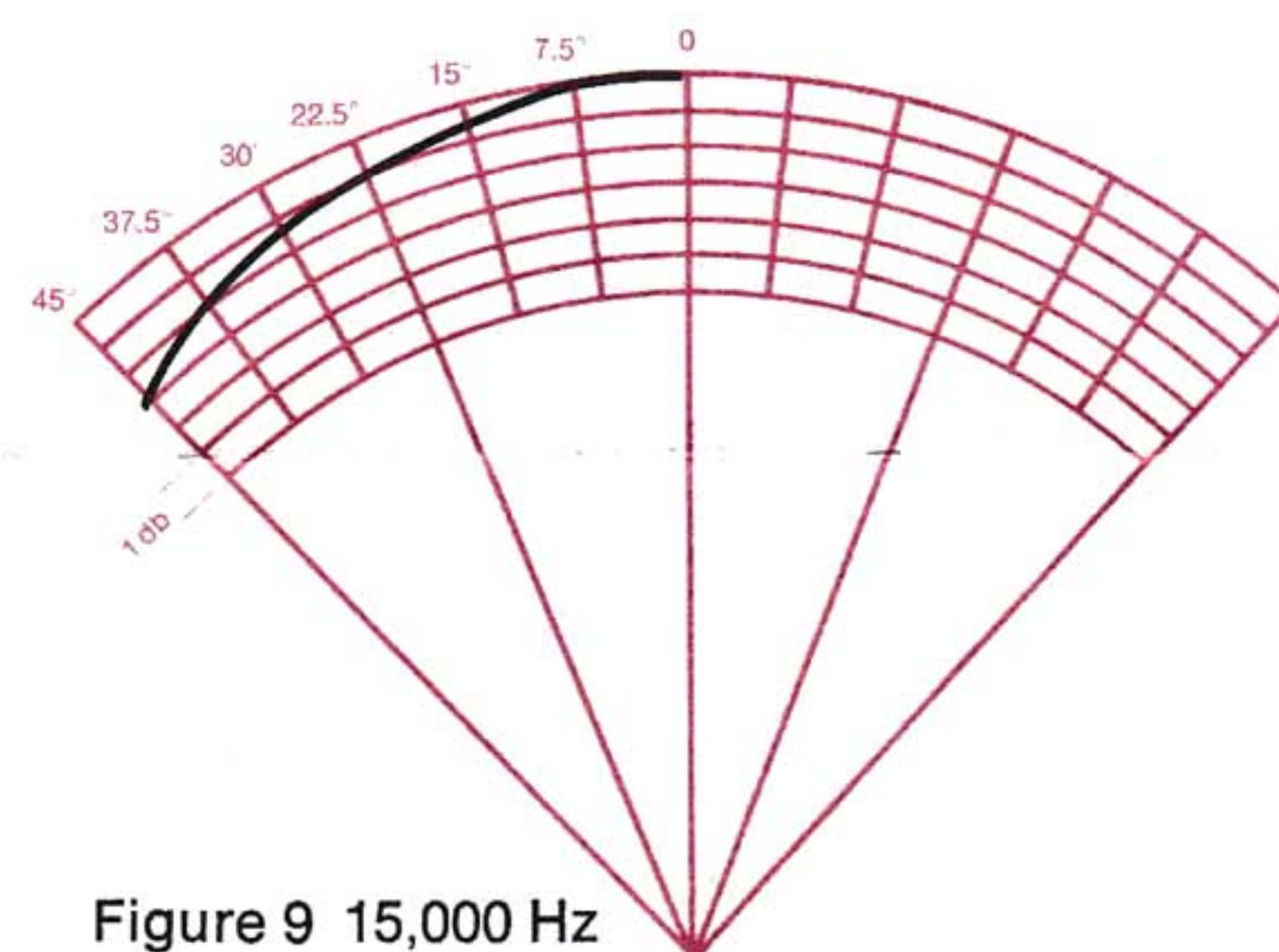


Figure 9 15,000 Hz

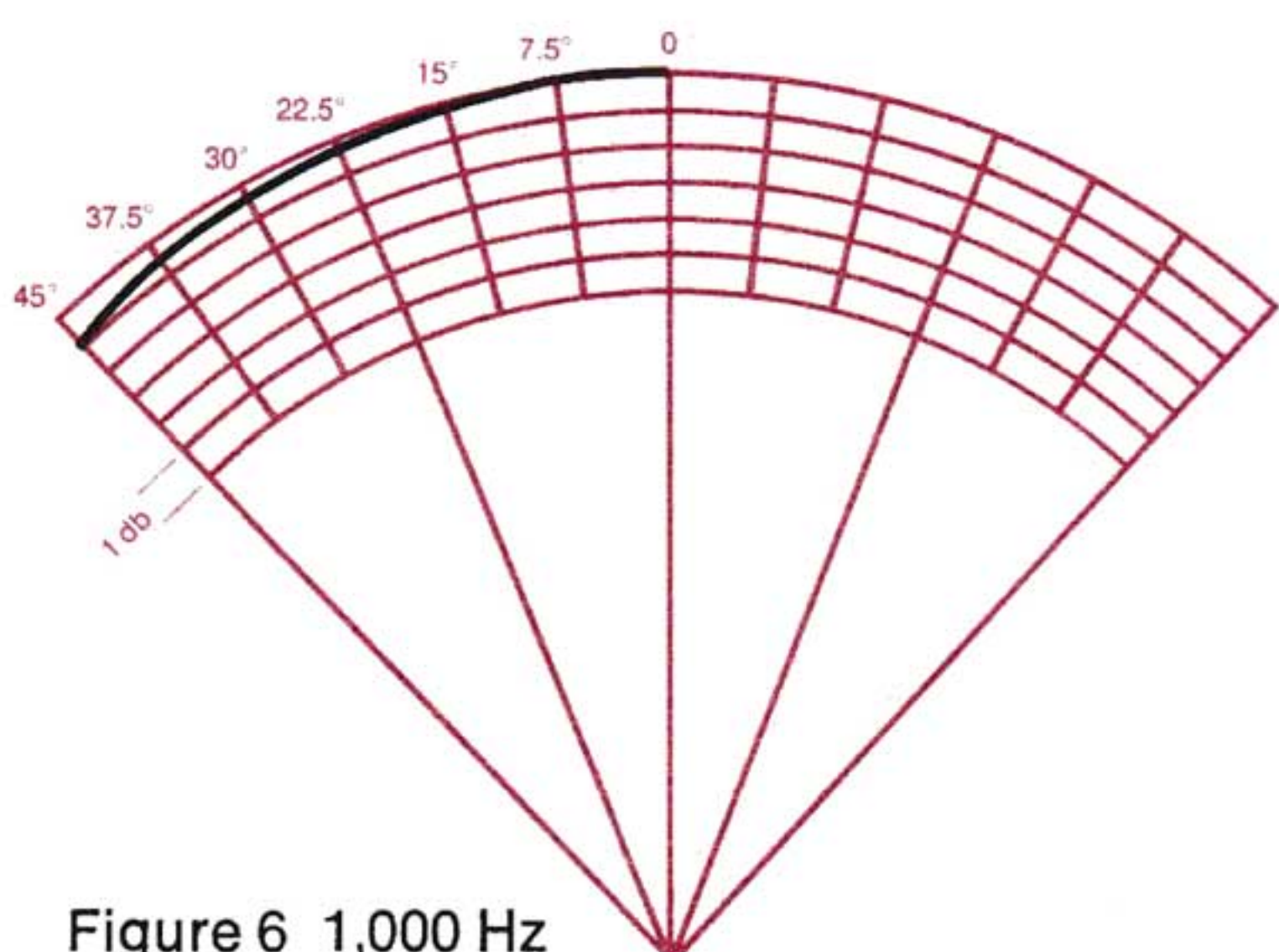


Figure 6 1,000 Hz

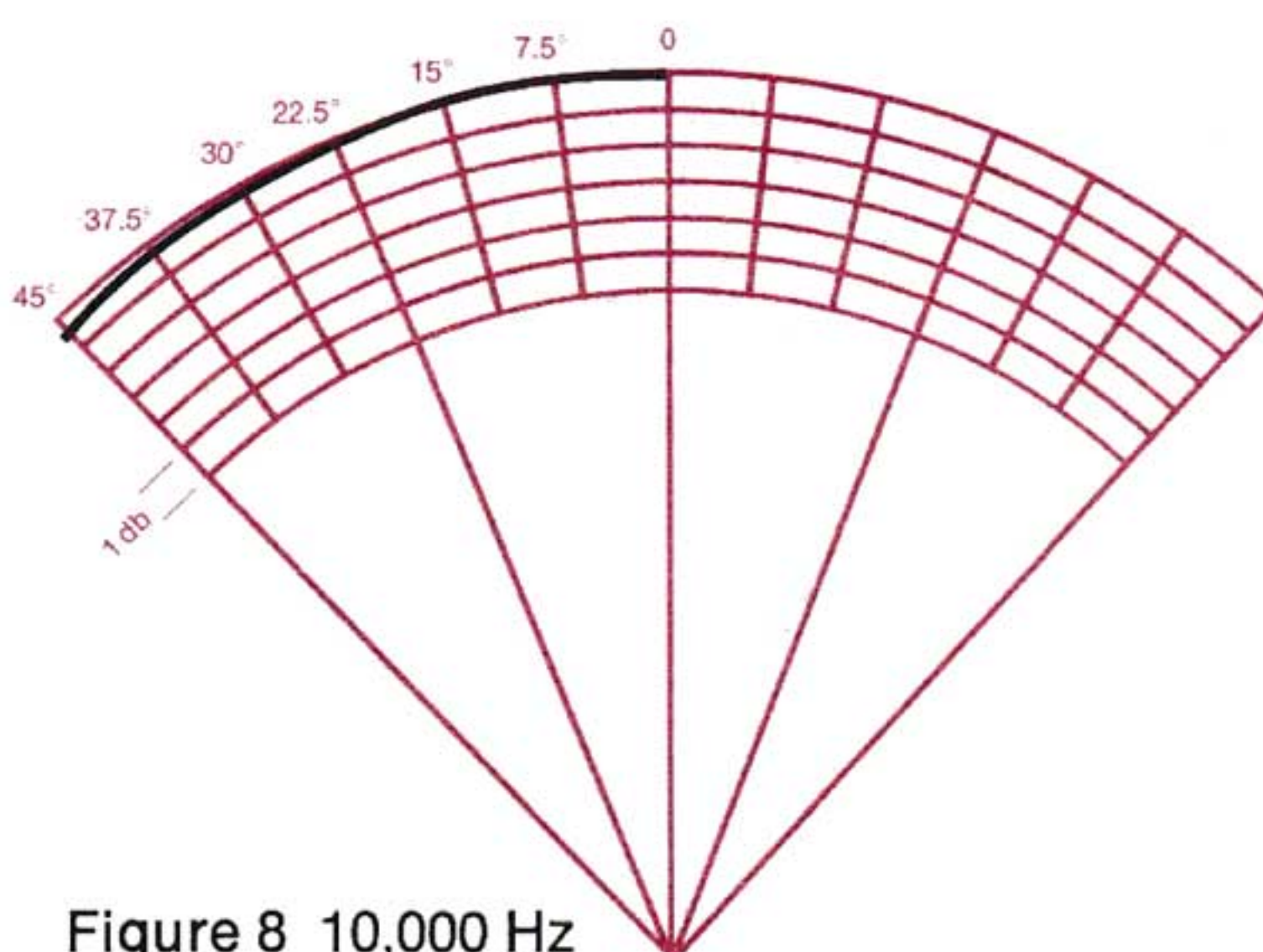


Figure 8 10,000 Hz

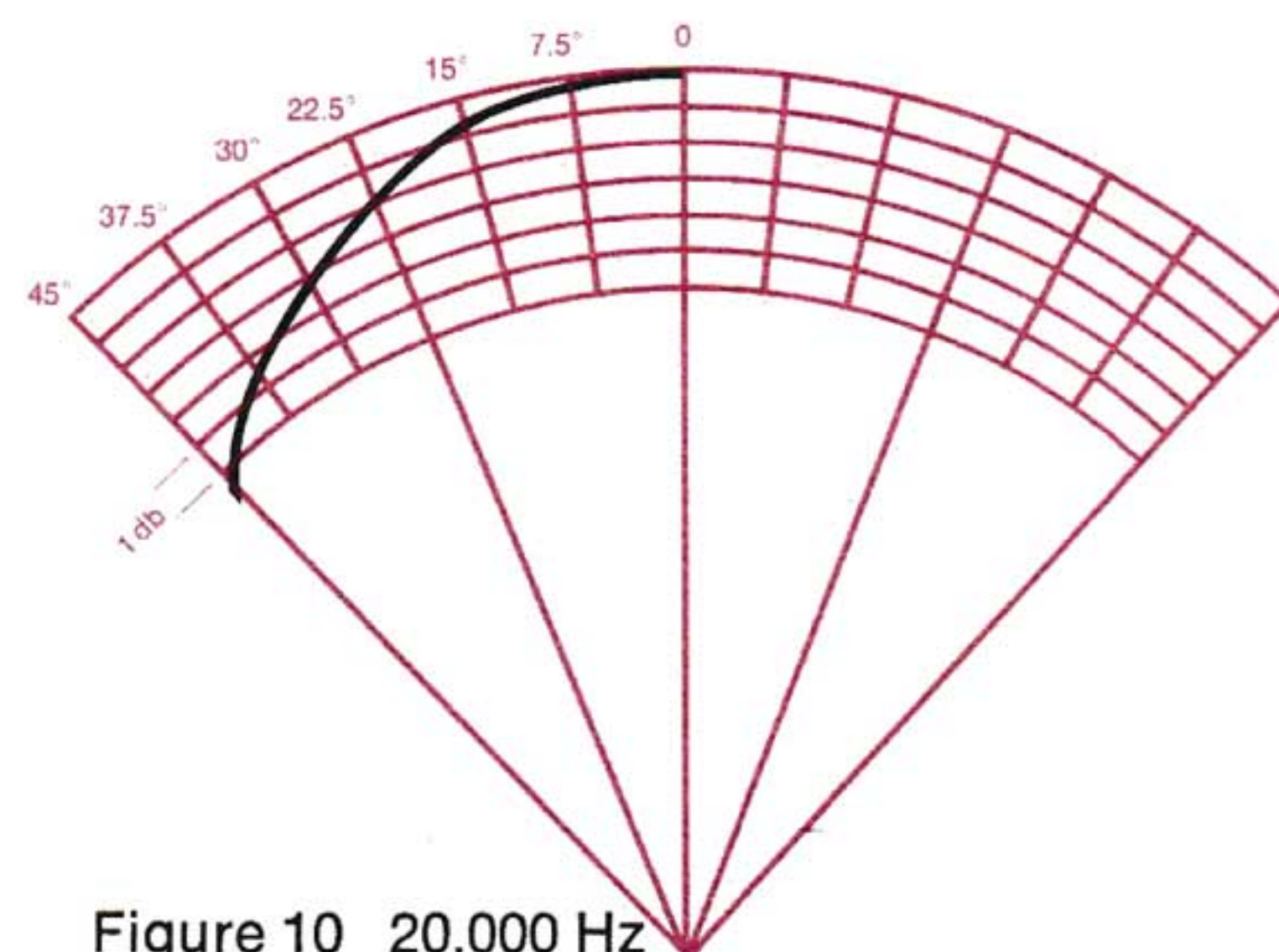


Figure 10 20,000 Hz

One of the outstanding characteristics of the AR-3a is its excellent dispersion at all frequencies. This is due mainly to the small diameters of the two hemispheres used to radiate tones in the middle and high range. By proper placement of the speaker systems, stereophonic listening may be done over a wide range of positions with good effective balance as a result of the AR-3a's wide-dispersion radiators. The graphs above show the reduction in level resulting from movement off axis at

