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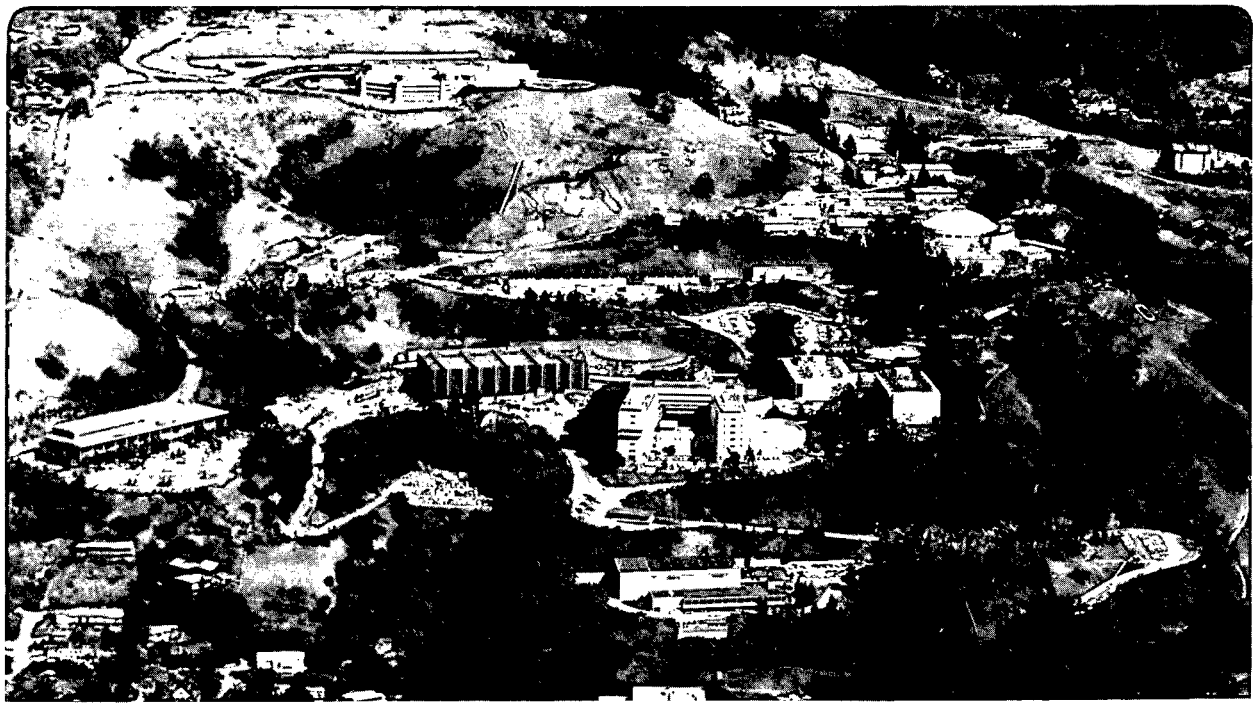

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GRAFPAC on VAX/VMS

LBID-327

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Standard GRAFPAC Drivers and Modules on the VAX

Name	Function	Availability
REVC3	Review C3 metafile	yes
OPN	Open (multiple devices)	yes
SWT	Switch (between devices)	yes
D	Dummy entry points	yes
VLTR	Vector characters	not yet
AID	Interactive and misc. aids	yes
TK	Tektronix 4014 driver	yes
TX	Tektronix 4012 driver (use also for ADM-3A with Retrographics board)	yes
T7,TF	Tektronix 4027 drivers	yes
NG	Non-graphics terminal driver	yes
FB,F4	ISI frame buffer drivers	*
R1	Ramtek 9400 driver (Tektronix 4027 style)	yes
R2	Ramtek 9400 driver	yes
R3	Ramtek 9400 driver	not yet
CI	Metafile (version 2) driver	yes
C3	Metafile (version 3) driver	yes
DC,DS, DL,D6	Dicomed D-48 drivers	yes
PR	Line printer driver	yes
VA	Varian plotter driver	yes
ZE	ZETA 4-pen plotter (33-inch)	yes
ZT	ZETA 4-pen plotter (10-inch)	yes

* other versions available, but not in standard form

This GRAFPAC system corresponds to the BKY system of March 15, 1979, and is fully described in the current GRAFPAC document available on PSS (library Writeups, subset Grafpac).

The list of modules and drivers above overlaps considerably with the system familiar to BKY users of GRAFPAC and IDDS. The list includes drivers for those devices known to be available and useful on CSAM's VAXes at this time. The list is expected to expand as more types of terminals and other devices are attached to VAXes.

The 'NG' driver was known as 'TT' on the BKY system. Its name has been changed to reflect its real purpose (and to avoid some unpleasant misunderstandings by VMS).

