"NEW ORTHOPHONIC" RECORDING CHARACTERISTIC

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ENGINEERING SECTION

Record Department

TMKS®

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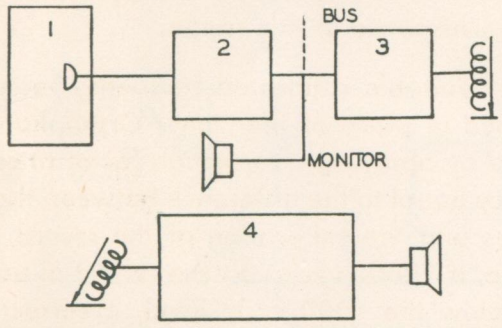
The significance of a recording and reproducing characteristic is perhaps most easily illustrated by the following sketch showing a typical recording-reproducing chain.

The basic components are (1) Studio and microphones (2) Microphone amplifiers, mixer, special equalizers and monitor speaker (3) Disc recorder (4) Disc reproducer and speaker.



It can readily be seen that if the over-all characteristics of "3" and "4" are not matched, i. e. if one does not complement the other, the sound coming from the two speakers cannot be the same.

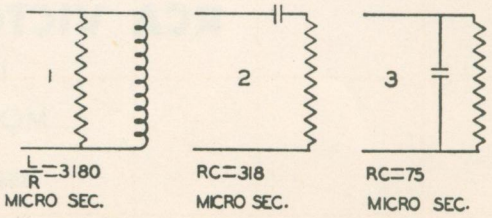
At a recording session adjustments in microphone placement, equalization and system response are often made to obtain the musical effects and impressions desired by the artist and musical director. These effects are judged by the sound heard from the monitor speaker. The function of the disc recorder is to capture this particular sound in such a manner that it may be faithfully duplicated in your living room. This will be achieved only if the output voltage from the reproducer conforms in every respect to the input voltage to the disc recorder. This means that the recording and reproducing characteristic have to be carefully matched so that no change in frequency response is introduced between recorder input and reproducer output.

By definition "recording characteristic" is the actual recorded velocity plotted as a function of signal frequency with the input signal voltage to the disc recorder being held constant. With minor technical exceptions "recorded velocity" refers to the velocity of the lateral motion of the recording stylus as it cuts the record grooves. It should be noted that the recording characteristic as here defined applies only to item 3 of the recording channel and not to variable factors such as studio, microphones and special recording equalizers.

Lateral stylus velocity is represented by the expression $2\pi fa$, where "f" is frequency and "a" is amplitude. It follows then that a constant velocity recording has increasing groove amplitude (lateral swing of the groove) with decreasing frequency. Phonograph records are normally recorded with low frequencies reduced in velocity and high frequencies increased in velocity.

The decrease in low frequency velocity is introduced in order to limit the lateral groove excursions and thereby make more efficient use of the space on a record. The low frequencies are restored to their original volume by the reproducing system. The increase in high frequency velocity is introduced as part of a scheme to reduce surface noise when reproducing a record. The actual noise reduction is obtained by reducing the high frequency response of the reproducer. The amount of decrease is determined by the amount of increase in the high frequencies used in the recording so that they are reproduced at their original volume relative to the lower frequencies. The increase of high frequency velocity is possible in recording since these frequencies in music and speech are normally weaker than the lower frequencies.

The particular characteristic used for "New Orthophonic" recordings has been selected by RCA Victor engineers to provide a maximum reduction of all types of noise consistent with good pickup tracking at all frequencies.



The "New Orthophonic" characteristic (relative stylus velocity vs frequency) may be expressed as the algebraic sum of the ordinates of three individual curves which conform to the admittances of the above networks expressed in db.