various frequencies, up to ± 45 degrees. This limit corresponds to a listening location at the center of a square with the speaker systems in two of the corners. As the graphs show, the difference in level between this location and that directly in front of one of the speakers is only 0.6 db at 10,000 Hz. Since it is rarely possible for all listeners to occupy an ideal listening location, broad dispersion can greatly enhance the effect of stereophonic programs.

Figure 11 Harmonic distortion

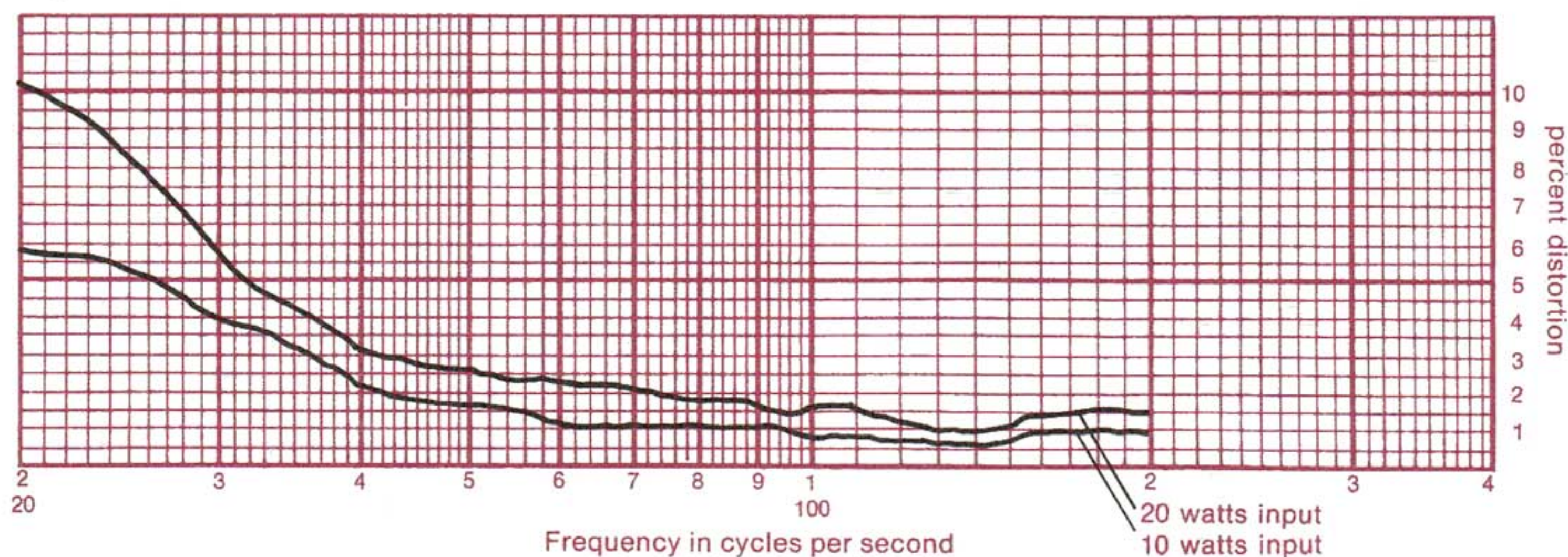


Figure 12 Frequency response with amplifier flat

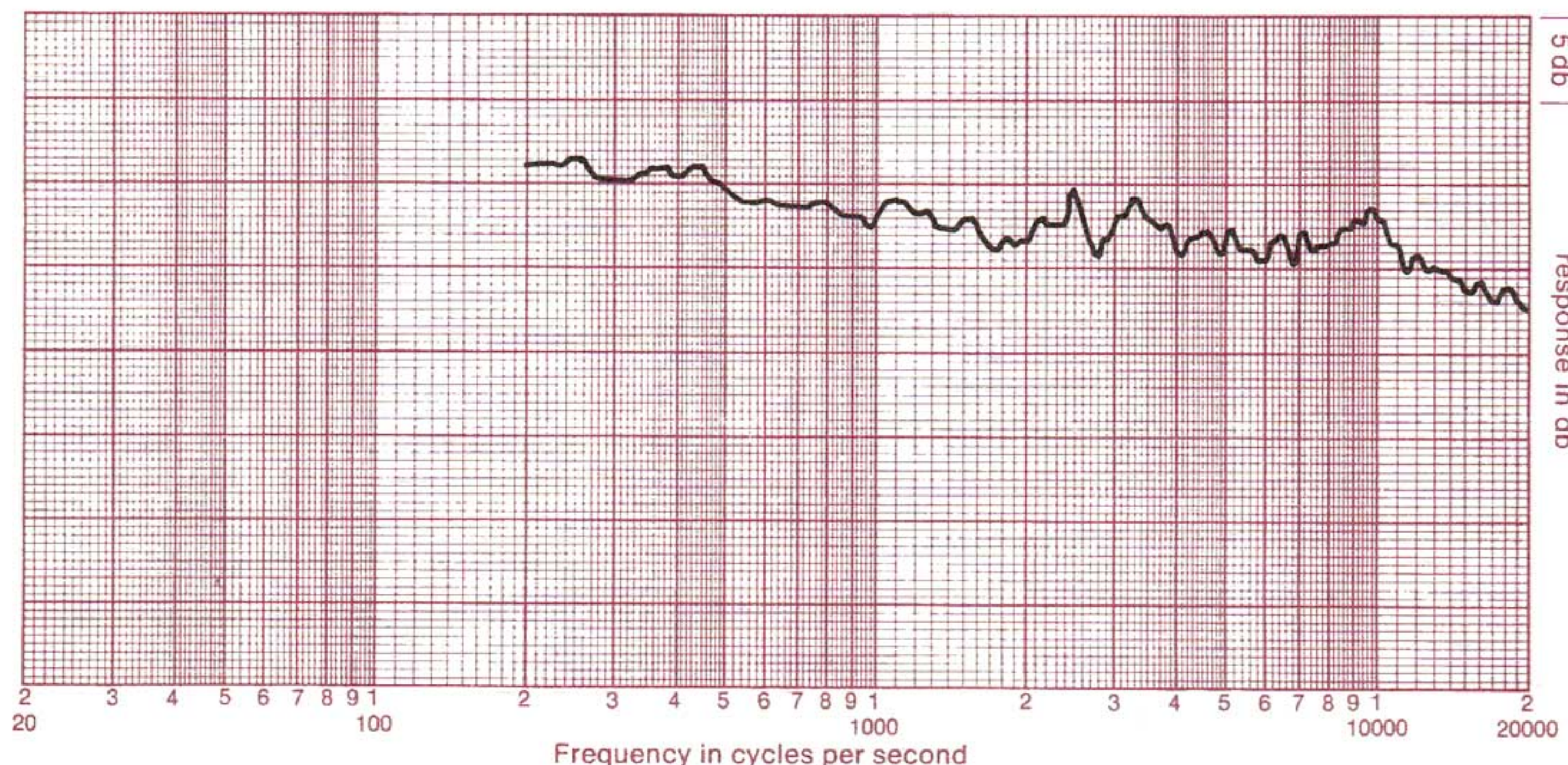


Figure 13 Frequency response with amplifier +2 db at 10 kHz

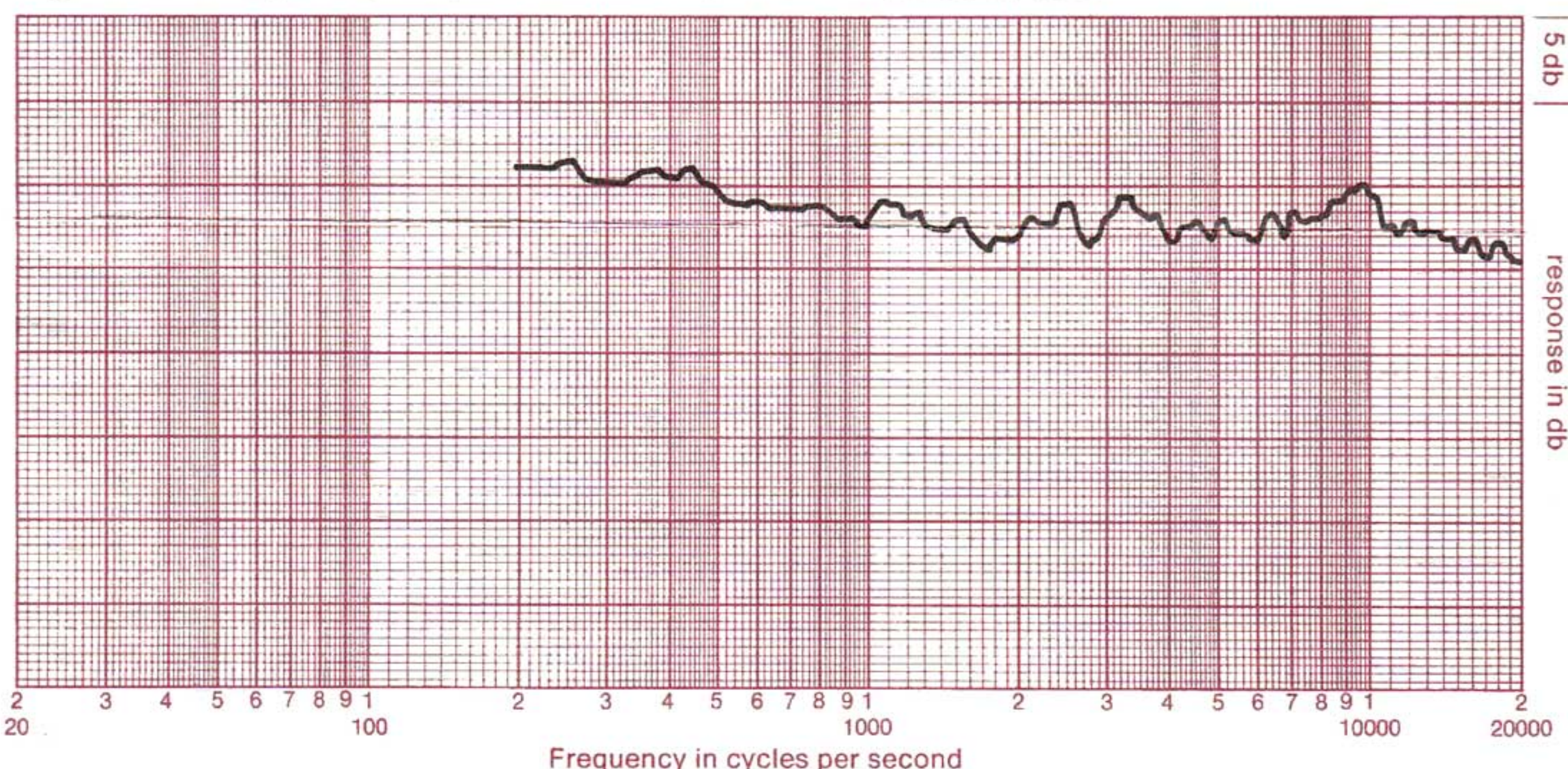
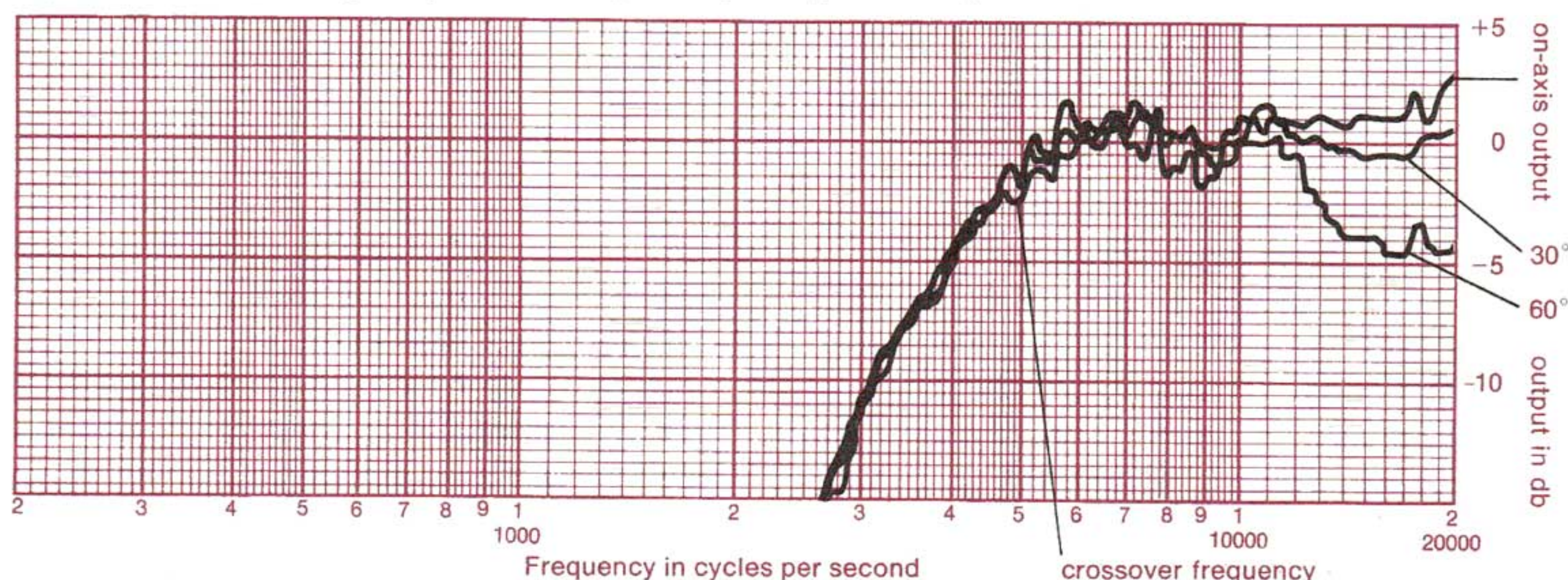


