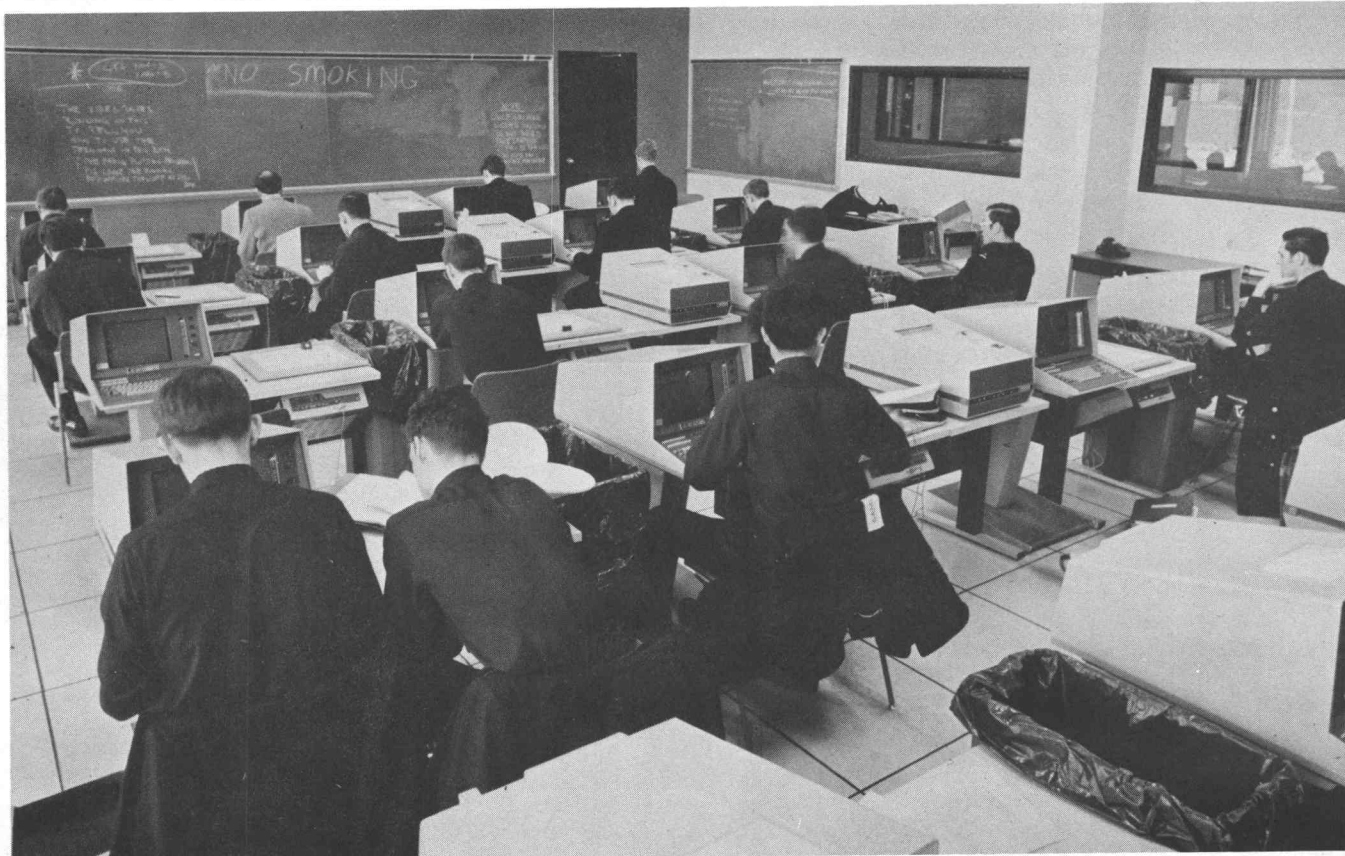


Tekniques

The 4051 Applications Library Newsletter

Vol. 1 No. 8



Computer Graphics Book Available

By Robert J. Publitz

A new book is available on computer graphics techniques. Doctors David F. Rogers, Department of Aerospace Engineering and James Alan Adams, Department of Mechanical Engineering at the U.S. Naval Academy are the authors of *Mathematical Elements for Computer Graphics* (McGraw-Hill, 239 pages, \$9.95).

