RCA Application Note

AN-188

Comparison of Picture-Tube Performance In Grid-Drive and Cathode-Drive Service

This Note compares the performance of picture tubes operated under cathode-drive and grid-drive conditions, and points out the relative advantages of each type of service. In addition, the Note presents curves of light output, and ultor current as a function of video drive from raster cutoff for both types of service. These comparisons permit the equipment designer to select the type of drive on the basis of individual requirements.

Cathode Drive versus Grid Drive

Many picture-tube types operate satisfactorily when a video signal having the correct polarity is applied to either the control grid (grid-No.1) or the cathode of the electron gun. The comparative advantages of each operating mode for a given gun design capable of operation in either manner are summarized as follows:

Grid-Drive Service	Cathode-Drive Service
Optimum beam focus retained.	Increased beam current and light output
Because the grid-No.2-to-cathode voltage remains constant, variations of the electric fields within the gun structure are minimized.	Because the grid-No.2-to-cathode voltage is also video modulated, the modulation sensitivity of the electron gun is increased.

The solid-line curves of Fig.1 compare the modulation (drive) sensitivity of an electron gun operated in grid-drive and cathode-drive service. These curves show the performance of a typical 17DSP4 picture tube, which employs one of the more widely used gun designs.

The dashed-line curves illustrate the influence which the voltage applied to the grid-No.2 electrode has upon the drive performance of the electron gun. The curves show that a given gun structure requires less video signal to provide a given beam current when a lower value of grid-No.2 voltage is used. However, operation of an electron gun at a lower grid-No.2 voltage normally results in some degradation of electron-beam focus because of the influence of the grid-No.2 electrode potential on the electric fields in the k-g_1-g_2 (cathode-grid-No.1-grid-No.2) region of the gun. These field variations in turn, result in a loss of picture sharpness and clarity. Moreover, lower grid-No.2 voltages cause some reduction in the maximum beam current which the gun can provide.

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Recently, a family of electron guns intended for cathode-drive service only was introduced. These guns were designed to minimize the problem of maintaining optimum beam focus in cathode-drive service while retaining the benefits of the cathode-drive system. Although

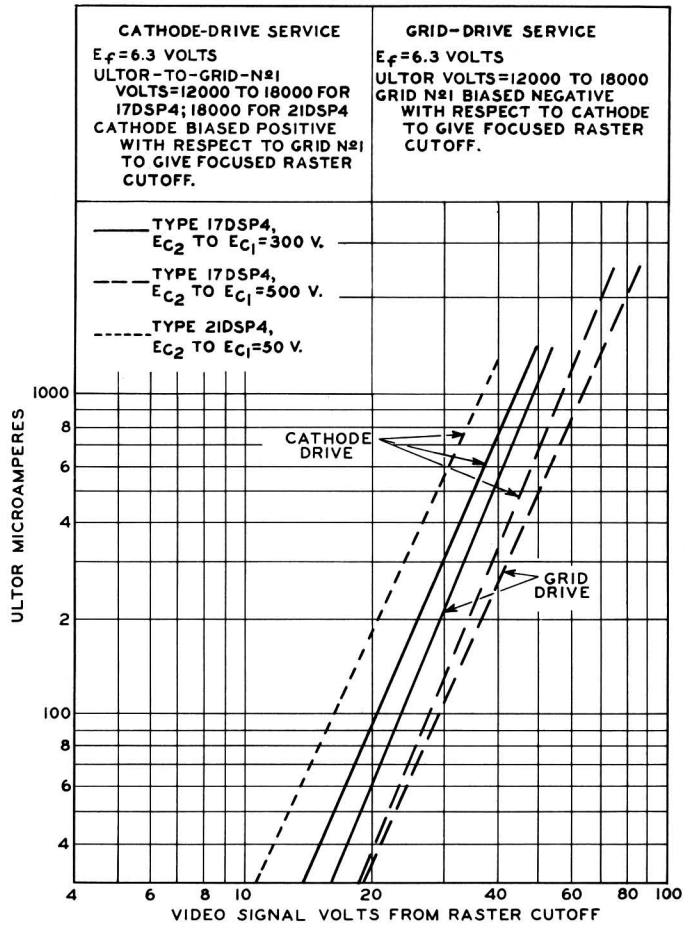

Fig.1 - Ultor current as a function of video signal volts from raster cutoff for both cathode-drive and grid-drive service.

this problem was not completely solved, commercially acceptable performance was obtained. In addition to improved beam focus, the operating voltage required by the grid-No.2 electrode was also significantly reduced. The dotted curve in Fig.1 shows the drive characteristic of picture-tube type 21DSP4 which utilizes a typical gun from this family.