Figure 14 Frequency response of high-frequency unit only



The performance characteristics of the AR-3a are of particular interest in applications which require low harmonic distortion, even at the lowest frequencies likely to be encountered in musical program material, and extended uniformity of frequency response. Figure 11 shows the harmonic distortion of the AR-3a at low frequencies

at two different power input levels. Figure 12 indicates the frequency response of an AR-3a driven by an AR amplifier with the amplifier included in the measurement and set with tone controls out of the circuit. In Figure 13, the AR amplifier treble control has been set to increase output +2 db at 10,000 Hz, a setting found to give the flat-

Figure 15

1,000 Hz

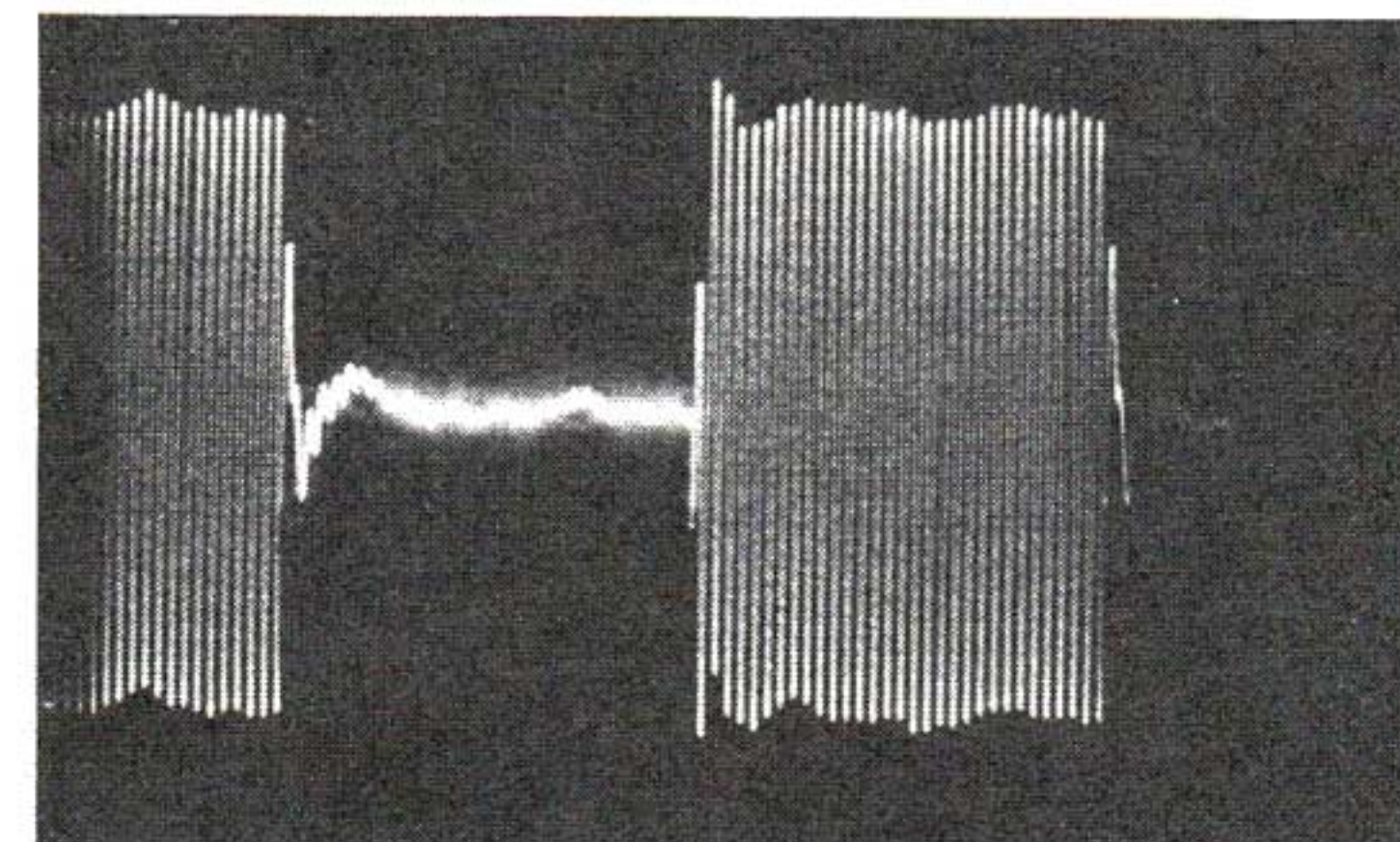


Figure 16

3,000 Hz

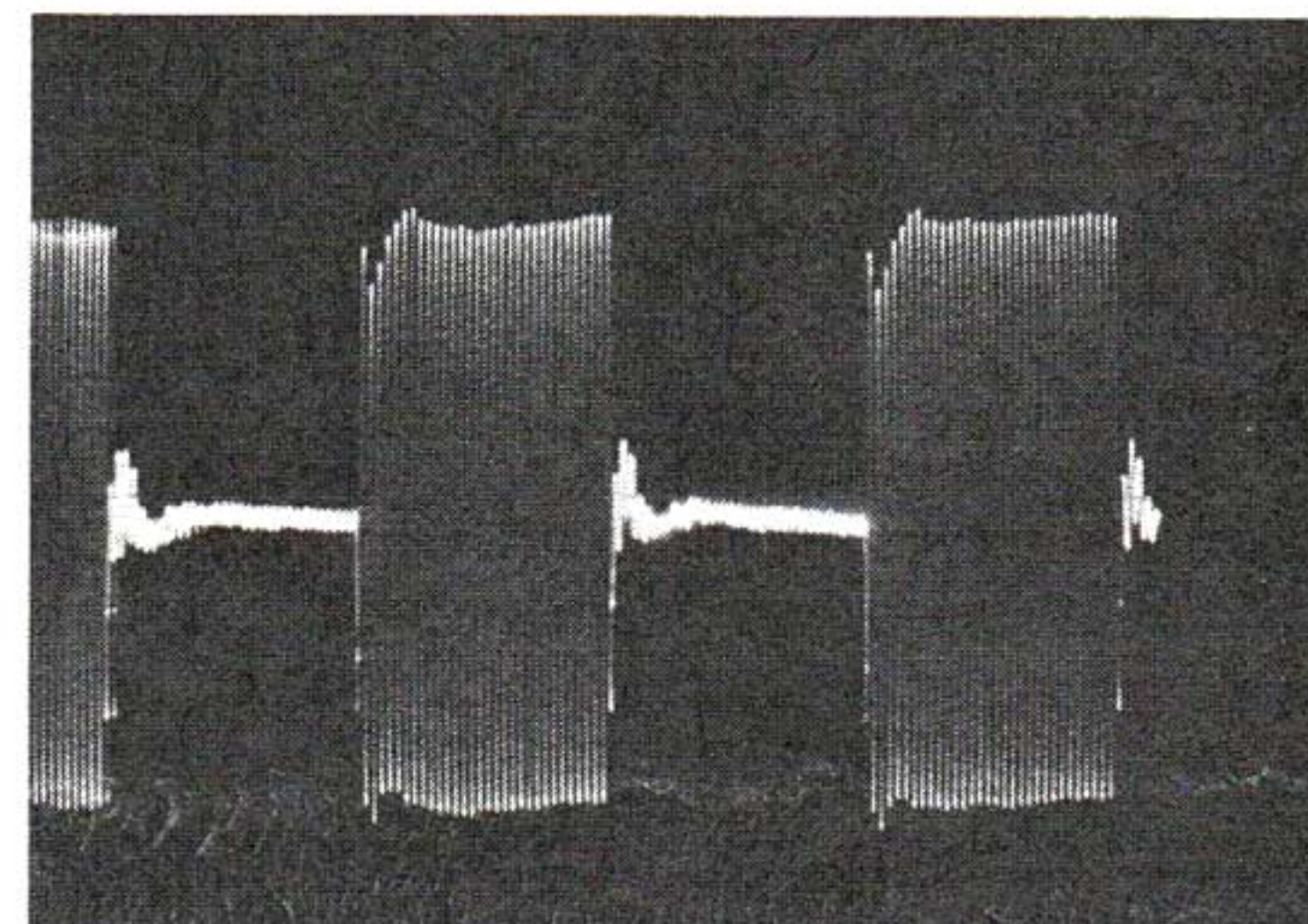


Figure 17

10,000 Hz

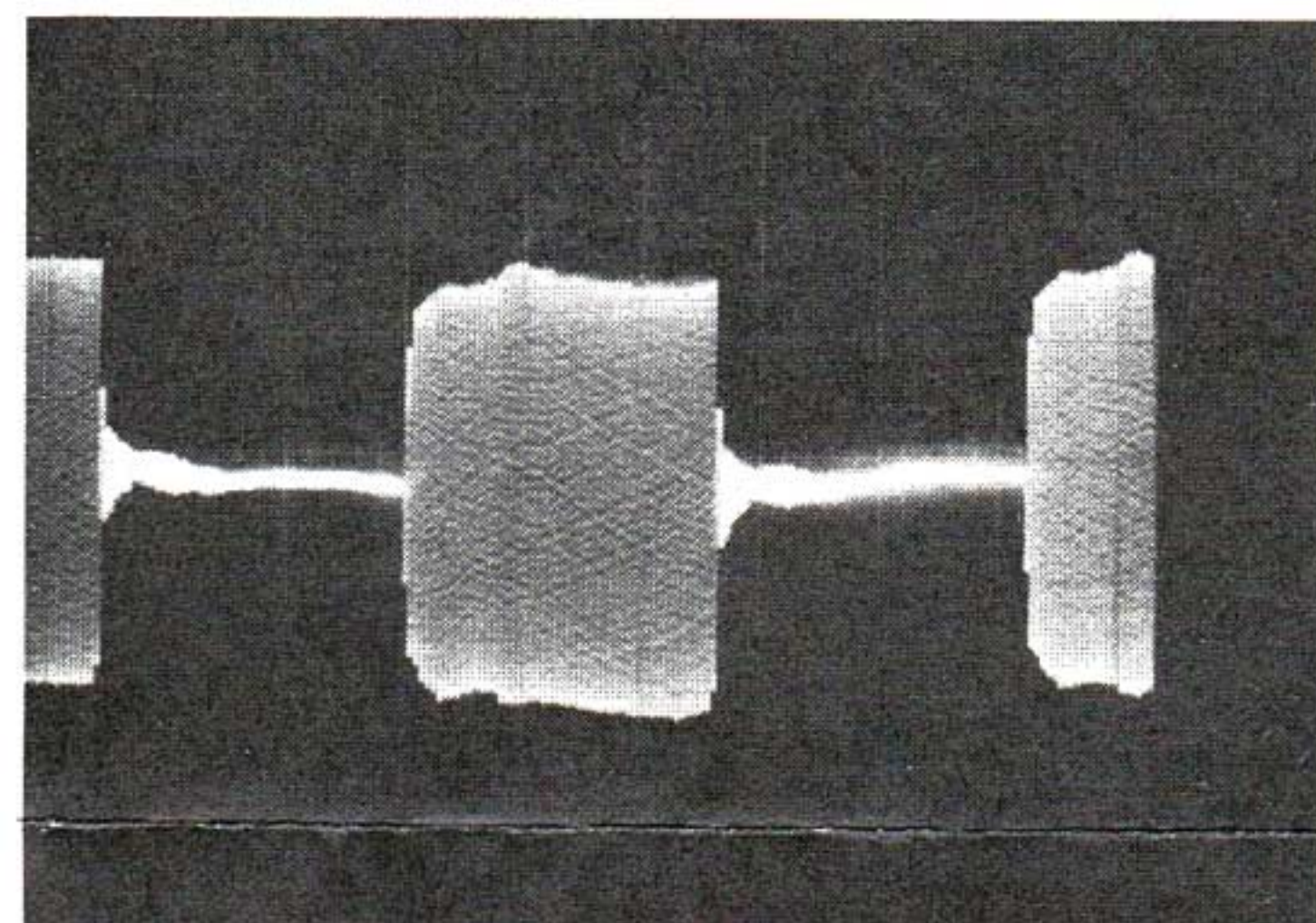
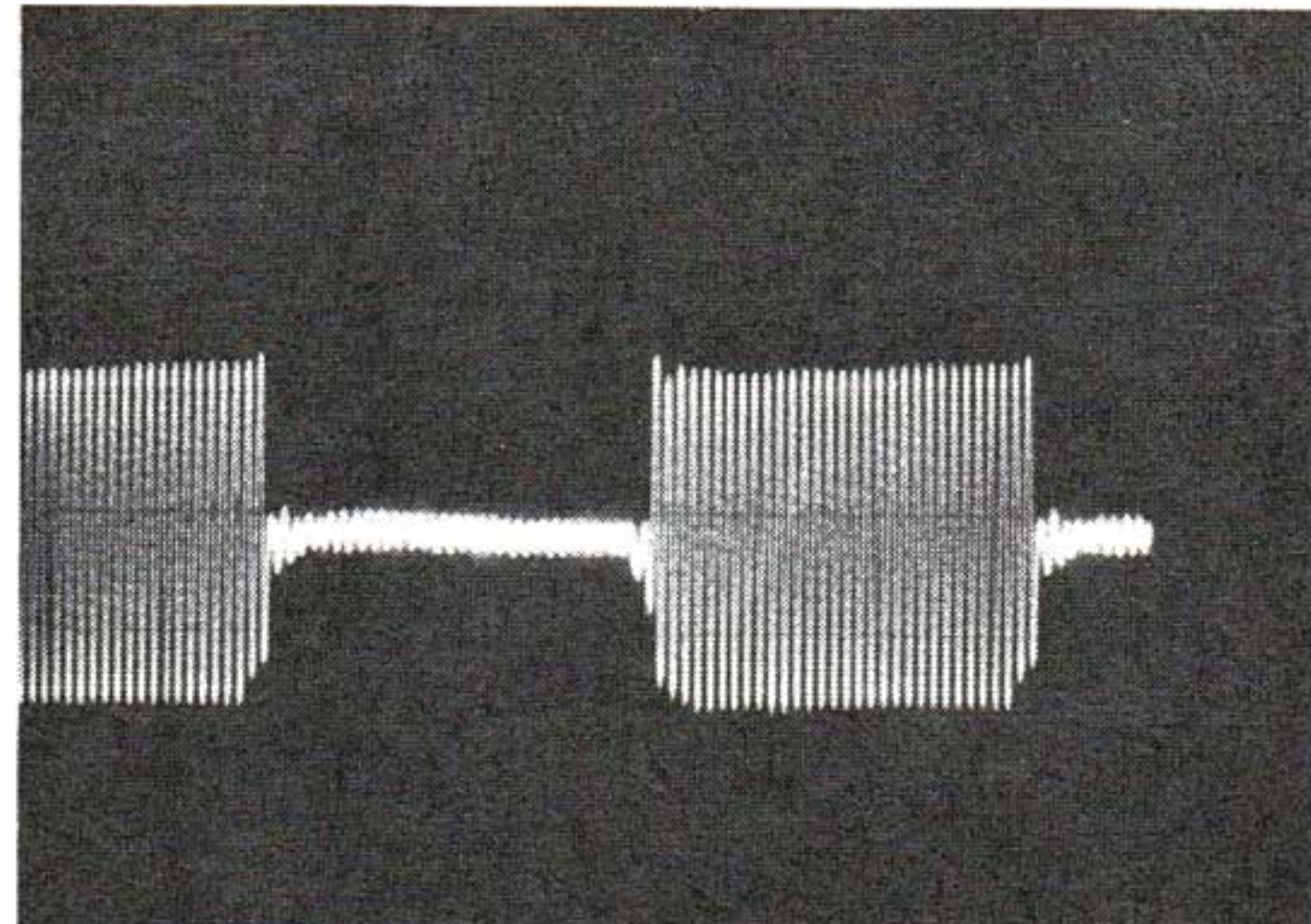