'REVC3' and 'C3' are equivalent functionally to the DD-Review package on BKY. The C3 driver puts out a metafile ("coded intermediate, version 3", hence "C3") of a different format than the DD file format. REVC3 is the program which reviews C3 files. REVC3 and C3 are available on both the VAXes and on BKY, so that C3 files can be created on one system and reviewed on another. Note: REVC3 and C3 were released on LBLG in December, 1980, but will not be available on BKY until January, 1981. The metafile/review programs allow graphics produced on a VAX to be plotted on the Calcomp plotters, etc. (which are not directly available on the VAX). You would link the C3 driver with your VAX program, run it to create a C3 metafile, which would be processed for BKY and copied to tape. The tape would then be read on the 6600 (or 6400) computer creating an input file ('CAMERA') for Review. You would then run REVC3 on any of the BKY computers, linking the appropriate drivers - CC etc. to get graphics output unavailable directly on the VAX. The inverse process would allow C3 files generated on BKY to be transported via tape to the VAX, reviewed with a driver unique to the VAX, such as the T7, or R2.

A previous metafile format was "CI" (coded intermediate, version 2). CI is available on the VAXes and on BKY, but will be phased out in 1981 sometime. REVC is available on BKY to review CI files.

The CI(C3) driver has proven to be too expensive (in terms of the size of the output file) for some applications, in particular, complex shaded maps. In fact, the use of CI(C3) can crash a VAX. To alleviate this problem, ZETA drivers have been made available on the VAX (both ZE and ZT). The output file will be an ASCII file to be written to tape, and then read on BKY (just as for a CI file), and then directly submitted for ZETA plotting, without going through the Review program.

SUBROUTINE TVDEF

All Grafpac drivers on the VAX support the entry point TVDEF, which resets all Grafpac parameters and the system state in general, to default values. TVDEF is called initially by TVINIT, and may be called at any time by the application programmer.

RASTER PRIMITIVES

Grafpac now supports a user-defined "virtual raster space" through the addition of some raster primitives. This capability exists in addition to the vector/text/area-fill primitives and calligraphic virtual space (known as "world coordinates") already existing in Grafpac. The virtual raster space ("VRS") will be

supported on raster devices only (i.e. Ramtek and Dicomed). Other drivers will permit the new entry points and parameters, but no action will result. The virtual raster space concept will allow use of raster devices in a direct raster mode. Since the full calligraphic capability will co-exist, vector and raster images can be adjacent or superimposed on the same frame. Vector images can be oriented relative to the VRS in a device-independent way.

The user specifies to Grafpac the dimensions of the virtual raster space in terms of virtual raster columns x rows, e.g. 4096x4096 or 512x480. By default, the pixels (picture elements) are square and closely packed, although some devices allow user-defined variations. If not specified explicitly, a default VRS equal to the physical raster surface (PRS) will be set up by Grafpac when the first raster primitive is invoked. The Grafpac call

```
CALL TVVRS (NX, NY)
```

will set up a virtual raster space with nx columns and ny rows. The (integer) coordinate system will range from 0 to nx-1 in X and from 0 to ny-1 in Y.

Grafpac will map the user's virtual raster space in the physical raster space available on the device. The image will be as large as possible; it will be right- and bottom-justified; the scaling will not distort the aspect ratio. For example, a user-specified VRS of 512x512 on the Ramtek 9400 will produce a right-justified image of resolution 1024x1024. Obviously, it is most efficient for the user to use the minimum virtual resolution adequate for the application, to minimize Grafpac overhead.

Grafpac's NDC coordinates will be adjusted to reflect the VRS to device mapping selected. [0.0, 1.0] in NDC space will correspond to the shorter dimension of the VRS. You can inquire the NDC limits of the VRS by using TVINQ to inquire on XNDCMX and YNDCMX (one of which is guaranteed to be 1.0).

In mapping the VRS to the surface, the virtual pixels will be **centered** on their pixel location. This will require adjustment of the mapping of the default NDC space limits to the physical device, as well. That is, the default 0-1 NDC square will get slightly smaller since the outer pixels are centered on its outline, but must still fit on the physical surface. This effect is minimized by using small virtual pixels. The maximum NDC coordinates allowable can be inquired by call TVSTAT with arguments 'NXMN', etc. This capability has already been introduced in some drivers; note that calling TVVRS simply causes the numbers which are returned to change.

The color model used in the raster mode is specified through "NRCOLR", analogous to NVCOLR, NACOLR, etc. TVSET and TVINQ accept new argument "nrco" to specify raster color model HSI or RGB or a named color. The default for NRCOLR will be "comp".