Beam Current versus Light Output

Fig.2 shows typical curves of light output from a picture tube as a function of beam current to the phosphor screen. In the range from zero to 700 microamperes, beam current and ultor current are substantially equal; above 700 microamperes, beam current becomes increasingly less than ultor current. However, in the normal operating range, the curves of Fig.2 provide a useful guide if the following approximations are made, when all other factors are constant: For small changes of ultor voltage of the order of ± 3 kilovolts, provided the ultor voltage rating is not exceeded, light output is proportional to ultor voltage (proportionality factor may be approximated from Fig.2). For small changes in raster

area, light output is inversely proportional to raster area (raster width times raster height—not the quoted area for the non-rectangular picture-tube screen).

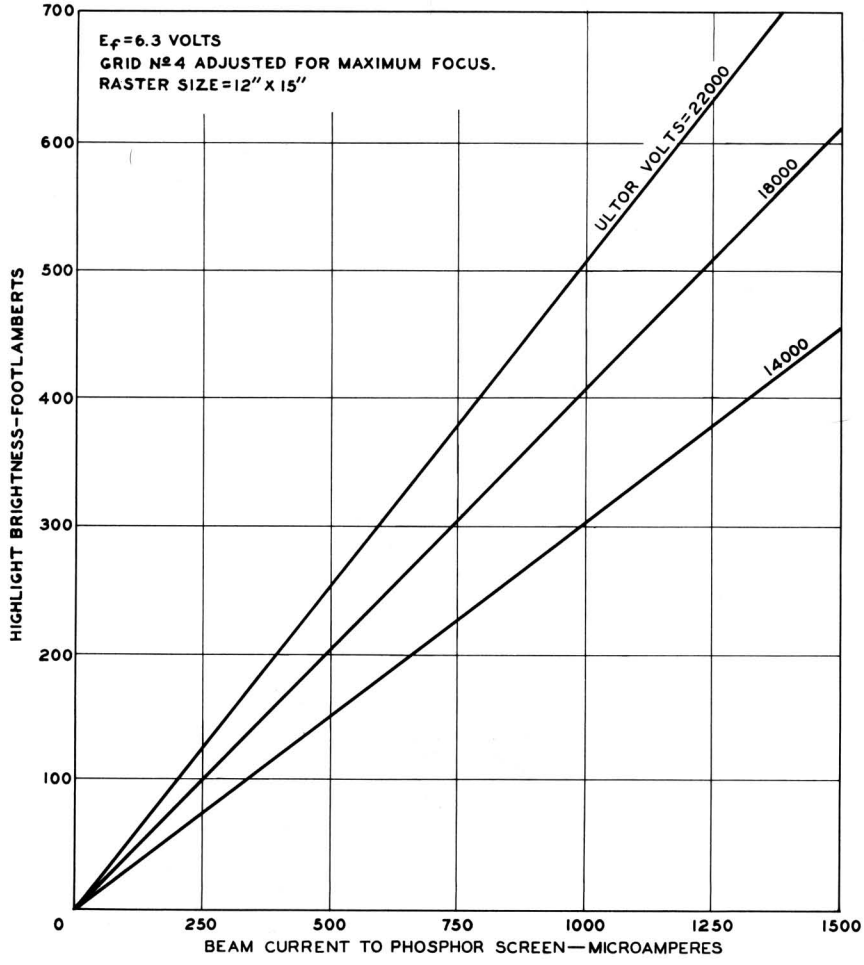

Fig. 2 - Light output as a function of beam current to phosphor screen for various values of ultor voltage.

Summary

In summary, Figs. 1 and 2 show that some increase in beam current and, consequently, light output can be realized from a given amount of video signal by use of cathode-drive service on a conventional gun. Further gain is possible through the use of a gun designed specifically for cathode-drive service. There is, in addition, a possible economic advantage in that the output requirements from the video-amplifier stage are reduced. However, some undesirable effects such as impaired beam focus and picture sharpness normally also result.

Because all these factors are subject to variation from one picture-tube type to another, and from one application to another, the equipment manufacturer should base his final decision upon electrical and visual engineering tests of the specific tube types and chassis designs under consideration.

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