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# USER'S MANUAL FOR THPLOT, A FORTRAN 77 COMPUTER PROGRAM FOR TIME HISTORY PLOTTING

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# FOR TIME HISTORY PLOTTING

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## INTRODUCTION

This report describes THPLOT, a general purpose FORTRAN 77 computer program for plotting time histories using Calcomp pen plotters (ref. 1). THPLOT is designed to read a time history data file and to generate time history plots for selected time intervals and/or selected data channels.

The capabilities of the program are described. The card input required to define the plotting operation is described. Examples of card input and the resulting plotted output are given. The examples are followed by a description of the printed output, including both normal output and error messages. Lastly, implementation of the program is described. A complete listing of the program with reference maps produced by the CDC FTN 5.0 compiler (ref. 2) is included on microfiche as a supplement.

## PROGRAM CAPABILITIES

This section describes the capabilities of the program which allow for ease of use, flexibility, and generality.

All card input is free-format; input data are not fixed to specific columns.

Plots may be oriented with the time axis in either of two perpendicular directions. Any width of plotting paper may be specified. The dimensions of the plot page may be specified. An overall scale factor for reducing or enlarging the plot image may be specified.

The program can plot a virtually unlimited number of data points, without mandatory thinning. The data may, however, be thinned by a specified factor. The time points need not be uniformly spaced.

A scale factor for plotting the time axis may be specified, or the time points may be autoscaled to fit within a specified time axis length. Multiple time intervals may be plotted on a single plot page. Multiple time intervals need not be specified in sequential order.

Channels may be plotted in any specified order. Each channel axis may be any specified length; the program automatically fits the maximum number of channels on each plot page. Minimum and maximum limits for plotting each channel axis may be specified, or the data points for the channel may be autoscaled to fit within the specified channel axis length. Multiple channels may be plotted on the same axis. Additional channels may be created during program execution and plotted.

The program automatically computes the total number of time plus data words per record for data files with fixed record length.

A large buffer is provided in core to store data to be plotted. The program automatically partitions the buffer in order to read in the maximum number of data points. The number of time points in a plot may exceed the dimension limits of the buffer.

All important dimension limits and physical plot parameters are contained in parameter statements.

## CARD INPUT

This section describes the card input required to run THPLOT. Each card is composed of fields separated by delimiters. Fields are either keywords or values, depending on application. Keywords are character strings of not more than 8 characters length recognizable by the program. In this report keywords are capitalized and partially or wholly underlined. The underlined portion of each keyword is the portion recognizable by the program, the remaining characters may differ or be omitted. Values are integer or real constants or character strings, according to application. Character strings are not enclosed in quotes. Fields are separated by one or more delimiters, and may not contain blanks or other delimiters. The set of valid delimiters varies according to application. If a field is followed by one or more blanks in addition to another delimiter, it is considered delimited by the nonblank delimiter.

Many variables used by the program are assigned values through the use of keyword-value pairs. A keyword-value pair consists of a keyword, followed by one of two delimiters (blank, equals), followed by the associated value in the proper mode (integer, real, character). The value is assigned to an associated variable or array element. Keyword-value pairs may be in any order on all cards. Stand-alone keywords, stand-alone values, and keyword-value pairs are delimited by one of two

delimiters (blank, comma).

A card is either a directive card or a definition card. A directive card is a title, time, channel, or plot directive card. Any card following a directive card and preceeding the next directive card is a definition card associated with the preceeding directive. Each directive and any associated definition cards together make up a specification; a specification is a title, time, channel, or plot specification.

Functionally,the card input consists of one or more groups of specifications known as a plot set. Each plot set is terminated by a plot specification and may contain any other specifications in any order. Each specification may appear at most once in the plot set. Each plot set defines a set of plots to be generated according to the specified parameters.

The number of plot sets in the card input is unlimited.

The four specifications are described in detail in the following sections.