Students at the academy in Annapolis are fortunate to have forty 4051 Graphic Systems available to apply the theory underlying computer graphics techniques discussed in this book.

The book is an introduction to the mathematical theory underlying computer graphics techniques presented in a unified manner. Although the material is presented in new ways, the mathematical material is not new. All the material in this book exists scattered throughout technical literature. This book brings it all together in one place in one notation.

In selecting material, the authors chose techniques which were mathematical in nature rather than those which were more procedural. Accordingly, the reader will find more extensive discussions of rotation, translation, perspective, and curve and surface description than of clipping or hidden line and surface removal. First year college mathematics is a sufficient prerequisite for the major part of the text.

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After a discussion of current computer graphics technology in chapter 1, the manipulation of graphic elements represented in matrix form using homogeneous coordinates is described. A discussion follows detailing existing techniques for representing points, lines, curves, and surfaces within a digital computer, as well as computer software procedures for manipulating and displaying computer output in graphic form.

Mathematical techniques for producing axonometric and perspective views are given, along with generalized techniques for rotation, translation, and scaling of geometric figures. Curve definition procedures for both explicit and parametric representations are presented for both two-dimensional and three-dimensional curves. Curve definition techniques include the use of conic sections, circular arc interpolation, cubic splines, parabolic blending, bezier curves and curves based on B-splines. An introduction to the mathematics of surface description is included.

Computer algorithms for most of the fundamental elements in an interactive graphics package are given in

an appendix as BASIC language subprograms. However, these algorithms deliberately stop short of the coding necessary to actually display the results. Unfortunately, there are no standard language commands or subroutines available for graphic display. Although some preliminary discussion of graphic primitives and graphic elements is given in Appendix A, each user will, in general, find it necessary to work within the confines of the computer system and graphics devices available to him.

The fundamental ideas in this book are the foundation for an introductory course in computer graphics given to under-graduate students majoring in technical or scientific fields. It is suitable for use at both universities and schools of technology. It is also suitable as a supplementary text in more advanced computer programming courses or as a supplementary text in some advanced mathematics courses. Further, it can be profitably used by individuals engaged in professional programming. Finally, the documented computer programs should be useful to computer users interested in developing computer graphics capability. **TEKniques**

PLOT 50 Electrical Engineering Software

By Bob Ross

PLOT 50 Electrical Engineering Vol. 1 is a powerful ac circuit analysis program for the 4051. Much of the program is useful for microwave circuits, but it also applies to conventional circuits (e.g., amplifiers, and low-pass filters) that are analyzed at lower frequencies.

The typical system consists of a 4051 with 32K of memory and a Hard Copy Unit to provide copies of the tabular and graphical outputs. (24K of memory can be used with some reduction in speed). The 4662 Digital Plotter can also be used with no software change.

This self-contained system provides several advantages over programs offered through time-sharing services. The primary advantage is that there are no charges accumulating while entering and editing circuits, performing analysis, or presenting results. Neither are there unreliable, noise-prone telephone systems to deal with, nor irritating delays during prime computer time.

You interact with the EE program using the User Definable Keys on the 4051. With the aid of a printed overlay you choose routines to enter your circuit, to run the analysis, and to display the results. The circuit itself is entered using the internal library of components. These components range from resistors, capacitors, inductors, and two-port presentations of devices, to lossy transmission lines, dual networks, gyrators and circulators. An

analysis is run over the specified frequencies, and the results are stored on tape. User Definable Keys allow listings and plots of the results.

