HIGH SPEED, LARGE FORMAT FLATBED PHOTOCOMPOSITION SYSTEM

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I. Introduction

The CRT Flatbed Photocomposition System was developed to produce high quality cartographic plots and color separations on film at high speeds from digital data bases. The color separations are used to prepare press-ready printing plates for conventional multicolor presses.

Replacement of a standard optical photohead on a flatbed plotter table with a computer controlled cathode ray tube exposure head dramatically improves plotting throughputs and versatility for cartographic applications.

Four CRT Flatbed Photocomposition Systems recently delivered to government agencies have demonstrated reductions in plotting times from 20-200 times depending upon the data content and format. A typical complex chart 48" X 60" can be plotted on film in less than 30 minutes.

The CRT Exposure Head may be used for the composition and placement of names data and special symbology of graphic arts quality. Characters, alphanumerics, and symbols can be recorded in a variety of font styles and sizes ranging from 4-72 points and rotated on command in 1^{o} increments. Thousands of characters and symbols of many different styles may be put on-line. Line

widths may be varied at random from .002" to .256" and vectors up to 1" long may be rotated in 1° increments.

II. System Description

A typical CRT Flatbed Photocomposition shown in Figures 1 and 2 consists of several major subsystems; a CRT Exposure Head, a Flatbed Plotter Table; a Symbol/Vector Generator; a Computer Controller and associated software. The CRT Exposure Head and its associated control electronics are mounted on the "Y" carriage of a flatbed plotter table, as shown in Figure 1.

Cartographic plot and names/symbol data are generated with a computer controlled Symbol/Vector Generator in a 2" X 2" area on the face of the CRT and imaged through a 75 mm, f/4 lens at 1:1 to expose a 2" X 2" area on a large sheet of film attached to the flatbed plotter table.

The CRT Exposure Head typically exposes each 2" X 2" area in less than 1 second and then is moved and positioned to expose an adjacent 2" X 2" area as illustrated in Figure 3. The process is repeated until the entire sheet of film has been exposed to form a latent image of a map or chart. The film sheet is then removed from the flatbed plotter table and processed using conventional film processing techniques.

Figure 4 is a block diagram of a typical CRT Flatbed Photocomposition System.

Computer Controller - The exact configuration of the Computer Controller is not critical. It usually consists of a PDP11/34 or PDP11/45 basic binary minicomputer processor with a 16 bit word and 64K words of memory; a 9 track magnetic tape input system; a magnetic disk system with adequate capacity for storing all utility and operating software programs and a font library; I/O devices such as CRT and paper keyboard consoles; an interactive graphics storage display; a direct memory access interface to the Symbol/Vector Generator and a communications interface to the Flatbed Plotter Table Control.

Symbol/Vector Generator (SVG) - The SVG converts all digital data commands from the computer controller into analog signals which operate the CRT Exposure Head.

The SVG includes all of the circuitry for: (a) character and symbol generation and placement; (b) incremental plot and stroke vector generation; and (c) X-Y random positioning. All scaling of characters and symbols from 4-72 pts; rotation of 360° in 1° increments and line width control from .002" to .256" in .001" increments is accomplished with the SVG.

CRT Exposure Head - The CRT Exposure Head, as shown in Figure 5, consists of a high resolution, 5" diameter flat face CRT with P11 phosphor assembled in a magnetic shield with its electromagnetic focus and deflection coils and its optical lens. The CRT assembly with its control electronics chassis are mounted on a mechanical structure which interfaces to the "Y" carriage of a Flatbed Plotter Table.

Flatbed Plotter Table - Flatbed Plotter Tables used in present systems have been the Gerber Model 32 and the Concord Control E-113. Any high performance plotting table may be used provided it has a positioning accuracy of better than .0005", and a table surface flatness of less than $\pm$ .005".

The computer controller transfers position instructions to the Flatbed Plotter Table Control to position the CRT Exposure Head.

System Data Flow - Data flow for the CRT Flatbed Photocomposition System is illustrated in Figure 6. Input data to the system furnished on magnetic tape may be prepared in the CRT Photocomposition format with the user's host computer or may be in the user's standard plotter production data tape format which can be converted in real time or off-line using one of the conversion software packages supplied with the system.