## Title Specification

The first field of a title directive card is the keyword TITLE. The title directive card and associated title definition card together specify the title to be plotted at the bottom of each plot page. The title directive card contains no additional fields, and is delimited by a slash. The title directive card is followed by a title definition card, which contains 80 characters and no delimiters.

An example of a valid title specification is shown below.

```
TITLE/
SRV FLIGHT 45:  SKEWED DELTA-P/QBAR VS. ALPHA-F
```

If the title specification is omitted from a plot set, the title specification remains the same as for the previous plot set; default for the first plot set is blank.

## Time Specification

The first field of a time directive card is the keyword TIMES. The time directive and associated time definition card(s) together specify the data thinning factor, time axis (axes) length and scaling factor, and requested time interval(s). The time axis is plotted across the width of the plot page, 3 centimeters above the bottom; if multiple time intervals are requested, multiple time axes are plotted. The first time axis starts 3 centimeters from the left margin of the plot page; succeeding time axes start at integral centimeter distances from the left margin, with no less than 0.5 and no more than 1.5 centimeter horizontal separation between axes.

The time directive card contains three optional keyword-value pairs:

THIN - Integer value which defines data thinning factor. Every THINth time point which is read off the data file is plotted. The default value for THIN is 1.

LENGTH - Floating point value which defines time axis length in centimeters. The time axes for all requested time intervals are plotted within this length. The default value of LENGTH depends on the values of TIMEAX and PAPER for the plot set as defined by the plot specification (see Plot Specification section). If TIMEAX has a value of 'X', the default value of LENGTH is 100; if TIMEAX equals 'Y', the default value of LENGTH is PAPER - 3.

SCALE - Floating point value which defines time axis (axes) scale, in units of seconds per centimeter. If multiple time intervals are specified, all time axes are plotted with the same scale. The default value for SCALE is 0.

The values of LENGTH and SCALE together determine the scaling factor used in plotting the time axis (axes). If SCALE has a value of 0., the program autoscales the time axis (axes) to fit within LENGTH. If SCALE is non-zero, the program determines whether the time axis (axes) when SCALEd, fits within LENGTH. If so, the specified SCALE is used. If not, the time axis (axes) is autoscaled to fit within LENGTH.

The final field of the time directive card is delimited by a slash.

The time directive card is followed by a number of time definition cards. Each time definition card defines a time interval to be plotted containing all points found on the data file between the requested start and end times, inclusive.

Each time definition card contains start and end times for the time interval. Each time is in the form of four integer fields (hours, minutes, seconds, milliseconds), separated by a set of delimiters (blank, colon, period, dash); the start and end time are separated by the same set of delimiters. The final card of the group contains either a single slash or a start/end time pair terminated by a slash.

Time intervals need not be requested in sequential order; they are plotted in the order requested. Up to 10 time intervals may be requested for each plot set.

If the group of time definition cards is a single card containing only a slash, the program reads and plots the entire data file as one time interval.

Examples of valid time specifications are shown below.

```
TIME,  THIN=5,  LEN=50.,  SCALE = 20./
07:01:17.750 - 07:04:15.500
7-22-16-005   7-23-56-985
 7 10 15.0   7 12 21.480/

TIMES  LENGTH 20.  /
14 15 22 00   14 26 57 00
/

TIME/
/
```

If the time specification is omitted from a plot set, the time specification remains the same as for the previous plot set. If omitted from the first plot set, every time point of the entire data file is plotted, autoscaled to fit the default time axis length dependent upon TIMEAX and PAPER. This is equivalent to the last time specification example above.

## Channel Specification

The first field of a channel directive card is the keyword CHANNELS. The channel directive and associated channel definition card(s) together specify the requested data channels, channel axis labels and lengths, and minimum and maximum axis limits for each plotted channel. The channel axes are plotted 3 centimeters from the left margin of the plot page, with 1 centimeter vertical separation between succesive axes.

The channel directive card contains one optional keyword-value pair:

LENGTH - Floating point value which defines default axis length for all channels, in centimeters. The default value is the value from the previous plot set; default for the first plot set is 4.