Internally the computations are done using scattering parameters (S-parameters). However, S-parameters are mathematically related to other two-port parameters (Z, Y, H, G) and to numerous calculated outputs. Some of the outputs provided in graphic or tabular form are stability factor, maximum available power gain, matched source and load gammas, VSWR, return loss, mismatch loss, delay, and stability circles. The two-port parameters Z, Y, G, H and reciprocals $1/Z$, $1/Y$ and $1/S$ are also provided. With these parameters you have much useful information such as voltage gains, current gains, input and output impedances or admittances, trans-

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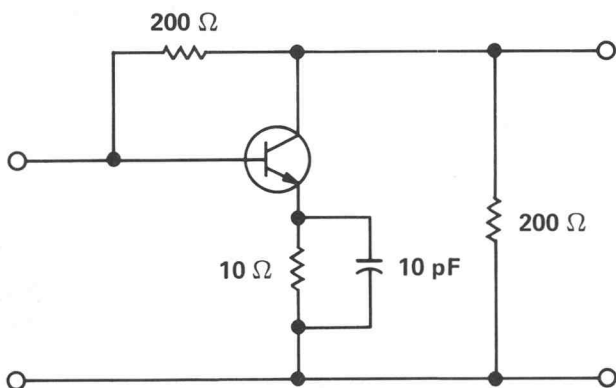
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impedances and transadmittances and reflection coefficients. Presentations can be in tabular form or graphed in linear, logarithmic, polar or Smith grids.

Two-port parameters provide useful information for conventional circuit analysis. For example, Z11 gives input impedance with the output open circuited; 1/Y11 gives input impedance with the output shorted. G21 gives voltage gain, H21 gives current gain. You can pick from a wide selection of parameters, as appropriate for your particular analysis.

A circuit is specified by components and how they are interconnected. Some of the common two-port interconnections available are cascade, series, and parallel. Active devices can be stored on tape in two-port data files (internally as S-parameters) or can be modeled using some gain components in the program. An example illustrates how a simple circuit is coded.

Example



```

1: FE .1 10 20
2: RP 10 CA
3: CP 10 SE
4: DAT 1 PA
5: RS 200 CA
6: RP 200 EQ
7: NEX
Code length = 63. Simple diagnostic (Y or N)?

```

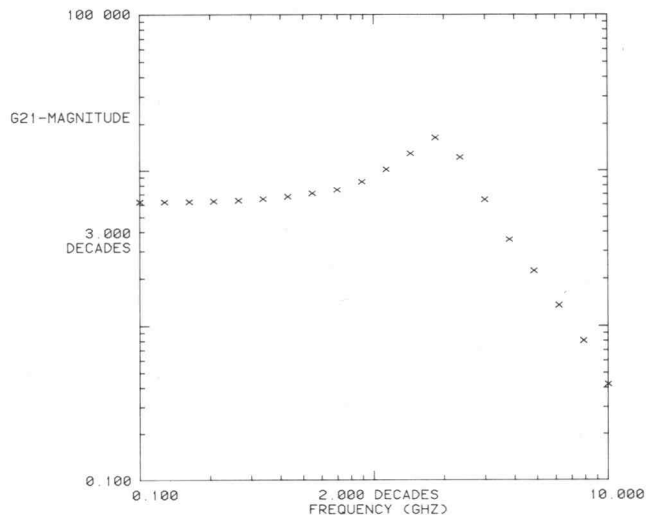
Code Listing Description

Line 1 specifies that the analysis is to be done from 0.1 to 10 GHz, in 20 exponentially spaced steps. Lines 2-6 construct the circuit. The emitter RC circuit contains parallel components specified by RP and CP. These are cascaded together by the code step CA in line 2. The combination is taken in series (SE) in line 3 with the transistor specified by DAT 1 in line 4. The transistor two-port parameters are already stored on the tape in data file 1.

The base-collector resistor is a series component (RS) that is combined in parallel with the circuit constructed so far. This combination is cascaded with the parallel output resistor in line 6. The equals step (EQ) in line 6 completes

the specification and causes the overall computation to be performed. The NEX step (next) completes the frequency loop specification.