For names or symbol placement, the input commands call out the type of character or symbol style, which are stored as digital font representations on magnetic disk, and transfer the font data to the minicomputer memory. Relative recording parameters such as size, angle and position are assigned to the character or symbol for controlling the Symbol/Vector Generator (SVG). The Symbol/Vector Generator generates the character or symbol of proper size, angle and location on the face of the CRT using a subraster. For plotting lines, arcs, and contours, the input data files supply

command codes to the minicomputer and the Symbol/Vector Generator for computing the position, the angle and width of the florescent spot on the CRT face. Line work can be plotted in incremental or stroke vectors depending upon the data content.

The Software Packages provided with a typical CRT Flatbed Photocomposition System are:
Operating System - for PDP11/34 or PDP11/45 minicomputer controllers is Digital Equipment Corporation's standard RSX11M multitasking system.

Vector/Symbol Plot (VSP) - is the principle plot program which controls all plotting; and all names and text composition and placement from input data tapes formatted in the Symbol/Vector Generator command code.

Font Library Update (FLU) - is the software package which is used to create digital font libraries on magnetic disks from properly formatted input font tapes. FLU can be used to add, delete, display or list symbol data and to perform minor editing on font data words.

Conversion Programs - Are real-time conversion programs developed for converting existing data bases in Gerber plot format into Symbol/Vector generator formats for controlling plotting.

Font Preparation - Digital Fonts are prepared with a stand-alone system from original artwork. Symbols or characters are scanned and digitized with a scanning optical beam, processed, edited and then formatted into a digital font input tape for the system. FLU is then used to develop and maintain a Font Library by storing two sizes of each font style on magnetic disk. All other sizes and orientation are produced with the Symbol/Vector Generator hardware.

Interactive Graphics Display

A Tektronix 4014-1 Interactive Graphics Display Terminal has been provided to allow viewing of the data being plotted; for software development; for previewing input data tapes and an alternate I/O peripheral for the system.

III. CRT Flatbed Photocomposition Output

Figures 7-12 are examples of output from the system.

Figure 7 is a recording of a typical graphic arts quality font stored on-line and used for Names Placement. Figure 8 is a recording to demonstrate the size and rotation control of the Symbol/Vector Generator. Figure 9 is a composite plot showing line work, contours and annotation.

Figure 10 is composite plot made up of vectors of different lengths and widths.

Figure 11 is a section of a 20" X 30" chart of the United States which was plotted in less than 20 minutes. Figure 12 is a section of a 48" X 60" chart which was plotted in less than 30 minutes.

The CRT Flatbed Photocomposition System output demonstrates the system's versatility and high throughput for large format charts and maps. This gives the cartographer the ability to produce complex cartographic products quickly and accurately.

IV. Acknowledgements

This work was sponsored by U.S. Army Engineering Laboratories, Fort Belvoir, Virginia, Defense Mapping Agency and the Central Intelligence Agency.