There are currently two raster primitives, TVRSTD (for densities) and TVRSTC (for HSI/RGB colors). Both of these subroutines output a sequence of virtual pixels of specified color/density beginning at a specified location in VRS.

```
CALL TVRSTD (irx, iry, d, n)
```

will output n virtual pixels in the current named color. The ith virtual pixel has density d(i). The starting location is (irx,iry) in VRS.

```
CALL TVRSTC (IRX, IRY, C1, C2, C3, N)
```

is similar, except that NRCOLR must be HSI or RGB, and C1, C2, C3 are arrays of length n giving the hsi or rgb colors.

Future expansion includes access to the color look-up table capabilities (both hardware and software currently under development for the Ramtek and Dicomed). Watch this space!

Using the VARIAN Printer/Plotter

A driver (VA) is available for the 14-inch Varian Statos printer/plotter on LBLG. Some of the features of this plotter are: upper-case hardware characters of many sizes, boldface characters, lines of variable width, shaded polygons, etc.

The following will change, but for the time being, to output a Varian file already created by a Grafpac program, do (on LBLG):

```
$ run dba0:[graphics]varian
ENTER FILE NAME: for010.dat
```

You type the name of your Varian file, when prompted. The process must have write access to the file. If any message appears before 'ENTER FILE NAME', then there is a problem --- either, the driver was not loaded at the last system start, or the plotter is already in use. Retrieval of Varian output is strictly self-service. The plotter should always be left with the power ON and ON-LINE.

The Varian supports polygons which are shaded with either a solid gray of variable intensity or one of several patterns (hatching, diagonal lines, etc). To draw a shaded polygon, do

```
CALL TVPOLY (X,Y,N)
```

where X and Y describe an open polygon of N vertices (i.e. X(1) . ne. X(N)). The type of area-fill is controlled by using the TVSET subroutine to set a value for area-density or area-color. The area-density can range from 0.0 (empty interior) to 1.0 (black interior), with approximately 10 useful values. For example,

```
CALL TVSET('aden', 0.5)
```

would specify a solid gray interior of average density (this is the default). The special patterns are controlled by specifying the 'area-color' parameter. The colors black, white or 'comp' (the default) mean no pattern is selected (gray level instead). Patterns are selected by using the colors red, green, blue, cyan, magenta, and yellow. For example, to fill an interior with small circles, do

```
CALL TVSET('naco','yell')
```

The Varian also supports boldface characters and thick lines, which are controlled by setting paramters 'cdens' and 'vdens', respectively. The hardware character sizes available are multiples of 0.07 inch (envelope width). The plotting surface is 14 inches wide, so the smallest size is KSIZE=200, the next is KSIZE=100, etc.

A Varian sampler is posted which displays the different possibilities for lines, characters, and polygons.

HOW TO USE THE DICOMED DRIVERS

GRAFPAC drivers for LBL's new DICOMED D-48 B&W and color film recorder are now available for use on LBLG and LBLH.

These drivers are a substantial re-write of previous BKY versions, and produce more compact D-48 files, with minimal time-consuming filter changing. They are also more powerful, providing some new features: line style (LSTYLE=0,...,9); and "hardware" characters (which support arbitrary size, spacing, and angle values) which are actually vector characters generated when the film is being recorded. Note that on the VAX, only the "complete" GRAFPAC drivers are available, i.e. all VAX drivers support area filling in TVPOLY.

Special Features of the DICOMED Drivers:

1) Seven Fortan logical units are required for scratch files. The defaults are units 70-76 (logical names FOR070-FOR076). To change these units, use:

```
CALL TVSET('SCR1',integer unit #)
CALL TVSET('SCR2',integer unit #)
        etc.
```

2) A formatted dump of the GRAFPAC output file, which is useful in analyzing a GRAFPAC problem, can be obtained on Fortran unit n by doing:

```
CALL TVSET('idbg',n)
```

The default value is n=0 (no dump output). The debug output can be dynamically started and stopped using TVSET calls. No more than 3000 lines will ever be printed in a single run.

3) There is a new GRAFPAC entry point TVDEF, which resets GRAFPAC parameters and attributes to their default values (including file names, etc.) If there is signficant interest, this subroutine will be added soon to other GRAFPAC drivers. (If there is no interest, it will be added at my convenience sometime in the future anyway!)

4) There is a new GRAFPAC entry point TVSTAT, which returns various kinds of status information about particular drivers. Currently implemented on the Dicomed is the ability to find out the minimum and maximum permisable NDC values. These numbers have previously been available only in tables printed in documentation (see the table which follows). Now they can be retrieved by your program. The calling sequences are:

```
call tvstat('nxmn',x1)
call tvstat('nxmx',x2)
call tvstat('nymn',y1)
call tvstat('nymx',y2)
```

5) There are currently 4 flavors of DICOMED driver, with possibly more to come. Each flavor corresponds to a set of camera/film configurations.