When this program is executed, by pressing RUN on the overlay template, the overall S-parameters for each frequency are stored on tape. Much useful information can be extracted from these parameters. For example, the plot of voltage gain that is given by the two-port parameter G21 is shown below.



Here normal access of the results is illustrated. The question-answer format gives numerous possibilities for plots. Auto scaling is chosen for convenience. Manual scaling can be used to give more flexibility. For example, a portion of a plot can be selected and magnified.

An analysis, including all plots and listings, can be totally automated by entering into the code which results are desired. The Hard Copy Unit can be set up to automatically generate copies of the display as results are presented.

Many advanced features are provided in the PLOT 50 Electrical Engineering Software. Among them are mapping capability to display the effects of imbedded elements on overall S-parameters, "lossless" matching network design, component stripping capability to remove elements or circuit modules rather than add them. Also included is the ability to make any numerical entry in the code variable whose value is requested during execution.

Some typical applications include microwave circuit design and analysis, matching network design, conventional circuit analysis, device characterization using the error stripping capability, and filter analysis.

This is just a glimpse of the capabilities and features in PLOT 50 Electrical Engineering Vol. 1. Much more information, with additional examples, is contained in the manual accompanying the software. **tek**niques


GPIB Hardware Support Manual

The 4051 GPIB Hardware Support Manual provides hardware support information for anyone interested in designing interfaces for the 4051 Graphic System and its GPIB. The manual clarifies the guidelines set forth in the IEEE Standard, and also provides practical working models of 4051 GPIB interfaces.

Section 1 of the manual contains background information on IEEE Standard 488-1975. Section 2 discusses a model of a general purpose TTL interface that works on the 4051 GPIB. Starting with the GPIB connector, this section shows how to make the proper electrical connections to the bus and how to arrange bus receivers and transmitters in an effective listen/talk configuration. Typical TTL circuit designs are then discussed, starting with Listen Handshake circuitry. Talk Handshake circuitry, Address Decoding circuitry, and Serial Poll circuitry are then covered.

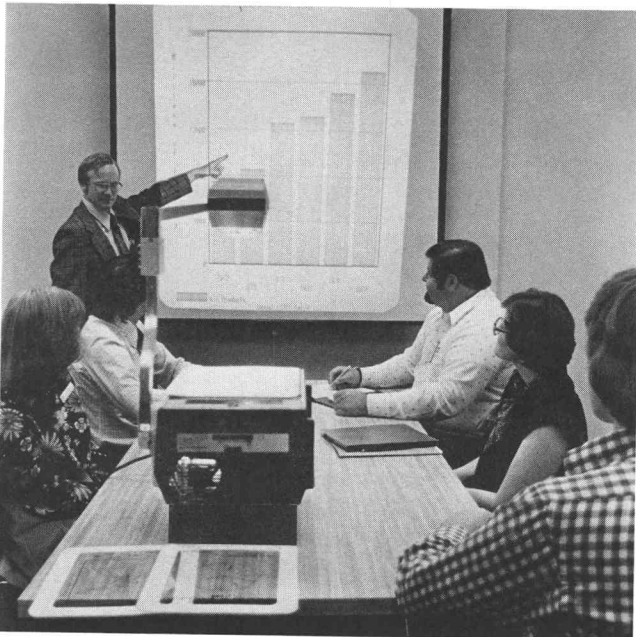
A working model of a microprocessor-based GPIB interface is then presented. Following this model, Section 4 covers detailed timing information on the 4051 GPIB. Diagrams are included to illustrate GPIB data transfer characteristics for the BASIC I/O statements. Section 5 discusses methods to calculate maximum effective data rates for 4051 GPIB data transfers. The information in this section may be used to determine if the 4051 GPIB data rates are compatible with a particular system application.

An Appendix contains information on the 4051 internal floating-point format for numeric data.

The manual is available through your local Tektronix Sales Engineer under part number 070-2270-00. 