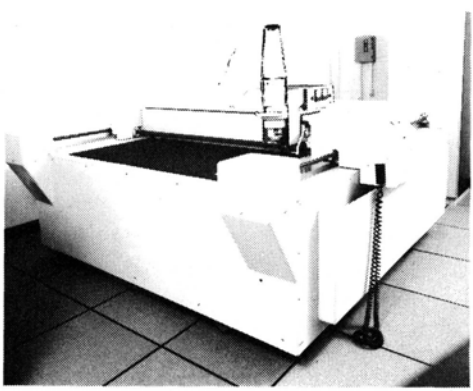

Figure 1 CRT Exposure Head Mounted on Flatbed Table

Figure 2 Computer Controller

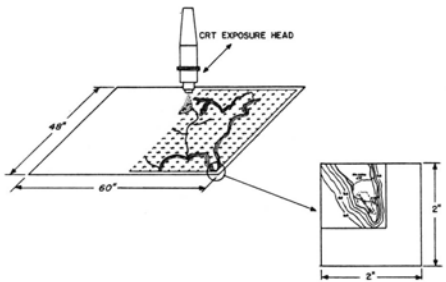

Figure 3 CRT Exposure Process

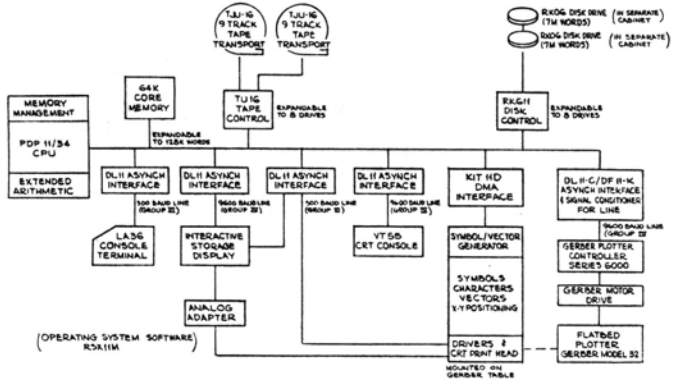

Figure 4 Block Diagram of a Typical System

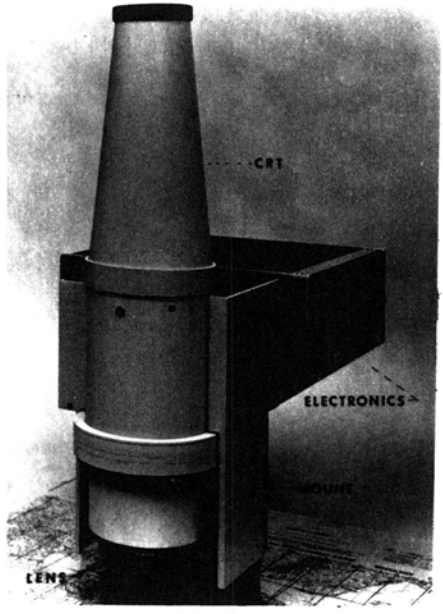

Figure 5 CRT Exposure Head

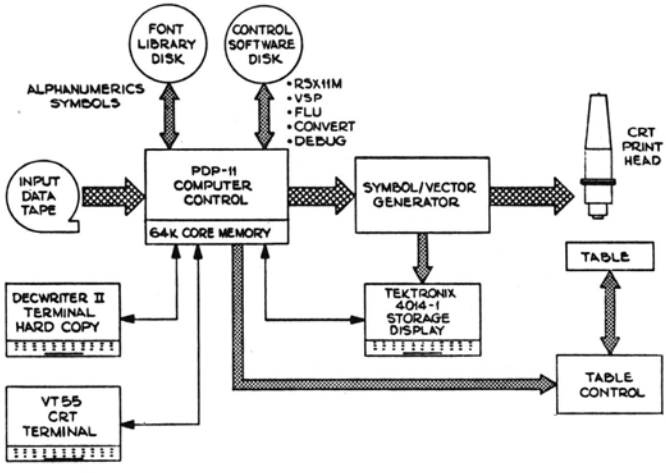

Figure 6 System Data Flow

ABCDEFGHIJKLM
NOPQRSTUVWXYZ
abcdefghijklm
nopqrstuvwxyz
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"#±%&'()½¼!