DC - 35mm, comic "full-frame":

displays the largest possible slide
D6 - 16mm cine
DS - 4x5 sheet film, Poloroid (prints)
(square image)
DL - 4x5 sheet film (Lantern slides)
(or rectangular Poloroid image)

VIEWPORT PARAMETERS TO USE MAXIMUM PHYSICAL VIEW SURFACE

	DC	D6	DS	DL
XNDCMN	-0.48	-0.2	0.0	-0.25
XNDCMX	1.0	1.2	1.0	1.0
YNDCMN	0.0	0.0	0.0	0.0
YNDCMX	1.0	1.0	1.0	1.0

These numbers can be obtained by your program calling TVSTAT (as described above).

Other possible configurations, which do not currently have their own driver, are as follows:

1) 35mm comic, "full resolution". To produce a 35mm slide which uses the full 4096x4096 resolution of the D-48 (but not the largest image on film). If there is enough use, a DF driver will be created, but for now use the DS driver, and

```
call DCBGN
call DCHDR
```

after TVINIT in your program to create a header frame. Otherwise the operator won't know whose film it is when it comes back from the developing shop.

2) 35mm cine. To produce 35mm movies. Not currently available.

3) Microfilm (105mm) formats: Use any Dicomed Grafpac driver. It may be necessary to do extra frame advances.

4) To produce a rectangular rather than square image on Poloroid (Carte users!) use the DL rather than the DS driver. The minimum x NDC coordinate is -0.34, rather than the -0.25 returned by TVSTAT for lantern slide makers.

6) Color vs Black-and-White:
Any of the drivers can be used for B&W output, as well as color. The default colors are "comp" (as usual), which in this case is white on black. When you submit your tape for processing, you must specify color or black-and-white film. Microfiche is black-and-white only, and 4x5 sheet film is color only.

HOW TO RUN WITH THE DICOMED DRIVERS

1) Load the GRAFPAC driver for the film/camera configuration you want in the usual way on LBLG or LBLH (they are in library form),

i.e.:

```
$ LINK    ...,dba0:[graphics.grafpac]DC/lib
                (or DS, DL, or D6)
```

2) Note that these versions have been compiled to allow running under DEBUG control (at the cost of running non-optimized code).

3) The output (FOR010 by default as usual) will be a binary file. Eventually there will be some kind of "Dispose Dicomed File to Queue for Processing" command available on LBLG and LBLH, but for now users will have to write tapes and submit them for processing themselves. The future will also bring an accounting scheme. It is hightly recommended that users batch their files to minimize the number of tapes handled at the D-48. The following sequence of commands will write a Dicomed tape:

```
$ alloc mta0:
$ mount/foreign/dens=1600 mta0:
$ run dba0:[graphics.grafpac]wbtape
```

You will be prompted for the file name(s).

4) To get a Dicomed tape processed, submit the tape at the I/O counter and fill out the form provided. Output will be returned to the I/O Counter (50B-1232).

ONE FINAL NOTE

Producing Dicomed frames can be very expensive, both in the computer time to execute your program, and in the size of the output files generated. Lines, characters, and the "named" colors produce small files; polygons and HSI or RGB colors produce potentially enormous files. Start small: one or two frames at a time, before jumping into the movie-making business on a large scale.

Using the Ramtek 9400

Several drivers exist for the Ramtek 9400 frame buffer. The R1 driver emulates the Tektronix 4027; i.e. it uses the 64 colors available on that terminal. The R2 driver uses an HSI color space which contains 2048 colors. The current version provides 64 hues, 4 levels of saturation and 8 levels of intensity. The R2 driver is also faster than the R1 driver, and should normally be the one to use. The Ramtek drivers provide the new Grafpac raster functions also. The Ramtek drivers have the TVDEF and TVSTAT entry points referred to in the section on Dicomed drivers, above. They also provide user-settable background color, using TVSET, as on the Tektronix 4027 (see below). An interactive program demonstrating the colors available with the R2 driver is available, as posted in the Graphics Lab. Either driver can be used with the Dunn camera to produce film hardcopy. At the current time, input (TVFARE) is not yet available, but will be in the near future.

Using the Tektronix 4027

It is impossible to make effective use of the Tektronix 4027 Color Graphics Terminal without some familiarity with its operating characteristics. The following is intended only to supplement, for Grafpac programmers, what can be learned from other sources: the Tektronix Operator's Guide, internal SEEDIS documentation, or auxiliary Grafpac documentation.

More than one Grafpac driver is available for the 4027.

(1) The T7 driver uses the 64 solid colors native to the 4027 to produce excellent quality pictures on both the 4027 itself (and on a Dunn camera system, where available). The T7 driver has limits on the number of colors displayable simultaneously (approximately six different area-filling colors).

(2) The TF driver uses "dither pattern" simulations of the 64 colors to produce optimal output on a Xerox 6500 color copier (where available). TF output on the 4027 itself or on a Dunn camera system may look less pleasing than T7 driver output, because of the limitations of the color patterns. Any number of colors may be displayed simultaneously with the TF driver.