The final field of the channel directive card is delimited by a slash.

The channel directive card is followed by a number of channel definition cards. Each channel definition card defines one data channel to be read from the data file and plotted.

The first field of each channel definition card is an integer defining the channel number. The channel number indicates the location of the data channel in the data vector read from the data file. The second field of each channel definition card is a character string which defines the channel name. The channel name is used to label the channel axis. This field is mandatory unless there are no additional fields on the card. This field may contain up to 10 nonblank characters; the last

character may not be a slash. If this field is omitted, the default label for the axis is equal to the channel number. The remainder of each channel definition card contains three optional keyword-value pairs:

LENGTH - Floating point value which defines the length in centimeters of the channel axis. The default value is the value of LENGTH from the channel directive card.

MINIMUM - Floating point value which defines the value plotted at the lower end point of the channel axis. Default is 0.

MAXIMUM - Floating point value which defines the value plotted at the upper end point of the channel axis. Default is 0.

MINIMUM and MAXIMUM are used as end points for scaling the channel axis and plotting the channel data. Any data value outside the range specified by MINIMUM and MAXIMUM is truncated to the appropriate limit. The channel axis may be plotted with the maximum value at the lower end point; MINIMUM may be greater than MAXIMUM. If MINIMUM and MAXIMUM are equal for a channel, the channel axis is autoscaled to fit within the channel LENGTH.

If the keyword-value pairs are omitted and replaced by the keyword SAME, the data channel is plotted on the axis of the data channel immediately preceeding. The axis label for each overplotted channel is drawn beneath the previous axis label. The dashes for the first overplotted channel are one millimeter in length; the dash length doubles with each additional overplotted channel. The length of the space between dashes remains constant at one millimeter for all overplotted channels. An unlimited number of channels may be plotted on the same axis; however, the doubling of dash length with each additional channel forces a practical limit of five or six overplotted channels.

The final card of the group contains either a single slash or a channel definition delimited by a slash. Up to 200 channels may be specified in the channel specification.

Examples of valid channel specifications are shown below.

```
CHANNELS, LENGTH 10./
1, MACH, MIN 0., MAX 2.0
14   QBAR  LEN = 6.
2  QBAR-VANE  SAME
7  BETA  MIN -10.  MAX 10.  LEN 4.  /

CHANS  /
2, PSTATIC,  MAX=400.
3  PTOTAL  LENGTH=20.
/
```

```
CHAN  /
/
```

If the channel specification is omitted from a plot set, the channel specification remains the same as for the previous plot set. If omitted for the first plot set, all channels are plotted in sequential order, autoscaled, and with axis labels equal to the channel number. This is equivalent to the last channel specification example above.

## Plot Specification

The first field of a plot directive card is the keyword PLOT. This card defines the orientation of the plot axes, the dimensions of each plot page, and the overall plot scaling factor. The plot directive card contains four optional keyword-value pairs:

TIMEAX - Character value which defines the orientation of the plot axes. There are two permissible values. A value of 'X' places the time axis (axes) parallel to the long axis of the paper, a value of 'Y' places it perpendicular to the long axis. The default value is the value from the previous plot set; default for the first plot set is 'X'.

PAPER - Floating point value which defines the width in centimeters of plot paper to be used. The default value is the value from the previous plot set; default for the first plot set is 25.

HEIGHT - Floating point value which defines the plot page height, in centimeters, when TIMEAX equals 'Y'. HEIGHT is not used when TIMEAX equals 'X'. The default value is the value from the previous plot set, default for the first plot set is 50.

SIZE - Floating point value which defines the overall plot scaling factor. All pen movements are multiplied by SIZE before execution. The default value is the value from the previous plot set; default for the first plot set is 1.