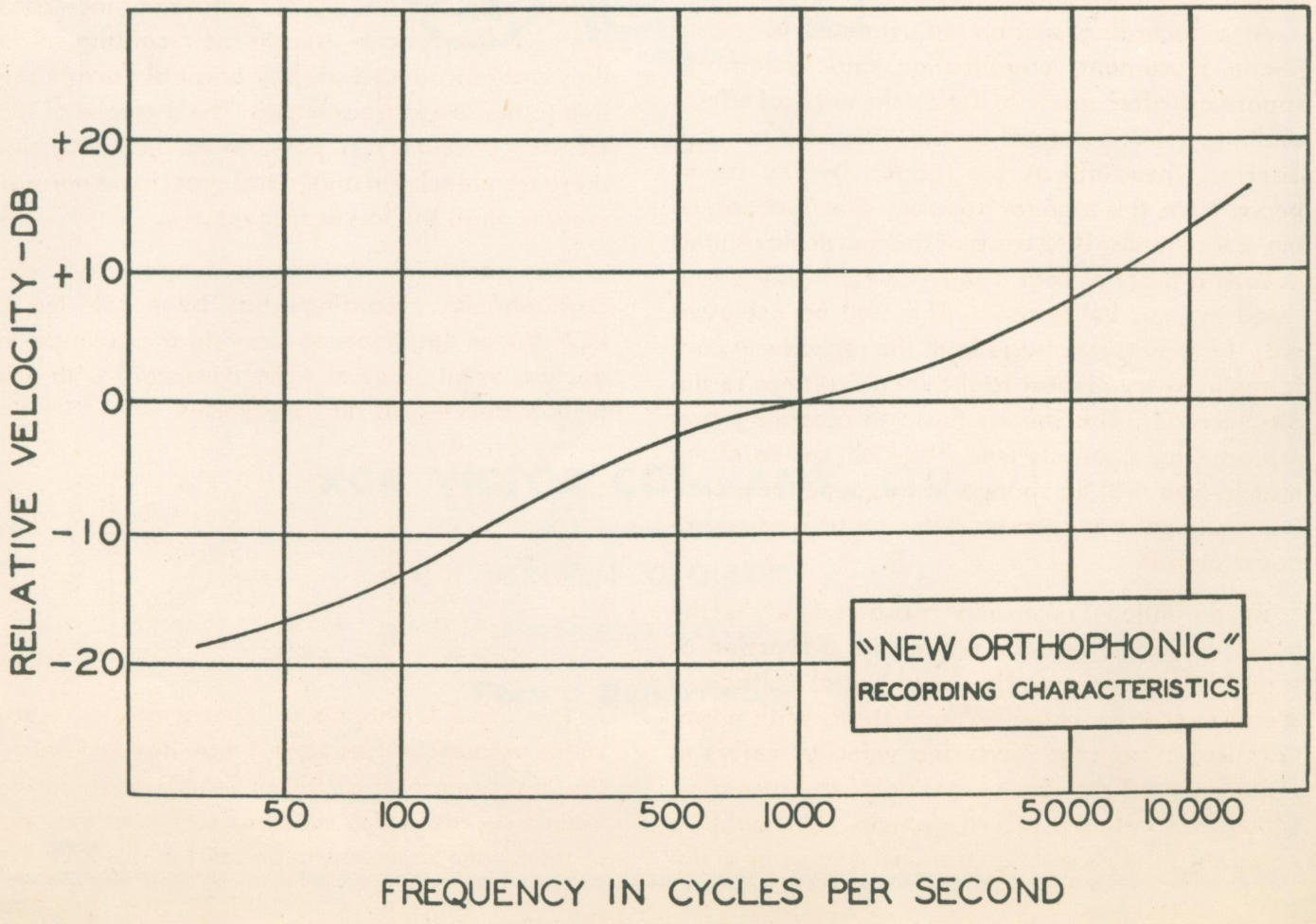
Briefly these curves are (1) 3 db low frequency boost at 50 cycles (2) 500 cycle crossover, and (3) 13.7 db high frequency preemphasis at 10000 cycles. A reproducer accordingly should be adjusted as close as possible to the inverse of these conditions, i. e. low frequencies increased in reproduction by the same amount that they are decreased in recording and vice versa for the high frequencies. This means that the crossover frequency should first be set at 500 cycles after which high and low frequency tone controls should be adjusted to give the desired response.