Making Slides with the 4051 and 4662

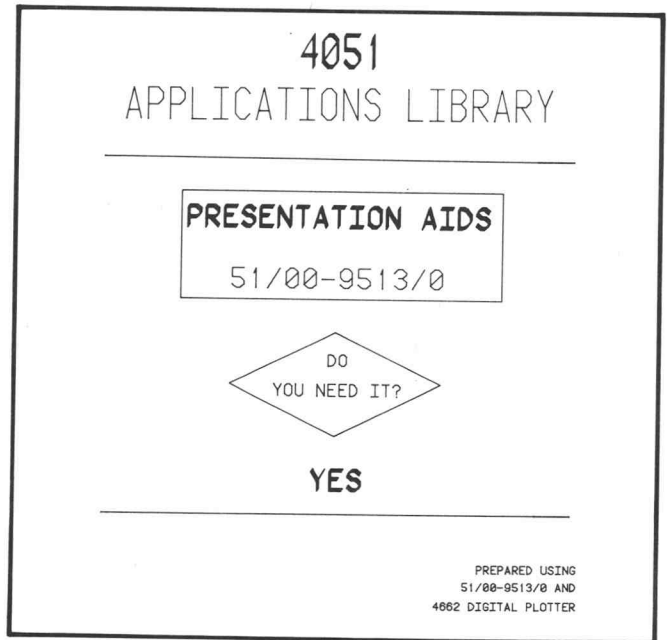
By Byron Fisher



A bar chart is quick and exact with the aid of a 4662 Plotter and 4051.

From time to time, all of us have occasion to produce slides for classes or for presentations to colleagues and management. The 4662 Interactive Digital Plotter, used with a 4051 Graphic System, is a practical way to fulfill such requirements.

The Applications Library contains a program that is useful for making graphs for presentations. This program includes a slide maker and pie chart in Presentation Aids



Demonstrating the 4662 Plotter's versatility, this slide was produced using 4051 Applications Library program #51/00-9513/0.

(51/00-9513/0). Using this BASIC program in the 4051 Graphic System with a 4662 Plotter attached, making slides is easy.

Slides can be prepared in two ways. To produce 35mm slides with the 4051/4662 combination, a program is run on the 4051 to generate the desired graphic presentation. The graphic output is directed to the Plotter. The resulting graphics, which can be in several colors, is then photographed to produce 35mm slides. The other method

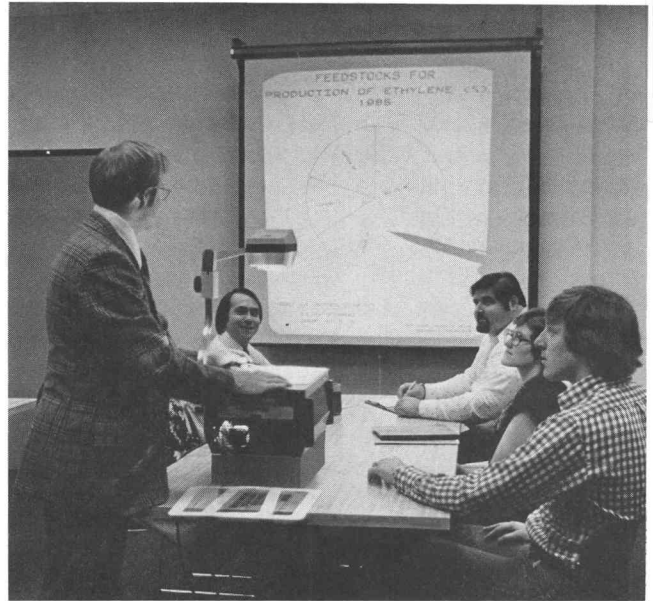
produces slide for an overhead projector. This method uses clear film on the plotting surface to produce the overhead transparency directly on the Plotter. The clear write-on film to use is 3M no. 78-6969-1733-1 or equivalent. Tektronix offers nine colors of special pens that can be used to write on the clear film. These pens make presentations clear, interesting, and easy to understand. Information on the pens is as follows.