TIMEAX, PAPER, and HEIGHT together define the maximum allowable dimensions of each plot page; each plot page, in general, has smaller dimensions. If TIMEAX has a value of 'X', the maximum height is PAPER and the maximum width is 1000 centimeters; if TIMEAX equals 'Y', the maximum height is HEIGHT and the maximum width is PAPER. The maximum dimensions include a 3 centimeter allowance in page width for plotting channel axis labels and a 3 centimeter allowance in page height for plotting system date and time, plot title, and time axis (axes) annotation. For example, if the plot page is 25 centimeters wide and 50 centimeters high, 22 centimeters are useable for plotting the time axis (axes) and 47 centimeters are available for plotting the channel axes.

The final field of the plot directive card is delimited by a slash.

There are no definition cards associated with the plot directive card.

Examples of valid plot specifications are shown below.

```
PLOT, TIMEAX=Y,  PAPER=83.,  H = 85.  /

PLOT  HEIGHT 40.  SIZE 0.5  /

PLOT/
```

The plot specification marks the end of a plot set; the plot specification may not be omitted from a plot set. All desired parameters must be defined via their respective specifications before the plot specification is read.

## EXAMPLES

This section contains two examples of valid card inputs for THPLOT. The second example is followed by a sample of the resulting plotted output.

### Example 1

```
PLOT/
```

This is the minimum card input required by THPLOT; all default values are selected. A single set of untitled plots is generated. Every time point of every channel on the data file is plotted. A single time axis is plotted parallel to the long axis of the plot paper, autoscaled to fit within the 100 centimeter time axis length. Each channel axis is autoscaled to fit a 4 centimeter axis. In order to fit on 25 centimeter wide plot paper, four channel time histories are plotted on each plot page.

### Example 2

```
TITLE/
SRV FLIGHT 39  --  MMLE PARAMETERS
TIME  THIN 5  SCALE 2.  /
07 57 06 000 - 07 57 26 000
07 59 29 000 - 07 59 43 000  /
CHANS  LEN 10./
28  ALPHA  MIN -10.  MAX 90.  LEN 5.
27  BETA  LEN 4.
24  QBAR-BOOM
20  QBAR-VANE  SAME  /
PLOT  TIMEAX Y  HEIGHT 30.  /
```

This card input uses a number of program options. One set of titled plots is generated. Two time axes are plotted across

the width of 25 centimeter plot paper, with a scale of 2 seconds per centimeter. Every fifth time point of each of the four requested channels is plotted. The axis for the first channel is plotted with the specified limits and lengths, while the axis for the second channel is autoscaled to the specified length. The axis for the third channel is autoscaled to fit a 10 centimeter length, as specified by the channel directive card. The fourth channel is overplotted on the same axis as the third channel.

A sample of the plot page produced by the example card input above is shown in figure 1.

