COMPUTER TECHNOLOGY

VT125 graphics hardcopy on an Epson MX-80 serial printer for RT-11 and TSX-Plus

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A collection of computer programs is presented that allows the user of a DEC VT125 graphics terminal to generate hardcopy of REGIS graphics on an inexpensive Epson MX-80 serial matrix printer. These programs allow easy production of hardcopy graphics without the user's having to purchase more expensive devices.

The availability of computer graphics terminals, such as the Digital Equipment Corporation Model VT125, with REMote Graphics Instruction Set (REGIS), has enhanced the data analysis and display capabilities of the researcher. However, relatively expensive devices, such as a DEC LA34 printer or a video hardcopy unit, have been required in order to generate hardcopy of REGIS graphics. The collection of FORTRAN computer programs presented here will allow the user of a DEC VT125 graphics terminal to generate REGIS graphics on an inexpensive Epson MX-80 serial matrix printer.

The Epson MX-80 printer, which retails for less than \$500, is one example of a number of versatile serial dot-matrix printers produced by various manufacturers for the personal and small computer market. It can print text in 80 or 132 columns (compressed characters) at 80 characters/sec. This speed is enhanced by bidirectional logic-seeking movement of the print head. In addition to several formatting options (such as underlining, wide characters, superscripts, and subscripts, the Epson MX-80 is available with a graphics option (called GRAFTRAX) which permits the computer to place dots anywhere within a 480 x 792 dot matrix on 8.5 x 11 in. paper. Many other printers have similar price/performance characteristics.¹

The VT125 terminal produces graphical displays when it receives commands in a special graphics protocol called REGIS. REGIS commands allow the user to send graphing instructions to the terminal, instructions such as change position, draw vectors, curves, circles, and arcs, display text in various sizes, orientations, and tilts, and modify certain parameters of subsequent graphing operations, such as what color (or shade of gray) to use or whether to erase portions of a graph. The VT125 terminal interprets the REGIS commands and produces

an image in response to the commands. The resulting graphics image information is stored locally in the terminal and can be retrieved in a format different from REGIS, known as "bit-map graphics DECwriter descriptor" (referred to as "bit-map graphics").

The bit-map graphics data are typically intended for direct transmission to an interfaced DEC LA34 printer, which can translate the specially encoded data into a hardcopy plot. However, although the Epson printer and many other serial printers also can perform bit-map graphics, that is, can individually control the pins in the dot-matrix head and place a single dot anywhere on a page, these printers do not conform to the DECwriter descriptor format.

The programs in this VT125-to-Epson package perform the two essential functions required for hardcopy graphics. One group of programs displays a REGIS graph on the terminal, retrieves the bit-map graphics data from it, and stores the data on the disk. The other group of programs manipulates these bit-map graphics data, translates them into the graphics format required by the Epson printer, and prints them out on paper.

The programs are intended for use on a DEC PDP-11 computer using either the RT-11 or TSX-Plus operating systems. With the RT-11, a subset of the programs can be used to store the bit-map graphics produced by the VT125 terminal, recall a previously stored graph, and optionally produce a hardcopy. However, greater utility can be achieved in conjunction with the TSX-Plus time-sharing system through which the user can interactively or automatically initiate hardcopy plots of whatever graphics are currently displayed on the VT125 by issuing a single command. Furthermore, a FORTRAN subroutine that can cause a hardcopy of the current graph to be initiated from within a program is provided. This feature is particularly useful for generating automatic (unattended) hardcopy plotting of numerous plots within a FORTRAN program that uses the REGIS Graphics Library (RGL) software available from Digital Equipment Corporation.

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Figure 1. This is an example of the hardcopy graphics produced using a DEC VT125 graphics terminal and an Epson MX-80 printer in conjunction with the software package described in the text. Figure 1A illustrates the small-format hardcopy (which took 3 min to produce), and Figure 1B illustrates the full-page large-format hardcopy (which took 7 min to produce).

Two hardcopy output formats are available: small (4.5 x 8 in.) (see Figure 1A) or large (8 x 11 in.) (see Figure 1B).

HARDWARE REQUIRED

A PDP-11 (or LSI-11) computer system with at least

32K words of memory and mass storage is required. The RT-11 operating system is also required. A DEC VT125 graphics terminal and an Epson MX-80 serial printer with bit-map graphics (GRAFTRAX Plus) and serial-interface option (RS-232) are also required. Other serial matrix printers with bit-map graphics capability may be substituted for the Epson when appropriate changes

are made in the software. Instructions that aid the user in adapting the programs to use printers other than the Epson are provided in the documentation.

The automatic plotting feature provided by the programs when used with TSX-Plus requires that, in addition to the console line connected to the communication port of the terminal, a serial RS-232 line be connected to the auxiliary port of the VT125 terminal.

OTHER SOFTWARE REQUIRED

RT-11 V4 is required for operating the programs, and FORTRAN IV is required if the user wishes to make any changes in the programs. TSX-Plus is optional and, if available, permits greater flexibility and ease of use than does the RT-11 version alone.

To enable the user to compile and relink the programs, if needed, a library of FORTRAN-callable special TSX-Plus system calls, TSXLIB, available as DECUS 11-490 (Bourgeois, 1982), is included with this package. However, the user should refer to DECUS 11-490 for full documentation.

Note that the serial line-printer handlers provided with RT-11 and TSX-Plus are not compatible with graphics generation on the Epson MX-80. Appropriate modified handlers for both systems are provided in both source and runnable form in this package. Command files are provided to facilitate the incorporation of the handlers into the users' systems.

SOFTWARE PACKAGE DESCRIPTION

The VT125-to-Epson hardcopy graphics package consists of a number of components. RT-11 uses a subset of the components, whereas TSX-Plus utilizes the entire

package. With the exception of one MACRO-11 subroutine, all programs are written in FORTRAN IV. There are 11 FORTRAN programs and subroutines consisting of approximately 1,500 lines of source code and 31 miscellaneous elements including supporting documentation. The package of programs occupies 573 blocks of disk storage, although only 286 blocks are required for the executable form of the program (plus an additional 105 blocks of temporary disk storage when a large-format graph is being generated).

Detailed descriptions of the programs and their interrelationships are provided in the user's manual included in the package.

PROGRAM AVAILABILITY

The programs, in both source and executable form, and all necessary documentation are available on floppy disk from the author. To receive a copy of the programs, the reader should send an RX02-compatible, double-density, single-sided 8-in. floppy disk to the author.

REFERENCES

- BOURGEOIS, N. A. A library implementation of programmed requests for TSX-PLUS. *Digital Equipment Corporation Users Society Program Library: PDP-11/VAX Software Catalog*, 1982, 11-490, 132.

NOTE

1. The author's choice of the Epson printer does not necessarily indicate that it would be the best choice for all other users. Individual needs and resources available are important factors to consider before the purchase of any equipment.

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