Black	016-0386-00	Package of Three
Brown	016-0386-01	Package of Three
Red	016-0386-02	Package of Three
Orange	016-0386-03	Package of Three
Yellow	016-0386-04	Package of Three
Green	016-0386-05	Package of Three
Blue	016-0386-06	Package of Three
Purple	016-0386-07	Package of Three
Magenta	016-0386-08	Package of Three

Use these pens with the Slide Maker Program to produce professional slides for your presentations.

Consider the mirror-image approach when preparing overhead slides. When using the mirror image, the presentation is drawn backwards on the back side of your clear film. Place the slide on the projector with the written surface down; the projected image will be righted again. You can then use a marking pen to highlight or note items on the top surface during your presentation. These notes can be erased after the presentation. The Plotter's drawing on the other side of the film will remain intact for the next showing.

Creating a mirror image of the plots is easy by using the 4662's front panel pushbutton controls. The 4662 powers



The pie chart and text were drawn directly onto the clear write-on film by the 4662 Plotter driven by the 4051.

up with the page size and orientation set to default conditions (full page, bottom left = bottom left, upper right = upper right). For mirror image, move the pen to lower right position on the desired page area and hold down LOWER LEFT button until the bell rings. Then move the pen to the upper left position on the desired page area and hold down the UPPER RIGHT button until the bell rings. All incoming data will now be plotted as a mirror image. **Techniques**

Programming Tips



Branching On Alpha Response

By Dan Taylor

Here's another branching technique that allows you to branch upon a response to a choice of answers:

```
200 PRINT "Input your choice of the menu ";
210 INPUT A$ [or POI A,B,A#]
220 A$=SEG(A$,1,1)
230 GO TO POS("TAEIG",A$,1) OF 1000,2000,3000,4000,5000
240 GO TO 200
```

This method allows a 5-way branch based on the first character entered in the response. **Techniques**

Branching On YES-NO

Leroy Nollette, Application Specialist,
Tektronix, Inc.

Looking for a quick way to convert alpha responses to "Yes-No" questions into GOTO addresses? Try this.

```
400 PRINT "DO YOU WISH TO CONTINUE (YES OR NO)?"
410 INPUT A$
420 P=POS("YESNO",A$,1)
430 GO TO P OF 500,400,400,600,400
440 GO TO 400
450 REM YES PROCESSING
```

```
|
```

```
600 REM NO PROCESSING
```

```
|
```

The advantage of this method is that it accepts Y, YES, y, yes, N, NO, n, or no as valid answers. If line 440 is omitted, the program defaults to a "yes" answer when the RETURN key is pressed with no prior entry. **Techniques**

4051 Applications Library Program Abstracts

Documentation and program listings of these programs may be ordered for \$15.00 each. Programs will be put on tape for an additional \$2.00 handling charge per program and a \$26.00 charge for the tape cartridge. (The program material contained herein is supplied without warranty or representation of any kind. Tektronix, Inc. assumes no responsibility and shall have no liability, consequential or otherwise, of any kind arising from the use of this program material or any part thereof.)

Please use the Applications Library Order Form. Order forms are included in the Membership Packet and are available from your local Tektronix Sales Engineer.

ABSTRACT NUMBER: 51/00-8013/0

Title: **Format Tape to Load Motorola 6800
Microprocessor Under MINIBUG Control**

Author: Fred L. Royer, Ph. D.
Cleveland V.A. Hospital,
Brecksville, Ohio

Memory Requirements: 8K bytes

Peripherals: Option 1

Data Communications Interface

The Program

This program allows loading of the M6800 Microprocessor with MINIBUG. To do so requires that a record be input in a special format, as follows. The record begins with a header "S1," followed by the number of bytes (a pair of hexadecimal digits), the starting address in memory, and then the data. The data ends with a checksum that is the 1's complement of the sum of all data, including the starting address. The end of all such records is indicated by an added tail "S9."