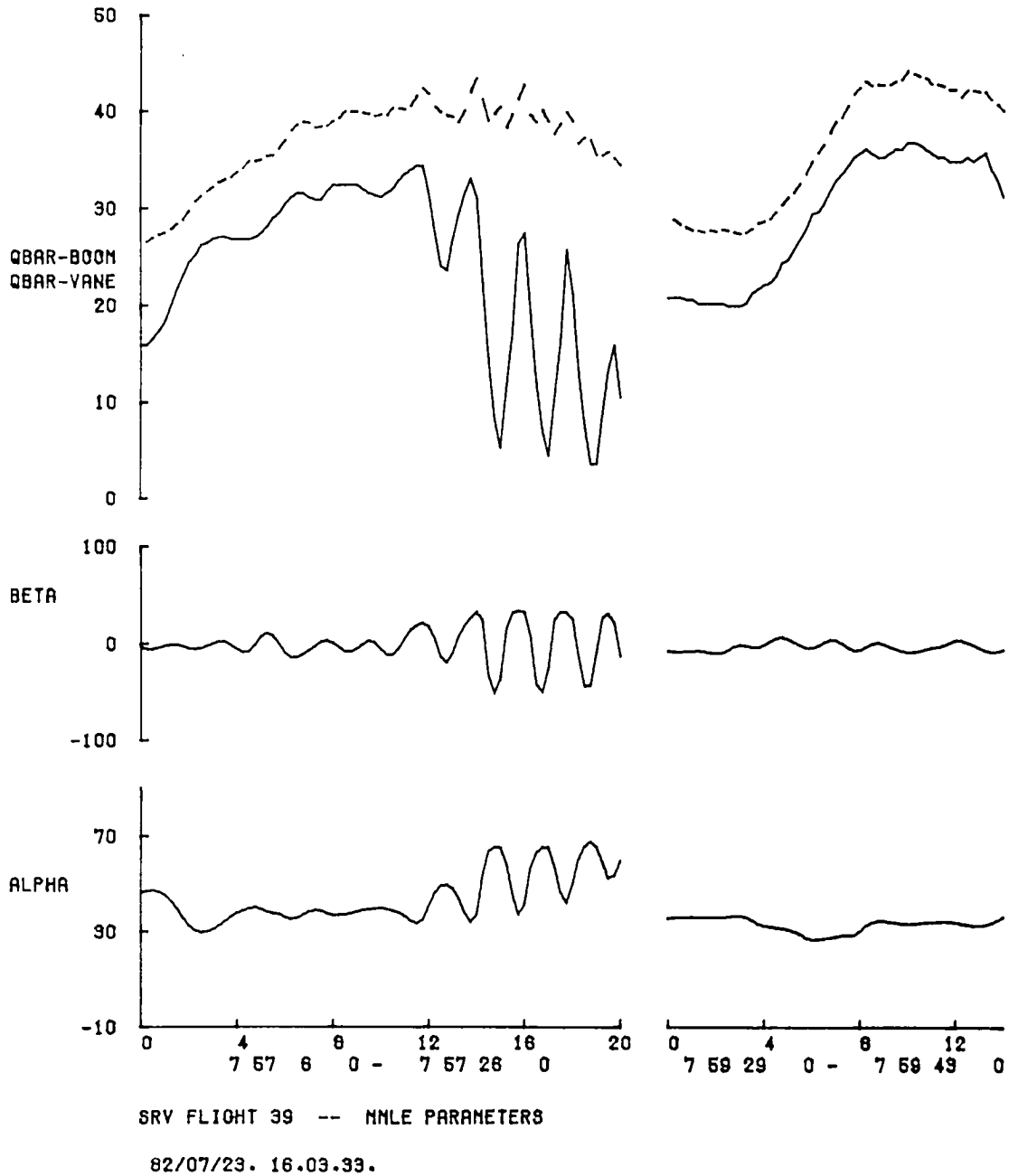


Figure 1. Plot page produced by second card input example.

## PRINTED OUTPUT

This section describes the printed output of THPLOT. The first section describes the normal output; the second describes the error messages. Lower case quantities in the messages indicate program variable values.

### Normal Output

The printed output from the program is a series of plot set descriptions; each plot set description normally begins on a new plot page. All card input information for each plot set is printed in the order specified. Only card input information which is newly specified for the current plot set is printed; default title, time, and channel specifications from the previous plot set are not printed.

Each time the program reads a title specification, a header containing program identification, plot title, and system date and time is printed at the top of a new page. For this reason, the title specification is generally the first specification for each plot set.

If new time intervals are requested for the plot set, card input information from the time specification is printed. First, values (whether default or specified) for THIN, LENGTH, and SCALE are printed. The requested time intervals follow, printed one line apiece, in the specified order. Start and end times are printed in hours, minutes, seconds, milliseconds format. If the entire data file is requested (by a single slash on the time definition card), the words "WHOLE FILE" replace the requested start and end times.

Following the requested time intervals, the time intervals actually found on the data file are printed, one line apiece. Actual start and end times are printed, as well as the number of time points to be plotted for the interval. If, for any interval, an end-of-file is found before the requested end time, the message "WARNING - EOF FOUND BEFORE END TIME" is issued.