Figure 18

20,000 Hz



The above tone-burst photographs indicate the ability of the AR-3a to respond with precision to short bursts at different frequencies. The absence of ringing and overshoot are evidence of a speaker system with smooth, even response without major peaks or deficiencies.

test overall system response. In this mode of operation, the system is ± 2 db from 500 Hz to nearly 17,000 Hz. Figure 14 shows the frequency response of the high-frequency driver in the AR-3a at several angles off-axis, as well as on-axis.

Figure 19

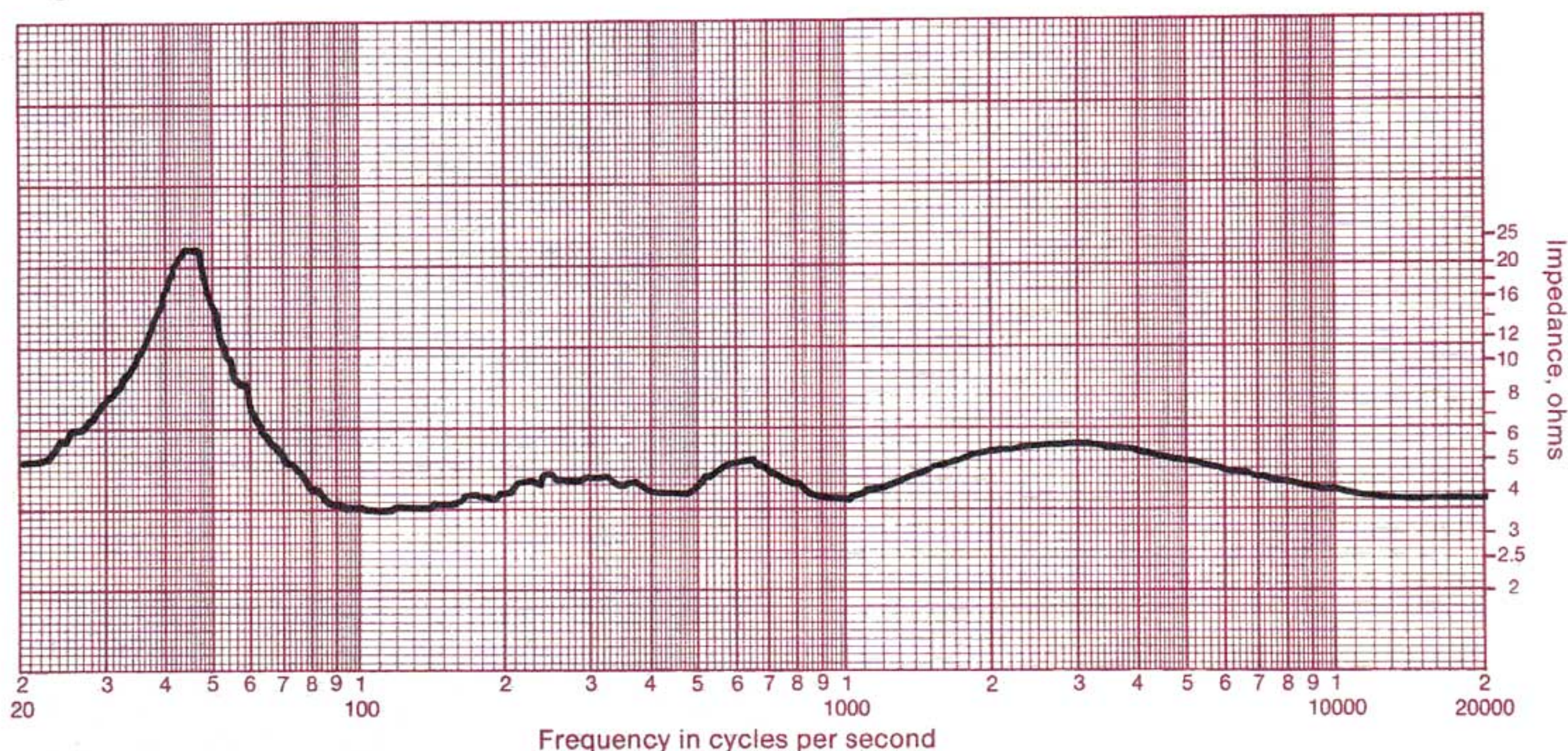


Figure 20

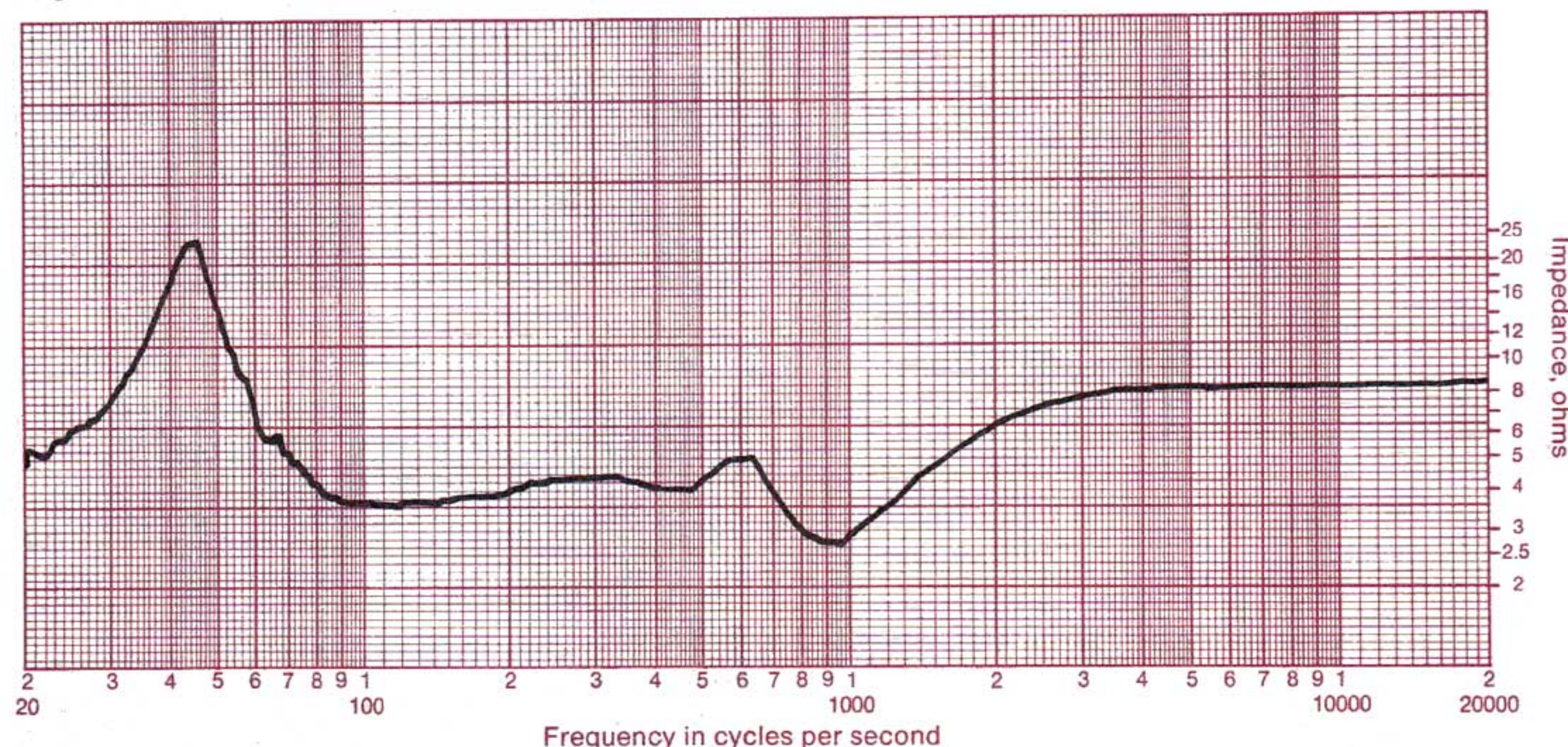
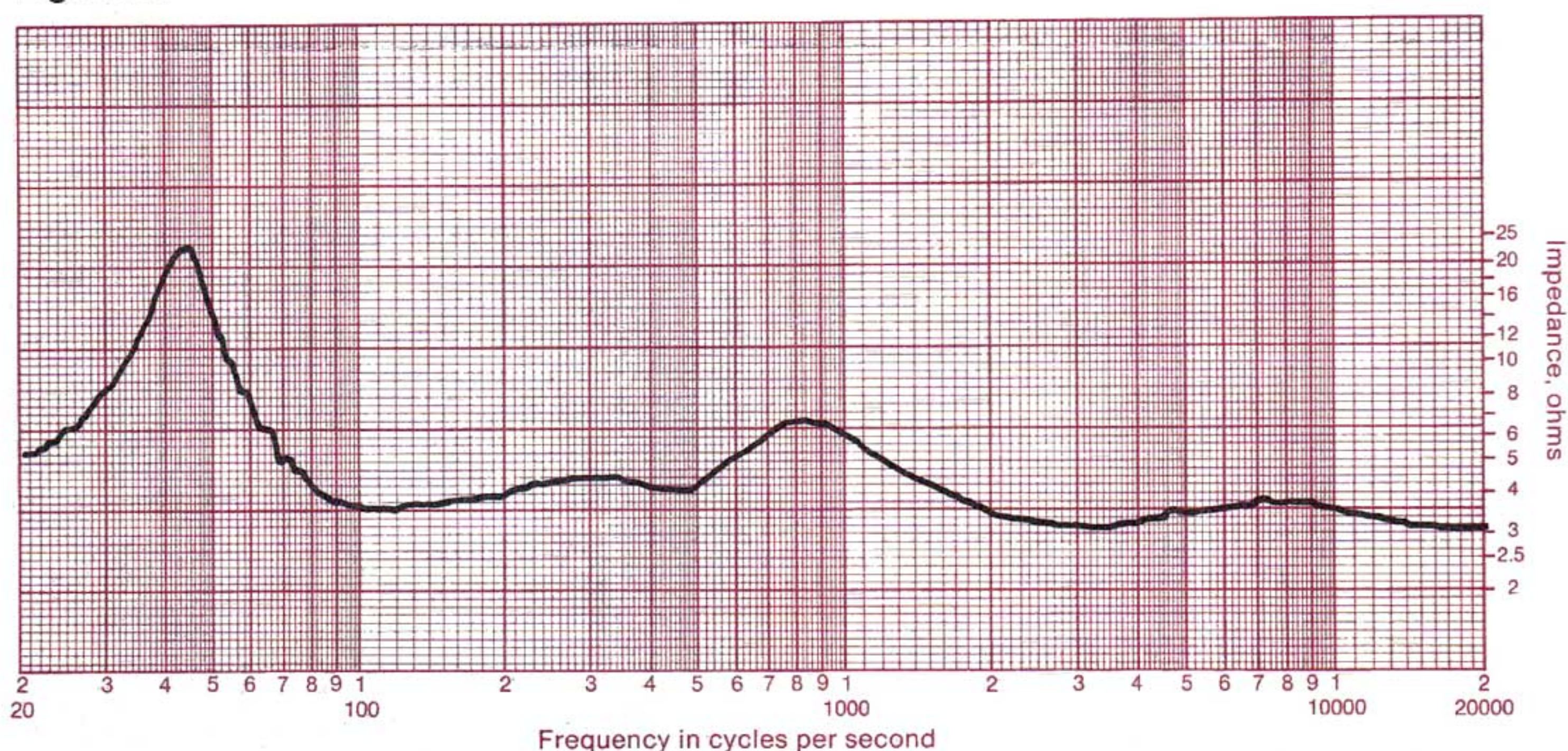


Figure 21



Prices *

Glossy walnut, oiled walnut, cherry, oiled teak	\$250
Mahogany, birch	\$240
Unfinished pine	\$225
Factory conversion of an AR-3 to an AR-3a	\$ 90**
Size: 14" x 25" x 11 ³ / ₈ " deep.	
Net weight: 53 lbs. (24 kg.)	
Shipping weight: 60 lbs. (27.2 kg.)	

* 5% higher in the West and Deep South
** plus freight both ways

The AR-3a is guaranteed for 5 years from date of purchase. The guarantee covers parts, labor, freight to and from the factory or nearest authorized service station, and new carton if needed. If an AR-3 is converted to an AR-3a, a new 5-year guarantee applies from the date of conversion.

Acoustic Research designs and manufactures equipment for high-fidelity music reproduction in homes. AR equipment has, however, been frequently chosen for use in broadcasting and recording applications by professionals.