Relative velocities for the complete recording curve as shown on the graph below are as follows:

F	V—db	F	V—db	F	V—db
15000	+ 17.2	7000	+ 10.8	400	— 3.8
14000	+ 16.6	6000	+ 9.6	300	— 5.5
13000	+ 16.0	5000	+ 8.2	200	— 8.2
12000	+ 15.3	4000	+ 6.6	100	— 13.1
11000	+ 14.5	3000	+ 4.8	70	— 15.3
10000	+ 13.7	2000	+ 2.6	50	— 17.0
9000	+ 12.9	1000	0	30	— 18.6
8000	+ 11.9	700	— 1.2		

In order to facilitate compensation and adjustment of phonograph systems to the "New Orthophonic" characteristic, RCA Victor now has available a ten inch 33⅓ LP and seven inch 45 rpm frequency record; 12-5-49 and 12-5-51 respectively, recorded to the new characteristic. When using either of these records a properly adjusted system will produce the same voltage output at all frequencies from 10000 cycles to thirty cycles. Also included is a band of frequencies from 15000 to 10000 cycles for those interested in checking system response in this range.

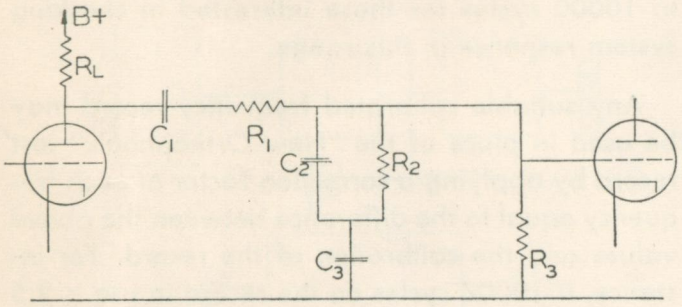
Any suitable calibrated frequency record may be used in place of the "New Orthophonic" test record by applying a correction factor at each frequency equal to the difference between the above values and the calibration of the record. For instance, if 10000 cycles on the record in use is 2.5 db below the 1000 cycle level, a correct output reading would be 13.7 + 2.5 or 16.2 db below the 1000 cycle level, and if 100 cycles is 14 db below 1000 cycles, a correct reading would be 0.9 db below the 1000 cycle level.



REPRODUCER EQUALIZATION FOR THE RCA "NEW ORTHOPHONIC" RECORDING CHARACTERISTIC

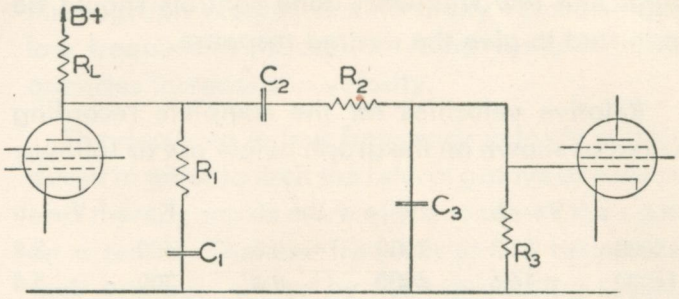
The following pentode and triode amplifier circuits when used with a high quality amplifier and magnetic pickup are recommended to obtain the desired basic reproducing characteristic. Minor amplifier tone control adjustment may be required to compensate for pickup characteristics.

Triode Equalizer:



C_1 = 0.1 mfd. R_1 = 470,000 ohms
C_2 = 0.0035 mfd. R_2 = 22,000 ohms
C_3 = 0.01 mfd. R_3 = 680,000 ohms

Pentode Equalizer:



C_1 = 0.02 mfd. R_1 = 15,000 ohms
C_2 = 0.1 mfd. R_2 = 100,000 ohms
C_3 = 500 mmfd. R_3 = 680,000 ohms