If new channels are requested for the plot set, card input information from the channel specification is printed. There is one line of output for each channel. Values (whether default or specified) are printed for the channel number, channel name, minimum and maximum axis limits, and axis length. If the channel is to be plotted on the axis of the preceeding channel, the words "USE PREVIOUS AXIS" replace the axis minimum, maximum, and length. If every channel on the data file is requested (by a single slash on the channel definition card), the words "ALL CHANNELS" replace the requested channel descriptions.

The plot set description is concluded when the plot specification is read. Values (whether specified or default) for TIMEAX, PAPER, HEIGHT and SIZE are printed.

The message "PLOT EXECUTION INITIATED" indicates that the title, time interval(s) and channels are satisfactorily defined for the plot set. At this point, the plot file is opened, and execution of pen plotter commands begins.

As each requested data channel is processed, one line concerning the processing of the channel is printed. Values are printed for the channel number, channel name, actual plotted minimum and maximum axis limits, and axis length.

If data points are found outside the range specified by MINIMUM and MAXIMUM for a channel, the message "number POINTS TRUNCATED FOR EXCEEDING AXIS LIMITS" is also printed for the channel.

If a channel is plotted on the axis of the preceeding channel, the words "PREVIOUS AXIS USED" replace the axis minimum, maximum, and length.

If the data value of a channel to be autoscaled does not vary in the requested time interval(s), the channel axis and data are not plotted, and the message "VALUE CONSTANT - NO AXIS PLOTTED" replaces the axis minimum, maximum, and length. If the following data channel was to have been plotted on the same axis, the axis is autoscaled using the following data channel, and the message "NEXT CHANNEL WILL BE USED TO SCALE AXIS" is also printed.

At the successful completion of the plot set, the message "PLOT SET COMPLETED" is issued.

At the successful completion of the job run, the message "END OF CARD INPUT, JOB COMPLETED" is issued, and execution is terminated.

## Error Messages

The error messages issued by THPLOT are listed below in alphabetical order. A description of each error and the resulting program action follows. Possible system error messages are both system-dependent and large in number; system error messages are not covered.

Several fatal error messages are preceeded by the message "SUBROUTINE BOOBOO CALLED. MESSAGE BELOW." and followed by the message "INTENTIONAL END-OF-FILE FOLLOWS TO GET TRACEBACK.". The end-of-file error which follows is designed to force a system error traceback; it does not represent a problem due to encountering an end-of-file.

"name AXIS TOO LARGE FOR PLOT PAGE" - Axis length of the named channel is too large to fit on the plot page with the given margins. Fatal.

"BLANK CHANNEL DEFINITION CARD" - A blank card was read in the location of a channel definition card. Fatal.

"BLANK TIME DEFINITION CARD" - A blank card was read in the location of a time definition card. Fatal.

"CHANNEL NUMBER EXCEEDS TOTAL NUMBER OF CHANNELS" - The channel number requested exceeds the sum of the number of data channels on the data file and user-created channels. Fatal.

"END TIME BEFORE START: card" - The end time is earlier than start time for the requested interval; the whole time definition card is printed. Fatal.

"EOF FOUND AFTER TITLE DIRECTIVE CARD" - An end-of-file was read on the card input immediately after the title directive card. Fatal.

"EOF FOUND BEFORE LAST CHANNEL DEFINITION CARD" - An end-of-file was read on the card input before the final channel definition card was read. Fatal.

"EOF FOUND BEFORE LAST TIME DEFINITION CARD" - An end-of-file was read on the card input before the final time definition card was read. Fatal.

"EOF FOUND BEFORE START TIME" - An end-of-file was read on the data file before the requested start time was reached. Fatal.

"ERROR ON CHANNEL DEFINITION CARD: card" - Invalid or unrecognizable field(s) were found on a channel definition card; the whole card is printed. Fatal.

"ERROR ON TIME DEFINITION CARD: card" - Invalid or unrecognizable field(s) were found on a time definition card; the whole card is printed. Fatal.

"FEWER THAN 2 TIME POINTS FOUND IN TIME INTERVAL" - The requested time interval contains fewer than two time points. Fatal.

