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**SPOT PULSE WIDTH AND REPETITION RATE IN RASTER DOT
ALPHA-NUMERIC CRT PRESENTATIONS FOR
RECTANGULAR PULSES**

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TEPAC ENGINEERING BULLETIN No. 23-A

CRT
APPLICATION AND
REFERENCE NOTES

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ALPHA-NUMERIC CRT PRESENTATIONS FOR
RECTANGULAR PULSES

Prepared by

Frederick G. Oess

Member, JT-20 Committee on Opto Electronic Devices

SPOT PULSE WIDTH AND REPETITION RATE IN RASTER DOT
ALPHA-NUMERIC CRT PRESENTATIONS FOR
RECTANGULAR PULSES *

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* Obsoletes TEPAC Engineering Bulletin No. 23-1 "Spot Pulse Width and Repetition Rate in Raster Dot Alpha-Numeric CRT Presentations" dated February, 1980

A. PURPOSE

These notes explain how pulse width and repetition rate affect the spot configuration and brightness in alpha-numeric dot presentations. Some common errors in drive conditions and their effects on the display are also pointed out.

B. PRELIMINARY NOTES, EQUATIONS AND ASSUMPTIONS

To simplify this discussion, the following assumptions are made:

1. The beam density has a Solid Gaussian Distribution (SGD).
2. There is very little or no phosphor saturation.
3. The pulse is an idealized square wave.
4. Spot motion is horizontal and writing speed is constant.
5. The σ values given are those associated with the luminous cross-section of the fully written line.
6. The luminance response to beam current density is assumed to be instantaneous rather than possessing finite rise and decay times. This assumption does not affect the validity of the analysis.
7. The term "instantaneous luminance values" as used in these notes, designates the integrated instantaneous luminance values at the given repetition rate and writing speed and for the drive level and location relative to the beam center applying at that instant. Values used may be expressed in the time or the spatial domain.

The maximum or highlight luminance across a single, well separated CRT line is given by:

$$L_H = \rho_o E'_{VS} T \eta_S \frac{\sqrt{\pi}}{S} r_{(e^{-1})}^N = \rho_o E'_{VS} T \eta_S \frac{\sqrt{\pi}}{S} \frac{r_{(1-e^{-1})}}{.67726} N \quad <1$$

where:

L_H ----- is the highlight luminance in FL.

ρ_o ----- is the maximum beam current density within the beam in A/cm².

E'_{VS} ----- is the effective view screen voltage in Volts (actual view screen voltage relative to the cathode minus the screen breakthrough voltage).

T ----- is the transmission of the glass faceplate as a decimal fraction.

η_S ----- is the phosphor screen efficiency in FL/Watt/cm².

S ----- is the writing speed in inches/sec.

$r_{(e^{-1})}$ -- is the spot radius at the e^{-1} level of the Gaussian in cm.

$r_{(1-e^{-1})}$ is the shrinking raster spot radius in cm.

N ----- is the repetition rate in Hz.

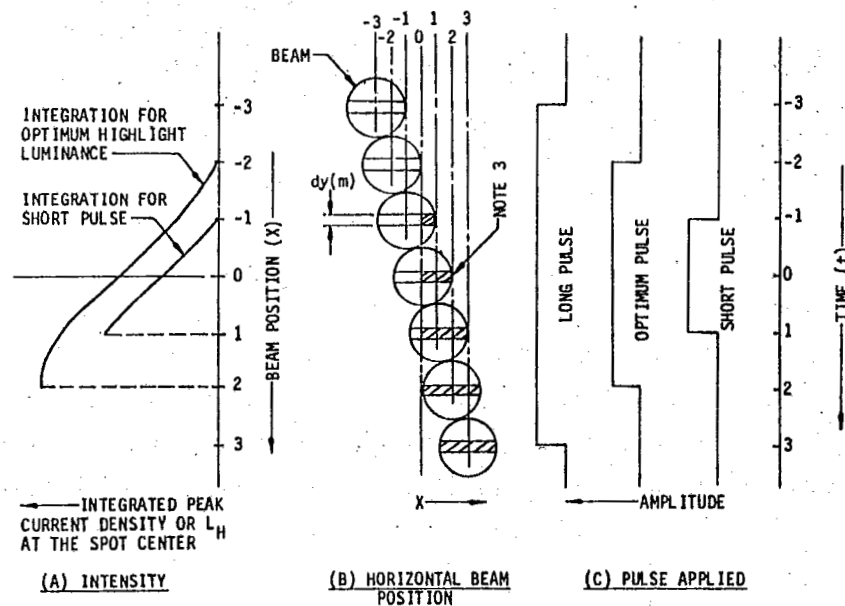
The equation will remain the same for all consistent dimensional systems.

C. THEORETICAL DISCUSSION

The objectives in dot writing are to:

1. Approach the maximum highlight luminance of the written line as nearly as possible (Equation 1) at a reasonably round dot configuration.
2. Prevent excessive elongation of the spot.
3. Avoid integration of the beam by too closely sequencing adjacent spots or line segments.

To investigate this problem one needs first to examine what occurs when a single spot is written using a moving beam. This is shown in Figure 1. The beam is assumed to be circumscribed by say, the 3σ level of the solid Gaussian. Although mathematically the SGD is infinite, the additional electron density contribution would be less than 0.3% compared to the integrated theoretical total light output, also physically the beam cross-section has, in the practical sense, a finite diameter.



- NOTES:
1. THE POSITION AND TIME POINTS COINCIDE AND ARE OF ARBITRARY DIMENSIONS.
 2. THE VERTICAL BEAM POSITIONS ARE PHYSICALLY COINCIDENT, BUT SHOWN EXPANDED IN THE TIME DOMAIN FOR THE PURPOSE OF ILLUSTRATION.
 3. THE SHADED AREAS SHOW THE DENSITY INTEGRATION AT THE CENTRAL AXIS OF THE SPOT IN THE DIRECTION OF MOTION.

FIGURE 1: CURRENT OR LUMINANCE INTEGRATION FOR A SINGLE SPOT AT A CRT SCREEN OR TARGET