Both the T7 and TF drivers use only the visible part of the 4027's workspace, and thus only produce half-page images on the Xerox 6500. In the future, Grafpac drivers will be able to make use of the entire graphics area.

The following text first presents information common to both the T7 and TF drivers, and then discusses the differences between them.

Setting the Baud Rate:

The user must take responsibility for selecting an appropriate baud rate, since this is one task which Grafpac does not perform. After you have logged on to a Vax (possibly using Gandalf) at 9600 baud, you may need to reduce the baud rate to 2400 baud. Application programs such as CARTE which generate large amounts of graphics data may crash the 4027 at 9600 baud (no permanent damage -- just hit reset and adjust the baud rate!). Less demanding applications will do just fine at 9600 baud. To change the baud rate to 2400, do:

```
$ set term/speed=2400          (a VMS command)
!BAUD 2400                     (a 4027 command,
```

assuming ! is the command character).

Please reset the baud rate to 9600 (!BAUD 9600) before leaving. The baud rate is remembered by the 4027 even when the power is off, and trying to log on at the wrong baud rate can be perplexing.

Grafpac Initialization:

Grafpac initializes the 4027 when the first call which causes graphics output is made (e.g. TVPLOT). The Grafpac drivers make as few assumptions as possible about the state of the 4027 when Grafpac is first invoked. For example, Grafpac will turn off snoopy mode if it happens to be on, and reset the color maps. The command character is changed from whatever it was before (probably the default "!") to ESC (the ASCII escape character). This procedure causes a sequence of commands to flash on the

screen and eventually disappear.

SETTING THE COMMAND CHARACTER

The user can override the Grafpac default command character of ESC and use (almost) any other character. The command character must never be one of the following: A-Z, a-z, 0-9, space, comma, / , &, CR, LF, etc. To do this, call

```
CALL TVSET('comm',char)
```

where char contains the new command character right-justified in an Integer*4 4-byte word.

Background Color:

The Grafpac default is to use a white background. This produces better copies on both the Xerox 6500 and Tektronix 4631 Hardcopy Unit. However, the user does have control over the background color. The background color is set using subroutine TVSET and arguments 'NBCO' for nbcolr (named background color), 'BDEN' for bdens (background density), 'Bhue' for background hue, etc. Alternatively, the background color can be set by calling TVHSI or TVRGB with fourth argument 'BKGD' or 'BGRD'. This is exactly analagous to the method of setting vector, character, or area colors in Grafpac. However, the background color is not updated immediately. The background color is changed only when initializing the first frame (if TVSET has been called after TVINIT but before the first TVPLOT, etc.) or during a TVNEXT.

Note that the definition of the color 'comp' depends on the background color. When the background is black, 'comp' is white; otherwise, 'comp' is black.

Erasing the Screen:

The screen can be erased at any time by hitting the shift-F12 key.

Hardware Characters:

The 4027 only allows one color to be used at a time for hardware characters. When changing the Grafpac character color in mid-frame, the results are driver-dependent (see below). Device-independent results are achievable by setting the character color before each TVNEXT. The default for KSIZE is 56.

The positioning of the 4027's hardware characters is limited. The full screen is divided into 80 columns and 33 rows, and a character can only be located in exactly one of the 33*80 rectangular envelopes. A character's envelope will replace any graphics which were previously in that location. The problems caused by the hardware character limitations on the 4027 are unfortunately unavoidable. Software-generated (vector) characters can look quite good on the screen, but the fonts currently in use look terrible on the Dunn camera output (decide for yourself on the Xerox).

Device-Dependent Parameters and Specifications:

Parameter	Default Values
RINTEN	0.5

MLWDTH,KLWDTH	1
KSIZE	56
XSIZE	0.0138
YSIZE,XSPACE	0.0179

Device Specifications

Vector Densities *	3 (VDENS=0.5,0.75,1.0)
Line Widths (vector)	infinite
Line Styles	8
Character Sizes	1
Fonts and Cases	Upper, lower case Roman
Angles of Rotation	0.,90.,180.,270.

* VDENS > 1.0 produces denser lines at intervals of 0.25

Physical View Surface (PVS)

Dimensions	X = 25 cm. (7.5")
	Y = 19 cm. (10")
Addressable points	
	X = 640
	Y = 462
Resolvability	1

Logical View Surface = Grafpac's Defaults

Dimensions (X and Y)	17.5 cm (5.75")
Corner coords on PVS	xmin=178
	xmax=625
	ymin=0
	ymax=447
Addressable points(X,Y)	448
NDC values to utilize full PVS	
	xndcmn=-0.39
	xndcmx=1.0
	yndcmn=0.0
	yndcmx=1.0

Termination:

It is recommended that a Grafpac program terminate with a call to TVEND, which restores a black background, sets the command character to "!", deletes the workspace, etc. If TVEND was not called, due to program abort, system crash, etc. please reset the 4027 for the next user, by pressing the RESET button on the back of the terminal, or by powering off the terminal.

