



RCA MANUFACTURING COMPANY, INC.

A RADIO CORPORATION OF AMERICA SUBSIDIARY

Harrison, New Jersey

RCA RADIOTRON
D I V I S I O N

APPLICATION NOTE No. 53
November 27, 1935
Reprinted May, 1937

APPLICATION NOTE
ON
THE 6L7 AS A VOLUME EXPANDER FOR PHONOGRAPHS

The ratio of maximum to minimum amplitudes that is feasible to record phonographically is not sufficient to take care of very large volume changes, such as may be produced by a symphony orchestra. For this reason, very large ranges in sound intensity are reduced in some way before the record is made. Such reduction, known as "compression," is usually accomplished manually by careful monitoring.

Most home phonographs have no provision for expanding the signal in order to compensate for the compression introduced at the time of recording. Hence, passages are distorted in the sense that they are not reproduced with full volume range. If full compensation for compression is desired, it is necessary to provide the phonograph with some means for increasing the amplification of loud passages in the same proportion that they were compressed at the recorder. However, if the volume control on the phonograph is set for reasonably loud volume on expanded passages, the residual noise level in the room may impair reception of soft passages when full expansion is used. Therefore, full compensation may not be desirable.

The characteristics of the type 6L7 tube permit its use in a comparatively simple volume-expander circuit. This tube has a heater, a cathode, five grids, and a plate. Two of the five grids are control grids; the first (G_1) has a remote cut-off characteristic and the second (G_2) has a sharp cut-off characteristic. Of the three remaining grids, two are screens and one is a suppressor.

The schematic diagram of a volume expander is appended. The signal to be expanded is fed to the remote cut-off grid (G_1) of a 6L7 and also to the input of a 6C5, as shown. The output of the 6C5 is rectified by a 6H6; the positive terminal of the rectified output connects to the sharp cut-off grid (G_2) of the 6L7. The no-signal bias of this grid is such that the G_1 -Plate transconductance of the 6L7 is low (under 50 micromhos). When a signal is applied, the rectified voltage fed to G_2 increases the trans-

Copyright, 1935, by
RCA Manufacturing Co., Inc.

AN-53-11-13-35
Printed in U.S.A.

conductance, and hence the gain, of the 6L7. This increase in gain is approximately proportional to the rectified diode voltage and, hence, to the signal amplitude.