"FIRST CHANNEL CANNOT USE PREVIOUS AXIS - DEFAULT AXIS PARAMETERS USED" - The first channel definition card contains the keyword "SAME"; this option is ignored and the default axis length, minimum, and maximum are used. Nonfatal.

"INVALID DIRECTIVE KEYWORD FOUND: keyword" - The first field of a directive card was not recognized as a valid keyword; the first field is printed. Fatal.

"INVALID KEYWORD FOUND ON directive DIRECTIVE CARD: keyword" - A field in the location of a keyword on the specified directive card was not recognized as a valid keyword; the field is printed. Fatal.

"NEXT OF field IS LT 1 OR GT LENGTH OF STRING: card" - This message indicates an internal program bug and should not be encountered. Fatal.

"NUMBER OF CHANNELS ON DATA FILE EXCEEDS LIMIT" - The number of data words on the data file exceeds 200. Fatal.

"NUMBER OF CHANNELS REQUESTED EXCEEDS LIMIT" - More than 200 channels were requested for the plot set. Fatal.

"NUMBER OF TIME INTERVALS REQUESTED EXCEEDS LIMIT" - More than 10 time intervals were requested for the plot set. Fatal.

"NUMBER OF TIME POINTS PROCESSED EXCEEDS LIMIT" - The program attempted to process more than ten million time points. This may indicate an infinite loop. Fatal.

"TIME AXES CANNOT BE PROPERLY SCALED" - The number of time intervals requested is too great to be successfully scaled. This is generally due to the additional space required between interval axes. Fatal.

"TIME AXIS TOO LARGE FOR PLOT PAGE" - The time axis length is too large to fit on the plot page with the given margins. Fatal.

"TIME NOT INCREASING AT TIME: time" - The time read on the data file is not increasing at the specified time. Fatal.

"TOTAL NUMBER OF CHANNELS EXCEEDS LIMIT" - The sum of the number of data channels on the data file and user-created channels exceeds 200. Fatal.

## PROGRAM IMPLEMENTATION

This section describes the program entities of THPLOT which may require modification for a particular user application. These entities include the subroutines which interface with the data file, the subroutine which modifies data channels, the subroutines which interface with the pen plotter, and the symbolic constant specifications. The function of these program entities is described in the following sections.

### Data File Interface

Three subroutines interface with the data file. These subroutines are configured to read a fixed-length, uncompressed, FORTRAN unformatted file (ref. 3) with a single total seconds time word; modification of these subroutines may be necessary in

order to read different files.

The subroutine OPNDAT opens the data file and computes the number of data channels on the data file. OPNDAT has no arguments; the subroutine must define the first variable in the common block RECORD. This variable is the number of data words on one data file record. As configured, the subroutine automatically computes this as the total number of words minus one.

The subroutine REWDAT rewinds the data file. REWDAT has no arguments or associated variables.

The subroutine RDDAT reads a record from the data file and computes a time word readable by the calling routine. RDDAT returns three arguments to the calling routine. The first is a floating point value which defines the total seconds time word for the data frame. The second argument is a floating point vector of data channels of length 200. The third argument is a logical variable indicating the end of the data file; a value of .TRUE. indicates an end-of-file was read on the data file, while .FALSE. indicates a valid data frame. As configured, the subroutine reads the first word of each record as the time word and the remaining words as data channels, and an end-of-file is automatically detected by the FORTRAN READ statement (ref. 3).

## Data Channel Modification

The subroutine NEWDAT provides a facility for modifying existing channels and creating new data channels during program execution. NEWDAT receives two arguments from the calling routine. The first is a floating point value defining the total seconds timeword for the data frame. The second argument is a floating point vector of data channels of length 200. Both arguments may be redefined and both are returned to the calling routine. The subroutine must also define the second variable in the common block RECORD. This integer value is the total number of data channels - the sum of the number on the data file and the number created within NEWDAT. As configured, the subroutine makes no changes to the data channels and computes the total number of data channels to be equal to the number on the data file; modification of the subroutine is necessary in order to make changes to the data channels.