The program requires entering the data file number, the starting address, and the data. The program computes the number of bytes and the checksum; the properly formatted record is then stored on the requested file. If the file is to be immediately loaded into the microprocessor, the appropriate parameters are sent to the Data Communications Interface, and the records are read and transmitted.

Data Tape Structure

The program is limited to a maximum of 128 bytes of two hexadecimal digits per file. (These are 1 header byte, 1 byte count, two starting address, 122 data, 1 checksum and 1 tail).

Data Tape Structure

The data is stored in an ASCII file. Use of File 2 is mandatory; additional files are optional. The format is

identical to the punched tape format for the Motorola M6800/MINIBUG microprocessor. An index is not required. The data file is located on the program tape; be sure data file(s) are previously marked.

ABSTRACT NUMBER: 51/00-9515/0

Title: **Forms Design**

Author: Dr. P.C. Holman

University of Wisconsin-Stevens Point

Memory Requirements: 24k bytes

This is a program for designing any form or straight-line geometric pattern. The screen is treated as a graph and the user is prompted for horizontal and vertical coordinates. The pattern may be drawn after any sequence of coordinate points input and the user may review his coordinate points after each draw. Changes are allowed throughout design construction.

Two methods are employed, one being faster but less extensive than the other. Both are tutorial.

488 Lines

ABSTRACT NUMBER: 51/00-0714/0

Title: **Time Lapse Analysis Program**

Author: Wendell W. Berry

Memory Requirements: 16K-32K

Peripherals: 4631 Hard Copy Unit

This program provides a statistical analysis of elapsed time (in days) from one event to another in a particular process, such as order processing. Specific calendar dates are assigned to each event. A variable number of events may be used; the number of samples is limited only by the amount of memory available.

The events to be compared are then specified. The program computes the absolute value of the difference in days between these events throughout the entire sample. These values are then sorted; the frequency of identical elapsed times is the first tabular output. The number of different elapsed times are then computed along with the total usable samples, the mean, standard deviation, median, and mode of the elapsed times. These also are output in tabular form, and a bar graph is then produced showing the mean elapsed times for all comparisons.

You can gain access to any previously analyzed data for two further options. First, the dates on file for any or all events may be viewed in regular notation, and changes may be made. Secondly, detailed comparisons of two events, date by date, may be made. These options are useful in the explanation of specific data occurrences.

When entering data, you have the option of entering a "0" when a date is missing in the sample. This will be

calculated as a "No match" during the comparison routines, and will not enter into the mean calculations, etc. Also included is the option of saving the information entered and computed by the program. This is done to allow later access to data, and is particularly useful in large data samples. The only limitation for data comparison is that the data must be complete. That is, the data must contain three sets of digits separated by a non-numerical character, following the format mo/day/year, where the year is presumed to be in this century and not requiring the entry of the preceding "19".

Basic Bits



Drawing Upside Down or Backwards

By Leland C. Sheppard
Sunnyvale, California 94086

You can have the 4051 draw backwards (right to left) or upside down, including axis drawings with the tic marks pointing to the left. The method is simple: reverse the margins specified in the VIEWPORT command.

To go from top to bottom you reverse the upper and lower limits; to go from right to left, the left and right limits (I have never tried both at the same time).

Example applications might be to draw an axis at the right hand side of a chart comparable to the one at the left. Reverse the left and right margins and reissue the AXIS command. Presto! A reversed axis at the right.

An application for upside down: two arrays of numbers, one of which represents positive values to be drawn and the other negative values where both arrays are stored as positive numbers. You could make the one array negative; you can also reverse the upper and lower limits and achieve the same effect. Try it!

GPIB

Each device on the GPIB supplies its own power. When the devices are off, they load down the GPIB. Therefore, to enable effective interfacing, more than half of the peripherals on the GPIB must be powered up.

Cartridge Respooling

If you have occasion to take a data cartridge apart for respooling, don't use a magnetic screwdriver. Magnetic

screwdrivers, like other magnetic surfaces, can damage the data on a tape, causing some information to become unreadable.