Graphics Input:

TVFARE (graphics input) works like it does on the other Tektronix terminals. The crosshairs are moved with the four keys with arrows on them, on the right side of the keyboard. Hitting any other key causes the location and the key value to be returned from TVFARE.

Hard Copy:

Tektronix black and white hard copy output can be obtained

by pressing the 'COPY' button on the Tektronix 4631 unit next to the 4027. Xerox 6500 color copies can be made when the main power is ON for the Xerox, the paper mask is in place, and the laser is ON (as indicated by the red light). Press the F12 key on the 4027 (Grafpac has programmed this key for you). To use the Dunn camera system (8x10 Poloroid or 35mm), refer to the Dunn camera instructions. Nothing special needs to be done at the 4027.

Special Tricks

There are some special "tricks" which can be used to customize pictures on the 4027, which will be described here for the adventurous user.

(1) Scrolling: Grafpac sets up the 4027 so that keyboard input goes into the monitor, which consists of the bottom line of the screen only. The scrolling keys can be used to scroll the monitor. This is particularly useful when a SYS command has been performed, displaying multiple output lines, only one of which is visible without scrolling. However, you may wish to be able to scroll the workspace (which contains the 33 row graphics area), in order to retrieve a picture which was scrolled up by the 4027, for example. Since the scroll keys only affect the scroll to which keyboard input is directed, do a WORK K command (remember, the command character is ESC) to be able to scroll the workspace. You should always know which state (WORK K or MONITOR K) the terminal is in, since the terminal-host computer communications may be affected.

(2) Once keyboard input has been directed to the workspace (see (1) above) you can move the cursor around and "edit" the picture by typing in labels, etc. Be very cautious since a line or area erased by writing a character (even a space) over it is essentially impossible to restore from the keyboard.

(3) Commands such as JUMP to move the cursor may be useful when entered at the keyboard. The ERASE key at the upper left will erase either the workspace or the monitor, depending on which scroll the keyboard input is currently directed to. Shift-F12 is programmed by Grafpac to do ERASE G, erasing the graphics area.

(4) Colors can be dynamically changed, using the MAP or MIX commands. The results are unpredictable when using the TF driver, but with caution (especially when changing the C0 (foreground) or C7 (background) registers) this trick can be very useful with the T7 driver. Use the SYS command to find out which register you want to change and the MAP command, to use HLS color model, or the MIX command, to use the RGB color model. Remember that Grafpac will not be aware of these color changes, so future graphics may be of the "wrong" color.

The T7 Driver

(1) The T7 driver uses the 64 native colors of the 4027, as shown on the Tektronix double cone. These colors look beautiful on the 4027's screen or on Dunn camera output; but the Xerox 6500 color copier is capable of producing only the maximum density colors. For example, both the brightest red (ADENS = 1.0) and (default) medium red (ADENS = 0.5) appear as bright red on a

Xerox copy, in spite of their different appearance on the 4027. Light red (ADENS <= 0.3) doesn't reproduce on the Xerox at all.

(2) Only six registers are available in the T7 driver for vector and area-filling colors. When a 7th color is needed, the register first assigned is redefined. The color assigned to a register may be used for vectors or polygon areas, or both. Until the user defines additional colors, only one color is defined: the default 'comp' (usually black) for both vectors and areas.

The TF Driver

(1) The TF driver uses patterns composed of the eight "basic" colors (white, black, red, green, blue, cyan, yellow, magenta at maximum density) to simulate the 64 native 4027 colors shown on the Tektronix double cone. These patterned colors will reproduce well on the Xerox 6500. The Grafpac color chart for the 4027 was copied from the 4027 by the Xerox 6500. The appearance of the patterns on the 4027 or Dunn camera system will depend on the particular color and the size of the area.

The color patterns are used for area filling only. The eight "basic" colors are the only colors used for background, character, and vector colors. Other colors may be passed to TVSET, TVHSI, or TVRGB, but the nearest of the eight will be the actual result. This restriction is required by the use made of the 4027's color registers in constructing the patterns. Changes to the background and character (foreground) colors are made only during a TVNEXT call and at the beginning of the first plotting call (note that this is how background color is handled in the T7 driver). This is to allow resetting of pattern definitions without unpredictable effects on existing graphics.

(3) The trick of setting color maps from the terminal (described above) will have possibly unexpected results with the TF driver, since the patterns are defined in terms of the color registers C0-C7, not in terms of direct color definitions.

(4) There are no constraints on the number of distinct vector and area colors visible at one time with the TF driver.