Figure 7

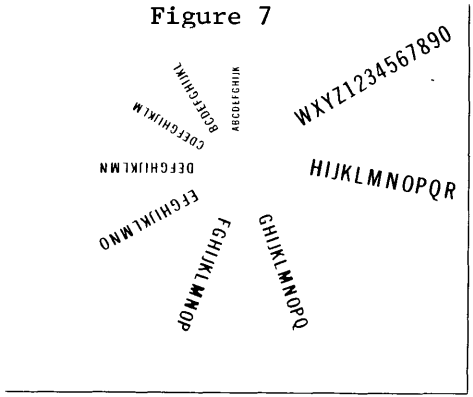

Figure 8

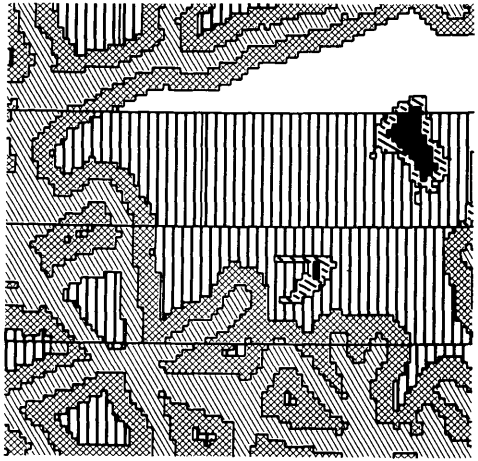

Figure 10

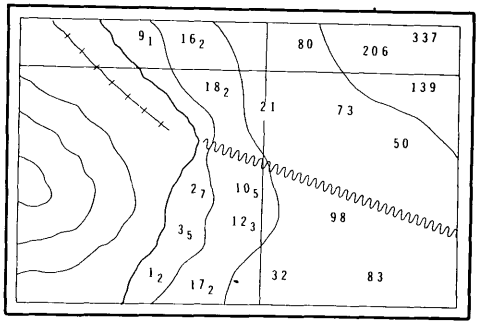