The criteria employed in the design and testing of AR speaker systems are those of scientific method. We recognize that the sound produced by musical instruments may or may not please an individual, and that this is a matter of taste. Whether or not a loudspeaker has succeeded in accurately reproducing that sound, however, is a matter of fact, subject to measurement and control in accordance with principles of physical acoustics.

The first AR speaker system, the AR-1, was developed to reproduce music accurately by operating with reduced distortion at low

Impedance characteristics of the AR-3a are shown in the three curves at left, for three settings of the level controls on the back panel of the system. In Figure 19, the controls are set with pointers opposite marks on the panel indicated as "normal". Figure 20 was made with the controls set at "minimum". Figure 21 was made with both of the controls set at "maximum".

frequencies. The solution to this problem was one which also provided unusual uniformity of response and the relatively small enclosure size characteristic of AR systems. As applied by AR, the acoustic suspension principle required that the air inside the enclosure act as the "spring" against which the speaker cone worked, rather than the pleated cloth or paper ring normally seen around the circumference of the cone. The bass reproducing system evolved is the same as that used in the AR-3a.

In the December, 1967, issue of *db*, Dr. Harry F. Olson of R.C.A. Laboratories set forth criteria to be satisfied by a loudspeaker system if it is to be capable of high-fidelity sound reproduction. Reprints of Dr. Olson's article are available from Acoustic Research, Inc.