Add a Byte to Binary String

When READiNG binary strings from tape (internal 4051 tape as well as the 4924 Digital Cartridge Tape Drive), always dimension string variables one byte larger than the number of characters to be read. This allows memory space for the appended auxiliary byte utilized by the 4051.

* Editor's Note

Attention Applications Library Contributors

If your program contains several files, please use variables for the file numbers when calling these files during execution. This will enable other users of your programs to recode easily, since the program files can be put in any location on the tape. (Don't assume that your program will always use the first files on a tape).

4051 Applications Library Catalog

The 4051 Applications catalog of 59 programs is available by writing Tektronix, Inc., Information Display Group, P.O. Box 500, Group 451, Beaverton, Oregon 97077.



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Documenter/4641 and Documenter/4631

Debugging/documenting aid provides three sorted cross references (variable, statement #, For/Next) + eight statistics on Basic resources

used + program listing with same-line commentary and abstract (if files containing these are provided) + error statement #s flagged; single program or entire tape; handles most programs to 20K; more. The copyrighted program "Documenter," written in TEK 4051 Basic, is thoroughly documented and tested; it has been in use for more than a year. Program listing including abstract, user instructions, line commentary (printed by Documenter) \$20/copy. Specify 4641 or screen version (\$30 for both). 24K minimum system. 10% discount on total order to multi-4051 installations. Leland C. Sheppard, P.O. Box 60051, Sunnyvale, California, 94086, (408) 733-8651.

Surveyor's Graphic Geometry

A surveyor's geometry program suitable for surveyors, engineers, or any agency that requires the calculation of spatial relationships related to property development. The software requires a 4051 with 32K of memory, and supports optional use of a 4662 Plotter or a printer. Allows calculation of point locations using their relationships to other known or previously-calculated points. Includes traverse from a point and bearing-bearing, bearing-distance, and distance-distance relative to two points. Allows choice from multiple solutions, inverting between points, and display of point locations. Graphic display can be directed to the crt or to a plotter. Output may also be directed to a printer. This program is useful in road design, building site selection, lot design, and other similar applications. Up to 300 points can be manipulated. Leonard G. Barton, consultant. 1248 Juanita Drive, Walnut Creek, California 94595, (415) 939-5889. Price: \$400.00.

Surveyor's Graphic Traverse

A surveyor's graphic system suitable for the practicing surveyor, or for any organization that requires visualization of formal property descrip-

tions. The software requires a 4051 with 32K of memory, and supports the optional use of a plotter or printer. Includes traverse entry and editing; closure and area calculation; adjustment by compass, transit, or Crandall's rule; arc calculation; and graphic display. Entry forms include angles left and right; deflection angle; bearing, or azimuth and arcs specified by central angle; outbound sight from center; or arc length. Graphic displays can be directed to the crt or to a plotter; alphanumeric output can be directed to the crt, a plotter, or a printer. Use of this software can reduce field note requirements. It can also be used for map checking and for limited subdivision design. The software can manipulate over 200 courses, side shots, and/or arcs. Leonard G. Barton, consultant. 1248 Juanita Drive, Walnut Creek, California 94595, (415) 939-5889. Price: \$850.00.

Graphic Word Processing System

A word processing system suitable for the preparation of documents, specifications, and certificates. The software requires a 4051 with 32K of memory, and a graphic input device (such as a joystick or a graphics tablet). The software consists of two programs, an interactive editor and a runoff program. The editor allows you to point to the location of insertions, deletions, and modifications. It includes word search and substitution with automatic capitalization. About 17,000 characters can be edited and stored on tape; any number of tape files can be linked to form a document. The software allows control of spacing, indenting, centering, right and left justification, and other editing and output functions. Output can be directed to the crt, a plotter, a printer or other compatible typing device. This software can be used for contracts, map certificates, specifications, and other structured documentation. Approximately 5-6 pages of finished text can be stored in each tape file. Leonard G. Barton, consultant. 1248 Juanita Drive, Walnut Creek, California 94595, (415) 939-5889. Price: \$300.00.

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