How to link GRAFPAC on the VAX

Current production versions of GRAFPAC modules are kept on dba0:[GRAPHICS.GRAFPAC] on LBLG, LBLH, and other VAXes. Test versions are kept on lblg::sy$user:[GRAPHTEST.GRAFPAC.OBJECT]. Linking with GRAFPAC on the VAX is similar to the linking process on BKY.

To load a single driver, do

```
$ LINK      your program,dba0:[GRAPHICS.GRAFPAC]xx
```

where 'xx' is the driver name, e.g. C3 or TK.

To link VA,ZE,ZT,DC,DS,DL,D6,R1,R2,or R3, do:

```
$ LINK      your program,dba0:[GRAPHICS.GRAFPAC]xx/LIB
```

To link the Aid Module:

```
$ LINK      your program,GRAFPAC Driver,
             dba0:[graphics,grafpac]AID/LIB
```

MULTIPLE DEVICES

Multiple devices can be used simultaneously (TVOPEN) and sequentially (TVSW) as on BKY. To use either one of these routines, load opn.obj before the device drivers, and load d.obj (dummy entry points to resolve unresolved references) at the end. For example,

```
$ link  yourprog, dba0:[graphics.grafpac]opn,tf,ds/lib,d
```

REVIEW

The Review program for C3 metafiles is REVC3. It works like the review programs for DD, CI, or C3 files on BKY. It runs in either interactive or non-interactive mode, depending on whether or not an interactive device driver has been loaded. Frames can be displayed interactively, overlaid, copies made to the hardcopy driver loaded, etc. Frames can be referenced randomly, although it will be more efficient to progress sequentially through a metafile. Examples of various uses of Review follow:

(1) Preview only (no hardcopy)

```
$ link/exe=rtf  dba0:[graphics.grafpac]revc3,tf,d
$ run rtf
```

(2) Preview and make hardcopy

```
$ link/exe=rr2ds dba0:[graphics.grafpac]revc3,opn,r2/lib,ds/lib,d
$ run rr2ds
... ds output will be written to logical file FOR010 ...
```

(3) Hardcopy only (no interaction)

```
$ link/exe=rds  dba0:[graphics.grafpac]revc,ds/lib,d
$ run rds
... ds output will be written to logical file FOR010 ...
```

In all cases, Review will prompt you for the name of your input (C3) file, which was created by the C3 Grafpac driver. Output from "keep" commands is written to logical file FOR010.

The format of C3 files is ASCII, fixed-length records of 512 bytes/record. A C3 file can easily be dumped for archival or debugging purposes by running a utility program dba0:[graphics.grafpac]dumpc3 which will prompt you for the input file name and write a dump to file FOR002.

How to create graphics files on the VAX to be plotted on BKY and vice versa.

VAX to BKY

1. Run your applications program, linking the CI driver. This will create an output file in the coded intermediate file format recognized by REVC. If you wish, you may review this file on the VAX using REVC before proceeding to the BKY system. To create a Zeta file directly on the VAX, run your application program linking the ZE or ZT driver.

2. Write your tape using the utility program 'mtw' as follows:

```
$ allocate mta0:
$ mount/foreign mta0:
$ mtw -b75:128 <your CI,ZE, or ZT filename>
```

The tape is written in 8-bit ASCII, with 75 128-character lines per block.

3. Carry the tape from the VAX to the i/o counter at the LBL Computer Center. Read the tape onto BKY by running the following 7600 job:

```
<job card>
*7
TEXT,CON,[CI.nnnnnn].      nnnnnn is your account number
TEXT,CON,[ASSIGN,WC,CAM.].
TEXT,CON,[REQUEST,T,nnnnn,D8,QT,PD.]. nnnnn is your tape number
TEXT,CON,[LIBCOPY,BKYLGOB,CODE9,CODE9.].
TEXT,CON,[TEXT,TRANS,[000 55]].].  TRANSLATE <NULL> TO <BLANK>
TEXT,CON,[TEXT,TRANS,[047 64]].].  TRANSLATE ' TO #
TEXT,CON,[COPY,TRANS/RX,0FXB,TTRANS/XR.].
TEXT,CON,[CODE9,F=T,B=CAM,RL=128,BF=75,NF=0,M=BKYVAX,I=TTRANS.].
TEXT,CON,[RETURN,T.].
TEXT,CON,[EXIT.].
TEXT,CON,[CXIT.].
TEXT,CON,[FIN.].
TEXT,CON,[WIPE.].
TEXT,CON,[MESSG76,6.].
TEXT,CON,[END.].
COPY,CON/RX,0FXB,CON66/XR.
SUBMIT6,I=CON66.
DISPOSE,CAM=MF,HO.                if CI file
DISPOSE,CAM=ZP.                   if Zeta file, plot it.
```

This job will read the tape, do the necessary translation, and dispose of the file in some appropriate way, depending on whether it is a CI file or a Zeta file. A suggested way to handle a CI file is to leave the resulting file in the MF (microfiche) queue, held-out. This is merely a convenient way to provide for temporary output from the 7600. You may then (from the 6000's) process the file using REVC (if it is a CI file), save it on tape or PSS, etc. Zeta files may be submitted for plotting by using

the DISPOSE control card, as shown above.