## Pen Plotter Interface

Several subroutines interface with the pen plotter software. These subroutines are configured to directly call Calcomp pen plotter subroutines (ref. 1); modification of these subroutines may be necessary in order to interface with other pen plotter software packages.

The subroutine PLTOPN opens and closes the plot output file. The entry point PLTOPN opens the plot output file. As

configured, the local file name for the plot output file is TAPE13. The entry point PLTCLS closes the plot output file. Neither entry point has any arguments.

The subroutine PLTMAG defines the overall plot scaling factor. PLTMAG has a single argument; all pen movements are multiplied by this floating point value before execution.

The subroutine NEWORG defines the origin for a new plot page. The two arguments of NEWORG are floating point values which specify the coordinates of the new origin relative to the current origin.

The subroutine PENTO moves the plot pen to a new location with the pen up. The two arguments of PENTO are floating point values which specify the coordinates to which the pen is moved.

The subroutine DRAWTO draws a line to a new location. The two arguments of DRAWTO are floating point values which specify the coordinates to which the line is drawn.

The subroutine TXTPLT draws text on the plot page. TXTPLT has five arguments. The first two arguments are floating point values which specify the starting coordinates at which the text is drawn. The next two arguments are floating point values which specify the angle (in degrees) and the height (in centimeters) of the text. The last argument is a character string which contains the text to be drawn. As configured, up to 100 characters may be drawn.

## Parameter Specifications

Array dimensions and important physical plot spacing parameters are specified with symbolic constants. All dimension limit checking as well as plot page partitioning depend on the symbolic constants. Symbolic constants are assigned values with the FORTRAN PARAMETER statement (ref. 3); array dimensions and plot spacing parameters may be changed by changing the value of the corresponding symbolic constant. Symbolic constants which the user may choose to change are given below; each symbolic constant is listed with its current value in parenthesis and a brief description of its application.

NCMAX (200) - Maximum number of channels which can be requested for each plot set.

NIMAX (10) - Maximum number of time intervals which can be requested for each plot set.

HGT (0.25) - Height, in centimeters, of all characters printed on the plots.

BMARG (3.) - Distance, in centimeters, of the time axis above the bottom margin of the plot page. This space is required

for plotting the system date and time, plot title, and the time axis (axes) annotation.

TMARG (3.) - Distance, in centimeters, of the channel axes from the left margin of the plot page. This space is required for plotting the channel axes labels.

PMARG (3.) - Distance, in centimeters, between succesive plot pages.

CGAP (1.) - Distance, in centimeters, between sucessive channel axes.

TGAP (1.) - Average distance, in centimeters, between successive time interval axes. Each time interval axis starts at an integral centimeter distance from the left margin of the plot page, with no less than 0.5 centimeter and no more than 1.5 centimeter distance between axes.

BOUND (0.01) - Distance, in centimeters, of channel plot boundary beyond channel axis limits. If a data point was to be plotted more than BOUND centimeters outside the axis limits, the point will be truncated to this limit. A nonzero value is required due to numerical roundoff during channel axis scaling.

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15. Supplementary Notes

Microfiche supplement is attached.

16. Abstract

This report describes THPLOT, a general purpose FORTRAN 77 computer program for plotting time histories using Calcomp pen plotters. THPLOT is designed to read a time history data file and to generate time history plots for selected time intervals and/or selected data channels.

The capabilities of the program are described. The card input required to define the plotting operation is described. Examples of card input and the resulting plotted output are given. The examples are followed by a description of the printed output, including both normal output and error messages. Lastly, implementation of the program is described. A complete listing of the program with compiler reference maps is included as a supplement.

| 17. Key Words (Suggested by Author(s)) | 18. Distribution Statement |
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| FORTRAN<br>Computer program<br>Time history<br>Data plotting | Unclassified-Unlimited<br><br>STAR category 61 |

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USER'S MANUAL FOR THPLOT, A FORTRAN 77 COMPUTER PROGRAM FOR TIME HISTORY PLOTTING

by James E. Murray