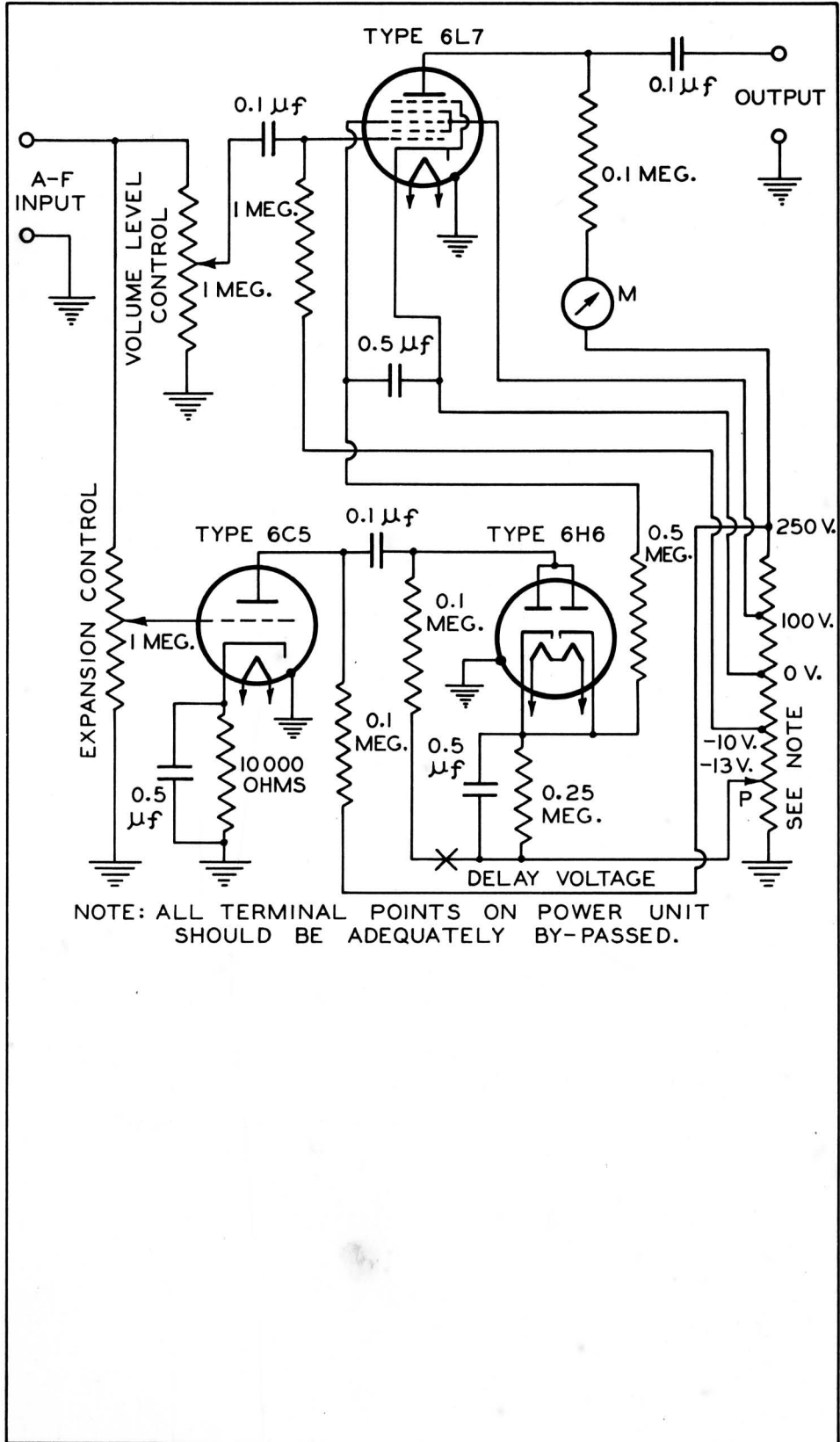
It is essential that the time constant of the circuit generating the control voltage be so adjusted that changes in this voltage occur only for comparatively slow changes in signal amplitude. If the time constant is too short, speech will sound particularly unnatural; if the time constant is too long, there will be an objectionable lag. A time constant of 0.25 to 0.5 second is generally regarded as a satisfactory choice.

Distortion of the signal due to the characteristic of the remote cut-off grid (G_1) is appreciable for large signals. Therefore, the maximum signal input to G_1 should be 1 volt peak, which is of the same order as that obtainable from the usual magnetic phonograph pick-up.

The plate-current value of the 6L7 serves as a good measure of the degree of expansion. It is suggested, therefore, that the initial bias on G_3 be adjusted for a no-signal plate current of approximately 0.15 milliamperes by means of potentiometer P. This potentiometer requires no further adjustment if the same 6L7 is always used. The plate of the 6H6 may be biased negatively in order to delay expansion until a predetermined signal amplitude is reached. This delay voltage may be inserted at point X.

Although this system can operate from a radio receiver to provide expansion, it is suggested that, at the present time, volume expansion be used for phonograph reproduction only. Since large unanticipated changes in sound level during a broadcast may not be adequately monitored, the expander will act to exaggerate these changes. It is not probable that such accidental changes will be present in a phonograph record.

VOLUME-EXPANDER CIRCUIT USING 6L7 TUBE



The license extended to the purchaser of tubes appears in the License Notice accompanying them. Information contained herein is furnished without assuming any obligations.