5. Further processing for CI files: Run the version of Review which reads CI (rather than DD) files. It is called REVCBN and is available on libraries GPACBN6 (for the 6000's) and GPACBN7 (for the 7600). Link REVCBN with whatever device drivers you want. REVCBN works exactly like REVWBN.

BKY to VAX

1. Run your application program on the 7600, 6400, or 6600 computer, linking with the CI driver. CIBN is available on both GPACBN6 and GPACBN7. The output file (default name 'FILM') may be reviewed on BKY before transporting to the VAX by using the special Review program REVCBN. REVCBN works just like REVWBN except that it expects CI-format files rather than DD files.

2. Write the 'FILM' file to tape, using the utility program FILE11, as follows.

```
*b  or *c
LIBCOPY,JSSTOOLS,FILE11,FILE11.
.
.  control cards to get the CI file 'FILM' go here
.
FILE11,FILM.
REQUEST,T,nnnnn,QT,D8,NN,W,ownername     (nnnnn is tape no.)
COPY,NTTAPE/RB,0F,T/RX.
```

3. Retrieve your tape at the i/o counter and carry it over to the VAX, where program TREAD is used to read it, as follows.

```
$ allocate mta0:
$ mount/foreign/dens=800 mta0:
$ run SY$UTILITIES:tread
```

TREAD will respond with the first line of the file and ask for a file name.

4. The file just read from tape will now have to be massaged to translate all # characters in it to '. This is easily done using the 'tr' software tool. Simply type:

```
$ tr <infile >outfile # "'"
```

(using appropriate file names, of course).

5. Now you are ready to review the file created in step 4. Follow the instructions above for running the REVC program.

Notes on differences between BKY GRAFPAC and VAX GRAFPAC

1. Subroutine TVSET must be used. The code which provides for compatibility with previous GRAFPAC systems on BKY has been eliminated on the VAX. This clean break with the past will allow sleeker and more efficient GRAFPAC drivers.

2. Hollerith type alphanumeric variables, rather than the 'character' data type allowed in VMS Fortran (and Fortran 77) will be used exclusively in GRAFPAC at the present time. This will minimize some conversion difficulties. However, all arguments to GRAFPAC subroutines will be limited to Hollerith strings of length 4, i.e. they must be contained in a variable of type INTEGER (or INTEGER*4). The exception is the character string argument to TVLTR, which may be as long as 150 characters. Arguments to subroutines such as TVPLOT are the first 4 characters of the argument acceptable on the CDC machines, e.g. 6HNOJOIN is 4HNOJO or 4Hnojo or 'noJO', etc. on the VAX. Any combination of lower and upper case is allowed, and the nH or quoted syntax is permissible. The GRAFPAC writeup on BKY contains the permissible 4 character names of the TVSET parameters, which are in most cases the leading 4 characters of the full name. Note that the BKY GRAFPAC drivers also accept the 4 character arguments.

3. 'IFILE' (old ITV), the GRAFPAC output file, is expressed as a Fortran logical unit number (integer). If file=nn, then graphics output will be written to logical name FOR0nn. You can of course associate this name with any file-spec you want by using the DCL 'assign' command to assign a file-spec other than FOR0nn.DAT to FOR0nn. Do not use the Fortran 'OPEN' statement, since some GRAFPAC drivers (in particular, the interactive ones) use low-level i/o to open the file. Interactive programs must associate IFILE with the terminal by ASSIGNing FOR010 to SYS$OUTPUT or by calling TVSET(4Hifil,6) (since unit 6 is by default assigned to SYS$OUTPUT). The default is IFILE=10, so a program which does nothing else would create a file called FOR010.DAT in the current directory.
Similarly, the second argument to TVOPEN is a logical unit number, rather than a file name.

4. KFONT (old KASE) has the following effect: If KFONT = 'uppe' or KFONT = 2, then the string is translated to upper case. Note that this behaves like the TTY LOCK key on a Tektronix terminal. If KFONT ='lowe' (or 1), then the string is translated to lower case. If KFONT = 0, then no translation is done. Upper and lower case characters will appear as found in the string. The default is KFONT = 0. This is not the same as the default on BKY (KFONT=2).

5. The 'TT' driver is now called the 'NG' driver, for 'non-graphics' terminals. The NG driver is suitable for both CRTs

without graphics capabilities (ADM-3) and hardcopy terminals (TI-700).

6. The maximum length of the character string argument to TVLTR is 150 characters.

7. TVSW and TVOPEN are entry points to a single module "opn".

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