Figure 9

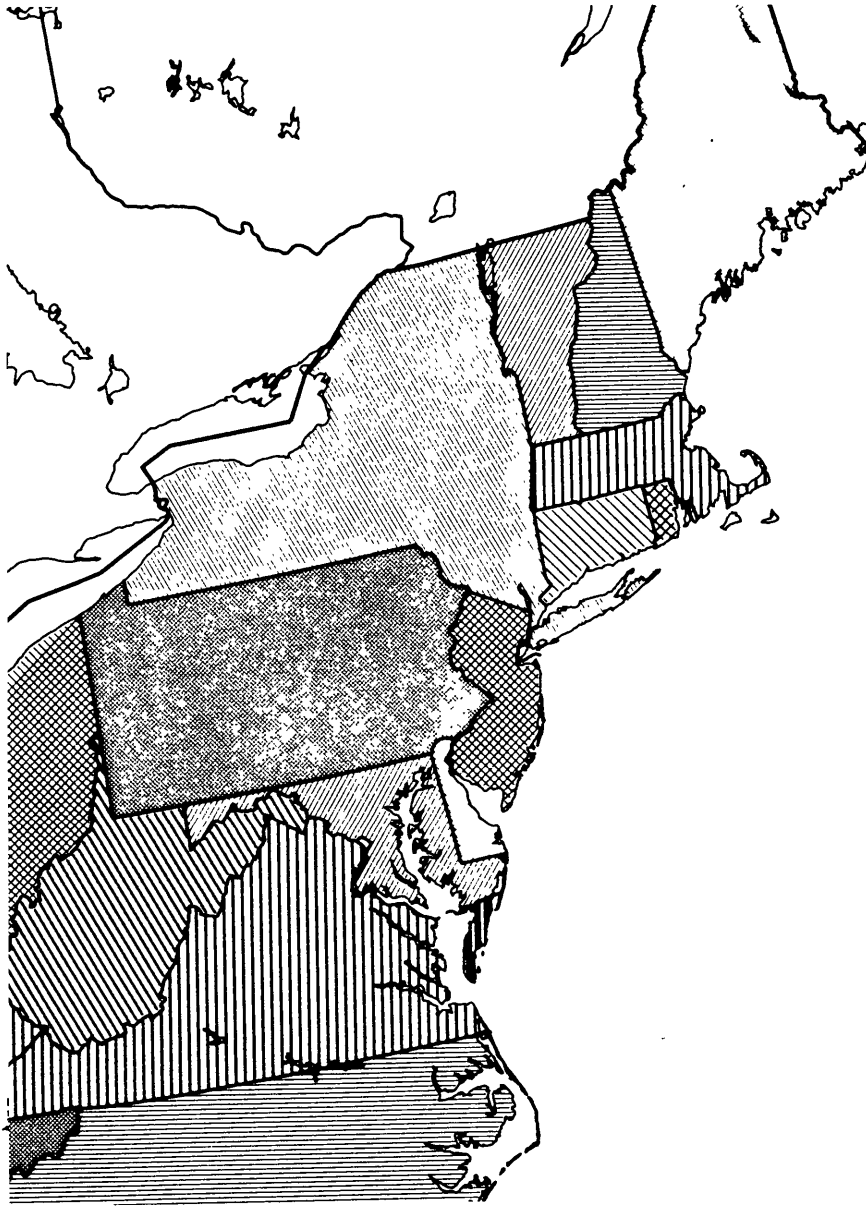

Figure 11 Portion of 20"X30" Chart

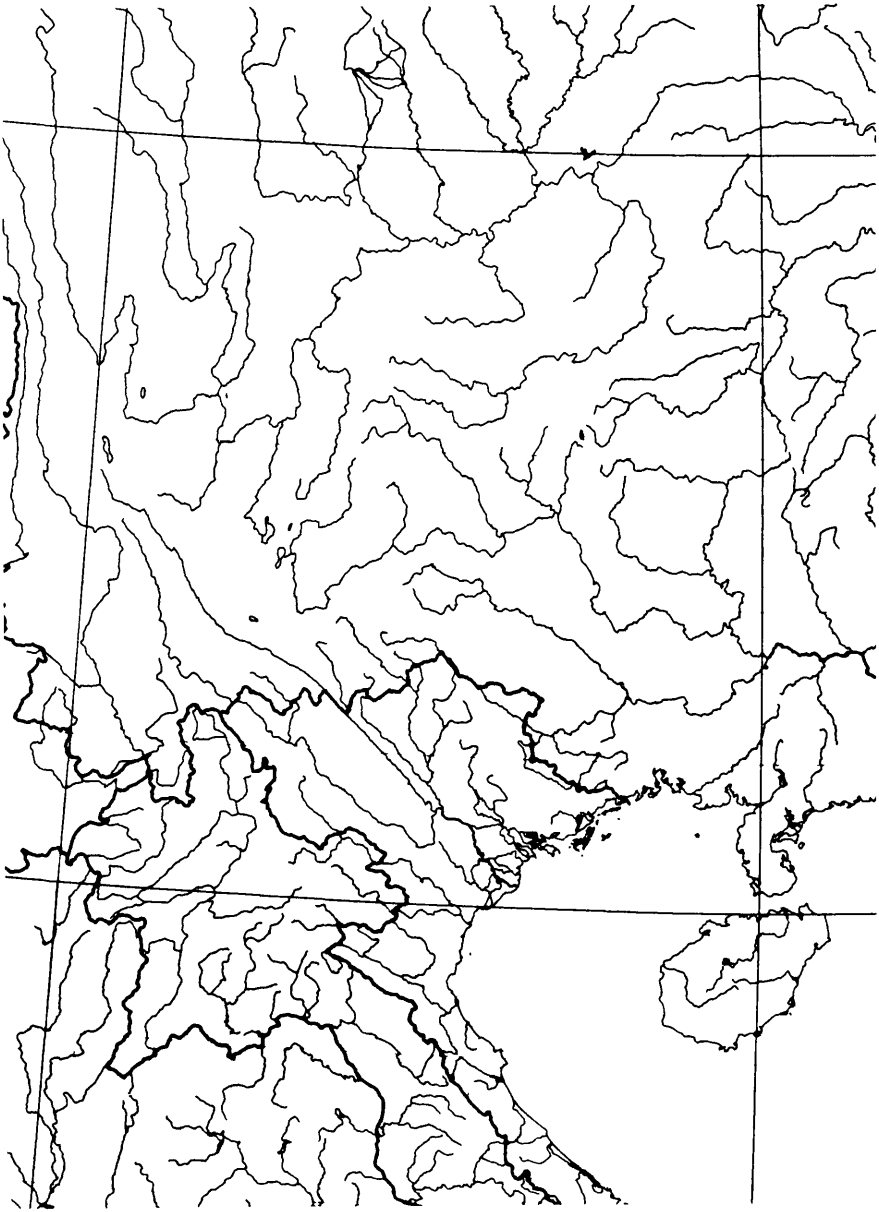

Figure 12 Portion of 48"X60" Chart